National Building Code of Canada 1995

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Code national du bâtiment – Canada 1995

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Preface

The National Building Code of Canada (NBC) is prepared by the Canadian Commission on Building and Fire Codes (CCBFC) and is published by the National Research Council. It is prepared in the form of a recommended model code to permit adoption by an appropriate authority.

The NBC is essentially a code of minimum regulations for public health, fire safety and structural sufficiency with respect to the public interest. It establishes a standard of safety for the construction of buildings, including extensions or alterations, the evaluation of buildings undergoing a change of occupancy and upgrading of buildings to remove an unacceptable hazard.

The content of the NBC pertains primarily to the needs of health and safety. Requirements unrelated to health and safety are kept to a minimum; any requirements that would increase the scope of the NBC are only considered after thorough consultation with regulatory authorities, provincial governments, other affected parties and Code users. Requirements for workmanship related to aesthetics only are not considered appropriate for the NBC although requirements for quality and durability that affect health and safety are appropriate.

Under the terms of the Constitution Act, regulation of building in Canada is the responsibility of provincial and territorial governments. The NBC has received wide use as the basis for municipal bylaws and provincial building codes. Liaison with provincial and territorial code authorities is maintained through the Provincial/Territorial Committee on Building Standards, established by these authorities to provide policy guidance to the Commission.

Committees. The Code has been developed and continues to be developed through the voluntary assistance of many experts from coast to coast. The Commission has direct responsibility under the National Research Council for the preparation and publication of the Code. The members of the Commission are appointed by the National Research Council. They serve as individuals and not as designated appointees of any organization and the membership is broadly representative of all major phases of construction in Canada.

The Commission is assisted in the technical aspects of code writing by standing committees, each of which is responsible for specific portions of the Code or its associated documents. The members of each standing committee are knowledgeable in the particular field for which the committee is responsible. Building and fire officials, architects, engineers, contractors, building owners and others share their experience in the national interest. These committees and their memberships are listed in the following pages. The Commission wishes to acknowledge the assistance provided by the many individuals who have contributed to the production of this edition of the Code. The Commission also wishes to express its appreciation to the standards writing organizations whose standards are referenced throughout the Code documents.

IRC Staff. The staff of the Institute for Research in Construction (IRC) of the National Research Council provides technical and administrative support at the direction of the Commission. Technical problems revealed through the use of the Code are referred to the Institute for study. IRC's participation makes available to the Commission the most up-to-date information on building technology.

Related Documents. The National Research Council of Canada publishes other code-related documents that are of interest to code users.

National Fire Code of Canada 1995. A model set of technical requirements designed to provide an acceptable level of fire protection and fire prevention within a community.

National Plumbing Code of Canada 1995. Contains detailed requirements for the design and installation of plumbing systems in buildings.

National Farm Building Code of Canada 1995. A model set of minimum requirements affecting human health, fire safety and structural sufficiency for farm buildings.

National Housing Code of Canada 1998 and Illustrated Guide. A compilation of all requirements from the National Building Code 1995 that apply to houses, including detached, semi-detached and row houses without shared egress, together with illustrations and explanatory material.

User's Guide – NBC 1995, Structural Commentaries (Part 4). Provides commentaries on the structural design requirements of Part 4 of the NBC 1995, including a new commentary on Application of NBC Part 4 for the Structural Evaluation and Upgrading of Existing Buildings.

Model National Energy Code of Canada for Buildings 1997. A set of minimum requirements that provide the basis for improving the energy use characteristics of new buildings.

Model National Energy Code of Canada for Houses 1997. A set of minimum requirements that provide the basis for improving the energy use characteristics of new houses.

User's Guide – NBC 1995, Environmental Separation (Part 5). Describes the general principles and objectives behind many of the requirements of Part 5 of the NBC 1995.

User's Guide – NBC 1995, Housing and Small Buildings (Part 9). Describes the principles behind many of the requirements of Part 9 of the NBC 1995 and some of the historical background, where this will assist users in understanding the objectives of certain provisions.

User's Guide – NBC 1995, Fire Protection, Occupant Safety and Accessibility (Part 3). Explains the intent of requirements in Part 3 of the NBC 1995 and how these requirements might be applied to existing buildings. Composed of three Commentaries: Commentary A, Application of Part 3 of the NBC to New Construction; Commentary B, Application of Part 3 of the NBC to Existing Buildings; and Commentary C, Measures for Fire Safety in Existing High Buildings.

CCBFC Policies and Procedures 1992. Contains the terms of reference and operating procedures of the CCBFC and its standing committees, a statement on the supporting role of the Institute for Research in Construction of NRC and the membership matrices for the various standing committees.

Relationship between the National Building Code and the National Fire Code

A special relationship exists between the National Building Code and the National Fire Code with respect to fire safety. The contents of both Codes must be considered in building design, construction and maintenance. The role of each Code with respect to fire safety can be summarized as follows:

National Building Code (NBC) — establishes a satisfactory standard of fire safety for the construction of new buildings, the reconstruction of buildings, including extensions, alterations, or changes in occupancy and upgrading of buildings to remove an unacceptable fire hazard.‡

National Fire Code (NFC) — establishes a satisfactory standard for fire prevention, fire fighting and life safety in buildings in use,‡ including standards for the conduct of activities causing fire hazards, maintenance of fire safety equipment and egress facilities, standards for portable extinguishers, limitations on building contents and the establishment of fire safety plans, including the organization of supervisory staff for emergency purposes. In addition, the NFC establishes the standard for prevention, containment and suppression of fires originating outside buildings, which may present a hazard to a community, and sets standards for the storage and handling of dangerous goods, and flammable and combustible liquids.

The two Codes have been developed as complementary and coordinated documents in order to reduce to a minimum the possibility of conflict in their respective contents. To aid in their effective application, fire and building officials must be fully conversant with the fire safety standards of both Codes. Such officials should be involved both in the review and the approval of plans with respect to fire safety prior to granting a building permit and with the inspection of buildings for fire safety. This is the only way to determine that all known hazards have been considered and a satisfactory standard of fire safety has been achieved.‡

‡ The extent of application of the NBC and the NFC to the upgrading of buildings to remove an unacceptable fire hazard should be based on the judgement of the authority having jurisdiction, who must deal with each case on its merits.

A Guide to the Use of the Code

The National Building Code of Canada is essentially a set of minimum provisions for the safety of buildings with reference to public health, fire protection and structural sufficiency. It is not intended to be a textbook on building design, advice on which should be sought from professional sources. Its primary purpose is the promotion of public safety through the application of appropriate uniform building standards throughout Canada.

The Code is drafted in such a way that it may be adopted or enacted for legal use by any jurisdictional authority in Canada. It is divided into 9 Parts. A decimal numbering system has been used throughout the Code. The first number indicates the Part of the Code; the second, the Section in the Part; the third, the Subsection and the fourth, the Article in the Subsection. Code requirements are provided at the Sentence level (indicated by numbers in brackets), and Sentences may be broken down into Clauses and Subclauses. This structure is illustrated as follows:

3	Part
3.5.	Section
3.5.2.	Subsection
3.5.2.1.	Article
3.5.2.1.(2)	Sentence
3.5.2.1.(2)(a)	Clause
3.5.2.1.(2)(a)(i)	Subclause

A summary of the contents of the Code follows:

Part 1: Scope and Definitions

Part 1 contains the definitions of all words throughout the Code that appear in italic type. This Part also contains a list of abbreviations used in the Code.

Part 2: General

Part 2 contains provisions of an administrative nature, such as the use of referenced documents, climatic data, plans and specifications, provision for equivalent materials, systems, equipment, and procedures, and the construction review process.

Part 3: Fire Protection, Occupant Safety and Accessibility

This Part contains the requirements with respect to health and fire safety, which depend upon the use to which a building is put and its type of occupancy. The first Section contains material relating to occupancy classification and the more general features of fire protection. Sections that follow contain specific requirements relating to building size and occupancy, fire safety within floor areas, exit requirements, requirements for service spaces and health requirements. Section 3.8. contains specific requirements for those buildings required to be accessible to persons with physical or sensory disabilities.

Part 4: Structural Design

This Part is made up of 4 Sections. The first deals with the loads to be used in design calculations and the methods of design to be followed. Section 4.2. regulates foundation design and construction. Section 4.3. deals with design in wood, masonry, concrete, steel and aluminum and the structural design of air-supported structures. Section 4.4. contains only short performance requirements referring to the design methods outlined in detail in the relevant CSA standards.

Part 5: Environmental Separation

This Part provides criteria for the design and construction of building elements that separate environments that differ one from another. These include elements that separate conditioned interior spaces from exterior spaces or the ground, and elements that separate adjacent interior spaces that are conditioned differently. The requirements address the control of condensation, and the control of heat, air and moisture transfer, including precipitation, surface water and moisture in the ground.

Part 6: Heating, Ventilating and Air-Conditioning

Part 6 is concerned with the effective and safe functioning of heating, ventilating and air-conditioning equipment installed in a building.

Part 7: Plumbing Services

This Part contains only the basic legal statements with reference to Scope, Application, Required Facilities and conformance to the appropriate regulations. All detailed technical requirements are contained in the National Plumbing Code (NPC), which is published separately. The NPC contains requirements for the size and quality of fixtures and related pipes and fittings for plumbing systems and, in its Appendix, has explanatory sketches and notes to further clarify these requirements.

Part 8: Safety Measures at Construction and Demolition Sites

Part 8 regulates the precautions that must be taken for fire safety and to protect the public at construction and demolition sites.

Part 9: Housing and Small Buildings

This Part provides detailed requirements for the construction of houses and small buildings up to 600 m^2 per floor and 3 storeys high, and applies to all occupancies except assembly, care or detention, and high hazard industrial.

Appendix A: Explanatory Material

Appendix A contains additional explanatory information to assist Code users in understanding the intent of the requirements contained in Parts 1 to 9. It is not a mandatory section of the Code.

Appendix B: Fire Safety in High Buildings

Appendix B contains material formerly found in Chapter 3 of the Supplement to the NBC 1990 as applied to sprinklered buildings, updated for 1995. It contains information in support of the high-rise requirements in Part 3. It is not a mandatory section of the Code.

Appendix C: Climatic Information for Building Design in Canada

Appendix C contains material formerly found in Chapter 1 of the Supplement to the NBC 1990, updated for 1995. It contains information on the climatic loads to be expected in all parts of Canada. It is through the use of these climatic factors, with appropriate adjustments for climate variation in different localities, that the Code can be used nationally. It is not a mandatory section of the Code.

Appendix D: Fire-Performance Ratings

Appendix D contains material formerly found in Chapter 2 of the Supplement to the NBC 1990, updated for 1995. It provides a guide to the determination of the combustibility, flame spread rating and smoke developed classification of construction materials and fire-resistance ratings of construction assemblies in relation to the provisions of the Code. It gives a procedure for calculating the fire-resistance rating of construction assemblies based on generic descriptions of materials used in the assemblies. It is not a mandatory section of the Code.

Change Indication

Where a technical change or addition to the 1990 edition has been made, the requirements affected are indicated by a vertical line in the margin. No indication is provided where requirements have been renumbered or deleted.

Renumbering

There is extensive renumbering due to additions, deletions and relocation of requirements. Care should be taken therefore in relating requirements in previous codes with the 1995 edition.

Administration

The separate document entitled Administrative Requirements for Use with the National Building Code of Canada 1995 is available. It is automatically adopted under Subsection 1.1.1. of the Code when the adopting authority has not provided other administrative requirements.

Metric Conversion

All values in the Code are given in metric units. A conversion table of imperial equivalents for the most common units used in building design and construction is located at the end of the document.

Coordination with NFC

An important feature of this Code is its close coordination with its companion document, the National Fire Code, which is also prepared under the direction of the Canadian Commission on Building and Fire Codes. To avoid duplication of requirements in the two Codes, the National Building Code makes reference to appropriate requirements in the National Fire Code and vice versa.

The Commission has designed the two Codes to be administered as complementary documents, with both building and fire officials being involved in their enforcement. The relationship statement following the preface to this document takes on a special significance in light of the strong, continuing interest being shown by provincial and territorial governments in the use of both of these documents as the basis for uniform standards for building safety.

Public Comment and Inquiries

Comments and inquiries on the use of this Code and suggestions for its improvement are welcomed and should be submitted to: The Secretary, Canadian Commission on Building and Fire Codes, National Research Council of Canada, Ottawa, Ontario K1A 0R6.

As Code revisions are developed by the committees, they will be made available for public review and comment prior to the next edition of the Code being published.

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(4) Deceased.

Part 1
Scope and Definitions

Section 1.1. General

1.1.1. Administration

1.1.1.1. Conformance with Administrative Requirements

1) This Code shall be administered in conformance with the appropriate provincial or municipal regulations or, in the absence of such regulations, in conformance with the Administrative Requirements for Use with the National Building Code of Canada 1985. e3

1.1.2. Scope

1.1.2.1. Application

1) This Code applies to the design, construction and *occupancy* of new *buildings*, and the *alteration*, reconstruction, demolition, removal, relocation and *occupancy* of existing *buildings*. (See Appendix A.)

1.1.3. Definitions of Words and Phrases

1.1.3.1. Non-defined Terms

1) Definitions of words and phrases used in this Code that are not included in the list of definitions in this Part shall have the meanings that are commonly assigned to them in the context in which they are used in this Code, taking into account the specialized use of terms with the various trades and professions to which the terminology applies.

1.1.3.2. Defined Terms

1) The words and terms in italics in this Code have the following meanings:

Access to exit means that part of a *means of egress* within a *floor area* that provides access to an *exit* serving the *floor area*.

Adfreezing means the adhesion of *soil* to a *foundation unit* resulting from the freezing of *soil* water. (Also referred to as “frost grip.”)

Air barrier system means the assembly installed to provide a continuous barrier to the movement of air.

Air-supported structure means a structure consisting of a pliable membrane which achieves and maintains its shape and support by internal air pressure.

Alarm signal means an audible signal transmitted throughout a zone or zones or throughout a *building* to advise occupants that a fire emergency exists.

Alert signal means an audible signal to advise designated persons of a fire emergency.

Alteration means a change or extension to any matter or thing or to any *occupancy* regulated by this Code.

Appliance means a device to convert fuel into energy and includes all components, controls, wiring and piping required to be part of the device by the applicable standard referred to in this Code.

Artesian groundwater means a confined body of water under pressure in the ground.

Assembly occupancy means the *occupancy* or the use of a *building*, or part thereof, by a gathering of persons for civic, political, travel, religious, social, educational, recreational or like purposes, or for the consumption of food or drink.

Attic or roof space means the space between the roof and the ceiling of the top *storey* or between a dwarf wall and a sloping roof.

Authority having jurisdiction means the governmental body responsible for the enforcement of any part of this Code or the official or agency designated by that body to exercise such a function.

Barrier-free means that a *building* and its facilities can be approached, entered, and used by persons with physical or sensory disabilities.

Basement means a *storey* or *storeys* of a *building* located below the *first storey*.

Bearing surface means the contact surface between a *foundation unit* and the *soil* or *rock* upon which it bears.

Boiler means an *appliance* intended to supply hot water or steam for space heating, processing or power purposes.

Breeching means a *flue pipe* or chamber for receiving *flue* gases from one or more *flue* connections and for discharging these gases through a single *flue* connection.

Building means any structure used or intended for supporting or sheltering any use or *occupancy*.

Building area means the greatest horizontal area of a *building* above *grade* within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of *firewalls*.

Building height (in *storeys*) means the number of *storeys* contained between the roof and the floor of the *first storey*.

Business and personal services occupancy means the *occupancy* or use of a *building* or part thereof for the transaction of business or the rendering or receiving of professional or personal services.

Caisson (see *Pile*).

Care or detention occupancy means the *occupancy* or use of a *building* or part thereof by persons who require special care or treatment because of cognitive or physical limitations or by persons who are restrained from, or are incapable of, self preservation because of security measures not under their control.

Cavity wall means a construction of masonry units laid with a cavity between the wythes. The wythes are tied together with metal ties or bonding units, and are relied on to act together in resisting lateral loads.

Chimney means a primarily vertical shaft enclosing at least one *flue* for conducting *flue* gases to the outdoors.

Chimney liner means a conduit containing a *chimney flue* used as a lining of a *masonry or concrete chimney*.

Closure means a device or assembly for closing an opening through a *fire separation* or an exterior wall, such as a door, a shutter, wired glass or glass block, and includes all components such as hardware, closing devices, frames and anchors.

Combustible means that a material fails to meet the acceptance criteria of CAN4-S114-M, "Test for Determination of Non-Combustibility in Building Materials."

Combustible construction means that type of construction that does not meet the requirements for *noncombustible construction*.

Combustible liquid means a liquid having a *flash point* at or above 37.8°C and below 93.3°C.

Conditioned space means any space within a *building* the temperature of which is controlled to limit variation in response to the exterior ambient temperature by the provision, either directly or indirectly, of heating or cooling over substantial portions of the year.

Constructor means a person who contracts with an *owner* or his authorized agent to undertake a project, and includes an *owner* who contracts with more than one person for the work on a project or undertakes the work on a project or any part thereof.

Contained use area means a supervised area containing one or more rooms in which occupant movement is restricted to a single room by security measures not under the control of the occupant.

Dead load means the weight of all permanent structural and nonstructural components of a *building*.

Deep foundation means a *foundation unit* that provides support for a *building* by transferring loads either by end-bearing to a *soil* or *rock* at considerable depth below the *building*, or by adhesion or friction, or both, in the *soil* or *rock* in which it is placed. *Piles* are the most common type of *deep foundation*.

Designer means the person responsible for the design.

Dwelling unit means a *suite* operated as a housekeeping unit, used or intended to be used as a domicile by one or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

Excavation means the space created by the removal of *soil*, *rock* or *fill* for the purposes of construction.

Exhaust duct means a duct through which air is conveyed from a room or space to the outdoors.

Exit means that part of a *means of egress*, including doorways, that leads from the *floor area* it serves, to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. (See Appendix A.)

Exit level (as applying to Subsection 3.2.6.) means the level of an enclosed *exit* stair at which an exterior *exit* door or *exit* corridor leads to the exterior.

Exit storey (as applying to Subsection 3.2.6.) means a *storey* having an exterior *exit* door.

Exposing building face means that part of the exterior wall of a *building* which faces one direction and is located between ground level and the ceiling of its top *storey* or, where a *building* is divided into *fire compartments*, the exterior wall of a *fire compartment* which faces one direction.

Factory-built chimney means a *chimney* consisting entirely of factory-made parts, each designed to be assembled with the other without requiring fabrication on site.

Farm building means a *building* or part thereof which does not contain a *residential occupancy* and which is associated with and located on land devoted to the practice of farming, and used essentially for the housing of equipment or livestock, or the production, storage or processing of agricultural and horticultural produce or feeds. (See Appendix A.)

Fill means *soil*, *rock*, rubble, industrial waste such as slag, organic material or a combination of these that is transported and placed on the natural surface of a *soil* or *rock* or organic terrain. It may or may not be compacted.

Fire compartment means an enclosed space in a *building* that is separated from all other parts of the *building* by enclosing construction providing a *fire separation* having a required *fire-resistance rating*.

Fire damper means a *closure* which consists of a damper installed in an air distribution system or in a wall or floor assembly, which is normally held open but is designed to close automatically in the event of a fire in order to maintain the integrity of the *fire separation*.

Fire detector means a device which detects a fire condition and automatically initiates an electrical signal to actuate an *alert signal* or *alarm signal* and includes *heat detectors* and *smoke detectors*.

Fire load (as applying to an *occupancy*) means the *combustible* contents of a room or *floor area* expressed in terms of the average weight of *combustible* materials per unit area, from which the potential heat liberation may be calculated based on the calorific value of the materials, and includes the furnishings, finished floor, wall and ceiling finishes, trim and temporary and movable *partitions*.

Fire-protection rating means the time in minutes or hours that a *closure* will withstand the passage of flame when exposed to fire under specified conditions of test and performance criteria, or as otherwise prescribed in this Code. e

Fire-resistance rating means the time in minutes or hours that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived therefrom as prescribed in this Code. e

Fire-retardant treated wood means wood or a wood product that has had its surface-burning characteristics, such as flame spread, rate of fuel contribution and density of smoke developed, reduced by impregnation with fire-retardant chemicals.

Fire separation means a construction assembly that acts as a barrier against the spread of fire. (See Appendix A.)

Fire stop flap means a device intended for use in horizontal assemblies required to have a *fire-resistance rating* and incorporating protective ceiling membranes, which operates to close off a duct opening through the membrane in the event of a fire.

Firewall means a type of *fire separation* of *noncombustible construction* which subdivides a *building* or separates adjoining *buildings* to resist the spread of fire and which has a *fire-resistance rating* as prescribed in this Code and has structural stability to remain intact under fire conditions for the required fire-rated time.

First storey means the uppermost *storey* having its floor level not more than 2 m above *grade*.

Flame-spread rating means an index or classification indicating the extent of spread-of-flame on the surface of a material or an assembly of materials as determined in a standard fire test as prescribed in this Code.

Flammable liquid means a liquid having a *flash point* below 37.8°C and having a vapour pressure not more than 275.8 kPa (absolute) at 37.8°C as determined by ASTM D 323, "Vapor Pressure of Petroleum Products (Reid Method)."

Flash point means the minimum temperature at which a liquid within a container gives off vapour in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Floor area means the space on any *storey* of a *building* between exterior walls and required *firewalls*, including the space occupied by interior walls and *partitions*, but not including *exits*, *vertical service spaces*, and their enclosing assemblies.

Flue means an enclosed passageway for conveying *flue* gases.

Flue collar means the portion of a fuel-fired *appliance* designed for the attachment of the *flue pipe* or *breeching*.

Flue pipe means the pipe connecting the *flue collar* of an *appliance* to a *chimney*.

Forced-air furnace means a *furnace* equipped with a fan that provides the primary means for the circulation of air.

Foundation means a system or arrangement of *foundation units* through which the loads from a *building* are transferred to supporting *soil* or *rock*.

Foundation unit means one of the structural members of the *foundation* of a *building* such as a footing, raft or *pile*.

Frost action means the phenomenon that occurs when water in *soil* is subjected to freezing which, because of the water/ice phase change or ice lens growth, results in a total volume increase or the build-up of expansive forces under confined conditions or both, and the subsequent thawing that leads to loss of *soil* strength and increased compressibility.

Furnace means a *space-heating appliance* using warm air as the heating medium and usually having provision for the attachment of ducts.

Gas vent means that portion of a venting system designed to convey vent gases to the outdoors from the *vent connector* of a gas-fired *appliance* or directly from the *appliance* when a *vent connector* is not used.

Grade (as applying to the determination of *building height*) means the lowest of the average levels of finished ground adjoining each exterior wall of a *building*, except that localized depressions such as for vehicle or pedestrian entrances need not be considered in the determination of average levels of finished ground. (See *First storey*.)

Groundwater means a free standing body of water in the ground.

Groundwater level (groundwater table) means the top surface of a free standing body of water in the ground.

Guard means a protective barrier around openings in floors or at the open sides of stairs, landings, balconies, *mezzanines*, galleries, raised *walkways* or other locations to prevent accidental falls from one level to another. Such barrier may or may not have openings through it.

Heat detector means a *fire detector* designed to operate at a predetermined temperature or rate of temperature rise.

Heavy timber construction means that type of *combustible construction* in which a degree of fire safety is attained by placing limitations on the sizes of wood structural members and on thickness and composition of wood floors and roofs and by the avoidance of concealed spaces under floors and roofs.

High hazard industrial occupancy (Group F, Division 1) means an *industrial occupancy* containing sufficient quantities of highly *combustible* and flammable or explosive materials which, because of their inherent characteristics, constitute a special fire hazard.

Horizontal exit means an *exit* from one *building* to another by means of a doorway, vestibule, *walkway*, bridge or balcony.

Horizontal service space means a space such as an attic, duct, ceiling, roof or crawl space oriented essentially in a horizontal plane, concealed and generally inaccessible, through which *building* service facilities such as pipes, ducts and wiring may pass.

Impeded egress zone means a supervised area in which occupants have free movement but require the release, by security personnel, of security doors at the boundary before they are able to leave the area, but does not include a *contained use area*.

Indirect service water heater means a *service water heater* that derives its heat from a heating medium such as warm air, steam or hot water.

Industrial occupancy means the *occupancy* or use of a *building* or part thereof for the assembling, fabricating, manufacturing, processing, repairing or storing of goods and materials.

Interconnected floor space means superimposed *floor areas* or parts of *floor areas* in which floor assemblies that are required to be *fire separations* are penetrated by openings that are not provided with *closures*.

Limiting distance means the distance from an *exposing building face* to a property line, the centre line of a *street*, lane or public thoroughfare, or to an imaginary line between 2 *buildings* or *fire compartments* on the same property, measured at right angles to the *exposing building face*.

Live load means the load other than *dead load* to be assumed in the design of the structural members of a *building*. It includes loads resulting from snow, rain, wind and earthquake and those due to *occupancy*.

Loadbearing (as applying to a building element) means subjected to or designed to carry loads in addition to its own *dead load*, excepting a wall element subjected only to wind or earthquake loads in addition to its own *dead load*.

Low hazard industrial occupancy (Group F, Division 3) means an *industrial occupancy* in which the *combustible* content is not more than 50 kg/m² or 1 200 MJ/m² of *floor area*.

Major occupancy means the principal *occupancy* for which a *building* or part thereof is used or intended to be used, and shall be deemed to include the subsidiary *occupancies* which are an integral part of the principal *occupancy*.

Masonry or concrete chimney means a *chimney* of brick, stone, concrete or masonry units constructed on site.

Means of egress means a continuous path of travel provided for the escape of persons from any point in a *building* or contained open space to a separate *building*, an open public thoroughfare, or an exterior open space protected from fire exposure from the *building* and having access to an open public thoroughfare. *Means of egress* includes *exits* and *access to exits*.

Medium hazard industrial occupancy (Group F, Division 2) means an *industrial occupancy* in which the *combustible* content is more than 50 kg/m² or 1 200 MJ/m² of *floor area* and not classified as *high hazard industrial occupancy*.

Mercantile occupancy means the *occupancy* or use of a *building* or part thereof for the displaying or selling of retail goods, wares or merchandise.

Mezzanine means an intermediate floor assembly between the floor and ceiling of any room or *storey* and includes an interior balcony.

Noncombustible means that a material meets the acceptance criteria of CAN4-S114-M, "Test for

Determination of Non-Combustibility in Building Materials."

Noncombustible construction means that type of construction in which a degree of fire safety is attained by the use of *noncombustible* materials for structural members and other *building* assemblies.

Occupancy means the use or intended use of a *building* or part thereof for the shelter or support of persons, animals or property.

Occupant load means the number of persons for which a *building* or part thereof is designed.

Open air storey means a *storey* in which at least 25% of the total area of its perimeter walls is open to the outdoors in a manner that will provide cross ventilation to the entire *storey*.

Owner means any person, firm or corporation controlling the property under consideration.

Partition means an interior wall 1 *storey* or part-*storey* in height that is not *loadbearing*.

Party wall means a wall jointly owned and jointly used by 2 parties under easement agreement or by right in law, and erected at or upon a line separating 2 parcels of land each of which is, or is capable of being, a separate real-estate entity.

Perched groundwater means a free standing body of water in the ground extending to a limited depth.

Pile means a slender *deep foundation unit*, made of materials such as wood, steel or concrete or combination thereof, which is either premanufactured and placed by driving, jacking, jetting or screwing, or cast-in-place in a hole formed by driving, excavating or boring. (Cast-in-place bored *piles* are often referred to as *caissons* in Canada.)

Plenum means a chamber forming part of an air duct system.

Plumbing system means a drainage system, a venting system and a water system or parts thereof.

Post-disaster building means a *building* essential to provide services in the event of a disaster, and includes hospitals, fire stations, police stations, radio stations, telephone exchanges, power stations, electrical substations, pumping stations (water and sewage) and fuel depot *buildings*.

Private sewage disposal system means a privately owned plant for the treatment and disposal of sewage (such as a septic tank with an absorption field).

Public corridor means a corridor that provides *access to exit* from more than one *suite*. (See Appendix A.)

Public way means a sidewalk, *street*, highway, square or other open space to which the public has access, as of right or by invitation, expressed or implied.

Range means a cooking *appliance* equipped with a cooking surface and one or more ovens.

Repair garage means a *building* or part thereof where facilities are provided for the repair or servicing of motor vehicles.

Residential occupancy means the *occupancy* or use of a *building* or part thereof by persons for whom sleeping accommodation is provided but who are not harboured or detained to receive medical care or treatment or are not involuntarily detained.

Return duct means a duct for conveying air from a space being heated, ventilated or air-conditioned back to the heating, ventilating or air-conditioning *appliance*.

Rock means that portion of the earth's crust that is consolidated, coherent and relatively hard and is a naturally formed, solidly bonded, mass of mineral matter that cannot readily be broken by hand.

Sanitary drainage system means a drainage system that conducts sewage.

Service room means a room provided in a *building* to contain equipment associated with *building* services. (See Appendix A.)

Service space means space provided in a *building* to facilitate or conceal the installation of *building* service facilities such as chutes, ducts, pipes, shafts or wires.

Service water heater means a device for heating water for plumbing services.

Shallow foundation means a *foundation unit* that derives its support from *soil* or *rock* located close to the lowest part of the *building* which it supports.

Smoke alarm means a combined *smoke detector* and audible alarm device designed to sound an alarm within the room or *suite* in which it is located upon the detection of smoke within that room or *suite*.

Smoke detector means a *fire detector* designed to operate when the concentration of airborne combustion products exceeds a pre-determined level.

Soil means that portion of the earth's crust that is fragmentary, or such that some individual particles of a dried sample may be readily separated by agitation in water; it includes boulders, cobbles, gravel, sand, silt, clay and organic matter.

Space heater means a *space-heating appliance* for heating the room or space within which it is located, without the use of ducts.

Space-heating appliance means an *appliance* intended for the supplying of heat to a room or space directly, such as a *space heater*, fireplace or *unit heater*, or to rooms or spaces of a *building* through a heating system such as a central *furnace* or *boiler*.

Sprinklered (as applying to a *building* or part thereof) means that the *building* or part thereof is equipped with a system of automatic sprinklers.

Stage means a space designed primarily for theatrical performances with provision for quick change scenery and overhead lighting, including environmental control for a wide range of lighting and sound effects and which is traditionally, but not necessarily, separated from the audience by a proscenium wall and curtain opening.

Storage garage means a *building* or part thereof intended for the storage or parking of motor vehicles and which contains no provision for the repair or servicing of such vehicles.

Storage-type service water heater means a *service water heater* with an integral hot water storage tank.

Storey means that portion of a *building* which is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it.

Stove means an *appliance* intended for cooking and space heating.

Street means any highway, road, boulevard, square or other improved thoroughfare 9 m or more in width, which has been dedicated or deeded for public use, and is accessible to fire department vehicles and equipment.

Subsurface investigation means the appraisal of the general subsurface conditions at a *building* site by analysis of information gained by such methods as geological surveys, in situ testing, sampling, visual inspection, laboratory testing of samples of the subsurface materials and *groundwater* observations and measurements.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes *dwelling units*, individual guest rooms in motels, hotels, boarding houses, rooming houses and dormitories as well as individual stores and individual or complementary rooms for *business and personal services occupancies*. (See Appendix A.)

Supply duct means a duct for conveying air from a heating, ventilating or air-conditioning *appliance* to a space to be heated, ventilated or air-conditioned.

Theatre means a place of public assembly intended for the production and viewing of the performing arts or the screening and viewing of motion pictures, and consisting of an auditorium with permanently fixed seats intended solely for a viewing audience.

Unit heater means a suspended *space heater* with an integral air circulating fan.

Unprotected opening (as applying to *exposing building face*) means a doorway, window or opening other than one equipped with a *closure* having the required *fire-protection rating*, or any part of a wall forming part of the *exposing building face* that has a *fire-resistance rating* less than required for the *exposing building face*.

Unsafe condition means any condition that could cause undue hazard to life, limb or health of any person authorized or expected to be on or about the premises.

Vapour barrier means the elements installed to control the diffusion of water vapour.

Vent connector (as applying to heating or cooling systems) means the part of a venting system that conducts the *flue* gases or vent gases from the *flue collar* of a gas *appliance* to the *chimney* or *gas vent*, and may include a draft control device.

Vertical service space means a shaft oriented essentially vertically that is provided in a *building* to facilitate the installation of *building* services including mechanical, electrical and plumbing installations and facilities such as elevators, refuse chutes and linen chutes.

Walkway means a covered or roofed pedestrian thoroughfare used to connect 2 or more *buildings*.

1.1.4. Abbreviations

1.1.4.1. Abbreviations of Proper Names

1) The abbreviations of proper names in this Code shall have the meanings assigned to them in this Article. The appropriate addresses are shown in brackets following the name.

ACGIH	American Conference of Governmental Industrial Hygienists (1330 Kemper Meadow Drive, Cincinnati, Ohio 45240 U.S.A.)
ANSI	American National Standards Institute (25 West 43rd Street, 4th Floor, New York, New York 10036 U.S.A.)
ASCE	American Society of Civil Engineers (1801 Alexander Bell Drive, Reston, Virginia 20191-4400 U.S.A.)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers (1791 Tullie Circle N.E., Atlanta, Georgia 30329 U.S.A.)
ASME	American Society of Mechanical Engineers (22 Law Drive, Fairfield, New Jersey 07007-2900 U.S.A.)
ASTM	American Society for Testing and Materials (100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428–2959 U.S.A.)
AWPA	American Wood-Preservers' Association (P.O. Box 5690, Granbury, Texas 76049-7979 U.S.A.)
BNQ	Bureau de normalisation du Québec (333, rue Franquet, Sainte-Foy (Québec) G1P 4C7)

CAN .... National Standard of Canada designation. (The number or name following the CAN designation represents the agency under whose auspices the standard is issued. CAN1 designates CGA, CAN2 designates CGSB, CAN3 designates CSA, and CAN4 designates ULC.)

CCBFC .... Canadian Commission on Building and Fire Codes (National Research Council of Canada, Ottawa, Ontario K1A 0R6)

CGA .... now part of CSA International. See CSA.

CGSB .... Canadian General Standards Board (Place du Portage, Phase III, 6B1 11 Laurier Street, Hull, Quebec K1A 1G6)

CHS .... Canadian Hearing Society (271 Spadina Road, Toronto, Ontario M5R 2V3)

CLA .... Canadian Lumbermen's Association (27 Goulburn Avenue, Ottawa, Ontario K1N 8C7)

CMHC .... Canada Mortgage and Housing Corporation (700 Montreal Road, Ottawa, Ontario K1A 0P7)

CSA .... CSA International (178 Rexdale Blvd., Toronto, Ontario M9W 1R3)

CWC .... Canadian Wood Council (1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8)

EPA .... Environmental Protection Agency (Office of Radiation and Air, 1200 Pennsylvania Avenue, NW, Washington, DC 20460 U.S.A.)

FCC .... Forintek Canada Corporation (319, rue Franquet, Ste-Foy (Québec) G1P 4R4)

FMRC .... Factory Mutual Research Corporation (1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, Massachusetts 02062-9957 U.S.A.)

FPS .... Forest Products Society (2801 Marshall Court, Madison, Wisconsin 53705-2295 U.S.A.)

HC .... Health Canada (Communications Directorate, Ottawa, Ontario K1A 0K9)

HI .... Hydronics Institute (35 Russo Place, Berkley Heights, New Jersey 07922 U.S.A.)

HRAI .... Heating, Refrigerating and Air-Conditioning Institute of Canada (5045 Orbitor Drive, Building 11, Suite 300, Mississauga, Ontario L4W 4Y4)

IRC .... Institute for Research in Construction (National Research Council of Canada, Ottawa, Ontario K1A 0R6)

ISO .... International Standards Organization (Standards Council of Canada, 270 Albert Street, Suite 200, Ottawa, Ontario K1P 6N7)

NBC .... National Building Code of Canada 1995 (See CCBFC)

NFC .... National Fire Code of Canada 1995 (See CCBFC)

NFPA .... National Fire Protection Association (1 Batterymarch Park, Quincy, Massachusetts 02269-9101 U.S.A.)

NLGA .... National Lumber Grades Authority (406 - First Capital Place, 960 Quayside Drive, New Westminster, British Columbia V3M 6G2)

SFPE .... Society of Fire Protection Engineers (7315 Wisconsin Avenue, Suite 1225 W, Bethesda, Maryland 20814 U.S.A.)

SMACNA .... Sheet Metal and Air Conditioning Contractors' National Association (4201 Lafayette Center Drive, Chantilly, Virginia 20151-1209 U.S.A.)

TC .... Transport Canada (Public Affairs, Tower C, Place de Ville, 330 Sparks Street, 28th Floor, Ottawa, Ontario K1A 0N5)

TPIC .... Truss Plate Institute of Canada (c/o 16 Nixon Road, Bolton, Ontario L7E 1K3, Attn: Ken Coo)

UL .... Underwriters Laboratories Incorporated (333 Pfingsten Road, Northbrook, Illinois 60062-2096 U.S.A.)

ULC .... Underwriters' Laboratories of Canada (7 Crouse Road, Toronto, Ontario M1R 3A9)

WCLIB .... West Coast Lumber Inspection Bureau (P.O. Box 23145, Portland, Oregon 97281-3145 U.S.A.)

WWPA .... Western Wood Products Association (522 SW Fifth Avenue, Suite 500, Portland, Oregon 97204-2122 U.S.A.)

1.1.4.2. Symbols and Other Abbreviations

1) The symbols and other abbreviations in this Code shall have the meanings assigned to them in this Article.

1 in 2	slope of 1 vertical to 2 horizontal
cm	centimetre(s)
°	degree(s)
°C	degree(s) Celsius
dB(A)	A-weighted sound level
diam	diameter
g	gram(s)
ga	gauge
h	hour(s)
Hz	hertz
Inc.	Incorporated
J	joule(s)
kg	kilogram(s)
kN	kilonewton(s)
kPa	kilopascal(s)
kW	kilowatt(s)
L	litre(s)
lx	lux
m	metre(s)
max.	maximum
min.	minimum
min	minute(s)
MJ	megajoule(s)
mm	millimetre(s)
MPa	megapascal(s)
N	newton
N/A	not applicable
ng	nanogram(s)
No.	number(s)
nom.	nominal
o.c.	on centre
OSB	oriented strandboard
s	second(s)
temp.	temperature
T&G	tongue and groove
W	watt(s)
wt	weight
%	per cent

Part 2
General Requirements

(See Appendix A.) e3

Section 2.1. Application

2.1.1. Parts 1, 2, 7 and 8

2.1.1.1. Scope

1) Except as provided in Subsection 2.1.5., Parts 1, 2, 7 and 8 apply to all *buildings*.

2.1.2. Parts 3, 4, 5 and 6

2.1.2.1. Scope

1) Except as provided in Subsection 2.1.5., Parts 3, 4, 5 and 6 apply to

a) all *buildings* used for *major occupancies* classified as
  i) Group A, *assembly occupancies*,
  ii) Group B, *care or detention occupancies*, or
  iii) Group F, Division 1, *high hazard industrial occupancies*, and

b) all *buildings* exceeding 600 m² in *building area* or exceeding 3 *storeys* in *building height* used for *major occupancies* classified as
  i) Group C, *residential occupancies*,
  ii) Group D, *business and personal services occupancies*,
  iii) Group E, *mercantile occupancies*, or
  iv) Group F, Division 2 and 3, *medium* and *low hazard industrial occupancies*.

2.1.3. Part 9

2.1.3.1. Scope

1) Except as provided in Subsection 2.1.5., Part 9 applies to *buildings* of 3 *storeys* or less in *building height*, having a *building area* not exceeding 600 m² and used for *major occupancies* classified as

a) Group C, *residential occupancies* (see Appendix A-9.1.1.1.(1)), e3
b) Group D, *business and personal services occupancies*,
c) Group E, *mercantile occupancies*, or
d) Group F, Division 2 and 3, *medium* and *low hazard industrial occupancies*.

2.1.4. Site Assembled and Factory-Built Buildings

2.1.4.1. Application

1) This Code applies both to site assembled and factory-made *buildings*. (See Appendix A.)

2.1.5. Farm Buildings

2.1.5.1. Conformance to National Farm Building Code

1) *Farm buildings* shall conform to the requirements in the National Farm Building Code of Canada 1995.

2.1.6. Building Size Determination

2.1.6.1. Buildings Divided by Firewalls

1) Where a *firewall* divides a *building*, each portion of the *building* so divided shall be considered as a separate *building*, except when this requirement is specifically modified in other parts of this Code. (See Appendix A.)

2.1.6.2. Buildings Divided by Vertical Fire Separations

1) Except as permitted in Sentence (2), where portions of a *building* are completely separated by a vertical *fire separation* that has a *fire-resistance rating* of not less than 1 h and extends through all *storeys* and *service spaces* of the separated portions, each separated portion is permitted to be considered as a separate *building* for the purpose of determining *building height* provided

a) each separated portion is not more than 3 *storeys* in *building height* and is used only for *residential occupancies*, and
b) the unobstructed path of travel for the fire fighter from the nearest *street* to one entrance of each separated portion is not more than 45 m.

(See Appendix A.)

2) The vertical *fire separation* referred to in Sentence (1) may terminate at the floor assembly immediately above a *basement* provided the *basement* conforms to Article 3.2.1.2.

Section 2.2. Climatic Data

2.2.1. General

2.2.1.1. Climatic Values

1) The climatic values required for the design of *buildings* under this Code shall be in conformance with the values established by the *authority having jurisdiction* or, in the absence of such data, with Sentence (2) and the climatic values in Appendix C. (See Appendix A.)

2) The outside winter design temperatures determined from Appendix C shall be those listed for the January 2.5% values. (See Appendix A.)

2.2.1.2. Depth of Frost Penetration

1) Depth of frost penetration shall be established on the basis of local experience.

Section 2.3. Plans, Specifications and Calculations

2.3.1. General

2.3.1.1. Required Information

1) Sufficient information shall be provided to show that the proposed work will conform to this Code and whether or not it may affect adjacent property.

2.3.1.2. Required Plans

1) Plans shall be drawn to scale and shall indicate the nature and extent of the work or proposed *occupancy* in sufficient detail to establish that, when completed, the work and the proposed *occupancy* will conform to this Code.

2.3.2. Site Plans

2.3.2.1. Reference to Survey

1) Site plans shall be referenced to an up-to-date survey and, when required to prove compliance with this Code, a copy of the survey shall be provided.

2.3.2.2. Information Required on Site Plans

1) Site plans shall show
- a) by dimensions from property lines, the location of the proposed *building*,
- b) the similarly dimensioned location of every adjacent existing *building* on the property,
- c) existing and finished ground levels to an established datum at or adjacent to the site, and
- d) the access routes for fire fighting.

2.3.3. Fire Protection Components

2.3.3.1. Information Required for Fire Protection Components

1) Information shall be submitted to show the major components of fire protection including
- a) the division of the *building* by *firewalls*,
- b) the *building area*,
- c) the degree of *fire separation* of *storeys*, shafts and special rooms or areas, including the location and rating of *closures* in *fire separations*,
- d) the source of information for *fire-resistance ratings* of elements of construction (to be indicated on large-scale sections),
- e) the location of *exits*, and
- f) fire detection, suppression and alarm systems.

2.3.3.2. Plans of Sprinkler Systems

1) Before a sprinkler system is installed or altered, plans showing full details of the proposed sprinkler system and essential details of the *building* in which it is to be installed shall be drawn to an indicated scale.

2.3.4. Structural and Foundation Drawings and Calculations

2.3.4.1. Application

1) Requirements of this Subsection apply only to *buildings* falling within the scope of Part 4.

2.3.4.2. Professional Seal and Signature of Designer

1) Structural drawings and related documents submitted with the application to build shall be dated and shall bear the authorized professional seal and signature of the *designer* as defined in Sentence 4.1.1.2.(2).

2.3.4.3. Information Required on Structural Drawings

1) Structural drawings and related documents submitted with the application to build shall indicate, in addition to those items specified in Article 2.3.4.6. and Part 4 applicable to the specific material,
- a) the name and address of the person responsible for the structural design,
- b) the date of issue of the Code and standards to which the design conforms,

c) the dimensions, location and size of all structural members in sufficient detail to enable the design to be checked,
d) sufficient detail to enable the *dead loads* to be determined, and
e) all effects and loads, other than *dead loads*, used for the design of the structural members and exterior cladding.

2.3.4.4. Drawings of Parts or Components

1) Structural drawings of parts or components including *guards* designed by a person other than the *designer* of the *building* shall be dated and shall bear the authorized professional seal and signature of the *designer* of such parts or components.

2.3.4.5. Design Calculations and Analysis

1) The calculations and analysis made in the design of the structural members, including parts and components, of a *building* shall be available for inspection upon request.

2.3.4.6. Information Required on Foundation Drawings

1) *Foundation* drawings submitted with the application to build or excavate shall be provided to indicate
a) the type and condition of the *soil* or *rock*, as well as the *groundwater* conditions, as determined by the *subsurface investigation*,
b) the allowable bearing pressures on the *soil* or *rock*, the allowable loads when applicable and the design loads applied to *foundation units*, and
c) the earth pressures and other loads applied to the supporting structures of supported *excavations*.

2) When required, evidence that justifies the information on the drawings shall be submitted with the application to excavate or build.

2.3.4.7. Altered Conditions

1) Where conditions as described under Sentences 4.2.2.4.(1) and (2) are encountered, or where *foundation units* or their locations are altered, this information shall be recorded on appropriate drawings or new “as constructed” drawings.

2.3.5. Heating, Ventilating and Air-Conditioning Drawings and Specifications

2.3.5.1. Application

1) Requirements of this Subsection apply only to *buildings* falling within the scope of Part 6.

2.3.5.2. Information Required on Architectural and HVAC Drawings

1) The information shown on architectural plans and on plans for heating, ventilating and air-conditioning systems shall be clear and legible and shall contain all necessary details to demonstrate conformance with this Code. (See Appendix A.)

Section 2.4. Materials, Appliances, Systems and Equipment

2.4.1. General

2.4.1.1. Characteristics of Materials, Appliances, Systems and Equipment

1) All materials, *appliances*, systems and equipment installed to meet the requirements of this Code shall possess the necessary characteristics to perform their intended functions when installed in a *building*.

2.4.1.2. Storage on the Building Site

1) All *building* materials, *appliances* and equipment on the *building* site shall be stored in such a way as to prevent deterioration or impairment of their essential properties.

2.4.1.3. Used Materials, Appliances and Equipment

1) Unless otherwise specified, used materials, *appliances* and equipment are permitted to be reused when they meet the requirements of this Code for new materials and are satisfactory for the intended use.

Section 2.5. Equivalents

2.5.1. General

2.5.1.1. Alternate Materials, Appliances, Systems and Equipment Permitted

1) The provisions of this Code are not intended to limit the appropriate use of materials, *appliances*, systems, equipment, methods of design or construction procedures not specifically described herein.

2.5.1.2. Evidence of Equivalent Performance

1) Any person desirous of providing an equivalent to satisfy one or more of the requirements of this Code shall submit sufficient evidence to demonstrate that the proposed equivalent will provide the level of performance required by this Code.

2.5.1.3. Equivalence Demonstrated by Past Performance, Test or Evaluation

1) Materials, *appliances*, systems, equipment, methods of design and construction procedures not specifically described herein, or which vary from the specific requirements in this Code, are permitted to be used if it can be shown that these alternatives are suitable on the basis of past performance, tests or evaluations.

2.5.2. Structural Equivalents

(See Appendix A.)

2.5.2.1. Structural Equivalents

1) Provided the design is carried out by a person especially qualified in the specific methods applied and provided it demonstrates a level of safety and performance in accordance with the requirements of Part 4, *buildings* and their structural components falling within the scope of Part 4 that are not amenable to analysis using a generally established theory may be designed by

a) evaluation of a full-scale structure or a prototype by a loading test, or
b) studies of model analogues.

2.5.3. Equivalent Test Standards

2.5.3.1. Acceptance

1) The results of tests based on test standards other than as described in this Code are permitted to be used provided such alternative test standards will provide comparable results.

Section 2.6. Review

2.6.1. General

2.6.1.1. Application

1) Requirements of this Section apply only to *buildings* falling within the scope of Part 4, except that Subsection 2.6.5. applies to all *buildings*.

2.6.2. Review of Construction

2.6.2.1. Review of Construction

1) The *designer* or another suitably qualified person shall review the construction of any *building* or part thereof to determine conformance with the design.

2.6.3. Review of Shop Drawings

2.6.3.1. Conformance with Design

1) The *designer* or another suitably qualified person shall review all shop drawings and other related documents relevant to the design to determine conformance with the design.

2.6.4. Workmanship and Materials

2.6.4.1. Review

1) Workmanship, materials and all reports of material tests shall be reviewed by the *designer* or other suitably qualified person during the process of construction.

2.6.5. Off-Site Review

2.6.5.1. Factory-Built Assemblies

1) Where a *building* or component of a *building* is assembled off the *building* site in such a manner that it cannot be reviewed on site, off-site reviews shall be provided to determine compliance with this Code.

Section 2.7. Referenced Documents

2.7.1. Application

2.7.1.1. Limitation

1) The provisions of referenced documents in this Code apply only to the extent that they relate to *buildings*.

2.7.2. Conflicting Requirements

2.7.2.1. Conflict Between Code and Referenced Documents e3

1) In the case of conflict between the provisions of this Code and those of a referenced document, the provisions of this Code shall govern.

2.7.3. Effective Date

2.7.3.1. Documents Referenced

1) Unless otherwise specified herein, the documents referenced in this Code shall include all amendments, revisions and supplements effective to 31 October 2001. r r4

2.7.3.2. Applicable Editions

1) Where documents are referenced in this Code, they shall be the editions designated in Table 2.7.3.2. (See Appendix A.) e3

Table 2.7.3.2. r2 r4
Documents Referenced in the National Building Code of Canada 1995
Forming Part of Article 2.7.3.2.

Issuing Agency	Document Number	Title of Document	Code Reference
ANSI	A208.1-1993 r e2	Particleboard	9.23.14.2.(3) 9.29.9.1.(1) 9.30.2.2.(1)
ANSI	B18.6.1-1981	Slotted and Recessed Wood Screws (Inch Series)	9.23.3.1.(2)
ANSI/ ASHRAE	62-1999 r4	Ventilation for Acceptable Indoor Air Quality	6.2.2.1.(2)
ASTM	A 123/A 123M-00 r r4	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	Table 9.20.16.1.
ASTM	A 153/A 153M-00 r r4	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	Table 9.20.16.1.
ASTM	A 252-98 r r4	Welded and Seamless Steel Pipe Piles	4.2.3.8.(1)
ASTM	A 283/A 283M-00 r r4	Low and Intermediate Tensile Strength Carbon Steel Plates	4.2.3.8.(1)
ASTM	A 653/A 653M-00 r r4	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process	9.3.3.2.(1)
ASTM	A 924/A 924M-99 r r4	Steel Sheet, Metallic-Coated by the Hot-Dip Process	9.3.3.2.(1)
ASTM	A 1008/A 1008M-01 r4	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability	4.2.3.8.(1)
ASTM	A 1011/A 1011M-01 r4	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability	4.2.3.8.(1)
ASTM	C 4-00 r r4	Clay Drain Tile and Perforated Clay Drain Tile	9.14.3.1.(1)
ASTM	C 5-79	Quicklime for Structural Purposes	9.20.3.1.(1)
ASTM	C 27-98 r4	Classification of Fireclay and High-Alumina Refractory Brick	9.21.3.4.(1)
ASTM	C 36/C 36M-99e1 r r4	Gypsum Wallboard	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 37/C 37M-99 r r4	Gypsum Lath	9.29.5.2.(1)
ASTM	C 79/C 79M-00 e r4	Treated Core and Nontreated Core Gypsum Sheathing Board	Table 9.23.16.2.A.
ASTM	C 126-99 r r4	Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units	9.20.2.1.(1)
ASTM	C 207-91	Hydrated Lime for Masonry Purposes	9.20.3.1.(1)
ASTM	C 212-96 r	Structural Clay Facing Tile	5.6.1.2.(3) 9.20.2.1.(1)
ASTM	C 260-95 r	Air-Entraining Admixtures for Concrete	9.3.1.8.(1)
ASTM	C 411-97 r	Hot-Surface Performance of High-Temperature Thermal Insulation	3.6.5.4.(4) 3.6.5.5.(1) 9.33.6.4.(4) 9.33.8.2.(2)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
ASTM	C 412M-99 r4	Concrete Drain Tile	9.14.3.1.(1)
ASTM	C 442/C 442M-99 r r4	Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 444M-95 r	Perforated Concrete Pipe (Metric)	9.14.3.1.(1)
ASTM	C 494/C 494M-99a r r4	Chemical Admixtures for Concrete	9.3.1.8.(1)
ASTM	C 588/C 588M-99 r r4	Gypsum Base for Veneer Plasters	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 630/C 630M-00 r r4	Water-Resistant Gypsum Backing Board	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 700-00 r r4	Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	9.14.3.1.(1)
ASTM	C 931/C 931M-98 r r4	Exterior Gypsum Soffit Board	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 960-97 r	Predecorated Gypsum Board	3.1.5.11.(4) 9.29.5.2.(1)
ASTM	C 1002-00 r r4	Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs	9.24.1.4.(1) 9.29.5.7.(1)
ASTM	D 323-99a r r4	Vapor Pressure of Petroleum Products (Reid Method)	1.1.3.2.(1)
ASTM	D 2178-97a r	Asphalt Glass Felt Used in Roofing and Waterproofing	5.6.1.2.(1)
ASTM	D 2898-94	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing	3.1.5.5.(4) 3.1.5.5.(5)
ASTM	E 90-97 r	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements	3.3.4.6.(1) 9.11.1.1.(1)
ASTM	E 96-95 r	Water Vapor Transmission of Materials	5.5.1.2.(4) 9.30.1.2.(1)
ASTM	E 336-97 r	Measurement of Airborne Sound Insulation in Buildings	3.3.4.6.(1) 9.11.1.1.(1)
ASTM	E 413-87	Classification for Rating Sound Insulation	3.3.4.6.(1) 9.11.1.1.(1)
ASTM	F 476-84 r	Security of Swinging Door Assemblies	9.6.8.10.(1)
AWPA	M4-01 r r4	Care of Preservative-Treated Wood Products	4.2.3.2.(2)
BNQ	NQ 3624-115-2000 r r4	Polyethylene (PE) Pipe and Fittings – Flexible Corrugated Pipes for Drainage – Characteristics and Test Methods	9.14.3.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CCBFC	NRCC 38727	National Fire Code of Canada 1995	3.2.5.17.(1) 3.3.1.2.(1) 3.3.5.2.(1) 6.2.2.5.(1) 8.2.2.2.(1) 8.2.2.4.(1) 8.2.2.6.(1) 8.2.2.15.(1) 8.2.3.2.(1) 8.2.3.4.(1) 8.2.3.6.(1) 8.2.3.10.(1) 8.2.3.12.(1) 9.10.19.4.(1) 9.10.20.8.(1)
CCBFC	NRCC 38728	National Plumbing Code of Canada 1995	5.6.2.2.(2) 7.1.2.1.(1) 9.31.6.3.(1)
CCBFC	NRCC 38732	National Farm Building Code of Canada 1995	2.1.5.1.(1)
CGA	CAN/CGA-6.19-M93	Residential Carbon Monoxide Detectors	9.32.3.8.(6) 9.32.3.8.(8)
CGSB	CAN/CGSB-1.501-M89	Method for Permeance of Coated Wallboard	5.5.1.2.(3) 9.25.4.2.(5)
CGSB	CAN/CGSB-7.1-M86	Cold Formed Steel Framing Components	9.24.1.2.(1)
CGSB	CAN/CGSB-7.2-94	Adjustable Steel Columns	9.17.3.4.(1)
CGSB	CAN/CGSB-10.3-92	Air Setting Refractory Mortar	9.21.3.4.(1) 9.21.3.9.(1) 9.22.2.2.(2)
CGSB	CAN/CGSB-11.3-M87	Hardboard	5.6.1.2.(3) 9.27.10.1.(2) 9.29.7.1.(1) 9.30.2.2.(1)
CGSB	CAN/CGSB-11.5-M87	Hardboard, Precoated, Factory Finished, for Exterior Cladding	5.6.1.2.(3) 9.27.10.1.(1)
CGSB	CAN/CGSB-12.1-M90 e	Tempered or Laminated Safety Glass	3.3.1.18.(2) 3.4.6.14.(1) 3.4.6.14.(3) 9.6.6.2.(2) 9.7.3.1.(1) 9.8.8.6.(1)
CGSB	CAN/CGSB-12.2-M91	Flat, Clear Sheet Glass	9.6.6.2.(2) 9.7.3.1.(1)
CGSB	CAN/CGSB-12.3-M91	Flat, Clear Float Glass	9.7.3.1.(1)
CGSB	CAN/CGSB-12.4-M91	Heat Absorbing Glass	9.7.3.1.(1)
CGSB	CAN/CGSB-12.8-97 r4	Insulating Glass Units	5.3.1.2.(2) 9.7.3.1.(1)
CGSB	CAN/CGSB-12.10-M76	Glass, Light and Heat Reflecting	9.7.3.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	CAN/CGSB-12.11-M90	Wired Safety Glass	3.3.1.18.(2) 3.4.6.14.(1) 3.4.6.14.(3) 9.6.6.2.(2) 9.7.3.1.(1) 9.8.8.6.(1)
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	4.3.6.1.(1) 9.7.3.2.(1)
CGSB	19-GP-5M-1984 r	Sealing Compound, One-Component, Acrylic Base, Solvent Curing	9.27.4.2.(2)
CGSB	CAN/CGSB-19.13-M87	Sealing Compound, One-Component, Elastomeric, Chemical Curing	9.27.4.2.(2)
CGSB	19-GP-14M-1976	Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing	9.27.4.2.(2)
CGSB	CAN/CGSB-19.22-M89	Mildew-Resistant Sealing Compound for Tubs and Tiles	9.29.10.5.(1)
CGSB	CAN/CGSB-19.24-M90	Multicomponent, Chemical-Curing Sealing Compound	9.27.4.2.(2)
CGSB	CAN/CGSB-34.4-M89	Siding, Asbestos-Cement, Shingles and Clapboards	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.5-M89	Sheets, Asbestos-Cement, Corrugated	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.14-M89	Sheets, Asbestos-Cement, Decorative	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.16-M89	Sheets, Asbestos-Cement, Flat, Fully Compressed	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.17-M89	Sheets, Asbestos-Cement, Flat, Semicompressed	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.21-M89	Panels, Sandwich, Asbestos-Cement with Insulating Cores	5.6.1.2.(3) 9.27.8.1.(1)
CGSB	CAN/CGSB-34.22-94 r	Asbestos-Cement Drain Pipe	9.14.3.1.(1)
CGSB	CAN/CGSB-37.1-M89	Chemical Emulsified Type, Emulsified Asphalt for Dampproofing	9.13.2.1.(1)
CGSB	CAN/CGSB-37.2-M88	Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings	5.8.2.2.(6) 9.13.2.1.(1)
CGSB	CAN/CGSB-37.3-M89 e	Application of Emulsified Asphalts for Dampproofing or Waterproofing	5.8.2.3.(1) 9.13.1.4.(1)
CGSB	CAN/CGSB-37.4-M89	Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing	5.6.1.2.(1) 9.26.2.1.(1)
CGSB	CAN/CGSB-37.5-M89	Cutback Asphalt Plastic Cement	5.6.1.2.(1) 9.26.2.1.(1)
CGSB	37-GP-6Ma-1983 e	Asphalt, Cutback, Unfilled, for Dampproofing	5.8.2.2.(7) 5.8.2.2.(8) 9.13.2.1.(1)
CGSB	CAN/CGSB-37.8-M88	Asphalt, Cutback, Filled, for Roof Coating	5.6.1.2.(1) 9.26.2.1.(1)
CGSB	37-GP-9Ma-1983	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing	5.6.1.2.(1) 5.8.2.2.(6) 9.26.2.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	37-GP-12Ma-1984 e	Application of Unfilled Cutback Asphalt for Dampproofing	5.8.2.3.(2) 9.13.1.4.(1)
CGSB	CAN/CGSB-37.16-M89	Filled, Cutback Asphalt for Dampproofing and Waterproofing	5.8.2.2.(6) 9.13.2.1.(1)
CGSB	37-GP-18Ma-1985 e	Tar, Cutback, Unfilled, for Dampproofing	5.8.2.2.(7) 5.8.2.2.(8) 9.13.2.1.(1)
CGSB	37-GP-21M-1985	Tar, Cutback, Fibrated, for Roof Coating	5.6.1.2.(1) 9.26.2.1.(1)
CGSB	CAN/CGSB-37.22-M89 e	Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing	5.8.2.3.(2) 9.13.1.4.(1)
CGSB	37-GP-36M 1976 e	Application of Filled Cutback Asphalts for Dampproofing and Waterproofing	5.8.2.3.(1)
CGSB	37-GP-37M 1977 e	Application of Hot Asphalt for Dampproofing or Waterproofing	5.8.2.3.(1)
CGSB	CAN/CGSB-37.50-M89	Hot Applied, Rubberized Asphalt for Roofing and Waterproofing	5.6.1.2.(1) 5.8.2.2.(6) 9.26.2.1.(1)
CGSB	CAN/CGSB-37.51-M90 e	Application for Hot-Applied Rubberized Asphalt, for Roofing and Waterproofing	5.6.1.3.(1) 5.8.2.3.(1) 9.26.15.1.(1)
CGSB	37-GP-52M-1984	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	5.6.1.2.(1) 5.8.2.2.(6) 9.26.2.1.(1)
CGSB	CAN/CGSB-37.54-95 r	Polyvinyl Chloride Roofing and Waterproofing Membrane	5.6.1.2.(1) 5.8.2.2.(6) 9.26.2.1.(1)
CGSB	37-GP-55M-1979	Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane	5.6.1.3.(1) 9.26.16.1.(1)
CGSB	37-GP-56M-1985 r	Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing	5.6.1.2.(1) 5.8.2.2.(6) 9.26.2.1.(1)
CGSB	37-GP-64M-1977	Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-Up Roofing	5.6.1.2.(1)
CGSB	41-GP-6M-1983	Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced	5.6.1.2.(1) 9.26.2.1.(1)
CGSB	CAN/CGSB-41.24-95 r	Rigid Vinyl Siding, Soffits and Fascia	5.6.1.2.(3) 9.27.13.1.(1)
CGSB	51-GP-21M-1978	Thermal Insulation, Urethane and Isocyanurate, Unfaced	5.3.1.2.(2) Table 9.23.16.2.A. 9.25.2.2.(1)
CGSB	CAN/CGSB-51.25-M87	Thermal Insulation, Phenolic, Faced	5.3.1.2.(2) Table 9.23.16.2.A. 9.25.2.2.(1)
CGSB	CAN/CGSB-51.26-M86	Thermal Insulation, Urethane and Isocyanurate, Boards, Faced	5.3.1.2.(2) Table 9.23.16.2.A. 9.25.2.2.(1)
CGSB	51-GP-27M-1979	Thermal Insulation, Polystyrene, Loose Fill	5.3.1.2.(2) 9.25.2.2.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	CAN/CGSB-51.32-M77 e	Sheathing, Membrane, Breather Type	5.6.1.2.(1) 5.6.1.2.(3) 9.20.13.9.(1) 9.23.17.1.(1) 9.26.2.1.(1)
CGSB	CAN/CGSB-51.33-M89	Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction	5.5.1.2.(2) 9.25.4.2.(4)
CGSB	CAN/CGSB-51.34-M86 (Amended 1988) r	Vapour Barrier, Polyethylene Sheet for Use in Building Construction	5.5.1.2.(2) 9.13.2.1.(1) 9.13.2.1.(2) 9.18.6.2.(1) 9.25.3.2.(2) 9.25.4.2.(3)
CGSB	CAN/CGSB-63.14-M89	Plastic Skylights	5.4.1.2.(3) 5.4.1.2.(4) 5.6.1.2.(1) 5.6.1.2.(2) 9.7.7.1.(1) 9.7.7.2.(1)
CGSB	CAN/CGSB-82.1-M89	Sliding Doors	5.3.1.2.(2) 5.4.1.2.(3) 5.4.1.2.(5) 5.6.1.2.(3) 5.6.1.2.(4) 9.6.5.2.(1)
CGSB	CAN/CGSB-82.5-M88	Insulated Steel Doors	5.3.1.2.(2) 5.4.1.2.(3) 5.6.1.2.(3) 9.6.5.3.(1)
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Sliding or Folding, Wardrobe	9.6.6.3.(1)
CGSB	CAN/CGSB-93.1-M85	Sheet, Aluminum Alloy, Prefinished, Residential	5.6.1.2.(3) 9.27.12.1.(4)
CGSB	CAN/CGSB-93.2-M91 e	Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use	5.6.1.2.(3) 9.27.12.1.(3)
CGSB	CAN/CGSB-93.3-M91 e	Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use	5.6.1.2.(3) 9.27.12.1.(2)
CGSB	CAN/CGSB-93.4-92 e	Galvanized and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential	5.6.1.2.(3) 9.27.12.1.(1)
CSA	A5-98 r4	Portland Cement	9.3.1.2.(1) 9.20.3.1.(1) 9.28.2.1.(1)
CSA	A8-98 r4	Masonry Cement	9.20.3.1.(1)
CSA	A23.1-00 r4	Concrete Materials and Methods of Concrete Construction	4.2.3.6.(1) 4.2.3.9.(1) 9.3.1.3.(1) 9.3.1.4.(1)
CSA	A23.3-94	Design of Concrete Structures	Table 4.1.9.1.B. 4.3.3.1.(1)
CSA	CAN/CSA-A82.1-M87	Burned Clay Brick (Solid Masonry Units Made from Clay or Shale)	9.20.2.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	A82.3-M1978	Calcium Silicate (Sand-Lime) Building Brick	9.20.2.1.(1)
CSA	A82.4-M1978	Structural Clay Load-Bearing Wall Tile	9.20.2.1.(1)
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	9.20.2.1.(1)
CSA	CAN3-A82.8-M78	Hollow Clay Brick	9.20.2.1.(1)
CSA	CAN/CSA-A82.27-M91 e	Gypsum Board	3.1.5.11.(4) Table 9.23.16.2.A. 9.29.5.2.(1)
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	9.29.4.1.(1)
CSA	A82.31-M1980	Gypsum Board Application	9.10.12.5.(1) 9.29.5.1.(2)
CSA	A82.56-M1976	Aggregate for Masonry Mortar	9.20.3.1.(1)
CSA	CAN3-A93-M82	Natural Airflow Ventilators for Buildings	9.19.1.2.(6)
CSA	A123.1-98 r4	Asphalt Shingles Made From Organic Felt and Surfaced with Mineral Granules	5.6.1.2.(1) 9.26.2.1.(1)
CSA	A123.2-M1979	Asphalt Coated Roofing Sheets	5.6.1.2.(1) 9.26.2.1.(1)
CSA	A123.3-98 r4	Asphalt Saturated Organic Roofing Felt	5.6.1.2.(1) 9.26.2.1.(1)
CSA	A123.4-98 r4	Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems	5.6.1.2.(1) 5.8.2.2.(6) 9.13.2.1.(1) 9.26.2.1.(1)
CSA	A123.5-98 r4	Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules	5.6.1.2.(1) 9.26.2.1.(1)
CSA	A123.17-1963	Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs	5.6.1.2.(1) 9.26.2.1.(1)
CSA	CAN3-A123.51-M85	Asphalt Shingle Application on Roof Slopes 1:3 and Steeper	5.6.1.3.(1) 9.26.1.2.(1)
CSA	CAN3-A123.52-M85	Asphalt Shingle Application on Roof Slopes 1:6 to Less Than 1:3	5.6.1.3.(1) 9.26.1.2.(1)
CSA	A165.1-94	Concrete Masonry Units	9.15.2.2.(1) 9.17.5.1.(1) 9.20.2.1.(1) 9.20.2.6.(1)
CSA	A165.2-94	Concrete Brick Masonry Units	9.20.2.1.(1)
CSA	A165.3-94	Prefaced Concrete Masonry Units	9.20.2.1.(1)
CSA	CAN3-A165.4-M85	Autoclaved Cellular Units	9.20.2.1.(1)
CSA	CAN/CSA-A220.0-M91	Performance of Concrete Roof Tiles	5.6.1.2.(1) 9.26.2.1.(1)
CSA	CAN/CSA-A220.1-M91	Installation of Concrete Roof Tiles	9.26.17.1.(1)
CSA	CAN/CSA-A247-M86	Insulating Fibreboard	5.3.1.2.(2) 9.23.15.6.(3) Table 9.23.16.2.A. 9.25.2.2.(1) 9.29.8.1.(1)
CSA	CAN/CSA-A324-M88	Clay Flue Liners	9.21.3.3.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	A371-94	Masonry Construction for Buildings	5.6.1.2.(3) 5.6.1.3.(3) 9.20.15.2.(1)
CSA	CAN/CSA-A405-M87	Design and Construction of Masonry Chimneys and Fireplaces	9.21.3.5.(1) 9.22.1.4.(1) 9.22.5.2.(2)
CSA	CAN3-A438-M84	Concrete Construction for Housing and Small Buildings	9.3.1.1.(1) 9.3.1.7.(1)
CSA	A440-00 r4	Windows	5.4.1.2.(3) 5.4.1.2.(5) 5.4.1.2.(6) 5.6.1.2.(3) 5.6.1.2.(4) 5.6.1.2.(5) 9.7.2.1.(1) 9.7.2.1.(2) 9.7.6.1.(1)
CSA	A440.1-00 e2 r4	User Selection Guide to A440	5.4.1.2.(5) 5.4.1.2.(6) 5.6.1.2.(4) 5.6.1.2.(5)
CSA	B44-00 r r4	Safety Code for Elevators	3.2.6.7.(2) 3.5.2.1.(1) 3.5.2.1.(2) 3.5.2.1.(3) 3.5.4.2.(1) 3.8.3.5.(1) Table 4.1.10.5.
CSA	B51-97 r	Boiler, Pressure Vessel, and Pressure Piping Code	6.2.1.5.(1) 9.31.6.3.(2) 9.33.5.2.(1)
CSA	B52-99 r r4	Mechanical Refrigeration Code	6.2.1.5.(1) 9.33.5.2.(1)
CSA	CAN/CSA-B72-M87	Installation Code for Lightning Protection Systems	6.3.1.4.(1)
CSA	B111-1974	Wire Nails, Spikes and Staples	9.23.3.1.(1) 9.26.2.2.(1) 9.29.5.6.(1)
CSA	B139-00 r4	Installation Code for Oil-Burning Equipment	6.2.1.5.(1) 8.2.2.11.(1) 9.31.6.3.(2) 9.33.5.2.(1)
CSA	B149.1-00 r4	Natural Gas and Propane Installation Code	6.2.1.5.(1) 8.2.2.11.(1) 9.10.21.1.(1) 9.31.6.3.(2) 9.33.5.2.(1)
CSA	B182.1-99 r r4	Plastic Drain and Sewer Pipe and Pipe Fittings	9.14.3.1.(1)
CSA	B355-00 r4	Lifts for Persons with Physical Disabilities	3.8.3.5.(2)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	B365-01 r4	Installation Code for Solid-Fuel-Burning Appliances and Equipment	6.2.1.5.(1) 9.21.1.3.(2) 9.22.10.2.(1) 9.31.6.3.(2) 9.33.5.2.(1) 9.33.5.3.(1)
CSA	C22.1-98 r4	Canadian Electrical Code, Part I	3.6.1.2.(1) 3.6.2.1.(6) 3.6.2.8.(1) 6.2.1.5.(1) 8.2.2.9.(2) 9.31.6.3.(2) 9.33.5.2.(1) 9.34.1.1.(1)
CSA	C22.2 No. 0.3-96 r	Test Methods for Electrical Wires and Cables	3.1.4.3.(1) 3.1.5.17.(1) 3.6.4.3.(1)
CSA	C22.2 No.113-M1984	Fans and Ventilators	9.32.3.9.(6)
CSA	C22.2 No.141-M1985	Unit Equipment for Emergency Lighting	3.2.7.4.(2) 9.9.11.3.(6)
CSA	C22.2 No. 211.0-M1984	General Requirements and Methods of Testing for Nonmetallic Conduit	3.1.5.19.(1)
CSA	CAN/CSA-C260-M90	Rating the Performance of Residential Mechanical Ventilating Equipment	9.32.3.9.(1)
CSA	C282-00 r4	Emergency Electrical Power Supply for Buildings	3.2.7.5.(1)
CSA	C439-00 r4	Standard Laboratory Methods of Test for Rating the Performance of Heat/Energy-Recovery Ventilators	9.32.3.9.(3)
CSA	CAN/CSA-C445-M92	Design and Installation of Earth Energy Heat Pump Systems for Residential and Other Small Buildings	9.33.5.2.(1)
CSA	CAN/CSA-F280-M90	Determining the Required Capacity of Residential Space Heating and Cooling Appliances	6.2.1.3.(1) 9.33.5.1.(1)
CSA	CAN/CSA-F326-M91	Residential Mechanical Ventilation Systems	9.32.3.1.(1)
CSA	G40.21-98 r4	Structural Quality Steels	4.2.3.8.(1) 9.23.4.3.(2)
CSA	G401-93	Corrugated Steel Pipe Products	9.14.3.1.(1)
CSA	O80 Series-97 r	Wood Preservation	3.1.4.4.(1) 4.2.3.2.(1) 4.2.3.2.(2)
CSA	O80.1-97 r	Preservative Treatment of All Timber Products by Pressure Processes	9.3.2.9.(3)
CSA	O80.2-97 r	Preservative Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Processes	4.2.3.2.(1) 9.3.2.9.(3)
CSA	O80.3-97 r	Preservative Treatment of Piles by Pressure Processes	4.2.3.2.(1)
CSA	O80.9-97 r	Preservative Treatment of Plywood by Pressure Processes	9.3.2.9.(3)
CSA	O80.15-97 r	Preservative Treatment of Wood for Building Foundation Systems, Basements, and Crawl Spaces by Pressure Processes	4.2.3.2.(1) 9.3.2.9.(3)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	O86-01 r4	Engineering Design in Wood	Table 4.1.9.1.B. 4.3.1.1.(1)
CSA	O115-M1982	Hardwood and Decorative Plywood	5.6.1.2.(3) 9.27.9.1.(1) 9.30.2.2.(1)
CSA	O118.1-97 r	Western Cedars, Shakes and Shingles	5.6.1.2.(1) 5.6.1.2.(3) 9.26.2.1.(1) 9.27.7.1.(1)
CSA	O118.2-M1981	Eastern White Cedar Shingles	5.6.1.2.(1) 5.6.1.2.(3) 9.26.2.1.(1) 9.27.7.1.(1)
CSA	O121-M1978 e	Douglas Fir Plywood	5.6.1.2.(3) 9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.2.A. 9.27.9.1.(1) 9.30.2.2.(1) Table A-14 Table A-16 Table A-18
CSA	CAN/CSA-O122-M89	Structural Glued-Laminated Timber	Table A-11 Table A-20
CSA	CAN/CSA-O132.2 Series-90	Wood Flush Doors	9.6.5.1.(1)
CSA	CAN/CSA-O141-91	Softwood Lumber	3.1.4.6.(2) 9.3.2.6.(1)
CSA	O151- M1978 e	Canadian Softwood Plywood	5.6.1.2.(3) 9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.2.A. 9.27.9.1.(1) 9.30.2.2.(1) Table A-14 Table A-16 Table A-18
CSA	O153-M1980	Poplar Plywood	5.6.1.2.(3) 9.23.14.2.(1) 9.23.15.1.(1) Table 9.23.16.2.A. 9.27.9.1.(1) 9.30.2.2.(1)
CSA	CAN/CSA-O177-M89 e	Qualification Code for Manufacturers of Structural Glued-Laminated Timber	4.3.1.2.(1) Table A-11 Table A-20

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CSA	CAN/CSA-O325.0-92 e	Construction Sheathing	5.6.1.2.(3) 9.23.14.2.(1) Table 9.23.14.5.B. 9.23.15.1.(1) Table 9.23.15.6.B. Table 9.23.16.2.B. Table A-14 Table A-16 Table A-18
CSA	O437.0-93 e	OSB and Waferboard	5.6.1.2.(3) 9.23.14.2.(1) 9.23.14.4.(2) 9.23.15.1.(1) 9.23.15.2.(2) Table 9.23.16.2.A. 9.27.11.1.(1) 9.29.9.1.(2) 9.30.2.2.(1) Table A-14 Table A-16 Table A-18
CSA	S16-01 r5	Limit States Design of Steel Structures	Table 4.1.9.1.B. 4.3.4.1.(1)
CSA	S136-01 r5	North American Specification for the Design of Cold-Formed Steel Structural Members (using the Appendix B provisions applicable to Canada)	4.3.4.2.(1)
CSA	CAN3-S157-M83	Strength Design in Aluminum	4.3.5.1.(1)
CSA	S269.1-1975	Falsework for Construction Purposes	4.1.1.3.(3)
CSA	CAN/CSA-S269.2-M87	Access Scaffolding for Construction Purposes	4.1.1.3.(3)
CSA	CAN/CSA-S269.3-M92	Concrete Formwork	4.1.1.3.(3)
CSA	CAN3-S304-M84 e	Masonry Design for Buildings	4.3.2.1.(1) 9.21.4.5.(1)
CSA	S304.1-94 e	Masonry Design for Buildings (Limit States Design)	Table 4.1.9.1.B. 4.1.9.3.(5) 4.3.2.1.(1)
CSA	S307-M1980	Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings	9.23.13.11.(5)
CSA	S350-M1980	Code of Practice for Safety in Demolition of Structures	8.1.1.3.(1)
CSA	CAN3-S367-M81	Air-Supported Structures	4.4.1.1.(1)
CSA	CAN/CSA-S406-92	Construction of Preserved Wood Foundations	9.15.1.3.(3) 9.16.5.1.(1)
CSA	S413-94	Parking Structures	4.4.2.1.(1)
CSA	CAN/CSA-Z32.4-M86	Essential Electrical Systems for Hospitals	3.2.7.6.(1)
CSA	CAN/CSA-Z240.2.1-92	Structural Requirements for Mobile Homes	9.12.2.2.(6) 9.15.1.4.(1)
CSA	Z240.10.1-94	Site Preparation, Foundation, and Anchorage of Mobile Homes	9.15.1.4.(1) 9.23.6.3.(1)
CSA	CAN/CSA-Z305.1-92	Nonflammable Medical Gas Piping Systems	3.7.5.1.(1)
CSA	CAN/CSA-Z317.2-M91	Special Requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities	6.2.1.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
EPA	EPA 402-R-93-003 r4	Protocols for Radon and Radon Decay Product Measurements in Homes	9.13.8.2.(7)
HC	H46-2/90-156E e r4	Exposure Guidelines for Residential Indoor Air Quality	9.13.8.2.(10)
ISO	8201: 1987(E)	Acoustics – Audible emergency evacuation signal	3.2.4.19.(2)
NFPA	13-1999 r r4	Installation of Sprinkler Systems	3.2.4.8.(2) 3.2.4.16.(1) 3.2.5.13.(1) 3.3.2.12.(3)
NFPA	13D-1999 r r4	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	3.2.5.13.(3)
NFPA	13R-1999 r r4	Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height	3.2.5.13.(2)
NFPA	14-2000 r r4	Installation of Standpipe, Private Hydrants and Hose Systems	3.2.5.9.(1) 3.2.5.10.(1)
NFPA	20-1999 r r4	Installation of Stationary Pumps for Fire Protection	3.2.5.19.(1)
NFPA	71-1989	Installation, Maintenance and Use of Signaling Systems for Central Station Service	3.2.4.7.(4)
NFPA	72-1990	Installation, Maintenance and Use of Protective Signaling Systems	3.2.4.7.(4)
NFPA	80-1999 r r4	Fire Doors and Fire Windows	3.1.8.5.(2) 3.1.8.10.(2) 3.1.8.12.(2) 3.1.8.12.(3) 3.1.8.14.(1) 9.10.13.1.(1) 9.10.13.2.(3)
NFPA	82-1999 r4	Incinerators and Waste and Linen Handling Systems and Equipment	6.2.6.1.(1) 9.10.10.5.(2)
NFPA	96-1998 e2 r4	Ventilation Control and Fire Protection of Commercial Cooking Operations	6.2.2.6.(1)
NFPA	211-2000 r r4	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances	6.3.1.2.(2) 6.3.1.3.(1)
NFPA	214-1999 r r4	Water-Cooling Towers	6.2.3.15.(4)
NLGA		Standard Grading Rules for Canadian Lumber (2000) r4	9.3.2.1.(1)
SMACNA r		HVAC Duct Construction Standards – Metal and Flexible (1985) 2nd Edition - 1995	6.2.4.2.(1) 9.33.6.5.(2)
TC e2		Airport Regulations of the Aeronautics Act	4.1.6.12.(1)
TPIC r2		Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (1996)	9.23.13.11.(6)
ULC	CAN/ULC-S101-M89	Fire Endurance Tests of Building Construction and Materials	3.1.5.11.(3) 3.1.5.11.(4) 3.1.5.11.(6) 3.1.7.1.(1) 3.1.11.7.(1) 3.2.3.7.(7) 3.2.6.5.(6)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
ULC	CAN/ULC-S102-M88	Test for Surface Burning Characteristics of Building Materials and Assemblies	3.1.12.1.(1)
ULC	CAN/ULC-S102.2-M88	Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies	3.1.12.1.(2) 3.1.13.4.(1)
ULC	ULC S102.3-M1982	Fire Test of Light Diffusers and Lenses	3.1.13.4.(1)
ULC	CAN4-S104-M80 e2	Fire Tests of Door Assemblies	3.1.8.4.(1) 3.2.6.5.(3)
ULC	CAN4-S105-M85	Fire Door Frames Meeting the Performance Required by CAN4-S104	9.10.13.6.(1)
ULC	CAN4-S106-M80	Fire Tests of Window and Glass Block Assemblies	3.1.8.4.(1)
ULC	CAN/ULC-S107-M87	Fire Tests of Roof Coverings	3.1.15.1.(1)
ULC	CAN/ULC-S109-M87	Flame Tests of Flame-Resistant Fabrics and Films	3.1.6.5.(1) 3.2.3.20.(1) 3.6.5.2.(2) 3.6.5.3.(1) 9.33.6.3.(1)
ULC	CAN/ULC-S110-M86	Fire Tests for Air Ducts	3.6.5.1.(2) 3.6.5.1.(5) 9.33.6.2.(2) 9.33.6.2.(4)
ULC	ULC-S111-95 r	Fire Tests for Air Filter Units	6.2.3.14.(1) 9.33.6.15.(1)
ULC	CAN/ULC-S112-M90 e2	Fire Test of Fire Damper Assemblies	3.1.8.4.(1)
ULC	CAN4-S113-79	Wood Core Doors Meeting the Performance Required by CAN4-S104-77 for Twenty Minute Fire Rated Closure Assemblies	9.10.13.2.(1)
ULC	CAN4-S114-M80	Test for Determination of Non-Combustibility in Building Materials	1.1.3.2.(1)
ULC	ULC-S115-95 r	Fire Tests of Firestop Systems	3.1.5.15.(3) 3.1.9.1.(1) 3.1.9.1.(2) 3.1.9.4.(4) 9.10.9.7.(3)
ULC	CAN4-S124-M85	Test for the Evaluation of Protective Coverings for Foamed Plastics	3.1.5.11.(2)
ULC	CAN/ULC-S126-M86	Test for Fire Spread Under Roof-Deck Assemblies	3.1.14.1.(1) 3.1.14.2.(1)
ULC	CAN/ULC-S134-92	Fire Test of Exterior Wall Assemblies	3.1.5.5.(1)
ULC	S505-1974	Fusible Links for Fire Protection Service	3.1.8.9.(1)
ULC	CAN/ULC-S524-01 r4	Installation of Fire Alarm Systems	3.2.4.5.(1)
ULC	CAN/ULC-S531-M87	Smoke Alarms	3.2.4.21.(1) 9.10.18.1.(1)
ULC	CAN/ULC-S537-97 r	Verification of Fire Alarm Systems	3.2.4.5.(2)
ULC	CAN/ULC-S553-M86	Installation of Smoke Alarms	3.2.4.21.(7)
ULC	CAN/ULC-S610-M87	Factory-Built Fireplaces	9.22.8.1.(1)
ULC	ULC-S628-93	Fireplace Inserts	9.22.10.1.(1)

Table 2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
ULC	CAN/ULC-S629-M87	650°C Factory-Built Chimneys	9.21.1.2.(1)
ULC	CAN/ULC-S639-M87	Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces	9.22.2.3.(1)
ULC	CAN/ULC-S701-97 r r2	Thermal Insulation, Polystyrene, Boards and Pipe Covering	5.3.1.2.(2) Table 9.23.16.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S702-97 r e4	Mineral Fibre Thermal Insulation for Buildings	5.3.1.2.(2) Table 9.23.16.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S703-01 r4	Cellulose Fibre Insulation (CFI) for Buildings	5.3.1.2.(2) 9.25.2.2.(1)
ULC	CAN/ULC-S705.1-98 r2	Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Material Specification	5.3.1.2.(2) 9.25.2.2.(1)
ULC	CAN/ULC-S705.2-98 r2	Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities–Specification	5.3.1.3.(3) 9.25.2.5.(1)
ULC	ULC/ORD-C199P-M1988	Combustible Piping for Sprinkler Systems	3.2.5.14.(2)
ULC	ULC/ORD-C376-1995 r4	Fire Growth of Foamed Plastic Insulated Building Panels in a Full-Scale Room Configuration	3.1.5.11.(7)

Part 3
Fire Protection, Occupant Safety and Accessibility

(See Appendix A.)

Section 3.1. General

3.1.1. Scope and Definitions

3.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1.

3.1.1.2. Defined Words

1) Words that appear in italics are defined in Part 1.

3.1.1.3. Fire Protection Information

1) Information to be submitted regarding major components of fire protection shall conform to the requirements of Articles 2.3.3.1. and 2.3.3.2.

3.1.2. Classification of Buildings or Parts of Buildings by Major Occupancy

(See Appendix A.)

3.1.2.1. Classification of Buildings

1) Except as permitted by Articles 3.1.2.3. to 3.1.2.5., every *building* or part thereof shall be classified according to its *major occupancy* as belonging to one of the Groups or Divisions described in Table 3.1.2.1. (See Appendix A.)

2) A *building* intended for use by more than one *major occupancy* shall be classified according to all *major occupancies* for which it is used or intended to be used.

Table 3.1.2.1.
Major Occupancy Classification
Forming Part of Sentence 3.1.2.1.(1)

Group	Division	Description of *Major Occupancies*
A	1	*Assembly occupancies* intended for the production and viewing of the performing arts
A	2	*Assembly occupancies* not elsewhere classified in Group A
A	3	*Assembly occupancies* of the arena type
A	4	*Assembly occupancies* in which occupants are gathered in the open air
B	1	*Care or detention occupancies* in which persons are under restraint or are incapable of self preservation because of security measures not under their control
B	2	*Care or detention occupancies* in which persons having cognitive or physical limitations require special care or treatment
C	—	*Residential occupancies*
D	—	*Business and personal services occupancies*
E	—	*Mercantile occupancies*
F	1	*High hazard industrial occupancies*
F	2	*Medium hazard industrial occupancies*
F	3	*Low hazard industrial occupancies*

3.1.2.2. Occupancies of Same Classification

1) Any *building* is deemed to be occupied by a single *major occupancy*, notwithstanding its use for more than one *major occupancy*, provided that all *occupancies* are classified as belonging to the same Group classification or, where the Group is divided into Divisions, as belonging to the same Division classification described in Table 3.1.2.1.

3.1.2.3. Arena Type Buildings

1) An arena type *building* intended for occasional use for trade shows and similar exhibition purposes shall be classified as Group A, Division 3 *occupancy*. (See Appendix A.)

2) If the *building area* of an arena type *building* referred to in Sentence (1) is more than 1 500 m², the *building* shall be *sprinklered* throughout.

3.1.2.4. Police Stations

1) A police station with detention quarters is permitted to be classified as a Group B, Division 2 *major occupancy* provided the station is not more than 1 *storey* in *building height* and 600 m² in *building area*. e

3.1.2.5. Convalescent and Children's Custodial Homes

1) Convalescent homes and children's custodial homes are permitted to be classified as *residential occupancies* provided that occupants are ambulatory and live as a single housekeeping unit in a *dwelling unit* with sleeping accommodation for not more than 10 persons.

2) A care facility accepted for residential use pursuant to provincial or territorial legislation is permitted to be classified as a *residential occupancy* provided
- a) the occupants live in a *dwelling unit* used as a single housekeeping unit with sleeping accommodation for not more than 10 persons,
- b) interconnected *smoke alarms* are installed in each sleeping room in addition to the requirements of Article 3.2.4.21.,
- c) emergency lighting is provided in conformance with Subsection 3.2.7., and
- d) the *building* is *sprinklered* throughout.

3.1.3. Multiple Occupancy Requirements

3.1.3.1. Separation of Major Occupancies

1) Except as permitted by Sentences (2) and (3), *major occupancies* shall be separated from adjoining *major occupancies* by *fire separations* having *fire-resistance ratings* conforming to Table 3.1.3.1.

2) In a *building* not more than 3 *storeys* in *building height*, if not more than 2 *dwelling units* are contained together with a Group E *major occupancy*, the *fire-resistance rating* of the *fire separation* between the 2 *major occupancies* need not be more than 1 h.

3) In a *building* conforming to the requirements of Articles 3.2.8.2. to 3.2.8.9., the requirements of Sentence (1) for *fire separations* between *major occupancies* do not apply at the vertical plane around the perimeter of an opening through the horizontal *fire separation*.

Table 3.1.3.1.
Major Occupancy Fire Separations[1]
Forming Part of Sentence 3.1.3.1.(1)

Major Occupancy	Minimum *Fire-Resistance Rating* of *Fire Separation*, h											
	Adjoining *Major Occupancy*											
	A-1	A-2	A-3	A-4	B-1	B-2	C	D	E	F-1	F-2	F-3
A-1	—	1	1	1	2	2	1	1	2	(2)	2	1
A-2	1	—	1	1	2	2	1	1	2	(2)	2	1
A-3	1	1	—	1	2	2	1	1	2	(2)	2	1
A-4	1	1	1	—	2	2	1	1	2	(2)	2	1
B-1	2	2	2	2	—	2	2	2	2	(2)	2	2
B-2	2	2	2	2	2	—	2	2	2	(2)	2	2
C	1	1	1	1	2	2	—	1	2(3)	(2)	2(4)	1
D	1	1	1	1	2	2	1	—	—	3	—	—
E	2	2	2	2	2	2	2(3)	—	—	3	—	—
F-1	(2)	(2)	(2)	(2)	(2)	(2)	(2)	3	3	—	2	2
F-2	2	2	2	2	2	2	2(4)	—	—	2	—	—
F-3	1	1	1	1	2	2	1	—	—	2	—	—

Notes to Table 3.1.3.1.:

(1) Section 3.3. contains requirements for the separation of *occupancies* and tenancies that are in addition to the requirements for the separation of *major occupancies.*
(2) See Sentence 3.1.3.2.(1).
(3) See Sentence 3.1.3.1.(2).
(4) See Sentence 3.1.3.2.(2).

3.1.3.2. Prohibition of Occupancy Combinations

1) No *major occupancy* of Group F, Division 1 shall be contained within a *building* with any *occupancy* classified as Group A, B or C.

2) Not more than one *suite* of *residential occupancy* shall be contained within a *building* classified as a Group F, Division 2 *major occupancy*.

3.1.4. Combustible Construction

3.1.4.1. Combustible Materials Permitted

1) A *building* permitted to be of *combustible construction* is permitted to be constructed of *combustible* materials described in Part 9, with or without *noncombustible* components.

3.1.4.2. Protection of Foamed Plastics

1) Foamed plastics that form part of a wall or ceiling assembly in *combustible construction* shall be protected from adjacent spaces in the *building*, other than adjacent concealed spaces within *attic or roof spaces*, crawl spaces, and wall assemblies,

a) by one of the interior finishes described in Subsections 9.29.4. to 9.29.9.,

b) provided the *building* does not contain a Group B or Group C *major occupancy*, by sheet metal
   i) mechanically fastened to the supporting assembly independent of the insulation,
   ii) not less than 0.38 mm thick, and
   iii) with a melting point not below 650°C, or

c) by any thermal barrier that meets the requirements of Sentence 3.1.5.11.(2) (see Appendix A). e

3.1.4.3. Wires and Cables

1) Optical fibre cables and electrical wires and cables installed in a *building* permitted to be of *combustible construction* shall

a) not convey flame or continue to burn for more than 1 min when tested in conformance with the Vertical Flame Test in Clause 4.11.1. of CSA C22.2 No. 0.3, "Test Methods for Electrical Wires and Cables," or

b) be located in

i) totally enclosed *noncombustible* raceways (see Appendix A),

ii) masonry walls,

iii) concrete slabs, or

iv) totally enclosed nonmetallic raceways conforming to Article 3.1.5.19.

(See Appendix A.)
(See also Sentence 3.6.4.3.(1).)

3.1.4.4. Fire-Retardant Treated Wood

1) If *fire-retardant treated wood* is specified in this Part, the wood shall

a) be pressure impregnated with fire-retardant chemicals in conformance with CSA O80 Series, "Wood Preservation," and

b) have a *flame-spread rating* not more than 25.

3.1.4.5. Heavy Timber Construction Alternative

1) If *combustible construction* is permitted and is not required to have a *fire-resistance rating* more than 45 min, *heavy timber construction* is permitted to be used.

2) If *heavy timber construction* is permitted, it shall conform to Article 3.1.4.6.

3.1.4.6. Heavy Timber Construction

1) Wood elements in *heavy timber construction* shall be arranged in heavy solid masses and with essentially smooth flat surfaces to avoid thin sections and sharp projections.

2) The actual dimensions of solid sawn lumber used in *heavy timber construction* shall conform to CAN/CSA-O141, "Softwood Lumber."

3) Except as permitted by Sentences (4) to (7), the minimum dimensions of wood elements in *heavy timber construction* shall conform to Table 3.1.4.6.

Table 3.1.4.6.
Heavy Timber Dimensions
Forming Part of Sentence 3.1.4.6.(3)

Supported Assembly	Structural Element	Solid Sawn (width x depth), mm x mm	Glued-Laminated (width x depth), mm x mm	Round (diam), mm
Roofs only	Columns	140 x 191	130 x 190	180
	Arches supported on the tops of walls or abutments	89 x 140	80 x 152	—
	Beams, girders and trusses	89 x 140	80 x 152	—
	Arches supported at or near the floor line	140 x 140	130 x 152	—
Floors, floors plus roofs	Columns	191 x 191	175 x 190	200
	Beams, girders, trusses and arches	140 x 241 or 191 x 191	130 x 228 or 175 x 190	—

4) Roof arches supported on the tops of walls or abutments, roof trusses, roof beams and roof girders in *heavy timber construction* shall be spliced where necessary with splice plates not less than 64 mm thick and be
- a) not less than 64 mm wide where 2 or more spaced members are used for the construction, with intervening spaces
  - i) blocked solidly throughout, or
  - ii) tightly closed by a continuous wood cover plate not less than 38 mm thick secured to the underside of the members, or
- b) not less than 64 mm wide, provided there is automatic sprinkler protection under the roof deck.

5) Floors in *heavy timber construction* shall be of glued-laminated or solid sawn plank not less than
- a) 64 mm thick, splined or tongued and grooved, or
- b) 38 mm wide and 89 mm deep set on edge and well-spiked together.

6) Floors in *heavy timber construction* shall be laid
- a) so that no continuous line of end joints will occur except at points of support, and covered with
  - i) tongued and grooved flooring not less than 19 mm thick laid cross-wise or diagonally, or
  - ii) tongued and grooved phenolic-bonded plywood, strandboard or waferboard not less than 12.5 mm thick, and
- b) not closer than 15 mm to the walls to provide for expansion, with the gap covered at the top or bottom.

7) Roofs in *heavy timber construction* shall be of tongued and grooved phenolic-bonded plywood not less than 28 mm thick, or glued-laminated or solid sawn plank that is
- a) not less than 38 mm thick, splined or tongued and grooved, or
- b) not less than 38 mm wide and 64 mm deep set on edge and laid so that no continuous line of end joints will occur except at the points of support.

8) Wood columns in *heavy timber construction* shall be continuous or superimposed throughout all *storeys*.

9) Superimposed wood columns in *heavy timber construction* shall be connected by
- a) reinforced concrete or metal caps with brackets,
- b) steel or iron caps with pintles and base plates, or
- c) timber splice plates fastened to the columns by metal connectors housed within the contact faces.

10) Where beams and girders in *heavy timber construction* enter masonry, wall plates, boxes of the self-releasing type or hangers shall be used.

11) Wood girders and beams in *heavy timber construction* shall be closely fitted to columns, and adjoining ends shall be connected by ties or caps to transfer horizontal loads across the joints.

12) In *heavy timber construction*, intermediate wood beams used to support a floor shall be supported on top of the girders or on metal hangers into which the ends of the beams are closely fitted.

3.1.5. Noncombustible Construction

3.1.5.1. Noncombustible Materials

1) Except as permitted by Articles 3.1.5.2. to 3.1.5.19., 3.1.13.4. and 3.2.2.16., a *building* or part of a *building* required to be of *noncombustible construction*, shall be constructed with *noncombustible* materials.

3.1.5.2. Minor Combustible Components

1) The following minor *combustible* components are permitted in a *building* required to be of *noncombustible construction*:
- a) paint,
- b) tightly adhering paper covering not more than 1 mm thick applied to a *noncombustible* backing provided the assembly has a *flame-spread rating* not more than 25 (see Appendix A),
- c) mastics and caulking materials applied to provide flexible seals between the major components of exterior wall construction,
- d) fire stop materials conforming to Sentence 3.1.9.1.(1) and Article 3.1.11.7.,
- e) tubing for pneumatic controls provided it has an outside diameter not more than 10 mm,
- f) adhesives, *vapour barriers* and sheathing papers,
- g) electrical outlet and junction boxes,
- h) wood blocking within wall assemblies intended for the attachment of handrails, fixtures, and similar items mounted on the surface of the wall, and
- i) similar minor components.

3.1.5.3. Combustible Roofing Materials

1) *Combustible* roof covering which has an A, B, or C classification determined in conformance with Subsection 3.1.15. is permitted on a *building* required to be of *noncombustible construction*.

2) *Combustible* roof sheathing and roof sheathing supports installed above a concrete deck are permitted on a *building* required to be of *noncombustible* construction provided
- a) the concrete deck is not less than 50 mm thick,
- b) the height of the roof space above the deck is not more than 1 m,
- c) the roof space is divided into compartments by fire stops in conformance with Article 3.1.11.5.,
- d) openings through the concrete deck other than for *noncombustible* roof drains and plumbing piping are protected by masonry or concrete shafts
  - i) constructed as *fire separations* having a *fire-resistance rating* not less than 1 h, and
  - ii) extending from the concrete deck to not less than 150 mm above the adjacent roof sheathing,
- e) the perimeter of the roof is protected by a *noncombustible* parapet extending from the concrete deck to not less than 150 mm above the adjacent sheathing, and
- f) except as permitted by Clause (d), the roof space does not contain any *building* services.

3) *Combustible* cant strips, roof curbs, nailing strips and similar components used in the installation of roofing are permitted on a *building* required to be of *noncombustible construction*.

4) Wood nailer facings to parapets, not more than 600 mm high, are permitted on a *building* required to be of *noncombustible construction*, if the facings and any roof membranes covering the facings are protected by sheet metal.

3.1.5.4. Combustible Glazing and Skylights

1) *Combustible* skylight assemblies are permitted in a *building* required to be of *noncombustible construction* if the assemblies have a *flame-spread rating* not more than
- a) 150 provided the assemblies
  - i) have an individual area not more than 9 m^2,
  - ii) have an aggregate horizontal projected area of the openings through the ceiling not more than 25% of the area of the ceiling of the room or space in which they are located, and
  - iii) are spaced not less than 2.5 m from adjacent assemblies and from required *fire separations*, or
- b) 75 provided the assemblies
  - i) have an individual area not more than 27 m^2,
  - ii) have an aggregate horizontal projected area of the openings through the ceiling not more than 33% of the area of the ceiling of the room or space in which they are located, and
  - iii) are spaced not less than 1.2 m from adjacent assemblies and from required *fire separations*.

(See Appendix A.)

2) *Combustible* vertical glazing installed no higher than the second *storey* is permitted in a *building* required to be of *noncombustible construction*.

3) Except as permitted by Sentence (4), the *combustible* vertical glazing permitted by Sentence (2) shall have a *flame-spread rating* not more than 75.

4) The *flame-spread rating* of *combustible* glazing is permitted to be not more than 150 if the aggregate area of glazing is not more than 25% of the wall area of the *storey* in which it is located, and
- a) the glazing is installed in a *building* not more than 1 *storey* in *building height*,
- b) the glazing in the *first storey* is separated from the glazing in the second *storey* in accordance with the requirements of Article 3.2.3.16. for opening protection, or
- c) the *building* is *sprinklered* throughout.

5) *Combustible* window sashes and frames are permitted in a *building* required to be of *noncombustible construction* provided
- a) each window in an exterior wall face is an individual unit separated by *noncombustible* wall construction from every other opening in the wall,

b) windows in exterior walls in contiguous *storeys* are separated by not less than 1 m of *noncombustible construction*, and
c) the aggregate area of openings in an exterior wall face of a *fire compartment* is not more than 40% of the area of the wall face.

3.1.5.5. Combustible Components for Exterior Walls

1) Except for an *exposing building face* required to conform to Sentence 3.2.3.7.(1) or Sentence 3.2.3.7.(4), an exterior non-*loadbearing* wall assembly that includes *combustible* components is permitted to be used in a *building* required to be of *noncombustible construction* provided
a) the *building* is
  i) not more than 3 *storeys* in *building height*, or
  ii) *sprinklered* throughout,
b) the interior surfaces of the wall assembly are protected by a thermal barrier conforming to Sentence 3.1.5.11.(3), and
c) the wall assembly satisfies the criteria of Sentences (2) and (3) when subjected to testing in conformance with CAN/ULC-S134, "Fire Test of Exterior Wall Assemblies."
(See Appendix A.)

2) Flaming on or in the wall assembly shall not spread more than 5 m above the opening during or following the test procedure referenced in Sentence (1). (See Appendix A.)

3) The heat flux during the flame exposure on a wall assembly shall be not more than 35 kW/m^2 measured 3.5 m above the opening during the test procedure referenced in Sentence (1). (See Appendix A.)

4) A wall assembly permitted by Sentence (1) that includes *combustible* cladding of *fire-retardant treated wood* shall be tested for fire exposure after the cladding has been subjected to an accelerated weathering test as specified in ASTM D 2898, "Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing."

5) Wood decorative cladding is permitted to be used on exterior marquee fascias, of a *storey* having direct access to a *street* or access route, of a *building* required to be of *noncombustible construction* provided the cladding is *fire-retardant treated wood* that has been, before testing, conditioned in conformance with ASTM D 2898, "Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing."

3.1.5.6. Nailing Elements

1) Wood nailing elements attached directly to or set into a continuous *noncombustible* backing for the attachment of interior finishes, are permitted in a *building* required to be of *noncombustible construction* provided the concealed space created by the wood elements is not more than 50 mm thick.

3.1.5.7. Combustible Millwork

1) *Combustible* millwork including interior trim, doors and door frames, show windows together with their frames, aprons and backing, handrails, shelves, cabinets and counters is permitted in a *building* required to be of *noncombustible construction*.

3.1.5.8. Combustible Flooring Elements

1) *Combustible stage* flooring supported on *noncombustible* structural members is permitted in a *building* required to be of *noncombustible construction*.

2) Wood members more than 50 mm but not more than 300 mm high applied directly to or set into a *noncombustible* floor slab are permitted for the construction of a raised platform in a *building* required to be of *noncombustible construction* provided the concealed spaces are fire stopped in conformance with Sentence 3.1.11.3.(2).

3) The floor system for the raised platform referred to in Sentence (2) is permitted to include *combustible* subfloor and *combustible* finished flooring.

4) *Combustible* finished flooring is permitted in a *building* required to be of *noncombustible construction*.

3.1.5.9. Combustible Stairs in Dwelling Units

1) *Combustible* stairs are permitted in a *dwelling unit* in a *building* required to be of *noncombustible construction*.

3.1.5.10. Combustible Interior Finish

1) *Combustible* interior finish, including paint, wallpaper, and other interior finishes not more than 1 mm thick, is permitted in a *building* required to be of *noncombustible construction*.

2) *Combustible* interior wall finishes, other than foamed plastics, are permitted in a *building* required to be of *noncombustible construction* provided they
a) are not more than 25 mm thick, and
b) have a *flame-spread rating* not more than 150 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction.

3) *Combustible* interior ceiling finishes, other than foamed plastics, are permitted in a *building* required to be of *noncombustible construction* provided they

a) are not more than 25 mm thick, except for exposed *fire-retardant treated wood* battens, and

b) have a *flame-spread rating* not more than 25 on any exposed surface, or on any surface that would be exposed by cutting through the material in any direction, or are of *fire-retardant treated wood*, except that not more than 10% of the ceiling area within each *fire compartment* is permitted to have a *flame-spread rating* not more than 150.

3.1.5.11. Combustible Insulation and its Protection r4

1) *Combustible* insulation, other than foamed plastics, is permitted in a *building* required to be of *noncombustible construction* provided that it has a *flame-spread rating* not more than 25 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction, where the insulation is not protected as described in Sentences (3) and (4).

2) Foamed plastic insulation having a *flame-spread rating* not more than 25 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction, is permitted in a *building* required to be of *noncombustible construction* provided the insulation is protected from adjacent space in the *building*, other than adjacent concealed spaces within wall assemblies, by a thermal barrier consisting of

a) not less than 12.7 mm thick gypsum board mechanically fastened to a supporting assembly independent of the insulation,

b) lath and plaster, mechanically fastened to a supporting assembly independent of the insulation,

c) masonry,

d) concrete, or

e) any thermal barrier that meets the requirements of classification B when tested in conformance with ULC standard CAN4-S124-M, "Test for the Evaluation of Protective Coverings for Foamed Plastics" (see Appendix A).

3) *Combustible* insulation having a *flame-spread rating* more than 25 but not more than 500 on an exposed surface, or any surface that would be exposed by cutting through the material in any direction, is permitted in the exterior walls of a *building* required to be of *noncombustible construction*, provided the insulation is protected from adjacent space in the *building*, other than adjacent concealed spaces within wall assemblies, by a thermal barrier as described in Sentence (2), except that in a *building* that is not *sprinklered* throughout and is more than 18 m high, measured between *grade* and the floor level of the top *storey*, the insulation shall be protected by a thermal barrier consisting of

a) gypsum board not less than 12.7 mm thick, mechanically fastened to a supporting assembly independent of the insulation and with all joints either backed or taped and filled,

b) lath and plaster, mechanically fastened to a supporting assembly independent of the insulation,

c) masonry or concrete not less than 25 mm thick, or

d) any thermal barrier that, when tested in conformance with CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials," will not develop an average temperature rise more than 140°C or a maximum temperature rise more than 180°C at any point on its unexposed face within 10 min. (See also Article 3.2.3.7.)

4) *Combustible* insulation having a *flame-spread rating* more than 25 but not more than 500 on any exposed surface, or any surface that would be exposed by cutting through the material in any direction, is permitted in the interior walls, within ceilings and within roof assemblies of a *building* required to be of *noncombustible construction*, provided the insulation is protected from adjacent space in the *building*, other than adjacent concealed spaces within wall assemblies, by a thermal barrier as described in Sentence (2), except that in a *building* that is not *sprinklered* throughout and is more than 18 m high, measured between *grade* and the floor level of the top *storey*, the insulation shall be protected by a thermal barrier consisting of

- a) Type X gypsum board not less than 15.9 mm thick, mechanically fastened to a supporting assembly independent of the insulation and with all joints either backed or taped and filled, conforming to
  - i) CAN/CSA-A82.27-M, "Gypsum Board,"
  - ii) ASTM C 36/C 36M, "Gypsum Wallboard," r4
  - iii) ASTM C 442/C 442M, "Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board," r4
  - iv) ASTM C 588/C 588M, "Gypsum Base for Veneer Plasters," r4
  - v) ASTM C 630/C 630M, "Water-Resistant Gypsum Backing Board," r
  - vi) ASTM C 931/C 931M, "Exterior Gypsum Soffit Board," or r
  - vii) ASTM C 960, "Predecorated Gypsum Board,"
- b) non-*loadbearing* masonry or concrete not less than 50 mm thick,
- c) *loadbearing* masonry or concrete not less than 75 mm thick, or
- d) any thermal barrier that, when tested in conformance with CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials,"
  - i) will not develop an average temperature rise more than 140°C or a maximum temperature rise more than 180°C at any point on its unexposed face within 20 min, and
  - ii) will remain in place for not less than 40 min.

5) *Combustible* insulation, including foamed plastics, installed above roof decks, outside of *foundation* walls below ground level and beneath concrete slabs-on-ground is permitted to be used in a *building* required to be of *noncombustible construction*.

6) Thermosetting foamed plastic insulation having a *flame-spread rating* not more than 500 which forms part of a factory-assembled exterior wall panel that does not incorporate an air space is permitted to be used in a *building* required to be of *noncombustible construction* provided

- a) the foamed plastic is protected on both sides by sheet steel not less than 0.38 mm thick that will remain in place for not less than 10 min when the wall panel is tested in conformance with CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials,"
- b) the *flame-spread rating* of the wall panel, determined by subjecting a sample including an assembled joint to the appropriate test described in Subsection 3.1.12., is not more than the *flame-spread rating* permitted for the room or space which it bounds,
- c) the *building* does not contain a Group B or Group C *major occupancy*, and
- d) the *building* is not more than 18 m high, measured between *grade* and the floor level of the top *storey*.

7) A factory-assembled non-*loadbearing* interior or exterior wall or ceiling panel containing foamed plastic insulation having a *flame-spread rating* of not more than 500 is permitted to be used in a *building* required to be of *noncombustible construction* provided r4

- a) the *building* is *sprinklered*,
- b) the *building* is not more than 18 m high, measured between *grade* and the floor level of the uppermost *storey*,
- c) the *building* does not contain a Group A, Group B, or Group C *major occupancy*,
- d) the panel does not contain an air space,
- e) the panel, when tested in conformance with ULC/ORD-C376, "Fire Growth of Foamed Plastic Insulated Building Panels in a Full-Scale Room Configuration," meets the criteria defined in the document, and
- f) the *flame-spread rating* of a panel, determined by subjecting a sample, including an assembled joint typical of field installation, to the appropriate test described in Subsection 3.1.12., is not more than the *flame-spread rating* permitted for the room or space that it bounds.

3.1.5.12. Combustible Elements in Partitions

1) Except as permitted by Sentence (2), solid lumber *partitions* not less than 38 mm thick and wood framing in *partitions* located in a *fire compartment* not more than 600 m² in area are permitted to be used in a *building* required to be of *noncombustible construction* in a *floor area* that is not *sprinklered* throughout provided the *partitions*

a) are not required *fire separations*, and
b) are not located in a *care or detention occupancy*.

2) *Partitions* installed in a *building* of *noncombustible construction* are permitted to contain wood framing provided

a) the *building* is not more than 3 *storeys* in *building height*,
b) the *partitions* are not located in a *care or detention occupancy*, and
c) the *partitions* are not installed as enclosures for *exits* or *vertical service spaces*.

3) Solid lumber *partitions* not less than 38 mm thick and *partitions* that contain wood framing are permitted to be used in a *building* required to be of *noncombustible construction* provided

a) the *building* is *sprinklered* throughout, and
b) the *partitions* are not
   i) located in a *care or detention occupancy*,
   ii) installed as enclosures for *exits* or *vertical service spaces*, or
   iii) used to satisfy the requirements of Clause 3.2.8.1.(1)(a).

3.1.5.13. Storage Lockers in Residential Buildings

1) Storage lockers in storage rooms are permitted to be constructed of wood in a *building* of *residential occupancy* required to be of *noncombustible construction*.

3.1.5.14. Combustible Ducts

1) Except as required by Sentence 3.6.4.3.(1), *combustible* ducts, including *plenums* and duct connectors, are permitted to be used in a *building* required to be of *noncombustible construction* provided these ducts and duct connectors are used only in horizontal runs.

2) *Combustible* duct linings, duct coverings, duct insulation, vibration isolation connectors, duct tape, pipe insulation and pipe coverings are permitted to be used in a *building* required to be of *noncombustible construction* provided they conform to the appropriate requirements of Subsection 3.6.5.

3) In a *building* required to be of *noncombustible construction*, *combustible* ducts need not comply with the requirements of Sentences 3.6.5.1.(1) and (2) provided the ducts are

a) part of a duct system conveying only ventilation air, and
b) contained entirely within a *dwelling unit*.

3.1.5.15. Combustible Piping Materials

1) Except as permitted by Clause 3.1.5.2.(1)(e) and Sentences (2) and (3), *combustible* piping and tubing and associated adhesives are permitted to be used in a *building* required to be of *noncombustible construction* provided that, except when concealed in a wall or concrete floor slab, they

a) have a *flame-spread rating* not more than 25, and
b) if used in a *building* described in Subsection 3.2.6., have a smoke developed classification not more than 50.

2) *Combustible* sprinkler piping is permitted to be used within a *sprinkleredfloor area* in a *building* required to be of *noncombustible construction*. (See also Article 3.2.5.14.)

3) Polypropylene pipes and fittings are permitted to be used for drain, waste and vent piping for the conveyance of highly corrosive materials and for piping used to distribute distilled or dialyzed water in laboratory and hospital facilities in a *building* required to be of *noncombustible construction*, provided

a) the *building* is *sprinklered* throughout,
b) the piping is not located in a vertical shaft, and
c) piping that penetrates a *fire separation* is sealed at the penetration by a fire stop system that, when subjected to the fire test method in ULC-S115, “Fire Tests of Firestop Systems,” has an FT rating not less than the *fire-resistance rating* of the *fire separation*.

3.1.5.16. Combustible Plumbing Fixtures

1) *Combustible* plumbing fixtures, including wall and ceiling enclosures that form part of the plumbing fixture, are permitted in a *building* required to be of *noncombustible construction* provided they are constructed of material having a *flame-spread rating* and smoke developed classification not more than that permitted for the wall surface of the room or space in which they are installed.

3.1.5.17. Wires and Cables

1) Except as permitted by Article 3.1.5.18., optical fibre cables and electrical wires and cables with *combustible* insulation, jackets or sheathes are permitted in a *building* required to be of *noncombustible construction*, provided

a) the wires and cables exhibit a vertical char of not more than 1.5 m when tested in conformance with the Vertical Flame Test – Cables in Cabletrough in Clause 4.11.4. of CSA C22.2 No. 0.3, "Test Methods for Electrical Wires and Cables,"

b) the wires and cables are located in
   i) totally enclosed *noncombustible* raceways (see A-3.1.4.3.(1)(b)(i) in Appendix A),
   ii) masonry walls,
   iii) concrete slabs,
   iv) a *service room* separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h, or
   v) totally enclosed nonmetallic raceways conforming to Article 3.1.5.19., or

c) the wires and cables are communication cables used at the service entry to a *building* and are not more than 3 m long.

(See Appendix A.)

3.1.5.18. Combustible Travelling Cables for Elevators

1) *Combustible* travelling cables are permitted on elevating devices in a *building* required to be of *noncombustible construction*.

3.1.5.19. Nonmetallic Raceways

1) Subject to limits on size for penetrations of *fire separations* as required by Sentence 3.1.9.3.(2), within a *fire compartment* of a *building* required to be of *noncombustible construction*, totally enclosed nonmetallic raceways not more than 120 mm in outside diameter, or an equivalent rectangular area, are permitted to be used to enclose optical fibre cables and electrical wires and cables, provided the raceways exhibit a vertical char not more than 1.5 m when tested in conformance with the Vertical Flame Test (FT - 4) – Conduit or Tubing on Cable Tray in Clause 6.16 of CSA C22.2 No. 211.0-M, "General Requirements and Methods of Testing for Nonmetallic Conduit." r4

3.1.6. Tents and Air-Supported Structures

(See Appendix A.)

3.1.6.1. Means of Egress

1) Tents and *air-supported structures* shall conform to Sections 3.3. and 3.4.

3.1.6.2. Restrictions

1) An *air-supported structure* shall not be located above the *first storey* on any *building*.

2) An *air-supported structure* shall not be used for Groups B, C, or Group F, Division 1 *major occupancies* or for classrooms.

3) An *air-supported structure* shall be designed as open floor space without interior walls, *mezzanines*, intermediate floors or similar construction.

3.1.6.3. Clearance to Other Structures

1) Except as permitted by Sentences (2), (3) and (4), every tent and *air-supported structure* shall conform to Subsection 3.2.3.

2) Tents and *air-supported structures*

a) shall not be erected closer than 3 m to other structures on the same property except as permitted by Sentences (3) and (4), and

b) shall be sufficiently distant from one another to provide an area to be used as a means of emergency egress.

3) Tents and *air-supported structures* not occupied by the public

a) need not be separated from one another, and

b) are permitted to be erected less than 3 m from other structures on the same property provided this spacing does not create a hazard to the public.

4) Tents not more than 120 m^2 in ground area, located on fair grounds or similar open spaces, need not be separated from one another provided this does not create a hazard to the public.

3.1.6.4. Clearance to Flammable Material

1) The ground enclosed by a tent or *air-supported structure* and for not less than 3 m outside the structure shall be cleared of all flammable material or vegetation that will spread fire.

3.1.6.5. Flame Resistance

1) Every tent and *air-supported structure* and all tarpaulins and decorative materials used in connection with these structures shall conform to CAN/ULC-S109-M, "Flame Tests of Flame-Resistant Fabrics and Films."

3.1.6.6. Emergency Air Supply

1) An *air-supported structure* used as a place of assembly for more than 200 persons shall have either

a) an automatic emergency engine-generator set capable of powering one blower continuously for 4 h, or

b) a supplementary blower powered by an automatic internal combustion engine.

3.1.7. Fire-Resistance Ratings

3.1.7.1. Determination of Ratings

1) Except as permitted by Sentence (2) and Article 3.1.7.2., the rating of a material, assembly of materials or a structural member that is required to have a *fire-resistance rating*, shall be determined on the basis of the results of tests conducted in conformance with CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials."

2) A material, assembly of materials or a structural member is permitted to be assigned a *fire-resistance rating* on the basis of Appendix D.

3.1.7.2. Exception for Exterior Walls

1) The limit on the rise of temperature on the unexposed surface of an assembly as required by the tests referred to in Sentence 3.1.7.1.(1) shall not apply to an exterior wall that has a *limiting distance* of 1.2 m or more, provided correction is made for radiation from the unexposed surface in accordance with Sentence 3.2.3.1.(6).

3.1.7.3. Exposure Conditions for Rating

1) Floor, roof and ceiling assemblies shall be rated for exposure to fire on the underside.

2) *Firewalls* and interior vertical *fire separations* shall be rated for exposure to fire on each side.

3) Exterior walls shall be rated for exposure to fire from inside the *building*.

3.1.7.4. Minimum Fire-Resistance Rating

1) The use of materials or assemblies having a greater *fire-resistance rating* than required shall impose no obligation to exceed in whole or in part the minimum *fire-resistance ratings* required by this Part.

3.1.7.5. Rating of Supporting Construction

1) Except as permitted by Sentence (2) and by Articles 3.2.2.20. to 3.2.2.83. for mixed types of construction, all *loadbearing* walls, columns and arches in the *storey* immediately below a floor or roof assembly required to have a *fire-resistance rating* shall have a *fire-resistance rating* not less than that required for the supported floor or roof assembly.

2) *Loadbearing* walls, columns and arches supporting a *service room* or *service space* need not conform to Sentence (1).

3) If an assembly is required to be of *noncombustible construction* and have a *fire-resistance rating*, it shall be supported by *noncombustible construction*.

3.1.8. Fire Separations and Closures

3.1.8.1. General Requirements

1) Any wall, *partition* or floor assembly required to be a *fire separation* shall
- a) except as permitted by Sentence (2), be constructed as a continuous element (see Appendix A), and
- b) as required in this Part, have a *fire-resistance rating* as specified (see Appendix A).

2) Openings in a *fire separation* shall be protected with *closures*, shafts or other means in conformance with Articles 3.1.8.4. to 3.1.8.17. and Subsections 3.1.9. and 3.2.8. (See Appendix A.)

3.1.8.2. Combustible Construction Support

1) *Combustible construction* that abuts on or is supported by a *noncombustible fire separation* shall be constructed so that its collapse under fire conditions will not cause the collapse of the *fire separation*.

3.1.8.3. Continuity of Fire Separations

1) Except as permitted by Sentence 3.6.4.2.(2), a *horizontal service space* or other concealed space located above a required vertical *fire separation*, including the walls of a vertical shaft, shall be divided at the *fire separation* by an equivalent *fire separation* within the *service space*.

2) The *fire separation* required by Sentence (1) shall terminate so that smoke-tight joints are provided where it abuts on or intersects
- a) a floor,
- b) a roof slab, or
- c) a roof deck.

3) Except as required by Subsection 3.6.3. for a shaft penetrating a roof assembly, a shaft, including an *exit* enclosure, that penetrates a *fire separation*, shall
- a) extend through any *horizontal service space* or any other concealed space, and
- b) terminate so that smoke-tight joints are provided where the shaft abuts on or intersects
  - i) a floor,
  - ii) a roof slab, or
  - iii) a roof deck.

3.1.8.4. Determination of Ratings

1) Except as permitted by Sentences (2) and 3.1.8.14.(2), the *fire-protection rating* for a *closure* shall be determined on the basis of the results of tests conducted in conformance with the appropriate provisions in
- a) CAN4-S104-M, "Fire Tests of Door Assemblies,"

b) CAN4-S106-M, “Fire Tests of Window and Glass Block Assemblies,” or
c) CAN/ULC-S112-M, “Fire Test of Fire Damper Assemblies.”

(See Articles 3.1.8.15. to 3.1.8.17. for additional requirements for *closures*.)

2) Except as permitted by Sentence 3.1.8.10.(1), the *fire-protection rating* of a *closure* shall conform to Table 3.1.8.4. for the required *fire-resistance rating* of the *fire separation*.

Table 3.1.8.4.
Fire-Protection Rating of Closures
Forming Part of Sentence 3.1.8.4.(2)

Fire-Resistance Rating of *Fire Separation*	Minimum *Fire-Protection Rating* of *Closure*
45 min	45 min
1 h	45 min
1.5 h	1 h
2 h	1.5 h
3 h	2 h
4 h	3 h

3.1.8.5. Installation of Closures

1) Except where *fire dampers*, window assemblies and glass block are used as *closures*, *closures* of the same *fire-protection rating* installed on opposite sides of the same opening are deemed to have a *fire-protection rating* equal to the sum of the *fire-protection ratings* of the *closures*. (See A-3.1.8.1.(2) in Appendix A.)

2) Except as otherwise specified in this Part, every door, window assembly or glass block used as a *closure* in a required *fire separation* shall be installed in conformance with NFPA 80, “Fire Doors and Fire Windows.” (See A-3.1.8.1.(2) in Appendix A.)

3) If a door is installed so that it could damage the integrity of a *fire separation* if its swing is unrestricted, door stops shall be installed to prevent the damage.

3.1.8.6. Maximum Openings

1) The size of an opening in an interior *fire separation* required to be protected with a *closure* shall be not more than 11 m², with no dimension more than 3.7 m, if a *fire compartment* on either side of the *fire separation* is not *sprinklered*.

2) The size of an opening in an interior *fire separation* required to be protected with a *closure* shall be not more than 22 m², with no dimension more than 6 m, provided the *fire compartments* on both sides of the *fire separation* are *sprinklered*.

3.1.8.7. Fire Dampers

1) Except as permitted by Article 3.1.8.8., a duct that connects 2 *fire compartments* or that penetrates an assembly required to be a *fire separation* shall be equipped with a *fire damper*.

2) A *fire damper* required by Sentence (1) or a *fire damper* used as a *closure* in a *fire separation* shall have a *fire-protection rating* conforming to Sentence 3.1.8.4.(2).

3.1.8.8. Fire Dampers Waived

1) *Fire dampers* need not be provided in *noncombustible* branch ducts that have a melting point above 760°C and that penetrate a required *fire separation* provided the ducts

a) serve only air-conditioning units or combined air-conditioning and heating units discharging air not more than 1.2 m above the floor and have a cross-sectional area not more than 0.013 m², or
b) are connected to *exhaust duct* risers that are under negative pressure and in which the air flow is upward as required by Article 3.6.3.4. and are carried up inside the riser not less than 500 mm.

2) A duct penetrating a vertical *fire separation* not required to have a *fire-resistance rating* need not be equipped with a *fire damper* at the *fire separation*.

3) A *noncombustible* duct that penetrates a horizontal *fire separation* not required to have a *fire-resistance rating* need not be equipped with a *fire damper* at the *fire separation*.

4) A *noncombustible* duct that penetrates a *fire separation* that separates a *vertical service space* from the remainder of the *building* need not be equipped with a *fire damper* at the *fire separation* provided

a) the duct has a melting point above 760°C, and
b) each individual duct exhausts directly to the outside at the top of the *vertical service space*.

5) A continuous *noncombustible* duct having a melting point above 760°C that penetrates a vertical *fire separation* as required by Sentence 3.3.1.1.(1) between *suites* of other than *residential* or *care or detention occupancy* need not be equipped with a *fire damper* at the *fire separation*.

6) A duct that serves commercial cooking equipment and penetrates a required *fire separation* need not be equipped with a *fire damper* at the *fire separation*. (See also Article 6.2.2.6.)

3.1.8.9. Installation of Fire Dampers

1) A *fire damper* shall be arranged to close automatically upon the operation of a fusible link conforming to ULC-S505, "Fusible Links for Fire Protection Service," or other heat-actuated or smoke-actuated device.

2) A heat-actuated device referred to in Sentence (1) shall

a) be located where it is readily affected by an abnormal rise of temperature in the duct, and

b) have a temperature rating approximately 30°C above the maximum temperature that would exist in the system either with the system in operation or shut down.

3) A *fire damper* shall be installed in the plane of the *fire separation* so as to stay in place should the duct be dislodged during a fire.

4) A *fire damper* tested in the vertical or horizontal position shall be installed in the manner in which it was tested.

5) A tightly fitted access door shall be installed for each *fire damper* to provide access for the inspection of the damper and the resetting of the release device. (See Appendix A.)

3.1.8.10. Twenty-Minute Closures

1) A door assembly having a *fire-protection rating* not less than 20 min is permitted to be used as a *closure* in

a) a *fire separation* not required to have a *fire-resistance rating* more than 1 h, located between

i) a *public corridor* and a *suite*,

ii) a corridor and adjacent sleeping rooms, or

iii) a corridor and adjacent classrooms, offices and libraries in Group A, Division 2 *major occupancies*, or

b) a *fire separation* not required to have a *fire-resistance rating* more than 45 min, located in a *building* not more than 3 *storeys* in *building height*.

2) The requirements for *noncombustible* sills and *combustible* floor coverings in NFPA 80, "Fire Doors and Fire Windows," do not apply to a door described in Sentence (1).

3) A door described in Sentence (1) shall have a clearance not more than 6 mm at the bottom and not more than 3 mm at the sides and top.

3.1.8.11. Self-Closing Devices

1) Except as permitted by Sentence (2), every door in a *fire separation*, other than doors to freight elevators and dumbwaiters, shall be equipped with a self-closing device designed to return the door to the closed position after each use.

2) A self-closing device need not be provided on a door that is located between

a) a classroom and a corridor providing *access to exit* from the classroom in a *building* that is not more than 3 *storeys* in *building height*,

b) a *public corridor* and an adjacent room of *business and personal services occupancy* in a *building* that is not more than 3 *storeys* in *building height* provided the door is not located in a dead-end portion of the corridor,

c) a patients' sleeping room and a corridor serving the patients' sleeping room, provided the room and corridor are within a *fire compartment* in a hospital or nursing home that complies with the requirements of Article 3.3.3.5., or

d) a patients' sleeping room and an adjacent room that serves the patients' sleeping room, provided these rooms are within a *fire compartment* in a hospital or nursing home that complies with the requirements of Article 3.3.3.5.

3.1.8.12. Hold-Open Devices

1) A hold-open device is permitted on a door in a required *fire separation*, other than an *exit* door in a *building* more than 3 storeys in *building height*, and on a door for a vestibule required by Article 3.3.5.7., provided the device is designed to release the door in conformance with Sentences (2), (3) and (4).

2) Except as required by Sentence (3), a hold-open device permitted by Sentence (1) shall be designed to release by a signal from

a) an automatic sprinkler system,

b) a heat-actuated device, or

c) a *smoke detector* located as described in Appendix B of NFPA 80, "Fire Doors and Fire Windows."

3) A hold-open device permitted by Sentence (1) shall be designed to release upon a signal from a *smoke detector* located as described in Appendix B of NFPA 80, "Fire Doors and Fire Windows," if used on

a) an *exit* door,

b) a door opening into a *public corridor*,

c) an egress door referred to in Sentence 3.4.2.4.(2),

d) a door serving

i) an *assembly occupancy*,

ii) a *care or detention occupancy*, or

iii) a *residential occupancy*, or

e) a door required to function as part of a smoke control system.

4) A hold-open device permitted by Sentence (1) shall be designed to release upon a signal from the *building* fire alarm system if a fire alarm system is provided, except that this requirement does not apply to

a) a hold-open device on a door located between a corridor used by the public and an adjacent sleeping room in a hospital or nursing home, or

b) a hold-open device that is designed to release by a heat-actuated device in conformance with Sentence (2).

3.1.8.13. Door Latches

1) Except as permitted by Article 3.3.3.5., a swing-type door in a *fire separation* shall be equipped with a positive latching mechanism designed to hold the door in the closed position after each use.

3.1.8.14. Wired Glass and Glass Block

1) Except as permitted by Articles 3.1.8.16. and 3.1.8.17. for the separation of *exits*, an opening in a *fire separation* having a *fire-resistance rating* not more than 1 h is permitted to be protected with fixed wired glass assemblies or glass blocks installed in conformance with NFPA 80, "Fire Doors and Fire Windows."

2) Wired glass assemblies permitted by Sentence (1) and assigned a fire protection capability in Appendix D are permitted to be used as *closures* in vertical *fire separations* without being tested in accordance with Sentence 3.1.8.4.(1).

3) Glass blocks permitted by Sentence (1) shall be installed in accordance with Subsection 4.3.2. and reinforced with steel reinforcement in each horizontal joint.

3.1.8.15. Temperature Rise Limit for Doors

1) Except as permitted by Article 3.1.8.17., the maximum temperature rise on the opaque portion of the unexposed side of a door used as a *closure* in a *fire separation* in a location shown in Table 3.1.8.15., shall conform to the Table when tested in conformance with Sentence 3.1.8.4.(1).

Table 3.1.8.15.
Restrictions on Temperature Rise and Glazing for Closures
Forming Part of Articles 3.1.8.15. and 3.1.8.16.

Location	Minimum Required *Fire-Protection Rating* of Door	Maximum Temperature Rise on Opaque Portion of Unexposed Side of Door, °C	Maximum Area of Wired Glass in Door, m^2	Maximum Aggregate Area of Glass Block and Wired Glass Panels not in a Door, m^2
Between a dead-end corridor and an adjacent *occupancy* where the corridor provides the only *access to exit* and is required to have a *fire-resistance rating*	Less than 45 min	No limit	No limit	No limit
	45 min	250 after 30 min	0.0645	0.0645
Between an *exit* enclosure and the adjacent *floor area* in a *building* not more than 3 *storeys* in *building height*	All ratings	No limit	0.8	0.8
Between an *exit* enclosure and the adjacent *floor area* (except as permitted above)	45 min	250 after 30 min	0.0645	0.0645
	1.5 h	250 after 1 h	0.0645	0.0645
	2 h	250 after 1 h	0.0645	0.0645
In a *firewall*	1.5 h	250 after 30 min	0.0645	0
	3 h	250 after 1 h	0	0

3.1.8.16. Area Limits for Wired Glass and Glass Block

1) Except as permitted by Article 3.1.8.17., the maximum area of wired glass in a door used in the locations shown in Table 3.1.8.15. shall conform to the Table. (See Appendix A.)

2) Except as permitted by Article 3.1.8.17., the maximum area of glass block and wired glass panels not in a door, used in the locations shown in Table 3.1.8.15., shall conform to the Table.

3.1.8.17. Temperature Rise and Area Limits Waived

1) The temperature rise limits and glass area limits required by Articles 3.1.8.15. and 3.1.8.16. are waived for a *closure* between an *exit* enclosure and an enclosed vestibule or corridor provided

a) the vestibule or corridor is separated from the remainder of the *floor area* by a *fire separation* having a *fire-resistance rating* not less than 45 min,

b) the *fire separation* required by Clause (a) contains no wired glass or glass block within 3 m of the *closure* into the *exit* enclosure, and

c) the vestibule or corridor contains no *occupancy*.

(See Appendix A.)

3.1.9. Building Services in Fire Separations and Fire Rated Assemblies

3.1.9.1. Fire Stopping of Service Penetrations

1) Piping, tubing, ducts, *chimneys*, optical fibre cables, electrical wires and cables, totally enclosed *noncombustible* raceways, electrical outlet boxes and other similar *building* services that penetrate a membrane forming part of an assembly required to have a *fire-resistance rating*, or a *fire separation*, shall be

a) tightly fitted, or

b) sealed by a fire stop system that, when subjected to the fire test method in ULC-S115, "Fire Tests of Firestop Systems," has an F rating not less than the *fire-protection rating* required for *closures* in the *fire separation*.

(See A-9.10.9.6.(1) in Appendix A.)
(See also Article 3.1.9.4. for penetrations involving *combustible* drain, waste and vent piping.)

2) Piping, tubing, ducts, *chimneys*, optical fibre cables, electrical wires and cables, totally enclosed *noncombustible* raceways, electrical outlet boxes and other similar *building* services that penetrate a *firewall* or a horizontal *fire separation* that is required to have a *fire-resistance rating* in conformance with Article 3.2.1.2., shall be sealed at the penetration by a fire stop system that, when subjected to the fire test method in ULC-S115, "Fire Tests of Firestop Systems," has an FT rating not less than the *fire-resistance rating* for the *fire separation*.

3.1.9.2. Combustibility of Service Penetrations

1) Except as permitted by Articles 3.1.9.3. and 3.1.9.4., pipes, ducts, electrical outlet boxes, totally enclosed raceways or other similar service equipment that penetrate an assembly required to have a *fire-resistance rating* shall be *noncombustible* unless the assembly has been tested incorporating that service equipment.

3.1.9.3. Penetration by Wires, Cables and Outlet Boxes

1) Optical fibre cables and electrical wires and cables in totally enclosed *noncombustible* raceways are permitted to penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2.

2) Except as permitted by Sentence (3), totally enclosed nonmetallic raceways conforming to Article 3.1.5.19., optical fibre cables, and electrical wires and cables, single or grouped, with *combustible* insulation, jackets or sheathes that conform to the requirements of Clause 3.1.5.17.(1)(a) and that are not installed in totally enclosed *noncombustible* raceways are permitted to penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the overall diameter of the single or grouped wires or cables, or the raceways is not more than 25 mm.

3) Single conductor metal sheathed cables with *combustible* jacketting that are more than 25 mm in overall diameter are permitted to penetrate a *fire separation* required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the cables are not grouped.

4) *Combustible* totally enclosed raceways which are embedded in a concrete floor slab are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the concrete cover between the raceway and the bottom of the slab is not less than 50 mm.

5) *Combustible* outlet boxes are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the opening through the membrane into the box is not more than 0.016 m^2.

6) Outlet boxes that penetrate opposite sides of a wall assembly shall be offset where necessary to maintain the integrity of the *fire separation*.

3.1.9.4. Combustible Piping Penetrations

1) *Combustible* sprinkler piping is permitted to penetrate a *fire separation* provided the *fire compartments* on each side of the *fire separation* are *sprinklered*.

2) *Combustible* water distribution piping that has an outside diameter not more than 30 mm is permitted to penetrate a vertical *fire separation* that is required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required by Article 3.1.9.2., provided the piping is sealed in conformance with Clause 3.1.9.1.(1)(b).

3) Except as permitted by Sentences (4) to (6), *combustible* piping shall not be used in a drain, waste and vent piping system if any part of that system penetrates
- a) a *fire separation* required to have a *fire-resistance rating*, or
- b) a membrane that forms part of an assembly required to have a *fire-resistance rating*.

4) *Combustible* drain, waste and vent piping is permitted to penetrate a *fire separation* required to have a *fire-resistance rating* or a membrane that forms part of an assembly required to have a *fire-resistance rating*, provided
- a) the piping is sealed at the penetration by a fire stop system that has an F rating not less than the *fire-resistance rating* required for the *fire separation* when subjected to the fire test method in ULC-S115, “Fire Tests of Firestop Systems,” with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side, and
- b) the piping is not located in a vertical shaft.

5) *Combustible* drain piping is permitted to penetrate a horizontal *fire separation* provided it leads directly from a *noncombustible* water closet through a concrete floor slab.

6) *Combustible* drain, waste and vent piping is permitted on one side of a vertical *fire separation* provided it is not located in a vertical shaft.

3.1.9.5. Openings through a Membrane Ceiling

1) A membrane ceiling forming part of an assembly assigned a *fire-resistance rating* on the basis of Appendix D is permitted to be penetrated by openings leading into ducts within the ceiling space provided
- a) the ducts are sheet steel, and
- b) the amount of openings and their protection conform to the requirements of Appendix D.

3.1.9.6. Plenums

1) A ceiling assembly used as a *plenum* shall conform to Article 3.6.4.3.

3.1.10. Firewalls

3.1.10.1. Prevention of Firewall Collapse

1) Except as permitted by Sentence (2), the connections and supports for structural framing members that are connected to or supported on a *firewall* and have a *fire-resistance rating* less than that required for the *firewall*, shall be designed so that the collapse of the framing members during a fire will not cause the collapse of the *firewall*.

2) Sentence (1) does not apply to a *firewall* consisting of two separate wall assemblies each tied to its respective *building* frame but not to each other, provided each wall assembly is
- a) a *fire separation* having one half of the *fire-resistance rating* required for the *firewall* by Sentences 3.1.10.2.(1) and (2), and
- b) designed so that the collapse of one wall assembly will not cause collapse of the other.

3) A *firewall* is permitted to be supported on the structural frame of a *building* of *noncombustible construction* provided the supporting frame has a *fire-resistance rating* not less than that required for the *firewall*.

4) Piping, ducts and totally enclosed *noncombustible* raceways shall be installed so that their collapse will not cause collapse of the *firewall*.

3.1.10.2. Rating of Firewalls

1) A *firewall* which separates a *building* or *buildings* with *floor areas* containing a Group E or a Group F, Division 1 or 2 *major occupancy* shall be constructed as a *fire separation* of *noncombustible construction* having a *fire-resistance rating* not less than 4 h, except that where the upper portion of a *firewall* separates *floor areas* containing other than Group E or Group F, Division 1 or 2 *major occupancies*, the *fire-resistance rating* of the upper portion of the *firewall* is permitted to be not less than 2 h.

2) A *firewall* which separates a *building* or *buildings* with *floor areas* containing *major occupancies* other than Group E or Group F, Division 1 or 2 shall be constructed as a *fire separation* of *noncombustible construction* having a *fire-resistance rating* not less than 2 h.

3) Except for *closures*, the required *fire-resistance rating* of a *firewall* shall be provided by masonry or concrete.

3.1.10.3. Continuity of Firewalls

1) A *firewall* shall extend from the ground continuously through, or adjacent to, all *storeys* of a *building* or *buildings* so separated, except that a *firewall* located above a *basement storage garage* conforming to Article 3.2.1.2. is permitted to commence at the floor assembly immediately above the *storage garage*. (See also Sentence 3.1.10.1.(3).)

2) A *firewall* is permitted to terminate on the underside of a reinforced concrete roof slab provided
- a) the roof slab on both sides of the *firewall* has a *fire-resistance rating* not less than
  - i) 1 h if the *firewall* is required to have a *fire-resistance rating* not less than 2 h, or
  - ii) 2 h if the *firewall* is required to have a *fire-resistance rating* not less than 4 h, and
- b) there are no concealed spaces within the roof slab in that portion immediately above the *firewall*.

3.1.10.4. Parapets

1) Except as permitted by Sentences (2) and 3.1.10.3.(2), a *firewall* shall extend above the roof surface to form a parapet not less than
- a) 150 mm high for a *firewall* required to have a *fire-resistance rating* not less than 2 h, and
- b) 900 mm high for a *firewall* required to have a *fire-resistance rating* not less than 4 h.

2) A *firewall* that separates 2 *buildings* with roofs at different elevations need not extend above the upper roof surface to form a parapet, provided the difference in elevation between the roofs is more than 3 m.

3.1.10.5. Maximum Openings

1) Openings in a *firewall* shall conform to the size limits described in Article 3.1.8.6. and the aggregate width of openings shall be not more than 25% of the entire length of the *firewall*.

3.1.10.6. Exposure Protection for Adjacent Walls

1) The requirements of Article 3.2.3.13. shall apply to the external walls of 2 *buildings* that meet at a *firewall* at an angle less than 135°.

3.1.10.7. Combustible Projections

1) *Combustible* material shall not extend across the end of a *firewall* but is permitted to extend across a roof above a *firewall* that is terminated in conformance with Sentence 3.1.10.3.(2).

2) If *buildings* are separated by a *firewall*, *combustible* projections on the exterior of one *building*, including balconies, platforms, canopies, eave projections and stairs, that extend outward beyond the end of the *firewall*, shall not be permitted within 2.4 m of *combustible* projections and window or door openings of the adjacent *building*. (See also Article 3.2.3.6.)

3.1.11. Fire Stops in Concealed Spaces

3.1.11.1. Separation of Concealed Spaces

1) Concealed spaces in interior wall, ceiling and crawl spaces shall be separated from concealed spaces in exterior walls and *attic or roof spaces* by fire stops conforming to Article 3.1.11.7.

3.1.11.2. Fire Stopping in Wall Assemblies

1) Except as permitted by Sentence (2), fire stops conforming to Article 3.1.11.7. shall be provided to block off concealed spaces within a wall assembly
- a) at every floor level,
- b) at every ceiling level where the ceiling forms part of an assembly required to have a *fire-resistance rating*, and
- c) so that the maximum horizontal dimension is not more than 20 m and the maximum vertical dimension is not more than 3 m.

2) Fire stops conforming to Sentence (1) are not required provided
- a) the wall space is filled with insulation,
- b) the exposed construction materials and any insulation within the wall space are *noncombustible*,
- c) the exposed construction materials and any insulation within the wall space have a *flame-spread rating* not more than 25 on any exposed surface, or on any surface that would be exposed by cutting through the material in any direction, and fire stops are installed so that the vertical distance between them is not more than 10 m, or
- d) the insulated wall assembly contains not more than one concealed air space, and the horizontal thickness of that air space is not more than 25 mm.

3.1.11.3. Fire Stopping between Nailing and Supporting Elements

1) In a *building* required to be of *noncombustible construction*, a concealed space in which there is an exposed ceiling finish with a *flame-spread rating* more than 25, shall be provided with fire stops conforming to Article 3.1.11.7. between wood nailing elements, so that the maximum area of the concealed space is not more than 2 m^2.

2) In a *building* required to be of *noncombustible construction*, fire stops conforming to Article 3.1.11.7. shall be provided in the concealed spaces created by the wood members permitted by Sentence 3.1.5.8.(2)so that the maximum area of a concealed space is not more than 10 m^2.

3.1.11.4. Fire Stopping between Vertical and Horizontal Spaces

1) Fire stops conforming to Article 3.1.11.7. shall be provided

a) at all interconnections between concealed vertical and horizontal spaces in interior coved ceilings, drop ceilings and soffits in which the exposed construction materials within the space have a *flame-spread rating* more than 25, and

b) at the end of each run and at each floor level in concealed spaces between stair stringers in which the exposed construction materials within the space have a *flame-spread rating* more than 25.

3.1.11.5. Fire Stopping of Roof Spaces, Balconies and Canopies

1) A concealed space within a ceiling or roof assembly of *combustible construction*, including an *attic or roof space*, in which sprinklers are not installed, shall be separated by construction conforming to Article 3.1.11.7. into compartments not more than

a) 600 m^2 in area with no dimension more than 60 m if the exposed construction materials within the space have a *flame-spread rating* not more than 25, and

b) 300 m^2 in area with no dimension more than 20 m if the exposed construction materials within the space have a *flame-spread rating* more than 25.

(See Appendix A.)

2) A concealed space in an exterior cornice, a mansard style roof, a balcony or a canopy in which exposed construction materials within the space have a *flame-spread rating* more than 25, shall be separated by construction conforming to Article 3.1.11.7.

a) at locations where the concealed space extends across the ends of required vertical *fire separations*, and

b) so that the maximum dimension in the concealed space is not more than 20 m.

3.1.11.6. Fire Stopping of Crawl Spaces

1) A crawl space which is not considered as a *basement* by Article 3.2.2.9.and in which sprinklers are not installed, shall be separated by construction conforming to Article 3.1.11.7. into compartments not more than 600 m^2 in area with no dimension more than 30 m.

3.1.11.7. Fire Stop Materials

1) Except as permitted by Sentences (2) to (4), materials used to separate concealed spaces into compartments shall remain in place and prevent the passage of flames for not less than 15 min when subjected to the standard fire exposure in CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials."

2) Gypsum board not less than 12.7 mm thick and sheet steel not less than 0.38 mm thick need not be tested in conformance with Sentence (1) provided all joints have continuous support.

3) In a *building* required to be of *noncombustible construction*, wood nailing elements described in Article 3.1.5.6.need not be tested in conformance with Sentence (1).

4) In a *building* permitted to be of *combustible construction*, in a *combustible* roof system permitted by Sentence 3.1.5.3.(2), and in a raised platform permitted by Sentence 3.1.5.8.(2), materials used to separate concealed spaces into compartments are permitted to be

a) solid lumber not less than 38 mm thick,

b) phenolic bonded plywood, waferboard, or strandboard not less than 12.5 mm thick with joints supported, or

c) two thicknesses of lumber, each not less than 19 mm thick with joints staggered, where the width or height of the concealed space requires more than one piece of lumber not less than 38 mm thick to block off the space.

5) Openings through materials referred to in Sentences (1) to (4) shall be protected to maintain the integrity of the construction.

6) Where materials referred to in Sentences (1) to (4) are penetrated by construction elements or by service equipment, fire stop materials shall be used to seal the penetration.

3.1.12. Flame-Spread Rating and Smoke Developed Classification

3.1.12.1. Determination of Ratings

1) Except as required by Sentence (2) and as permitted by Sentence (3), the *flame-spread rating* and smoke developed classification of a material, assembly, or structural member shall be determined on the basis of not less than three tests conducted in conformance with CAN/ULC-S102-M, "Test for Surface Burning Characteristics of Building Materials and Assemblies."

2) The *flame-spread rating* and smoke developed classification of a material or assembly shall be determined on the basis of not less than three tests conducted in conformance with CAN/ULC-S102.2-M, "Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies," if the material or assembly

a) is designed for use in a relatively horizontal position with only its top surface exposed to air,

b) cannot be tested in conformance with Sentence (1) without the use of supporting material that is not representative of the intended installation, or

c) is thermoplastic.

3) A material, assembly, or structural member is permitted to be assigned a *flame-spread rating* and smoke developed classification on the basis of Appendix D.

3.1.13. Interior Finish

3.1.13.1. Interior Finish Description

1) Interior finish material shall include any material that forms part of the interior surface of a floor, wall, *partition* or ceiling, including

a) interior cladding of plaster, wood or tile,

b) surfacing of fabric, paint, plastic, veneer or wallpaper,

c) doors, windows and trim,

d) lighting elements such as light diffusers and lenses forming part of the finished surface of the ceiling, and

e) carpet material that overlies a floor that is not intended as the finished floor.

3.1.13.2. Flame-Spread Rating

1) Except as otherwise required or permitted by this Subsection, the *flame-spread rating* of interior wall and ceiling finishes, including glazing and skylights, shall be not more than 150 and shall conform to Table 3.1.13.2.

Table 3.1.13.2.
Flame-Spread Ratings
Forming Part of Sentence 3.1.13.2.(1)

Occupancy, Location or Element	Maximum *Flame-Spread Rating* for Walls and Ceilings	
	Sprinklered	Not *Sprinklered*
Group A, Division 1 *occupancies*, including doors, skylights, glazing and light diffusers and lenses	150	75
Group B *occupancies*	150	75
Exits(1)	25	25
Lobbies described in Sentence 3.4.4.2.(2)	25	25
Covered vehicular passageways, except for roof assemblies of *heavy timber construction* in the passageways	25	25
Vertical service spaces	25	25

Notes to Table 3.1.13.2.:

(1) See Articles 3.1.13.8. and 3.1.13.10.

2) Except as permitted by Sentence (3), doors, other than those in Group A, Division 1 *occupancies*, need not conform to Sentence (1) provided they have a *flame-spread rating* not more than 200. (See Appendix A.)

3) Doors within a *dwelling unit* need not conform to Sentences (1) and (2).

4) Up to 10% of the total wall area and 10% of the total ceiling area of a wall or ceiling finish that is required by Sentence (1) to have a *flame-spread rating* less than 150 is permitted to have a *flame-spread rating* not more than 150, except that up to 25% of the total wall area of lobbies described in Sentence 3.4.4.2.(2) is permitted to have a *flame-spread rating* not more than 150.

5) Except in the case of Group A, Division 1 *occupancies*, *combustible* doors, skylights, glazing and light diffusers and lenses shall not be considered in the calculation of wall and ceiling areas described in Sentence (4).

3.1.13.3. Bathrooms in Residential Suites

1) The *flame-spread rating* of interior wall and ceiling finishes for a bathroom within a *suite* of *residential occupancy* shall be not more than 200.

3.1.13.4. Light Diffusers and Lenses

1) The *flame-spread rating* of *combustible* light diffusers and lenses in all *occupancies* other than Group A, Division 1 is permitted to be more than the *flame-spread rating* limits required elsewhere in this Subsection, provided the light diffusers and lenses
- a) have a *flame-spread rating* not more than 250 and a smoke developed classification not more than 600 when tested in conformance with CAN/ULC-S102.2-M, "Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies,"
- b) fall to the bottom of the test apparatus before igniting when tested in conformance with ULC S102.3-M, "Fire Test of Light Diffusers and Lenses,"
- c) are not prevented from falling from the ceiling by construction located beneath the elements, and
- d) are not used in a corridor that is required to be separated from the remainder of the *building* by a *fire separation* or in an *exit* shaft unless individual diffusers or lenses are not more than 1 m^2 in area and are not less than 1.2 m apart.

3.1.13.5. Skylights

1) Individual *combustible* skylights in a corridor that is required to be separated from the remainder of the *building* by a *fire separation* shall be not more than 1 m^2 in area and not less than 1.2 m apart.

3.1.13.6. Corridors

1) Except as permitted by Sentences (2) and (3), the *flame-spread rating* shall be not more than 75 for the interior wall finish of
- a) a *public corridor*,
- b) a corridor used by the public in
  - i) an *assembly occupancy*, or
  - ii) a *care or detention occupancy*,
- c) a corridor serving classrooms, or
- d) a corridor serving sleeping rooms in a *care or detention occupancy*.

2) The *flame-spread rating* limit specified in Sentence (1) does not apply to corridors referred to in Sentence (1) provided the *flame-spread rating* is not more than
- a) 25 on the upper half of the wall, and
- b) 150 on the lower half of the wall.

3) The *flame-spread rating* limits specified in Sentences (1) and (2) for corridors referred to in Sentence (1) does not apply to a corridor in which the *flame-spread rating* is not more than 150 provided the *building* is *sprinklered* throughout.

4) The *flame-spread rating* limits specified in Sentences (1), (2) and (3) apply to *occupancies* in the corridor as well as to the corridor itself.

5) Except in a *building* that is *sprinklered* throughout, the interior ceiling finish of corridors and *occupancies* referred to in Sentences (1) and (4) shall have a *flame-spread rating* not more than 25.

3.1.13.7. High Buildings

1) Except as permitted by Sentences (2) to (4), the interior wall, ceiling and floor finishes in a *building* regulated by the provisions of Subsection 3.2.6. shall conform to the *flame-spread rating* requirements in Article 3.1.13.2. and to the *flame-spread rating* and smoke developed classification values in Table 3.1.13.7.

2) Except for a *building* of Group B *major occupancy* and elevator cars, the *flame-spread rating* and smoke developed classification of interior wall, floor and ceiling finishes need not conform to the values in Table 3.1.13.7., provided the *building* is *sprinklered* throughout.

3) Trim and millwork in an *exit* stairway, a vestibule to an *exit* stairway, a lobby described in Sentence 3.4.4.2.(2), or a corridor not within a *suite* need not conform to the *flame-spread rating* and smoke developed classification requirements of Sentence (1) provided they have
- a) a *flame-spread rating* not more than 150,
- b) a smoke developed classification not more than 300, and
- c) an aggregate area not more than 10% of the area of the wall or ceiling on which they occur.

4) A door serving an *exit* stairway, a vestibule to an *exit* stairway, a lobby described in Sentence 3.4.4.2.(2), or a corridor not within a *suite* need not conform to the *flame-spread rating* and smoke developed classification requirements of Sentence (1) provided
- a) it has a *flame-spread rating* not more than 200,
- b) it has a smoke developed classification not more than 300, and
- c) the aggregate area of all doors is not more than 10% of the area of the wall in which they are located.

Table 3.1.13.7.
Flame-Spread Rating and Smoke Developed Classification in a High Building
Forming Part of Sentence 3.1.13.7.(1)

Location or Element	Maximum *Flame-Spread Rating*			Maximum Smoke Developed Classification		
	Wall Surface	Ceiling Surface(1)	Floor Surface	Wall Surface	Ceiling Surface(1)	Floor Surface
Exit stairways, vestibules to *exit* stairs and lobbies described in Sentence 3.4.4.2.(2)	25	25	25	50	50	50
Corridors not within *suites*	(2)	(2)	300	100	50	500
Elevator cars and vestibules	25	25	300	100	100	300
Service spaces and *service rooms*	25	25	25	50	50	50
Other locations and elements	(2)	(2)	No Limit	300	50	No Limit

Notes to Table 3.1.13.7.:
(1) See Article 3.1.13.4. for lighting elements.
(2) Other requirements of this Part apply.

3.1.13.8. Noncombustible Construction

1) In a *building* required to be of *noncombustible construction*,
a) the *flame-spread ratings* required by Subsection 3.1.5. shall apply in addition to the requirements in this Subsection, and
b) the *flame-spread ratings* for *exits* in this Subsection shall also apply to any surface in the *exit* that would be exposed by cutting through the material in any direction, except that this requirement does not apply to doors, *heavy timber construction* in a *sprinklered building* and *fire-retardant treated wood*.

3.1.13.9. Underground Walkways

1) Except for paint, the interior wall and ceiling finishes of an underground *walkway* shall be of *noncombustible* materials.

3.1.13.10. Exterior Exit Passageway

1) The wall and ceiling finishes of an exterior *exit* passageway that provides the only *means of egress* from the rooms or *suites* it serves, including the soffit beneath and the *guard* on the passageway, shall have a *flame-spread rating* not more than 25, except that a *flame-spread rating* not more than 150 is permitted for up to 10% of the total wall area and for up to 10% of the total ceiling area.

3.1.14. Roof Assemblies

3.1.14.1. Fire-Retardant Treated Wood Roof Systems

1) If a *fire-retardant treated wood* roof system is used to comply with the requirements of Subsection 3.2.2., the roof deck assembly shall meet the conditions of acceptance of CAN/ULC-S126-M, "Test for Fire Spread Under Roof-Deck Assemblies."

2) Supports for the roof deck assembly referred to in Sentence (1) shall consist of
a) *fire-retardant treated wood*,
b) *heavy timber construction*,
c) *noncombustible construction*, or
d) a combination thereof.

3.1.14.2. Metal Roof Deck Assemblies

1) Except as permitted by Sentence (2), a metal roof deck assembly shall meet the conditions of acceptance of CAN/ULC-S126-M, "Test for Fire Spread Under Roof-Deck Assemblies," if
a) it supports a *combustible* material above the deck that could propagate a fire beneath the roof deck assembly, and
b) the deck is used to comply with the requirements of Sentences 3.2.2.25.(2), 3.2.2.32.(2), 3.2.2.53.(2), 3.2.2.59.(2), 3.2.2.69.(2) and 3.2.2.76.(2) for *noncombustible construction*.

2) The requirements of Sentence (1) are waived provided
- a) the *combustible* material above the roof deck is protected by not less than 12.7 mm thick gypsum board, mechanically fastened to a supporting assembly if located beneath the roof deck, or by a thermal barrier conforming to one of Clauses 3.1.5.11.(2)(c) to (e) that is located
  - i) on the underside of the *combustible* material, or
  - ii) beneath the roof deck,
- b) the *building* is *sprinklered* throughout, or
- c) the roof assembly has a *fire-resistance rating* not less than 45 min.

3.1.15. Roof Covering

3.1.15.1. Roof Covering Classification

1) A roof covering classification shall be determined in conformance with CAN/ULC-S107-M, "Fire Tests of Roof Coverings."

3.1.15.2. Roof Coverings

1) Except as permitted by Sentence (2), every roof covering shall have a Class A, B or C classification as determined in accordance with Article 3.1.15.1.

2) A roof covering is not required to have a Class A, B or C classification for
- a) a tent,
- b) an *air-supported structure*, or
- c) a *building* of Group A, Division 2 *occupancy* not more than 2 *storeys* in *building height* and not more than 1 000 m² in *building area* provided the roof covering is underlaid with *noncombustible* material.

3.1.16. Occupant Load

3.1.16.1. Occupant Load Determination

1) The *occupant load* of a *floor area* or part of a *floor area* shall be based on
- a) the number of seats in an *assembly occupancy* having fixed seats,
- b) 2 persons per sleeping room in a *dwelling unit*, or
- c) the number of persons for which the area is designed, but not less than that determined from Table 3.1.16.1. for *occupancies* other than those described in Clauses (a) and (b), unless it can be shown that the area will be occupied by fewer persons.

2) If a *floor area* or part thereof has been designed for an *occupant load* other than that determined from Table 3.1.16.1., a permanent sign indicating that *occupant load* shall be posted in a conspicuous location.

3) For the purposes of this Article, *mezzanines*, tiers and balconies shall be regarded as part of the *floor area*.

4) If a room or group of rooms is intended for different *occupancies* at different times, the value to be used from Table 3.1.16.1. shall be the value which gives the greatest number of persons for the *occupancies* concerned.

Table 3.1.16.1.
Occupant Load
Forming Part of Article 3.1.16.1.

Type of Use of *Floor Area* or Part Thereof	Area per person m^2
Assembly uses	
space with fixed seats	(1)
space with non-fixed seats	0.75
stages for theatrical performances	0.75
space with non-fixed seats and tables	0.95
standing space	0.40
stadia and grandstands	0.60
bowling alleys, pool and billiard rooms	9.30
classrooms	1.85
school shops and vocational rooms	9.30
reading or writing rooms or lounges	1.85
dining, beverage and cafeteria space	1.20
laboratories in schools	4.60
Care or detention uses	
treatment and sleeping room areas	10.00
detention quarters	11.60
Residential uses	
dwelling units	(2)
dormitories	4.60
Business and personal services uses	
personal services shops	4.60
offices	9.30
Mercantile uses	
basements and *first storeys*	3.70
second *storeys* having a principal entrance from a pedestrian thoroughfare or a parking area	3.70
other *storeys*	5.60
Industrial uses	
manufacturing or process rooms	4.60
storage garages	46.00
storage spaces (warehouse)	28.00
aircraft hangars	46.00
Other uses	
cleaning and repair goods	4.60
kitchens	9.30
storage	46.00
public corridors intended for *occupancies* in addition to pedestrian travel	3.70(3)

Notes to Table 3.1.16.1.:
(1) See Clause 3.1.16.1.(1)(a).
(2) See Clause 3.1.16.1.(1)(b).
(3) See A-3.3.1.4.(1) in Appendix A.

Section 3.2. Building Fire Safety

3.2.1. General

3.2.1.1. Exceptions in Determining Building Height

1) A roof-top enclosure provided for elevator machinery, a stairway or a *service room* used for no purpose other than for service to the *building*, shall not be considered as a *storey* in calculating the *building height*.

2) Space under tiers of seats in a *building* of the arena type shall not be considered as adding to the *building height* provided the space is used only for dressing rooms, concession stands and similar purposes incidental to the *major occupancy* of the *building*.

3) Except as required by Sentence (5), a *mezzanine* shall not be considered as a *storey* in calculating the *building height* provided
a) the aggregate area of the *mezzanine* floor is not more than 40% of the area of the *storey* in which it is located,
b) it is used as an open *floor area* except as permitted by Sentence 3.3.2.11.(3), and
c) the space above the *mezzanine* floor and the space above the floor beneath it have no visual obstructions more than 1 070 mm above the floor.

(See Appendix A.)

4) Except as required by Sentence (5), a *mezzanine* need not be considered as a *storey* in calculating *building height* and need not conform to Sentence (3) provided the aggregate area of the *mezzanine* floor is not more than 10% of the area of the *storey* in which it is located. (See A-3.2.1.1.(3) in Appendix A.)

5) If one or more levels of *mezzanine* is partially or wholly superimposed above another *mezzanine* in the *storey*, each level additional to the first level shall be considered as a *storey* in calculating the *building height*.

6) The floor assembly of a *mezzanine* that is required to be considered as a *storey* in determining *building height*, shall be constructed in conformance with the *fire separation* requirements of Articles 3.2.2.20. to 3.2.2.83. for floor assemblies.

7) A *service space* in which facilities are included to permit a person to enter and to undertake maintenance and other operations pertaining to *building* services from within the *service space* need not be considered a *storey* if it conforms to Articles 3.2.5.15. and 3.3.1.23., and Sentences 3.2.4.19.(12), 3.2.7.3.(2), 3.3.1.3.(7), 3.4.2.4.(3) and 3.4.4.4.(9). (See Appendix A.)

3.2.1.2. Storage Garage Considered as a Separate Building

1) A *basement* used primarily as a *storage garage* is permitted to be considered as a separate *building* for the purposes of Subsection 3.2.2., provided the floor and roof assemblies above the *basement* and the exterior walls of the *basement* above the adjoining ground level are constructed as *fire separations* of masonry or concrete having a *fire-resistance rating* not less than 2 h, except as permitted by Sentence (2).

2) The exterior wall of a *basement* that is required to be a *fire separation* with a *fire-resistance rating* in accordance with Sentence (1) is permitted to be penetrated by openings that are not protected by *closures* provided

- a) the *storage garage* is *sprinklered* throughout,
- b) every opening in the exterior wall is separated from *storeys* above the opening by a projection of the floor or roof assembly above the *basement*, extending not less than
  - i) 1 m beyond the exterior face of the *storage garage* if the upper *storeys* are required to be of *noncombustible construction*, or
  - ii) 2 m beyond the exterior face of the *storage garage* if the upper *storeys* are permitted to be of *combustible construction*, or
- c) the exterior walls of any *storeys* located above the floor or roof assembly referred to in Sentence (1) are recessed behind the outer edge of the assembly by not less than
  - i) 1 m if the upper *storeys* are required to be of *noncombustible construction*, or
  - ii) 2 m if the upper *storeys* are permitted to be of *combustible construction*.

3) The floor or roof assembly projection referred to in Clause (2)(b) shall have a *fire-resistance rating* not less than 2 h and shall have no openings within the projection.

3.2.1.3. Roof Considered as a Wall

1) For the purposes of this Section any part of a roof that is pitched at an angle of 60° or more to the horizontal and is adjacent to a space intended for *occupancy* within a *building* shall be considered as part of an exterior wall of the *building*.

3.2.1.4. Floor Assembly over Basement

1) Except as permitted by Sentences 3.2.2.42.(3), 3.2.2.43.(3), 3.2.2.44.(3), 3.2.2.45.(3), 3.2.2.46.(3), 3.2.2.47.(3) or 3.2.2.48.(3), a floor assembly immediately above a *basement* shall be constructed as a *fire separation* having a *fire-resistance rating* conforming to the requirements of Articles 3.2.2.20. to 3.2.2.83. for a floor assembly, but not less than 45 min.

2) All *loadbearing* walls, columns and arches supporting a floor assembly immediately above a *basement* shall have a *fire-resistance rating* not less than that required by Sentence (1) for the floor assembly.

3.2.1.5. Fire Containment in Basements

1) Except as permitted by Sentences (2) and 3.2.2.15.(3), in a *building* in which an automatic sprinkler system is not required to be installed by Article 3.2.2.18., every *basement* shall

- a) be *sprinklered* throughout, or
- b) be subdivided into *fire compartments* not more than 600 m² in area by a *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly immediately above the *basement*.

2) An *open-air storey* need not conform to Sentence (1).

3.2.2. Building Size and Construction Relative to Occupancy

3.2.2.1. Application

1) Except as permitted by Article 3.2.2.3., a *building* shall be constructed in conformance with this Subsection to prevent fire spread and collapse caused by the effects of fire. (See Subsection 3.1.3. for *fire separations* between *major occupancies*.)

3.2.2.2. Special and Unusual Structures

1) A structure which cannot be identified with the characteristics of a *building* in Articles 3.2.2.20. to 3.2.2.83. shall be protected against fire spread and collapse in conformance with good fire protection engineering practice. (See A-3, A-3.2.2.2.(1) and A-3.2.5.13.(1) in Appendix A.)

3.2.2.3. Exceptions to Structural Fire Protection

1) Fire protection is not required for

- a) steel lintels above openings not more than 2 m wide in *loadbearing* walls and not more than 3 m wide in non-*loadbearing* walls,

b) steel lintels above openings more than 2 m wide in *loadbearing* walls and more than 3 m wide in non-*loadbearing* walls provided the lintels are supported at intervals of not more than 2 m by structural members with the required *fire-resistance rating*,
c) the bottom flanges of shelf angles and plates that are not a part of the structural frame,
d) steel members for framework around elevator hoistway doorways, steel for the support of elevator and dumbwaiter guides, counterweights and other similar equipment, that are entirely enclosed in a hoistway and are not a part of the structural frame of the *building*,
e) steel members of stairways and escalators that are not a part of the structural frame of a *building*,
f) steel members of porches, exterior balconies, exterior stairways, fire escapes, cornices, marquees and other similar appurtenances, provided they are outside an exterior wall of a *building*, and
g) *loadbearing* steel or concrete members wholly or partly outside a *building* face in a *building* not more than 4 *storeys* in *building height* and classified as Group A, B, C, D or F, Division 3 *major occupancy* provided the members are
   i) not less than 1 m away from any *unprotected opening* in an exterior wall, or
   ii) shielded from heat radiation in the event of a fire within the *building* by construction that will provide the same degree of protection that would be necessary if the member was located inside the *building*, with the protection extending on either side of the member a distance equal to the projection of the member from the face of the wall.

(See also Article 3.2.3.8.)

3.2.2.4. Buildings with Multiple Major Occupancies

1) The requirements restricting fire spread and collapse for a *building* of a single *major occupancy* classification are provided in this Subsection according to its *building height* and *building area*.

2) If a *building* contains more than one *major occupancy*, classified in more than one Group or Division, the requirements of this Subsection concerning *building* size and construction relative to *major occupancy* shall apply according to Articles 3.2.2.5. to 3.2.2.8.

3.2.2.5. Applicable Building Height and Area

1) In determining the fire safety requirements of a *building* in relation to each of the *major occupancies* contained therein, the *building height* and *building area* of the entire *building* shall be used.

3.2.2.6. Multiple Major Occupancies

1) Except as permitted by Articles 3.2.2.7. and 3.2.2.8., in a *building* containing more than one *major occupancy*, the requirements of this Subsection for the most restricted *major occupancy* contained shall apply to the whole *building*.

3.2.2.7. Superimposed Major Occupancies

1) Except as permitted by Article 3.2.2.8. and as required by Sentence 3.2.2.18.(2), in a *building* in which one *major occupancy* is located entirely above another *major occupancy*, the requirements in this Subsection for each portion of the *building* containing a *major occupancy* shall apply to that portion as if the entire *building* was of that *major occupancy*.

2) If one *major occupancy* is located above another *major occupancy*, the *fire-resistance rating* of the floor assembly between the *major occupancies* shall be determined on the basis of the requirements of this Subsection for the lower *major occupancy*. (See also Article 3.1.3.1.)

3.2.2.8. Exceptions for Major Occupancies

1) In a *building* in which the aggregate area of all *major occupancies* in a particular Group or Division is not more than 10% of the *floor area* of the *storey* in which they are located, these *major occupancies* need not be considered as *major occupancies* for the purposes of this Subsection, provided they are not classified as Group F, Division 1 or 2 *occupancies*.

3.2.2.9. Crawl Spaces

1) For the purposes of Articles 3.2.1.4. and 3.2.1.5., a crawl space shall be considered as a *basement* if it is
a) more than 1.8 m high between the lowest part of the floor assembly and the ground or other surface below,
b) used for any *occupancy*,
c) used for the passage of *flue pipes*, or
d) used as a *plenum* in *combustible construction*.

2) A floor assembly immediately above a crawl space is not required to be constructed as a *fire separation* and is not required to have a *fire-resistance rating* provided the crawl space is not required to be considered as a *basement* by Sentence (1).

3.2.2.10. Streets

1) Every *building* shall face a *street* located in conformance with the requirements of Articles 3.2.5.4. and 3.2.5.5. for access routes. e

2) For the purposes of Subsections 3.2.2. and 3.2.5. an access route conforming to Subsection 3.2.5. is permitted to be considered as a *street*.

3) A *building* is considered to face 2 *streets* provided not less than 50% of the *building* perimeter is located within 15 m of the *street* or *streets*.

4) A *building* is considered to face 3 *streets* provided not less than 75% of the *building* perimeter is located within 15 m of the *street* or *streets*.

5) Enclosed spaces, tunnels, bridges and similar structures, even though used for vehicular or pedestrian traffic, are not considered as *streets* for the purpose of this Part.

3.2.2.11. Exterior Balconies

1) An exterior balcony shall be constructed in accordance with the type of construction required by Articles 3.2.2.20. to 3.2.2.83., as applicable to the *occupancy* classification of the *building*.

3.2.2.12. Exterior Passageways

1) An elevated exterior passageway used as part of a *means of egress* shall conform to the requirements of Articles 3.2.2.20. to 3.2.2.83. for *mezzanines*.

3.2.2.13. Occupancy on Roof

1) A portion of a roof that supports an *occupancy* shall be constructed in conformance with the *fire separation* requirements of Articles 3.2.2.20. to 3.2.2.83. for floor assemblies, and not the *fire-resistance rating* for roof assemblies.

3.2.2.14. Roof-Top Enclosures

1) A roof-top enclosure for elevator machinery or for a *service room* shall be constructed in accordance with the type of construction required by Articles 3.2.2.20. to 3.2.2.83.

2) A roof-top enclosure for elevator machinery or for a *service room*, not more than one *storey* high, is not required to have a *fire-resistance rating*.

3) A roof-top enclosure for a stairway shall be constructed in accordance with the type of construction required by Articles 3.2.2.20. to 3.2.2.83.

4) A roof-top enclosure for a stairway need not have a *fire-resistance rating* nor be constructed as a *fire separation*.

3.2.2.15. Storeys below Ground

1) If a *building* is erected entirely below the adjoining finished ground level and does not extend more than one *storey* below that ground level, the minimum precautions against fire spread and collapse shall be the same as are required for *basements* under a *building* of 1 *storey* in *building height* having the same *occupancy* and *building area*.

2) If any portion of a *building* is erected entirely below the adjoining finished ground level and extends more than one *storey* below that ground level, the following minimum precautions against fire spread and collapse shall be taken:

- a) except as permitted by Sentence (3), the *basements* shall be *sprinklered* throughout,
- b) a floor assembly below the ground level shall be constructed as a *fire separation* with a *fire-resistance rating* not less than
  - i) 3 h if the *basements* are used as Group E or Group F, Division 1 or 2 *occupancies*, or
  - ii) 2 h if the *basements* are not used as Group E or Group F, Division 1 or 2 *occupancies*, and
- c) all *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the construction that they support.

3) If the *first storey* of a *building* is not required to be *sprinklered*, sprinklers are not required in the *storey* immediately below the *first storey* provided the *storey* below

- a) contains only *residential occupancies*, and
- b) has at least one unobstructed access opening conforming to Sentence 3.2.5.1.(2) installed on that *storey* for each 15 m of wall length in at least one wall required by this Subsection to face a *street*.

3.2.2.16. Heavy Timber Roof Permitted

1) Unless otherwise permitted by Articles 3.2.2.20. to 3.2.2.83., a roof assembly in a *building* up to 2 *storeys* in *building height* is permitted to be of *heavy timber construction* regardless of *building area* or type of construction required, provided the *building* is *sprinklered* throughout.

2) If Sentence (1) permits a roof assembly to be of *heavy timber construction*, structural members in the *storey* immediately below the roof assembly are permitted to be of *heavy timber construction*.

3.2.2.17. Arena Type Building Roof Assembly

1) The requirements for a roof assembly to have a *fire-resistance rating* are permitted to be waived for a gymnasium, a swimming pool, an arena, or a rink if no part of the roof assembly is less than 6 m above the main floor or balcony and the roof carries no loads other than normal roof loads, including permanent access walks, and ventilating, sound and lighting equipment, except that the restriction concerning minimum distance shall not apply to

a) an inclined and stepped floor ascending from the main floor which is used for seating purposes only, or
b) a balcony used for seating purposes only.

3.2.2.18. Automatic Sprinkler System Required

1) Except as permitted by Sentence (2), an automatic sprinkler system conforming to the requirements of Articles 3.2.4.7., 3.2.4.8., 3.2.4.9. and 3.2.5.13. shall be installed throughout a *building* regulated by one or more of Articles 3.2.2.20., 3.2.2.21., 3.2.2.22., 3.2.2.23., 3.2.2.24., 3.2.2.26., 3.2.2.27., 3.2.2.29., 3.2.2.31., 3.2.2.33., 3.2.2.36., 3.2.2.37., 3.2.2.38., 3.2.2.39., 3.2.2.40., 3.2.2.41., 3.2.2.42., 3.2.2.43., 3.2.2.45., 3.2.2.48., 3.2.2.49., 3.2.2.51., 3.2.2.52., 3.2.2.54., 3.2.2.56., 3.2.2.57., 3.2.2.58., 3.2.2.60., 3.2.2.62., 3.2.2.63., 3.2.2.64., 3.2.2.65., 3.2.2.67., 3.2.2.68., 3.2.2.70., 3.2.2.72., 3.2.2.73., 3.2.2.75., 3.2.2.77., 3.2.2.79. and 3.2.2.81.

2) If a *storey* in a *building* or a *floor area* is required to have an automatic sprinkler system installed throughout in accordance with one or more of Articles 3.2.2.20. to 3.2.2.83. or Section 3.3., the automatic sprinkler system shall also be installed throughout all lower *storeys* in the *building* notwithstanding permission in Articles 3.2.2.20. to 3.2.2.83. to construct one or more of those *storeys* without installing automatic sprinkler protection. (See Appendix A.)

3.2.2.19. Buildings Containing Impeded Egress Zones

1) A *building* containing an *impeded egress zone* and conforming to the appropriate requirements of Articles 3.2.2.20. to 3.2.2.83. is not required to conform to the requirements of Articles 3.2.2.36. and 3.2.2.37. for a Group B, Division 1 *major occupancy* provided

a) the *building* is *sprinklered* throughout,
b) it is not more than 1 *storey* in *building height*,
c) it does not include
   i) a *contained use area*,
   ii) sleeping accommodation,
   iii) a *high hazard industrial occupancy*, or
   iv) a *mercantile occupancy*,
d) the *building area* is not more than 6 400 m² if the *building* includes a *medium hazard industrial occupancy*,
e) the *impeded egress zone* does not extend beyond the boundaries of the *fire compartment* in which it is located, and
f) the *occupant load* of the *impeded egress zone* is not more than 100.

3.2.2.20. Group A, Division 1, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.21. and 3.2.2.22., a *building* classified as Group A, Division 1 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.21. Group A, Division 1, One Storey, Limited Area, Sprinklered

1) A *building* classified as Group A, Division 1 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 1 *storey* in *building height*,
c) it has less than 40% of the area of the *building* as 2 *storeys* for the purpose of
   i) development of productions, including preparation of scenery and costumes and rehearsal of performers,
   ii) organization of performers, scenery and sound equipment,
   iii) preparation by performers for a performance,
   iv) managerial functions, or
   v) toilets, rest rooms and similar public facilities,
d) it has no *occupancy* above or below the auditorium other than one which serves it or is dependent on it,
e) it is not more than 600 m² in *building area*, and
f) the *occupant load* is not more than 600.

2) The *building* referred to in Sentence (1) is permitted to be of *heavy timber construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations*
 i) with a *fire-resistance rating* not less than 45 min, or
 ii) of *heavy timber construction*, and

b) *loadbearing* walls, columns and arches shall
 i) have a *fire-resistance rating* not less than that required for the supported assembly, or
 ii) be of *heavy timber construction*.

3.2.2.22. Group A, Division 1, One Storey, Sprinklered

1) A *building* classified as Group A, Division 1 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 1 *storey* in *building height*,
c) no part of an auditorium floor is more than 5 m above or below *grade*,
d) no *occupancy* is above or below the auditorium other than one which serves it or is dependent on it, and
e) the *occupant load* of the auditorium floor is not more than 300.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,
c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
 i) have a *fire-resistance rating* not less than 45 min, or
 ii) be of *noncombustible construction*, and
d) *loadbearing* walls, columns and arches supporting a *fire separation* shall have a *fire-resistance rating* not less than that required for the *fire separation*.

3.2.2.23. Group A, Division 2, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.24. to 3.2.2.28., a *building* classified as Group A, Division 2 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.24. Group A, Division 2, up to 6 Storeys, Any Area, Sprinklered

1) A *building* classified as Group A, Division 2, that is not limited by *building area*, is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout, and
b) it is not more than 6 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.25. Group A, Division 2, up to 2 Storeys

1) A *building* classified as Group A, Division 2 is permitted to conform to Sentence (2) provided

a) it is not more than 2 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.25.

Table 3.2.2.25.
Maximum Building Area, Group A, Division 2, up to 2 Storeys
Forming Part of Sentence 3.2.2.25.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 600	2 000	2 400
2	800	1 000	1 200

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,

b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,

c) roof assemblies shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, except that in a *building* not more than 1 *storey* in *building height*, the *fire-resistance rating* is permitted to be waived provided the roof assembly is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1., and the *building area* is not more than

i) 800 m² if facing one *street*,

ii) 1 000 m² if facing 2 *streets*, or

iii) 1 200 m² if facing 3 *streets*, and

d) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall

i) have a *fire-resistance rating* not less than 45 min, or

ii) be of *noncombustible construction*.

3.2.2.26. Group A, Division 2, up to 2 Storeys, Increased Area, Sprinklered

1) A *building* classified as Group A, Division 2 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,

b) it is not more than 2 *storeys* in *building height*, and

c) it has a *building area* not more than

i) 4 800 m² if 1 *storey* in *building height*, or

ii) 2 400 m² if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,

b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, and

c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall

i) have a *fire-resistance rating* not less than 45 min, or

ii) be of *noncombustible construction*.

3.2.2.27. Group A, Division 2, up to 2 Storeys, Sprinklered

1) A *building* classified as Group A, Division 2 is permitted to be of *combustible construction* or *noncombustible construction*, used singly or in combination, provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,

b) it is not more than 2 *storeys* in *building height*, and

c) it has a *building area* not more than

i) 2 400 m² if 1 *storey* in *building height* with no *basement*,

ii) 1 200 m² if 1 *storey* in *building height*, or

iii) 600 m² if 2 *storeys* in *building height*.

3.2.2.28. Group A, Division 2, One Storey

1) A *building* classified as Group A, Division 2 is permitted to be of *combustible construction* or *noncombustible construction*, used singly or in combination, provided

a) it is not more than 1 *storey* in *building height*, and

b) except as permitted by Sentence (2), it has a *building area* not more than

i) 400 m² if facing one *street*,

ii) 500 m² if facing 2 *streets*, or

iii) 600 m² if facing 3 *streets*.

2) In a *building* referred to in Sentence (1) without a *basement*, the *building area* limits of Sentence (1) are permitted to be doubled provided a *fire separation* with a *fire-resistance rating* not less than 1 h is used to separate the *building* into *fire compartments*, each one of which does not exceed the limits of Clause (1)(b).

3.2.2.29. Group A, Division 3, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.30. to 3.2.2.34., a *building* classified as Group A, Division 3 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.30. Group A, Division 3, up to 2 Storeys

1) A *building* classified as Group A, Division 3 is permitted to conform to Sentence (2) provided

a) it is not more than 2 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.30.

Table 3.2.2.30.
Maximum Building Area, Group A, Division 3, up to 2 Storeys
Forming Part of Sentence 3.2.2.30.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	4 000	5 000	6 000
2	2 000	2 500	3 000

2) Except as permitted by Clauses (c) and (d), the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
c) roof assemblies shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *heavy timber construction*, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly, except that arches and structural members within the *storey* immediately below a roof assembly are permitted to be of *heavy timber construction*.

3.2.2.31. Group A, Division 3, up to 2 Storeys, Sprinklered

1) A *building* classified as Group A, Division 3 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
   i) 12 000 m^2 if 1 *storey* in *building height*, or
   ii) 6 000 m^2 if 2 *storeys* in *building height*.

2) Except as permitted by Clause (c) and Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly, except that arches are permitted to be of *heavy timber construction*.

3.2.2.32. Group A, Division 3, One Storey, Increased Area

1) A *building* classified as Group A, Division 3 is permitted to conform to Sentence (2) provided

a) it is not more than 1 *storey* in *building height*, and
b) it has a *building area* not more than
   i) 2 400 m^2 if facing one *street*,
   ii) 3 000 m^2 if facing 2 *streets*, or
   iii) 3 600 m^2 if facing 3 *streets*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,

b) roof assemblies shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, except that the *fire-resistance rating* is permitted to be waived provided the roof assembly is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1., and the *building area* is not more than
   i) 1 200 m² if facing one *street*,
   ii) 1 500 m² if facing 2 *streets*, or
   iii) 1 800 m² if facing 3 *streets*, and
c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.33. Group A, Division 3, One Storey, Sprinklered

1) A *building* classified as Group A, Division 3 is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 1 *storey* in *building height*, and
c) it has a *building area* not more than 7 200 m².

3.2.2.34. Group A, Division 3, One Storey

1) A *building* classified as Group A, Division 3 is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination provided
a) it is not more than 1 *storey* in *building height*, and
b) it has a *building area* not more than
   i) 1 000 m² if facing one *street*,
   ii) 1 250 m² if facing 2 *streets*, or
   iii) 1 500 m² if facing 3 *streets*.

3.2.2.35. Group A, Division 4

1) Except as permitted by Sentences (2) and (3), a *building* classified as Group A, Division 4 shall be of *noncombustible construction*.

2) Roof assemblies and supporting arches and columns are permitted to be of *heavy timber construction*.

3) A *building* classified as Group A, Division 4 is permitted to be of *combustible construction* provided
a) the *occupant load* is less than 1 500, and
b) the *building* has a *limiting distance* not less than 6 m.

4) Sprinklers shall be installed in all spaces below tiers of seats in a *building* classified as Group A, Division 4 if those spaces are used for *occupancy*. (See Appendix A.)

3.2.2.36. Group B, Division 1, Any Height, Any Area, Sprinklered

1) Except as permitted by Article 3.2.2.37., a *building* classified as Group B, Division 1 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.37. Group B, Division 1, up to 3 Storeys, Sprinklered

1) A *building* classified as Group B, Division 1 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 3 *storeys* in *building height*, and
c) it has a *building area*
   i) that is not limited if the *building* is not more than 1 *storey* in *building height*,
   ii) not more than 12 000 m² if 2 *storeys* in *building height*, or
   iii) not more than 8 000 m² if 3 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.38. Group B, Division 2, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.39. to 3.2.2.41., a *building* classified as Group B, Division 2 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.39. Group B, Division 2, up to 3 Storeys, Sprinklered

1) A *building* classified as Group B, Division 2 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 3 *storeys* in *building height*, and
c) it has a *building area*
i) that is not limited if the *building* is not more than 1 *storey* in *building height*,
ii) not more than 12 000 m² if 2 *storeys* in *building height*, or
iii) not more than 8 000 m² if 3 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.40. Group B, Division 2, up to 2 Storeys, Sprinklered

1) A *building* classified as Group B, Division 2 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
i) 2 400 m² if 1 *storey* in *building height*, or
ii) 1 600 m² if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.41. Group B, Division 2, One Storey, Sprinklered

1) A *building* classified as Group B, Division 2 is permitted to be of *combustible construction* or *noncombustible construction*, used singly or in combination, provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 1 *storey* in *building height*, and
c) it has a *building area* not more than 500 m².

3.2.2.42. Group C, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.43. to 3.2.2.48., a *building* classified as Group C shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) except as permitted by Sentence (3), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.

3.2.2.43. Group C, up to 6 Storeys, Sprinklered

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
- b) it is not more than 6 *storeys* in *building height*, and
- c) it has a *building area*
  - i) that is not limited if the *building* is not more than 2 *storeys* in *building height*,
  - ii) not more than 12 000 m² if 3 *storeys* in *building height*,
  - iii) not more than 9 000 m² if 4 *storeys* in *building height*,
  - iv) not more than 7 200 m² if 5 *storeys* in *building height*, or
  - v) not more than 6 000 m² if 6 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
- a) except as permitted by Sentence (3), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
- b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
- c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.

3.2.2.44. Group C, up to 3 Storeys, Noncombustible Construction

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
- a) it is not more than 3 *storeys* in *building height*,
- b) it has a *building area* not more than the value in Table 3.2.2.44.

Table 3.2.2.44.
Maximum Building Area, Group C, up to 3 Storeys
Forming Part of Sentence 3.2.2.44.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	not limited	not limited	not limited
2	6 000	not limited	not limited
3	4 000	5 000	6 000

2) The *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
- a) except as permitted by Sentence (3), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
- b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
- c) roof assemblies shall have a *fire-resistance rating* not less than 1 h, and
- d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.

3.2.2.45. Group C, up to 4 Storeys, Sprinklered

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
- b) it is not more than 4 *storeys* in *building height*, and
- c) it has a *building area* not more than
  - i) 7 200 m² if 1 *storey* in *building height*,
  - ii) 3 600 m² if 2 *storeys* in *building height*,
  - iii) 2 400 m² if 3 *storeys* in *building height*, or
  - iv) 1 800 m² if 4 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
- a) except as permitted by Sentences (3) and (4), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,

b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.

4) In a *building* in which there is no *dwelling unit* above another *dwelling unit*, the *fire-resistance rating* for floor assemblies entirely within the *dwelling unit* is waived.

3.2.2.46. Group C, up to 3 Storeys, Increased Area

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
a) it is not more than 3 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.46.

Table 3.2.2.46.
Maximum Building Area, Group C, up to 3 Storeys, Increased Area
Forming Part of Sentence 3.2.2.46.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	2 400	3 000	3 600
2	1 200	1 500	1 800
3	800	1 000	1 200

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) except as permitted by Sentences (3) and (4), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
c) roof assemblies shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns, and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 1 h but need not be constructed as *fire separations*.

4) In a *building* in which there is no *dwelling unit* above another *dwelling unit*, the *fire-resistance rating* for floor assemblies entirely within the *dwelling unit* is waived.

3.2.2.47. Group C, up to 3 Storeys

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
a) it is not more than 3 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.47.

Table 3.2.2.47.
Maximum Building Area, Group C, up to 3 Storeys
Forming Part of Sentence 3.2.2.47.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 800	2 250	2 700
2	900	1 125	1 350
3	600	750	900

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) except as permitted by Sentences (3) and (4), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 45 min but need not be constructed as *fire separations*.

4) In a *building* in which there is no *dwelling unit* above another *dwelling unit*, the *fire-resistance rating* for floor assemblies entirely within the *dwelling unit* is waived.

3.2.2.48. Group C, up to 3 Storeys, Sprinklered

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
- b) it is not more than 3 *storeys* in *building height*, and
- c) it has a *building area* not more than
  - i) 5 400 m² if 1 *storey* in *building height*,
  - ii) 2 700 m² if 2 *storeys* in *building height*, or
  - iii) 1 800 m² if 3 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
- a) except as permitted by Sentences (3) and (4), floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
- b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, and
- c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3) In a *building* that contains *dwelling units* that have more than one *storey*, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over *basements*, which are entirely contained within these *dwelling units*, shall have a *fire-resistance rating* not less than 45 min but need not be constructed as *fire separations*.

4) In a *building* in which there is no *dwelling unit* above another *dwelling unit*, the *fire-resistance rating* for floor assemblies entirely within the *dwelling unit* is waived.

3.2.2.49. Group D, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.50. to 3.2.2.56., a *building* classified as Group D shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
- b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
- c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
- d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.50. Group D, up to 6 Storeys

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided
- a) it is not more than 6 *storeys* in *building height*, and
- b) it has a *building area* not more than the value in Table 3.2.2.50.

Table 3.2.2.50.
Maximum Building Area, Group D, up to 6 Storeys
Forming Part of Sentence 3.2.2.50.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	not limited	not limited	not limited
2	7 200	not limited	not limited
3	4 800	6 000	7 200
4	3 600	4 500	5 400
5	2 880	3 600	4 320
6	2 400	3 000	3 600

2) The *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
- a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
- b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
- c) roof assemblies shall have a *fire-resistance rating* not less than 1 h, except that in a *building* not more than 1 *storey* in *building height* this requirement is waived, and
- d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.51. Group D, up to 6 Storeys, Sprinklered

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,

b) it is not more than 6 *storeys* in *building height*, and
c) it has a *building area*
   i) that is not limited if the *building* is not more than 2 *storeys* in *building height*,
   ii) not more than 14 400 m² if 3 *storeys* in *building height*,
   iii) not more than 10 800 m² if 4 *storeys* in *building height*,
   iv) not more than 8 640 m² if 5 *storeys* in *building height*, or
   v) not more than 7 200 m² if 6 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.52. Group D, up to 4 Storeys, Sprinklered

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 4 *storeys* in *building height*, and
c) it has a *building area* not more than 3 600 m².

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.53. Group D, up to 3 Storeys

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided
a) it is not more than 3 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.53.

Table 3.2.2.53.
Maximum Building Area, Group D, up to 3 Storeys
Forming Part of Sentence 3.2.2.53.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	4 800	6 000	7 200
2	2 400	3 000	3 600
3	1 600	2 000	2 400

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,
c) roof assemblies shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, except that in a *building* not more than 1 *storey* in *building height*, the *fire-resistance rating* is permitted to be waived provided the roof assembly is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1. and the *building area* is not more than
   i) 2 400 m² if facing one *street*,
   ii) 3 000 m² if facing 2 *streets*, or
   iii) 3 600 m² if facing 3 *streets*, and
d) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.54. Group D, up to 3 Storeys, Sprinklered

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 3 *storeys* in *building height*, and
c) it has a *building area* not more than
   i) 14 400 m² if 1 *storey* in *building height*,
   ii) 7 200 m² if 2 *storeys* in *building height*, or
   iii) 4 800 m² if 3 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, and
c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.55. Group D, up to 2 Storeys

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided

a) it is not more than 2 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.55.

Table 3.2.2.55.
Maximum Building Area, Group D, up to 2 Storeys
Forming Part of Sentence 3.2.2.55.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 000	1 250	1 500
2	800	1 000	1 200

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.56. Group D, up to 2 Storeys, Sprinklered

1) A *building* classified as Group D is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
   i) 3 000 m^2 if 1 *storey* in *building height*, or
   ii) 2 400 m^2 if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.57. Group E, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.58. to 3.2.2.62., a *building* classified as Group E shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.58. Group E, up to 4 Storeys, Sprinklered

1) A *building* classified as Group E is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 4 *storeys* in *building height*, and
c) it has a *building area* not more than 1 800 m^2.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,

b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.59. Group E, up to 3 Storeys

1) A *building* classified as Group E is permitted to conform to Sentence (2) provided
a) it is not more than 3 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.59.

Table 3.2.2.59.
Maximum Building Area, Group E, up to 3 Storeys
Forming Part of Sentence 3.2.2.59.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 500	1 500	1 500
2	1 200	1 500	1 500
3	800	1 000	1 500

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,
c) roof assemblies shall have a *fire-resistance rating* not less than 45 min, except that in a *building* not more than 1 *storey* in *building height*, the *fire-resistance rating* is permitted to be waived provided the roof assembly is of *noncombustible construction* or is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1.,
d) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
i) have a *fire-resistance rating* not less than 45 min, or
ii) be of *noncombustible construction*, and
e) *loadbearing* walls, columns and arches supporting a *fire separation* shall have a *fire-resistance rating* not less than that required for the *fire separation*.

3.2.2.60. Group E, up to 3 Storeys, Sprinklered

1) A *building* classified as Group E is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 3 *storeys* in *building height*, and
c) it has a *building area* not more than
i) 7 200 m^2 if 1 *storey* in *building height*,
ii) 3 600 m^2 if 2 *storeys* in *building height*, or
iii) 2 400 m^2 if 3 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,
c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
i) have a *fire-resistance rating* not less than 45 min, or
ii) be of *noncombustible construction*, and
d) *loadbearing* walls, columns and arches supporting a *fire separation* shall have a *fire-resistance rating* not less than that required for the *fire separation*.

3.2.2.61. Group E, up to 2 Storeys

1) A *building* classified as Group E is permitted to conform to Sentence (2) provided
a) it is not more than 2 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.61.

Table 3.2.2.61.
Maximum Building Area, Group E, up to 2 Storeys
Forming Part of Sentence 3.2.2.61.(1)

No. of *Storeys*	Maximum Area, m^2		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 000	1 250	1 500
2	600	750	900

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.62. Group E, up to 2 Storeys, Sprinklered

1) A *building* classified as Group E is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
i) 3 000 m^2 if 1 *storey* in *building height*, or
ii) 1 800 m^2 if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.63. Group F, Division 1, up to 4 Storeys, Sprinklered

1) Except as permitted by Articles 3.2.2.64. to 3.2.2.66., a *building* classified as Group F, Division 1 shall conform to Sentence (2) provided
a) it is not more than 4 *storeys* in *building height*, and
b) it has a *building area* not more than
i) 9 000 m^2 if 1 *storey* in *building height*,
ii) 4 500 m^2 if 2 *storeys* in *building height*,
iii) 3 000 m^2 if 3 *storeys* in *building height*, or
iv) 2 250 m^2 if 4 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.64. Group F, Division 1, up to 3 Storeys, Sprinklered

1) A *building* classified as Group F, Division 1 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 3 *storeys* in *building height*, and
c) it has a *building area* not more than
i) 3 600 m^2 if 1 *storey* in *building height*,
ii) 1 800 m^2 if 2 *storeys* in *building height*, or
iii) 1 200 m^2 if 3 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *heavy timber construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.65. Group F, Division 1, up to 2 Storeys, Sprinklered

1) A *building* classified as Group F, Division 1 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
i) 2 400 m^2 if 1 *storey* in *building height*, or
ii) 1 200 m^2 if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and

b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.66. Group F, Division 1, One Storey

1) A *building* classified as Group F, Division 1 is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination provided

a) it is not more than 1 *storey* in *building height*, and

b) it has a *building area* not more than 800 m².

3.2.2.67. Group F, Division 2, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.68. to 3.2.2.72., a *building* classified as Group F, Division 2 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,

b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h,

c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and

d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.68. Group F, Division 2, up to 4 Storeys, Increased Area, Sprinklered

1) A *building* classified as Group F, Division 2 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,

b) it is not more than 4 *storeys* in *building height*, and

c) it has a *building area* not more than
   i) 18 000 m² if 1 *storey* in *building height*,
   ii) 9 000 m² if 2 *storeys* in *building height*,
   iii) 6 000 m² if 3 *storeys* in *building height*, or
   iv) 4 500 m² if 4 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,

b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and

c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.69. Group F, Division 2, up to 3 Storeys

1) A *building* classified as Group F, Division 2 is permitted to conform to Sentence (2) provided

a) it is not more than 3 *storeys* in *building height*, and

b) it has a *building area* not more than the value in Table 3.2.2.69.

Table 3.2.2.69.
Maximum Building Area, Group F, Division 2, up to 3 Storeys
Forming Part of Sentence 3.2.2.69.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 500	1 500	1 500
2	1 500	1 500	1 500
3	1 070	1 340	1 500

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,

b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,

c) roof assemblies shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, except that in a *building* not more than 1 *storey* in *building height*, the *fire-resistance rating* is permitted to be waived provided that the roof assembly is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1.,

d) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*, and
e) *loadbearing* walls, columns and arches supporting a *fire separation* shall have a *fire-resistance rating* not less than that required for the *fire separation*.

3.2.2.70. Group F, Division 2, up to 4 Storeys, Sprinklered

1) A *building* classified as Group F, Division 2 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 4 *storeys* in *building height*, and
c) it has a *building area* not more than
   i) 9 600 m² if 1 *storey* in *building height*,
   ii) 4 800 m² if 2 *storeys* in *building height*,
   iii) 3 200 m² if 3 *storeys* in *building height*, or
   iv) 2 400 m² if 4 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 45 min,
b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,
c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*, and
d) *loadbearing* walls, columns and arches supporting a *fire separation* shall have a *fire-resistance rating* not less than that required for the *fire separation*.

3.2.2.71. Group F, Division 2, up to 2 Storeys

1) A *building* classified as Group F, Division 2 is permitted to conform to Sentence (2) provided
a) it is not more than 2 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.71.

Table 3.2.2.71.
Maximum Building Area, Group F, Division 2, up to 2 Storeys
Forming Part of Sentence 3.2.2.71.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 000	1 250	1 500
2	600	750	900

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.72. Group F, Division 2, up to 2 Storeys, Sprinklered

1) A *building* classified as Group F, Division 2 is permitted to conform to Sentence (2) provided
a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 2 *storeys* in *building height*, and
c) it has a *building area* not more than
   i) 4 500 m² if 1 *storey* in *building height*, or
   ii) 1 800 m² if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and
b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
   i) have a *fire-resistance rating* not less than 45 min, or
   ii) be of *noncombustible construction*.

3.2.2.73. Group F, Division 3, Any Height, Any Area, Sprinklered

1) Except as permitted by Articles 3.2.2.74. to 3.2.2.83., a *building* classified as Group F, Division 3 shall conform to Sentence (2).

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* shall be *sprinklered* throughout,
b) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 2 h, except that floor assemblies are permitted to be *fire separations* with a *fire-resistance rating* not less than 1 h in a *storage garage* with all *storeys* constructed as *open-air storeys*,
c) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.74. Group F, Division 3, up to 6 Storeys

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided

a) it is not more than 6 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.74.

Table 3.2.2.74.
Maximum Building Area, Group F, Division 3, up to 6 Storeys
Forming Part of Sentence 3.2.2.74.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	not limited	not limited	not limited
2	7 200	9 000	10 800
3	4 800	6 000	7 200
4	3 600	4 500	5 400
5	2 880	3 600	4 320
6	2 400	3 000	3 600

2) The *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h,
c) roof assemblies shall have a *fire-resistance rating* not less than 1 h, and
d) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.75. Group F, Division 3, up to 6 Storeys, Sprinklered

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
b) it is not more than 6 *storeys* in *building height*, and
c) it has a *building area*
   i) that is not limited if the *building* is not more than 1 *storey* in *building height*,
   ii) not more than 21 600 m² if 2 *storeys* in *building height*,
   iii) not more than 14 400 m² if 3 *storeys* in *building height*,
   iv) not more than 10 800 m² if 4 *storeys* in *building height*,
   v) not more than 8 640 m² if 5 *storeys* in *building height*, or
   vi) not more than 7 200 m² if 6 *storeys* in *building height*.

2) Except as permitted by Article 3.2.2.16., the *building* referred to in Sentence (1) shall be of *noncombustible construction*, and

a) floor assemblies shall be *fire separations* with a *fire-resistance rating* not less than 1 h,
b) *mezzanines* shall have a *fire-resistance rating* not less than 1 h, and
c) *loadbearing* walls, columns and arches shall have a *fire-resistance rating* not less than that required for the supported assembly.

3.2.2.76. Group F, Division 3, up to 4 Storeys

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided

a) it is not more than 4 *storeys* in *building height*, and
b) it has a *building area* not more than the value in Table 3.2.2.76.

Table 3.2.2.76.
Maximum Building Area, Group F, Division 3, up to 4 Storeys
Forming Part of Sentence 3.2.2.76.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	4 800	6 000	7 200
2	2 400	3 000	3 600
3	1 600	2 000	2 400
4	1 200	1 500	1 800

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,

b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,

c) roof assemblies shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min, except that in a *building* not more than 1 *storey* in *building height*, the *fire-resistance rating* is permitted to be waived provided the roof assembly is constructed as a *fire-retardant treated wood* roof system conforming to Article 3.1.14.1., and the *building area* is not more than
  i) 2 400 m² if facing one *street*,
  ii) 3 000 m² if facing 2 *streets*, or
  iii) 3 600 m² if facing 3 *streets*, and

d) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
  i) have a *fire-resistance rating* not less than 45 min, or
  ii) be of *noncombustible construction*.

3.2.2.77. Group F, Division 3, up to 4 Storeys, Sprinklered

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,

b) it is not more than 4 *storeys* in *building height*, and

c) it has a *building area* not more than
  i) 14 400 m² if 1 *storey* in *building height*,
  ii) 7 200 m² if 2 *storeys* in *building height*,
  iii) 4 800 m² if 3 *storeys* in *building height*, or
  iv) 3 600 m² if 4 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min,

b) *mezzanines* shall have, if of *combustible construction*, a *fire-resistance rating* not less than 45 min,

c) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
  i) have a *fire-resistance rating* not less than 45 min, or
  ii) be of *noncombustible construction*.

3.2.2.78. Group F, Division 3, up to 2 Storeys

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided

a) it is not more than 2 *storeys* in *building height*, and

b) it has a *building area* not more than the value in Table 3.2.2.78.

Table 3.2.2.78.
Maximum Building Area, Group F, Division 3, up to 2 Storeys
Forming Part of Sentence 3.2.2.78.(1)

No. of *Storeys*	Maximum Area, m²		
	Facing 1 *Street*	Facing 2 *Streets*	Facing 3 *Streets*
1	1 600	2 000	2 400
2	800	1 000	1 200

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and

a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and

b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
  i) have a *fire-resistance rating* not less than 45 min, or
  ii) be of *noncombustible construction*.

3.2.2.79. Group F, Division 3, up to 2 Storeys, Sprinklered

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
- b) it is not more than 2 *storeys* in *building height*, and
- c) it has a *building area* not more than
  - i) 7 200 m² if 1 *storey* in *building height*, or
  - ii) 2 400 m² if 2 *storeys* in *building height*.

2) The *building* referred to in Sentence (1) is permitted to be of *combustible construction* or *noncombustible construction* used singly or in combination, and
- a) floor assemblies shall be *fire separations* and, if of *combustible construction*, shall have a *fire-resistance rating* not less than 45 min, and
- b) *loadbearing* walls, columns and arches supporting an assembly required to have a *fire-resistance rating* shall
  - i) have a *fire-resistance rating* not less than 45 min, or
  - ii) be of *noncombustible construction*.

3.2.2.80. Group F, Division 3, One Storey

1) A *building* classified as Group F, Division 3 is permitted to be of *heavy timber construction* or *noncombustible construction* used singly or in combination provided
- a) it is not more than 1 *storey* in *building height*, and
- b) it has a *building area* not more than
  - i) 5 600 m² if facing one *street*,
  - ii) 7 000 m² if facing 2 *streets*, or
  - iii) 8 400 m² if facing 3 *streets*.

3.2.2.81. Group F, Division 3, One Storey, Sprinklered

1) A *building* classified as Group F, Division 3 is permitted to be of *heavy timber construction* or *noncombustible construction* used singly or in combination provided
- a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the *building* is *sprinklered* throughout,
- b) it is not more than 1 *storey* in *building height*, and
- c) it has a *building area* not more than 16 800 m².

3.2.2.82. Group F, Division 3, One Storey, Any Area, Low Fire Load Occupancy

1) A *building* classified as Group F, Division 3 is permitted to conform to Sentence (2) provided it is
- a) not more than 1 *storey* in *building height*,
- b) used solely for low *fire load occupancies* such as
  - i) power generating plants, or
  - ii) plants for the manufacture or storage of *noncombustible* materials, and
- c) not limited in *building area*.

2) The *building* referred to in Sentence (1) shall be of *noncombustible construction*.

3.2.2.83. Group F, Division 3, Storage Garages up to 22 m High

1) A *building* used as a *storage garage* with all *storeys* constructed as *open-air storeys* and having no other *occupancy* above it is permitted to have its floor, wall, ceiling and roof assemblies constructed without a *fire-resistance rating* provided it is
- a) of *noncombustible construction*,
- b) not more than 22 m high, measured between *grade* and the ceiling level of the top *storey*,
- c) not more than 10 000 m² in *building area*, and
- d) designed so that every portion of each *floor area* is within 60 m of an exterior wall opening.

3.2.3. Spatial Separation and Exposure Protection

3.2.3.1. Limiting Distance and Area of Unprotected Openings

1) Except as permitted by Articles 3.2.3.9. to 3.2.3.11., the area of *unprotected openings* in an *exposing building face* for the applicable *limiting distance* shall be not more than the value determined in accordance with
- a) Table 3.2.3.1.A. or Table 3.2.3.1.B. for an *exposing building face* conforming to Article 3.2.3.2. of a *building* or *fire compartment* which is not *sprinklered*, or
- b) Table 3.2.3.1.C. or Table 3.2.3.1.D. for an *exposing building face* conforming to Article 3.2.3.2. of a *sprinklered fire compartment* that is part of a *building* which is *sprinklered* in conformance with Section 3.2.

(See A-3, Fire Fighting Assumptions, in Appendix A.)
(See also Article 3.1.6.3.)

2) The area of the *unprotected openings* in an *exposing building face* shall be the aggregate area of *unprotected openings* expressed as a percentage of the area of the *exposing building face* in Table 3.2.3.1.A., Table 3.2.3.1.B., Table 3.2.3.1.C. or Table 3.2.3.1.D. (See Sentence 3.2.3.2.(1).)

3) For the purpose of determining the type of construction and cladding and the *fire-resistance rating* of an exterior wall,

a) the *exposing building face* shall be taken as the projection of the exterior wall onto a vertical plane located so that no portion of the exterior wall of the *building* or of a *fire compartment*, if the *fire compartment* complies with the requirements of Sentences 3.2.3.2.(2), (4) or (6), is between the vertical plane and the line to which the *limiting distance* is measured, and

b) the area of *unprotected openings* shall be determined from Table 3.2.3.1.A., Table 3.2.3.1.B., Table 3.2.3.1.C. or Table 3.2.3.1.D.

4) For the purpose of determining the actual percentage of *unprotected openings* permitted in an exterior wall, the location of the *exposing building face* is permitted to be taken at a vertical plane located so that there are no *unprotected openings* between the vertical plane and the line to which the *limiting distance* is measured. (See Appendix A.)

5) If a *building* has any *storey* that is not *sprinklered* and fire fighting facilities cannot reach it within 10 min of the alarm being received, the *limiting distance* shall be doubled.

6) If the surface temperature on the unexposed surface of a wall assembly exceeds the temperature limit of a standard fire test as permitted by Article 3.1.7.2., an allowance shall be made for the radiation from the hot unexposed wall surface by adding an equivalent area of *unprotected opening* to the area of actual openings as follows:

$$A_C = A + (A_F \times F_{EO})$$

where

A_C = corrected area of *unprotected openings* including actual and equivalent openings,

A = actual area of *unprotected openings*,

A_F = area of exterior surface of the *exposing building face*, exclusive of openings, on which the temperature limit of the standard test is exceeded, and **e**

F_{EO} = an equivalent opening factor derived from the following expression:

$$F_{EO} = \frac{(T_u + 273)^4}{(T_e + 273)^4}$$

T_u = average temperature in degrees Celsius of the unexposed wall surface at the time the required *fire-resistance rating* is reached under test conditions,

T_e = 892°C for a *fire-resistance rating* not less than 45 min, 927°C for a *fire-resistance rating* not less than 1 h, and 1 010°C for a *fire-resistance rating* not less than 2 h.

7) Unless a *closure* used to protect an opening in an *exposing building face* has a protective performance equivalent to that required for the wall assembly in which it is located, an equivalent area of *unprotected opening*, determined in accordance with the procedures of Sentence (6) shall be added to the greater of

a) the actual area of *unprotected openings*, or

b) the corrected area of *unprotected openings*.

Table 3.2.3.1.A.
Unprotected Opening Limits for a Building or Fire Compartment that is not Sprinklered Throughout
Forming Part of Article 3.2.3.1.

Exposing Building Face		Area of *Unprotected Opening* for Groups A, C, D, and F, Division 3 *Occupancies*, %																									
Max. Area, m^2	Ratio (L/H or H/L)(1)	*Limiting Distance*, m																									
		0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	25	30	35	40	45	50
10	Less than 3 : 1	0	8	10	18	29	46	91	100																		
	3 : 1 to 10 : 1	0	8	12	21	33	50	96	100																		
	over 10 : 1	0	11	18	32	48	68	100																			
15	Less than 3 : 1	0	7	9	14	22	33	63	100																		
	3 : 1 to 10 : 1	0	8	10	17	25	37	67	100																		
	over 10 : 1	0	10	15	26	39	53	87	100																		
20	Less than 3 : 1	0	7	9	12	18	26	49	81	100																	
	3 : 1 to 10 : 1	0	8	10	15	21	30	53	85	100																	
	over 10 : 1	0	9	14	23	33	45	72	100																		
25	Less than 3 : 1	0	7	8	11	16	23	41	66	98	100																
	3 : 1 to 10 : 1	0	8	9	13	19	26	45	70	100																	
	over 10 : 1	0	9	13	21	30	39	62	90	100																	
30	Less than 3 : 1	0	7	8	11	15	20	35	56	83	100																
	3 : 1 to 10 : 1	0	7	9	12	17	23	39	61	88	100																
	over 10 : 1	0	8	12	19	27	36	56	79	100																	
40	Less than 3 : 1	0	7	8	10	13	17	28	44	64	89	100															
	3 : 1 to 10 : 1	0	7	8	11	15	20	32	48	69	93	100															
	over 10 : 1	0	8	11	17	24	31	47	66	88	100																
50	Less than 3 : 1	0	7	8	9	12	15	24	37	53	72	96	100														
	3 : 1 to 10 : 1	0	7	8	10	14	18	28	41	57	77	100															
	over 10 : 1	0	8	10	15	21	28	41	57	76	97	100															
60	Less than 3 : 1	0	7	8	9	11	14	21	32	45	62	81	100														
	3 : 1 to 10 : 1	0	7	8	10	13	16	25	36	49	66	85	100														
	over 10 : 1	0	8	10	14	20	25	38	51	67	85	100															

Table 3.2.3.1.A. (Continued)

Exposing Building Face		Area of *Unprotected Opening* for Groups A, C, D, and F, Division 3 *Occupancies*, %																									
Max. Area, m²	Ratio (L/H or H/L)(1)	*Limiting Distance*, m																									
		0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	25	30	35	40	45	50
80	Less than 3 : 1	0	7	7	8	10	12	18	26	36	48	62	79	98	100												
	3 : 1 to 10 : 1	0	7	8	9	11	14	21	29	40	52	67	84	100													
	over 10 : 1	0	8	9	13	17	22	32	44	56	70	86	100														
100	Less than 3 : 1	0	7	7	8	9	11	16	22	30	40	51	65	80	97	100											
	3 : 1 to 10 : 1	0	7	8	9	11	13	18	25	34	44	56	69	84	100												
	over 10 : 1	0	7	9	12	16	20	29	39	49	61	74	89	100													
150	Less than 3 : 1	0	7	7	8	9	10	13	17	22	29	37	46	56	67	79	93	100									
	3 : 1 to 10 : 1	0	7	7	8	10	11	15	20	26	33	41	50	60	71	84	97	100									
	over 10 : 1	0	7	8	11	13	17	24	31	39	48	57	68	79	91	100											
250	Less than 3 : 1	0	7	7	7	8	9	10	13	16	20	25	30	36	43	51	59	68	87	100							
	3 : 1 to 10 : 1	0	7	7	8	9	10	12	15	19	24	28	34	40	47	55	63	72	92	100							
	over 10 : 1	0	7	8	9	11	14	19	24	30	36	43	50	57	65	73	82	92	100								
350	Less than 3 : 1	0	7	7	7	8	8	9	11	14	16	20	24	28	33	38	44	50	64	81	99	100					
	3 : 1 to 10 : 1	0	7	7	8	8	9	11	13	16	19	23	27	32	37	42	48	55	69	85	100						
	over 10 : 1	0	7	8	9	10	12	16	21	25	30	36	41	47	53	59	66	73	88	100							
500	Less than 3 : 1	0	7	7	7	7	8	9	10	12	14	16	19	22	25	29	33	37	47	59	71	100					
	3 : 1 to 10 : 1	0	7	7	7	8	8	10	12	14	16	19	22	25	29	33	37	41	52	63	76	100					
	over 10 : 1	0	7	7	8	9	11	14	18	22	25	30	34	38	43	48	53	58	70	82	96	100					
1 000	Less than 3 : 1	0	7	7	7	7	7	8	9	9	10	12	13	14	16	18	20	22	27	33	39	58	82	100			
	3 : 1 to 10 : 1	0	7	7	7	7	8	9	10	11	12	14	15	17	19	21	23	26	31	37	43	63	86	100			
	over 10 : 1	0	7	7	8	8	9	11	13	16	19	21	24	27	30	33	36	39	46	53	60	82	100				
2 000	Less than 3 : 1	0	7	7	7	7	7	7	8	8	9	9	10	11	12	13	14	15	17	20	23	33	44	58	74	93	100
	3 : 1 to 10 : 1	0	7	7	7	7	7	8	8	9	10	11	12	13	14	15	16	17	20	23	27	37	49	63	79	97	100
	over 10 : 1	0	7	7	7	8	8	9	11	12	14	16	18	19	21	23	25	27	32	36	40	53	66	82	99	100	

Notes to Table 3.2.3.1.A.:

(1) Apply whichever ratio is greater.

L = Length of *exposing building face*

H = Height of *exposing building face*

Table 3.2.3.1.B.
Unprotected Opening Limits for a Building or Fire Compartment that is not Sprinklered Throughout
Forming Part of Article 3.2.3.1.

Exposing Building Face		Area of *Unprotected Openings* for Groups E and F, Division 1 and 2 *Occupancies*, %																													
Max. Area, m^2	Ratio (L/H or H/L)(1)	*Limiting Distance*, m																													
		0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	25	30	35	40	45	50	55	60	65	70
10	Less than 3 : 1	0	4	5	9	15	23	46	77	100																					
	3 : 1 to 10 : 1	0	4	6	10	17	25	48	79	100																					
	over 10 : 1	0	5	9	16	24	34	58	91	100																					
15	Less than 3 : 1	0	4	5	7	11	16	32	53	79	100																				
	3 : 1 to 10 : 1	0	4	5	8	13	18	34	55	82	100																				
	over 10 : 1	0	5	8	13	19	26	43	66	93	100																				
20	Less than 3 : 1	0	4	4	6	9	13	25	40	61	85	100																			
	3 : 1 to 10 : 1	0	4	5	7	11	15	27	43	63	87	100																			
	over 10 : 1	0	5	7	11	17	22	36	53	74	99	100																			
25	Less than 3 : 1	0	4	4	6	8	11	20	33	49	69	92	100																		
	3 : 1 to 10 : 1	0	4	5	7	9	13	22	35	51	71	94	100																		
	over 10 : 1	0	4	6	10	15	20	31	45	62	82	100																			
30	Less than 3 : 1	0	4	4	5	7	10	18	28	42	58	77	100																		
	3 : 1 to 10 : 1	0	4	4	6	9	12	20	30	44	60	80	100																		
	over 10 : 1	0	4	6	10	14	18	28	40	54	71	91	100																		
40	Less than 3 : 1	0	4	4	5	6	8	14	22	32	44	59	76	94	100																
	3 : 1 to 10 : 1	0	4	4	6	8	10	16	24	34	47	61	78	97	100																
	over 10 : 1	0	4	5	8	12	15	23	33	44	57	72	89	100																	
50	Less than 3 : 1	0	4	4	5	6	7	12	18	26	36	48	61	76	93	100															
	3 : 1 to 10 : 1	0	4	4	5	7	9	14	20	29	38	50	63	79	95	100															
	over 10 : 1	0	4	5	8	11	14	21	29	38	48	61	74	90	100																
60	Less than 3 : 1	0	4	4	4	5	7	11	16	23	31	40	52	64	78	94	100														
	3 : 1 to 10 : 1	0	4	4	5	6	8	12	18	25	33	43	54	66	81	96	100														
	over 10 : 1	0	4	5	7	10	13	19	26	34	43	53	64	77	92	100															

Table 3.2.3.1.B. (Continued)

Exposing Building Face		Area of *Unprotected Openings* for Groups E and F, Division 1 and 2 *Occupancies*, %																													
Max. Area, m^2	Ratio (L/H or H/L)(1)	*Limiting Distance*, m																													
		0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	25	30	35	40	45	50	55	60	65	70
80	Less than 3 : 1	0	4	4	4	5	6	9	13	18	24	31	40	49	60	71	84	98	100												
	3 : 1 to 10 : 1	0	4	4	5	6	7	10	15	20	26	33	42	51	62	74	86	100													
	over 10 : 1	0	4	5	6	9	11	16	22	28	35	43	52	62	73	85	98	100													
100	Less than 3 : 1	0	4	4	4	5	5	8	11	15	20	26	32	40	48	58	68	79	100												
	3 : 1 to 10 : 1	0	4	4	4	5	6	9	13	17	22	28	35	42	51	60	70	81	100												
	over 10 : 1	0	4	4	6	8	10	14	19	25	31	37	44	52	61	71	81	92	100												
150	Less than 3 : 1	0	4	4	4	4	5	6	8	11	14	18	23	28	33	40	46	54	70	89	100										
	3 : 1 to 10 : 1	0	4	4	4	5	6	8	10	13	16	20	25	30	36	42	49	56	73	92	100										
	over 10 : 1	0	4	4	5	7	8	12	16	20	24	29	34	39	46	52	59	67	84	100											
250	Less than 3 : 1	0	4	4	4	4	4	5	7	8	10	12	15	18	22	25	29	34	44	55	68	100									
	3 : 1 to 10 : 1	0	4	4	4	4	5	6	8	10	12	14	17	20	24	27	32	36	46	57	70	100									
	over 10 : 1	0	4	4	5	6	7	9	12	15	18	21	25	28	32	37	41	46	56	68	81	100									
350	Less than 3 : 1	0	4	4	4	4	4	5	6	7	8	10	12	14	16	19	22	25	32	40	49	77	100								
	3 : 1 to 10 : 1	0	4	4	4	4	4	5	7	8	10	12	14	16	18	21	24	27	34	43	52	79	100								
	over 10 : 1	0	4	4	4	5	6	8	10	13	15	18	21	23	26	30	33	36	44	53	62	90	100								
500	Less than 3 : 1	0	4	4	4	4	4	4	5	6	7	8	9	11	13	14	16	19	24	29	36	55	78	100							
	3 : 1 to 10 : 1	0	4	4	4	4	4	5	6	7	8	9	11	13	14	16	18	21	26	31	38	57	80	100							
	over 10 : 1	0	4	4	4	5	5	7	9	11	13	15	17	19	21	24	26	29	35	41	48	68	92	100							
1 000	Less than 3 : 1	0	4	4	4	4	4	4	4	5	5	6	6	7	8	9	10	11	14	16	20	29	41	55	71	89	100				
	3 : 1 to 10 : 1	0	4	4	4	4	4	4	5	5	6	7	8	9	10	11	12	13	15	18	22	31	43	57	73	91	100				
	over 10 : 1	0	4	4	4	4	5	6	7	8	9	11	12	13	15	16	18	20	23	26	30	41	53	68	84	100					
2 000	Less than 3 : 1	0	4	4	4	4	4	4	4	4	4	5	5	5	6	6	7	7	9	10	12	16	22	29	37	46	56	68	80	94	100
	3 : 1 to 10 : 1	0	4	4	4	4	4	4	4	5	5	5	6	6	7	7	8	9	10	12	13	18	24	31	39	49	59	70	83	96	100
	over 10 : 1	0	4	4	4	4	4	5	5	6	7	8	9	10	11	12	13	14	16	18	20	26	33	41	50	59	70	81	94	100	

Notes to Table 3.2.3.1.B.:

(1) Apply whichever ratio is greater.
L = Length of *exposing building face*
H = Height of *exposing building face*

Table 3.2.3.1.C.
Unprotected Opening Limits for a Building or Fire Compartment that is Sprinklered Throughout
Forming Part of Article 3.2.3.1.

Exposing Building Face	Area of *Unprotected Opening* for Groups A, B, C, D and F, Division 3 *Occupancies*, %											
Max. Area, m^2	*Limiting Distance*, m											
	0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9
10	0	16	24	42	66	100						
15	0	16	20	34	50	74	100					
20	0	16	20	30	42	60	100					
25	0	16	18	26	38	52	90	100				
30	0	14	18	24	34	46	78	100				
40	0	14	16	22	30	40	64	96	100			
50	0	14	16	20	28	36	56	82	100			
60	0	14	16	20	26	32	50	72	98	100		
80	0	14	16	18	22	28	42	58	80	100		
100	0	14	16	18	22	26	36	50	68	88	100	
150 or more	0	14	14	16	20	22	30	40	52	66	82	100

Table 3.2.3.1.D.
Unprotected Opening Limits for a Building or Fire Compartment that is Sprinklered Throughout
Forming Part of Article 3.2.3.1.

Exposing Building Face	Area of *Unprotected Opening* for Groups E and F, Division 1 and 2 *Occupancies*, %																	
Max. Area, m^2	*Limiting Distance*, m																	
	0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	9	10	11	12	13	14	15
10	0	8	12	20	34	50	96	100										
15	0	8	10	16	26	36	68	100										
20	0	8	10	14	22	30	54	86	100									
25	0	8	10	14	18	26	44	70	100									
30	0	8	8	12	18	24	40	60	88	100								
40	0	8	8	12	16	20	32	48	68	94	100							
50	0	8	8	10	14	18	28	40	58	76	100							
60	0	8	8	10	12	16	24	36	50	66	86	100						
80	0	8	8	10	12	14	20	30	40	52	66	84	100					
100	0	8	8	8	10	12	18	26	34	44	56	70	84	100				
150	0	8	8	8	10	12	16	20	26	32	40	50	60	72	84	98	100	
200 or more	0	8	8	8	8	10	14	18	22	28	34	42	50	60	68	80	92	100

3.2.3.2. Area of Exposing Building Face

1) Except as permitted by Sentences (2), (4) and (6), the area of an *exposing building face* shall be calculated as the total area of exterior wall facing in one direction on any side of a *building* measured from the finished ground level to the uppermost ceiling.

2) Except as permitted by Sentence (3), if a *building* containing only Group A, B, C, D or Group F, Division 3 *occupancies* is divided by *fire separations* into *fire compartments*, the area of *exposing building face* is permitted to be calculated for each *fire compartment* provided the *fire separations* have a *fire-resistance rating* not less than 1 h.

3) The *fire-resistance rating* of the *fire separations* referred to in Sentence (2) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for

a) the floor assembly above the *fire compartment*, or

b) the floor assembly below the *fire compartment*, if there is no floor assembly above.

4) Except as required by Sentence (5), if a *building* containing Group E or Group F, Division 1 or 2 *occupancies* is divided by *fire separations* into *fire compartments*, the area of *exposing building face* is permitted to be calculated for each *fire compartment* provided the *fire separations* have a *fire-resistance rating* not less than 45 min.

5) The *fire-resistance rating* of the *fire separations* referred to in Sentence (4) shall be not less than that required by Subsection 3.2.2. for

a) the floor assembly above the *fire compartment*, or

b) the floor assembly below the *fire compartment*, if there is no floor assembly above.

6) In a *building* that is *sprinklered* throughout and contains an *interconnected floor space*, the area of the *exposing building face* for the *interconnected floor space* is permitted to be determined by considering each *storey* as a separate *fire compartment* notwithstanding openings through the floor assemblies.

3.2.3.3. Wall Enclosing Attic or Roof Space

1) An exterior wall enclosing an *attic or roof space* and located above an *exposing building face*, shall be constructed in conformance with the requirements for the *exposing building face*.

3.2.3.4. Party Wall

1) A *party wall* shall be constructed as a *firewall*.

3.2.3.5. Wall with Limiting Distance Less Than 1.2 m

1) Openings in a wall that has a *limiting distance* less than 1.2 m shall be protected by *closures* whose *fire-protection rating* is in conformance with the *fire-resistance rating* required for the wall.

2) Wired glass or glass block shall not be used for a *closure* referred to in Sentence (1).

3.2.3.6. Combustible Projections

1) Except for a *building* containing one or 2 *dwelling units* only, *combustible* projections on the exterior of a wall that could expose an adjacent *building* to fire spread and are more than 1 m above ground level, including balconies, platforms, canopies, eave projections and stairs, shall not be permitted within

a) 1.2 m of a property line or the centreline of a *public way*, or

b) 2.4 m of a *combustible* projection on another *building* on the same property.

3.2.3.7. Construction of Exposing Building Face

1) Except as permitted by Articles 3.2.3.9. and 3.2.3.10., if a *limiting distance* shown in Table 3.2.3.1.A. or Table 3.2.3.1.C. for a Group A, B, C, D or Group F, Division 3 *occupancy* classification permits an *exposing building face* to have *unprotected openings* not more than 10% of the *exposing building face*, the *exposing building face* shall be

a) of *noncombustible construction* having a *fire-resistance rating* not less than 1 h, and

b) clad with *noncombustible* cladding.

2) Except as permitted by Sentence (9) and Articles 3.2.3.9. and 3.2.3.10., if a *limiting distance* shown in Table 3.2.3.1.A. or Table 3.2.3.1.C. for a Group A, B, C, D or Group F, Division 3 *occupancy* classification permits an *exposing building face* to have *unprotected openings* more than 10% but not more than 25% of the *exposing building face*, the *exposing building face* shall

a) have a *fire-resistance rating* not less than 1 h, and

b) be clad with *noncombustible* cladding.

3) Except as permitted by Articles 3.2.3.9. and 3.2.3.10., if a *limiting distance* shown in Table 3.2.3.1.A. or Table 3.2.3.1.C. for a Group A, B, C, D or Group F, Division 3 *occupancy* classification permits an *exposing building face* to have *unprotected openings* more than 25% but less than 100% of the *exposing building face*, the *exposing building face* shall have a *fire-resistance rating* not less than 45 min.

4) Except as permitted by Article 3.2.3.9., if a *limiting distance* shown in Table 3.2.3.1.B. or Table 3.2.3.1.D. for a Group E, or Group F, Division 1 or 2 *occupancy* classification permits an *exposing building face* to have *unprotected openings* not more than 10% of the *exposing building face*, the *exposing building face* shall be

a) of *noncombustible construction* having a *fire-resistance rating* not less than 2 h, and
b) clad with *noncombustible* cladding.

5) Except as permitted by Sentence (9) and Article 3.2.3.9., if a *limiting distance* shown in Table 3.2.3.1.B. or Table 3.2.3.1.D. for a Group E, or Group F, Division 1 or 2 *occupancy* classification permits an *exposing building face* to have *unprotected openings* more than 10% but not more than 25% of the *exposing building face*, the *exposing building face* shall e

a) have a *fire-resistance rating* not less than 2 h, and
b) be clad with *noncombustible* cladding.

6) Except as permitted by Article 3.2.3.9., if a *limiting distance* shown in Table 3.2.3.1.B. or Table 3.2.3.1.D. for a Group E, or Group F, Division 1 or 2 *occupancy* classification permits an *exposing building face* to have *unprotected openings* more than 25% but less than 100% of the *exposing building face*, the *exposing building face* shall have a *fire-resistance rating* not less than 1 h.

7) Except as permitted by Sentence (9), in addition to the requirements of Sentences (2), (3), (5) and (6), foamed plastic insulation used in an exterior wall of a *building* more than 3 *storeys* in *building height* shall be protected on its exterior surface by

a) concrete or masonry not less than 25 mm thick, or
b) *noncombustible* material that complies with the criteria for testing and conditions of acceptance of Sentence (8) when tested in conformance with CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials."

8) The criteria for testing and the conditions of acceptance for a wall assembly to satisfy the requirements of Clause (7)(b) are that

a) the fire exposed area of the wall assembly shall be not less than 9.3 m^2 and have no dimension less than 2.75 m,
b) the exposed surface will include typical vertical and horizontal joints,
c) the test shall be continued for not less than 15 min and the standard time/temperature curve of the referenced standard shall be followed,
d) the *noncombustible* protective material will remain in place and no through openings will develop that are visible when viewed normal to the face of the material, and
e) the *noncombustible* protective material will not disintegrate in a manner that would permit fire to propagate along the surface of the test assembly.

9) The requirements of Clauses (2)(b) and (5)(b) and Sentence (7) are waived for a wall assembly that complies with the requirements of Article 3.1.5.5. (See Appendix A.)

3.2.3.8. Protection of Structural Members

1) Structural members, including beams, columns and arches, placed wholly or partly outside an exterior face of a *building* and 3 m or more from the property line or centreline of a public thoroughfare need not be protected from exterior fires.

2) Structural members referred to in Sentence (1) that are less than 3 m from the property line or centreline of a public thoroughfare shall be protected from exterior fire by fire protection having a *fire-resistance rating* not less than that required by Articles 3.2.2.20. to 3.2.2.83. for their protection from interior fires, but not less than 1 h.

3) Structural members of *heavy timber construction*, including beams, columns and arches, placed wholly or partly outside an exterior face of a *building* and 3 m or more from the property line or centreline of a public thoroughfare need not be covered with *noncombustible* cladding.

3.2.3.9. Unlimited Unprotected Openings

1) An *exposing building face* in a *storage garage* with all *storeys* constructed as *open-air storeys* is permitted to have unlimited *unprotected openings* provided it has a *limiting distance* not less than 3 m.

2) The *exposing building face* of a *storey* that faces a *street* and is at the same level as the *street* is permitted to have unlimited *unprotected openings* if the *limiting distance* is not less than 9 m.

3.2.3.10. Low Fire Load, One Storey Building

1) An *exposing building face* of a *building* of *low hazard industrial occupancy* conforming to Article 3.2.2.82. is permitted to be of *noncombustible construction* without a *fire-resistance rating* provided

a) it is not a *loadbearing* wall, and
b) the *limiting distance* is not less than 3 m.

3.2.3.11. Area Increase for Unprotected Openings

1) The maximum area of *unprotected openings* in any *exposing building face* of a *building* in which an automatic sprinkler system is not installed is permitted to be doubled if the openings are glazed with

a) glass block conforming to the requirements of Article 3.1.8.14., or
b) wired glass assemblies conforming to D-2.3.14. in Appendix D.

(See Appendix A.)

3.2.3.12. Protection of Exit Facilities

1) Except as required by Sentence (3) and as permitted by Sentence 3.4.4.3.(1), if the plane of an exterior wall of an *exit* enclosure forms an angle less than 135° with the plane of an exterior wall of the *building* it serves, and an opening in the exterior wall of the *exit* enclosure could be exposed to fire from an opening in the exterior wall of the *building*, the opening in either the exterior wall of the *exit* or the exterior wall of the *building* shall be protected in conformance with the requirements of Sentence (4) where the opening in the exterior wall of the *building* is within 3 m horizontally and

a) less than 10 m below an opening in the exterior wall of the *exit*, or
b) less than 2 m above an opening in the exterior wall of the *exit*.

(See A-3.2.3.13.(1) in Appendix A.)

2) If an unenclosed exterior *exit* stair or ramp could be exposed to fire from an opening in the exterior wall of the *building* it serves, the opening in the exterior wall of the *building* shall be protected in conformance with the requirements of Sentence (4) where the opening in the exterior wall of the *building* is within 3 m horizontally and

a) less than 10 m below the *exit* stair or ramp, or
b) less than 5 m above the *exit* stair or ramp.

3) Except as permitted by Sentence 3.4.4.3.(1), if an exterior *exit* door in one *fire compartment* is within 3 m horizontally of an opening in another *fire compartment* and the exterior walls of these *fire compartments* intersect at an exterior angle of less than 135°, the opening shall be protected in conformance with the requirements of Sentence (4).

4) The opening protection referred to in Sentences (1), (2) and (3) shall consist of

a) glass block conforming to the requirements of Article 3.1.8.14.,
b) a wired glass assembly conforming to D-2.3.14. in Appendix D, or
c) a *closure* conforming to the requirements of Subsection 3.1.8. and Articles 3.2.3.1. and 3.2.3.13.

3.2.3.13. Wall Exposed to Another Wall

1) Except as required by Sentences (3) and 3.2.3.12.(1) or as permitted by Sentence 3.2.3.18.(4), if an *unprotected opening* in an exterior wall of a *fire compartment* is exposed to an *unprotected opening* in the exterior wall of another *fire compartment*, and the planes of the 2 walls are parallel or at an angle less than 135°, measured from the exterior of the *building*, the *unprotected openings* in the 2 *fire compartments* shall be separated by a distance not less than D_o where $D_o = 2D - ((\theta/90) \times D)$ but in no case less than 1 m, and e

D = the greater required *limiting distance* for the *exposing building faces* of the 2 *fire compartments*, and
θ = the angle made by the intersecting planes of the *exposing building faces* of the 2 *fire compartments* (in the case where the exterior walls are parallel and face each other, $\theta = 0°$).

(See Appendix A.)

2) The exterior wall of each *fire compartment* referred to in Sentence (1) within the distance, D_o, shall have a *fire-resistance rating* not less than that required for the interior vertical *fire separation* between the *fire compartment* and the remainder of the *building*.

3) Sentence (1) does not apply to *unprotected openings* of *fire compartments* within a *building* that is *sprinklered* throughout, but shall apply to

a) *unprotected openings* of *fire compartments* on opposite sides of a *firewall*, and
b) exposure from *unprotected openings* of a *fire compartment* that is not protected by an automatic sprinkler system.

3.2.3.14. Wall Exposed to Adjoining Roof

1) Except as permitted by Sentence 3.2.3.18.(4), if a wall in a *building* is exposed to a fire hazard from an adjoining roof of a separate *fire compartment* that is not *sprinklered* in the same *building*, and the exposed wall contains windows within 3 *storeys* vertically and 5 m horizontally of the roof, the roof shall contain no skylights within 5 m of the exposed wall.

3.2.3.15. Protection of Soffits

1) Except as permitted by Sentences (3) and (4), where there is a common *attic or roof space* above more than 2 *suites* of *residential occupancy* or above more than 2 patients' sleeping rooms, and the common *attic or roof space* projects beyond the exterior wall of the *building*, the soffit, and any opening in the soffit or other surface of the projection located within 2 500 mm of a window or door opening, shall be protected by

a) *noncombustible* material
   i) not less than 0.38 mm thick, and
   ii) having a melting point not below 650°C,

b) plywood not less than 11 mm thick,
c) strandboard or waferboard not less than 12.5 mm thick, or
d) lumber not less than 11 mm thick.

2) The soffit protection required by Sentence (1) shall extend the full width of the opening and to not less than 1 200 mm on either side of it, and shall apply to all openings through the soffit within this limit.

3) If an eave overhang is completely separated from the remainder of the *attic or roof space* by fire stopping, the requirements of Sentence (1) do not apply.

4) The protection required by Sentence (1) for projections is permitted to be omitted if
a) the *fire compartments* behind the window and door openings are *sprinklered* in accordance with Article 3.2.5.13., and
b) all rooms, including closets and bathrooms, having openings in the wall beneath the soffit are *sprinklered*, notwithstanding exceptions permitted in the standards referenced in Article 3.2.5.13. for the installation of automatic sprinkler systems.

3.2.3.16. Canopy Protection for Vertically Separated Openings

1) Except as permitted by Sentences (2) and (3), if a *storey* classified as a Group E or Group F, Division 1 or 2 *major occupancy* is required to be separated from the *storey* above by a *fire separation*,
a) every opening in the exterior wall of the lower *storey* that is located vertically below an opening in the *storey* above shall be separated from the *storey* above by a canopy projecting not less than 1 m from the face of the *building* at the intervening floor level, and
b) the canopy required by Clause (a) shall have a *fire-resistance rating* not less than that required for the floor assembly but need not be more than 1 h, except as required elsewhere in this Subsection.

2) Except as permitted by Sentence (3), the canopy required by Sentence (1) is permitted to be omitted if the exterior wall of the upper *storey* is recessed not less than 1 m behind the exterior wall containing the opening in the lower *storey*.

3) The requirements of Sentences (1) and (2) are permitted to be waived if the *building* is *sprinklered* throughout.

3.2.3.17. Covered Vehicular Passageway

1) A covered vehicular passageway designed as a receiving or shipping area shall be separated from every *building* or part of a *building* adjoining it by a *fire separation* having a *fire-resistance rating* not less than 1.5 h.

2) A covered vehicular passageway constructed below *grade* shall be of *noncombustible construction*.

3.2.3.18. Walkway between Buildings

1) Except as required by Sentence 3.2.3.19.(2), if *buildings* are connected by a *walkway*, each *building* shall be separated from the *walkway* by a *fire separation* with a *fire-resistance rating* not less than 45 min.

2) Except as permitted by Sentence (3), a *walkway* connected to a *building* required to be of *noncombustible construction* shall also be of *noncombustible construction*.

3) A *walkway* connected to a *building* required to be of *noncombustible construction* is permitted to be of *heavy timber construction* provided
a) not less than 50% of the area of any enclosing perimeter walls is open to the outdoors, and
b) the *walkway* is at ground level.

4) A *walkway* of *noncombustible construction* used only as a pedestrian thoroughfare need not conform to the requirements of Articles 3.2.3.13. and 3.2.3.14.

5) A *walkway* between *buildings* shall be not more than 9 m wide.

3.2.3.19. Underground Walkway

1) An underground *walkway* shall not be designed or used for any purpose other than pedestrian travel unless
a) the purpose is acceptable to the *authority having jurisdiction*, and
b) sprinklers are installed in any space in the *walkway* containing an *occupancy*.

2) *Buildings* connected by an underground *walkway* shall be separated from the *walkway* by a *fire separation* with a *fire-resistance rating* not less than 1 h.

3) An underground *walkway* shall be of *noncombustible construction* suitable for an underground location.

4) In an underground *walkway*
a) smoke barrier doors shall be installed at intervals of not more than 100 m, or
b) the travel distance from the door of an adjacent room or space to the nearest *exit* shall be not more than one and a half times the least allowable travel distance to an *exit* for any of the adjacent occupancies as permitted by Sentence 3.4.2.5.(1).

5) An underground *walkway* between *buildings* shall be not more than 9 m wide.

3.2.3.20. Fabric Canopies and Marquees

1) Fabrics used as part of an awning, canopy or marquee that is located within or attached to a *building* of any type of construction shall conform to CAN/ULC-S109-M, "Flame Tests of Flame-Resistant Fabrics and Films."

3.2.4. Fire Alarm and Detection Systems

(See Appendix A.)

3.2.4.1. Determination of Requirement for a Fire Alarm System

1) A fire alarm system shall be installed in a *building* in which an automatic sprinkler system is installed.

2) Except as permitted by Sentences (3) to (5) and Sentence 3.2.4.2.(4), a fire alarm system shall be installed in a *building* that is not *sprinklered* throughout but which contains

a) a *contained use area*,
b) an *impeded egress zone*,
c) more than 3 *storeys*, including *storeys* below *grade*,
d) a total *occupant load* more than 300, other than in open air seating areas,
e) an *occupant load* more than 150 above or below the *first storey*, other than in open air seating areas,
f) a school, college, or child care facility, including a day care facility, with an *occupant load* more than 40,
g) a licensed beverage establishment or a restaurant, with an *occupant load* more than 150,
h) a *medium hazard industrial occupancy* or a *low hazard industrial occupancy* with an *occupant load* more than 75 above or below the *first storey*,
i) a *residential occupancy* with sleeping accommodation for more than 10 persons,
j) a *high hazard industrial occupancy* with an *occupant load* more than 25, or
k) an *occupant load* more than 300 below an open air seating area.

3) If each *dwelling unit* has direct access to an exterior *exit* facility leading to ground level, a fire alarm system is not required in an apartment *building*

a) in which not more than 4 *dwelling units* share a common *means of egress*, or
b) which is not more than 3 *storeys* in *building height*.

4) A fire alarm system is not required in a hotel or motel 3 *storeys* or less in *building height* provided each *suite* has direct access to an exterior *exit* facility leading to ground level.

5) A fire alarm system is not required in a *storage garage* conforming to Article 3.2.2.83. provided there are no other *occupancies* in the *building*.

3.2.4.2. Continuity of Fire Alarm System

1) If there are openings through a *firewall*, other than those for piping, tubing, wiring and totally enclosed *noncombustible* raceways, the requirements in this Subsection shall apply to the *floor areas* on both sides of the *firewall* as if they were in the same *building*.

2) Except as permitted by Sentence (4), if a *building* contains more than one *major occupancy* and a fire alarm system is required, a single system shall serve all *occupancies*.

3) Except as permitted by Sentence (4), if a fire alarm system is required in any portion of a *building*, it shall be installed throughout the *building*.

4) Except as required by Sentence (5), the requirements in this Subsection are permitted to be applied to each portion of a *building* not more than 3 *storeys* in *building height*, in which a vertical *fire separation* having a *fire-resistance rating* not less than 1 h separates the portion from the remainder of the *building* as if it were a separate *building*, provided there are no openings through the *fire separation*, other than those for piping, tubing, wiring and totally enclosed *noncombustible* raceways.

5) The permission in Sentence (4) to consider separated portions of a *building* as separate *buildings* does not apply to *service rooms* and storage rooms.

3.2.4.3. Types of Fire Alarm Systems

1) A fire alarm system shall be

a) a single stage system in a Group F, Division 1 *occupancy*,
b) a 2 stage system in a Group B *occupancy* other than those described in Clause (c),
c) a single or 2 stage system in a *building* 3 *storeys* or less in *building height* used for a children's custodial home, a convalescent home or an orphanage, and
d) a single or 2 stage system in all other cases.

3.2.4.4. Description of Fire Alarm Systems

1) A single stage fire alarm system shall, upon the operation of any manual pull station, waterflow detecting device, or *fire detector*, cause an *alarm signal* to sound on all audible signal devices in the system. (See Appendix A.)

2) A 2 stage fire alarm system shall

a) cause an *alert signal* to sound upon the operation of any manual pull station, waterflow detecting device, or *fire detector*,

b) automatically cause an *alarm signal* to sound if the *alert signal* is not acknowledged within 5 min of its initiation, and
c) have each manual pull station equipped so that the use of a key or other similar device causes an *alarm signal* to sound and continue to sound upon the removal of the key or similar device from the manual pull station.

(See Appendix A.)

3) A 2 stage fire alarm system is permitted to be zone coded so that, upon the operation of any manual pull station, waterflow detecting device, or *fire detector*,
a) a coded *alert signal* is sounded indicating the zone of alarm initiation,
b) the coded *alert signal* is repeated in its entirety not less than 4 times, and
c) a continuous *alert signal* is sounded upon completion of the coded signals referred to in Clause (b) and Sentence (4).

4) If a second manual pull station, waterflow detecting device, or *fire detector* is operated in a fire alarm system with zone coding as permitted by Sentence (3), in a zone other than that for which the first *alert signal* was sounded, the coded *alert signal* for the first zone shall be completed before the coded *alert signal* for the second zone is repeated not less than 4 times.

3.2.4.5. Installation and Testing of Fire Alarm Systems

1) Fire alarm and voice communication systems shall be installed in conformance with CAN/ULC-S524, "Installation of Fire Alarm Systems." r4

2) A fire alarm system shall be tested in conformance with CAN/ULC-S537, "Verification of Fire Alarm Systems," to ensure satisfactory operation.

3.2.4.6. Silencing of Alarm Signals

1) A fire alarm system shall be designed so that when an *alarm signal* is actuated, it cannot be silenced automatically before a period of time has elapsed that is not less than
a) 5 min for a *building* not required to be equipped with an annunciator, and
b) 20 min for any other *building*.

2) Except as permitted by Sentence 3.2.4.19.(9) and Sentences 3.2.4.22.(2) and (3), a fire alarm system shall not incorporate manual silencing switches other than those installed inside the fire alarm control unit. (See Appendix A.)

3.2.4.7. Signals to Fire Department

1) A single stage fire alarm system installed in a *building* of *assembly occupancy* that has an *occupant load* more than 300 shall be designed to notify the fire department, in conformance with Sentence (4), that an *alarm signal* has been initiated.

2) An automatic sprinkler system shall be designed to notify the fire department, in conformance with Sentence (4), that a waterflow switch has been actuated.

3) A 2 stage fire alarm system shall be designed to notify the fire department, in conformance with Sentence (4), that an *alert signal* has been initiated.

4) Except as permitted by Sentence (5), signals to the fire department shall be by way of
a) an independent central station conforming to NFPA 71, "Installation, Maintenance and Use of Signaling Systems for Central Station Service," or
b) a proprietary control centre conforming to Chapter 9 of NFPA 72, "Installation, Maintenance and Use of Protective Signaling Systems."

5) If the facilities referred to in Sentence (4) are not available in the municipality in which the *building* is to be built, an independent system is permitted to be used to transmit signals to the fire department.

6) If a single stage fire alarm system or a local group of sprinklers has been installed and Sentence (1) does not require provision to transmit a signal to the fire department, a legible notice, that is not easily removed, shall be affixed to the wall near each manual pull station with wording that the fire department is to be notified in the event of a fire emergency and including the emergency telephone number for the municipality or the telephone number of the fire department. (See Appendix A.)

3.2.4.8. Annunciator and Zone Indication

1) Except as permitted by Sentences (3) to (5), an annunciator shall be installed in close proximity to a *building* entrance that faces a *street* or an access route for fire department vehicles that complies with Sentence 3.2.5.5.(1).

2) Except as permitted by Sentence (6), the annunciator required by Sentence (1) shall have separate zone indication of the actuation of the alarm initiating devices in each
a) *floor area* so that the area of coverage for each zone in a *building* that is not *sprinklered* is not more than 2 000 m²,

b) *floor area* so that the area of coverage for each zone is neither
   i) more than one *storey*, nor
   ii) more than the system area limits as specified in NFPA 13, "Installation of Sprinkler Systems,"
c) shaft required to be equipped with *smoke detectors*,
d) air handling system required to be equipped with *smoke detectors*,
e) *contained use area*,
f) *impeded egress zone*, and
g) *fire compartment* required by Sentence 3.3.3.5.(2).

(See Appendix A.)

3) An annunciator need not be provided for a fire alarm system if not more than one zone indicator is required by Sentence (2).

4) If an annunciator is not installed as part of a fire alarm system in conformance with Sentence (1), a visual and audible trouble signal device shall be provided inside the main entrance of the *building*.

5) The requirements of Sentence (1) are waived in a *building*
a) in which an automatic sprinkler system is not installed,
b) that has an aggregate area for all *storeys* of not more than 2 000 m², and
c) that is not more than 3 *storeys* in *building height*.

6) The area limits of Clause (2)(a) are waived for an interior undivided open space used as an arena, a rink, or a swimming pool provided that other spaces in the *building* that are separated from the open space are individually zoned in accordance with the requirements of Sentence (2).

7) Notwithstanding the requirements for an annunciator in this Article,
a) all fire alarm systems shall include a main control unit to which all signal and supervision circuits shall report, either directly or by means of transponders, and
b) each annunciator or trouble signal device shall be connected to the main control unit.

8) All indicators required for an annunciator or trouble signal device shall be included on the main control unit as well as on the annunciator or trouble signal device. (See Appendix A.)

3.2.4.9. Electrical Supervision

1) Electrical supervision shall be provided for a fire alarm system.

2) An automatic sprinkler system shall be electrically supervised to indicate a supervisory signal on the *building* fire alarm system annunciator for each of the following:
a) movement of a valve handle that controls the supply of water to sprinklers;
b) loss of excess water pressure required to prevent false alarms in a wet pipe system;
c) loss of air pressure in a dry pipe system;
d) loss of air pressure in a pressure tank;
e) a significant change in water level in any water storage container used for fire fighting purposes;
f) loss of power to any automatically starting fire pump (see Appendix A); and
g) a temperature approaching the freezing point in any dry pipe valve enclosure or water storage container used for fire fighting purposes.

3) Indication of a supervisory signal in accordance with Sentence (2) shall be transmitted to the fire department in conformance with Sentence 3.2.4.7.(4).

3.2.4.10. Fire Detectors

1) *Fire detectors* required by this Article shall be connected to the fire alarm system.

2) If a fire alarm system is required in a *building* that is not *sprinklered* throughout, *fire detectors* shall be installed in the following spaces if they are not *sprinklered*
a) storage rooms not within *dwelling units*,
b) *service rooms* not within *dwelling units*,
c) janitors' rooms,
d) rooms in which hazardous substances are to be used or stored (see A-3.3.1.2.(1) in Appendix A),
e) elevator and dumbwaiter shafts, and
f) a laundry room in a *building* of *residential occupancy*, but not one within a *dwelling unit*.

3.2.4.11. Smoke Detectors

1) If a fire alarm system is installed, *smoke detectors* shall be installed in
a) each sleeping room and each corridor serving as part of a *means of egress* from sleeping rooms in portions of a *building* classified as Group B *major occupancy*,
b) each room in a *contained use area* and corridors serving those rooms,
c) each corridor in portions of a *building* classified as Group A, Division 1 *major occupancy*,
d) each *public corridor* in portions of a *building* classified as Group C *major occupancy*,

e) each *exit* stair shaft, and
f) the vicinity of draft stops required by Article 3.2.8.7.

(See Appendix A.)

3.2.4.12. Prevention of Smoke Circulation

1) If a fire alarm system is installed, an air handling system shall be designed to prevent the circulation of smoke upon a signal from a duct-type *smoke detector* if the air handling system
a) serves more than one *storey*,
b) serves more than one *suite* in a *storey*, or
c) serves more than one *fire compartment* required by Sentence 3.3.3.5.(2).

3.2.4.13. Vacuum Cleaning System Shutdown

1) A central vacuum cleaning system in a *building* equipped with a fire alarm system shall be designed to shut down upon actuation of the fire alarm system.

3.2.4.14. Elevator Emergency Return

1) Except as permitted by Sentence (3), in a *building* having elevators that serve *storeys* above the *first storey* and that are equipped with an automatic emergency recall feature, *smoke detectors* shall be installed in the elevator lobbies on the recall level so that when these *smoke detectors* are actuated, the elevators will automatically return directly to an alternate floor level.

2) *Smoke detectors* required by Sentence (1) shall be designed as part of the *building* fire alarm system.

3) The alternate floor recall feature required by Sentence (1) is not required if the *floor area* containing the recall level is *sprinklered* throughout.

3.2.4.15. Sprinklers in Lieu of Fire Detectors

1) *Fire detectors* required by Article 3.2.4.10. need not be provided within a *floor area* if the *floor area* is *sprinklered* throughout.

3.2.4.16. System Monitoring

1) An automatic sprinkler system shall be equipped with waterflow detecting devices and, if an annunciator is required by Article 3.2.4.8., shall be installed so that each device serves
a) not more than one *storey*, and
b) an area on each *storey* that is not more than the system area limits as specified in NFPA 13, "Installation of Sprinkler Systems."

2) Waterflow detecting devices required by Sentence (1) shall be connected to initiate an *alert signal* or an *alarm signal* on the fire alarm system.

3) The actuation of each waterflow detecting device required by Sentence (1) shall be indicated separately on the fire alarm system annunciator.

3.2.4.17. Manual Pull Stations

1) Except as permitted by Sentences (2) and (3), if a fire alarm system is installed, a manual pull station shall be installed
a) in every *floor area* near the principal entrance to the *building*, and
b) near every required *exit*.

(See Appendix A.)

2) In a *building* that is *sprinklered* throughout, a manual pull station is not required at an exterior egress doorway from a *suite* that does not lead to an interior shared *means of egress* in a hotel or motel not more than 3 *storeys* in *building height*, provided each *suite* is served by an exterior *exit* facility leading directly to ground level.

3) In a *building* that is *sprinklered* throughout, a manual pull station is not required at an exterior egress doorway from a *dwelling unit* that does not lead to an interior shared *means of egress* in a *building* not more than 3 *storeys* in *building height* containing only *dwelling units*, provided each *dwelling unit* is served by an exterior *exit* facility leading directly to ground level.

4) In a *building* referred to in Sentences (2) or (3), manual pull stations shall be installed near doorways leading from shared interior corridors to the exterior.

3.2.4.18. Alert and Alarm Signals

1) In a 2 stage fire alarm system described in Sentence 3.2.4.4.(2), the same audible signal devices are permitted to be used to sound the *alert signals* and the *alarm signals*.

2) If audible signal devices with voice reproduction capabilities are intended for paging and similar voice message use, other than during a fire emergency, they shall be installed so that *alert signals* and *alarm signals* take priority over all other signals.

3) Audible signal devices forming part of a fire alarm or voice communication system shall not be used for playing music or background noise.

4) In a *building* or portion thereof intended for use primarily by persons with hearing impairment, visual signal devices shall be installed in addition to audible signal devices.

3.2.4.19. Audibility of Alarm Systems

(See Appendix A.)

1) Audible signal devices forming part of a fire alarm system shall be installed in a *building* so that *alert signals* and *alarm signals* are clearly audible throughout the *floor area* in which they are installed.
(See Appendix A.)

2) The temporal pattern of an *alarm signal* shall conform to the temporal pattern defined in Clause 4.2 of International Standard ISO 8201, "Acoustics – Audible emergency evacuation signal." (See Appendix A.)

3) The signals from *smoke alarms* and the patterns of *alert signals* shall be sufficiently different from the signals or patterns of *alarm signals* that there is no possibility of confusion.

4) The fire *alarm signal* sound pressure level shall be not more than 110 dBA in any normally occupied area. (See Appendix A.) e

5) The sound pressure level in a sleeping room from a fire alarm audible signal device shall be not less than 75 dBA in a *building* of *residential occupancy* when any intervening doors between the device and the sleeping room are closed. (See Appendix A.)

6) The sound pressure level from a fire alarm audible signal device in a *floor area* used for *occupancies* other than *residential occupancies* shall be not less than 10 dBA above the ambient noise level, but with a minimum value not less than 65 dBA.

7) Fire alarm audible signal devices shall be supplemented by visual signal devices in any *floor area* in which
- a) the ambient noise level is more than 87 dBA, or
- b) the occupants of the *floor area*
  - i) use ear protective devices,
  - ii) are located within an audiometric booth, or
  - iii) are located within sound insulating enclosures.

8) Sentence (7) shall also apply in an *assembly occupancy* in which music and other sounds associated with performances could exceed 100 dBA.

9) An audible signal device located within a *dwelling unit* shall incorporate a means that enables the device to be silenced for a period of not more than 10 min, after which the device shall restore to normal operation. (See Appendix A.)

10) An audible signal device located within a *dwelling unit* or a *suite* of *residential occupancy* shall be connected to the fire alarm system in a manner that disconnection of, or damage to, that device will not interfere with the ability of devices in other *dwelling units*, *public corridors*, or *suites* to sound an alarm.

11) Audible signal devices referred to in Sentence (10) are not required to have individual electrical supervision.

12) Audible signal devices shall be installed in a *service space* referred to in Sentence 3.2.1.1.(7) and shall be connected to the fire alarm system.

3.2.4.20. Visual Signals

1) Visual signal devices required by Sentences 3.2.4.18.(4) and 3.2.4.19.(7) and (8) shall be installed so that the signal from at least one device is visible throughout the *floor area* or portion thereof in which they are installed. (See Appendix A.)

2) In addition to the requirements for fire alarm and detection systems in this Subsection, visual signals from *smoke detectors* required in sleeping rooms of Group B *occupancy* shall be provided so that staff serving those rooms can easily identify the room or location of fire alarm initiation. (See Appendix A.)

3.2.4.21. Smoke Alarms

1) *Smoke alarms* conforming to CAN/ULC-S531-M, "Smoke Alarms," shall be installed in each *dwelling unit* and, except for *care or detention occupancies* required to have a fire alarm system, in each sleeping room not within a *dwelling unit*.

2) At least one *smoke alarm* shall be installed on each *storey* of a *dwelling unit*.

3) On any *storey* of a *dwelling unit* containing sleeping rooms, a *smoke alarm* shall be installed in a location between the sleeping rooms and the remainder of the *storey*, and if the sleeping rooms are served by a hallway, the *smoke alarm* shall be located in the hallway. e3

4) A *smoke alarm* shall be installed on or near the ceiling.

5) A *smoke alarm* shall be installed with permanent connections to an electrical circuit and shall have no disconnect switches between the overcurrent device and the *smoke alarm*. (See Appendix A.)

6) If more than one *smoke alarm* is required in a *dwelling unit*, the *smoke alarms* shall be wired so that the actuation of one *smoke alarm* will cause all *smoke alarms* within the *dwelling unit* to sound.

7) A *smoke alarm* required by Sentence (1) shall be installed in conformance with CAN/ULC-S553-M, "Installation of Smoke Alarms."

8) A manually operated device is permitted to be incorporated within the circuitry of a *smoke alarm* installed in a *dwelling unit* so that it will silence the signal emitted by the *smoke alarm* for a period of not more than 10 min, after which the *smoke alarm* will reset and again sound the alarm if the level of smoke in the vicinity is sufficient to reactuate the *smoke alarm*.

3.2.4.22. Voice Communication Systems

1) A voice communication system required by Subsection 3.2.6. shall consist of
- a) a 2-way communication system in each *floor area*, with connections to the central alarm and control facility and to the mechanical control centre, and
- b) loudspeakers operated from the central alarm and control facility which are designed and located so as to be audible and the messages intelligible in all parts of the *building*, except that this requirement does not apply to elevator cars. (See Appendix A.)

2) The voice communication system referred to in Sentence (1) shall include provision for silencing the *alarm signal* in a single stage fire alarm system when voice messages are being transmitted, but only after the *alarm signal* has sounded initially for not less than 60 s.

3) The voice communication system referred to in Sentence (1) shall include provision for silencing the *alert signal* and the *alarm signal* in a 2 stage fire alarm system when voice messages are being transmitted, but only after the *alert signal* has sounded initially for not less than
- a) 30 s in hospitals that have supervisory personnel on duty for twenty-four hours each day, or
- b) 60 s for all other *occupancies*.

4) The voice communication system referred to in Clause (1)(b) shall be designed so that voice instructions can be transmitted selectively to any zone or zones while maintaining an *alert signal* or *alarm signal* to other zones in the *building*.

5) The 2-way communication system referred to in Clause (1)(a) shall be installed so that emergency telephones are located in each *floor area* near *exit* stair shafts.

3.2.5. Provisions for Fire Fighting

(See A-3, Fire Fighting Assumptions, in Appendix A.)

3.2.5.1. Access to Above Grade Storeys

1) Except for *storeys* below the *first storey*, direct access for fire fighting shall be provided from the outdoors to every *storey* that is not *sprinklered* throughout and whose floor level is less than 25 m above *grade*, by at least one unobstructed window or access panel for each 15 m of wall in each wall required to face a *street* by Subsection 3.2.2.

2) An opening for access required by Sentence (1) shall
- a) have a sill no higher than 900 mm above the inside floor, and
- b) be not less than 1 100 mm high by not less than
  - i) 550 mm wide for a *building* not designed for the storage or use of dangerous goods, or
  - ii) 750 mm wide for a *building* designed for the storage or use of dangerous goods.

3) Access panels above the *first storey* shall be readily openable from both inside and outside, or the opening shall be glazed with plain glass.

3.2.5.2. Access to Basements

1) Direct access from at least one *street* shall be provided from the outdoors in a *building* that is not *sprinklered* to each *basement* having a horizontal dimension more than 25 m.

2) The access required by Sentence (1) is permitted to be provided by
- a) doors, windows or other means that provide an opening not less than 1 100 mm high and 550 mm wide, with a sill no higher than 900 mm above the inside floor, or
- b) an interior stairway immediately accessible from the outdoors.

3.2.5.3. Roof Access

1) On a *building* more than 3 *storeys* in *building height* where the slope of the roof is less than 1 in 4, all main roof areas shall be provided with direct access from the *floor areas* immediately below, either by
- a) a stairway, or
- b) a hatch not less than 550 mm by 900 mm with a fixed ladder.

3.2.5.4. Access Routes

1) A *building* which is more than 3 *storeys* in *building height* or more than 600 m² in *building area* shall be provided with access routes for fire department vehicles
- a) to the *building* face having a principal entrance, and
- b) to each *building* face having access openings for fire fighting as required by Articles 3.2.5.1. and 3.2.5.2.

(See Appendix A.)

3.2.5.5. Location of Access Routes

1) Access routes required by Article 3.2.5.4. shall be located so that the principal entrance and every access opening required by Articles 3.2.5.1. and 3.2.5.2. are located not less than 3 m and not more than 15 m from the closest portion of the access route required for fire department use, measured horizontally from the face of the *building*.

2) Access routes shall be provided to a *building* so that

a) for a *building* provided with a fire department connection, a fire department pumper vehicle can be located adjacent to the hydrants referred to in Article 3.2.5.16.,
b) for a *building* not provided with a fire department connection, a fire department pumper vehicle can be located so that the length of the access route from a hydrant to the vehicle plus the unobstructed path of travel for the fire fighter from the vehicle to the *building* is not more than 90 m, and
c) the unobstructed path of travel for the fire fighter from the vehicle to the *building* is not more than 45 m.

3) The unobstructed path of travel for the fire fighter required by Sentence (2) from the vehicle to the *building* shall be measured from the vehicle to the fire department connection provided for the *building*, except that if no fire department connection is provided, the path of travel shall be measured to the principal entrance of the *building*.

4) If a portion of a *building* is completely cut off from the remainder of the *building* so that there is no access to the remainder of the *building*, the access routes required by Sentence (2) shall be located so that the unobstructed path of travel from the vehicle to one entrance of each portion of the *building* is not more than 45 m.

3.2.5.6. Access Route Design

1) A portion of a roadway or yard provided as a required access route for fire department use shall

a) have a clear width not less than 6 m, unless it can be shown that lesser widths are satisfactory,
b) have a centreline radius not less than 12 m,
c) have an overhead clearance not less than 5 m,
d) have a change of gradient not more than 1 in 12.5 over a minimum distance of 15 m,
e) be designed to support the expected loads imposed by fire fighting equipment and be surfaced with concrete, asphalt or other material designed to permit accessibility under all climatic conditions,
f) have turnaround facilities for any dead-end portion of the access route more than 90 m long, and
g) be connected with a public thoroughfare.

(See Appendix A.)

3.2.5.7. Water Supply

1) An adequate water supply for fire fighting shall be provided for every *building*.

3.2.5.8. Standpipe Systems

1) Except as permitted by Sentence 3.2.5.9.(4), a standpipe system shall be installed in a *building* that is

a) more than 3 *storeys* in *building height*,
b) more than 14 m high measured between *grade* and the ceiling of the top *storey*, or
c) not more than 14 m high measured between *grade* and the ceiling of the top *storey* but has a *building area* exceeding the area shown in Table 3.2.5.8. for the applicable *building height* unless the *building* is *sprinklered* throughout.

Table 3.2.5.8.
Building Limits without Standpipe Systems
Forming Part of Sentence 3.2.5.8.(1)

Occupancy Classification	*Building Area*, m²		
	1 *storey*	2 *storeys*	3 *storeys*
A	2 500	2 000	1 500
C	2 000	1 500	1 000
D	4 000	3 000	2 000
F, Division 2	1 500	1 500	1 000
F, Division 3	3 000	2 000	1 000

3.2.5.9. Standpipe System Design

1) Except as required or permitted by Sentences (2) to (6) and Articles 3.2.5.10., 3.2.5.11. and 3.2.5.12., the design, construction, installation and testing of a standpipe system shall conform to NFPA 14, "Installation of Standpipe, Private Hydrants and Hose Systems." r4

2) A dry standpipe that is not connected to a water supply shall not be considered as fulfilling the requirements of this Article.

3) If more than one standpipe is provided, the total water supply need not be more than 30 L/s.

4) A standpipe need not be installed in a *storage garage* conforming to Article 3.2.2.83. provided the *building* is not more than 15 m high.

5) The residual water pressure at the design flow rate at the topmost hose connection of a standpipe system that is required to be installed in a *building* is permitted to be less than 690 kPa provided

a) the *building* is *sprinklered* throughout,

b) the water supply at the base of the sprinkler riser is capable of meeting, without a fire pump, the design flow rate and pressure demand of the sprinkler system, including the inside and outside hose allowance, and

c) fire protection equipment is available to deliver, by means of the fire department connection, the full demand flow rate at a residual water pressure of 690 kPa at the topmost hose connection of the standpipe system. (See Appendix A.)

6) A fire department connection shall be provided for every standpipe system.

3.2.5.10. Hose Connections

1) Hose connections shall be located in *exits*, in accordance with NFPA 14, "Installation of Standpipe, Private Hydrants and Hose Systems." r4

2) Hose connections are not required within a *floor area*.

3) Hose connections shall be provided with sufficient clearance to permit the use of a standard fire department hose key.

4) Except as permitted by Sentence (5), 64 mm diam hose connections shall be installed in a standpipe system.

5) Hose connections for 64 mm diam hose are not required in a *building* that is not more than 25 m high, measured between *grade* and the ceiling level of the top *storey* and in which an automatic sprinkler system is not installed.

3.2.5.11. Hose Stations

1) Hose stations for 38 mm diam hose shall be installed for a standpipe system in a *building* that is not *sprinklered* throughout.

2) Hose stations for 38 mm diam hose shall be installed for a standpipe system in a *floor area* that is not *sprinklered* throughout but are not required in a *floor area* that is *sprinklered* throughout.

3) Hose stations shall be located in the *floor area* within 5 m of *exits* and at other locations to provide coverage of the entire *floor area*.

4) A hose station located on one side of a *horizontal exit* shall be considered to serve only the *floor area* on that side of the *horizontal exit*.

5) A hose cabinet shall be located so that its door, when fully opened, will not obstruct the required width of a *means of egress*.

3.2.5.12. Trouble Signal Annunciation for Valves

1) If a fire alarm system in a *building* is required to have an annunciator by Sentence 3.2.4.8.(1), except for hose valves, all valves controlling water supplies in a standpipe system shall be equipped with an electrically supervised switch for transmitting a trouble signal to the annunciator in the event of movement of the valve handle.

3.2.5.13. Automatic Sprinkler Systems

1) Except as permitted by Sentences (2), (3) and (4), an automatic sprinkler system shall be designed, constructed, installed and tested in conformance with NFPA 13, "Installation of Sprinkler Systems." (See Appendix A.)

2) Instead of the requirements of Sentence (1), NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," is permitted to be used for the design, construction, installation and testing of an automatic sprinkler system installed in a *building* of *residential occupancy* throughout, not more than 4 *storeys* in *building height* conforming to Article 3.2.2.42., Article 3.2.2.43., Article 3.2.2.45. or Article 3.2.2.48.

3) Instead of the requirements of Sentence (1), NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes," is permitted to be used for the design, construction, installation and testing of an automatic sprinkler system installed in a *building* of *residential occupancy* throughout that contains not more than 2 *dwelling units*.

4) If a *building* contains fewer than 9 sprinklers, the water supply for these sprinklers is permitted to be supplied from the domestic water system for the *building* provided the required flow for the sprinklers can be met by the domestic system.

5) If a water supply serves both an automatic sprinkler system and a system serving other equipment, control valves shall be provided so that either system can be shut off independently.

6) Notwithstanding the requirements of the standards referenced in Sentences (1), (2) and (3) for the installation of automatic sprinkler systems, sprinklers shall not be omitted in any room or closet in the *storey* immediately below a roof assembly. (See Appendix A.)

7) Fast response sprinklers shall be installed in *residential occupancies* and in *care or detention occupancies*. (See Appendix A.)

8) Sprinklers in elevator machine rooms shall have a temperature rating not less than that required for an intermediate temperature classification and shall be protected against physical damage. (See Appendix A.)

3.2.5.14. Combustible Sprinkler Piping

1) *Combustible* sprinkler piping shall be used only for wet systems in *residential occupancies* and other light hazard *occupancies*. (See Appendix A.)

2) *Combustible* sprinkler piping shall meet the requirements of ULC/ORD-C199P-M, "Combustible Piping for Sprinkler Systems."

3) *Combustible* sprinkler piping shall be separated from the area served by the sprinkler system and from any other *fire compartment* by ceilings, walls, or soffits consisting of, as a minimum,
- a) lath and plaster,
- b) gypsum board not less than 9.5 mm thick,
- c) plywood not less than 13 mm thick, or
- d) a suspended membrane ceiling with
  - i) steel suspension grids, and
  - ii) lay-in panels or tiles having a mass not less than 1.7 kg/m².

4) If *combustible* sprinkler piping is located above a ceiling, an opening through the ceiling that is not protected in conformance with Sentence (3) shall be located so that the distance between the edge of the opening and the nearest sprinkler is not more than 300 mm.

3.2.5.15. Sprinklered Service Space

1) An automatic sprinkler system shall be installed in a *service space* referred to in Sentence 3.2.1.1.(7) if flooring for access within the *service space* is other than catwalks.

2) The sprinkler system required by Sentence (1) shall be equipped with waterflow detecting devices, with each device serving not more than one *storey*.

3) The waterflow detecting devices required by Sentence (2) shall be connected to the fire alarm system, to
- a) initiate an *alert signal* in a 2 stage system or an *alarm signal* in a single stage system, and
- b) indicate separately on the fire alarm system annunciator the actuation of each device.

3.2.5.16. Fire Department Connections

1) The fire department connection for a standpipe system shall be located so that the distance from the fire department connection to a hydrant is not more than 45 m and is unobstructed.

2) The fire department connection for an automatic sprinkler system shall be located so that the distance from the fire department connection to a hydrant is not more than 45 m and is unobstructed.

3.2.5.17. Portable Fire Extinguishers

1) Portable extinguishers shall be provided and installed in accordance with
- a) provincial, territorial or municipal regulations, or
- b) the National Fire Code of Canada 1995, in the absence of regulations referred to in Clause (a).

2) In a Group B, Division 1 *major occupancy*, portable fire extinguishers are permitted to be located in secure areas, or in lockable cabinets provided
- a) identical keys for all cabinets are located at all supervisory or security stations, or
- b) electrical remote release devices are provided and are connected to an emergency power supply.

3.2.5.18. Protection from Freezing

1) Equipment forming part of a fire protection system shall be protected from freezing if
- a) it could be adversely affected by freezing temperatures, and
- b) it is located in an unheated area.

3.2.5.19. Fire Pumps

1) If a fire pump is installed, it shall be installed in accordance with the requirements of NFPA 20, "Installation of Stationary Pumps for Fire Protection." (See Appendix A.) r4

3.2.6. Additional Requirements for High Buildings

(See Appendix B.)

3.2.6.1. Application

1) This Subsection applies to a *building*
- a) of Group A, D, E or F *major occupancy* classification that is more than
  - i) 36 m high, measured between *grade* and the floor level of the top *storey*, or
  - ii) 18 m high, measured between *grade* and the floor level of the top *storey*, and in which the cumulative or total *occupant load* on or above any *storey* above *grade*, other than the *first storey*, divided by 1.8 times the width in metres of all *exit* stairs at that *storey*, exceeds 300,

b) containing a Group B *major occupancy* in which the floor level of the highest *storey* of that *major occupancy* is more than 18 m above *grade*,
c) containing a *floor area* or part of a *floor area* located above the third *storey* designed or intended as a Group B, Division 2 *occupancy*, and
d) containing a Group C *major occupancy* whose floor level is more than 18 m above *grade*.

3.2.6.2. Limits to Smoke Movement

1) A *building* to which this Subsection applies shall be designed in accordance with Sentences (2) to (5) and Article 3.2.6.3. to limit the danger to occupants and fire fighters from exposure to smoke in a *building* fire.

2) A *building* referred to in Sentence (1) shall be designed so that, during a period of 2 h after the start of a fire, each *exit* stair serving *storeys* below the lowest *exit level* will not contain more than 1% by volume of contaminated air from the fire floor, assuming an outdoor temperature equal to the January design temperature on a 2.5% basis determined in accordance with Subsection 2.2.1. (See Appendix B.)

3) Each stairway that serves *storeys* above the lowest *exit level* shall have a vent to the outdoors, at or near the bottom of the stair shaft, that
a) has an openable area of 0.05 m^2 for every door between the stair shaft and a *floor area*, but not less than 1.8 m^2,
b) opens directly to the outdoors or into a vestibule that has a similar opening to the outdoors, and
c) has a door or *closure* that
  i) is openable manually, and
  ii) can remain in the open position during a fire emergency.
(See Appendix B.)

4) Measures shall be taken to limit movement of smoke from a fire in a *floor area* below the lowest *exit storey* into upper *storeys*. (See Appendix B.)

5) Except for exhaust fans in kitchens, washrooms and bathrooms in *dwelling units*, and except for fans used for smoke venting as required by Article 3.2.6.6., air moving fans in a system that serves more than 2 *storeys* shall be designed and installed so that in the event of a fire these fans can be stopped by means of a manually operated switch at the central alarm and control facility.

3.2.6.3. Connected Buildings

1) If a *building* described in Article 3.2.6.1. is connected to any other *building*, measures shall be taken to limit movement of contaminated air from one *building* into another during a fire. (See Appendix B.)

3.2.6.4. Emergency Operation of Elevators

1) Manual emergency recall shall be provided for all elevators serving *storeys* above the *first storey*.

2) Key-operated switches for emergency recall required by Sentence (1) shall be provided in a conspicuous location at
a) each elevator lobby on the recall level, and
b) the central alarm and control facility required by Article 3.2.6.7.

3) In-car emergency service switches shall be provided in all elevator cars.

4) Keys to operate the switches required by Sentences (2) and (3) shall be
a) provided in a suitably identified box conspicuously located on the outside of an elevator hoistway near the central alarm and control facility required by Article 3.2.6.7., and
b) kept at the central alarm and control facility.

3.2.6.5. Elevator for Use by Fire Fighters

1) At least one elevator shall be provided for use by fire fighters in conformance with Sentences (2) to (6).

2) The elevator referred to in Sentence (1) shall have a useable platform area not less than 2.2 m^2 and shall be capable of carrying a load of 900 kg to the top floor that it serves from a landing on the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5. within 1 min.

3) Each elevator for use by fire fighters shall
a) be provided with a *closure* at each shaft opening so that the interlock mechanism remains mechanically engaged and electrical continuity is maintained in the interlock circuits and associated wiring for a period of not less than 1 h when the assembly is subjected to the standard fire exposure described in CAN4-S104-M, "Fire Tests of Door Assemblies,"
b) be protected with a vestibule containing no *occupancy* and separated from the remainder of the *floor area* by a *fire separation* having a *fire-resistance rating* not less than 45 min, or
c) be protected with a corridor containing no *occupancy* and separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

4) Except as permitted by Sentence (5), an elevator referred to in Sentence (1) shall be capable of providing transportation from the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5. to every floor that is above *grade* in the *building* and that is normally served by the elevator system.

5) If it is necessary to change elevators to reach any floor referred to in Sentence (4), the system shall be designed so that not more than one change of elevator is required when travelling to any floor in the *building* from the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5.

6) Electrical conductors for the operation of the elevator referred to in Sentence (1) shall be
- a) installed in *service spaces* conforming to Section 3.6. that do not contain other *combustible* material, or
- b) protected against exposure to fire from the service entrance of the emergency power supply, or the normal service entrance of the normal power supply, to the equipment served, to ensure operation for a period of 1 h when subjected to the standard fire exposure described in CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials." (See Appendix B.)

3.2.6.6. Venting to Aid Fire Fighting

1) Means of venting each *floor area* to the outdoors shall be provided by windows, wall panels, smoke shafts, or the *building* exhaust system. (See Appendix B.)

2) Fixed glass windows shall not be used for the venting required by Sentence (1) if the breaking of the windows could endanger pedestrians below.

3) Openable windows used for the venting required by Sentence (1) shall be permanently marked so that they are easily identifiable.

4) Elevator hoistways shall not be designed for the venting required by Sentence (1).

3.2.6.7. Central Alarm and Control Facility

1) A central alarm and control facility shall be provided on the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5. in a location that
- a) is readily accessible to fire fighters entering the *building*, and
- b) takes into account the effect of background noise likely to occur under fire emergency conditions, so that the facility can properly perform its required function under these conditions.

(See Appendix B.)

2) The central alarm and control facility required by Sentence (1) shall include
- a) means to control the voice communication system required by Article 3.2.6.8., so that messages can be sent to
  - i) all loudspeakers simultaneously,
  - ii) individual *floor areas*, and
  - iii) *exit* stairwells,
- b) means to indicate audibly and visually *alert signals* and *alarm signals* and a switch to
  - i) silence the audible portion of these signals, and
  - ii) indicate visually that the audible portion has been silenced,
- c) means to indicate visually that elevators are on emergency recall,
- d) an annunciator conforming to Article 3.2.4.8.,
- e) means to transmit *alert signals* and *alarm signals* to the fire department in conformance with Article 3.2.4.7.,
- f) means to release hold-open devices on doors to vestibules,
- g) means to manually actuate *alarm signals* in the *building* selectively to any zone or zones,
- h) means to silence the *alarm signals* referred to in Clause (g) in conformance with Sentences 3.2.4.22.(2) and (3),
- i) means, as appropriate to the measure for fire safety provided in the *building*, to
  - i) actuate auxiliary equipment, or
  - ii) communicate with a continually staffed auxiliary equipment control centre,
- j) means to communicate with telephones in elevator cars, separate from connections to fire fighters' telephones, if elevator cars are required by CSA B44, "Safety Code for Elevators," to be equipped with a telephone, r4
- k) means to indicate visually, individual sprinkler system waterflow signals,
- l) means to indicate audibly and visually, sprinkler system supervisory signals and trouble signals,
- m) a switch to silence the audible portion of a supervisory signal or a trouble signal, and
- n) visual indication that the audible portion of a supervisory signal or a trouble signal has been silenced.

(See Appendix B.)

3.2.6.8. Voice Communication System

1) A voice communication system or systems conforming to Article 3.2.4.22. shall be provided in a *building* if
- a) the floor of the top *storey* is more than 36 m above *grade*, or
- b) a *floor area* or part of a *floor area* located above the third *storey* is designed or intended for use as a Group B, Division 2 *occupancy*.

3.2.6.9. Protection of Electrical Conductors

1) Electrical conductors that are installed in *service spaces* containing other *combustible* material and are used in connection with fire alarm systems and emergency equipment described in Articles 3.2.6.2. to 3.2.6.8. shall be
- a) separated from the remainder of the *service space* by a *fire separation* having a *fire-resistance rating* not less than 1 h, or
- b) protected against fire exposure from the source of power supply to the branch circuits serving the equipment to ensure continued operation for not less than 1 h.

2) If the central alarm and control facility and the fire alarm control unit are in different *fire compartments*, the electrical conductors connecting the fire alarm control unit to the central alarm and control facility shall be protected against fire exposure to ensure continued operation for not less than 1 h.

3.2.6.10. Testing

1) The systems for control of smoke movement and mechanical venting required by Articles 3.2.6.2. and 3.2.6.6. shall be tested to ensure satisfactory operation. (See Appendix B.)

3.2.7. Lighting and Emergency Power Systems

3.2.7.1. Minimum Lighting Requirements

1) An *exit*, a *public corridor*, or a corridor providing *access to exit* for the public or serving patients' sleeping rooms or classrooms shall be equipped to provide illumination to an average level not less than 50 lx at floor or tread level and at angles and intersections at changes of level where there are stairs or ramps.

2) Rooms and spaces used by the public shall be illuminated as described in Article 9.34.2.7.

3) Lighting outlets in a *building* of *residential occupancy* shall be provided in conformance with Subsection 9.34.2.

3.2.7.2. Recessed Lighting Fixtures

1) A recessed lighting fixture shall not be located in an insulated ceiling unless the fixture is designed for this type of installation.

3.2.7.3. Emergency Lighting

1) Emergency lighting shall be provided to an average level of illumination not less than 10 lx at floor or tread level in
- a) *exits*,
- b) principal routes providing *access to exit* in an open *floor area*,
- c) corridors used by the public,
- d) corridors serving patients' sleeping rooms,
- e) corridors serving classrooms,
- f) underground *walkways*,
- g) *public corridors*, and
- h) *floor areas* or parts thereof where the public may congregate in
  - i) Group A, Division 1 *occupancies*, or
  - ii) Group A, Division 2 and 3 *occupancies* having an *occupant load* of 60 or more.

2) Emergency lighting to provide an average level of illumination of not less than 10 lx at floor or catwalk level shall be included in a *service space* referred to in Sentence 3.2.1.1.(7).

3) The minimum value of the illumination required by Sentences (1) and (2) shall be not less than 1 lx.

3.2.7.4. Emergency Power for Lighting

1) An emergency power supply shall be
- a) provided to maintain the emergency lighting required by this Subsection from a power source such as batteries or generators that will continue to supply power in the event that the regular power supply to the *building* is interrupted, and
- b) so designed and installed that upon failure of the regular power it will assume the electrical load automatically for a period of
  - i) 2 h for a *building* within the scope of Subsection 3.2.6.,
  - ii) 1 h for a *building* of Group B *major occupancy* classification that is not within the scope of Subsection 3.2.6., and
  - iii) 30 min for a *building* of any other *occupancy*.

(See Appendix A.)

2) If self-contained emergency lighting units are used, they shall conform to CSA C22.2 No. 141-M, "Unit Equipment for Emergency Lighting."

3.2.7.5. Emergency Power Supply Installation

1) Except as required by Articles 3.2.7.6. and 3.2.7.7., an emergency electrical power system shall be installed in conformance with CSA C282, "Emergency Electrical Power Supply for Buildings." (See Sentence 3.2.7.8.(5) for emergency power supply for voice communication systems.) r4

3.2.7.6. Emergency Power for Hospitals and Nursing Homes

1) Except as required by Article 3.2.7.7., an emergency electrical power system for emergency equipment required by this Part for hospitals and nursing homes shall be installed in conformance with CAN/CSA-Z32.4-M, "Essential Electrical Systems for Hospitals." (See Appendix A.)

3.2.7.7. Fuel Supply Shut-off Valves

1) If a liquid or gas fuel-fired engine or turbine for an emergency electric power supply is dependent on a fuel supply from outside the *building*, the fuel supply shall be provided with a suitably-identified separate shut-off valve outside the *building*.

3.2.7.8. Emergency Power for Fire Alarm Systems

1) An emergency power supply conforming to Sentences (2), (3) and (4) shall be provided for fire alarm systems.

2) The emergency power supply required by Sentence (1) shall be supplied from
- a) a generator,
- b) batteries, or
- c) a combination thereof.

3) The emergency power supply required by Sentence (1) shall be capable of providing
- a) supervisory power for not less than 24 h, and
- b) immediately following, emergency power under full load for not less than
  - i) 2 h for a *building* within the scope of Subsection 3.2.6.,
  - ii) 1 h for a *building* classified as Group B *major occupancy* that is not within the scope of Subsection 3.2.6.,
  - iii) 5 min for a *building* not required to be equipped with an annunciator, and
  - iv) 30 min for any other *building*.

(See Appendix A.)

4) The emergency power supply required by Sentence (1) shall be designed so that there will be automatic transfer to emergency power in the event of a failure of the normal power source.

5) An emergency power supply shall be provided for the voice communication system required by Article 3.2.6.8.

6) The emergency power supply required by Sentence (5) for the voice communication system shall be capable of
- a) full operation immediately upon the failure of the normal source of power, and
- b) maintaining operation of the system for not less than 2 h.

7) If the emergency power supply required by Sentence (5) is provided by batteries, the batteries shall be sized to provide the total energy consumed by the maximum possible electrical supervision current plus the trouble signal current for a period of 24 h followed by 30 min of continuous voice communication.

3.2.7.9. Emergency Power for Building Services

1) An emergency power supply capable of operating under a full load for not less than 2 h shall be provided by an emergency generator for
- a) every elevator serving *storeys* above the *first storey* in a *building* that is more than 36 m high measured between *grade* and the floor level of the top *storey* and every elevator for fire fighters in conformance with Sentence (2),
- b) water supply for fire fighting in conformance with Article 3.2.5.7., if the supply is dependent on electrical power supplied to the *building*,
- c) fans and other electrical equipment that are installed to maintain the air quality specified in Article 3.2.6.2., and
- d) fans required for venting by Article 3.2.6.6.

(See Appendix A.)

2) Except as permitted by Sentence (3), the emergency power supply for elevators required by Clause (1)(a) shall be capable of operating all elevators for fire fighters plus one additional elevator simultaneously.

3) Sentence (2) does not apply if the time to recall all elevators under emergency power supply is not more than 5 min, each from its most remote *storey* to
- a) the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5., or
- b) to a transfer lobby.

3.2.8. Mezzanines and Openings through Floor Assemblies

3.2.8.1. Application

1) Except as permitted by Article 3.2.8.2. and Sentence 3.3.4.2.(3), the portions of a *floor area* or a *mezzanine* that do not terminate at an exterior wall, a *firewall* or a vertical shaft shall
a) terminate at a vertical *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly and extending from the floor assembly to the underside of the floor or roof assembly above, or
b) be protected in conformance with the requirements of Articles 3.2.8.3. to 3.2.8.9.

2) The penetration of a floor assembly by an *exit* or a *vertical service space* shall conform to the requirements of Sections 3.4., 3.5. and 3.6.

3) A *floor area* containing sleeping rooms in a *building* of Group B, Division 2 *major occupancy* shall not be constructed as part of an *interconnected floor space*.

3.2.8.2. Exceptions to Special Protection

1) A *mezzanine* need not terminate at a vertical *fire separation* nor be protected in conformance with the requirements of Articles 3.2.8.3. to 3.2.8.9. provided the *mezzanine*
a) serves a Group A, Division 1 *major occupancy*,
b) serves a Group A, Division 3 *major occupancy* in a *building* not more than 2 *storeys* in *building* height, or
c) serves a Group A, C, D, E or F *major occupancy* and
i) is 500 m² or less in area,
ii) has an aggregate area not more than 40% of the *storey* in which it is located,
iii) is not subdivided by *partitions* or walls if the *mezzanine* is more than 10% of the area of the *storey* in which it is located, and
iv) has no visual obstruction, except for open bookshelves, more than 1 070 mm above the floor of the *mezzanine* or above the floor of the space below it if the *mezzanine* is more than 10% of the area of the *storey* in which it is located.

2) Except for floors referred to in Sentence 3.1.10.3.(1) and Article 3.2.1.2., openings through a horizontal *fire separation* for vehicular ramps in a *storage garage* are not required to be protected with *closures* and need not conform to this Subsection.

3) If a *closure* in an opening in a *fire separation* would disrupt the nature of a manufacturing process, such as a continuous flow of material from *storey* to *storey*, the *closure* for the opening is permitted to be omitted provided precautions are taken to offset the resulting hazard. (See Appendix A.)

4) An *interconnected floor space* in a Group B, Division 1 *occupancy* need not conform to the requirements of Articles 3.2.8.3. to 3.2.8.9. provided the *interconnected floor space* does not interconnect more than 2 adjacent *storeys*.

5) Except as permitted by Sentence (6), openings for escalators and inclined moving walks need not conform to the requirements in Articles 3.2.8.3. to 3.2.8.9. provided
a) the opening for each escalator or walk does not exceed 10 m²,
b) the *building* is *sprinklered* throughout, and
c) the *interconnected floor space* contains only Group A, Division 1, 2 or 3, Group D or Group E *major occupancies*.
(See A-3.2.8.2.(6)(c) in Appendix A.)

6) An *interconnected floor space* need not conform to the requirements of Articles 3.2.8.3. to 3.2.8.9. provided
a) the *interconnected floor space* consists of the *first storey* and the *storey* next above or below it, but not both,
b) the openings through the floor are used only for stairways, escalators or moving walks or the *interconnected floor space* is *sprinklered* throughout (see Appendix A),
c) the *interconnected floor space* contains only Group A, Division 1, 2 or 3, Group D, Group E or Group F, Division 3 *major occupancies* (see Appendix A), and
d) the *building area* is not more than one half of the area permitted by Subsection 3.2.2.

3.2.8.3. Construction Requirements

1) A *building* constructed in conformance with Articles 3.2.8.4. to 3.2.8.9. shall be of *noncombustible construction*, except that *heavy timber construction* is permitted if Subsection 3.2.2. permits the *building* to be constructed of *combustible construction*.

3.2.8.4. Sprinklers

1) A *building* containing an *interconnected floor space* shall be *sprinklered* throughout.

3.2.8.5. Vestibules

1) An *exit* opening into an *interconnected floor space* shall be protected at each opening into the *interconnected floor space* by a vestibule
a) with doorways that are not less than 1.8 m apart,

b) that is separated from the remainder of the *floor area* by a *fire separation* that is not required to have a *fire-resistance rating* (see A-3.1.8.1.(1)(b) in Appendix A), and
c) that is designed to limit the passage of smoke so that the level of contamination in an *exit* stair shaft does not exceed the limit described in Sentence 3.2.6.2.(2).

2) An *exit* opening into an *interconnected floor space* shall conform to Sentence 3.4.3.3.(2).

3) If an elevator hoistway opens into an *interconnected floor space* and into *storeys* above the *interconnected floor space*, either the elevator doors opening into the *interconnected floor space* or the elevator doors opening into the *storeys* above the *interconnected floor space* shall be protected by vestibules conforming to Sentence (1).

3.2.8.6. Protected Floor Space

1) For the purposes of this Subsection, the term protected floor space applies to that part of a *floor area* separated from the *interconnected floor space* by a *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly of the *storey* in which it is located and in which openings through the vertical *fire separation* are protected by vestibules conforming to Sentence 3.2.8.5.(1).

2) A protected floor space as defined in Sentence (1) shall be designed so that it is not necessary to enter the *interconnected floor space* to reach an *exit*.

3.2.8.7. Draft Stops

1) A draft stop shall be provided at each floor level within an *interconnected floor space*, immediately adjacent to and surrounding the opening, and shall be not less than 500 mm deep measured from ceiling level down to the underside of the draft stop.

3.2.8.8. Mechanical Exhaust System

1) A mechanical exhaust system shall be provided to remove air from an *interconnected floor space* at a rate of 4 air changes per hour. (See Appendix A.)

2) The mechanical exhaust system required by Sentence (1) shall be actuated by a switch located on the *storey* containing the entrance for fire fighter access referred to in Articles 3.2.5.4. and 3.2.5.5. near the annunciator for the fire alarm system.

3.2.8.9. Combustible Content Limits

1) An *interconnected floor space* shall be designed so that the *combustible* contents, excluding interior finishes, in those parts of a *floor area* in which the ceiling is more than 8 m above the floor, are limited to not more than 16 g of *combustible* material for each cubic metre of volume of the *interconnected floor space*.

Section 3.3. Safety within Floor Areas

(See Appendix A.)

3.3.1. All Floor Areas

3.3.1.1. Separation of Suites

1) Except as permitted by Sentences (2) and (3), each *suite* in other than *business and personal services occupancies* shall be separated from adjoining *suites* by a *fire separation* having a *fire-resistance rating* not less than 1 h. (See also Subsection 3.3.3. for *care or detention occupancies*, Article 3.3.4.2. for *residential occupancies* and Article 3.1.8.7. for *fire dampers*.) e

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
a) the floor assembly above the *floor area*, or
b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) *Occupancies* that are served by *public corridors* conforming to Sentence 3.3.1.4.(4) in a *building* that is *sprinklered* throughout, are not required to be separated from one another by *fire separations* provided the *occupancies* are e
a) *suites* of *business and personal services occupancy*,
b) fast food vending operations that do not provide seating for customers, e
c) *suites* of *mercantile occupancy*, or e
d) any combination of these occupancies. e

3.3.1.2. Hazardous Substances, Equipment and Processes

1) If hazardous substances are used in connection with the activities of any *occupancy* other than as permitted by Subsection 3.3.5. for a *high hazard industrial occupancy*, the storage, handling and use of the hazardous substances shall be in conformance with

a) provincial, territorial or municipal regulations, or
b) the National Fire Code of Canada 1995, in the absence of regulations referred to in Clause (a).

(See Appendix A.)

2) Cooking equipment, not within a *dwelling unit*, used in processes producing grease-laden vapours shall be designed and installed in conformance with Part 6. (See Appendix A.)

3) A fuel-fired *appliance* shall not be installed in a corridor serving as an *access to exit*.

3.3.1.3. Means of Egress

1) *Access to exit* within *floor areas* shall conform to Subsections 3.3.2. to 3.3.5., in addition to the requirements of this Subsection.

2) If a podium, terrace, platform or contained open space is provided, egress requirements shall conform to the appropriate requirements of Sentence 3.3.1.5.(1) for rooms and *suites*.

3) *Means of egress* shall be provided from every roof which is intended for *occupancy*, and from every podium, terrace, platform or contained open space.

4) If a roof is used or intended for an *occupant load* more than 60, at least 2 separate *means of egress* shall be provided from the roof to stairs,

a) designed in conformance with the requirements for *exit* stairs, and
b) located so that the distance between the stairs conforms to the requirements of Article 3.4.2.3. for *exits*.

5) A rooftop enclosure shall be provided with an *access to exit* that leads to an *exit*

a) at the roof level, or
b) on the *storey* immediately below the roof.

6) A rooftop enclosure which is more than 200 m^2 in area shall be provided with at least 2 *means of egress*.

7) Two points of egress shall be provided for a *service space* referred to in Sentence 3.2.1.1.(7) if

a) the area is more than 200 m^2, or
b) the travel distance measured from any point in the *service space* to a point of egress is more than 25 m.

8) Except as permitted by Sentences 3.3.4.4.(5) and (6), each *suite* in a *floor area* that contains more than one *suite* shall have

a) an exterior *exit* doorway, or
b) a doorway
   i) into a *public corridor*, or
   ii) to an exterior passageway.

9) Except as permitted by this Section and by Sentence 3.4.2.1.(2), at the point where a doorway referred to in Sentence (8) opens onto a *public corridor* or exterior passageway, it shall be possible to go in opposite directions to each of 2 separate *exits*.

3.3.1.4. Public Corridor Separations

1) Except as otherwise required by this Part or permitted by Sentences (2) to (7), a *public corridor* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h. (See Appendix A.)

2) The *fire-resistance rating* of a *fire separation* between a *public corridor* and the remainder of a *floor area* is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for

a) the floor assembly above the *floor area*, or
b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) If a *floor area* is *sprinklered* throughout, no *fire-resistance rating* is required for a *fire separation* between a *public corridor* and the remainder of the *floor area* provided the corridor does not serve a *care or detention occupancy* or a *residential occupancy*. (See A-3.1.8.1.(1)(b) in Appendix A.)

4) If a *floor area* is *sprinklered* throughout, no *fire separation* is required between a *public corridor* and the remainder of the *floor area* provided the *public corridor*

a) is more than 5 m in unobstructed width, and
b) does not serve
   i) a *care or detention occupancy*, or
   ii) a *residential occupancy*.

5) If a *floor area* is *sprinklered* throughout, no *fire separation* is required between a room or a *suite* and a *public corridor* that serves it provided the *public corridor* complies with Sentence 3.3.1.9.(6) and Clause 3.4.2.5.(1)(d).

6) A floor assembly of a *public corridor* above a crawl space that conforms to Sentence 3.2.2.9.(2) is not required to be a *fire separation*.

7) If a *floor area* is *sprinklered* throughout, no *fire separation* is required between a *public corridor* and a room containing water closets and lavatories provided the room and the *public corridor* are separated from the remainder of the *floor area* by a *fire separation* that has a *fire-resistance rating* not less than that required between the *public corridor* and the remainder of the *floor area*.

3.3.1.5. Egress Doorways

1) Except for *dwelling units*, a minimum of 2 egress doorways located so that one doorway could provide egress from the room or *suite* as required by Article 3.3.1.3. if the other doorway becomes inaccessible to the occupants due to a fire which originates in the room or *suite*, shall be provided for every room and every *suite*

a) that is used for a *high hazard industrial occupancy* and whose area is more than 15 m²,
b) intended for an *occupant load* more than 60,
c) in a *floor area* that is not *sprinklered* throughout, and
   i) the area of a room or *suite* is more than the value in Table 3.3.1.5.A., or
   ii) the travel distance within the room or *suite* to the nearest egress doorway is more than the value in Table 3.3.1.5.A., or
d) in a *floor area* that is *sprinklered* throughout and does not contain a *high hazard industrial occupancy* and
   i) the travel distance to an egress doorway is more than 25 m, or
   ii) the area of the room or *suite* is more than the value in Table 3.3.1.5.B.

Table 3.3.1.5.A.
Egress in Floor Area not Sprinklered Throughout
Forming Part of Sentence 3.3.1.5.(1)

Occupancy of Room or *Suite*	Maximum Area of Room or *Suite*, m²	Maximum Distance to Egress Doorway, m
Group A	150	15
Group C	100(1)	15(1)
Group D	200	25
Group E	150	15
Group F, Division 2	150	10
Group F, Division 3	200	15

Notes to Table 3.3.1.5.A.:
(1) See Article 3.3.4.4. for *dwelling units.*

Table 3.3.1.5.B.
Egress in Floor Area Sprinklered Throughout
Forming Part of Sentence 3.3.1.5.(1)

Occupancy of Room or *Suite*	Maximum Area of Room or *Suite*, m²
Group A	200
Group B, Division 1	100
Group B, Division 2	
sleeping rooms	100
other than sleeping rooms	200
Group C	150(1)
Group D	300
Group E	200
Group F, Division 2	200
Group F, Division 3	300

Notes to Table 3.3.1.5.B.:
(1) See Article 3.3.4.4. for *dwelling units*.

3.3.1.6. Travel Distance

1) If more than one egress doorway is required from a room or *suite* referred to in Article 3.3.1.5., the travel distance within the room or *suite* to the nearest egress doorway shall not exceed the maximum travel distances specified in Clauses 3.4.2.5.(1)(a), (b), (c) and (f) for *exits*.

3.3.1.7. Protection on Floor Areas with a Barrier-Free Path of Travel

1) Every *floor area* above or below the *first storey* that is not *sprinklered* throughout and that has a *barrier-free* path of travel shall

a) be served by an elevator
   i) conforming to Sentences 3.2.6.5.(4) to (6),
   ii) protected against fire in conformance with Clauses 3.2.6.5.(3)(b) or (c), and
   iii) in a *building* over 3 *storeys* in *building height*, protected against smoke movement so that the hoistway will not contain more than 1% by volume of contaminated air from a fire floor during a period of 2 h after the start of a fire, assuming an outdoor temperature equal to the January design temperature on a 2.5% basis determined in conformance with Subsection 2.2.1.,

b) be divided into at least 2 zones by *fire separations* conforming to Sentences (2), (3) and (4) so that
   i) persons with physical disabilities can be accommodated in each zone, and
   ii) the travel distance from any point in one zone to a doorway leading to another zone shall be not more than the value for travel distance permitted by Sentence 3.4.2.5.(1) for the *occupancy* classification of the zone,

c) in the case of *residential occupancies*, be provided with balconies conforming to Sentence (5), except on the *storey* containing the *barrier-free* entrance required by Article 3.8.1.2.,

d) have an exterior *exit* at ground level, or

e) have a ramp leading to ground level.

(See Appendix A.)

2) Except as permitted by Sentence (3), the *fire separations* referred to in Clause (1)(b) shall have a *fire-resistance rating* not less than 1 h.

3) The *fire-resistance rating* of the *fire separations* referred to in Clause (1)(b) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for

a) the floor assembly above the *floor area*, or

b) the floor assembly below the *floor area*, if there is no floor assembly above.

4) A door acting as a *closure* in a *fire separation* referred to in Clause (1)(b) shall be weatherstripped or otherwise designed and installed to retard the passage of smoke. (See A-3.3.3.5.(6) in Appendix A.)

5) A balcony required by Clause (1)(c) shall

a) have direct *barrier-free* access from the *suite* or *floor area*

b) be not less than 1.5 m deep from the outside face of the exterior wall to the inside edge of the balcony, and

c) provide not less than 1.5 m^2 of balcony space for each nonambulatory occupant and 0.5 m^2 for each ambulatory occupant.

3.3.1.8. Headroom Clearance

1) Except within the *floor area* of a *storage garage*, the minimum headroom clearance in every *access to exit* shall conform to the requirements of Article 3.4.3.6. for *exits*. (See also Sentence 3.3.5.4.(5).)

3.3.1.9. Corridors

1) The minimum width of a *public corridor* shall be 1 100 mm.

2) Except as required by Sentence 3.3.3.3.(2), the minimum unobstructed width of a corridor used by the public or a corridor serving classrooms or patients' sleeping rooms shall be 1 100 mm.

3) Except as permitted by Sentence (4), obstructions located within 1 980 mm of the floor shall not project more than 100 mm horizontally into an *exit* passageway, a *public corridor*, a corridor used by the public or a corridor serving classrooms or patients' sleeping rooms in a manner that would create a hazard for a person with a visual disability traveling adjacent to the walls.

4) The horizontal projection of an obstruction referred to in Sentence (3) is permitted to be more than 100 mm provided the clearance between the obstruction and the floor is less than 680 mm. (See Appendix A.)

5) If a *public corridor*, a corridor used by the public, or a corridor serving classrooms or patients' sleeping rooms contains an *occupancy*, the *occupancy* shall not reduce the unobstructed width of the corridor to less than its required width.

6) If a *public corridor* conforming to Clause 3.4.2.5.(1)(d) contains an *occupancy*,

a) the *occupancy* shall be located so that for pedestrian travel there is an unobstructed width not less than 3 m at all times adjacent and parallel to all rooms and *suites* that front onto the *public corridor*, and

b) the combined area of all *occupancies* in the *public corridor* shall be not more than 15% of the area of the *public corridor*.

7) Except for a dead end corridor that is entirely within a *suite* or as permitted by Sentences 3.3.3.3.(1) and 3.3.4.4.(6), a dead end corridor is permitted provided it is not more than 6 m long.

3.3.1.10. Door Swing

1) Except as permitted by Article 3.3.1.11., a door that opens into a corridor or other facility providing *access to exit* from a *suite* or room not located within a *suite* shall swing on a vertical axis.

2) Except as permitted by Article 3.3.1.11., a door that opens into a corridor or other facility providing *access to exit* from a room or *suite* that is used or intended for an *occupant load* more than 60 or for a *high hazard industrial occupancy* shall swing in the direction of travel to the *exit*.

3) Every door that divides a corridor that is not wholly contained within a *suite* shall swing on a vertical axis in the direction of travel to the *exit*.

4) If a pair of doors is installed in a corridor that provides *access to exit* in both directions, the doors shall swing in opposite directions, with the door on the right hand side swinging in the direction of travel to the *exit*.

3.3.1.11. Sliding Doors

1) Except as permitted by Sentence (2), a sliding door provided in the locations described in Article 3.3.1.10. shall
- a) be designed and installed to swing on the vertical axis in the direction of travel to the *exit* when pressure is applied, and
- b) be identified as a swinging door by means of a label or decal affixed to it.

2) In a Group B, Division 1 *occupancy*, or in an *impeded egress zone* in other *occupancies*, sliding doors used in an *access to exit* need not conform to Sentence (1) and Article 3.3.1.10.

3) Movable *partitions* used to separate a *public corridor* from an adjacent *business and personal services occupancy* or a *mercantile occupancy* need not conform to Sentence (1) and Sentences 3.3.1.10.(1) and (2), provided the *partitions* are not located in the only *means of egress*. (See Appendix A.)

3.3.1.12. Doors and Door Hardware

1) A door that opens into or is located within a *public corridor* or other facility that provides *access to exit* from a *suite* shall
- a) provide a clear opening of not less than 800 mm if there is only one door leaf,
- b) in a doorway with multiple leaves, have the active leaf providing a clear opening of not less than 800 mm, and,
- c) not open onto a step.

2) A door in an *access to exit* shall be readily openable in travelling to an *exit* without requiring keys, special devices or specialized knowledge of the door opening mechanism, except that this requirement does not apply to a door serving a *contained use area*, or an *impeded egress zone*, provided the locking devices conform to Sentence (6).

3) Except as permitted by Sentence (4), door release hardware shall be operable by one hand and the door shall be openable with not more than one releasing operation. (See also Sentence 3.8.3.3.(3).)

4) An egress door from an individual *dwelling unit* or from a *suite* of *residential occupancy* is permitted to be provided with additional devices that require a releasing operation additional to the main door release hardware, provided the devices are readily operable from the inside without the use of keys, special devices or specialized knowledge. (See Appendix A.)

5) Door release hardware shall be installed not more than 1 200 mm above the finished floor.

6) An egress door in an *access to exit* serving a *contained use area* or an *impeded egress zone* is permitted to be equipped with locking devices that can be released either locally or remotely in conformance with Sentence (7) or Sentence (8). (See Appendix A.)

7) Local locking devices permitted by Sentence (6) shall be operable by a key from both sides of the door.

8) Controls for the remote release of door locking devices permitted by Sentence (6) shall be located in an area readily available to security personnel.

9) Locking devices permitted by Sentence (6) that are electrically operated shall be
- a) designed to operate on emergency power, and
- b) capable of manual release by security personnel.

3.3.1.13. Ramps and Stairways

1) Except as permitted by Sentence (2), Article 3.3.4.7., and Subsection 3.3.2., ramps and stairways shall conform to the dimensional, *guard* and handrail requirements in Section 3.4. for *exit* ramps and stairways.

2) Ramps and stairways that do not conform to the requirements of Sentence (1) are permitted to serve *service rooms* and *service spaces* and in *industrial occupancies*, provided the ramps and stairways are intended only for occasional use for servicing equipment and machinery.

3.3.1.14. Exterior Passageways

1) An exterior passageway leading to a required *exit* shall conform to the requirements of Section 3.4. for exterior *exit* passageways.

3.3.1.15. Curved or Spiral Stairs

1) A curved or spiral stair is permitted in a stairway not required as an *exit* provided the stair has
- a) treads with
  - i) a minimum run not less than 150 mm, and
  - ii) an average run not less than 200 mm, and
- b) risers in conformance with Sentence 3.4.6.7.(2).

3.3.1.16. Capacity of Access to Exits

(See Article 3.3.1.9. for minimum widths of corridors.)

1) The capacity of an *access to exit* shall be based on the *occupant load* of the portion of the *floor area* served.

2) In an *access to exit* the required width of ramps with a slope not more than 1 in 8, doorways, and corridors shall be based on not less than 6.1 mm per person.

3) In an *access to exit* the required width of a ramp with a slope more than 1 in 8 shall be based on not less than 9.2 mm per person.

4) In an *access to exit* from a *floor area* used or intended to be used for patients in a Group B, Division 2 *occupancy*, the required width of corridors, doorways, and ramps shall be based on not less than 18.4 mm per person.

5) The capacity of stairs in an *access to exit* shall conform to the requirements for stairs in Article 3.4.3.4.

3.3.1.17. Guards

1) Except for the front edges of *stages* and loading docks, a *guard* not less than 1 070 mm high shall be provided

a) around each roof to which access is provided for other than maintenance,

b) at openings into smoke shafts referred to in Subsection 3.2.6. that are less than 1 070 mm above the floor, and

c) at each raised floor, *mezzanine*, balcony, gallery, interior or exterior vehicular ramp, and at other locations where the difference in level is more than 600 mm.

2) Except as permitted by Sentence 3.3.2.8.(4) and unless it can be shown that the size of openings that exceed this limit does not present a hazard, there shall be no opening that permits the passage of a sphere whose diameter is more than 100 mm through a *guard* serving

a) an exterior balcony, or

b) a room, stairway, or space not within a *suite* of *residential occupancy*.

3) Unless it can be shown that the location and size of openings do not present a hazard, a *guard* shall be designed so that no member, attachment or opening located between 140 mm and 900 mm above the level protected by the *guard* will facilitate climbing.

3.3.1.18. Transparent Doors and Panels

1) Except as permitted by Sentence (4), a glass or transparent door shall be designed and constructed so that the existence and position of the door is readily apparent, by attaching non-transparent hardware, bars or other permanent fixtures to it.

2) A glass door shall be constructed of

a) laminated or tempered safety glass conforming to CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass," or

b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass."

3) Except as permitted by Sentence (4), transparent panels used in an *access to exit* that, because of their physical configuration or design, could be mistaken as a *means of egress* shall be made inaccessible by barriers or railings.

4) Sliding glass *partitions* that separate a *public corridor* from an adjacent *occupancy* and that are open during normal working hours need not conform to Sentences (1) and (3), provided the *partitions* are suitably marked to indicate their existence and position.

5) Glass in doors and in sidelights that could be mistaken for doors, within or at the entrances to *dwelling units* and in public areas, shall conform to the requirements of Article 9.6.6.2.

6) A window in a public area that extends to less than 1 000 mm above the floor and is located above the second *storey* in a *building* of *residential occupancy*, shall be protected by a barrier or railing to not less than 1 070 mm above the floor, or the window shall be non-openable and designed to withstand the lateral design loads for balcony *guards* required by Article 4.1.10.1.

3.3.1.19. Exhaust Ventilation

1) An exhaust ventilation system designed in conformance with the appropriate requirements of Part 6 shall be provided in a *building* or part of a *building* in which dust, fumes, gases, vapour or other impurities or contaminants have the potential to create a fire or explosion hazard. (See also Article 4.2.4.15.)

2) Explosion relief devices, vents or other protective measures conforming to Subsection 6.2.2. shall be provided for a space in which substances or conditions that have the potential to create an explosion hazard are present as a result of the principal use of a *building*.

3.3.1.20. Janitors' Rooms

1) Except as permitted by Sentences (2) and (3), a room or space within a *floor area* for the storage of janitorial supplies shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for

a) the floor assembly above the *floor area*, or

b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) The *fire separation* required by Sentence (1) is not required to have a *fire-resistance rating* if the *floor area* in which the room or space is located is *sprinklered* throughout.

3.3.1.21. Common Laundry Rooms

1) Except as permitted by Sentences (2) and (3), in a *building* of *residential occupancy*, a laundry room in a *floor area* that is not within a *dwelling unit* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
- a) the floor assembly above the *floor area*, or
- b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) The *fire separation* required by Sentence (1) is not required to have a *fire-resistance rating* if the *floor area* in which the laundry room is located is *sprinklered* throughout.

3.3.1.22. Obstructions

1) No obstruction shall be permitted in any *occupancy* that would restrict the width of a normal *means of egress* from any part of a *floor area* to less than 750 mm unless an alternative *means of egress* is provided adjacent to, accessible from, and plainly visible from the obstructed *means of egress*. (See Appendix A.)

3.3.1.23. Signs in Service Spaces

1) Illuminated signs conforming to Sentences 3.4.5.1.(3) and (5) shall be provided to indicate the direction to egress points in a *service space* referred to in Sentence 3.2.1.1.(7).

3.3.1.24. Welding and Cutting

1) If a room in other than an industrial *major occupancy* is used for welding and cutting operations, it shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h, except that this requirement does not apply to a room that is protected by an automatic fire extinguishing system.

3.3.2. Assembly Occupancy

3.3.2.1. Scope

1) This Subsection applies to *floor areas* or parts thereof used or intended for use as *assembly occupancies*.

3.3.2.2. Fire Separations

1) Except as permitted by Sentence (2), the seating area of a Group A, Division 1 *occupancy* shall be separated from adjacent *occupancies* in the *floor area* by a *fire separation* having a *fire-resistance rating* not less than 1 h if the *occupant load* in the seating area exceeds 200.

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
- a) the floor assembly above the *floor area*, or
- b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) If usable space exists under tiers of seats in arena type *buildings*, a *fire separation* with a *fire-resistance rating* not less than 45 min shall be provided between the space and the seats or the space shall be *sprinklered*.

3.3.2.3. Fixed Seats

1) Except for the requirements of Article 3.3.2.7. for bench-type seats and except as required or permitted by Sentence (2) and Articles 3.3.2.9. and 3.3.2.10., fixed seats in places of assembly shall be
- a) attached or secured to the floor, platform or platform riser,
- b) provided with arms and back, and
- c) arranged in rows having an unobstructed passage not less than 400 mm wide measured horizontally between plumb lines from the backs of the seats in one row and the edges of the furthest forward projection of the seats in the next row in the unoccupied position.

2) For fixed seats with backs and with folding tablet arms, the value of 400 mm required by Clause (1)(c) shall be measured when the tablet arms are in the use position, but is permitted to be measured in the stored position provided
- a) there are not more than 7 seats between any seat and the nearest aisle,
- b) the seats are located in a lecture hall or an auditorium used for instructional purposes, and
- c) the tablet arm, when raised manually to a vertical position, falls by the force of gravity to the stored position.

(See Appendix A.)

3) Except as permitted by Sentence (4), aisles shall be located so that there are not more than 7 seats with backs or 20 seats without backs between any seat and the nearest aisle.

4) The requirements of Sentence (3) do not apply if
- a) egress doorways are provided to serve both ends of rows of seats,
- b) each doorway referred to in Clause (a) serves not more than 3 rows of seats, and
- c) each row contains not more than 100 seats.

3.3.2.4. Aisles

1) Except as required by Articles 3.3.2.9. and 3.3.2.10., aisles leading to *exits* shall be provided in conformance with Sentences (2) to (17) in places of assembly which contain fixed seats. e

2) The minimum clear width of aisles shall be not less than 1 100 mm, except that the width is permitted to be reduced to not less than
- a) 750 mm if serving not more than 60 seats, and
- b) 900 mm if serving seats on one side only.

3) Except in the case of bleacher seats, the minimum clear width of aisles referred to in Sentence (2) shall be measured at the point farthest from an *exit*, cross aisle or foyer and shall be increased by 25 mm for each metre of distance toward the *exit*, cross aisle or foyer.

4) Aisles shall terminate in a cross aisle, foyer or *exit*, and the width of the cross aisle, foyer or *exit* shall be not less than the required width of the widest aisle plus 50% of the total required width of the remaining aisles that it serves.

5) Dead-end aisles shall be not more than 6 m long.

6) The length of travel to an *exit* door by any aisle shall be not more than 45 m.

7) Side aisles shall be not less than 1 100 mm wide if seating is provided in conformance with Sentence 3.3.2.3.(4).

8) An aisle that has a slope not more than 1 in 8 shall not be stepped.

9) An aisle that slopes more than 1 in 8 shall be stepped.

10) The passageway between rows of seats served by a stepped aisle shall be level at right angles to the line of travel.

11) The riser of a step in an aisle shall be
- a) not less than 110 mm high, and
- b) not more than 200 mm high.

12) Variations are permitted in riser height provided
- a) the height of adjacent risers does not vary by more than 6 mm, and
- b) the width of a tread or a platform in the direction of travel is not less than 430 mm.

13) Steps in an aisle shall
- a) have a run not less than 230 mm exclusive of nosings,
- b) have a tread width not less than 250 mm,
- c) extend to the adjacent rows of seats in a manner that will not create a hazard from tripping, and
- d) have a finish on the treads conforming to Sentence 3.4.6.1.(1).

14) The location of every riser in an aisle shall be made apparent from both directions of travel by strategically placed lighting or contrasting marking stripes.

15) A platform in an aisle shall be level, except that a slope not more than 1 in 50 is permitted for a platform that is not less than 430 mm wide in the direction of *exit* travel.

16) If a step is used at the entry to a row of seats from a stepped aisle, an unobstructed platform not less than 800 mm square shall be provided adjacent to the aisle.

17) The finish of the surface of a platform in or adjacent to a stepped aisle shall conform to Sentence 3.4.6.1.(1).

3.3.2.5. Corridors

1) Except as permitted by Sentences (2) to (4), a corridor used by the public in an *assembly occupancy* or a corridor serving classrooms as an *access to exit* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
- a) the floor assembly above the *floor area*, or
- b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) The *fire-resistance rating* required by Sentence (1) is permitted to be waived if the *floor area* in which the corridor is located is *sprinklered* throughout.

4) The *fire separation* required by Sentence (1) is permitted to be waived for a corridor serving classrooms if the distance from any point in the *floor area* to an *exit* measured along the path of travel to an *exit* does not exceed the travel distance permitted by Article 3.4.2.5.

3.3.2.6. Doors

1) A door equipped with a latching mechanism in an *access to exit* from a room or *suite* of *assembly occupancy* containing an *occupant load* more than 100 shall be equipped with a device that will release the latch and allow the door to swing wide open when a force not more than that specified in Sentence 3.8.3.3.(7) is applied to the device in the direction of travel to the *exit*.

3.3.2.7. Fixed Bench-Type Seats without Arms

1) If fixed bench-type seats without arms are provided, the seat width per person shall be assumed to be 450 mm.

2) The centre-to-centre spacing between rows of bench-type seats shall be not less than 760 mm if back rests are provided, and not less than 550 mm if back rests are not provided.

3) A clear space of not less than 300 mm shall be provided between the back of each seat and the front of the seat immediately behind it.

3.3.2.8. Guards

1) Except as required by Sentences (2) to (4) for bleacher seats, *guards* shall be installed in outdoor and indoor places of assembly with fixed seats so that
- a) at the fascia of every box, balcony or gallery where the seats extend to the edge, the height of *guards* is not less than
  - i) 760 mm in front of the seats, and
  - ii) 920 mm if located at the end of aisles or at the foot of steps,
- b) the height of *guards* along every cross aisle other than those adjacent to the fascia of every box, balcony or gallery is not less than 660 mm, except that *guards* need not be provided if the backs of the seats along the front side of the aisle are not less than 600 mm above the floor of the aisle, and
- c) where the seating is arranged in successive tiers and the height of rise between platforms is more than 450 mm, the height of *guards* is not less than 660 mm along the entire row of seats at the edge of the platform.

2) The backs and ends of bleacher seats more than 1 200 mm above the ground or floor that are not adjacent to a wall shall be protected with a *guard*
- a) not less than 1 070 mm high above an adjacent aisle surface or foot rest, and
- b) not less than 920 mm high above the centre of an adjacent seat board.

3) If the front of a bleacher is more than 600 mm above the ground or floor, it shall be protected with a *guard* not less than 840 mm high above the front foot rest.

4) The size of any opening in a *guard* required by Sentences (2) and (3) shall not allow the passage of a sphere whose diameter is more than 300 mm.

3.3.2.9. Outdoor Places of Assembly

1) A Group A, Division 4 *occupancy* and each tier or balcony that has a capacity of more than
- a) 1 000 persons shall have not less than 3 separate *exits*, or
- b) 4 000 persons shall have not less than 4 separate *exits*.

2) In a Group A, Division 4 *occupancy*, every seat shall be located so that the travel distance is not more than 45 m measured along the path of travel from the seat to
- a) the ground,
- b) an *exit*,
- c) an opening to a passageway leading from the seating area, or
- d) a portal, a vomitory or any other opening through the seating deck structure.

3) *Exits* from outdoor stadia or grandstands shall be located not more than 25 m apart.

4) The capacity of a *means of egress* for a Group A, Division 4 *occupancy* shall conform to the requirements of Sentence 3.4.3.4.(3).

5) Aisles in a Group A, Division 4 *occupancy*
- a) shall be located so that there are not more than 20 seats between any seat and the nearest aisle,
- b) shall be not less than 1 200 mm wide, except that an aisle serving less than 60 persons is permitted to be 750 mm wide, and
- c) shall not have steps unless the slope of the aisle is more than 1 in 8.

6) Except as permitted by Sentences 3.3.2.10.(1), (2) and (3), steps provided in an aisle shall
- a) extend the full width of the aisle,
- b) have risers not more than 230 mm high, and
- c) have treads with a run not less than 250 mm.

3.3.2.10. Bleachers

1) Steps provided in aisles of bleachers of the telescopic type shall
- a) have risers not more than 250 mm high, and
- b) have treads with a run not less than 280 mm.

2) If the vertical distance between seating platforms in bleachers is more than 280 mm, an intermediate step shall be provided the full width of the aisle and proportioned to provide 2 equal risers between platforms.

3) If the vertical distance between seating platforms in bleachers is more than 450 mm, 2 intermediate steps shall be provided the full width of the aisle so that there are 3 equal risers between platforms.

4) If the passageway between rows of seats is not a closed deck, footboards shall be provided so that
a) the total width of the footboards shall be not less than three quarters of the centre-to-centre spacing between rows of seats, and
b) the spacing between footboard members shall be not more than 25 mm.

3.3.2.11. Libraries

1) Except as permitted by Sentence (2), a library book storage room that is not normally accessible to the public shall be separated from the remainder of the *building* by a *fire separation* with a *fire-resistance rating* not less than 2 h if it
a) is more than 250 m² in area, or
b) contains book stacks that
 i) are more than 10 m high, or
 ii) penetrate more than one floor assembly.

2) The *fire separation* required by Sentence (1) is not required if the book storage room is *sprinklered*.

3) Open book shelves are permitted above and below a *mezzanine* floor in a library *building* provided the height of the shelves is not more than 2.1 m but not more than 75% of the floor-to-ceiling height of the space above or below the *mezzanine* floor assembly.

3.3.2.12. Stages for Theatrical Performances

1) A *stage* for theatrical performances and ancillary spaces, including workshops, dressing rooms and storage areas, shall be *sprinklered*.

2) A *fire separation* with a *fire-resistance rating* not less than 1 h shall be provided between a *stage* for theatrical performances and ancillary spaces, including workshops, dressing rooms and storage areas.

3) Except as permitted by Sentence (6), a *stage* for theatrical performances and ancillary spaces, including workshops, dressing rooms and storage areas, shall be separated from the seating area by a *fire separation* having a *fire-resistance rating* not less than 1 h, except for a proscenium opening protected with
a) a sprinkler deluge system conforming to the requirements of NFPA 13, “Installation of Sprinkler Systems,”
b) an unframed fire curtain if the opening is not more than 20 m wide, or
c) a semi-rigid fire curtain if the opening is more than 20 m wide.

4) A fire curtain required by Sentence (3) shall be of a type acceptable to the *authority having jurisdiction* and designed to close
a) automatically upon the actuation of the sprinkler system,
b) automatically upon actuation of the fire alarm system, and
c) manually by remote control devices located at the curtain control panel and at each side of the *stage*.

5) At least 2 vents for the purpose of venting fire and smoke to the outside of a *building* shall be provided above a *stage* designed for theatrical performances and shall
a) have an aggregate area not less than one eighth of the area of the *stage* behind the proscenium opening, and
b) be arranged to open automatically upon actuation of the sprinkler system.

6) The *fire separation* referred to in Sentence (3) is not required between a *stage* and a seating area in a *building* that is *sprinklered* throughout, provided a sprinkler deluge system is installed at the boundary between the *stage* and the seating area.

3.3.2.13. Risers for Stairs

1) In a Group A, Division 2 *occupancy* used for the serving of food and beverages, an interior flight of stairs with fewer than 3 risers is permitted provided it
a) is not less than 900 mm wide,
b) is illuminated at all times that occupants are on the premises, and
c) has a handrail on each side.

3.3.3. Care or Detention Occupancy

3.3.3.1. Scope

1) This Subsection applies to *floor areas* or parts thereof used or intended for use as a *care or detention occupancy*. (See Appendix A.)

3.3.3.2. Separations between Care or Detention Occupancies and Repair Garages

1) The *fire separation* required by Sentence 3.3.5.5.(1) between a *care or detention occupancy* and a *repair garage* shall have no openings.

3.3.3.3. Corridors

1) A corridor used by the public or serving patients’ sleeping rooms shall have no dead-end portion unless the area served by the dead-end portion has a second and separate *means of egress*.

2) A corridor in which it may be necessary to move a patient in a bed shall be not less than 2 400 mm wide.

3) Paired doors in a corridor referred to in Sentence (2) shall
a) swing in opposite directions, the right hand door swinging in the direction of travel, and
b) be not less than 1 100 mm wide.

3.3.3.4. Doorway Width

1) The minimum clear width of doorways through which it is necessary to move patients in bed shall be 1 050 mm. (See Appendix A.)

3.3.3.5. Hospitals and Nursing Homes

1) *Floor areas* containing patients' sleeping rooms in a hospital or nursing home shall conform to Sentences (2) to (14). (See Appendix A.)

2) Except as permitted by Sentence (3), a *floor area* containing patients' sleeping rooms in a hospital or nursing home shall be divided into not less than 2 *fire compartments*, each not more than 1 000 m^2 in area.

3) The *floor area* on either side of a *horizontal exit* conforming to Article 3.4.6.9. is permitted to be considered as a *fire compartment* in applying the requirements of this Article.

4) Except as permitted by Sentence (5), *fire separations* separating *fire compartments* required by Sentence (2) shall have a *fire-resistance rating* not less than 1 h.

5) The *fire-resistance rating* of a *fire separation* referred to in Sentence (4) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
a) the floor assembly above the *floor area*, or
b) the floor assembly below the *floor area*, if there is no floor assembly above.

6) A *closure* in a *fire separation* between *fire compartments* referred to in Sentence (2) shall be weatherstripped or otherwise designed and installed to retard the passage of smoke. (See Appendix A.)

7) The travel distance from any point within each *fire compartment* referred to in Sentence (2) to a door to an adjoining *fire compartment* shall be not more than 45 m.

8) Each *fire compartment* referred to in Sentence (2) shall be capable of accommodating, in addition to its own occupants, the occupants of the largest adjacent *fire compartment* based on a clear floor space of 2.5 m^2 per patient in the adjacent *fire compartment*.

9) Except as permitted by Sentences (11) and (12), walls between patients' sleeping rooms and adjacent rooms shall be constructed as *fire separations* but are not required to have a *fire-resistance rating*. (See A-3.1.8.1.(1)(b) in Appendix A.)

10) Except as permitted by Sentence (12), walls separating corridors serving patients' sleeping rooms from adjacent rooms shall be constructed as *fire separations* but are not required to have a *fire-resistance rating*. (See A-3.1.8.1.(1)(b) in Appendix A.)

11) The *fire separation* requirements of Sentence (9) do not apply to walls within a group of intercommunicating patients' rooms, provided the group of rooms does not
a) contain more than 5 patients, or
b) include storage, bathing or toilet facilities serving persons not occupying the group of rooms.
(See Appendix A.)

12) A door in a *fire separation* required by Sentence (9) or Sentence (10) is permitted to be equipped with a roller latch.

13) Except as permitted by Sentence (14), a *fire separation* required by Sentence (9) or Sentence (10) shall not contain any grilles, louvres or other openings.

14) A door or wall separating a patient's sleeping room from an ensuite toilet room, shower room or similar ancillary space is permitted to incorporate grilles and louvres provided
a) the adjacent rooms are not used to store flammable or *combustible* materials, and
b) the openings are located so that smoke cannot pass through these rooms to other parts of the *building*.
(See Appendix A.)

3.3.3.6. Areas of Refuge

1) Compartments containing rooms such as operating rooms, recovery rooms, delivery rooms and intensive care units, from which it is impracticable to move patients in an emergency, shall be
a) separated from adjacent spaces by *fire separations* having a *fire-resistance rating* not less than 1 h, and
b) provided with a mechanical air supply so that during a period of 2 h after the start of a fire in another space, the compartments will not contain more than 1% by volume of contaminated air from the fire area.

3.3.3.7. Contained Use Areas

1) A *contained use area* shall conform to Sentences (2) to (4).

2) A *contained use area* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

3) Except as permitted by Sentence (4), a *building* that includes a *contained use area* shall be *sprinklered* throughout.

4) A *contained use area*, in a *building* for which Articles 3.2.2.20. to 3.2.2.83. do not require the installation of an automatic sprinkler system, is not required to be *sprinklered* as required by Sentence (3) provided

a) the *building* is designed so that during a period of 2 h after the start of a fire in the *contained use area* other *fire compartments* will not contain more than 1% by volume of contaminated air from the *contained use area*,

b) the *building* is designed so that during a period of 2 h after the start of a fire in another part of the *building* the *contained use area* will not contain more than 1% by volume of contaminated air from the other part of the *building*,

c) all doors are designed to be remotely released in conformance with Sentence 3.3.1.12.(6), and

d) the *contained use area* does not contain any rooms lined with *combustible* padding.

3.3.4. Residential Occupancy

3.3.4.1. Scope

1) This Subsection applies to *floor areas* or parts thereof used or intended for use as *residential occupancies*.

3.3.4.2. Fire Separations

1) Except as permitted by Sentences (2) and 3.2.2.9.(2), *suites* of *residential occupancy* shall be separated from each other and the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

2) The *fire-resistance rating* of the *fire separation* required by Sentence (1) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for

a) the floor assembly above the *floor area*, or

b) the floor assembly below the *floor area*, if there is no floor assembly above.

3) Floor assemblies within a *dwelling unit* need not be constructed as *fire separations* provided

a) the distance between the lowest floor level and the uppermost floor level within the *dwelling unit* is not more than 6 m, and

b) the *dwelling unit* is separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than

i) 1 h if the *building* is not *sprinklered* throughout,

ii) 45 min if the *building* is *sprinklered* throughout and it is not more than 3 *storeys* in *building height*, or

iii) 1 h if the *building* is *sprinklered* throughout and it is more than 3 *storeys* in *building height*.

4) The *fire-resistance rating* of the *fire separation* required by Sentence 3.3.5.6.(1) is permitted to be waived if the *fire separation* is located between a *dwelling unit* and an attached *storage garage* containing not more than 5 vehicles, provided

a) the *dwelling unit* and the attached *storage garage* are *sprinklered*,

b) the *dwelling unit* and the attached *storage garage* are separated from the remainder of the *building* in conformance with Sentences (1), (2) and (3),

c) there are no air duct systems connecting the *storage garage* and the *dwelling unit*,

d) the construction between the *storage garage* and the *dwelling unit* provides an effective barrier to gas and exhaust fumes, and

e) every door between the *storage garage* and the *dwelling unit* is

i) tight fitting and weather-stripped to provide an effective barrier against the passage of gas and exhaust fumes,

ii) fitted with a self-closing device, and

iii) not located in a room intended for sleeping.

5) The *fire separation* required by Sentence 3.3.5.6.(1) is not required between a *dwelling unit* and an attached *storage garage*, serving that *dwelling unit* only, provided

a) the *dwelling unit* and its attached *storage garage* are separated from the remainder of the *building* in conformance with Sentences (1), (2) and (3),

b) there are no air duct systems connecting the *storage garage* and the *dwelling unit*,

c) the construction between the *storage garage* and the *dwelling unit* provides an effective barrier to gas and exhaust fumes, and
d) every door between the *storage garage* and the *dwelling unit* is
   i) tight fitting and weather-stripped to provide an effective barrier against the passage of gas and exhaust fumes,
   ii) fitted with a self-closing device, and
   iii) not located in a room intended for sleeping.

3.3.4.3. Storage Rooms

1) Sprinklers shall be installed in a storage room provided for the use of tenants in a *residential occupancy* within a *floor area* but not contained within a *suite*.

2) Except as permitted by Sentence (3), a storage room referred to in Sentence (1) shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

3) The *fire-resistance rating* of the *fire separation* required by Sentence (2) is permitted to be less than 1 h but not less than 45 min provided the *fire-resistance rating* required by Subsection 3.2.2. is permitted to be less than 1 h for
a) the floor assembly above the *floor area*, or
b) the floor assembly below the *floor area*, if there is no floor assembly above.

3.3.4.4. Egress from Dwelling Units

1) Single *storey dwelling units* in an apartment *building* need not lead to a *public corridor* or exterior passageway on the same *storey* provided the *dwelling units* are served by private stairways leading directly to a public *access to exit* on the *storey*
a) immediately above, and
b) immediately below.
(See Appendix A.)

2) Except as permitted by Sentences (3) and (4), a *dwelling unit* containing more than one *storey* shall have an *exit* door or an egress door opening directly into a public *access to exit* from the uppermost *storey* and from the lowest *storey* of the *dwelling unit* so that each *storey* is served by an *exit* or egress door located not more than 1.5 m above or below its floor level.

3) A single *exit* is permitted from a *dwelling unit* provided the *exit* is an exterior doorway not more than 1.5 m above adjacent ground level and
a) it is not necessary to travel up or down more than one *storey* to reach the *exit* door, or
b) the uppermost floor level opens to a balcony not more than 6 m above adjacent ground level.

4) An egress door from either the uppermost *storey* or the lowest *storey* of a *dwelling unit*, as required by Sentence (2), need not be provided if that *storey* is served by a stairway that
a) leads to a public *access to exit*,
b) has no direct access to any other *storey* in the *dwelling unit*, and
c) is separated from the other *storeys* in the *dwelling unit* by a *fire separation* having a *fire-resistance rating* not less than 45 min.

5) In a *building* of *residential occupancy* not more than 3 *storeys* in *building height*, a doorway from a *dwelling unit* is permitted to open directly into an *exit* stairway provided the *dwelling unit* has a second and separate *means of egress*.

6) If a *dwelling unit* has a second and separate *means of egress*, one *means of egress* from a *dwelling unit* is permitted to pass through
a) an interior corridor served by a single *exit*,
b) an exterior balcony served by a single *exit* stairway, or
c) an exterior passageway served by a single *exit* stairway.

3.3.4.5. Automatic Locking Prohibition

1) Except for hotels and motels, a door opening onto a *public corridor* which provides *access to exit* from a *suite* shall be designed not to lock automatically. (See Appendix A.)

3.3.4.6. Sound Transmission

1) Sound transmission class ratings shall be determined in accordance with ASTM E 413, “Classification for Rating Sound Insulation,” using results from measurements in accordance with
a) ASTM E 90, “Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements,” or
b) ASTM E 336, “Measurement of Airborne Sound Insulation in Buildings.”
(See Appendix A.)

2) Except as required by Sentence (3), a *dwelling unit* shall be separated from every other space in the *building* in which noise may be generated by construction providing a sound transmission class rating not less than 50, measured in accordance with the standards referenced in Sentence (1). (See A-9.11.1.1.(1) in Appendix A.)

3) Construction separating a *dwelling unit* from an elevator hoistway or a refuse chute shall have a sound transmission class rating not less than 55, measured in accordance with the standards referenced in Sentence (1).

3.3.4.7. Stairs, Handrails and Guards for Dwelling Units

1) Stairs, handrails and *guards* within a *dwelling unit* shall conform to the appropriate requirements in Section 9.8.

3.3.5. Industrial Occupancy

3.3.5.1. Scope

1) This Subsection applies to *floor areas* or parts thereof used or intended for use as *industrial occupancies*.

3.3.5.2. Fire Extinguishing Systems

1) In addition to other requirements in this Code for the installation of automatic fire extinguishing systems, an appropriate fire extinguishing system shall be installed in every *industrial occupancy floor area* to provide protection if required by
- a) provincial, territorial or municipal regulations, or
- b) the National Fire Code of Canada 1995, in the absence of regulations referred to in Clause (a).

3.3.5.3. Basements

1) A *basement* shall not be used for the storage, manufacture or handling of volatile solids, liquids or gases that generate explosive air-vapour mixtures or for processes that involve explosive dusts.

2) Entrances and *exits* to a *basement* and to rooms containing *building* services shall be separate from the remainder of the *building* in a *building* in which
- a) the storage, manufacture or handling of volatile materials can generate explosive air-vapour mixtures, or
- b) processes occur that produce explosive dusts.

3) *Basements* and rooms referred to in Sentence (2) shall be separated from the remainder of the *building* with a vapour-tight separation.

3.3.5.4. Repair and Storage Garages

1) If access is provided from a *storage garage* to a stair tower or elevator serving *occupancies* above the level of the *storage garage*, the access shall be through a vestibule conforming to Sentence 3.3.5.7.(3).

2) Treads and landings in interior stairs that extend to the roof of a *storage garage* shall be designed to be free of accumulations of ice and snow.

3) A mechanical *storage garage* not more than 4 *storeys* in *building height*, in which no persons other than parking attendants are permitted above the *street* floor level, need not have a *fire separation* between the *exits* and the remainder of the *building*.

4) A garage shall be provided with natural or mechanical ventilation in conformance with the requirements of Subsection 6.2.2. to prevent excessive accumulation of carbon monoxide, exhaust fumes or flammable and toxic vapours.

5) The clear height in a *storage garage* shall be not less than 2 m.

6) A continuous curb not less than 150 mm high and a *guard* not less than 1 070 mm high shall be provided at every garage floor opening and around the perimeter of every floor where the exterior walls are omitted.

7) Except for *open-air storeys*, every *storey* of a *storage garage* or *repair garage* located below *grade* shall be *sprinklered*.

3.3.5.5. Repair Garage Separation

1) A *repair garage* and any ancillary spaces serving it, including waiting rooms, reception rooms, tool and parts storage areas and supervisory office space, shall be separated from other *occupancies* by a *fire separation* having a *fire-resistance rating* not less than 2 h.

3.3.5.6. Storage Garage Separation

1) Except as permitted by Sentences 3.3.4.2.(4) and (5), a *storage garage* shall be separated from other *occupancies* by a *fire separation* with a *fire-resistance rating* not less than 1.5 h.

3.3.5.7. Vestibules

1) If access is provided through a *fire separation* between a *storage garage* and a Group A, Division 1 or Group B *occupancy*, the access shall be through a vestibule conforming to Sentence (3).

2) In a *building* more than 3 *storeys* in *building height*, access through a *fire separation* between a *storage garage* and a Group A, Division 2, 3 or 4, or a Group C *occupancy*, shall be through a vestibule conforming to Sentence (3).

3) If access is provided through a vestibule, as required by Sentences (1), (2) and 3.3.5.4.(1), the vestibule shall
- a) be not less than 1.8 m long,
- b) be ventilated
  - i) naturally to outside air by a vent that has an unobstructed area of not less than 0.1 m^2 for each door that opens into the vestibule but not less than 0.4 m^2, or
  - ii) mechanically at a rate of 14 m^3/h for each square metre of vestibule floor surface area, and
- c) have openings between the vestibule and an adjoining *occupancy* provided with self-closing doors with no hold-open devices.

3.3.5.8. Dispensing of Fuel

1) Facilities for the dispensing of fuel having a *flash point* below 37.8°C shall not be installed above any space intended for *occupancy*.

2) Facilities for the dispensing of fuel having a *flash point* below 37.8°C shall not be installed in any *building*, except that this requirement does not apply to a canopy which is open on not less than 75% of its perimeter.

3.3.5.9. Multiple Tenant Self Storage Warehouses

1) Unless the *building* is *sprinklered* throughout, each individual tenancy in a multiple tenant self storage warehouse classified as an *industrial occupancy* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 45 min.

Section 3.4. Exits

3.4.1. General

3.4.1.1. Scope

1) *Exit* facilities complying with this Section shall be provided from every *floor area* that is intended for *occupancy*. (See Appendix A.)

3.4.1.2. Separation of Exits

1) Except as permitted by Sentence (2), if more than one *exit* is required from a *floor area*, each *exit* shall be separate from every other *exit* leading from that *floor area*.

2) If more than 2 *exits* are provided from a *floor area*, *exits* are permitted to converge in conformance with Sentence 3.4.3.2.(2), provided the cumulative capacity of the converging *exits* does not contribute more than 50% of the total required *exit* width for the *floor area*.

3.4.1.3. Access to Exits

1) *Access to exits* shall conform to Section 3.3.

3.4.1.4. Types of Exit

1) Subject to the requirements of this Section, an *exit* from any *floor area* shall be one of the following, used singly or in combination:
a) an exterior doorway,
b) an exterior passageway,
c) an exterior ramp,
d) an exterior stairway,
e) a fire escape (conforming to Subsection 3.4.7.),
f) a *horizontal exit*,
g) an interior passageway,
h) an interior ramp, or
i) an interior stairway.

3.4.1.5. Exterior Exit Passageways

1) Access to an exterior *exit* passageway from a *floor area* shall be through *exit* doors at the floor level.

3.4.1.6. Restricted Use of Horizontal Exits

1) Except as permitted by Sentence (2), *horizontal exits* shall not comprise more than one half of the required number of *exits* from any *floor area*.

2) In a hospital or nursing home, *horizontal exits* serving patients' sleeping rooms shall comprise not more than two thirds of the required number of *exits* from any *floor area*. (See Appendix A.)

3.4.1.7. Slide Escapes

1) A slide escape shall not be erected on any *building* as a required *exit*, but is permitted to be provided as an additional egress facility if unusual hazards are foreseen.

3.4.1.8. Transparent Doors and Panels

1) Glass and transparent panels in an *exit* shall conform to the appropriate requirements of Article 3.3.1.18. for glass and transparent panels in an *access to exit*.

3.4.1.9. Mirrors near Exits

1) No mirror shall be placed in or adjacent to any *exit* in a manner that would confuse the direction of *exit*.

3.4.1.10. Combustible Glazing in Exits

1) *Combustible* glazing is not permitted in wall or ceiling assemblies or in *closures* used to construct an *exit* enclosure.

3.4.2. Number and Location of Exits from Floor Areas

3.4.2.1. Minimum Number of Exits

1) Except as permitted by Sentences (2) to (4), every *floor area* intended for *occupancy* shall be served by at least 2 *exits*.

2) A *floor area* in a *building* not more than 2 *storeys* in *building height*, is permitted to be served by one *exit* provided the total *occupant load* served by the *exit* is not more than 60, and
- a) in a *floor area* that is not *sprinklered* throughout, the *floor area* and the travel distance are not more than the values in Table 3.4.2.1.A., or
- b) in a *floor area* that is *sprinklered* throughout
  - i) the travel distance is not more than 25 m, and
  - ii) the *floor area* is not more than the value in Table 3.4.2.1.B.

Table 3.4.2.1.A.
Criteria for One Exit (Floor Area Not Sprinklered Throughout)
Forming Part of Sentence 3.4.2.1.(2)

Occupancy of *Floor Area*	Maximum *Floor Area*, m^2	Maximum Travel Distance, m
Group A	150	15
Group B	75	10
Group C	100	15
Group D	200	25
Group E	150	15
Group F, Division 2	150	10
Group F, Division 3	200	15

Table 3.4.2.1.B.
Criteria for One Exit (Floor Area Sprinklered Throughout)
Forming Part of Sentence 3.4.2.1.(2)

Occupancy of *Floor Area*	Maximum *Floor Area*, m^2
Group A	200
Group B	100
Group C	150
Group D	300
Group E	200
Group F, Division 2	200
Group F, Division 3	300

3) Except as permitted by Sentence (4), if Sentence (2) permits a single *exit* from a *floor area* classified as Group B or Group C *occupancy*, the *exit* shall be an exterior doorway not more than 1.5 m above adjacent ground level.

4) A *floor area* containing only *dwelling units* having *access to exit* conforming to Sentences 3.3.4.4.(1) to (4) need not comply with Sentences (1) or (3).

5) *Exits* are not required directly from rooftop enclosures that are provided with *access to exits* in conformance with Sentences 3.3.1.3.(5) and (6).

3.4.2.2. Mezzanine Exiting

1) Except as permitted by Sentence (2), a *mezzanine* shall be provided with *exits* on the same basis as required for *floor areas* by this Section.

2) A *mezzanine* need not conform to Sentence (1) provided
- a) Article 3.2.8.1. does not require it to terminate at a vertical *fire separation*,
- b) it is not intended for an *occupant load* more than 60,
- c) the area of the *mezzanine* does not exceed the area limits for rooms and *suites* in Table 3.3.1.5.A., and
- d) the distance limits of Table 3.3.1.5.A. are not exceeded from any point on the *mezzanine* to
  - i) the egress door from the room in which the *mezzanine* is located if that room has a single egress door, or
  - ii) an egress stair leading from the *mezzanine* if the room in which the *mezzanine* is located has 2 egress doors provided in conformance with Subsection 3.3.1.

3.4.2.3. Distance between Exits

1) Except for a *floor area* that is divided so that not less than one third of the *floor area* is on one side of a *fire separation* and it is necessary to pass through the *fire separation* to travel from one *exit* to another *exit*, the least distance between 2 required *exits* from a *floor area* shall be
- a) one half the maximum diagonal dimension of the *floor area*, but need not be more than 9 m for a *floor area* having a *public corridor*, or
- b) one half the maximum diagonal dimension of the *floor area*, but not less than 9 m for all other *floor areas*.

(See Appendix A.)

2) The minimum distance between *exits* referred to in Sentence (1) shall be the shortest distance that smoke would have to travel between the *exits*, assuming that the smoke will not penetrate an intervening *fire separation*.

3.4.2.4. Travel Distance

1) Except as permitted by Sentence (2), for the purposes of this Subsection, travel distance means the distance from any point in the *floor area* to an *exit* measured along the path of travel to the *exit*.

2) The travel distance from a *suite* or a room not within a *suite* is permitted to be measured from an egress door of the *suite* or room to the nearest *exit* provided
- a) the *suite* or room is separated from the remainder of the *floor area* by a *fire separation*
  - i) having a *fire-resistance rating* not less than 45 min in a *floor area* that is not *sprinklered* throughout, or
  - ii) which is not required to have a *fire-resistance rating*, in a *floor area* that is *sprinklered* throughout, and
- b) the egress door opens onto
  - i) an exterior passageway,
  - ii) a corridor used by the public that is separated from the remainder of the *floor area* in conformance with the requirements in Article 3.3.1.4. for the separation of *public corridors*, or
  - iii) a *public corridor* that is separated from the remainder of the *floor area* in conformance with Article 3.3.1.4. (See A-3.1.8.1.(1)(b) in Appendix A.)

3) Travel distance to an *exit* shall be not more than 50 m from any point in a *service space* referred to in Sentence 3.2.1.1.(7).

3.4.2.5. Location of Exits

1) Except as permitted by Sentences (2), (3) and 3.3.2.4.(6), if more than one *exit* is required from a *floor area*, the *exits* shall be located so that the travel distance to at least one *exit* shall be not more than
- a) 25 m in a *high hazard industrial occupancy*,
- b) 40 m in a *business and personal services occupancy*,
- c) 45 m in a *floor area* that contains an *occupancy* other than a *high hazard industrial occupancy*, provided it is *sprinklered* throughout,
- d) 105 m in any *floor area*, served by a *public corridor*, in which rooms and *suites* are not separated from the remainder of the *floor area* by a *fire separation*, provided
  - i) the *public corridor* is not less than 9 m wide,
  - ii) the ceiling height in the *public corridor* is not less than 4 m above all floor surfaces,
  - iii) the *building* is *sprinklered* throughout, and
  - iv) not more than one half of the required egress doorways from a room or *suite* open into the *public corridor* if the room or *suite* is required to have more than one egress doorway,
- e) except as permitted by Sentence (5), 60 m in any *storage garage* that conforms to the requirements of Article 3.2.2.83., and
- f) 30 m in any *floor area* other than those referred to in Clauses (a) to (e).

2) Except for a *high hazard industrial occupancy*, Sentence (1) need not apply if *exits* are placed along the perimeter of the *floor area* and are not more than 60 m apart, measured along the perimeter, provided each main aisle in the *floor area* leads directly to an *exit*.

3) If more than one *exit* is required, every *exit* shall be considered as contributing not more than one half of the required *exit* width.

4) *Exits* shall be located and arranged so that they are clearly visible or their locations are clearly indicated and they are accessible at all times.

5) Not more than 2 *exits* located remote from each other are required in a *storage garage* conforming to Article 3.2.2.83. provided persons other than parking attendants are not permitted above the *street* floor level.

3.4.3. Width and Height of Exits

3.4.3.1. Exit Width

1) The aggregate width of required *exits* shall be not less than the value determined in conformance with Sentence (2) and Articles 3.4.3.2. to 3.4.3.5.

2) The required width of an *exit* shall be not less than
- a) 1 100 mm for
  - i) corridors and passageways, and
  - ii) stairs and ramps that serve more than 3 *storeys* above *grade* or more than one *storey* below *grade*,
- b) 900 mm for stairs and ramps that serve not more than 3 *storeys* above *grade* or not more than one *storey* below *grade*,
- c) 1 650 mm for stairs and ramps serving patients' sleeping rooms,
- d) 1 050 mm for doorways serving patients' sleeping rooms, and
- e) 790 mm for doorways not serving patients' sleeping rooms.

(See Appendix A.)

3) Except as required by Article 3.4.3.3., the required *exit* width need not be cumulative in an *exit* serving 2 or more *floor areas* located one above the other.

3.4.3.2. Exit Width Based on Occupant Load

1) For the purpose of determining aggregate width of required *exits*, the *occupant load* of every room or *floor area* shall be determined in conformance with Subsection 3.1.16.

2) Except as permitted by Sentence 3.4.3.1.(3), the required *exit* width shall be cumulative if 2 or more *exits* converge.

3.4.3.3. Exits from Interconnected Floor Space

1) The required *exit* width for an *exit* stair in an assembly hall or *theatre* serving more than one balcony level shall conform to Sentence (2).

2) The required *exit* width for *exit* stairs that serve *interconnected floor space* designed in accordance with Articles 3.2.8.3. to 3.2.8.9. shall be cumulative, unless

a) the stairs provide not less than 0.3 m^2 of area of treads and landings for each occupant of the *interconnected floor space* (see Appendix A), or

b) protected floor spaces conforming to Article 3.2.8.6. are provided at each floor level and the protected floor space on a floor level has not less than 0.5 m^2 of space for each occupant of that floor level of the *interconnected floor space*.

(See Appendix A.)

3.4.3.4. Exit Capacity

1) Except as permitted by Sentence (3), the aggregate required width of *exits* serving *floor areas* intended for *assembly occupancies*, *residential occupancies*, *business and personal services occupancies*, *mercantile occupancies*, and *industrial occupancies* shall be determined by multiplying the *occupant load* of the area served by

a) 6.1 mm per person for ramps with a slope not more than 1 in 8, doorways, corridors and passageways, or

b) 8 mm per person for a stair consisting of steps whose rise is not more than 180 mm and whose run is not less than 280 mm, or

c) 9.2 mm per person for

  i) ramps with a slope more than 1 in 8, or

  ii) stairs, other than stairs conforming to Clause (b).

2) The aggregate required width of *exits* serving *floor areas* intended for *care or detention occupancy* shall be determined by multiplying the *occupant load* of the area served by 18.4 mm per person.

3) The required width of *means of egress* serving a Group A, Division 4 *occupancy* shall be determined by multiplying the *occupant load* of the area served by

a) 1.8 mm per person for

  i) aisles,

  ii) stairs other than *exit* stairs, and

  iii) ramps and passageways in vomitories and *exits*, and

b) 2.4 mm per person for *exit* stairs.

3.4.3.5. Exit Width Reduction

1) Except as permitted by Sentences (2) to (4), no fixture, turnstile or construction shall project into or be fixed within the required width of an *exit*.

2) *Exit* doors shall be hung so that, when open, they shall neither diminish nor obstruct the required width of the *exit* by more than 50 mm for each door leaf.

3) Swinging doors in their swing shall not reduce the required width of *exit* stairs or landings to less than 750 mm or reduce the width of an *exit* passageway to less than the minimum required width.

4) Handrails and construction below handrails are permitted to project into the required width of *means of egress* but the projections shall be not more than 100 mm on each side of the required width.

3.4.3.6. Headroom Clearance

1) Except as permitted by Sentences (2) to (4), every *exit* shall have a headroom clearance of not less than 2 100 mm.

2) The headroom clearance for stairways measured vertically above any landing or the nosing of any stair tread shall be not less than 2 050 mm.

3) The headroom clearance for doorways shall be not less than 2 030 mm.

4) No door closer or other device shall be installed so as to reduce the headroom clearance of a doorway to less than 1 980 mm.

3.4.4. Fire Separation of Exits

3.4.4.1. Fire-Resistance Rating of Exit Separations

1) Except as permitted by Sentences (2), 3.3.5.4.(3), 3.4.4.2.(2) and 3.4.4.3.(1), every *exit* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than that required by Subsection 3.2.2., but not less than 45 min, for

a) the floor assembly above the *storey*, or

b) the floor assembly below the *storey*, if there is no floor assembly above.

2) The *fire-resistance rating* of the *fire separation* referred to in Sentence (1) need not be more than 2 h.

3) If an *exit* stair in an assembly hall or *theatre* serves more than one balcony level, the *exit* stair shall be separated from the remainder of the *building* in conformance with Sentence (1).

3.4.4.2. Exits through Lobbies

1) Except as permitted by Sentence (2), no *exit* from a *floor area* above or below the *first storey* shall lead through a lobby.

2) Not more than one *exit* from a *floor area* is permitted to lead through a lobby provided
- a) the lobby floor is not more than 4.5 m above *grade*,
- b) the path of travel through the lobby to the outdoors is not more than 15 m,
- c) the adjacent rooms or premises having direct access to the lobby do not contain a *residential occupancy* or an *industrial occupancy*,
- d) the lobby is not located within an *interconnected floor space* other than as described in Sentence 3.2.8.2.(6),
- e) the lobby conforms to the requirements for *exits*, except that
  - i) rooms other than *service rooms* and storage rooms are permitted to open onto the lobby,
  - ii) the *fire separation* between the lobby and a room used for the sole purpose of control and supervision of the *building* need not have a *fire-resistance rating*, and
  - iii) the *fire separation* between the lobby and adjacent *occupancies* that are permitted to open onto the lobby need not have a *fire-resistance rating* provided the lobby and adjacent *occupancies* are *sprinklered*, and

  (see Appendix A)
- f) a *fire separation*, constructed in accordance with Sentence 3.4.4.1.(1), is maintained between the lobby and any *exit* permitted by this Sentence to lead through the lobby.

3.4.4.3. Exterior Passageway Exceptions

1) The requirements of Sentences 3.4.4.1.(1) and 3.2.3.12.(1) and (3) do not apply to an exterior *exit* passageway provided
- a) not less than 50% of the exterior side is open to the outdoors, and
- b) an *exit* stair is provided at each end of the passageway.

3.4.4.4. Integrity of Exits

1) A *fire separation* that separates an *exit* from the remainder of the *building* shall have no openings except for
- a) standpipe and sprinkler piping,
- b) electrical wires and cables, totally enclosed *noncombustible* raceways and *noncombustible* piping that serve only the *exit*,
- c) openings required by the provisions of Subsection 3.2.6.,
- d) *exit* doorways, and
- e) wired glass and glass block permitted by Article 3.1.8.14.

2) *Exits* within scissors stairs and other contiguous *exit* stairways shall be separated from each other by a smoke-tight *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly through which they pass.

3) *Fire separations* separating contiguous stairs described in Sentence (2) shall not be pierced by doorways, ductwork, piping or any other openings that affect the continuity of the separation.

4) A fuel-fired *appliance* shall not be installed in an *exit*.

5) An *exit* shall not be used as a *plenum* for a heating, ventilating or air-conditioning system.

6) An *exit* shall be designed for no purpose other than for exiting, except that an *exit* is permitted also to be designed to serve as an access to a *floor area*.

7) A *service room* shall not open directly into an *exit*.

8) Storage rooms, washrooms, toilet rooms, laundry rooms and similar ancillary rooms shall not open directly into an *exit*.

9) *Service spaces* referred to in Sentence 3.2.1.1.(7) shall not open directly into an *exit*.

3.4.5. Exit Signs

3.4.5.1. Exit Signage

1) Every *exit* door other than the main entrance to a room or *building* shall have an *exit* sign placed over or adjacent to it if the *exit* serves
- a) a *building* more than 2 *storeys* in *building height*,
- b) a *building* having an *occupant load* more than 150, or
- c) a room or *floor area* that has a fire escape as part of a required *means of egress*.

2) Every *exit* sign shall
- a) be visible from the *exit* approach,
- b) have the word EXIT or SORTIE displayed in plain legible letters, and
- c) be illuminated continuously while the *building* is occupied.

3) *Exit* signs shall consist of
- a) red letters on a contrasting background or contrasting letters on a red background, with the letters not less than 114 mm high and having a 19 mm stroke, if the sign is internally illuminated, and
- b) white letters on a red background or red letters on a contrasting background that is white or a light tint, with letters not less than 150 mm high and having a 19 mm stroke, if the sign is externally illuminated.

4) If illumination of an *exit* sign is provided from an electrical circuit, that circuit shall
a) serve no equipment other than emergency equipment, and
b) be connected to an emergency power supply as described in Sentence 3.2.7.4.(1).

5) If necessary, the direction of egress in *public corridors* and passageways shall be indicated by a sign conforming to Sentence (3) with a suitable arrow or pointer indicating the direction of egress.

6) Except for egress doorways described in Sentence 3.3.2.3.(4) and except for the main entrance door, an *exit* sign conforming to Sentences (2), (3) and (4) shall be placed over or adjacent to every egress doorway from rooms with an *occupant load* more than 60 in Group A, Division 1 *occupancies*, dance halls, licensed beverage establishments and other similar *occupancies* that, when occupied, have lighting levels below that which would provide easy identification of the egress doorway.

3.4.5.2. Signs for Basement Stairs and Ramps

1) In a *building* more than 2 *storeys* in *building height*, any part of an *exit* ramp or stair that continues past an exterior *exit* door down to a *basement* shall be clearly marked by a sign indicating that it does not lead to an *exit*. e

3.4.6. Types of Exit Facilities
(See Appendix A.)

3.4.6.1. Slip Resistance of Ramps and Stairs

1) The surfaces of ramps, and landings and treads
a) shall have a finish that is slip resistant, and
b) if accessible to the public, shall have either a colour contrast or a distinctive pattern to demarcate the leading edge of the tread and the leading edge of the landing, as well as the beginning and end of a ramp.

2) Treads and landings of exterior *exit* stairs more than 10 m high shall be designed to be free of ice and snow accumulations.

3.4.6.2. Minimum Number of Risers

1) Except as permitted by Sentence 3.3.2.13.(1), every flight of interior stairs shall have not less than 3 risers.

3.4.6.3. Landings and Maximum Vertical Rise of Stair Flights

1) No flight of stairs shall have a vertical rise of more than 3.7 m between floors or landings, except that a flight of stairs serving as an *exit* in a Group B, Division 2 *occupancy* shall have a vertical rise not more than 2.4 m between floors or landings.

2) The length and width of a landing shall be at least the width of the stairway in which it occurs, except that in a straight run the length of the landing need not be more than 1 100 mm.

3) Where a doorway or stairway empties onto a ramp through a side wall, there shall be a level area extending across the full width of the ramp, and for a distance of 300 mm on either side of the wall opening, except one side if it abuts on an end wall.

4) Where a doorway or stairway empties onto a ramp through an end wall, there shall be a level area extending across the full width of the ramp and along its length for not less than 900 mm.

5) A landing shall be provided at the top and bottom of every flight of stairs.

3.4.6.4. Handrails

1) An *exit* ramp or stairway shall have a handrail on at least one side, and if 1 100 mm or more in width, shall have handrails on both sides.

2) If the required width of a ramp or flight of stairs is more than 2 200 mm, one or more intermediate handrails continuous between landings shall be provided, and located so that there will be not more than 1 650 mm between handrails.

3) Handrails shall be continuously graspable along their entire length and shall have
a) a circular cross-section with an outside diameter not less than 30 mm and not more than 50 mm, or
b) any non-circular shape with a graspable portion that has a perimeter not less than 100 mm and not more than 155 mm and whose largest cross-sectional dimension is not more than 57 mm.

4) Handrails on stairs and ramps shall be not less than 865 mm and not more than 965 mm high, measured vertically from a line drawn through the outside edges of the stair nosing or from the surface of the ramp, except that handrails not meeting these requirements are permitted provided they are installed in addition to the required handrail.

5) At least one handrail shall be continuous throughout the length of the stairway, including landings, except where interrupted by doorways or newels at changes in direction. (See Appendix A.)

6) Handrails shall be terminated in a manner which will not obstruct pedestrian travel or create a hazard. (See A-3.4.6.4.(5) in Appendix A.)

7) At least one handrail at the side of a stairway or ramp shall extend horizontally not less than 300 mm beyond the top and bottom of the stairway or ramp. (See A-3.4.6.4.(5) in Appendix A.)

8) A clearance of not less than 40 mm shall be provided between a handrail and any wall to which it is fastened.

9) Handrails and their supports shall be designed and constructed to withstand the loading values obtained from the nonconcurrent application of
- a) a concentrated load not less than 0.9 kN applied at any point and in any direction for all handrails, and
- b) a uniform load not less than 0.7 kN/m applied in any direction to handrails not located within *dwelling units*.

3.4.6.5. Guards

1) Every *exit* shall have a wall or a well-secured *guard* on each side.

2) Except as required by Sentence (4), the height of *guards* for *exit* stairs shall be not less than 920 mm measured vertically to the top of the *guard* from a line drawn through the outside edges of the stair nosings and 1 070 mm around landings.

3) The height of *guards* for *exit* ramps and their landings shall be not less than 1 070 mm measured vertically to the top of the *guard* from the ramp surface.

4) The height of *guards* for exterior stairs and landings more than 10 m above adjacent ground level shall be not less than 1 500 mm measured vertically to the top of the *guard* from a line drawn through the outside edges of the stair nosings.

5) Unless it can be shown that the size of openings that exceed this limit does not present a hazard, there shall be no opening that permits the passage of a sphere whose diameter is more than 100 mm through a *guard* for an *exit*.

6) In a stairway, a window for which the distance measured vertically between the bottom of the window and a line drawn through the outside edges of the stair nosings is less than 900 mm, or a window that extends to less than 1 070 mm above the landing, shall
- a) be protected by a *guard* that is
  - i) located approximately 900 mm above a line drawn through the outside edges of the stair nosings, or
  - ii) not less than 1 070 mm high measured to the top of the *guard* from the surface of the landing, or
- b) be fixed in position and designed to resist the lateral design loads specified for *guards* and walls in Articles 4.1.10.1. and 4.1.10.3.

7) Unless it can be shown that the location and size of openings do not present a hazard, a *guard* shall be designed so that no member, attachment or opening located between 140 mm and 900 mm above the level being protected by the *guard* will facilitate climbing.

3.4.6.6. Ramp Slope e

(See also Article 3.8.3.4.)

1) Except as required for aisles by Article 3.3.2.4., the maximum slope of a ramp shall be
- a) 1 in 10 in any *assembly occupancy*, *care or detention occupancy* or *residential occupancy*,
- b) 1 in 6 in rooms or *floor areas* classified as *mercantile occupancy* or *industrial occupancy*,
- c) 1 in 8 in any other *floor area*, and
- d) 1 in 10 for an exterior ramp.

3.4.6.7. Treads and Risers

1) Except as permitted for *dwelling units* and by Sentence 3.4.7.5.(1) for fire escapes, steps for stairs shall have a run of not less than 280 mm between successive steps.

2) Steps for stairs referred to in Sentence (1) shall have a rise between successive treads not less than 125 mm and not more than 180 mm.

3) Treads and risers in every *exit* stair, except a fire escape stair, shall have uniform run and rise in any one flight, and shall not alter significantly in run and rise in successive flights in any stair system. (See Appendix A.)

4) The leading edge of a stair tread shall have either a radius or a bevel between 8 mm and 13 mm in horizontal dimension.

5) The front edge of stair treads in *exits* and public *access to exits* shall be at right angles to the direction of *exit* travel.

3.4.6.8. Curved Stairs

1) Except as permitted by Sentence (2), tapered treads shall not be used in an *exit*.

2) A curved stair used as an *exit* shall have
- a) a handrail on each side,
- b) treads with a minimum run of 240 mm exclusive of nosings,
- c) treads that conform to Article 3.4.6.7. where they are measured 230 mm away from the handrail at the narrow end of the tread, and
- d) an inside radius that is not less than twice the stair width.

3.4.6.9. Horizontal Exits

1) The *floor area* on each side of a *horizontal exit* shall be sufficient to accommodate the occupants of both *floor areas*, allowing not less than 0.5 m^2 of clear floor space per person, except that 1.5 m^2 shall be provided for each person in a wheelchair and 2.5 m^2 for each bedridden patient.

2) If vestibules, enclosed balconies or bridges are used as parts of a *horizontal exit*, their clear width shall be not less than that of the *exit* doorways opening into them, except that handrails are not permitted to project into this clear width more than 100 mm.

3) In a *horizontal exit* where there is a difference in level between the connected *floor areas*, slopes not more than those specified for ramps in Article 3.4.6.6. are permitted to be used.

4) No stairs or steps shall be used in a *horizontal exit*.

5) If 2 doors are provided in a *horizontal exit* that comprises a part of the required number of *exits* from the *floor areas* on both sides of the *exit*

a) the doors shall be mounted adjacent to each other with the door on the right side in the direction of travel through the *horizontal exit* swinging in the direction of travel through the *horizontal exit*, and

b) signs shall be provided on each side of the *horizontal exit* to indicate the door that swings in the direction of travel from that side.

(See Appendix A.)

6) If a *horizontal exit* utilizes bridges between *buildings* or outside balconies, the bridges or balconies shall conform to Article 3.2.3.18.

3.4.6.10. Doors

1) The distance between a stair riser and the leading edge of a door during its swing shall be not less than 300 mm.

2) No *exit* door shall open directly onto a step except that, if there is danger of blockage from ice or snow, an *exit* door is permitted to open onto not more than one step which shall be not more than 150 mm high.

3) *Exit* doors shall be clearly identifiable. (See Appendix A.)

4) No door leaf in an *exit* doorway with more than one leaf shall be less than 610 mm wide.

3.4.6.11. Direction of Door Swing

1) Except for doors serving a single *dwelling unit* and except as permitted by Article 3.4.6.13., every *exit* door shall

a) open in the direction of *exit* travel, and

b) swing on its vertical axis.

3.4.6.12. Self-Closing Devices

1) An *exit* door that is normally required to be kept closed

a) shall be provided with a self-closing mechanism, and

b) shall never be secured in an open position except as permitted by Sentence 3.1.8.12.(1).

3.4.6.13. Sliding Doors

1) Except as permitted by Sentence (2) an *exit* door leading directly to outdoors at ground level is permitted to be a sliding door provided it conforms to Sentence 3.3.1.11.(1).

2) An *exit* door serving a Group B, Division 1 *occupancy*, or an *impeded egress zone* in other *occupancies*, is permitted to be a sliding door that does not conform to Sentence 3.3.1.11.(1) provided it is designed to be released in conformance with Article 3.3.1.12.

3.4.6.14. Revolving Doors

1) Except as permitted by Sentence (3), a revolving door, if used, shall

a) be collapsible,

b) have hinged doors providing equivalent exiting capacity located adjacent to it,

c) be used as an *exit* from the ground floor level only,

d) not be used at the foot of any stairway, and

e) have all glass in door leaves and enclosure panels conforming to

i) CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass," or

ii) CAN/CGSB-12.11-M, "Wired Safety Glass."

2) Except as permitted by Sentence (3), a revolving door shall not be considered to have an exiting capacity for more than 45 persons.

3) An electrically powered revolving door is not required to conform to Sentences (1) and (2) provided

a) the door leaves will collapse and stop automatic rotation of the door system and not obstruct the doorway if a force not more than that specified in Sentence 3.4.6.15.(2) is applied at the centre of a door leaf,

b) the door leaves are capable of being opened from inside the *building* without requiring keys, special devices, or specialized knowledge of the door opening mechanism,

c) the allowable exiting capacity is based on the clear width of passage through the door enclosure when the doors are fully collapsed,

d) a permanent sign, whose centreline is between 1 000 mm and 1 500 mm above the floor, is placed on each face of each door leaf indicating the method for collapsing the door leaf in an emergency, and
e) glass used for door leaves and enclosure panels is safety glass conforming to
  i) CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass," or
  ii) CAN/CGSB-12.11-M, "Wired Safety Glass."

3.4.6.15. Door Release Hardware

1) Except for devices on doors serving a *contained use area* or an *impeded egress zone* designed to be remotely released in conformance with Article 3.3.1.12., and except as permitted by Sentence (4) and Article 3.4.6.16., locking, latching and other fastening devices on a principal entrance door to a *building* as well as on every *exit* door shall permit the door to be readily opened from the inside with not more than one releasing operation and without requiring keys, special devices or specialized knowledge of the door opening mechanism. (See Appendix A.)

2) If a door is equipped with a latching mechanism, a device that will release the latch and allow the door to swing wide open when a force of not more than 90 N is applied to the device in the direction of travel to the *exit* shall be installed on
a) every *exit* door from a *floor area* containing an *assembly occupancy* having an *occupant load* more than 100,
b) every door leading to an *exit* lobby from an *exit* stair shaft, and every exterior door leading from an *exit* stair shaft in a *building* having an *occupant load* more than 100, and
c) every *exit* door from a *floor area* containing a *high hazard industrial occupancy*.

3) Except as required by Sentence 3.8.3.3.(7), every *exit* door shall be designed and installed so that, when the latch is released, the door will open under a force of not more than 90 N, applied at the knob or other latch releasing device.

4) Electromagnetic locks that do not incorporate latches, pins or other similar devices to keep the door in the closed position are permitted to be installed on *exit* doors other than doors leading directly from a *high hazard industrial occupancy*, provided
a) the *building* is equipped with a fire alarm system,
b) the locking device, and all similar devices in the *access to exit* leading to the *exit* door, release upon actuation of the fire *alarm signal*,
c) the locking device releases immediately upon loss of power controlling the electromagnetic locking mechanism and its associated auxiliary controls,
d) the locking device releases immediately upon actuation of a manually operated switch readily accessible only to authorized personnel,
e) a force of not more than 90 N applied to the door opening hardware initiates an irreversible process that will release the locking device within 15 s and not relock until the door has been opened,
f) upon release, the locking device must be reset manually by the actuation of the switch referred to in Clause (d), and
g) a legible sign is permanently mounted on the *exit* door to indicate that the locking device will release within 15 s of applying pressure to the door-opening hardware.

(See Appendix A.)

5) Door hardware for the operation of the doors referred to in this Section shall be installed at a height not more than 1 200 mm above the finished floor.

3.4.6.16. Security for Banks and Mercantile Floor Areas

1) If a *building* is *sprinklered* throughout, the requirements of Sentence 3.4.6.15.(1) are permitted to be waived for *exit* and egress doors complying with Sentences (2) to (9) that serve a *floor area* or part of a *floor area* used exclusively for
a) a bank, or
b) the sale of retail merchandise.

(See Appendix A.)

2) *Exit* and egress doors referred to in Sentence (1) shall be designed to prevent locking at any time that the part of the *floor area* that they serve is open to the public.

3) A sign with the words "This door shall not be locked at any time that the public is present" in letters not less than 50 mm high shall be permanently affixed to both sides of doors referred to in Sentence (1).

4) *Exit* and egress facilities complying with Sentences (5) to (9) shall be incorporated for egress by persons other than the public from a *floor area* or a part of a *floor area* referred to in Sentence (1) during times when the public is neither present nor being admitted to the area that they serve.

5) In *exit* and egress facilities referred to in Sentence (4), at least one door at each *exit* and egress location shall

a) be operable in conformance with Sentence 3.4.6.15.(1), or
b) be equipped with locks conforming to Sentence 3.4.6.15.(4) that release immediately
   i) if an *alert signal* or *alarm signal* is initiated in the fire alarm system, or
   ii) the sprinkler system is actuated.

6) A door referred to in Sentence (5) shall be permanently and distinctly marked to indicate that it is an emergency *exit*.

7) *Exit* and egress facilities required for evacuation of persons other than the public from a *floor area* or a part of a *floor area* referred to in Sentence (1) shall have an aggregate width based on the maximum number of persons other than the public and determined in accordance with Articles 3.4.3.2. to 3.4.3.5.

8) Travel distance to an *exit* referred to in Sentence (7) shall not exceed the travel distance determined in accordance with Subsection 3.4.2.

9) *Exit* and egress doors serving a *floor area* or part of a *floor area* referred to in Sentence (1) are permitted to be equipped with locks that require keys, special devices or specialized knowledge of the door opening mechanism provided

a) the doors do not lead into *exit* stairs,
b) the doors do not lead from *exit* stairs to the exterior of the *building*,
c) the doors do not serve any other *occupancy*,
d) the area served contains at least one telephone
   i) that is accessible and in operation at all times,
   ii) that is not coin or card operated, and
   iii) marked to indicate that it is for emergency use,
e) the area served is illuminated by normal power or by emergency power when the doors are locked,
f) there are provisions that enable an announcement to be made throughout the area served before the locks are fastened, and
g) the locks are designed for use during times that the *building* is not occupied.

3.4.6.17. Emergency Access to Floor Areas

1) In a *building* more than 6 *storeys* in *building height*,

a) doors providing access to *floor areas* from *exit* stairs shall not have locking devices to prevent entry into any *floor area* from which the travel distance up or down to an unlocked door is more than 2 *storeys*,
b) doors referred to in Clause (a) that provide access into the *floor area* shall be identified by a sign on the stairway side to indicate that they are openable from that side, and
c) a master key to fit all door locking devices that are intended to prevent entry into a *floor area* from an *exit* stair shall be provided in a designated location accessible to fire fighters, or the door shall be provided with a wired glass panel not less than 0.0645 m^2 in area and located not more than 300 mm from the door opening hardware.

2) If access to *floor areas* through unlocked doors is required by Clause (1)(a), it shall be possible for a person entering the *floor area* to have access through unlocked doors within the *floor area* to at least one other *exit*.

3.4.6.18. Floor Numbering

1) Arabic numerals indicating the assigned floor number shall

a) be mounted permanently on the stair side of the wall at the latch side of doors to *exit* stair shafts,
b) be not less than 60 mm high, raised approximately 0.7 mm above the surface,
c) be located 1 500 mm from the finished floor and not more than 300 mm from the door, and
d) be contrasting in colour with the surface to which they are applied. (See Appendix A.)

3.4.7. Fire Escapes

3.4.7.1. Scope

1) Except as permitted by Sentence (2), fire escapes shall not be erected on a *building*.

2) If it is impracticable to provide one or more of the *exit* facilities listed in Article 3.4.1.4., fire escapes conforming to Articles 3.4.7.2. to 3.4.7.7. are permitted to serve *floor areas* in an existing *building* provided the *floor areas* served are not more than

a) 2 *storeys* above ground level in *care or detention occupancies*, and e
b) 5 *storeys* above ground level in other *occupancies*.

3.4.7.2. Fire Escape Construction

1) Fire escapes shall be of metal or concrete, of the stair type extending to ground level, constructed throughout in a strong substantial manner and securely fixed to the *building*, except that wooden fire escapes are permitted to be used on *buildings* of *combustible construction* if all posts and brackets are not less than 89 mm in their least dimension and all other woodwork is not less than 38 mm in its least dimension.

3.4.7.3. Access to Fire Escapes

1) Access to fire escapes shall be from corridors through doors at floor level, except that access from a *dwelling unit* is permitted to be through a casement window having an unobstructed opening not less than 1 100 mm high by 550 mm wide with a sill height of not more than 900 mm above the inside floor.

2) The clear area of a fire escape balcony onto which a door opens, shall be not less than 1 m^2.

3.4.7.4. Protection of Fire Escapes

1) If a fire escape serves any *storey* above the second, openings located in a zone described in Sentence (2), including access doorways in the exterior walls of the *building* to which the fire escape is attached, shall be protected by *closures* conforming to Subsection 3.1.8.

2) The zone referred to in Sentence (1) extends from any balcony, platform or stairway of a fire escape to a distance
a) 3 m horizontally,
b) 10 m below, or
c) 1.8 m above.

3.4.7.5. Stairs

1) Stairs shall be inclined at an angle of not more than 45° with the horizontal, and their steps shall have risers not more than 210 mm high and treads not less than 220 mm wide exclusive of nosing.

2) Stairway headroom shall be not less than 1 950 mm plus the height of one riser measured vertically above the nosing of any tread or platform.

3) The width of a fire escape shall conform to Sentence 3.4.3.1.(1), except that the width is permitted to be reduced to 550 mm provided the fire escape serves
a) not more than 3 *storeys*, and
b) not more than 15 persons.

4) If a flight of stairs leading to the ground at the foot of a fire escape is not fixed in position, it shall be held in the raised position without a latch or locking device, and shall be fitted with a counterbalancing device that will permit it to be easily and quickly brought into position for use.

3.4.7.6. Guards and Railings

1) The open sides of every platform, balcony and stairway forming part of a fire escape shall be protected by *guards* not less than 920 mm high measured vertically above the nosing of any tread or platform.

2) The top rail of a *guard* is permitted to serve as a handrail if it is free from obstructions which could break a handhold.

3) A wall handrail shall be installed if the fire escape is more than 550 mm wide.

4) Unless it can be shown that the size of openings that exceed this limit does not present a hazard, there shall be no opening that permits the passage of a sphere whose diameter is more than 100 mm through a *guard* for a fire escape.

5) Unless it can be shown that the location and size of an opening do not present a hazard, a *guard* for a fire escape shall be designed so that no member, attachment or opening located between 140 mm and 900 mm above a platform or the nosing of any tread will facilitate climbing. e

3.4.7.7. Landings

1) Platforms for a fire escape shall be provided in conformance with the requirements for stair landings in Article 3.4.6.3.

Section 3.5. Vertical Transportation

3.5.1. General

3.5.1.1. Scope

1) This Section applies to vertical transportation facilities installed in a *building*, including elevators, escalators and dumbwaiters.

2) Elevators in a *building* within the scope of Subsection 3.2.6. shall conform to Articles 3.2.6.4., 3.2.6.5. and 3.2.6.6.

3.5.2. Standards

3.5.2.1. Elevators, Escalators and Dumbwaiters

1) The design, construction, installation and *alteration* of every elevator, escalator and dumbwaiter shall conform to
a) provincial, territorial, or municipal regulations, or,
b) CSA B44, "Safety Code for Elevators," in the absence of regulations referred to in Clause (a). r4

(See Appendix A.) e3

2) Before being placed in service, every elevator, escalator or dumbwaiter installation, including safety and control devices, shall be inspected and tested in accordance with
a) provincial, territorial, or municipal regulations, or
b) CSA B44, "Safety Code for Elevators," in the absence of regulations referred to in Clause (a). (See A-3.5.2.1.(1) in Appendix A.) r4

3) Passenger elevators that are required to be *barrier-free* shall conform to Appendix E of CSA B44, "Safety Code for Elevators." r4

3.5.3. Fire Separations

3.5.3.1. Fire Separations for Elevator Hoistways

1) A *vertical service space* used as an elevator hoistway shall be separated from all other portions of each adjacent *storey* by a *fire separation* having a *fire-resistance rating* conforming to Table 3.5.3.1. for the *fire-resistance rating* required by Subsection 3.2.2. for
a) the floor assembly above the *storey*, or
b) the floor assembly below the *storey*, if there is no floor assembly above.

Table 3.5.3.1.
Fire Separation for Vertical Transportation Space
Forming Part of Articles 3.5.3.1. and 3.5.3.2.

Fire-Resistance Rating of *Fire Separation* Required for Floor Assembly	Minimum *Fire-Resistance Rating* of *Vertical Service Space* for Elevator Hoistway	Minimum *Fire-Resistance Rating* of *Vertical Service Space* for Dumbwaiters
less than 45 min	45 min	—
45 min	45 min	45 min
1 h	1 h	45 min
1.5 h	1.5 h	1 h
2 h or more	2 h	1 h

3.5.3.2. Vertical Service Spaces for Dumbwaiters

1) A *vertical service space* containing a dumbwaiter shall be separated from all other portions of each adjacent *storey* by a *fire separation* having a *fire-resistance rating* conforming to Table 3.5.3.1. for the *fire-resistance rating* required by Subsection 3.2.2. for
a) the floor assembly above the *storey* or
b) the floor assembly below the *storey*, if there is no floor assembly above.

3.5.3.3. Fire Separations for Elevator Machine Rooms

1) Except as permitted by Sentence (2), a room containing elevator machinery shall be separated from all other parts of the *building* by a *fire separation* having a *fire-resistance rating* not less than that required for the *vertical service space* containing the elevator hoistway.

2) A room containing elevator machinery need not be separated from the elevator hoistway that it serves provided the room and the hoistway are separated from all other parts of the *building* by a *fire separation* having a *fire-resistance rating* not less than that required for the *vertical service space* containing the elevator hoistway.

3.5.4. Dimensions and Signs

3.5.4.1. Elevator Car Dimensions

1) If one or more elevators are provided in a *building*, all *storeys* shall be served by at least one elevator which has inside dimensions that will accommodate and provide adequate access for a patient stretcher 2 010 mm long and 610 mm wide in the prone position. (See Appendix A.)

2) An elevator satisfying the requirements of Sentence (1) shall be clearly identified on the main entrance level of the *building*.

3.5.4.2. Floor Numbering

1) Arabic numerals indicating the assigned floor number shall be mounted permanently on both jambs of passenger elevator hoistway entrances in conformance with Appendix E of CSA B44, "Safety Code for Elevators." r4

Section 3.6. Service Facilities

3.6.1. General

3.6.1.1. Scope

1) The provisions of this Section apply to *horizontal service spaces*, *vertical service spaces*, *attic or roof spaces*, ducts, crawl spaces, shaft spaces, *service rooms*, and mechanical penthouses, and facilities contained therein.

3.6.1.2. Electrical Wiring and Equipment

1) The installation of electrical wiring and electrical equipment shall conform to the requirements of
a) provincial, territorial, or municipal regulations, or,
b) CSA C22.1, "Canadian Electrical Code, Part I," in the absence of regulations referred to in Clause (a).

3.6.1.3. Storage Use Prohibition

1) *Service spaces* shall not be designed to facilitate subsequent use as storage space.

3.6.1.4. Appliances Installed outside a Building

1) A fuel-fired *appliance* installed on the roof of a *building* or in another location outside the *building* shall be installed not less than

a) 1.2 m from a property line, measured horizontally, and

b) 3 m from an adjacent wall of the same *building* if that wall contains any opening within 3 *storeys* above and 5 m horizontally from the *appliance*, unless every opening within these limits is protected by

  i) a *closure* having a *fire-protection rating* not less than 45 min determined in accordance with Article 3.1.8.4., or

  ii) a wired glass assembly permitted for use in a vertical *fire separation* and described in Appendix D.

3.6.2. Service Rooms

3.6.2.1. Fire Separations around Service Rooms

1) Except as permitted by Article 3.6.2.2., a fuel-fired *appliance* in a *building* containing a Group B or Group F, Division 1 *occupancy* shall be located in a *service room* which shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than

a) 2 h if the *building* is more than 2 *storeys* in *building height* or more than 400 m² in *building area*, or

b) 1 h if the *building* is neither more than 2 *storeys* in *building height* nor more than 400 m² in *building area*.

(See Appendix A.)

2) Except as permitted by Article 3.6.2.2., a fuel-fired *appliance* in a *building* not containing a Group B or Group F, Division 1 *occupancy* shall be located in a *service room* which shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h if the *building* is more than 2 *storeys* in *building height* or more than 400 m² in *building area*. (See A-3.6.2.1.(1) in Appendix A.)

3) A solid-fuel-fired *appliance* shall not be located in a *repair garage*, a *storage garage* or any other location where the *appliance* could be exposed to flammable vapours or gases unless

a) it is enclosed in a *service room* which is

  i) separated from the remainder of the *building* in conformance with Sentence (1) or Sentence (2), and

  ii) supplied with combustion air directly from outside the *building*, and

b) the heat generated by the *appliance* is supplied indirectly to the space served by means of ducts or piping.

4) The *fire separation* requirements of Sentence (1) or Sentence (2) shall apply to a *service room* intended to contain equipment that uses a liquid having a *flash point* below 93.3°C. e

5) Except as permitted by Article 3.6.2.2., a *service room* used for a purpose not described in Sentences (1), (2), (3), or (4) and Articles 3.6.2.5., 3.6.2.6. and 3.6.2.8. shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 1 h.

6) Sentence (5) shall apply to a room that contains electrical equipment that is required to be located in a *service room* by CSA C22.1, "Canadian Electrical Code, Part I."

3.6.2.2. Waiver of Fire Separations

1) A *fire separation* is not required between a fireplace and the space it serves.

2) A *fire separation* is not required between a roof-top *appliance* and the *building* it serves.

3) The *fire separations* required by Sentence 3.6.2.1.(2) need not be provided for fuel-fired *appliances* that serve not more than one room or *suite*, provided the *appliances* are not solid-fuel-fired *appliances* referred to in Sentence 3.6.2.1.(3).

4) The *fire separation* required by Sentence 3.6.2.1.(5) need not be provided if the *service room* is located in a *floor area* that is *sprinklered* throughout.

5) If a room contains a limited quantity of service equipment, and the service equipment does not constitute a fire hazard, the requirements of Sentence 3.6.2.1.(5) for a *fire separation* shall not apply.

3.6.2.3. Service Rooms under Exits

1) A *service room* containing service equipment subject to possible explosion, such as *boilers* operating in excess of 100 kPa (gauge) and some types of refrigerating machinery and transformers, shall not be located directly under a required *exit*.

3.6.2.4. Service Equipment

1) A *service room* containing space heating, space cooling and service water heating *appliances* is permitted to contain other service equipment such as electrical service equipment.

3.6.2.5. Incinerator Rooms

1) A *service room* containing an incinerator shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* not less than 2 h.

2) A *service room* containing an incinerator shall not contain other fuel-fired *appliances*.

3.6.2.6. Combustible Refuse Storage

1) Except as required by Sentence 3.6.3.3.(9), a room for the storage of *combustible* refuse shall be
a) separated from the remainder of the *building* by a *fire separation* with a *fire-resistance rating* not less than 1 h, and
b) *sprinklered*.
(See Appendix A.)

3.6.2.7. Door Swing for Service Rooms

1) A swing-type door from a *service room* containing a *boiler* or incinerator shall swing outward from the room, except that the door shall swing inward if the door opens onto a corridor or any room used for an *assembly occupancy*. (See also Sentence 3.4.4.4.(7).)

3.6.2.8. Electrical Equipment Vaults

1) An electrical equipment vault shall conform to Sentences (2) to (8) if it is required by
a) provincial, territorial, or municipal regulations, or
b) CSA C22.1, "Canadian Electrical Code, Part I," in the absence of regulations referred to in Clause (a).

2) An electrical equipment vault referred to in Sentence (1) shall be separated from the remainder of the *building* by a *fire separation* of solid masonry or concrete construction having a *fire-resistance rating* not less than
a) 3 h if the vault is not protected by an automatic fire extinguishing system, or
b) 2 h if the vault is protected by an automatic fire extinguishing system.

3) If a *building* is *sprinklered* throughout, an electrical equipment vault referred to in Sentence (1) need not be *sprinklered* provided
a) the vault is designed for no purpose other than to contain the electrical equipment, and
b) the vault contains a *smoke detector* which will actuate the *building* fire alarm system in the event of a fire in the vault.

4) Only pipes or ducts necessary for fire protection or the proper operation of the electrical installation shall penetrate the *fire separation* referred to in Sentence (2).

5) Explosion-relief devices and vents or other protective measures conforming to Sentence 3.3.1.19.(2) shall be provided for an electrical equipment vault referred to in Sentence (1) that contains dielectric-liquid filled electrical equipment.

6) An electrical equipment vault referred to in Sentence (1) shall be provided with a ventilation system designed in conformance with Part 6 to prevent the ambient temperature in the vault from exceeding 40°C.

7) The ventilation system required by Sentence (6) shall be separate from the system for the remainder of the *building* and shall be designed so that it is automatically shut off in the event of a fire in the vault.

8) The floor of an electrical equipment vault referred to in Sentence (1) shall be liquid tight and surrounded by liquid tight walls and sills of sufficient height to confine within the vault all of the liquid from the largest item of electrical equipment, but to a height of not less than 100 mm.

3.6.3. Vertical Service Spaces and Service Facilities

3.6.3.1. Fire Separations for Vertical Service Spaces

1) Except as required by Section 3.5., a *vertical service space* shall be separated from all other portions of each adjacent *storey* by a *fire separation* having a *fire-resistance rating* conforming to Table 3.6.3.1. for the *fire-resistance rating* required by Subsection 3.2.2. for
a) the floor assembly above the *storey*, or
b) the floor assembly below the *storey*, if there is no floor assembly above.
(See Appendix A.)

Table 3.6.3.1.
Fire Separations for Vertical Service Spaces
Forming Part of Sentence 3.6.3.1.(1)

Fire-Resistance Rating of *Fire Separation* Required for Floor Assembly	Minimum *Fire-Resistance Rating* of *Vertical Service Space*
less than 45 min	—
45 min	45 min
1 h	45 min
1.5 h	1 h
2 h or more	1 h

2) A *vertical service space* that does not extend through the roof of a *building* shall be enclosed at the top with construction having a *fire-resistance rating* not less than that required for the *vertical service space* walls.

3) A *vertical service space* that does not extend to the bottom of a *building* shall be enclosed at the lowest level with construction having a *fire-resistance rating* not less than that required for the *vertical service space* walls.

4) A vent from a *vertical service space* not extending to the roof shall be enclosed within the *building* with construction having a *fire-resistance rating* not less than that required for the *vertical service space* walls.

5) Only openings that are necessary for the use of the *vertical service space* shall be permitted through a *vertical service space* enclosure.

3.6.3.2. Foamed Plastic Protection

1) Foamed plastic insulation in a *vertical service space* shall be protected in conformance with Article 3.1.5.11.

3.6.3.3. Linen and Refuse Chutes

1) A linen chute or refuse chute shall
a) be impervious to moisture,
b) have a smooth internal surface,
c) be corrosion-resistant,
d) be constructed of *noncombustible* material, and
e) be located in a shaft in which there are no services other than *noncombustible* drain, waste and vent piping or *noncombustible* water piping.

2) A shaft containing a linen chute or refuse chute shall have a *fire-resistance rating* conforming to Sentence 3.6.3.1.(1), but not less than
a) 1 h if the chute outlet for the discharge room is protected by an automatic, self-latching *closure* held open by a fusible link, or
b) 2 h if no *closure* is provided at the chute outlet into the discharge room.

3) An interior linen chute or refuse chute shall extend not less than 1 m above the roof and shall be vented above the roof with a vent which
a) has an unobstructed area not less than the cross-sectional area of the chute, and
b) is equipped with a cover that will open automatically, or that can be opened manually, in the event of a fire in the chute.

4) Intake openings for a linen chute or a refuse chute shall
a) have an area not more than 60% of the cross-sectional area of the chute, and
b) be fitted with *closures* designed to close automatically and latch after use.

5) Intake openings for a linen chute or a refuse chute shall be located in rooms or compartments that
a) have no dimension less than 750 mm,
b) are separated from the remainder of the *building* by a *fire separation* with a *fire-resistance rating* not less than 45 min,
c) are designed for no other purpose, and
d) do not open directly into an *exit*.

6) Sprinklers shall be installed at the top of each linen chute or refuse chute, at alternate floor levels and in the room or bin into which the chute discharges.

7) The room into which a linen chute discharges shall be separated from the remainder of the *building* by a *fire separation* with a *fire-resistance rating* not less than 1 h.

8) A refuse chute shall be equipped at the top with spray equipment for washing-down purposes.

9) A refuse chute shall discharge only into a room or bin separated from the remainder of the *building* by a *fire separation* with a *fire-resistance rating* not less than 2 h.

10) The room or bin into which a refuse chute discharges shall be of sufficient size to contain the refuse between normal intervals of emptying, be impervious to moisture and be equipped with a water connection and floor drain for washing-down purposes.

11) A room into which a refuse chute discharges shall contain no service equipment that is not related to refuse handling and disposal.

3.6.3.4. Exhaust Duct Negative Pressure

1) If a *vertical service space* contains an *exhaust duct* that serves more than one *fire compartment*, e3
a) the duct shall have a fan located at or near the exhaust outlet to ensure that the duct is under negative pressure, and
b) the individual *fire compartments* shall not have individual fans that exhaust directly into the duct in the *vertical service space*.

3.6.4. Horizontal Service Spaces and Service Facilities

3.6.4.1. Scope

1) This Subsection applies to *horizontal service spaces* and service facilities, including ceiling spaces, duct spaces, crawl spaces and *attic or roof spaces*.

3.6.4.2. Fire Separations for Horizontal Service Spaces

1) A *horizontal service space* that penetrates a required vertical *fire separation* shall be separated from the remainder of the *building* it serves in conformance with Sentence (2).

2) If a *horizontal service space* or other concealed space is located above a required vertical *fire separation* other than a vertical shaft, this space need not be divided at the *fire separation* as required by Article 3.1.8.3. provided the construction between this space and the space below is a *fire separation* with a *fire-resistance rating* equivalent to that required for the vertical *fire separation*, except that the *fire-resistance rating* is permitted to be not less than 30 min if the vertical *fire separation* is not required to have a *fire-resistance rating* more than 45 min. (See Appendix A.)

3.6.4.3. Plenum Requirements

1) A concealed space used as a *plenum* within a floor assembly or within a roof assembly need not conform to Sentence 3.1.5.14.(1) and Article 3.6.5.1. provided

a) all materials within the concealed space have a *flame-spread rating* not more than 25 and a smoke developed classification not more than 50, except for

i) tubing for pneumatic controls,

ii) optical fibre cables and electrical wires and cables that exhibit a vertical char not more than 1.5 m when tested in conformance with the Vertical Flame Test – Cables in Cabletrough in Clause 4.11.4 of CSA C22.2 No. 0.3, "Test Methods for Electrical Wires and Cables,"

iii) optical fibre cables and electrical wires and cables that are located in totally enclosed *noncombustible* raceways (see A-3.1.4.3.(1)(b)(i) in Appendix A), and

iv) totally enclosed nonmetallic raceways conforming to Article 3.1.5.19., and

b) the supports for the ceiling membrane are of *noncombustible* material having a melting point not below 760°C.

2) If a concealed space referred to in Sentence (1) is used as a return-air *plenum* and incorporates a ceiling membrane that forms part of the required *fire-resistance rating* of the assembly, every opening through the membrane shall be protected by a *fire stop flap* which shall

a) stop the flow of air into the concealed space in the event of a fire,

b) be supported in a manner that will maintain the integrity of the ceiling membrane for the duration of time required to provide the required *fire-resistance rating*, and

c) conform to the appropriate requirements of Appendix D.

3.6.4.4. Attic or Roof Space Access

1) An *attic or roof space* more than 600 mm high shall be provided with access from the floor immediately below by a hatchway not less than 550 mm by 900 mm or by a stairway.

3.6.4.5. Horizontal Service Space Access

1) A *horizontal service space*, consisting of ceiling and duct spaces, which is more than 1 200 mm high and 600 mm wide shall have inspection doors not less than 300 mm in both horizontal and vertical dimensions placed so that the entire interior of the duct or space can be viewed.

3.6.4.6. Crawl Space Access

1) A crawl space shall have at least one access opening not less than 550 mm by 900 mm.

3.6.5. Air Duct and Plenum Systems

3.6.5.1. Duct Materials

1) Except as permitted by Sentences (2) to (5) and Article 3.6.4.3., all ducts, duct connectors, associated fittings and *plenums* used in air duct systems shall be constructed of steel, aluminum alloy, copper, clay, asbestos-cement or other *noncombustible* material.

2) Except as permitted by Sentence (3), ducts, associated fittings and *plenums* are permitted to contain *combustible* material provided they

a) conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110-M, "Fire Tests for Air Ducts,"

b) conform to Article 3.1.5.14. in a *building* required to be of *noncombustible construction*,

c) conform to Subsection 3.1.9.,

d) are used only in horizontal runs in a *building* required to be of *noncombustible construction*,

e) are not used in vertical runs serving more than 2 *storeys* in a *building* permitted to be of *combustible construction*, and

f) are not used in air duct systems in which the air temperature could be more than 120°C.

3) *Combustible* ducts which are part of a duct system conveying only ventilation air and are contained entirely within a *dwelling unit* need not comply with the requirements of Sentences (1) and (2).

4) Duct sealants shall have a *flame-spread rating* not more than 25 and a smoke developed classification not more than 50.

5) Duct connectors that contain *combustible* materials and that are used between ducts and air outlet units shall

a) conform to the appropriate requirements for Class 1 air duct materials in CAN/ULC-S110-M, "Fire Tests for Air Ducts,"

b) be not more than 4 m long,

c) be used only in horizontal runs, and

d) not penetrate a required *fire separation*.

3.6.5.2. Vibration Isolation Connectors

1) Except as permitted by Sentence (2), vibration isolation connectors in air duct systems shall be *noncombustible*.

2) *Combustible* fabric vibration isolation connectors are permitted provided they
a) are not more than 250 mm long,
b) comply with the flame-resistance requirements of CAN/ULC-S109-M, “Flame Tests of Flame-Resistant Fabrics and Films,” and
c) are not used in a location where they are exposed to heated air or radiation from heat sources that could cause the exposed surface temperature to be more than 120°C.

3.6.5.3. Tape

1) Tape used to seal joints in air ducts, *plenums* and other parts of air duct systems shall meet the flame-resistance requirements for fabric in CAN/ULC-S109-M, “Flame Tests of Flame-Resistant Fabrics and Films.”

3.6.5.4. Coverings, Linings, Adhesives and Insulation

1) Coverings, linings and associated adhesives and insulation for air ducts, *plenums* and other parts of air duct systems that would have an exposed surface temperature more than 120°C when exposed to heated air or radiation from heat sources shall be of *noncombustible* material.

2) Except as permitted by Sentence (3), *combustible* coverings and linings, including associated adhesives and insulation, shall have
a) a *flame-spread rating* not more than 25 on any exposed surface or any surface that would be exposed by cutting through the material in any direction, and
b) a smoke developed classification not more than 50.

3) The outer covering of ducts, *plenums* and other parts of air duct systems used within an assembly of *combustible construction* is permitted to have
a) an exposed surface *flame-spread rating* not more than 75, and
b) a smoke developed classification not more than 50.

4) *Combustible* coverings and linings referred to in Sentences (2) and (3) shall not flame, glow, smoulder or smoke when tested in accordance with the method of test in ASTM C 411, “Hot-Surface Performance of High-Temperature Thermal Insulation,” at the maximum temperature to which the coverings and linings are to be exposed in service.

5) Except as permitted by Sentence (6), foamed plastic insulation shall not be used as part of an air duct system or for insulating an air duct.

6) Foamed plastic insulation is permitted to be installed in a ceiling space that is used as a return air *plenum* provided the foamed plastic insulation is protected from exposure to the *plenum* in accordance with Article 3.1.5.11.

7) *Combustible* coverings and linings of ducts, including associated adhesives and insulation, shall be interrupted where the duct penetrates a *fire separation* and at the immediate area of operation of heat sources in a duct system, including electric resistance heaters or fuel-burning heaters or *furnaces*.

3.6.5.5. Insulation and Coverings

1) Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C shall
a) be made of *noncombustible* material, or
b) not flame, glow, smoulder or smoke when tested in accordance with the method of test ASTM C 411, “Hot-Surface Performance of High-Temperature Thermal Insulation,” at the maximum temperature to which the insulation or covering is to be exposed in service.

2) Except as permitted by Sentence (5), where *combustible* insulation is used on piping in a *horizontal service space* or a *vertical service space*, the insulation and coverings on that piping shall have a *flame-spread rating*, on any exposed surface and on any surface that would be exposed by cutting through the material in any direction,
a) not more than 25 in a *building* required to be of *noncombustible construction*, or
b) not more than 75 in a *building* permitted to be of *combustible construction*.

3) Except as permitted by Sentence (5), insulation and coverings on piping located in rooms and spaces other than the *service spaces* described in Sentence (2) shall have a *flame-spread rating* not more than that required for the interior finish of the ceiling of the room or space.

4) Except as permitted by Sentence (5), *combustible* insulation and covering used on piping in a *building* within the scope of Subsection 3.2.6. shall have a smoke developed classification not more than 100.

5) No *flame-spread rating* or smoke developed classification limits are required for *combustible* insulation and coverings used on piping located within a
a) concealed space in a wall,
b) floor slab, or
c) *noncombustible* enclosure.

3.6.5.6. Clearance of Ducts and Plenums

1) The clearance of *furnace plenums* from *combustible* material shall conform to the requirements of the appropriate standards referenced in Sentence 6.2.1.5.(1).

2) If the *plenum* clearance required in accordance with Sentence (1) is not more than 75 mm, the clearance between a *supply duct* and *combustible* material shall be not less than

a) the required *plenum* clearance within a horizontal distance of 450 mm from the *plenum*, and
b) 12 mm at a horizontal distance of 450 mm or more from the *plenum*, except that this clearance is permitted to be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger.

(See Appendix A.)

3) If the *plenum* clearance required in accordance with Sentence (1) is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be not less than

a) the required *plenum* clearance within a horizontal distance of 1 800 mm from the *plenum*, and
b) 12 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance is permitted to be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger.

(See Appendix A.)

4) If the *plenum* clearance required in accordance with Sentence (1) is more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be not less than

a) the required *plenum* clearance within a horizontal distance of 1 000 mm from the *plenum*,
b) 150 mm within a horizontal distance between 1 000 mm and 1 800 mm from the *plenum*, and
c) 25 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance is permitted to be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger.

(See Appendix A.)

5) If a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted instead of the clearances listed in Sentences (2), (3) and (4).

3.6.5.7. Supply, Return, Intake and Exhaust-Air Openings

1) *Combustible* grilles, diffusers and other devices for supply, return, and exhaust-air openings in rooms shall conform to the *flame-spread rating* and smoke developed classification requirements for the interior finish of the surface on which they are installed.

3.6.5.8. Return-Air System

1) Except as required by Sentences (2) and (3), *return ducts* shall be constructed of material having a *flame-spread rating* not more than 150.

2) If any part of a *return duct* will be exposed to radiation from the *furnace* heat exchanger or other radiating part within the *furnace*, that part of a *return duct* directly above or within 600 mm of the outside *furnace* casing shall be *noncombustible*.

3) *Return ducts* serving solid-fuel-fired *furnaces* shall be constructed of *noncombustible* material.

4) *Combustible return ducts* shall be lined with *noncombustible* material

a) below floor registers,
b) at the bottom of vertical ducts, and
c) under *furnaces* having a bottom return.

Section 3.7. Health Requirements

3.7.1. Height of Rooms

3.7.1.1. Room and Space Height

1) The height of every room and space shall be sufficient that

a) adequate light and air are provided for the intended *occupancy*, and
b) no obstruction to movement or activities below is caused by the ceiling or ceiling fixtures.

2) The unobstructed height in *dwelling units* shall conform to Subsection 9.5.3.

3.7.2. Windows

3.7.2.1. Window Areas

1) Every sleeping room in a *building*, and every principal room in a *dwelling unit*, including a living room, a dining room, or a combination thereof, shall be provided with windows having areas conforming to Subsection 9.7.1. (See Appendix A.)

3.7.3. Ventilation

3.7.3.1. Ventilation Requirements

1) Ventilation shall conform to Part 6.

3.7.4. Plumbing Facilities

(See also Section 3.8. for plumbing facility requirements for persons with disabilities.)

3.7.4.1. Plumbing and Drainage Systems

1) A *building* situated on property that abuts a *street* in which a public or municipal water main is located shall be provided with or have accessible to its occupants a *plumbing system* including a potable water supply, a *sanitary drainage system* and toilet fixtures.

2) If the installation of a *sanitary drainage system* is not possible because of the absence of a water supply, sanitary privies, chemical closets or other means for the disposal of human waste shall be provided.

3.7.4.2. Water Closets

1) Except as permitted by Sentence (4), water closets shall be provided for each sex assuming that the *occupant load* is equally divided between males and females, unless the proportion of each sex expected in the *building* can be determined with reasonable accuracy. (See Appendix A.)

2) If a single special washroom is provided in accordance with the requirements of Section 3.8., the total number of persons in the *building* used to determine the number of water closets to be provided, is permitted to be reduced by 10 before applying Sentences (6), (7), (8), (12), (13) or (14).

3) Except as permitted by Sentence (2), if only one special washroom is provided in accordance with the requirements of Section 3.8., the water closet in this washroom shall not be considered in determining the number of water closets required by this Article.

4) Both sexes are permitted to be served by a single water closet if

a) the *occupant load* in an *occupancy* referred to in Sentences (6), (10), (12), (13) or (14) is not more than 10, or

b) the total area in a Group E *occupancy* is not more than 100 m^2.

5) Urinals are permitted to be substituted for two thirds of the number of water closets required by this Article for males, except that if only 2 water closets are required for males, one urinal is permitted to be substituted for one of the water closets.

6) Except as permitted by Sentences (4), (7) and (8), the number of water closets required for *assembly occupancies* shall conform to Table 3.7.4.2.A.

Table 3.7.4.2.A.
Water Closets for an Assembly Occupancy
Forming Part of Sentence 3.7.4.2.(6)

Number of Persons of Each Sex	Minimum Number of Water Closets	
	Male	Female
1 - 50	1	2
51 - 75	2	3
76 - 100	2	4
101 - 125	3	5
126 - 150	3	6
151 - 175	4	7
176 - 200	4	8
201 - 250	5	9
251 - 300	5	10
301 - 350	6	11
351 - 400	6	12
Over 400	7 plus 1 for each additional increment of 200 males in excess of 400	13 plus 1 for each additional increment of 100 females in excess of 400

7) The number of water closets required for primary schools and day-care centres shall be at least one for each 30 males and one for each 25 females.

8) The number of water closets required for places of worship and undertaking premises shall be at least one for each 150 persons of each sex.

9) The number of water closets required for a *care or detention occupancy* shall be determined on the basis of the special needs of the *occupancy*.

10) Except as permitted by Sentence (4), the number of water closets required for a *residential occupancy* shall be at least one for each 10 persons of each sex.

11) At least one water closet shall be provided for a *dwelling unit* that has a piped water supply available.

12) Except as permitted by Sentence (4), the number of water closets required for a *business and personal services occupancy* shall conform to Table 3.7.4.2.B.

Table 3.7.4.2.B.
Water Closets for a Business and Personal Services Occupancy
Forming Part of Sentence 3.7.4.2.(12)

Number of Persons of Each Sex	Minimum Number of Water Closets for Each Sex
1 - 25	1
26 - 50	2
Over 50	3 plus 1 for each additional increment of 50 persons of each sex in excess of 50

13) Except as permitted by Sentence (4), the number of water closets required for a *mercantile occupancy* shall be at least one for each 300 males and one for each 150 females.

14) Except as permitted by Sentence (4), the number of water closets required for an *industrial occupancy* shall conform to Table 3.7.4.2.C.

Table 3.7.4.2.C.
Water Closets for an Industrial Occupancy
Forming Part of Sentence 3.7.4.2.(14)

Number of Persons of Each Sex	Minimum Number of Water Closets for Each Sex
1 - 10	1
11 - 25	2
26 - 50	3
51 - 75	4
76 - 100	5
Over 100	6 plus 1 for each additional increment of 30 persons of each sex in excess of 100

15) In a *building* whose *floor area* is more than 600 m^2 and that includes one or more individual tenant spaces for *business and personal services occupancy* or *mercantile occupancy*, water closets shall be located so that they are accessible to the public when the *building* is occupied.

3.7.4.3. Lavatories

1) Except as permitted by Sentence (2), at least one lavatory shall be provided in a room containing one or 2 water closets or urinals, and at least one additional lavatory shall be provided for each additional 2 water closets or urinals.

2) Wash fountains in circular form are permitted to be provided in lieu of lavatories required by Sentence (1) provided each 500 mm of circumference is considered to be the equivalent of one lavatory.

3.7.4.4. Mobile Home Facilities

1) If mobile homes do not have individual sanitary facilities connected to a central water supply and drainage system, a service *building* shall be provided for public use.

2) The service *building* required by Sentence (1) shall contain
a) at least one water closet for each sex if the service *building* facilities serve not more than 10 mobile homes, and
b) an additional water closet for each sex for each additional 10 mobile homes.

3) If a service *building* is required by Sentence (1), it shall contain lavatories as required by Sentence 3.7.4.3.(1) and at least
a) one laundry tray or similar facility, and
b) one bathtub or shower for each sex.

3.7.4.5. Safety Glass

1) Glass, other than safety glass, shall not be used for a shower or bathtub enclosure.

3.7.4.6. Surface Protection near a Urinal

1) Wall and floor surfaces below the uppermost surfaces of a urinal shall be protected from deterioration by impervious and durable material for a distance from the urinal to a point not less than 900 mm from the projected outline of the urinal on to the wall or floor.

3.7.4.7. Floor Drain

1) A floor drain shall be installed in a washroom containing a urinal equipped with an automatic flushing device.

3.7.4.8. Grab Bar Installation

1) Grab bars that are installed shall resist a load not less than 1.3 kN applied vertically or horizontally.

3.7.5. Medical Gas Piping Systems

3.7.5.1. Medical Gas Piping

1) A non-flammable medical gas piping system shall be installed in conformance with CAN/CSA-Z305.1, “Nonflammable Medical Gas Piping Systems.”

Section 3.8. Barrier-Free Design

3.8.1. General

3.8.1.1. Application
(See Appendix A.)

1) The requirements of this Section apply to all *buildings* except
- a) houses, including semi-detached houses, duplexes, triplexes, town houses, row houses and boarding houses,
- b) *buildings* of Group F, Division 1 *major occupancy*, and
- c) *buildings* which are not intended to be occupied on a daily or full time basis, including automatic telephone exchanges, pumphouses and substations.

3.8.1.2. Entrances
(See Appendix A.)

1) In addition to the *barrier-free* entrances required by Sentence (2), not less than 50% of the pedestrian entrances of a *building* referred to in Sentence 3.8.1.1.(1) shall be *barrier-free* and shall lead from
- a) the outdoors at sidewalk level, or
- b) a ramp that conforms to Article 3.8.3.4. and leads from a sidewalk.

2) A *suite* of *assembly occupancy*, *business and personal services occupancy* or *mercantile occupancy* that is located in the *first storey* of a *building*, or in a *storey* to which a *barrier-free* path of travel is provided, and that is completely separated from the remainder of the *building* so that there is no access to the remainder of the *building*, shall have at least one *barrier-free* entrance.

3) A *barrier-free* entrance required by Sentences (1) or (2) shall be designed in accordance with Article 3.8.3.3.

4) At a *barrier-free* entrance that includes more than one doorway, only one of the doorways is required to be designed in accordance with the requirements of Article 3.8.3.3.

3.8.1.3. Barrier-Free Path of Travel

1) Except as permitted by Subsection 3.8.3., every *barrier-free* path of travel shall provide an unobstructed width of not less than 920 mm for the passage of wheelchairs.

2) Interior and exterior walking surfaces that are within a *barrier-free* path of travel shall
- a) have no opening that will permit the passage of a sphere more than 13 mm diam,
- b) have any elongated openings oriented approximately perpendicular to the direction of travel,
- c) be stable, firm and slip-resistant,
- d) be bevelled at a maximum slope of 1 in 2 at changes in level not more than 13 mm, and
- e) be provided with sloped floors or ramps at changes in level more than 13 mm.

3) A *barrier-free* path of travel is permitted to include ramps, elevators or other platform elevating devices where there is a difference in level.

3.8.1.4. Storeys Served by Escalators

1) In a *building* in which an escalator provides access to any *storey* above or below the entrance *storey*, an interior *barrier-free* path of travel shall be provided to that *storey*. (See Appendix A.)

3.8.1.5. Controls

1) Except as required by Article 3.8.3.5. for elevators, controls for the operation of *building* services or safety devices, including electrical switches, thermostats and intercom switches, intended to be operated by the occupant and located in a *barrier-free* path of travel shall be accessible to a person in a wheelchair, operable with one hand and mounted not more than 1 400 mm above the floor.

3.8.2. Occupancy Requirements

3.8.2.1. Areas Requiring a Barrier-Free Path of Travel
(See Appendix A.)

1) Except as permitted by Sentence (2), a *barrier-free* path of travel from the entrances required by Sentences 3.8.1.2.(1) and (2) to be *barrier-free* shall be provided throughout the entrance *storey* and within all other normally occupied *floor areas* served by a passenger elevator or other platform equipped passenger elevating device. (See Article 3.3.1.7. for additional requirements for *floor areas* above or below the *first storey* to which a *barrier-free* path of travel is required.)

2) A *barrier-free* path of travel for persons in wheelchairs is not required
- a) to *service rooms*,
- b) to elevator machine rooms,
- c) to janitor's rooms,
- d) to *service spaces*,
- e) to crawl spaces,
- f) to *attic or roof spaces*,
- g) to *mezzanines* not served by a passenger elevator or other platform equipped passenger elevating device,
- h) to *high hazard industrial occupancies*,

i) within portions of a *floor area* with fixed seats in an *assembly occupancy* where those portions are not part of the *barrier-free* path of travel to spaces designated for wheelchair use,
j) within floor levels of a *suite* of *residential occupancy* that are not at the same level as the entry level to the *suite*,
k) within a *suite* of *residential occupancy* that has not been designated by an *authority having jurisdiction* to be accessible for use by persons with physical disabilities, or
l) within those parts of a *floor area* that are not at the same level as the entry level, provided amenities and uses provided on any raised or sunken level are accessible on the entry level by means of a *barrier-free* path of travel.

3) In an *assembly occupancy*, the number of spaces designated for wheelchair use within rooms or areas with fixed seats shall conform to Table 3.8.2.1. (See also Article 3.8.3.6. for additional requirements.)

Table 3.8.2.1.
Designated Wheelchair Spaces
Forming Part of Sentence 3.8.2.1.(3)

Number of Fixed Seats in Seating Area	Number of Spaces Required for Wheelchairs
2 - 100	2
101 - 200	3
201 - 300	4
301 - 400	5
401 - 500	6
501 - 900	7
901 - 1 300	8
1 301 - 1 700	9
each increment of up to 400 seats in excess of 1 700	one additional space

3.8.2.2. Access to Parking Areas

1) A *barrier-free* path of travel shall be provided from the entrance described in Article 3.8.1.2. to
a) an exterior parking area, if exterior parking is provided (see Appendix A), and
b) at least one parking level, if a passenger elevator serves an indoor parking level.
(See Appendix A.)

2) If an exterior passenger loading zone is provided, it shall have
a) an access aisle not less than 1 500 mm wide and 6 000 mm long adjacent and parallel to the vehicle pull-up space,
b) a curb ramp, where there are curbs between the access aisle and the vehicle pull-up space, and
c) a height clearance of not less than 2 750 mm at the vehicle pull-up space and along the vehicle access and egress routes.

3.8.2.3. Washrooms Required to be Barrier-Free

(See Appendix A.)

1) Except as permitted by Sentence (2), a washroom in a *storey* to which a *barrier-free* path of travel is required in accordance with Article 3.8.2.1., shall be *barrier-free* in accordance with the appropriate requirements in Articles 3.8.3.8. to 3.8.3.12.

2) A washroom need not conform to the requirements of Sentence (1) provided
a) it is located within a *suite* of *residential occupancy*,
b) other *barrier-free* washrooms are provided on the same *floor area* within 45 m, or
c) it is located in an individual *suite* having an area less than 500 m^2 and the *suite* is completely separated from the remainder of the *building* and with no access to it.

3) In a *building* where a washroom is required in accordance with Subsection 3.7.4., a *barrier-free* washroom shall be provided in the entrance *storey*, unless a *barrier-free* path of travel is provided to a *barrier-free* washroom in another *storey*.

4) If *alterations* are made to an existing *building*, special washrooms conforming to Article 3.8.3.12. are permitted to be provided in lieu of facilities for persons with physical disabilities in washrooms used by the general public.

3.8.3. Design Standards

3.8.3.1. Accessibility Signs

1) Signs incorporating the international symbol of accessibility for persons with physical disabilities shall be installed to indicate the location of a *barrier-free* entrance. (See Appendix A.)

2) A washroom, shower, elevator or parking space designed to be *barrier-free* shall be identified by a sign consisting of the international symbol of accessibility for persons with physical disabilities and by appropriate graphic or written directions to indicate clearly the type of facility available. (See Appendix A.)

3) If a washroom is not designed to accommodate persons with physical disabilities in a *storey* to which a *barrier-free* path of travel is required, signs shall be provided to indicate the location of *barrier-free* facilities. (See Appendix A.)

4) Signs incorporating the symbol of accessibility for persons with hearing disabilities shall be installed to indicate the location of facilities for persons with hearing disabilities. (See Appendix A.)

3.8.3.2. Exterior Walks

1) Exterior walks that form part of a *barrier-free* path of travel shall
- a) have a slip-resistant, continuous and even surface,
- b) be not less than 1 100 mm wide, and
- c) have a level area conforming to Clause 3.8.3.4.(1)(c) adjacent to an entrance doorway.

2) The width of an exterior walk in a *barrier-free* path of travel that is more than 30 m long shall be increased to not less than 1 500 mm for a length of 2 000 mm at intervals of not more than 30 m.

3.8.3.3. Doorways and Doors

1) Every doorway that is located in a *barrier-free* path of travel shall have a clear width not less than 800 mm when the door is in the open position. (See Appendix A.)

2) The doorway to at least one bathroom within a *suite* of *residential occupancy* shall have a clear width not less than 760 mm when the door is in the open position. (See Appendix A.)

3) Door operating devices shall be of a design which does not require tight grasping and twisting of the wrist as the only means of operation. (See Appendix A.)

4) A thresholdfor a doorway referred to in Sentences (1) or (2) shall be not more than 13 mm higher than the finished floor surface and shall be bevelled to facilitate the passage of wheelchairs.

5) Except as permitted by Sentence (6), doors that provide a *barrier-free* path of travel at an entrance referred to in Article 3.8.1.2. shall be equipped with a power door operator in
- a) a hotel,
- b) a *building* of Group B, Division 2 *major occupancy*, and
- c) a *building* of Group A, D or E *major occupancy* more than 500 m² in *building area*.

(See Appendix A.)

6) The requirements of Sentence (5) do not apply to an individual *suite* having an area less than 500 m² in a *building* having only *suites* of *assembly occupancy*, *business and personal services occupancy* or *mercantile occupancy* if the *suite* is completely separated from the remainder of the *building* so that there is no access to the remainder of the *building*.

7) Except as permitted by Sentence (8) and except for a door with a power door operator, a closer for a door in a *barrier-free* path of travel shall be designed to permit the door to open when the force applied to the handle, push plate or latch-releasing device is not more than
- a) 38 N in the case of an exterior door, or
- b) 22 N in the case of an interior door.

8) Sentence (7) does not apply to a door at the entrance to a *dwelling unit*, or where greater forces are required in order to close and latch the door against the prevailing difference in air pressure on opposite sides of the door. (See Appendix A.)

9) Except for a door at the entrance to a *dwelling unit*, a closer for an interior door in a *barrier-free* path of travel shall have a closing period of not less than 3 s measured from when the door is in an open position of 70° to the doorway, to when the door reaches a point 75 mm from the closed position, measured from the leading edge of the latch side of the door. (See Appendix A.)

10) For every door equipped with a closer in a *barrier-free* path of travel, a clear space shall be provided on the latch side of not less than
- a) 600 mm where the door swings towards the approach side, and
- b) 300 mm where the door swings away from the approach side.

(See Appendix A.)

11) A vestibule located in a *barrier-free* path of travel shall be arranged to allow the movement of wheelchairs between doors and shall provide a distance between 2 doors in series of not less than 1 200 mm plus the width of any door that swings into the space in the path of travel from one door to another.

12) Only the active leaf in a multiple leaf door in a *barrier-free* path of travel need conform to the requirements of this Article.

3.8.3.4. Ramps

1) A ramp located in a *barrier-free* path of travel shall
- a) have a width not less than 870 mm between handrails,
- b) have a slope not more than 1 in 12 (see Appendix A),

c) have a level area not less than 1 500 by 1 500 mm at the top and bottom and at intermediate levels of a ramp leading to a door, so that on the latch side the level area extends not less than
   i) 600 mm beyond the edge of the door opening where the door opens towards the ramp, or
   ii) 300 mm beyond the edge of the door opening where the door opens away from the ramp

   (see Appendix A),
d) have a level area not less than 1 200 mm long and at least the same width as the ramp
   i) at intervals not more than 9 m along its length, and
   ii) where there is an abrupt change in the direction of the ramp, and
e) except as permitted by Sentence (2), be equipped with handrails and *guards* conforming to Articles 3.4.6.4. and 3.4.6.5.

2) The requirement for handrails in Clause (1)(e) need not apply to a ramp serving as an aisle for fixed seating.

3) Floors or walks in a *barrier-free* path of travel having a slope steeper than 1 in 20 shall be designed as ramps.

3.8.3.5. Elevators

1) A passenger elevator that is required to be *barrier-free* shall conform to Appendix E of CSA B44, "Safety Code for Elevators." r4

2) A passenger elevating device referred to in Article 3.8.2.1. shall conform to CSA B355, "Lifts for Persons with Physical Disabilities." e4

3.8.3.6. Spaces in Seating Area

1) Spaces designated for wheelchair use referred to in Sentence 3.8.2.1.(3) shall be
a) clear and level, or level with removable seats,
b) not less than 900 mm wide and 1 525 mm long to permit a wheelchair to enter from a side approach and 1 220 mm long where the wheelchair enters from the front or rear of the space,
c) arranged so that at least 2 designated spaces are side by side,
d) located adjoining a *barrier-free* path of travel without infringing on egress from any row of seating or any aisle requirements, and
e) situated, as part of the designated seating plan, to provide a choice of viewing location and a clear view of the event taking place.

3.8.3.7. Assistive Listening Devices

(See Appendix A.)

1) Except as permitted by Sentence (2), in a *building* of *assembly occupancy*, all classrooms, auditoria, meeting rooms and *theatres* with an area of more than 100 m² shall be equipped with an assistive listening system encompassing the entire seating area.

2) If the assistive listening system required by Sentence (1) is an induction loop system, only half the seating area in the room need be encompassed.

3.8.3.8. Water Closet Stalls

1) At least one water closet stall or enclosure in a washroom required by Article 3.8.2.3. to be *barrier-free* shall
a) be not less than 1 500 mm wide by 1 500 mm deep,
b) be equipped with a door which shall
   i) be capable of being locked from the inside,
   ii) provide a clear opening not less than 760 mm wide with the door in the open position,
   iii) swing outward, unless sufficient room is provided within the stall or enclosure to permit the door to be closed without interfering with the wheelchair (see Appendix A),
   iv) be provided on the inside with a door pull not less than 140 mm long located so that its midpoint is not less than 200 mm and not more than 300 mm from the hinged side of the door and not less than 900 mm and not more than 1 000 mm above the floor (see Appendix A), and
   v) be provided with a door pull on the outside, near the latch side of the door,
c) have a water closet located so that the clearance between the fixture and the wall on one side is not less than 285 mm and not more than 305 mm,

d) be equipped with grab bars which shall
   i) be mounted horizontally on the side wall closest to the water closet and shall extend not less than 450 mm in both directions from the most forward point of the water closet (see Appendix A),
   ii) be mounted on the wall behind the water closet, extending the full width of the toilet bowl where the water closet does not have a water tank,
   iii) be mounted not less than 840 mm and not more than 920 mm above the floor,
   iv) be installed to resist a load of not less than 1.3 kN applied vertically or horizontally,
   v) be not less than 30 mm and not more than 40 mm in diameter, and
   vi) have a clearance of not less than 35 mm and not more than 45 mm from the wall,
e) be equipped with a coat hook mounted not more than 1 400 mm above the floor on a side wall and projecting not more than 50 mm from the wall, and
f) have a clearance of not less than 1 700 mm between the outside of the stall face and the face of an in-swinging washroom door and 1 400 mm between the outside of the stall face and any wall-mounted fixture.

3.8.3.9. Water Closets

1) A water closet for a person with physical disabilities shall
a) be equipped with a seat located at not less than 400 mm and not more than 460 mm above the floor,
b) be equipped with hand-operated flushing controls that are easily accessible to a wheelchair user or be automatically operable,
c) be equipped with a seat lid or other back support, and
d) not have a spring-actuated seat.
(See Appendix A.)

3.8.3.10. Urinals

1) If urinals are provided in a *barrier-free* washroom, at least one urinal shall be
a) wall mounted, with the rim located between 488 mm and 512 mm above the floor, or
b) floor mounted, with the rim level with the finished floor.

2) The urinal described in Sentence (1) shall have
a) a clear width of approach of 800 mm centred on the urinal,
b) no step in front, and
c) installed on each side a vertically mounted grab bar that is not less than 300 mm long, with its centreline 1 000 mm above the floor, and located not more than 380 mm from the centreline of the urinal.

3.8.3.11. Lavatories

1) A *barrier-free* washroom shall be provided with a lavatory which shall
a) be located so that the distance between the centreline of the lavatory and the side wall is not less than 460 mm,
b) have a rim height not more than 865 mm above the floor,
c) have a clearance beneath the lavatory not less than
   i) 760 mm wide,
   ii) 735 mm high at the front edge,
   iii) 685 mm high at a point 205 mm back from the front edge, and
   iv) 230 mm high over the distance from a point 280 mm to a point 430 mm back from the front edge
   (see Appendix A),
d) have insulated pipes where they would otherwise present a burn hazard (see Appendix A),
e) be equipped with faucet handles of the lever type without spring loading or be automatically operable, and
f) have soap or towel dispensers located not more than 1 200 mm above the floor in an area that is accessible to persons in wheelchairs.

2) The lavatory required by Sentence (1) is permitted to be built into a counter provided the height and clearances required by Sentence (1) are maintained.

3) Shelves or other projections above lavatories shall be located so that they will not present a hazard to a person with a visual disability.

4) If mirrors are provided in a *barrier-free* washroom, at least one mirror shall be
a) mounted with its bottom edge not more than 1 000 mm above the floor, or
b) be inclined to the vertical to be usable by a person in a wheelchair.

3.8.3.12. Special Washrooms

(See Appendix A.)

1) A special washroom provided primarily for the use of persons of both sexes with physical disabilities, in lieu of facilities for persons with physical disabilities in washrooms used by the general public, shall

- a) be equipped with a door capable of being locked from the inside and released from the outside in case of emergency and which has
  - i) graspable latch operating and locking mechanisms located not less than 900 mm and not more than 1 000 mm above the floor, and
  - ii) on an outward swinging door, a door pull not less than 140 mm long located on the inside so that its midpoint is not less than 200 mm and not more than 300 mm from the hinged side of the door and not less than 900 mm and not more than 1 000 mm above the floor (see A-3.8.3.8.(1)(b)(iv) in Appendix A),
- b) be provided with a lavatory conforming to Article 3.8.3.11.,
- c) be equipped with a water closet conforming to the requirements of Article 3.8.3.9. and having a clearance between the fixture and the walls of
  - i) not less than 285 mm and not more than 305 mm on one side, and
  - ii) not less than 875 mm on the other side,
- d) be equipped with grab bars conforming to Clause 3.8.3.8.(1)(d),
- e) have no dimension less than 1 700 mm,
- f) have fixture clearances conforming to Articles 3.8.3.8. and 3.8.3.11.,
- g) be equipped with a coat hook conforming to Clause 3.8.3.8.(1)(e) and a shelf located not more than 1 200 mm above the floor,
- h) have a doorway conforming to Article 3.8.3.3.,
- i) be designed to permit a wheelchair to back in alongside the water closet in the space referred to in Subclause (c)(ii), and
- j) be designed to permit a wheelchair to turn in an open space that has a diameter not less than 1 500 mm.

3.8.3.13. Showers

1) If showers are provided in a *building* of *assembly occupancy*, at least one shower stall shall be *barrier-free* and shall

- a) be not less than 1 500 mm wide and 900 mm deep,
- b) have a clear floor space at the entrance to the shower not less than 900 mm deep and the same width as the shower, except that fixtures are permitted to project into that space provided they do not restrict access to the shower (see Appendix A),
- c) have a slip-resistant floor surface,
- d) have a bevelled threshold not more than 13 mm higher than the finished floor,
- e) be equipped with a hinged seat that is not spring-loaded or a fixed seat that is
  - i) not less than 450 mm wide and 400 mm deep,
  - ii) mounted approximately 450 mm above the floor, and
  - iii) designed to carry a minimum load of 1.3 kN,
- f) be equipped with a horizontal grab bar that shall
  - i) be not less than 900 mm long,
  - ii) be mounted approximately 850 mm above the floor,
  - iii) be located on the wall opposite the entrance to the shower so that not less than 300 mm of its length is at one side of the seat, and
  - iv) conform to Subclauses 3.8.3.8.(1)(d)(iv), (v) and (vi)

  (see Appendix A),
- g) be equipped with a pressure-equalizing or thermostatic mixing valve controlled by a lever or other device operable with a closed fist from the seated position,
- h) be equipped with a hand-held shower head with not less than 1 500 mm of flexible hose located so that it can be reached from the seated position and equipped with a support so that it can operate as a fixed shower head, and
- i) have fully recessed soap holders which can be reached from the seated position.

3.8.3.14. Counters

1) Every counter more than 2 m long serving the public shall have at least one *barrier-free* section in conformance with Sentences (2) and (3). (See Appendix A.) (See A-3.8.2.1. in Appendix A.)

2) A *barrier-free* counter surface shall be not more than 865 mm above the floor.

3) Knee space beneath a *barrier-free* counter intended to be used as a work surface shall be not less than

- a) 760 mm wide,
- b) 685 mm high, and
- c) 485 mm deep.

3.8.3.15. Shelves or Counters for Telephones

(See Appendix A.)

1) If built-in shelves or counters are provided for public telephones, they shall be level and shall

a) be not less than 305 mm deep, and

b) have, for each telephone provided, a clear space not less than 250 mm wide having no obstruction within 250 mm above the surface.

2) The top surface of a section of the shelf or counter described in Sentence (1) serving at least one telephone shall be not more than 865 mm above the floor.

3) If a wall-hung telephone is provided above the shelf or counter section described in Sentence (2), it shall be located so that the receiver and coin slot are not more than 1 200 mm above the floor.

3.8.3.16. Drinking Fountains

1) If drinking fountains are provided, at least one shall be *barrier-free* and shall

a) have a spout located near the front of the unit not more than 915 mm above the floor, and

b) be equipped with controls that are easily operable from a wheelchair using one hand with a force of not more than 22 N or be automatically operable.

Part 4
Structural Design

Section 4.1. Structural Loads and Procedures

4.1.1. General

4.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1.

4.1.1.2. Definitions

1) Words that appear in italics in this Part are defined in Part 1.

2) For design carried out within this Part, the *designer* shall be a professional engineer or architect skilled in the work concerned. (See Appendix A.)

4.1.1.3. Design Requirements

1) *Buildings* and their structural members including formwork and falsework shall be designed to have sufficient structural capacity and structural integrity to resist safely and effectively all loads and effects of loads and influences that may reasonably be expected, having regard to the expected service life of *buildings*, and shall in any case satisfy the requirements of this Section. (See Appendix A.)

2) All permanent and temporary structural members, including formwork and falsework of a *building*, shall be protected against loads exceeding the specified loads during the construction period except when, as verified by analysis or test, temporary overloading of a structural member would result in no impairment of that member or any other member.

3) Falsework, scaffolding, and formwork shall be designed in conformance with:
- a) CSA S269.1, "Falsework for Construction Purposes,"
- b) CAN/CSA-S269.2-M, "Access Scaffolding for Construction Purposes," or
- c) CAN/CSA-S269.3-M, "Concrete Formwork."

4) Precautions shall be taken during all phases of construction to ensure that the *building* is not damaged or distorted due to loads applied during construction.

4.1.1.4. Design Basis

1) *Buildings* and their structural members shall be designed in conformance with Parts 4 and 5. (See Subsection 2.5.2. for other methods of design.)

4.1.1.5. Deflections

1) In proportioning structural members to limit deflection, consideration shall be given to
- a) the intended use of the *building* or member,
- b) limiting damage to non-structural members and materials whose physical properties are known at the time of the design,
- c) limiting damage to the structure itself, and
- d) creep, shrinkage and temperature.

(See Appendix A.)

2) Sway effects produced by vertical loads acting on the structure in its displaced configuration shall be taken into account in the design of *buildings* and their structural members.

3) The lateral deflection of *buildings* due to design wind and gravity loads shall be checked to ensure that nonstructural elements whose nature is known at the time the structural design is carried out will not be damaged.

4) Except as provided in Sentence (5), the total drift per *storey* under specified wind and gravity loads shall not exceed 1/500 of the *storey* height unless other drift limits are specified in the design standards referenced in Section 4.3. (See Appendix A.)

5) The deflection limits required in Sentence (4) do not apply to industrial *buildings* or sheds if it is known by experience that greater movement will have no significant adverse effect on the strength and function of the *building*.

4.1.1.6. Vibrations

1) Floor systems susceptible to vibrations shall be designed so that there will be no significant adverse effects on the intended *occupancy* of the *building* from vibrations. (See Appendix A.)

2) Unusually flexible *buildings* and *buildings* whose ratio of height to minimum effective width exceeds 4 to 1 shall be designed so that there will be no significant adverse effects on the intended *occupancy* of the *building* from vibrations under dynamic wind load. (See Appendix A.)

4.1.1.7. Stability

1) Provision shall be made to ensure adequate stability of a structure as a whole, and adequate lateral, torsional and local stability of all structural parts.

4.1.1.8. Structural Drawings and Related Documents

1) Structural drawings and related documents shall conform to the appropriate requirements of Part 2. (See Subsection 2.3.4.)

4.1.2. Specified Loads and Effects

4.1.2.1. Loads, Forces and Effects

1) Except as provided for in Article 4.1.2.2., the following specified loads, forces and effects shall be considered in the design of a *building* and its structural members and connections:

D .... *dead loads* as provided for in Subsection 4.1.5.,

E .... *live load* due to earthquake as specified in Subsection 4.1.9.,

L .... *live load* due to static or inertia forces arising from intended use and *occupancy* (includes loads due to cranes); snow, ice and rain; earth and hydrostatic pressure,

T .... effects due to contraction or expansion caused by temperature changes, shrinkage, moisture changes, creep in component materials, movement due to differential settlement or combination thereof (see Appendix A),

W .... *live load* due to wind as specified in Subsection 4.1.8.

2) Minimum specified values of these loads, as set forth in Subsections 4.1.5. to 4.1.10., shall be increased to account for dynamic effects where applicable.

4.1.2.2. Loads Not Listed

1) Where a *building* or structural member can be expected to be subjected to loads, forces or other effects not listed in Article 4.1.2.1., such effects shall be taken into account in the design based on the most appropriate information available.

2) If it can be shown by engineering principles, or if it is known from experience, that neglect of some or all of the effects due to T does not affect the structural safety and serviceability, they need not be considered in the calculations.

4.1.2.3. Structural Design

1) Structural design shall be carried out in accordance with Subsection 4.1.3., Limit States Design or Subsection 4.1.4., Working Stress Design.

4.1.3. Limit States Design

(See Appendix A.)

4.1.3.1. Definitions

1) In this Subsection, the term
a) limit states means those conditions of a *building* structure in which the *building* ceases to fulfil the function for which it was designed (Those states concerning safety are called ultimate limit states and include exceeding the load carrying capacity, overturning, sliding, fracture and fatigue, while those states which restrict the intended use and *occupancy* of the *building* are called serviceability limit states, and include deflection, vibration, permanent deformation and cracking.),
b) specified loads (**D**, **E**, **L**, **T** and **W**) mean those loads defined in Article 4.1.2.1. and given in this Section,
c) load factor, α, means a factor in Sentence 4.1.3.2.(4) applied to a specified load which, for the limit states under consideration, takes into account the variability of the loads and load patterns and analysis of their effects,
d) factored load means the product of a specified load and its load factor,
e) load combination factor, ψ, means a factor in Sentences 4.1.3.2.(5) and (6) applied to the factored loads other than *dead load* to take into account the reduced probability of a number of loads from different sources acting simultaneously,
f) importance factor, γ, means a factor in Sentence 4.1.3.2.(7) applied to the factored loads other than *dead load* to take into account the consequences of collapse as related to the use and *occupancy* of the *building*,
g) resistance, R, of a member, connection, structure or *foundation*, is based on the dimensions and on the specified properties of the structural materials,

h) resistance factor, ϕ, means a factor applied to a specified material property or to the resistance of a member, connection, structure or *foundation*, which for the limit state under consideration takes into account the variability of dimensions and material properties, workmanship, type of failure and uncertainty in the prediction of resistance, and

i) factored resistance means the product of resistance and the applicable resistance factor.

4.1.3.2. Safety Check for Strength and Stability

1) A *building* and its structural components shall be designed to have sufficient strength and stability so that the factored resistance is greater than or equal to the effect of factored loads, as required in Sentences (3) or (8).

2) In cases of overturning, uplift and sliding, anchorage is required if the effect of loads tending to cause overturning, uplift or sliding, multiplied by load factors greater than 1.0 given in Sentence (4), is greater than the stabilizing effect of *dead load* multiplied by a load factor of 0.85 as given in Sentence (4).

3) For load combinations not including earthquake, the effect of factored loads is the structural effect due to the specified loads multiplied by load factors, α, in Sentence (4), a load combination factor, ψ, in Sentences (5) and (6) and an importance factor, γ, in Sentence (7), and the factored load combination shall be taken as

$$\alpha_D \mathbf{D} + \gamma\psi[\alpha_L \mathbf{L} + \alpha_W \mathbf{W} + \alpha_T \mathbf{T}].$$

4) The load factors, α, shall be equal to:

a) $\alpha_D = 1.25$, except that when the *dead load* resists overturning, uplift or reversal of load effect, $\alpha_D = 0.85$,

b) $\alpha_L = 1.5$,

c) $\alpha_W = 1.5$, and

d) $\alpha_T = 1.25$.

5) The load combination factor, ψ, shall be equal to

a) 1.0 when only one of the loads, **L**, **W** and **T** in Sentence 4.1.2.1.(1) acts,

b) 0.70 when 2 of the loads, **L**, **W** and **T** in Sentence 4.1.2.1.(1) act, and

c) 0.60 when all of the loads, **L**, **W** and **T** in Sentence 4.1.2.1.(1) act.

6) The most unfavourable effect shall be determined by considering the loads **L**, **W** and **T** in Sentence 4.1.2.1.(1) acting alone with $\psi = 1$ or in combination with $\psi = 0.70$ or 0.60.

7) The importance factor, γ, shall be not less than 1.0 for all *buildings*, except that for *buildings* where it can be shown that collapse is not likely to cause injury or other serious consequences, it shall be not less than 0.8. (See Appendix A.)

8) For load combinations including earthquake, the factored load combinations shall be taken as

a) $1.0\mathbf{D} + \gamma(1.0\mathbf{E})$ and either

b) $1.0\mathbf{D} + \gamma(1.0\mathbf{L} + 1.0\mathbf{E})$ for storage and *assembly occupancies*, or

c) $1.0\mathbf{D} + \gamma(0.5\mathbf{L} + 1.0\mathbf{E})$ for all other *occupancies*.

4.1.3.3. Serviceability and Fatigue

1) A *building* and its structural components shall be checked for serviceability limit states as defined in Clause 4.1.3.1.(1)(a) and fatigue under the effect of the specified loads as required in the standards described in Section 4.3.

2) Where more than one load contributes to the stress in a member, the combination of loads shall be assumed to be

$$\mathbf{D} + \psi[\mathbf{L} + \mathbf{W} + \mathbf{T}]$$

where ψ is in conformance with Sentences 4.1.3.2.(5) and (6).

4.1.4. Working Stress Design

4.1.4.1. Load Combinations

1) In designing *buildings* and their structural members, all of the loads listed in Article 4.1.2.1. shall be considered to act in the following combinations, whichever combination produces the most unfavourable effects in the *building*, *foundation* or structural member concerned, when appropriately reduced according to Article 4.1.4.2.:

a) **D**

b) **D + L**

c) **D + (W or 2/3E)**

d) **D + T**

e) **D + L + (W or 2/3E)**

f) **D + L + T**

g) **D + (W or 2/3E) + T**

h) **D + L + (W or 2/3E) + T**.

4.1.4.2. Load Combination Factors

1) The total of the combined load effects may be multiplied by the following load combination factors:

a) 1.0 for the combinations in Clauses 4.1.4.1.(1)(a) to (d),

b) 0.75 for the combinations in Clauses 4.1.4.1.(1)(e) to (g), and

c) 0.66 for the combination in Clause 4.1.4.1.(1)(h).

4.1.4.3. Stress Reversal

1) When loads other than **D** counteract **D** in a structural member or joint, special caution shall be exercised by the *designer* to ensure adequate safety for possible stress reversal. (See Appendix A.)

4.1.4.4. Overturning and Sliding

1) A *building* shall be proportioned to resist an overturning moment and sliding force of not less than twice that due to the loads acting on the structure when the structure is considered as an entire unit acting on or anchored to its bearing stratum or supporting structure.

2) The resistance to overturning shall be calculated as the sum of the stabilizing moment of the *dead load* only, plus the ultimate resistance of any anchoring devices.

4.1.5. Dead Loads

4.1.5.1. Dead Loads

1) The specified *dead load* for a structural member consists of
a) the weight of the member itself,
b) the weight of all materials of construction incorporated into the *building* to be supported permanently by the member,
c) the weight of *partitions*,
d) the weight of permanent equipment, and
e) forces due to prestressing.

2) Except as provided in Sentence (5), in areas of a *building* where *partitions* other than permanent *partitions* are shown on the drawings, or where *partitions* might be added in the future, allowance shall be made for the weight of such *partitions*.

3) The *partition* weight allowance in Sentence (2) shall be determined from the actual or anticipated weight of the *partitions* placed in any probable position, but shall be not less than 1 kPa over the area of floor being considered.

4) *Partition* loads used in design shall be shown on the drawings as provided in Clause 2.3.4.3.(1)(d).

5) In cases where the *dead load* is counteractive, the load allowances as provided in Sentences (2) and (3) shall not be included in the design calculations.

4.1.6. Live Loads Due to Use and Occupancy

4.1.6.1. Loads Due to Use of Floors and Roofs

1) The specified *live load* on an area of floor or roof depends on the intended use and *occupancy*, and shall not be less than the uniformly distributed load patterns in Article 4.1.6.3., the loads resulting from the intended use or the concentrated loads in Article 4.1.6.10., whichever produces the most critical effect.

4.1.6.2. Uses Not Stipulated

1) Where the use of an area of floor or roof is not provided for in Article 4.1.6.3., the specified *live loads* due to the use and *occupancy* of the area shall be determined from an analysis of the loads resulting from
a) the weight of the probable assembly of persons,
b) the weight of the probable accumulation of equipment and furnishings, and
c) the weight of the probable storage of materials.

4.1.6.3. Full and Partial Loading

1) The uniformly distributed load shall be not less than the value listed in Table 4.1.6.3., reduced as may be provided for in Article 4.1.6.9., applied uniformly over the entire area, or on any portions of the area, whichever produces the most critical effects in the members concerned.

Table 4.1.6.3.
Specified Uniformly Distributed Live Loads on an Area of Floor or Roof
Forming Part of Article 4.1.6.3.

Use of Area of Floor or Roof	Minimum Specified Load, kPa
Assembly Areas	
a) Except for those areas listed under (b) and (c), assembly areas with or without fixed seats including	
Arenas	
Auditoria	
Churches	
Dance floors	
Dining areas(1)	
Foyers and entrance halls	
Grandstands, reviewing stands and bleachers	4.8
Gymnasia	
Museums	
Promenades	
Rinks	
Stadia	
Stages	
Theatres	
and other areas with similar uses	
b) Assembly areas with fixed seats that have backs over at least 80% of the assembly area for the following uses:	
Churches	
Courtrooms	2.4
Lecture halls	
Theatres	
c) Classrooms with or without fixed seats	2.4
Attics	
Accessible by a stairway in *residential occupancies* only	1.4
Having limited accessibility so that there is no storage of equipment or material	0.5
Balconies	
Exterior	4.8
Interior and *mezzanines* that could be used by an assembly of people as a viewing area(2)	4.8
Interior and *mezzanines* other than above	(3)
Corridors, lobbies and aisles	
Other than those listed below	4.8
Not more than 1 200 mm in width and all upper floor corridors of residential areas only of apartments, hotels and motels (that cannot be used by an assembly of people as viewing area)(2)	(3)
Equipment areas and *service rooms* including	
Generator rooms	
Mechanical equipment exclusive of elevators	
Machine rooms	3.6(4)
Pump rooms	
Transformer vaults	
Ventilating or air-conditioning equipment	

Table 4.1.6.3. (Continued)

Use of Area of Floor or Roof	Minimum Specified Load, kPa
Exits and fire escapes	4.8
Factories	6.0(4)
Footbridges	4.8
Garages for	
Passenger cars	2.4
Light trucks and unloaded buses	6.0
Loaded buses and trucks and all other trucking spaces	12.0
Kitchens (other than residential)	4.8
Libraries	
Stack rooms	7.2
Reading and study rooms	2.9
Office areas (not including record storage and computer rooms) located in	
Basement and *first storey*	4.8
Floors above *first storey*	2.4
Operating rooms and laboratories	3.6
Patients' bedrooms	1.9
Recreation areas that cannot be used for assembly purposes including Billiard rooms Bowling alleys Pool rooms	3.6
Residential areas (within the scope of Subsection 2.1.2.)	
Sleeping and living quarters in apartments, hotels, motels, boarding schools and colleges	1.9
Residential areas (within the scope of Subsection 2.1.3.)	
Bedrooms	1.4
Other areas	1.9
Stairs within *dwelling units*	1.9
Retail and wholesale areas	4.8
Roofs	1.0(5)
Sidewalks and driveways over areaways and *basements*	12.0
Storage areas	4.8(4)
Toilet areas	2.4
Underground slabs with earth cover	(4)
Warehouses	4.8(4)

Notes to Table 4.1.6.3.:

(1) See Article 4.1.6.6.
(2) See Appendix A.
(3) See Article 4.1.6.4.
(4) See Article 4.1.6.7.
(5) See Article 4.1.7.1.

4.1.6.4. Loads for Occupancy Served

1) The following shall be designed to carry not less than the specified load required for the *occupancy* they serve, provided they cannot be used by an assembly of people as a viewing area:
a) corridors, lobbies and aisles not more than 1 200 mm wide,
b) all corridors above the *first storey* of residential areas of apartments, hotels and motels, and
c) interior balconies and *mezzanines*.

4.1.6.5. Loads on Exterior Areas

1) Exterior areas accessible to vehicular traffic shall be designed for their intended use, including the weight of fire fighting equipment, but not less than the *live loads* due to snow, ice and rain prescribed in Subsection 4.1.7.

2) Exterior areas accessible to pedestrian traffic, but not vehicular traffic, shall be designed for their intended use, but not less than
a) the *live load* prescribed for assembly areas in Table 4.1.6.3., and
b) the *live loads* due to snow, ice and rain as prescribed in Subsection 4.1.7.

4.1.6.6. Loads for Dining Areas

1) The minimum specified load in Table 4.1.6.3. for dining areas may be reduced to 2.4 kPa for dining areas in *buildings* to be converted for such purposes provided that the *floor area* does not exceed 100 m² and use of the dining area for other assembly purposes, including dancing, is precluded.

4.1.6.7. Floor Loads Due to Intended Use

1) Equipment areas and *service rooms*, factories, storage areas and warehouses shall be designed for the loads due to their intended use but not less than the specified loads listed in Table 4.1.6.3.

4.1.6.8. More Than One Occupancy

1) Where an area of floor or roof is intended for 2 or more *occupancies* at different times, the value to be used from Table 4.1.6.3. shall be the greatest value for any of the *occupancies* concerned.

4.1.6.9. Variation with Tributary Area

(See Appendix A.)

1) An area used for *assembly occupancies* designed for a *live load* of less than 4.8 kPa shall have no reduction for tributary area.

2) Where a structural member supports a tributary area of floor, roof or combination thereof greater than 80 m² used for *assembly occupancies* designed for a *live load* of 4.8 kPa or more, or for storage, manufacturing, retail stores, garages or as a footbridge, the specified *live load* due to use and *occupancy*, excluding snow, is the load provided for in Article 4.1.6.3. multiplied by

$$0.5 + \sqrt{20/\mathrm{A}}$$

where A is the tributary area in square metres for this type of use and *occupancy*, excluding the area supporting snow.

3) Where a structural member supports a tributary area of floor, roof or combination of these greater than 20 m² for any use or *occupancy* other than those indicated in Sentences (1) and (2), the specified live load due to use and *occupancy*, excluding snow, is the load provided for in Article 4.1.6.3. multiplied by

$$0.3 + \sqrt{9.8/\mathrm{B}}$$

where B is the tributary area in square metres for this type of use and *occupancy*, excluding the area supporting snow.

4.1.6.10. Concentrated Loads

1) The specified load due to possible concentrations of load resulting from the use of an area of floor or roof shall not be less than that listed in Table 4.1.6.10. applied over an area of 750 mm by 750 mm located so as to cause maximum effects, except that for *occupancies* not listed in Table 4.1.6.10. the concentrations of load shall be determined in accordance with Article 4.1.6.2.

Table 4.1.6.10.
Specified Concentrated Live Loads on an Area of Floor or Roof
Forming Part of Article 4.1.6.10.

Area of Floor or Roof	Minimum Specified Concentrated Load, kN
Roof surfaces	1.3
Floors of classrooms	4.5
Floors of offices, manufacturing *buildings*, hospital wards and *stages*	9.0
Floors and areas used by passenger cars	11
Floors and areas used by vehicles not exceeding 3 600 kg gross weight	18
Floors and areas used by vehicles exceeding 3 600 kg but not exceeding 9 000 kg gross weight	36
Floors and areas used by vehicles exceeding 9 000 kg gross weight(1)	54
Driveways and sidewalks over areaways and *basements*(1)	54

Notes to Table 4.1.6.10.:
(1) See Appendix A.

4.1.6.11. Bleacher Seats

1) Bleacher seats shall be designed for a uniformly distributed load of 1.75 kN for each linear metre or for a concentrated load of 2.2 kN distributed over a length of 0.75 m, whichever produces the greatest effect on the supporting members.

4.1.6.12. Helicopter Landing Areas

1) Helicopter landing areas on roofs shall be constructed in conformance with requirements contained in the "Airport Regulations of the Aeronautics Act" of Transport Canada.

4.1.6.13. Roof Parking Decks

1) Roof parking decks shall be designed for the uniformly distributed loads in Table 4.1.6.3., the concentrated loads in Table 4.1.6.10. or the roof snow load, whichever produces the greatest effect in the members concerned.

4.1.7. Live Loads Due to Snow, Ice and Rain

(See Appendix A.)

4.1.7.1. Specified Snow Loading

(See Appendix A.) e3

1) The specified loading, S, due to snow accumulation on a roof or any other *building* surface subject to snow accumulation shall be calculated from the formula

$$S = S_s(C_b C_w C_s C_a) + S_r$$

where
- S_s = the ground snow load in kPa, determined in accordance with Subsection 2.2.1.,
- S_r = the associated rain load in kPa, determined in accordance with Subsection 2.2.1., but not greater than $S_s(C_b C_w C_s C_a)$,
- C_b = the basic roof snow load factor of 0.8,
- C_w = the wind exposure factor in Sentences (2) and (3),
- C_s = the slope factor in Sentences (4), (5) and (6), and
- C_a = the accumulation factor in Sentence (7).

2) Except as provided for in Sentence (3), the wind exposure factor, C_w, shall be 1.0.

3) The wind exposure factor in Sentence (2) may be reduced to 0.75, or in exposed areas north of the treeline to 0.5, where
a) the *building* is in an exposed location, so that the roof is exposed to the winds on all sides, with no obstructions higher than the roof located closer to the *building* than a distance equal to 10 times the height of the obstruction above the roof,
b) the area of roof under consideration is exposed to the wind on all sides with no significant obstructions on the roof, such as parapet walls, within a distance of at least 10 times the difference between the height of the obstruction and $C_b C_w S_s/\gamma$ metres, where γ is the unit weight of snow on roofs, and
c) the loading does not involve accumulation of snow due to drifting from adjacent surfaces.

4) Except as provided for in Sentences (5) and (6), the slope factor, C_s, shall be
a) 1.0 when the roof slope, α, is equal to or less than 30°,
b) $(70° - \alpha)/40°$ when α is greater than 30°, but not greater than 70°, and
c) 0 when α exceeds 70°.

5) The slope factor, C_s, for unobstructed slippery roofs where snow and ice can slide completely off the roof shall be
a) 1.0 when the roof slope, α, is equal to or less than 15°,
b) $(60° - \alpha)/45°$ when α is greater than 15°, but not greater than 60°, and
c) 0 when α exceeds 60°.

6) The slope factor, C_s, shall be 1.0 when used in conjunction with accumulation factors for increased snow load as given in Subclauses (7)(c)(ii) and (7)(c)(v).

7) The accumulation factor, C_a,
a) shall be 1.0, except that
b) for large flat upper or lower roofs it shall be **e**
   i) $1.2[1 - (30/l^*)^2]$, but not less than 1.0, for roofs with $C_w = 1.0$, or
   ii) $1.6[1 - (120/l^*)^2]$, but not less than 1.0, for roofs with $C_w = 0.75$ or 0.5 where
      l^* = the characteristic length of the upper or lower roof defined as $l^* = 2w - w^2/l$, in metres,
      w = the smaller plan dimension of the roof, in metres,
      l = the larger plan dimension of the roof, in metres,

   and
c) where appropriate for the shape of the roof, shall be assigned other values which account for
   i) non-uniform snow loads on gable, arched or curved roofs and domes,
   ii) increased snow loads in valleys,
   iii) increased non-uniform snow loads due to snow drifting onto a roof which is at a level lower than other parts of the same *building* or at a level lower than another *building* within 5 m of it,
   iv) increased non-uniform snow loads on areas adjacent to roof projections, such as penthouses, large *chimneys* and equipment, and
   v) increased snow or ice loads due to snow sliding or drainage of melt water from adjacent roofs.

4.1.7.2. Full and Partial Loading

1) A roof or other *building* surface and its structural members subject to loads due to snow accumulation shall be designed for the specified load in Sentence 4.1.7.1.(1), distributed over the entire loaded area.

2) In addition to the distribution in Sentence (1), flat roofs and shed roofs, gable roofs of 15° slope or less and arched or curved roofs shall be designed for the specified uniform snow load in Sentence 4.1.7.1.(1), computed using $C_a = 1.0$, distributed on any one portion of the loaded area, and half of this load on the remainder of the loaded area, in such a way as to produce the greatest effects on the member concerned. (See Appendix A.) **r4**

4.1.7.3. Specified Rain Load

1) The specified load due to the accumulation of rain water on a surface, whose position and shape and deflection under load is such as to make such an accumulation possible, is that resulting from the 24 h rainfall determined in conformance with Subsection 2.2.1. over the horizontal projection of the surface and all tributary surfaces. (See Appendix A.)

2) The provisions of Sentence (1) apply whether or not the surface is provided with drainage, such as rain water leaders.

3) Except as provided for in Sentence 4.1.7.1.(1), loads due to rain need not be considered to act simultaneously with loads due to snow.

4.1.8. Live Loads Due to Wind

4.1.8.1. Specified Wind Loading

1) The specified external pressure or suction due to wind on part or all of a surface of a *building* shall be calculated from

$$p = qC_eC_gC_p$$

where
p = the specified external pressure acting statically and in a direction normal to the surface either as a pressure directed towards the surface or as a suction directed away from the surface,
q = the reference velocity pressure, as provided for in Sentence (4),
C_e = the exposure factor, as provided for in Sentence (5),
C_g = the gust effect factor, as provided for in Sentence (6), and
C_p = the external pressure coefficient, averaged over the area of the surface considered. (See Appendix A.)

2) The net wind load for the *building* as a whole shall be the algebraic difference of the loads on the windward and the leeward surfaces, and in some cases may be calculated as the sum of the products of the external pressures or suctions and the areas of the surfaces over which they are averaged as provided in Sentence (1). (See Appendix A.)

3) The net specified pressure due to wind on part or all of a surface of a *building* shall be the algebraic difference of the external pressure or suction as provided for in Sentence (1) and the specified internal pressure or suction due to wind calculated from

$$p_i = qC_eC_gC_{pi}$$

where

p_i = the specified internal pressure, acting statically and in a direction normal to the surface either as a pressure (directed outwards) or as a suction (directed inwards),

q = the reference velocity pressure, as provided for in Sentence (4),

C_e = the exposure factor, as provided for in Sentence (5), evaluated at the *building* mid-height instead of the height of the element considered,

C_g = the gust effect factor, as provided for in Sentence (6), and

C_{pi} = the internal pressure coefficient.

4) The reference velocity pressure, q, is the appropriate value determined in conformance with Subsection 2.2.1. for the following conditions:

a) the reference velocity pressure, q, for the design of cladding shall be based on a probability of being exceeded in any one year of 1 in 10,

b) the reference velocity pressure, q, for the design of structural members for deflection and vibration shall be based on a probability of being exceeded in any one year of 1 in 10,

c) for all *buildings*, except those listed in Clause (d), the reference velocity pressure, q, for the design of structural members for strength shall be based on a probability of being exceeded in any one year of 1 in 30, and

d) the reference velocity pressure, q, for the design of structural members for strength for *post-disaster buildings* shall be based on a probability of being exceeded in any one year of 1 in 100.

5) The exposure factor C_e shall be

a) the value shown in Table 4.1.8.1. for the appropriate reference height for the surface or part of the surface,

b) the value of the function $(h/10)^{1/5}$ but not less than 0.9, where h is the reference height above *grade* in metres for the surface or part of the surface, or

c) if a dynamic approach to the action of wind gusts is used, an appropriate value depending on both height and shielding (see Appendix A).

Table 4.1.8.1.
Exposure Factors, C_e
Forming Part of Sentence 4.1.8.1.(5)

Height, m	Exposure Factor
> 0 and ≤ 6	0.9
> 6 and ≤ 12	1.0
> 12 and ≤ 20	1.1
> 20 and ≤ 30	1.2
> 30 and ≤ 44	1.3
> 44 and ≤ 64	1.4
> 64 and ≤ 85	1.5
> 85 and ≤ 140	1.6
> 140 and ≤ 240	1.8
> 240 and ≤ 400	2.0

6) The gust effect factor C_g is one of the following values:

a) 1.0 or 2.0 for internal pressures as appropriate (see Appendix A),

b) 2.0 for the *building* as a whole and main structural members,

c) 2.5 for small elements including cladding, or

d) if a dynamic approach to the action of wind gusts is used, an appropriate value depending on the turbulence of the wind and the size and natural frequency of the structure (see Appendix A).

4.1.8.2. Dynamic Effects of Wind

1) *Buildings* whose height is greater than 4 times their minimum effective width or greater than 120 m and other *buildings* whose light weight, low frequency and low damping properties make them susceptible to vibration shall be

a) designed by experimental methods for the danger of dynamic overloading and vibration and the effects of fatigue, or

b) designed using a dynamic approach to the action of wind gusts (see Appendix A).

4.1.8.3. Full and Partial Loading

1) *Buildings* and structural members shall be capable of withstanding the effects of

a) the full wind loads acting along each of the 2 principal horizontal axes considered separately,

b) the wind loads as described in Clause (a) but with 25% of the load removed from any portion of the area,

c) the wind loads as in Clause (a) but considered simultaneously at 75% of their full value, and
d) the wind loads as described in Clause (c) but with 25% of these loads removed from any portion of the area.

(See Appendix A.)

4.1.8.4. Interior Walls and Partitions

1) In the design of interior walls and *partitions* due consideration shall be given to differences in air pressure on opposite sides of the wall or *partition* which may result from

a) pressure differences between the windward and leeward sides of a *building*,
b) stack effects due to a difference in air temperature between the exterior and interior of the *building*, and
c) air pressurization by the mechanical services of the *building*.

4.1.9. Live Loads Due to Earthquakes

4.1.9.1. Analysis

1) The specified loading due to earthquake motion shall be determined by the analysis given in this Subsection.

2) In this Subsection

A_r = response amplification factor to account for type of attachment of mechanical/electrical equipment, as defined in Sentence (19),
A_x = amplification factor at level x to account for variation of response of mechanical/electrical equipment with elevation within the *building*, as defined in Sentence (19),
C_p = seismic coefficient for mechanical/electrical equipment, as defined in Sentence (19),
D = dimension of the *building* in a direction parallel to the applied forces,
D_{nx} = plan dimension of the *building* at level x perpendicular to the direction of seismic loading being considered,
D_s = dimension of wall or braced frame which constitutes the main lateral-load-resisting system in a direction parallel to the applied forces,
e_x = distance measured perpendicular to the direction of seismic loading between center of mass and centre of rigidity at the level being considered (see Appendix A),
F = *foundation* factor as given in Sentence (11),
F_t = portion of V to be concentrated at the top of the structure, as defined in Sentence (13),
F_x = lateral force applied to level x,
h_i, h_n, h_x = the height above the base (i = 0) to level i, n, or x respectively, where the base of the structure is that level at which horizontal earthquake motions are considered to be imparted to the structure,
h_s = interstorey height ($h_i - h_{i-1}$),
I = seismic importance factor of the structure, as described in Sentence (10),
J = numerical reduction coefficient for base overturning moment as defined in Sentence (23),
J_x = numerical reduction coefficient for moment at level x as defined in Sentence (24),
Level i = any level in the *building*, i = 1 for first level above the base,
Level n = that level which is uppermost in the main portion of the structure,
Level x = that level which is under design consideration,
N = total number of *storeys* above exterior *grade* to level n (N is usually numerically equal to n.),
R = force modification factor that reflects the capability of a structure to dissipate energy through inelastic behaviour, as given in Sentence (8),
S = seismic response factor, for unit value of zonal velocity ratio, as defined in Sentence (6),
S_p = horizontal force factor for part or portion of a *building* and its anchorage, as given in Table 4.1.9.1.D. and Sentences (17) and (19),
T = fundamental period of vibration of the *building* or structure in seconds in the direction under consideration,
T_x = floor torque at level x as defined in Sentence (28),
U = factor representing level of protection based on experience, as specified in Sentence (4),
v = zonal velocity ratio = the specified zonal horizontal ground velocity expressed as a ratio to 1 m/s,
V = minimum lateral seismic force at the base of the structure, to be used with a load factor α_E = 1.0,
V_e = equivalent lateral force at the base of the structure representing elastic response, as specified in Sentence (5),
V_p = lateral force on a part of the structure,
W = *dead load* plus 25% of the design snow load specified in Subsection 4.1.7. plus 60% of the storage load for areas used for storage and the full contents of any tanks (see Appendix A),
W_i, W_x = that portion of W which is located at or is assigned to level i or x respectively,

W_p = the weight of a part or portion of a structure, e.g. cladding, *partitions* and appendages,
Z_a = acceleration-related seismic zone,
Z_v = velocity-related seismic zone.

3) Earthquake forces shall be assumed to act in any horizontal direction, except that independent design about each of the principal axes shall be considered to provide adequate resistance in the structure for earthquake forces applied in any direction. (See Appendix A.)

4) The minimum lateral seismic force, V, shall be calculated in accordance with the following formula:

$$V = (V_e/R)\,U$$

where U = 0.6.

5) The equivalent lateral seismic force representing elastic response, V_e, shall be calculated in accordance with the following formula:

$$V_e = v \bullet S \bullet I \bullet F \bullet W$$

where v is the zonal velocity ratio determined in conformance with Subsection 2.2.1., except that when $Z_v = 0$ and $Z_a > 0$, the value of Z_v shall be taken as 1 and v as 0.05 in all requirements of Subsection 4.1.9.

6) The seismic response factor, S, shall conform to Table 4.1.9.1.A.

Table 4.1.9.1.A.
Seismic Response Factors
Forming Part of Sentence 4.1.9.1.(6)

T	Z_a/Z_v	S
≤ 0.25	> 1.0	4.2
	1.0	3.0
	< 1.0	2.1
> 0.25 but < 0.50	> 1.0	4.2 – 8.4 (T – 0.25)
	1.0	3.0 – 3.6 (T – 0.25)
	< 1.0	2.1
≥ 0.50	All values	$1.5/T^{1/2}$

7) The fundamental period, T, in Sentence (6) shall be determined by
a) the formula 0.1 N for any moment resisting frame, or by the formulae $0.085\,(h_n)^{3/4}$ for a steel moment resisting frame or $0.075\,(h_n)^{3/4}$ for a concrete moment resisting frame, where the moment resisting system is a frame which resists 100% of the required lateral forces and the frame is not enclosed by or adjoined by more rigid elements that would tend to prevent the frame from resisting lateral forces, and where h_n is in metres,
b) the formula $0.09\,h_n/(D_s)^{1/2}$ for other structures, where h_n and D_s are in metres and D_s = length of the wall or braced frame which constitutes the main lateral-force-resisting system in the direction parallel to the applied forces; if the main lateral-force-resisting system does not have a well-defined length then D shall be used in lieu of D_s, or
c) other established methods of mechanics; the value of V_e used for design shall be not less than 0.80 of the value computed using the period calculated in Clause (a) or (b).

8) Except as provided for in Sentences 4.1.9.3.(1), (2) and (3), values of the force modification factor, R, shall conform to Table 4.1.9.1.B. (See Appendix A.)

9) For the purpose of applying Table 4.1.9.1.B.
a) a ductile moment-resisting frame shall mean a frame that is designed to resist the specified seismic forces and that, in addition, has adequate ductility or energy-absorptive capacity;
b) for combinations of different types of lateral-force-resisting systems acting in the same direction, R shall be taken as the lowest value of R corresponding to these systems except as given in Clause (c);
c) if one of the lateral-force-resisting systems of the structure is designed to take 100% of the lateral force, R can be selected as appropriate for the system; the components of the structure not considered to be part of the lateral-force-resisting system must be capable of resisting their gravity loads under seismically induced deformations calculated in accordance with Sentence 4.1.9.2.(2);
d) if it can be demonstrated through research or experience that the seismic performance of a structural system is at least equivalent to one of Cases 1-8, 10-14, 16-18 or 20–21 in Table 4.1.9.1.B., then such a structural system will qualify for a value of R corresponding to the equivalent case in that Table.

Table 4.1.9.1.B.
Force Modification Factors(1)
Forming Part of Sentence 4.1.9.1.(8)

Case	Type of Lateral-Force-Resisting System	R
	Steel Structures Designed and Detailed According to CSA S16 r5	
1	ductile moment-resisting frame	4.0
2	ductile eccentrically braced frame	4.0
3	ductile steel plate shear wall	4.0
4	ductile braced frame	3.0
5	moment-resisting frame with nominal ductility	3.0
6	nominally ductile steel plate shear wall	3.0
7	braced frame with nominal ductility	2.0
8	ordinary steel plate shear wall	2.0
9	other lateral-force-resisting systems not defined in Cases 1 to 8	1.5
	Reinforced Concrete Structures Designed and Detailed According to CSA A23.3	
10	ductile moment-resisting frame	4.0
11	ductile coupled wall	4.0
12	other ductile wall systems	3.5
13	moment-resisting frame with nominal ductility	2.0
14	wall with nominal ductility	2.0
15	other lateral-force-resisting systems not defined in Cases 10 to 14	1.5
	Timber Structures Designed and Detailed According to CSA O86 r4	
16	nailed shear panel with plywood, waferboard or OSB	3.0
17	concentrically braced heavy timber frame with ductile connections	2.0
18	moment-resisting wood frame with ductile connections	2.0
19	other systems not included in Cases 16 to 18	1.5
	Masonry Structures Designed and Detailed According to CSA S304.1	
20	reinforced masonry wall with nominal ductility	2.0
21	reinforced masonry	1.5
22	unreinforced masonry	1.0
23	Other Lateral-force-resisting Systems not Defined in Cases 1 to 22	1.0

Notes to Table 4.1.9.1.B.:
(1) See Appendix A.

10) The seismic importance factor, I, shall equal 1.5 for *post-disaster buildings*, 1.3 for schools and 1.0 for all other *buildings*.

11) The *foundation* factor, F, shall conform to Table 4.1.9.1.C., except that the product F • S need not exceed
a) 3.0 where Z_a does not exceed Z_v and
b) 4.2 where Z_a is greater than Z_v.
(See Appendix A.)

12) The weight, W, of the *building* shall be calculated in accordance with the following formula:

$$W = \sum_{i=1}^{n} W_i$$

Table 4.1.9.1.C.
Foundation Factors[1]
Forming Part of Sentence 4.1.9.1.(11)

Categories	Type and Depth of *Rock* and *Soil* Measured from the *Foundation* or *Pile* Cap Level	F
1	*Rock*, dense and very dense coarse-grained *soils*, very stiff and hard fine-grained *soils*; compact coarse-grained *soils* and firm and stiff fine-grained *soils* from 0 to 15 m deep	1.0
2	Compact coarse-grained *soils*, firm and stiff fine-grained *soils* with a depth greater than 15 m; very loose and loose coarse-grained *soils* and very soft and soft fine-grained *soils* from 0 to 15 m deep	1.3
3	Very loose and loose coarse-grained *soils* with depth greater than 15 m	1.5
4	Very soft and soft fine-grained *soils* with depth greater than 15 m	2.0

Notes to Table 4.1.9.1.C.:
(1) See Appendix A.

13) The total lateral seismic force, V, shall be distributed as follows:
a) a portion, F_t, shall be assumed to be concentrated at the top of the *building* and equal to 0.07 TV, except that F_t need not exceed 0.25 V and may be considered as zero where T does not exceed 0.7 s; the remainder, $V - F_t$, shall be distributed along the height of the *building*, including the top level, in accordance with the formula

$$F_x = (V - F_t)\, W_x h_x / \left(\sum_{i=1}^{n} W_i h_i \right)$$

or
b) by dynamic analysis, with the seismic effects scaled such that the base shear from the dynamic analysis equals V as given in Sentence (4) (see Appendix A).

14) The total shear in any horizontal plane shall be distributed to the various elements of the lateral-force-resisting system in proportion to their rigidities according to rational analysis, with due regard to the capacities and stiffnesses of the nonstructural elements and to the effects of torsion as required by Sentence (28).

15) Except as provided for in Sentence (16), parts of *buildings* as described in Tables 4.1.9.1.D. and 4.1.9.1.E. and their anchorage shall be designed to accommodate the deflections defined in Article 4.1.9.2., and for a lateral force, V_p, equal to $v \bullet I \bullet S_p \bullet W_p$, distributed according to the distribution of mass of the element under consideration, where v is determined in conformance with Subsection 2.2.1., and I is the same importance factor as used for the *building*.

16) For non *post-disaster buildings* in zones where Z_a and Z_v are equal to or less than 1.0 and F is equal to or less than 1.3, the requirements of Sentence (15) shall not apply to Table 4.1.9.1.E. or to Cases 7, 8, and 9 of Table 4.1.9.1.D.

17) Except as provided for in Sentence (21), the values of S_p in Sentences (15) and (16) for architectural components shall conform to Table 4.1.9.1.D.

18) All fasteners and anchors in a ductile connection, such as bolts, inserts, welds, or dowels, shall be capable of developing 3 times the yield load of the body of the connection.

19) The values of S_p in Sentences (15) and (16) for mechanical/electrical components shall be equal to

$$S_p = C_p \bullet A_r \bullet A_x$$

where
C_p = seismic coefficient for components of mechanical and electrical equipment as given in Table 4.1.9.1.E.,
A_r = 1.0 for components that are both rigid and rigidly connected and for non-brittle pipes and ducts,
= 1.5 for components located on the ground that are flexible or flexibly connected except for non-brittle pipes and ducts,
= 3.0 for all other cases,
A_x = $1.0 + (h_x/h_n)$.

20) For the purpose of applying Sentence (19)
a) components that are both rigid and rigidly connected are defined as those having a fundamental period for the component and connection less than or equal to 0.06 s, and
b) flexible components or connections are defined as those having a fundamental period greater than 0.06 s.

21) Floors and roofs acting as diaphragms shall be designed for a minimum force corresponding to a value of S_p equal to 0.7 applied to loads tributary from that *storey*, unless a greater force F_x is assigned to the level under consideration as in Sentences (13) and (14).

Table 4.1.9.1.D.
Values of S_p for Architectural Parts or Portions of Buildings
Forming Part of Sentence 4.1.9.1.(15)

Category	Architectural Part or Portion of *Building*	Direction of Force	Value of S_p
1	All exterior and interior walls except those of Categories 2 and 3	Normal to flat surface	1.5
2	Cantilever parapet and other cantilever walls except retaining walls	Normal to flat surface	6.5
3	Exterior and interior ornamentations and appendages	Any direction	6.5
4	Connections/attachments for Categories 1, 2 and 3		
	The body of ductile connections/attachments	Any direction	2.5
	All fasteners and anchors in the ductile connection, such as bolts, inserts, welds, or dowels	Any direction	(1)
	Non-ductile connections/attachments	Any direction	15.0
5	Floors and roofs acting as diaphragms(2)	Any direction	0.7
6	Towers, *chimneys*, smokestacks and penthouses when connected to or forming part of a *building*(3)	Any direction	4.5
7	Horizontally cantilevered floors, balconies, beams, etc.	Vertical	4.5
8	Suspended ceilings, light fixtures and other attachments to ceilings with independent vertical support	Any direction	2.0
9	Masonry veneer connections	Normal to flat surface	5.0

Notes to Table 4.1.9.1.D.:
(1) See Sentence 4.1.9.1.(18).
(2) See Sentence 4.1.9.1.(21).
(3) See Appendix A.

Table 4.1.9.1.E.
Values of C_p for Mechanical/Electrical Parts or Portions of Buildings
Forming Part of Sentence 4.1.9.1.(15)

Category	Mechanical/Electrical Part or Portion of *Building*	Direction of Force	Value of C_p
1	Machinery, fixtures, equipment, ducts, tanks and pipes (including contents) except as noted elsewhere in this table(1)	Any direction	1.0
2	Machinery, fixtures, equipment, ducts, tanks and pipes (including contents) containing toxic or explosive materials, materials having a *flash point* below 38°C or fire fighting fluids	Any direction	1.5
3	Flat bottom tanks (including contents) attached directly to a floor at or below *grade* within a *building*	Any direction	0.7
4	Flat bottom tanks (including contents) attached directly to a floor at or below *grade* within a *building* containing toxic or explosive materials, materials having a *flash point* below 38°C or fire fighting fluids	Any direction	1.0

Notes to Table 4.1.9.1.E.:
(1) See Appendix A.

22) When the mass of a tank plus contents is greater than 10% of the mass of the supporting floor, the lateral forces shall be determined by rational analysis.

23) The overturning moment, M, at the base of the structure shall be multiplied by a reduction coefficient, J, where
a) J = 1 where T is less than 0.5,
b) J = (1.1 – 0.2T) where T is not less than 0.5, but not more than 1.5, and
c) J = 0.8 where T is greater than 1.5.

24) The overturning moment M_x at any level x shall be
a) multiplied by J_x where

$$J_x = J + (1 - J)(h_x/h_n)^3$$

and
b) distributed as required in Sentences (25), (26) and (27).

25) The incremental changes in the design overturning moments, in the *storey* under consideration, shall be distributed to the various resisting elements in the same proportion as the distribution of shears in the resisting system.

26) Where other vertical members are provided which are capable of partially resisting the overturning moments, a redistribution may be made to these members if framing members of sufficient strength and stiffness to transmit the required loads are provided.

27) Where a vertical-resisting element is discontinuous, the overturning moment carried by the lowest *storey* of that element shall be carried down as loads to the *foundation*.

28) Torsional moments about a vertical axis of the *building* shall be calculated as:
a) for an analysis carried out in accordance with Clause (13)(a), the torsional moments applied at each level throughout the *building* shall be derived for each of the following load cases considered separately, where F_x is the lateral floor force at each level as given by Clause (13)(a) and the term $0.1\ D_{nx}\ F_x$ represents the accidental torsional moment applied at each level and where each element in the *building* is designed for the most severe effect of the following load cases: e3
   i) $T_x = F_x(1.5e_x + 0.1\ D_{nx})$
   ii) $T_x = F_x(1.5e_x - 0.1\ D_{nx})$
   iii) $T_x = F_x(0.5e_x + 0.1\ D_{nx})$
   iv) $T_x = F_x(0.5e_x - 0.1\ D_{nx})$; or
b) the effects of accidental torsional moments applied at each level throughout the *building* shall be derived for each of the following load cases considered separately and shall be added to the effects of a three dimensional dynamic analysis where each element in the *building* is designed for the most severe effect of the following load cases and F_x is the lateral floor force at each level as given by Clause (13)(a): e3
   i) $T_x = +\ 0.1\ D_{nx}\ F_x$
   ii) $T_x = -\ 0.1\ D_{nx}\ F_x$.

(See Appendix A.)

29) The *building* design shall take full account of the possible effects of setbacks. (See Appendix A.)

4.1.9.2. Deflections

1) Lateral deflections of a structure shall be calculated in accordance with accepted practice and based on the loads and requirements defined in this Section.

2) Lateral deflections obtained from an elastic analysis using the loads given in Sentences 4.1.9.1.(13) and (14) and incorporating the effects of torsion shall be multiplied by R to give realistic values of anticipated deflections.

3) The interstorey deflections based on the lateral deflections as calculated in Sentence (2) shall be limited to $0.01\ h_s$ for *post-disaster buildings* and $0.02\ h_s$ for all other *buildings*.

4) All portions of the structure shall be designed to act as integral units in resisting horizontal forces, unless separated by adequate clearances which permit horizontal deflections of the structure consistent with values of deflections calculated in accordance with Sentence (2).

5) The nonstructural components shall be designed so as not to transfer to the structural system any forces unaccounted for in the design, and any interaction of rigid elements such as walls and the structural system shall be designed so that the capacity of the structural system is not impaired by the action or failure of the rigid elements.

6) Adjacent structures shall either be separated by the sum of their individual deflections as calculated in Sentence (2), or shall be connected to each other.

7) The method of connection required in Sentence (6) shall take into account the mass, stiffness, strength, ductility and anticipated motion of the connected *buildings* and the character of the connection.

8) The deflections as calculated in Sentence (2) shall be used to account for sway effects due to seismic loading as required by Sentence 4.1.1.5.(2).

9) The connected *buildings* referred to in Sentence (6) shall be assumed to have the lowest R value of the *buildings* connected, unless the use of a higher value can be justified by rational analysis.

4.1.9.3. Special Provisions

1) *Buildings* more than 3 *storeys* in *building height* in velocity- or acceleration-related seismic zones of 2 and higher shall have a structural system as described in Cases 1-8, 10-14, 16-18 or 20-21 in Table 4.1.9.1.B.

2) For *buildings* more than 60 m in height with a structural system having R = 2.0 or R = 1.5 as determined from Table 4.1.9.1.B. or as determined from Clause 4.1.9.1.(9)(b), the value of V shall be increased by 50% in velocity-related seismic zones of 4 and higher.

3) Elevated tanks plus full contents not supported by a *building*, shall be designed using R = 1 in the formula in Sentence 4.1.9.1.(4), with the conditions

a) the minimum and maximum value of the product S • I shall be taken as 1.5 and 3.0, respectively,

b) the overturning moment reduction coefficient, J, as set forth in Sentence 4.1.9.1.(2) shall be 1.0, and

c) the torsional requirements of Sentence 4.1.9.1.(28) shall apply.

4) For *buildings* in velocity- or acceleration-related seismic zones of 2 and higher in which discontinuities in columns or shear walls occur, special design provisions shall be made to ensure that failure at the point of discontinuity will not occur before the capacity of the remaining portion of the structure has been realized.

5) In velocity- or acceleration-related seismic zones of 2 and higher, reinforcement conforming to Clause 6.3.3 of CSA S304.1, "Masonry Design for Buildings (Limit States Design)," shall be provided for masonry construction in

a) *loadbearing* and lateral-load-resisting masonry,

b) masonry enclosing elevator shafts and stairways, or used as exterior cladding, and

c) masonry *partitions*, except for *partitions* which

i) do not exceed 200 kg/m² in weight, and

ii) do not exceed 3 m in height and are laterally supported at the top.

4.1.9.4. Foundation Provisions

1) *Foundations* shall be designed so that yielding will occur first in the superstructure and not the *foundations*, unless the design specifically provides otherwise.

2) Except in velocity-related seismic Zone 0, individual *pile* footings, drilled piers and *caissons* shall be interconnected by ties in not less than 2 directions.

3) Ties required in Sentence (2) shall be designed to carry by tension or compression a horizontal force equal to the greatest factored *pile* cap loading multiplied by a factor 0.5 v, but not exceeding 10% of the greatest factored *pile* cap load, unless it can be demonstrated that equivalent restraints can be provided by other means. (See Appendix A.)

4) Except in velocity-related seismic Zone 0, *piles* shall be connected to the *pile* cap or structure by reinforcement having sufficient anchorage to develop the yield strength of the reinforcement, and the top of the *piles* (below the *pile* cap) shall be reinforced to allow ductile behaviour if the design depends upon such action.

5) Except in velocity-related seismic Zones 0 and 1, *basement* walls shall be designed to resist seismic lateral pressures from backfill or natural ground. (See Appendix A.)

4.1.10. Other Effects

4.1.10.1. Loads on Guards

(See Appendix A.)

1) The minimum specified horizontal load applied inward or outward at the top of every required *guard* shall be

a) 3.0 kN/m for *means of egress* in grandstands, stadia, bleachers and arenas,

b) a concentrated load of 1.0 kN applied at any point for access walkways to equipment platforms, contiguous stairs and similar areas where the gathering of many people is improbable, and

c) 0.75 kN/m or a concentrated load of 1.0 kN applied at any point, whichever governs, for locations other than described in Clauses (a) and (b).

2) Individual elements within the *guard*, including solid panels and pickets, shall be designed for a concentrated load of 0.5 kN at any point in the element.

3) The loads required in Sentence (2) need not be considered to act simultaneously with the loads provided for in Sentences (1) and (4).

4) The minimum specified load applied vertically at the top of every required *guard* shall be 1.5 kN/m and need not be considered to act simultaneously with the horizontal load provided for in Sentence (1).

4.1.10.2. Loads on Vehicle Guardrails

1) Vehicle guardrails for parking garages shall be designed for a concentrated load of 22 kN applied horizontally outward at any point 500 mm above the floor surface. (See Appendix A.)

4.1.10.3. Loads on Walls Acting As Guards

1) Where the floor elevation on one side of a wall, including a wall around a shaft, is more than 600 mm higher than the elevation of the floor or ground on the other side, the wall shall be designed to resist the appropriate lateral design loads prescribed elsewhere in this Section or 0.5 kPa, whichever produces the greatest effect.

4.1.10.4. Firewalls

(See Appendix A.) e3

1) *Firewalls* shall be designed to resist the maximum effect due to:

a) the appropriate lateral design loads prescribed elsewhere in this Section, or

b) a factored lateral load of 0.5 kPa under fire conditions as described in Sentence (2).

2) Under fire conditions, when the *fire-resistance rating* of the structure is less than that of the *firewall*,

a) lateral support shall be assumed to be provided by the structure on one side only, or

b) another structural support system capable of resisting the loads imposed by a fire on either side of the *firewall* shall be provided.

4.1.10.5. Vibrations and Impact of Machinery and Equipment

1) Where vibration effects, such as resonance and fatigue resulting from machinery or equipment, are likely to be significant, a dynamic analysis shall be carried out.

2) The minimum specified load due to equipment, machinery or other objects that may produce impact shall be the sum of the weight of the equipment or machinery and its maximum lifting capacity, multiplied by an appropriate factor listed in Table 4.1.10.5.

Table 4.1.10.5.
Factors for the Calculation of Impact Loads
Forming Part of Sentence 4.1.10.5.(2)

Impact Due to	Factor
Operation of cab or radio operated cranes	1.25
Operation of pendant or hand operated cranes	1.10
Operation of elevators	(1)
Supports for light machinery, shaft or motor driven	1.20
Supports for reciprocating machinery (e.g. compressors)	1.50
Supports for power driven units (e.g. piston engines)	1.50

Notes to Table 4.1.10.5.:

(1) See CSA B44, Clauses 2.6.2 and 2.10.3. r4

3) Crane runway structures shall be designed to resist a horizontal force applied normal to the top of the rails equal to not less than 20% of the sum of the weights of the lifted load and the crane trolley (excluding other parts of the crane).

4) The force described in Sentence (3) shall be equally distributed on each side of the runway and shall be assumed to act in either direction.

5) Crane runway structures shall be designed to resist a horizontal force applied parallel to the top of the rail equal to not less than 10% of the maximum wheel loads of the crane.

4.1.10.6. Resonance and Sway Forces

1) Where the fundamental vibration frequency of a structural system supporting an *assembly occupancy* used for rhythmic activities, such as dancing, concerts, jumping exercises or gymnastics, is less than 6 Hz, the effects of resonance shall be investigated by means of a dynamic analysis. (See Appendix A.)

2) The floor assembly and other structural elements that support fixed seats in any *building* used for *assembly occupancies* to accommodate large numbers of people at one time, such as grandstands, stadia and *theatre* balconies, shall be designed to resist a horizontal force equal to not less than 0.3 kN for each metre length of seats acting parallel to each row of seats, and not less than 0.15 kN for each metre length of seats acting at right angles to each row of seats, assuming such forces to be acting independently of each other.

4.1.10.7. Bleachers

1) Bleachers shall be checked by the erector after erection to ensure that all structural members including bracing specified in the design have been installed.

2) Telescopic bleachers shall be provided with locking devices to ensure stability while in use.

Section 4.2. Foundations

4.2.1. General

4.2.1.1. Application

1) This Section applies to *excavations* and *foundation* systems for *buildings*.

4.2.2. Subsurface Investigations, Drawings and Reviews

4.2.2.1. Subsurface Investigation

1) A *subsurface investigation*, including *groundwater* conditions, shall be carried out by or under the direction of a professional engineer having knowledge and experience in planning and executing such investigations to a degree appropriate for the *building* and its use, the ground and the surrounding site conditions. (See Appendix A.)

4.2.2.2. Drawings

1) Drawings associated with *foundations* and *excavations* shall conform to the appropriate requirements of Part 2. (See Article 2.3.4.6.)

4.2.2.3. Review

1) A review shall be carried out by the *designer* or by another suitably qualified person to ascertain that the subsurface conditions are consistent with the design and that construction is carried out in accordance with the design and good engineering practice. (See Appendix A.)

2) The review required in Sentence (1) shall be carried out

- a) on a continuous basis
  - i) during the construction of all *deep foundation units* with all pertinent information recorded for each unit, and
  - ii) during the installation and removal of retaining structures and related backfilling operations, and
- b) as required, unless otherwise directed by the *authority having jurisdiction*,
  - i) in the construction of all *shallow foundation units*, and
  - ii) in excavating, dewatering and other related works.

4.2.2.4. Altered Subsurface Condition

1) Where during construction the *soil*, *rock* or *groundwater* is found not to be of the type or in the condition used in design, and as indicated on the drawings, the design shall be reassessed by the *designer*.

2) Where during construction climatic or any other conditions have changed the properties of the *soil*, *rock* or *groundwater*, the design shall be reassessed by the *designer*.

4.2.3. Materials Used in Foundations

4.2.3.1. Wood

1) Wood used in *foundations* or in support of *soil* or *rock* shall conform with the appropriate requirements of Subsection 4.3.1.

4.2.3.2. Preservation Treatment of Wood

1) Wood exposed to *soil* or air above the lowest anticipated *groundwater* table shall be treated with preservative in conformance with CSA O80 Series, "Wood Preservation," and the requirements of the appropriate commodity standard as follows:

- a) CSA O80.2, "Preservative Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Processes,"
- b) CSA O80.3, "Preservative Treatment of Piles by Pressure Processes," or
- c) CSA O80.15, "Preservative Treatment of Wood for Building Foundation Systems, Basements, and Crawl Spaces by Pressure Processes."

2) Where timber has been treated as required in Sentence (1), it shall be cared for as provided in AWPA standard M4, "Care of Preservative-Treated Wood Products," as revised by Clause 6 of CSA O80 Series, "Wood Preservation."

4.2.3.3. Plain and Reinforced Masonry

1) Plain or reinforced masonry used in *foundations* or in support of *soil* or *rock* shall conform with the requirements of Subsection 4.3.2.

4.2.3.4. Prevention of Deterioration of Masonry

1) Where plain or reinforced masonry in *foundations* or in structures supporting *soil* or *rock* may be subject to conditions conducive to deterioration, protection shall be provided to prevent such deterioration.

4.2.3.5. Concrete

1) Plain, reinforced or prestressed concrete used in *foundations* or in support of *soil* or *rock* shall conform with the requirements of Subsection 4.3.3.

4.2.3.6. Protection Against Chemical Attack

1) Where concrete in *foundations* may be subject to chemical attack, it shall be treated in conformance with the requirements in CSA A23.1, "Concrete Materials and Methods of Concrete Construction."

4.2.3.7. Steel

1) Steel used in *foundations* or in support of *soil* or *rock* shall conform with the appropriate requirements of Subsections 4.3.3. or 4.3.4., unless otherwise specified in this Section.

4.2.3.8. Steel Piles

1) Where steel *piles* are used in *deep foundations* and act as permanent load-carrying members, the steel shall conform with one of the following standards:

- a) CSA G40.21, "Structural Quality Steels," r4
- b) ASTM A 252, "Welded and Seamless Steel Pipe Piles,"
- c) ASTM A 283/A 283M, "Low and Intermediate Tensile Strength Carbon Steel Plates,"

d) ASTM A 1008/A 1008M, "Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability," or r4
e) ASTM A 1011/A 1011M, "Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability." r4

4.2.3.9. High Strength Steel Tendons

1) Where high strength steel is used for tendons in anchor systems used for the permanent support of a *foundation* or in the erection of temporary support of *soil* or *rock* adjacent to an *excavation*, it shall conform with the requirements of CSA A23.1, "Concrete Materials and Methods of Concrete Construction."

4.2.3.10. Corrosion of Steel

1) Where conditions are corrosive to steel, adequate protection of exposed steel shall be provided. (See Subsection 2.5.1. for use of other materials.)

4.2.4. Design Requirements

4.2.4.1. Design Basis

1) The design of *foundations*, excavations and *soil*- and *rock*-retaining structures shall be based on a *subsurface investigation* carried out in conformance with the requirements of this Section, and on one of the following:
a) application of generally accepted geotechnical and civil engineering principles by a professional engineer especially qualified in this field of work, as provided in this Section and other Sections of Part 4,
b) established local practice, where such practice includes successful experience both with *soils* and *rocks* of similar type and condition and with a *foundation* or *excavation* of similar type, construction method, size and depth, or
c) in situ testing of *foundation units* such as the load testing of *piles*, anchors or footings carried out by a person competent in this field of work.

(See Appendix A.)

4.2.4.2. Subsurface Investigation

1) A *subsurface investigation* shall be carried out to the depth and extent to which the *building* or *excavation* will significantly change the stress in the *soil* or *rock*, or to such a depth and extent as to provide all the necessary information for the design and construction of the *excavation* or the *foundations*.

4.2.4.3. Identification

1) The identification and classification of *soil*, *rock* and *groundwater* and descriptions of their engineering and physical properties shall be in accordance with a widely accepted system.

4.2.4.4. Loads on Foundations

1) The *foundation* of a *building* shall be capable of resisting all loads as stipulated in Section 4.1., in accordance with limit states design in Subsection 4.1.3. or working stress design in Subsection 4.1.4. (See Appendix A.)

4.2.4.5. Differential Movements

1) The *foundation* of a *building* shall be proportioned so that the estimated total and differential movements of the *foundation* are not greater than the movements that the *building* is designed to accommodate. (See Appendix A.)

4.2.4.6. Depth of Foundations

1) Except as permitted in Sentence (2), the *bearing surface* of a *foundation* shall be below the level of potential damage, including damage resulting from *frost action*, and the *foundation* shall be designed to prevent damage resulting from *adfreezing* and frost jacking. (See Appendix A.)

2) The *bearing surface* of a *foundation* need not be below the level of potential damage from frost where the *foundation*
a) is designed against *frost action*, or
b) overlies material not susceptible to *frost action*.

4.2.4.7. Sloping Ground

1) Where a *foundation* is to rest on, in or near sloping ground, this particular condition shall be provided for in the design.

4.2.4.8. Eccentric and Inclined Loads

1) Where there is eccentricity or inclination of loading in *foundation units*, this effect shall be fully investigated and provided for in the design.

4.2.4.9. Dynamic Loading

1) Where dynamic loading conditions apply, the effects shall be assessed by a special investigation of these conditions and provided for in the design.

4.2.4.10. Hydrostatic Uplift

1) Where a *foundation* or any part of a *building* is subject to hydrostatic uplift, the effects shall be provided for in the design.

4.2.4.11. Groundwater Level Change

1) Where proposed construction will result in a temporary or permanent change in the *groundwater level*, the effects of this change on adjacent property shall be fully investigated and provided for in the design.

4.2.4.12. Permafrost

1) Where conditions of permafrost are encountered or proven to exist, the design of the *foundation* shall be based upon analysis of these conditions by a person especially qualified in that field of work.

4.2.4.13. Swelling and Shrinking Soils

1) Where swelling or shrinking *soils*, in which movements resulting from moisture content changes may be sufficient to cause damage to a structure, are encountered or known to exist, such a condition shall be fully investigated and provided for in the design.

4.2.4.14. Expanding and Deteriorating Rock

1) Where *rock* which expands or deteriorates when subjected to unfavourable environmental conditions or to stress release is known to exist, such condition shall be fully investigated and provided for in the design.

4.2.4.15. Construction on Fill

1) *Buildings* may be placed on *fill* if it can be shown by *subsurface investigation* that
- a) the *fill* is or can be made capable of safely supporting the *building*,
- b) detrimental movement of the *building* or services leading to the *building* will not occur, and
- c) explosive gases can be controlled or do not exist.

4.2.4.16. Structural Design

1) The structural design of the *foundation* of a *building*, the procedures and construction practices shall conform with the appropriate Sections of this Code unless otherwise specified in this Section.

4.2.5. Excavations

4.2.5.1. Design of Excavations

1) The design of *excavations* and of supports for the sides of *excavations* shall conform with the requirements of Subsection 4.2.4. and with this Subsection. (See Appendix A.)

4.2.5.2. Excavation Construction

1) Every *excavation* shall be undertaken in such a manner as to
- a) prevent movement which would cause damage to adjacent property, existing structures, utilities, roads and sidewalks at all phases of construction, and
- b) comply with the appropriate requirements of Part 8.

2) Material shall not be placed nor shall equipment be operated or placed in or adjacent to an *excavation* in a manner that may endanger the integrity of the *excavation* or its supports.

4.2.5.3. Supported Excavations

1) The sides of an *excavation* in *soil* or *rock* shall be supported by a retaining structure conforming with the requirements of Articles 4.2.5.1. and 4.2.5.2., except as permitted in Article 4.2.5.4.

4.2.5.4. Unsupported Excavations

1) The sides of an *excavation* in *soil* or *rock* may be unsupported where a design is prepared in conformance with the requirements of Articles 4.2.5.1. and 4.2.5.2.

4.2.5.5. Control of Water around Excavations

1) Surface water, all *groundwater*, *perched groundwater* and in particular *artesian groundwater*, shall be kept under control at all phases of *excavation* and construction.

4.2.5.6. Loss of Ground

1) At all phases of *excavation* and construction, loss of ground due to water or any other cause shall be prevented.

4.2.5.7. Protection and Maintenance at Excavations

1) All sides of an *excavation*, supported and unsupported, shall be continuously maintained and protected from possible deterioration by construction activity or by the action of frost, rain and wind.

4.2.5.8. Backfilling

1) Where an *excavation* is backfilled, the backfill shall be placed so as to
- a) provide lateral support to the *soil* adjacent to the *excavation*, and
- b) prevent detrimental movements.

2) The material used as backfill or *fill* supporting a footing, *foundation* or a floor on *grade* shall be of a type that is not subject to detrimental volume change with changes in moisture content and temperature.

4.2.6. Shallow Foundations

4.2.6.1. Design of Shallow Foundations

1) The design of *shallow foundations* shall be in conformance with Subsection 4.2.4. and the requirements of this Subsection. (See Appendix A.)

4.2.6.2. Support of Shallow Foundations

1) Where a *shallow foundation* is to be placed on *soil* or *rock*, the *soil* or *rock* shall be cleaned of loose and unsound material and shall be adequate to support the design load taking into account temperature, precipitation, construction activities and other factors which may lead to changes of the properties of *soil* or *rock*.

4.2.6.3. Incorrect Placement of Shallow Foundations

1) Where a *shallow foundation unit* has not been placed or located as indicated on the drawings,
a) the error shall be corrected or
b) the design of the *foundation unit* shall be recalculated for the altered conditions by the *designer* and action taken as required in Article 2.3.4.7.

4.2.6.4. Damaged Shallow Foundations

1) Where a *shallow foundation unit* is damaged,
a) it shall be repaired or
b) the design of the *foundation unit* shall be recalculated for the damaged condition by the *designer* and action taken as required in Article 2.3.4.7.

4.2.7. Deep Foundations

4.2.7.1. General

1) A *deep foundation unit* shall provide support for a *building* by transferring loads by end-bearing to a competent stratum at considerable depth below the structure, or by mobilizing resistance by adhesion or friction, or both, in the *soil* or *rock* in which it is placed. (See Appendix A.)

4.2.7.2. Design of Deep Foundations

1) *Deep foundation units* shall be designed in conformance with Subsection 4.2.4. and this Subsection. (See Appendix A.)

2) Where *deep foundation units* are load tested, as required in Clause 4.2.4.1.(1)(c), the determination of the number and type of load test and the interpretation of the results shall be carried out by a professional engineer especially qualified in this field of work. (See Appendix A.)

3) Where *deep foundation units* are not load tested as outlined in Clause 4.2.4.1.(1)(c), and where well established local practice as outlined in Clause 4.2.4.1.(1)(b) is not applicable, the design shall be carried out in conformance with Clause 4.2.4.1.(1)(a).

4) The design of deep *foundations* shall be determined on the basis of geotechnical considerations taking into account
a) the method of installation,
b) the degree of inspection,
c) the spacing of *foundation units* and group effects,
d) other requirements of this Subsection, and
e) the appropriate structural requirements of Section 4.1. and Subsections 4.3.1., 4.3.3. and 4.3.4.

5) The portion of a *deep foundation unit* permanently in contact with *soil* or *rock* shall be structurally designed as a laterally supported compression member.

6) The portion of a *deep foundation unit* which is not permanently in contact with *soil* or *rock* shall be structurally designed as a laterally unsupported compression member.

7) The structural design of prefabricated *deep foundation units* shall allow for all stresses resulting from driving, handling and testing.

4.2.7.3. Tolerance in Alignment and Location

1) Permissible deviations from the design alignment and the location of the top of *deep foundation units* shall be determined by design analysis, and shall be indicated on the drawings.

4.2.7.4. Incorrect Alignment and Location

1) Where a *deep foundation unit* has not been placed within the permissible deviations referred to in Article 4.2.7.3., the condition of the *foundation* shall be assessed by the *designer*, any necessary changes made and action taken as required in Article 2.3.4.7.

4.2.7.5. Installation of Deep Foundations

1) *Deep foundation units* shall be installed in such a manner as not to impair
a) the strength of the *deep foundation units* and the properties of the *soil* or *rock* on or in which they are placed beyond the calculated or anticipated limits,
b) the integrity of previously installed *deep foundation units*, or
c) the integrity of neighbouring structures and services.

4.2.7.6. Damaged Deep Foundation Units

1) Where inspection shows that a *deep foundation unit* is damaged or not consistent with design or good engineering practice,
a) such a unit shall be reassessed by the *designer*,
b) any necessary changes shall be made and
c) action shall be taken as required in Article 2.3.4.7.

4.2.8. Special Foundations

4.2.8.1. General

1) Where special *foundation* systems are used, such systems shall conform to Subsection 4.2.4. and Section 2.5.

4.2.8.2. Use of Existing Foundations

1) Existing *foundations* may be used to support new or altered *buildings* provided they comply with all pertinent requirements of this Section.

Section 4.3. Design Requirements for Structural Materials

4.3.1. Wood

4.3.1.1. Design Basis for Wood

1) *Buildings* and their structural members made of wood shall conform to CSA O86, "Engineering Design in Wood." r4

4.3.1.2. Glued-Laminated Members

1) Glued-laminated members shall be fabricated in plants conforming to CAN/CSA-O177-M, "Qualification Code for Manufacturers of Structural Glued-Laminated Timber."

4.3.1.3. Termites

1) In areas known to be infested by termites, the requirements in Articles 9.3.2.9., 9.12.1.1. and 9.15.5.1. shall apply.

4.3.2. Plain and Reinforced Masonry

4.3.2.1. Design Basis for Plain and Reinforced Masonry

1) *Buildings* and their structural members made of plain and reinforced masonry shall conform to
a) CAN3-S304-M, "Masonry Design for Buildings," or
b) CSA S304.1, "Masonry Design for Buildings (Limit States Design)."

4.3.3. Plain, Reinforced and Prestressed Concrete

4.3.3.1. Design Basis for Plain, Reinforced and Prestressed Concrete

1) *Buildings* and their structural members made of plain, reinforced and prestressed concrete shall conform to CSA A23.3, "Design of Concrete Structures." (See Appendix A.)

4.3.4. Steel

4.3.4.1. Design Basis for Structural Steel

1) *Buildings* and their structural members made of structural steel shall conform to CSA S16, "Limit States Design of Steel Structures." (See Appendix A.) r5

4.3.4.2. Design Basis for Cold Formed Steel

1) *Buildings* and their structural members made of cold formed steel shall conform to CSA S136, "North American Specification for the Design of Cold-Formed Steel Structural Members." (See Appendix A.) r5

4.3.5. Aluminum

4.3.5.1. Design Basis for Aluminum

1) *Buildings* and their structural members made of aluminum shall conform to CAN3-S157-M, "Strength Design in Aluminum."

4.3.6. Glass

4.3.6.1. Design Basis for Glass

1) Glass used in *buildings* shall be designed in conformance with CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings."

Section 4.4. Design Requirements for Special Structures

4.4.1. Air-Supported Structures

4.4.1.1. Design Basis for Air-Supported Structures

1) The structural design of *air-supported structures* shall conform to CAN3-S367-M, "Air-Supported Structures."

4.4.2. Parking Structures

4.4.2.1. Design Basis for Parking Structures

1) Parking structures shall be designed in conformance with CSA S413, "Parking Structures."

Part 5
Environmental Separation

(See Appendix A.)

Section 5.1. General

5.1.1. Scope

5.1.1.1. Scope

1) This Part is concerned with r3
a) the control of condensation
  i) in *building* components and assemblies, and
  ii) on *building* materials, components and assemblies, and
b) the transfer of heat, air and moisture through
  i) *building* materials, components and assemblies, and
  ii) interfaces between *building* materials, components and assemblies.

(See Appendix A.)

5.1.2. Application

5.1.2.1. Exposure to Exterior Space or the Ground and Separation of Environments r3

1) This Part applies, as described in Section 2.1., to
a) *building* materials, components and assemblies exposed to exterior space or the ground, including those separating interior space from exterior space or separating interior space from the ground,
b) *building* materials, components and assemblies separating environmentally dissimilar interior spaces, and
c) site materials, components, assemblies and grading that may affect environmental loads on *building* materials, components and assemblies exposed to exterior space or the ground.

(See Appendix A.)

5.1.3. Definitions

5.1.3.1. Defined Words

1) Words that appear in italics are defined in Part 1.

5.1.4. Environmental Separation Requirements

5.1.4.1. Resistance to Environmental Loads

1) *Building* components and assemblies that separate dissimilar environments shall
a) be designed to have sufficient capacity and integrity to resist or accommodate all environmental loads and effects of those loads that may be reasonably expected, having regard to
  i) the intended use of the *building*, and
  ii) the environment to which the components and assemblies are subject, and
b) satisfy the requirements of this Part.

5.1.4.2. Resistance to Deterioration

(See Appendix A.)

1) Except as provided in Sentence (2), materials that comprise *building* components and assemblies that separate dissimilar environments shall be:
a) compatible with adjoining materials, and
b) resistant to any mechanisms of deterioration which would be reasonably expected, given the nature, function and exposure of the materials.

2) Material compatibility and deterioration resistance are not required where it can be shown that incompatibility or uncontrolled deterioration will not adversely affect any of
a) the health or safety of *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

5.1.5. Other Requirements

5.1.5.1. Requirements in Other Parts of the Code

1) Acoustical, structural and fire safety requirements of other Parts of this Code shall apply.

Section 5.2. Loads and Procedures

5.2.1. Environmental Loads

5.2.1.1. Exterior Environmental Loads

1) Except as provided in Sentences (2) and (3), climatic loads shall be determined according to Section 2.2.

2) Except as provided in Sentence (3), below ground exterior environmental loads not described in Section 2.2. shall be determined from existing geological and hydrological data or from site tests.

3) Where local design and construction practice has shown *soil* temperature analysis to be unnecessary, *soil* temperatures need not be determined. (See Appendix A.)

5.2.1.2. Interior Environmental Loads

1) Interior environmental loads shall be derived from the intended use of the space. (See Appendix A.)

5.2.2. Procedures

5.2.2.1. Calculations

1) Heat, air and moisture transfer calculations shall conform to good practice such as described in the ASHRAE Handbooks.

2) For the purposes of any analysis conducted to indicate conformance to the thermal resistance levels required in Article 5.3.1.2., *soil* temperatures shall be determined based on annual average *soil* temperature, seasonal amplitude of variation and attenuation of variation with depth.

3) Wind load calculations shall conform to Subsection 4.1.8.

Section 5.3. Heat Transfer

(See Appendix A.)

5.3.1. Thermal Resistance of Assemblies

5.3.1.1. Required Resistance to Heat Transfer

(See Appendix A.)

1) Except as provided in Sentence (2), where a *building* component or assembly will be subjected to an intended temperature differential, the component or assembly shall include materials to resist heat transfer in accordance with the remainder of this Subsection.

2) The installation of materials to resist heat transfer in accordance with the remainder of this Subsection is not required where it can be shown that uncontrolled heat transfer will not adversely affect any of

a) the health or safety of *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

5.3.1.2. Properties to Resist Heat Transfer

(See Appendix A.)

1) Materials and components installed to provide the required resistance to heat transfer shall provide sufficient resistance, for the interior and exterior design temperatures,

a) to minimize surface condensation on the warm side of the component or assembly,
b) in conjunction with other materials and components in the assembly, to minimize condensation within the component or assembly, and
c) in conjunction with systems installed for space conditioning, to meet the interior design thermal conditions for the intended *occupancy*.

2) Except as provided in Sentence (3), where materials or components are installed to provide the required resistance to heat transfer and are covered in the scope of the standards listed below, the materials and components shall conform to the requirements of the respective standards:

a) CAN/CGSB-12.8, “Insulating Glass Units,” r4
b) CGSB 51-GP-21M, “Thermal Insulation, Urethane and Isocyanurate, Unfaced,”
c) CAN/CGSB-51.25-M, “Thermal Insulation, Phenolic, Faced,”
d) CAN/CGSB-51.26-M, “Thermal Insulation, Urethane and Isocyanurate, Boards, Faced,”

e) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill,"
f) CAN/CGSB-82.1-M, "Sliding Doors,"
g) CAN/CGSB-82.5-M, "Insulated Steel Doors,"
h) CAN/CSA-A247-M, "Insulating Fibreboard."
i) CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering," r
j) CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," r e4
k) CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings," or r4
l) CAN/ULC-S705.1, "Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Material Specification," r2

(See Appendix A.)

3) The requirements for *flame-spread ratings* contained in the standards listed in Sentence (2) need be applied only as required in Part 3.

4) Except as provided in Sentence (5), all metal-framed glazed assemblies separating interior *conditioned space* from interior unconditioned space or exterior space shall incorporate a thermal break to minimize condensation.

5) Metal framed glazed assemblies need not comply with Sentence (4) where these assemblies are
a) storm windows or doors, or
b) windows or doors that are required to have a *fire-protection rating*. e2

(See Appendix A.)

5.3.1.3. Location and Installation of Materials Providing Thermal Resistance

1) Where a material required by Article 5.3.1.1. is intersected by a *building* assembly, penetrated by a high conductance component or interrupted by expansion, control or construction joints, and where condensation is likely to occur at these intersections, penetrations or interruptions, sufficient thermal resistance shall be provided so as to minimize condensation at these locations.

2) Materials providing required thermal resistance shall have sufficient inherent resistance to air flow or be positioned in the assembly so as to prevent convective air flow through and around the material. (See Appendix A.)

3) Spray-in-place polyurethane insulation shall be installed in accordance with the requirements of CAN/ULC-S705.2, "Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities–Specification." r2

Section 5.4. Air Leakage

5.4.1. Air Barrier Systems

5.4.1.1. Required Resistance to Air Leakage

(See Appendix A.)

1) Except as provided in Sentence (2), where a *building* component or assembly separates interior *conditioned space* from exterior space, interior space from the ground, or environmentally dissimilar interior spaces, the component or assembly shall contain an *air barrier system*.

2) An *air barrier system* is not required where it can be shown that uncontrolled air leakage will not adversely affect any of
a) the health or safety of *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

5.4.1.2. Air Barrier System Properties

1) Except as provided in Sentence (2), sheet and panel type materials intended to provide the principal resistance to air leakage shall have an air leakage characteristic not greater than 0.02 L/(s • m^2) measured at an air pressure difference of 75 Pa. (See Appendix A.)

2) The air leakage limit specified in Sentence (1) is permitted to be increased where it can be shown that the higher rate of leakage will not adversely affect any of
a) the health or safety of the *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

(See Appendix A.)

3) Except as provided in Sentence (6), where components of the *air barrier system* are covered in the scope of the standards listed below, the components shall conform to the requirements of the respective standards:
a) CAN/CGSB-63.14-M, "Plastic Skylights,"
b) CAN/CGSB-82.1-M, "Sliding Doors,"
c) CAN/CGSB-82.5-M, "Insulated Steel Doors," or
d) CSA A440, "Windows." r4

(See Appendix A.)

4) Skylights not covered in the scope of CAN/CGSB-63.14-M, "Plastic Skylights," shall conform to the performance requirements of that standard.

5) Except as provided in Sentence (6), windows and sliding doors covered in the scope of CAN/CGSB-82.1-M, "Sliding Doors," or CSA A440, "Windows," and installed as components in an *air barrier system* shall conform at least to the airtightness requirements in CSA A440.1, "User Selection Guide to A440." r4

6) Where a wired glass assembly is installed as a component in an *air barrier system* in a required *fire separation*, the assembly need not conform to CSA A440, "Windows," or CSA A440.1, "User Selection Guide to A440." (See Appendix A.) r4

7) The *air barrier system* shall be continuous
a) across construction, control and expansion joints,
b) across junctions between different *building* assemblies, and
c) around penetrations through the *building* assembly.

8) An *air barrier system* installed in an assembly subject to wind load, and other elements of the separator that will be subject to wind load, shall transfer that load to the structure.

9) Except as provided in Sentence (11), an *air barrier system* installed in an assembly subject to wind load shall be designed and constructed to resist 100% of the specified wind load as determined according to Subsection 4.1.8. for cladding. r

10) Except as provided in Sentence (11), deflections of the *air barrier system* and other elements of the separator that will be subject to wind load shall not adversely affect non-structural elements at 1.5 times the specified wind load.

11) Where it can be shown by test or analysis that an *air barrier system* installed in an assembly will be subject to less than 100% of the specified wind load,
a) the *air barrier system* is permitted to be designed and constructed to resist the lesser load, and
b) deflections of the *air barrier system* and other elements of the separator that will be subject to wind load shall not adversely affect non-structural elements at 1.5 times the lesser load.

Section 5.5. Vapour Diffusion

5.5.1. Vapour Barriers

5.5.1.1. Required Vapour Barrier

1) Except as provided in Sentence (2), where a *building* component or assembly will be subjected to a temperature differential and a differential in water vapour pressure, the component or assembly shall include a *vapour barrier*.

2) A *vapour barrier* is not required where it can be shown that uncontrolled vapour diffusion will not adversely affect any of
a) the health or safety of *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

5.5.1.2. Vapour Barrier Properties and Installation

(See A-5.3.1.2. in Appendix A.)

1) The *vapour barrier* shall have sufficiently low permeance and shall be positioned in the *building* component or assembly so as to
a) minimize moisture transfer by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, or
b) reduce moisture transfer by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, to a rate that will not allow sufficient accumulation of moisture to cause deterioration or otherwise adversely affect any of
i) the health or safety of *building* users,
ii) the intended use of the *building*, or
iii) the operation of *building* services.

(See Appendix A.)

2) Where materials installed to provide the required resistance to vapour diffusion are covered in the scope of the standards listed below, the materials shall conform to the requirements of the respective standards:
a) CAN/CGSB-51.33-M, "Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction," or
b) CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

(See Appendix A.)

3) Coatings applied to gypsum wallboard to provide required resistance to vapour diffusion shall be shown to conform with the requirements of Sentence (1) when tested in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard."

4) Coatings applied to materials other than gypsum wallboard to provide required resistance to vapour diffusion shall be shown to conform with the requirements of Sentence (1) when tested in accordance with ASTM E 96, "Water Vapor Transmission of Materials" by the desiccant method (dry cup).

Section 5.6. Precipitation

5.6.1. Protection from Precipitation

5.6.1.1. Required Protection from Precipitation

(See Appendix A.)

1) Except as provided in Sentence (2), where a *building* component or assembly is exposed to precipitation, the component or assembly shall
- a) minimize ingress of precipitation into the component or assembly, and
- b) prevent ingress of precipitation into interior space.

2) Protection from ingress of precipitation is not required where it can be shown that such ingress will not adversely affect any of
- a) the health or safety of *building* users,
- b) the intended use of the *building*, or
- c) the operation of *building* services.

5.6.1.2. Protective Material and Component Properties

1) Where materials or components applied to sloped or horizontal assemblies are installed to provide required protection from precipitation and are covered in the scope of the standards listed below, the materials or components shall conform to the requirements of the respective standards:
- a) ASTM D 2178, "Asphalt Glass Felt Used in Roofing and Waterproofing,"
- b) CAN/CGSB-37.4-M, "Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing,"
- c) CAN/CGSB-37.5-M, "Cutback Asphalt Plastic Cement,"
- d) CAN/CGSB-37.8-M, "Asphalt, Cutback, Filled, for Roof Coating,"
- e) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"
- f) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating,"
- g) CAN/CGSB-37.50-M, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing,"
- h) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
- i) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane," r
- j) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing,"
- k) CGSB 37-GP-64M, "Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-Up Roofing,"
- l) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"
- m) CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type,"
- n) CAN/CGSB-63.14-M, "Plastic Skylights,"
- o) CSA A123.1, "Asphalt Shingles Made From Organic Felt and Surfaced with Mineral Granules," r4
- p) CSA A123.2-M, "Asphalt Coated Roofing Sheets,"
- q) CSA A123.3, "Asphalt Saturated Organic Roofing Felt," r4
- r) CSA A123.4, "Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems," r4
- s) CSA A123.5, "Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules," r4
- t) CSA A123.17, "Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs,"
- u) CAN/CSA-A220.0-M, "Performance of Concrete Roof Tiles,"
- v) CSA O118.1, "Western Cedars, Shakes and Shingles," with shakes not less than No. 1 or Handsplit grade and shingles not less than No. 2 grade, or r e2
- w) CSA-O118.2-M, "Eastern White Cedar Shingles," not less than B grade.

(See Appendix A.)

2) Skylights that are not covered in the scope of CAN/CGSB-63.14-M, "Plastic Skylights," shall conform to the performance requirements of that standard.

3) Except as provided in Sentence (5), where materials or components applied to vertical assemblies are installed to provide required protection from precipitation and are covered in the scope of the standards listed below, the materials or components shall conform to the requirements of the respective standards:
- a) ASTM C 212, "Structural Clay Facing Tile,"
- b) CAN/CGSB-11.3-M, "Hardboard," types 1, 2 or 5 when not factory finished,
- c) CAN/CGSB-11.5-M, "Hardboard, Precoated, Factory Finished, for Exterior Cladding,"
- d) CAN/CGSB-34.4-M, "Siding, Asbestos-Cement, Shingles and Clapboards,"
- e) CAN/CGSB-34.5-M, "Sheets, Asbestos-Cement, Corrugated,"
- f) CAN/CGSB-34.14-M, "Sheets, Asbestos-Cement, Decorative,"

g) CAN/CGSB-34.16-M, "Sheets, Asbestos-Cement, Flat, Fully Compressed,"
h) CAN/CGSB-34.17-M, "Sheets, Asbestos-Cement, Flat, Semicompressed,"
i) CAN/CGSB-34.21-M, "Panels, Sandwich, Asbestos-Cement with Insulating Cores,"
j) CAN/CGSB-41.24, "Rigid Vinyl Siding, Soffits and Fascia," r
k) CAN/CGSB-51.32–M, "Sheathing, Membrane, Breather Type," r
l) CAN/CGSB-82.1-M, "Sliding Doors," r
m) CAN/CGSB-82.5-M, "Insulated Steel Doors," r
n) CAN/CGSB-93.1-M, "Sheet, Aluminum Alloy, Prefinished, Residential," r
o) CAN/CGSB-93.2-M, "Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use," r
p) CAN/CGSB-93.3-M, "Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use," r
q) CAN/CGSB-93.4, "Galvanized and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential," r
r) CSA A371, "Masonry Construction for Buildings," Section 4, r
s) CSA A440, "Windows," r r4
t) CSA O115-M, "Hardwood and Decorative Plywood," r
u) CSA O118.1, "Western Cedars, Shakes and Shingles," with shakes not less than No. 1 or Handsplit grade and shingles not less than No. 2 grade, except that No. 3 grade may be used for undercoursing, r e2
v) CSA O118.2-M, "Eastern White Cedar Shingles," not less than B (clear) grade, except that C grade may be used for undercoursing, r
w) CSA O121-M, "Douglas Fir Plywood," r
x) CSA O151-M, "Canadian Softwood Plywood," r
y) CSA O153-M, "Poplar Plywood," r
z) CAN/CSA-O325.0, "Construction Sheathing," or r
aa) CSA O437.0, "OSB and Waferboard." r

(See Appendix A.)

4) Except as provided in Sentence (5), windows and sliding doors exposed to the exterior and covered in the scope of CSA A440, "Windows," or CAN/CGSB-82.1-M, "Sliding Doors," shall conform at least to the water tightness requirements in CSA A440.1, "User Selection Guide to A440." r4

5) Where a wired glass assembly in a required *fire separation* is exposed to the exterior, the assembly need not conform to CSA A440, "Windows," or CSA A440.1, "User Selection Guide to A440." (See Appendix A.) r4

5.6.1.3. Installation of Protective Materials

1) Where a material applied to a sloped or horizontal assembly is installed to provide required protection from precipitation and its installation is covered in the scope of one of the standards listed below, installation shall conform to the requirements of the respective standard:
a) CAN/CGSB-37.51-M, "Application of Hot-Applied Rubberized Asphalt for Roofing and Waterproofing,"
b) CGSB 37-GP-55M, "Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane,"
c) CAN3-A123.51-M, "Asphalt Shingle Application on Roof Slopes 1:3 and Steeper," or
d) CAN3-A123.52-M, "Asphalt Shingle Application on Roof Slopes 1:6 to Less Than 1:3."

2) Protective materials applied to sloped or horizontal assemblies shall be installed to resist wind-uplift loads determined according to Subsection 4.1.8.

3) Where masonry applied to vertical assemblies is installed to provide required protection from precipitation, installation shall conform to the requirements of CSA A371, "Masonry Construction for Buildings."

4) Where protective materials applied to assemblies are installed to provide required protection from precipitation, the materials shall be installed to shed precipitation or otherwise minimize its entry into the assembly and prevent its penetration through the assembly.

5.6.2. Sealing, Drainage, Accumulation and Disposal

5.6.2.1. Sealing and Drainage

(See Appendix A.)

1) Except as provided in Sentence (2), materials, components, assemblies, joints in materials, junctions between components and junctions between assemblies exposed to precipitation shall be
a) sealed to prevent ingress of precipitation, or
b) drained to direct precipitation to the exterior.

2) Sealing or drainage are not required where it can be shown that the omission of sealing and drainage will not adversely affect any of
a) the health or safety of *building* users,
b) the intended use of the *building*, or
c) the operation of *building* services.

5.6.2.2. Accumulation and Disposal

1) Where water, snow or ice can accumulate on a *building*, provision shall be made to minimize the likelihood of hazardous conditions arising from such accumulation.

2) Where precipitation can accumulate on sloped or horizontal assemblies, provision shall be made for drainage conforming with the relevant provincial, territorial or municipal regulations or, in the absence of such regulations, with Article 4.10.4. of the National Plumbing Code of Canada 1995.

3) Where downspouts are provided and are not connected to a sewer, provisions shall be made to
- a) divert the water from the *building*, and
- b) prevent *soil* erosion.

4) Junctions between vertical assemblies, and sloped or horizontal assemblies, shall be designed and constructed to minimize the flow of water from the sloped or horizontal assembly onto the vertical assembly.

Section 5.7. Surface Water

5.7.1. Protection from Surface Water

5.7.1.1. Prevention of Accumulation and Ingress

1) Except as provided in Sentence (2), the *building* shall be located, the *building* site graded, catch basins installed, or *foundation* walls constructed so that surface water will not
- a) accumulate against or enter into the *building*, or
- b) damage moisture-susceptible materials.

2) *Buildings* specifically designed to accommodate accumulation of water at the *building* or water ingress need not comply with Clause (1)(a).

Section 5.8. Moisture in the Ground

5.8.1. Foundation and Floor Drainage

5.8.1.1. Required Drainage

1) Except where a wall or floor is subject to continuous hydrostatic pressure, or unless it can be shown to be unnecessary, the bottom of every exterior *foundation* wall and every floor-on-ground shall be provided with drainage. (See Appendix A.)

5.8.1.2. Drainage Materials and Installation

1) Drainage shall be specified and installed to accommodate the drainage load.

5.8.2. Protection from Moisture in the Ground

(See Appendix A.)

5.8.2.1. Required Moisture Protection

1) Except as provided in Sentence (2), where a *building* element separates interior space from the ground, materials, components or assemblies shall be installed to prevent moisture transfer into the space.

2) Materials, components or assemblies need not be installed to prevent moisture transfer from the ground where it can be shown that such transfer will not adversely affect any of
- a) the health or safety of *building* users,
- b) the intended use of the *building*, or
- c) the operation of *building* services.

5.8.2.2. Protective Material and Component Properties

1) Except where it can be shown that lesser protection will not lead to adverse conditions, or as provided in Article 5.8.2.3., materials and components installed to provide required moisture protection shall conform to the requirements of this Article.

2) Except as provided in Sentence (3), materials installed to provide required moisture protection shall be capable of bridging
- a) construction, control and expansion joints,
- b) junctions between different *building* assemblies, and
- c) junctions between *building* assemblies and elements penetrating *building* assemblies.

3) Where the required moisture protection material is not capable of bridging construction, control and expansion joints, those joints shall be designed to maintain the continuity of the moisture protection.

4) Moisture protection materials and components shall have sufficiently low water permeance to resist moisture loads.

5) Moisture protection shall be designed and constructed to resist design hydrostatic pressures as determined in accordance with Section 4.2.

6) Where materials installed to provide the required resistance to moisture transfer are covered in the scope of the standards listed below, the materials shall conform to the requirements of the respective standards:
a) CAN/CGSB-37.2-M, "Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings,"
b) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"
c) CAN/CGSB-37.16-M, "Filled, Cutback Asphalt for Dampproofing and Waterproofing,"
d) CAN/CGSB-37.50-M, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing,"
e) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
f) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane," r
g) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing," or
h) CSA A123.4, "Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems." r4

(See Appendix A.)

7) Except as provided in Sentence (8), materials covered in the scope of the standards listed below shall not be installed to provide the required resistance to moisture transfer:
a) CGSB 37-GP-6Ma, "Asphalt, Cutback, Unfilled, for Dampproofing," or
b) CGSB 37-GP-18Ma, "Tar, Cutback, Unfilled, for Dampproofing."

8) Where the substrate is cast-in-place concrete, and a drainage layer is installed between the *building* assembly and the *soil*, and the assembly will not be subject to hydrostatic pressure,
a) materials and components installed to provide the required resistance to moisture transfer need not conform with Sentences 5.8.2.2.(1) to (5), and
b) materials covered in the scope of the following standards are permitted to be installed to provide the required resistance to moisture transfer where those materials conform to the requirements of the standards:
   i) CGSB 37-GP-6Ma, "Asphalt, Cutback, Unfilled, for Dampproofing," or
   ii) CGSB 37-GP-18Ma, "Tar, Cutback, Unfilled, for Dampproofing."

(See Appendix A.)

5.8.2.3. Installation of Moisture Protection

1) Except as provided in Sentence (2), where materials are installed to provide the required resistance to moisture transfer and their installation is covered in the scope of the standards listed below, installation shall conform to the waterproofing requirements of the respective standards:
a) CAN/CGSB-37.3-M, "Application of Emulsified Asphalts for Dampproofing or Waterproofing,"
b) CGSB 37-GP-36M, "Application of Filled Cutback Asphalts for Dampproofing and Waterproofing,"
c) CGSB 37-GP-37M, "Application of Hot Asphalt for Dampproofing or Waterproofing," or
d) CAN/CGSB-37.51-M, "Application of Hot-Applied Rubberized Asphalt for Roofing and Waterproofing."

2) Where the substrate is cast-in-place concrete, and a drainage layer is installed between the *building* assembly and the *soil*, and the assembly will not be subject to hydrostatic pressure
a) materials and components installed to provide the required resistance to moisture transfer and whose installation is covered in the scope of the standards listed in Sentence (1), are permitted to be installed in conformance with the dampproofing requirements of the standards listed in Sentence (1), or
b) materials installed to provide the required resistance to moisture transfer and whose installation is covered in the scope of the standards listed below, shall be installed in conformance with the requirements of the respective standards:
   i) CGSB 37-GP-12Ma, "Application of Unfilled Cutback Asphalt for Dampproofing," or
   ii) CAN/CGSB-37.22-M, "Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing."

(See A-5.8.2.2.(8) in Appendix A.)

Part 6
Heating, Ventilating and Air-Conditioning

Section 6.1. General

6.1.1. Application

6.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1.

6.1.1.2. Application

1) This Part applies to systems and equipment for heating, ventilating and air-conditioning services.

6.1.2. Definitions

6.1.2.1. Defined Terms

1) Words that appear in italics are defined in Part 1.

6.1.3. Plans and Specifications

6.1.3.1. Required Plans and Specifications

1) Plans, specifications and other information for heating, ventilating and air-conditioning systems shall conform to Subsection 2.3.5.

Section 6.2. Design and Installation

6.2.1. General

6.2.1.1. Good Engineering Practice

1) Heating, ventilating and air-conditioning systems, including mechanical refrigeration equipment, shall be designed, constructed and installed to conform to good engineering practice such as described in

a) the ASHRAE Handbooks and Standards,
b) the HRAI Digest,
c) the Hydronics Institute Manuals,
d) the NFPA standards,
e) the SMACNA Manuals,
f) the Industrial Ventilation Manual published by the American Conference of Governmental Industrial Hygienists, and
g) CAN/CSA-Z317.2-M, “Special Requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities.”

6.2.1.2. Fire Safety Requirements

1) The fire safety characteristics of heating, ventilating and air-conditioning systems shall comply with Subsection 3.6.5.

2) Characteristics referred to in Sentence (1) include but are not limited to

a) use of *combustible* materials in duct systems,
b) *flame-spread ratings* and smoke-developed ratings of duct and pipe materials and coverings,
c) installation of equipment relative to property lines, and
d) requirements for *fire dampers* and *fire-stop flaps*.

6.2.1.3. Capacity of Heating Appliances in Dwelling Units

1) The required capacity of a space heating *appliance* located in a *dwelling unit* and serving only that *dwelling unit*, shall be determined in accordance with CAN/CSA-F280-M, “Determining the Required Capacity of Residential Space Heating and Cooling Appliances,” except that the outside winter design temperatures shall conform to Subsection 2.2.1.

6.2.1.4. Structural Movement

(See Appendix A.) r

1) Mechanical systems and equipment shall be designed and installed to accommodate the maximum relative structural movement provided for in the construction of the *building*. (See Article 4.1.1.5., Subsection 4.1.9. and Article 4.1.10.5. for information on the types of structural movements that may be encountered.) e

6.2.1.5. Installation Standards

1) Except as provided in Articles 6.2.1.6. and 6.2.1.7., the installation of heating and air-conditioning equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to the requirements of

a) CSA B51, "Boiler, Pressure Vessel, and Pressure Piping Code,"
b) CSA B52, "Mechanical Refrigeration Code," r
c) CSA B139, "Installation Code for Oil-Burning Equipment," r4
d) CSA B149.1, "Natural Gas and Propane Installation Code," r4
e) CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment," and r4
f) CSA C22.1, "Canadian Electrical Code, Part I."

6.2.1.6. Fireplaces

1) Fireplaces shall conform to the requirements of Section 9.22.

6.2.1.7. Heat Recovery Ventilators

1) Heat recovery ventilators with rated capacities of not less than 25 L/s and not more than 200 L/s shall be installed in accordance with Subsection 9.32.3.

6.2.1.8. Outside Design Conditions

1) The outside conditions to be used in designing heating, ventilating and air-conditioning systems shall be determined in conformance with Subsection 2.2.1.

6.2.1.9. Installation – General

1) Equipment requiring periodic maintenance and forming part of a heating, ventilating or air-conditioning system shall be installed with provision for access for inspection, maintenance, repair and cleaning. (See Appendix A.)

2) Mechanical equipment shall be guarded to prevent injury to the public or maintenance staff.

3) Equipment forming part of a heating or air-conditioning system shall be protected from freezing if

a) it may be adversely affected by freezing temperatures; and
b) it is located in an unheated area.

6.2.1.10. Expansion, Contraction and System Pressure

1) Heating and cooling systems shall be designed to allow for expansion and contraction of the heat transfer fluid and to maintain the system pressure within the rated working pressure limits of all components of the system.

6.2.1.11. Asbestos

1) Asbestos shall not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

6.2.1.12. Access Openings

1) Any covering of an access opening through which a person could enter shall be openable from the inside without the use of keys where there is a possibility of the opening being accidentally closed while the system or equipment is being serviced.

6.2.2. Ventilation

6.2.2.1. Required Ventilation

1) Except as provided in Sentence (3), all rooms and spaces in *buildings* shall be ventilated in accordance with this Part.

2) Except in *storage garages* covered by Article 6.2.2.3., the rates at which outdoor air is supplied to rooms and spaces in *buildings* by ventilation systems shall be not less than the rates required by ANSI/ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality."

3) Self-contained mechanical ventilation systems serving only one *dwelling unit* which conform to the requirements of Subsection 9.32.3. shall be considered to satisfy the requirements of this Article.

6.2.2.2. Natural Ventilation

1) The ventilation required by Article 6.2.2.1. shall be provided by mechanical ventilation except that it can be provided by natural ventilation or a combination of natural and mechanical ventilation in

a) *buildings* of other than *residential occupancy* having an *occupant load* of not more than one person per 40 m² during normal use,
b) *buildings* of *industrial occupancy* where the nature of the process contained therein permits or requires the use of large openings in the *building* envelope even during the winter, and
c) seasonal *buildings* not intended to be occupied during the winter.

6.2.2.3. Ventilation of Storage Garages

1) Except as provided in Sentences (4) and (6), an enclosed *storage garage* shall have a mechanical ventilation system designed to
a) limit the concentration of carbon monoxide to not more than 100 parts per million parts of air when measured between 900 mm and 1 200 mm from the floor, or
b) provide, during operating hours, a continuous supply of outdoor air at a rate of not less than 3.9 L/s for each square metre of *floor area*. (See also Article 3.3.1.19. and Sentence 3.3.5.4.(4).)

2) Mechanical ventilation systems provided in accordance with Clause (1)(a) shall be controlled by carbon monoxide monitoring devices.

3) Mechanical ventilation systems provided in accordance with Sentence (1) shall be designed such that the pressure in the *storage garage* is less than the pressure in adjoining *buildings* of other *occupancy*, or in adjacent portions of the same *building* having a different *occupancy*.

4) In *storage garages* subject to the requirements of Sentences (1) and (2), where motor vehicles are parked by mechanical means, the ventilation requirements may be reduced by one half.

5) Except as provided in Sentence (6), ticket and attendant booths of *storage garages* shall be pressurized with a supply of uncontaminated air.

6) The requirements of Sentences (1) to (5) shall not apply to *open-air storeys* in a *storage garage*.

6.2.2.4. Air Contaminants

1) Air contaminants released within *buildings* shall be removed insofar as possible at their points of origin and shall not be permitted to accumulate in concentrations greater than permitted in the Industrial Ventilation Manual published by the American Conference of Governmental Industrial Hygienists.

2) Systems serving spaces that contain sources of contamination and systems serving other occupied parts of the *building* but located in or running through spaces that contain sources of contamination shall be designed in such a manner as to prevent spreading of such contamination to other occupied parts of the *building*.

3) Heating, ventilating and air-conditioning systems shall be designed to minimize the growth of micro-organisms. (See Appendix A.)

6.2.2.5. Hazardous Gases, Dusts or Liquids

1) Systems serving spaces that contain hazardous gases, dusts or liquids, such as grain elevators, metal powder plants and ammonium nitrate storage, shall be designed, constructed and installed to conform to the requirements of the appropriate provincial or territorial legislation or, in the absence of such legislation, to good engineering practice such as is described in the publications of the National Fire Protection Association and in the National Fire Code of Canada 1995. (See Appendix A.)

6.2.2.6. Commercial Cooking Equipment

1) Systems for the ventilation of commercial cooking equipment shall be designed, constructed and installed to conform to NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," except as required by Sentence 3.6.3.1.(1) and Article 3.6.4.2.

6.2.2.7. Crawl Spaces and Attic or Roof Spaces

1) Every crawl space and every *attic or roof space* shall be ventilated by natural or mechanical means.

6.2.3. Air Duct Systems

6.2.3.1. Application

1) Where ducts serve a heating system with a rated heat input not more than 120 kW, the requirements of Subsection 6.2.4. shall apply in addition to those in this Subsection.

6.2.3.2. Materials in Air Duct Systems

1) Ducts in a location where they may be subjected to excessive moisture shall be
a) constructed of materials that have no appreciable loss of strength when wet, and
b) corrosion-resistant.

6.2.3.3. Connections and Openings in Air Duct Systems

1) Air duct systems shall have
a) tight-fitting connections throughout, and
b) no openings other than those required for proper operation and maintenance of the system.

2) Except for systems that serve one *dwelling unit* only, access openings shall be provided in duct systems where lint, grease, debris, paper or other *combustible* material may accumulate in *plenums* and ducts.

6.2.3.4. Duct Linings

1) Linings of ducts shall be installed so that they will not interfere with the operation of volume or balancing dampers or of *fire dampers*, *fire stop flaps* and other *closures*.

6.2.3.5. Underground Ducts

1) Underground ducts
a) shall be constructed to provide interior drainage from and access to all low points, and
b) shall not be connected directly to a sewer.

6.2.3.6. Clearances

1) The clearances from *combustible* material and supply *plenums*, *supply ducts*, boots and register boxes of heating systems shall conform to the requirements of Subsection 3.6.5.

6.2.3.7. Fire Dampers

1) *Fire dampers* shall conform to the requirements of Article 3.1.8.9.

6.2.3.8. Smoke Detector Control

1) Air handling systems shall incorporate *smoke detector* control where and as required by Article 3.2.4.12.

6.2.3.9. Exhaust Ducts and Outlets

1) Except as provided in Sentence (2), *exhaust ducts* of nonmechanical ventilating systems serving separate rooms or spaces shall not be combined.

2) *Exhaust ducts* of nonmechanical ventilating systems serving similar *occupancies* may be combined immediately below the point of final delivery to the outside, such as the base of a roof ventilator.

3) *Exhaust ducts* of ventilating systems shall have provision for the removal of condensation where this may be a problem.

4) Exhaust outlets shall be designed to prevent backdraft under wind conditions.

5) Except as permitted in Sentence (6), exhaust systems shall discharge directly to the outdoors. (See Appendix A.)

6) Exhaust systems are permitted to exhaust into a *storage garage* provided such systems serve rooms which
a) are accessible only from that *storage garage*, and
b) are not served by duct systems serving other parts of the *building*.
(See Appendix A.)

7) *Exhaust ducts* connected to laundry drying equipment shall be independent of other *exhaust ducts*.

8) Except as provided in Sentence (10) and except for self-contained systems serving individual *dwelling units*, *exhaust ducts* serving rooms containing water closets, urinals, basins, showers or slop sinks shall be independent of other *exhaust ducts*.

9) Except as provided in Sentence (10) and except for self-contained systems serving individual *dwelling units*, *exhaust ducts* serving rooms containing residential cooking equipment shall be independent of other *exhaust ducts*.

10) Two or more exhaust systems described in Sentences (8) and (9) may be interconnected or connected with *exhaust ducts* serving other areas of the *building* provided
a) the connections are made at the inlet of an exhaust fan, and
b) all interconnected systems are equipped with suitable back pressure devices to prevent passage of odours from one system to another when the fan is not in operation.

11) Where *exhaust ducts* containing air from heated spaces pass through or are adjacent to unheated spaces, the ducts shall be insulated to prevent moisture condensation in the ducts.

6.2.3.10. Interconnection of Systems

1) Except as provided in Sentence 6.2.3.9.(6), air duct systems serving garages shall not be interconnected with other parts of the *building*.

2) In a *residential occupancy*, air from one *suite* shall not be circulated to any other *suite* or to a *public corridor*.

6.2.3.11. Ducts in Exit Stairways

1) Duct penetration of *fire separations* separating *exits* from the remainder of the *building* shall be in accordance with Article 3.4.4.4.

6.2.3.12. Make-up Air

1) In ventilating systems that exhaust air to the outdoors, provision shall be made for the admission of a supply of make-up air in sufficient quantity so that the operation of the exhaust system and other exhaust equipment or combustion equipment is not adversely affected.

2) Make-up air facilities required by Sentence (1) shall be interlocked with the exhaust devices they serve so that both operate together.

3) Where make-up air facilities are intended to introduce air directly from outdoors to occupied parts of the *building* in winter, they shall incorporate means of tempering that air to maintain the indoor design temperature.

6.2.3.13. Supply, Return, Intake and Exhaust Air Openings

1) Supply, return and exhaust air openings in rooms or spaces in *buildings* when located less than 2 m above the floor shall be protected by grilles having openings of a size that will not allow the passage of a 15 mm diam sphere.

2) Outdoor air intakes and exhaust outlets at the *building* exterior shall be designed or located so that air entering the *building* system will not contain more contaminants than the normal exterior air of the locality in which the *building* is situated.

3) Exterior openings for outdoor air intakes and exhaust outlets shall be shielded from the entry of snow and rain and shall be fitted with corrosion-resistant screens of mesh having openings not larger than 15 mm, except where experience has shown that climatic conditions require larger openings to avoid icing over of the screen openings.

4) Screens required in Sentence (3) shall be accessible for maintenance.

6.2.3.14. Filters and Odour Removal Equipment

1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in ULC-S111, "Fire Tests for Air Filter Units." r

2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or, in *dwelling units*, when the *furnace* circulating fan is not operating.

3) When odour removal equipment of the adsorption type is used it shall be
- a) installed to provide access so that adsorption material can be reactivated or renewed, and
- b) protected from dust accumulation by air filters installed on the inlet side.

4) Facilities for flushing and drainage shall be provided where filters are designed to be washed in place.

6.2.3.15. Air Washers and Evaporative Cooling Sections or Towers

1) The filter and water evaporation medium of every air washer and evaporative cooling section enclosed within a *building* shall be made of *noncombustible* material.

2) Sumps for air washer and evaporative cooling sections shall be constructed and installed so that they can be flushed and drained.

3) Evaporative cooling sections or towers of *combustible* material located on or outside *buildings* shall have a clearance from sources of ignition such as *chimneys* or incinerators of not less than
- a) 12 m when the tower exterior construction is *noncombustible*, and
- b) 30 m when the tower exterior construction is *combustible*.

4) Evaporative cooling sections or towers whose main structure exceeds a volume of 55 m^3 shall comply with the requirements of NFPA 214, "Water-Cooling Towers." e3

6.2.3.16. Fans and Associated Air Handling Equipment

1) Fans for heating, ventilating and air-conditioning systems shall be located and installed so that their operation
- a) does not adversely affect the draft required for proper operation of fuel-fired *appliances*, and
- b) does not allow the air in the duct system to be contaminated by air or gases from the *boiler*-room or *furnace*-room.

2) Fans and associated air handling equipment, such as air washers, filters and heating and cooling units, when installed on the roof or elsewhere outside the *building*, shall be of a type designed for outdoor use.

6.2.4. Air Ducts for Low Capacity Heating Systems

6.2.4.1. Application

1) The design, construction and installation of air duct distribution systems serving heating systems in which the rated heat input does not exceed 120 kW shall conform to this Subsection and Subsection 6.2.3.

6.2.4.2. Duct Design

1) The design of ducts and fittings shall conform to SMACNA, "HVAC Duct Construction Standards – Metal and Flexible."

6.2.4.3. Construction and Installation of Ducts and Plenums

1) Rectangular panels in *plenums* and ducts more than 300 mm wide shall be shaped to provide sufficient stiffness.

2) Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space shall be fire stopped with *noncombustible* material at each end.

3) Ducts shall be securely supported by metal hangers, straps, lugs or brackets, except that, where zero clearance is permitted, wooden brackets may be used.

4) All round duct joints shall be tight-fitting and lapped not less than 25 mm.

5) Rectangular duct connections shall be made with S and drive cleats or equivalent mechanical connections.

6) Trunk *supply ducts* shall not be nailed directly to wood members.

7) Branch ducts shall be supported at suitable spacings to maintain alignment and prevent sagging.

8) *Combustible* ducts in concrete slabs-on-ground that are connected to a *furnace* supply *plenum* shall be located not less than
a) 600 mm from that *plenum*, and
b) 600 mm from its connection to a riser or register.

9) Ducts in or beneath concrete slabs-on-ground shall be watertight and corrosion-, decay-, and mildew-resistant.

6.2.4.4. Warm-Air Supply Outlets

1) In a *dwelling unit*, a warm-air supply outlet shall be provided in each finished room that is located adjacent to unheated space.

2) Except as provided in Sentence (3), when a room described in Sentence (1) is located adjacent to exterior walls, a warm-air supply outlet shall be located so as to bathe at least one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical.

3) Where the heating system is also designed to provide ventilation air, ceiling outlets or outlets located high on interior walls may be installed provided the outlets are
a) designed for this purpose, and
b) installed with diffusers.

4) At least one warm-air supply outlet shall be provided for each 40 m² of *floor area* in unfinished *basements* serving *dwelling units*.

5) The warm-air supply outlet required in Sentence (4) shall be located so as to provide adequate distribution of warm air throughout the *basement*.

6) Except for pipeless *furnaces* and floor *furnaces*, the capacity of warm-air supply outlets serving *dwelling units*
a) shall be not less than the design heat loss from the area served, and
b) shall not exceed 3 kW per outlet.

7) In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces may be considered in calculating the design heat loss.

8) Warm-air supply outlets located in finished areas
a) shall be provided with diffusers and adjustable openings, and
b) shall not be located on a *furnace plenum*.

9) The temperature of supply air at warm-air supply outlets shall not exceed 70°C.

6.2.4.5. Concrete Slabs-on-Ground

1) Warm-air supply systems for *buildings* of *residential occupancy* built on concrete slabs-on-ground
a) shall be installed in the slab, and
b) shall be of the perimeter loop type or radial perimeter type.

6.2.4.6. Adjustable Dampers and Balance Stops

1) All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops shall be
a) supplied with adjustable dampers, and
b) fitted with devices to indicate the positions of the dampers.

6.2.4.7. Return-Air System

1) A *public corridor* or public stairway shall not be used as a return-air *plenum*.

2) Except for a return-air *plenum* located within a *dwelling unit*, where a ceiling assembly is used as a *plenum*, the requirements of Subsection 3.6.5. shall apply. e4

6.2.5. Heating Appliances, General

6.2.5.1. Location of Appliances

1) Except for *appliances* installed in *dwelling units*, fuel-fired heating *appliances* shall be located, enclosed or separated from the remainder of the *building* in conformance with Section 3.6. (See also Subsection 9.10.10.)

6.2.5.2. Appliances Installed outside the Building

1) Fuel-fired *appliances* installed on the roof of a *building* or otherwise outside the *building* shall be designed for outdoor use.

6.2.6. Incinerators

6.2.6.1. Applicable Standard

1) The design, construction, installation and *alteration* of every indoor incinerator shall conform to NFPA 82, "Incinerators and Waste and Linen Handling Systems and Equipment."

6.2.6.2. Venting

1) Every incinerator shall be served by a *chimney flue* conforming to Section 6.3.

6.2.7. Unit Heaters

6.2.7.1. Clearances

1) Every *unit heater* using either steam or hot water as the heating medium shall be installed with a clearance of not less than 25 mm between the *appliance* and adjacent *combustible* material.

6.2.8. Radiators and Convectors

6.2.8.1. Lining or Backing

1) A *noncombustible* lining or backing shall be provided for every steam or hot water radiator and convector
a) located in a recess or concealed space, or
b) attached to the face of a wall of *combustible construction*.

6.2.9. Piping for Heating and Cooling Systems

6.2.9.1. Piping Materials and Installation

1) Piping shall be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system. (See Articles 3.1.5.15., 3.1.9.1., 9.10.9.6. and 9.10.9.7. for fire safety requirements.)

2) Every pipe used in a heating or air-conditioning system shall be installed to allow for expansion and contraction due to temperature changes.

3) Supports and anchors for piping in a heating or air-conditioning system shall be designed and installed to ensure that undue stress is not placed on the supporting structure.

6.2.9.2. Insulation and Coverings

1) Insulation and coverings on pipes shall be composed of material which will withstand deterioration from softening, melting, mildew and mould at the operating temperature of the system.

2) Pipes that are exposed to human contact shall be insulated so that the temperature of the exposed surface does not exceed 70°C. (See Appendix A.)

6.2.9.3. Clearances

1) Clearances between *combustible* material and bare pipes carrying steam or hot water shall conform to Table 6.2.9.3.

Table 6.2.9.3.
Clearance between Steam or Hot Water Pipes and Combustible Material r3
Forming Part of Article 6.2.9.3.

Steam or Water Temperature, °C	Minimum Clearance, mm
Up to 95	No clearance
Above 95 to 120	15
Above 120	25

6.2.9.4. Surface Temperature

1) The exposed surface temperature of a steam or hot water radiator shall not exceed 70°C unless precautions are taken to prevent human contact.

6.2.9.5. Protection

1) Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction shall be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

2) Unprotected steam or hot water pipes that pass through a storage space shall be covered with not less than 25 mm of *noncombustible* insulation to prevent direct contact with the material stored.

6.2.9.6. Piping in Shafts

1) Where piping for heating or air-conditioning systems is enclosed in a shaft, the requirements of Article 3.6.3.1. for shafts shall apply.

6.2.10. Refrigerating Systems and Equipment for Air-Conditioning

6.2.10.1. Cooling Units

1) Where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, the cooling unit shall be installed
a) in parallel with the heating *furnace*,
b) upstream of the *furnace* provided the *furnace* is designed for such application, or
c) downstream of the *furnace* provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

6.2.11. Storage Bins

6.2.11.1. Storage Bins

1) Service pipes passing through a storage bin for solid fuel shall be protected or so located as to avoid damage to the pipes.

2) Except for fuel-thawing pipes, every pipe designed to operate at a temperature of 50°C or above shall be located where fuel cannot be stored in contact with it.

3) A storage bin for solid fuel shall not be located above a sewer opening or drain opening.

4) Storage bins for solid fuel shall be designed and constructed so that the air temperature in the bin or the surface temperature of any part of the floor or walls is below 50°C.

6.2.11.2. Ash Storage Bins

1) Every ash storage bin shall be constructed of *noncombustible* material.

2) Where an ash storage bin is not covered, the ceiling of the room in which it is located shall be of *noncombustible* material.

3) Every opening in an ash storage bin shall be protected by a tight-fitting metal door with metal frame securely fastened to the bin.

Section 6.3. Chimneys and Venting Equipment

6.3.1. General

6.3.1.1. Requirement for Venting

1) Except as provided in Articles 6.3.1.2. and 6.3.1.3., the products of combustion from oil-, gas- and solid-fuel burning *appliances* shall be vented in conformance with the requirements in the applicable *appliance* installation standard listed in Article 6.2.1.5.

6.3.1.2. Masonry or Concrete Chimneys

1) Rectangular *masonry or concrete chimneys* not more than 12 m in height shall conform to Part 9 if they serve
a) *appliances* with a combined total rated heat output of 120 kW or less, or
b) fireplaces.

2) *Masonry or concrete chimneys* other than those described in Sentence (1) shall be designed and installed in conformance with the appropriate requirements in NFPA 211, "Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances."

6.3.1.3. Metal Smoke Stacks

1) Single wall metal smoke stacks shall be designed and installed in conformance with NFPA 211, "Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances."

6.3.1.4. Lightning Protection Systems

1) A lightning protection system, when provided, shall conform to the requirements of the appropriate provincial or territorial legislation or, in the absence of such legislation, to CAN/CSA-B72-M, "Installation Code for Lightning Protection Systems."

6.3.1.5. Access Ladders

1) Access ladders for *chimneys*, when provided, shall consist of steel or bronze rungs, built into the walls of the *chimneys*.

2) Rungs for external ladders shall begin at not less than 2.5 m from ground level.

Part 7
Plumbing Services

Section 7.1. General

7.1.1. Scope

7.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1.

7.1.1.2. Application

1) This Part applies to the design, construction, extension, *alteration*, renewal or repair of *plumbing systems*.

7.1.2. Design and Installation

7.1.2.1. Conformance with Regulations or National Plumbing Code

1) Every *plumbing system* shall be designed and installed in conformance with appropriate municipal, territorial or provincial regulations or, in the absence of such regulations, in conformance with the National Plumbing Code of Canada 1995.

7.1.3. Required Facilities

7.1.3.1. All Buildings Except Dwelling Units

1) *Buildings* shall be equipped with plumbing facilities as required in Subsection 3.7.4. and Article 3.8.2.3.

7.1.3.2. Dwelling Units

1) *Dwelling units* shall be equipped with plumbing facilities as required in Section 9.31.

7.1.4. Definitions

7.1.4.1. Defined Terms

1) Words that appear in italics are defined in Part 1.

Part 8
Safety Measures at Construction and Demolition Sites

Section 8.1. General

8.1.1. Scope

8.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1.

2) This Part applies to fire safety and the protection of the public during the construction, *alteration* or demolition of every *building*, including any incompleted or abandoned *building*.

8.1.1.2. Definitions

1) Words that appear in italics are defined in Part 1.

8.1.1.3. Demolition Procedures

1) Measures shall be taken during demolition to protect the public in conformance with CSA S350-M, "Code of Practice for Safety in Demolition of Structures," and Subsection 8.2.2.

8.1.2. Application

8.1.2.1. Application

1) Where a *building* is undergoing construction, *alteration* or demolition, measures shall be taken at the *building* site in conformance with this Code. (See Appendix A.)

8.1.2.2. Protection from Risk

1) Precautions shall be taken to ensure that no person is exposed to undue risk.

Section 8.2. Protection of the Public and Fire Safety

8.2.1. Fencing and Barricades

8.2.1.1. Covered Way Exceptions

1) Where the construction may constitute a hazard to the public, work shall not commence on the construction, *alteration* or repair of a *building* until a covered way has been provided as described in Article 8.2.1.2. to protect the public, except where
a) the work is done within a solid enclosure,
b) the *building* is at a distance of 2 m or more from a *public way* used by pedestrians, or
c) site conditions warrant a distance greater than provided in Clause (b).

8.2.1.2. Covered Way Construction

1) A covered way shall
a) have a clear height of not less than 2.5 m,
b) have a clear width of not less than 1.5 m or the width of the *public way*, whichever is the lesser,
c) be designed and constructed to support safely all loads that may be reasonably expected to be applied to it, but in no case less than 2.4 kPa on the roof,
d) have a weathertight roof sloped towards the site or, if flat, be equipped with a splash board not less than 300 mm high on the *street* side,
e) be totally enclosed on the site side with a structure having a reasonably smooth surface facing the *public way*,
f) have a railing 1 070 mm high on the *street* side where the covered way is supported by posts on the *street* side, and
g) be adequately lighted when the *public way* is lighted.

8.2.1.3. Fencing, Boarding or Barricades

1) When a construction or demolition activity may constitute a hazard to the public and is located 2 m or more from a *public way*, a strongly constructed fence, boarding or barricade not less than 1.8 m high shall be erected between the site and the *public way* or open sides of a construction site.

2) Barricades shall have a reasonably smooth surface facing the *public way* and shall be without openings, except those required for access.

3) Access openings through barricades shall be equipped with gates that shall be
a) kept closed and locked when the site is unattended, and
b) maintained in place until completion of the construction or demolition activity.

8.2.1.4. Special Hazards

1) Where any special hazard exists from which it is not possible to protect the public by other means, persons shall be employed to prevent the public from entering the danger zone at any time of the day or night.

8.2.1.5. Work Shutdown

1) When work on a construction site is suspended or ceases so that it will not be occupied during normal working hours, the hazardous part of the construction site shall be protected by
a) covering all windows, doors and other openings located within 3 m of the ground which may give access to the *building* with a securely fastened barricade, or
b) a fence or barricade constructed according to the requirements of Article 8.2.1.3.

8.2.2. Fire Safety at Demolition Sites

8.2.2.1. Application to Demolition Sites

1) This Subsection applies to *buildings* or parts of *buildings* undergoing demolition. (See Appendix A.)

2) The degree of application of this Subsection to each demolition activity shall be determined prior to the commencement of demolition as part of the fire safety plan. (See Appendix A.)

8.2.2.2. Fire Safety Plan

1) Prior to the commencement of demolition, a fire safety plan conforming to Section 2.14. of the National Fire Code of Canada 1995 shall be prepared for the demolition site.

8.2.2.3. Access for Fire Fighting

1) Unobstructed access shall be maintained to fire hydrants and to fire department connections for standpipe and sprinkler systems.

2) Where practicable, access routes to the demolition site shall be provided for fire department vehicles. (See Appendix A.)

3) Where a demolition site is fenced so as to prevent general entry, provision shall be made for access by fire department equipment and personnel.

8.2.2.4. Portable Extinguishers

1) Portable extinguishers shall be installed and maintained in conformance with Part 6 of the National Fire Code of Canada 1995.

2) In addition to the requirements of Sentence (1), portable extinguishers shall be provided
a) adjacent to cutting or welding operations,
b) in areas where *combustibles* are stored,
c) near or on any internal-combustion engines,
d) adjacent to areas where *flammable liquids* or gases are stored or handled, and
e) adjacent to temporary oil-fired or gas-fired equipment.

3) The minimum rating for extinguishers required by Sentences (1) and (2) shall be
a) 2-A:10-B:C on moveable equipment, and
b) 4-A:40-B:C in all other locations.

8.2.2.5. Standpipe Systems

1) Where a *building* being demolished floor by floor is equipped with a standpipe system, such system, together with fire department connections and valves, shall be maintained in operable condition on all *storeys* below that being demolished except the *storey* immediately below it. (See Appendix A.)

8.2.2.6. Cutting and Welding Operations

1) Cutting and welding operations shall conform to Section 5.2. of the National Fire Code of Canada 1995.

2) Areas on a demolition site where cutting and welding operations have taken place shall be kept under supervision for not less than 1 h after the operations have been completed.

8.2.2.7. Egress Provision

1) At least one stairway shall be maintained in usable condition at all times.

8.2.2.8. Fire Warning

1) A system shall be provided to alert site personnel of fire in a *building* being demolished.

2) The system required by Sentence (1) shall be capable of being heard throughout the *building*.

8.2.2.9. Building Service Shut-Off

1) Except as required by Sentence (2), and except for water supplies for fire fighting, *building* services shall be shut off and gas and fuel lines shall be capped in a *building* being demolished.

2) Temporary electrical installations shall be installed in conformance with the requirements of
- a) provincial, territorial or municipal regulations, or
- b) CSA C22.1, "Canadian Electrical Code, Part I," in the absence of regulations referred to in Clause (a).

8.2.2.10. Clearance to Combustible Materials

1) Internal-combustion engines shall be located so that the exhaust discharges not less than 500 mm from *combustible* materials.

2) Where exhaust from internal-combustion engines is piped outdoors, a clearance of not less than 150 mm shall be maintained between the exhaust pipe and *combustible* material.

8.2.2.11. Fuel Supply Installation

1) Fuel supplies for heating equipment and internal-combustion engines shall conform to
- a) CSA B139, "Installation Code for Oil-Burning Equipment," or r4
- b) CSA B149.1, "Natural Gas and Propane Installation Code." r4

8.2.2.12. Tank, Piping and Machinery Reservoir Safety

1) Tanks, piping and machinery reservoirs containing *combustible liquids* or *flammable liquids* or which are likely to contain flammable vapours shall be drained and, except as permitted by Sentence (2), removed prior to demolition of the *building*.

2) Where it is impracticable to remove tanks, piping or machinery reservoirs from the *building* prior to demolition, such equipment shall be conspicuously identified and removed as soon as conditions permit.

3) Tanks, piping and machinery reservoirs referred to in Sentences (1) and (2) which contained *combustible liquids*, *flammable liquids* or flammable gases shall be purged with inert materials prior to demolition to prevent an explosion. (See Appendix A.)

8.2.2.13. Fire Separations in Partly Occupied Building

1) Where part of a *building* continues to be occupied during demolition, the occupied part shall be separated from that being demolished by a *fire separation* having a *fire-resistance rating* of not less than 1 h.

8.2.2.14. Watch

1) A watch, with tours at intervals of not more than 1 h, shall be provided throughout demolition sites when there are occupants in the portion of the *building* not being demolished.

2) Facilities shall be provided to enable the watcher to communicate with the fire department.

8.2.2.15. Smoking Restrictions

1) Smoking shall be permitted only in conformance with Subsection 2.4.2. of the National Fire Code of Canada 1995.

8.2.3. Fire Safety at Construction Sites

8.2.3.1. Application to Construction Sites

1) This Subsection applies to all *buildings* and portions of *buildings* under construction and includes *alterations*. (See Appendix A.)

8.2.3.2. Fire Safety Plan

1) Prior to construction, a fire safety plan conforming to Section 2.14. of the National Fire Code of Canada 1995 shall be prepared for the construction site.

8.2.3.3. Access for Fire Fighting

1) Unobstructed access to fire protection equipment, such as hydrants, fire department connections and portable extinguishers, shall be maintained at all times.

2) Where practicable, access routes to the construction site shall be provided for fire department vehicles. (See A-8.2.2.3.(2) in Appendix A.)

3) Where a construction site is fenced so as to prevent general entry, provision shall be made for access by fire department equipment and personnel.

8.2.3.4. Portable Extinguishers

1) Portable extinguishers shall be installed and maintained in conformance with Part 6 of the National Fire Code of Canada 1995.

2) In addition to the requirements of Sentence (1), portable extinguishers shall be provided
- a) adjacent to cutting or welding operations,
- b) in areas where combustibles are stored,
- c) near or on any internal-combustion engines,
- d) adjacent to areas where *flammable liquids* or gases are stored or handled,
- e) adjacent to temporary oil-fired or gas-fired equipment, and
- f) adjacent to bitumen heating equipment.

3) The minimum rating for extinguishers required by Sentences (1) and (2) shall be
a) 2-A:10-B:C on moveable equipment, and
b) 4-A:40-B:C in all other locations.

8.2.3.5. Standpipe Systems

1) Where a standpipe system is to be installed in a *building*, such system shall be installed progressively in conformance with Article 3.2.5.9.

8.2.3.6. Cutting and Welding Operations

1) Cutting and welding operations shall conform to Section 5.2. of the National Fire Code of Canada 1995.

8.2.3.7. Egress Provisions

1) In areas of the *building* in which construction operations are taking place, at least one *exit* shall be accessible and usable at all times.

8.2.3.8. Fire Warning

1) A system shall be provided to alert site personnel of fire.

2) The system required by Sentence (1) shall be capable of being heard throughout the *building*.

8.2.3.9. Clearance to Combustible Materials

1) Clearances between *combustible* material and internal-combustion engines shall conform to Article 8.2.2.10.

2) The clearance between *combustible* materials and temporary heating equipment, including *flues*, shall be in conformance with Part 6 or in conformance with the minimum clearances shown on certified heating equipment.

8.2.3.10. Combustible Liquid and Flammable Liquid Storage

1) *Combustible liquids* and *flammable liquids* shall be stored and used in conformance with Part 4 of the National Fire Code of Canada 1995.

2) Bitumen heating equipment shall be provided with metal covers.

3) Bitumen heating equipment shall be under constant supervision when in operation.

4) Mops used for spreading bitumen shall be kept outside the *building* in a safe location.

8.2.3.11. Watch

1) Except where the *building* is provided with a fire alarm system or similar equipment acceptable to the *authority having jurisdiction*, a watch, with tours at intervals of not more than 1 h, shall be provided when a portion of a *building* is occupied while construction operations are taking place.

2) In *buildings* which are occupied prior to completion of construction, provision shall be made for the watcher to sound the alarm and notify the fire department.

8.2.3.12. Smoking Restrictions

1) Smoking shall be permitted only in conformance with Subsection 2.4.2. of the National Fire Code of Canada 1995.

8.2.3.13. Disposal of Combustible Refuse

1) *Combustible* refuse in sufficient quantities to constitute a fire hazard shall be moved to a safe location. (See also Subsection 8.2.7.)

8.2.3.14. Temporary Enclosures

1) Fabrics and films used temporarily to enclose *buildings* shall be securely fastened to prevent them from being blown against heaters or other ignition sources.

8.2.4. Excavation

8.2.4.1. Building Services Shut-Off

1) Except as provided in Article 8.2.4.2., before *excavation* begins, all existing gas, electrical, water, steam and other services shall be shut off, capped and labelled so as to permit easy identification outside the limits of the *excavation*.

2) The service company whose service connections will be affected shall be notified in advance of any action and, if it is necessary to maintain any such service, it shall be
a) relocated as necessary, and
b) protected from damage in such a way as to afford safety to the public.

8.2.4.2. Maintaining Existing Services

1) Existing gas, electrical, water, steam and other services are permitted to be left within the area of the *excavation* provided that
a) before work begins the approval of the service company involved is obtained to the proposed method of operation,
b) their location is determined before *excavation* commences,
c) a suitable method of *excavation* is adopted that will ensure that they are not damaged, and
d) suitable temporary supports are provided.

8.2.4.3. Water Removal

1) *Excavations* shall be kept reasonably clear of water so as not to endanger the safety of the public or to create conditions hazardous to health.

8.2.4.4. Protection of Adjoining Property

1) If the stability of adjoining structures, walks, walls or services may be endangered by the work of excavating, adequate underpinning, shoring and bracing shall be provided to prevent
a) damage to, or movement of, any part of the adjoining property, or
b) the creation of a hazard to the public.

8.2.5. Use of Streets or Public Property

8.2.5.1. Safe Passage Past Site

1) Except as provided in Article 8.2.5.2., provisions shall be made at all times for the safe passage of pedestrian and vehicular traffic past the site.

2) Material or equipment shall not be placed on any *street* or other public property except as authorized.

3) Except as provided in Sentence (4), where a sidewalk exists adjacent to the site it shall be kept clear of obstructions at all times.

4) Where construction operations necessitate the obstruction of a sidewalk, a temporary sidewalk shall be provided and it shall be kept clear of obstruction at all times.

8.2.5.2. Overhead Activities

1) Operations such as the hoisting of major components onto a tall *building* or other overhead activities that constitute a hazard to pedestrians below from which the public cannot be protected by barricades, covered ways or similar means shall not be carried out until the *street* or other *public way* is closed.

8.2.5.3. Barricades

1) *Excavations* in *streets* or public property shall
a) be adequately barricaded, and
b) have warning signs or lights installed on each section of the barricades referred to in Clause (a).

8.2.5.4. Restoration and Repair

1) All sidewalks, *streets* or other public property that have been damaged shall be restored to a safe condition.

2) All obstructions on sidewalks, *streets* or other public property shall be removed when the need for such obstructions is ended.

8.2.5.5. Warning Lights

1) Warning lights shall be placed and shall be in operation during the hours of darkness at all obstructions on *streets* or other *public ways*.

8.2.6. Direction of Vehicular Traffic

8.2.6.1. Hazards to Vehicular Traffic

1) Where a hazard to vehicular traffic on a *public way* is created by work on a construction site, the following shall be provided to direct the traffic:
a) one or more workers,
b) warning signs,
c) barriers,
d) lane control devices, or
e) flashing lights or flares located at a suitable distance from the hazard.

8.2.6.2. Flags Used for Directing Traffic

1) A flag used to direct traffic shall be
a) red,
b) not less than 450 mm by 500 mm,
c) mounted on a staff not less than 1 m long, with the long side of the flag attached securely to the staff along its entire length, and
d) maintained in a clean and untorn condition when being used.

8.2.6.3. Signs Used for Directing Traffic

1) A sign used to direct traffic shall be
a) diamond-shaped and of material not less rigid than 6 mm thick plywood,
b) not less than 450 mm by 450 mm in size and mounted at one corner on a substantial pole not less than 1.2 m long,
c) red on one side with black corner areas so that the red area is a regular 8-sided figure, and with the word “STOP” or “ARRÊT” in clearly distinguishable white letters not less than 150 mm high located centrally on the sign,
d) yellow on the other side with the word “SLOW” or “LENTEMENT” in clearly distinguishable black letters not less than 150 mm high located centrally on the sign, or symbols recognized by the International Traffic Code, and
e) maintained in a clean condition when being used.

8.2.6.4. Worker Directing Traffic

1) A worker who is directing traffic shall
a) be equipped as required by Article 8.2.6.5.,

b) be instructed in the signals to be used in controlling traffic,
c) be provided with a copy of written instructions on the correct methods for traffic direction, and
d) direct traffic by using either a flag or sign.

8.2.6.5. Clothing While Directing Traffic

1) A worker while directing traffic shall wear the following clothing which shall be fluorescent and coloured either blaze orange or red:
a) a vest, or
b) sleeves that extend from above the elbow to the wrist.

8.2.7. Waste Material

8.2.7.1. Control of Waste Material

1) Waste material or other material shall not be permitted to fall freely from one *storey* to another.

8.2.7.2. Removal of Waste Material

1) Waste material shall be removed as quickly as possible by means of
a) appropriate containers,
b) an enclosed shaft or chute conforming to Sentence 8.2.7.4.(1), or
c) a hoisting apparatus if large pieces or objects are involved.

8.2.7.3. Enclosures for Waste Material

1) Waste material cleared as provided in Sentence 8.2.7.2.(1) shall be deposited in an enclosure
a) so arranged as to prevent waste material from being projected beyond the confines of the enclosure, and
b) not accessible to the public.

8.2.7.4. Chutes for Waste Material

1) The chute described in Clause 8.2.7.2.(1)(b) shall
a) be closed if it is inclined more than 45° with the horizontal,
b) be kept closed or covered at its entrance when not in use, and
c) have a device to prevent wheelbarrows from entering the top of the chute.

Part 9
Housing and Small Buildings

Section 9.1. General

9.1.1. Scope

9.1.1.1. Scope

1) The scope of this Part shall be as described in Section 2.1. (See Appendix A regarding application to seasonally and intermittently occupied *buildings*.)

Section 9.2. Definitions

9.2.1. General

9.2.1.1. Defined Words

1) Words in italics are defined in Part 1.

Section 9.3. Materials, Systems and Equipment

9.3.1. Concrete

9.3.1.1. Concrete

1) Concrete shall be designed, mixed, placed, cured and tested in accordance with CAN3-A438-M, "Concrete Construction for Housing and Small Buildings."

9.3.1.2. Cement

1) Cement shall meet the requirements of CSA A5, "Portland Cement." r4

9.3.1.3. Concrete in Contact with Sulphate Soil

1) Concrete in contact with sulphate *soil* deleterious to normal cement shall conform to the requirements in Clause 15.5 of CSA A23.1, "Concrete Materials and Methods of Concrete Construction."

9.3.1.4. Aggregates

1) Aggregates shall
- a) consist of sand, gravel, crushed *rock*, crushed air-cooled blast *furnace* slag, expanded shale or expanded clay conforming to CSA A23.1, "Concrete Materials and Methods of Concrete Construction," and
- b) be clean, well-graded and free of injurious amounts of organic and other deleterious material.

9.3.1.5. Water

1) Water shall be clean and free of injurious amounts of oil, organic matter, sediment or any other deleterious material.

9.3.1.6. Compressive Strength

(See also Articles 9.12.4.1., 9.15.4.1. and 9.18.6.1.)

1) Except as provided elsewhere in this Part, the compressive strength of unreinforced concrete after 28 days shall be not less than
- a) 15 MPa for walls, columns, fireplaces and *chimneys*, *foundation* walls, grade beams, piers, and floors other than those for garages and carports, and r
- b) 25 MPa for garage and carport floors, and exterior steps.

2) Concrete used for garage and carport floors and exterior steps shall have air entrainment of 5 to 8%.

9.3.1.7. Concrete Mixes

1) The concrete mixes described in Table 9.3.1.7. shall be considered acceptable if, when measured according to the slump test described in Appendix A of CAN3-A438-M, "Concrete Construction for Housing and Small Buildings," the slump does not exceed
- a) 150 mm for footings for walls, columns, fireplaces and *chimneys*, *foundation* walls, grade beams and piers, or
- b) 100 mm for slabs-on-ground.

Table 9.3.1.7.
Concrete Mixes
Forming Part of Sentence 9.3.1.7.(1)

Maximum Size of Coarse Aggregate, mm	Materials, volume					
	Cement		Fine Aggregate (damp average coarse sand)		Coarse Aggregate (gravel or crushed stone)	
	Parts	L(1)	Parts	L	Parts	L
14	1	28	1.75	49	2	56
20	1	28	1.75	49	2.5	70
28	1	28	2	56	3	84
40	1	28	2	56	3.5	98

Notes to Table 9.3.1.7.:
(1) A 40 kg bag of cement contains 28 L.

2) Aggregate for unreinforced concrete mixes referred to in Sentence (1) shall not exceed in size
a) 1/5 the distance between the sides of vertical forms, or
b) 1/3 the thickness of flatwork.

9.3.1.8. Admixtures

1) Admixtures shall conform to ASTM C 260, “Air-Entraining Admixtures for Concrete,” or ASTM C 494/C 494M, “Chemical Admixtures for Concrete,” as applicable. rr4

9.3.1.9. Reinforced Concrete

1) Reinforced concrete shall be designed to conform to the requirements of Part 4.

9.3.1.10. Cold Weather Requirements

1) When the air temperature is below 5°C, concrete shall be
a) kept at a temperature of not less than 10°C or more than 25°C while being mixed and placed, and
b) maintained at a temperature of not less than 10°C for 72 h after placing.

2) No frozen material or ice shall be used in concrete described in Sentence (1).

9.3.2. Lumber and Wood Products

9.3.2.1. Grade Marking

1) Lumber for joists, rafters, trusses and beams and for the uses listed in Table 9.3.2.1. shall be identified by a grade stamp to indicate its grade as determined by the NLGA “Standard Grading Rules for Canadian Lumber.” (See Appendix A.)

9.3.2.2. Lumber Grades

1) Except for joists, rafters, trusses and beams, visually graded lumber shall conform to the grades in Table 9.3.2.1. (See Article 9.23.4.2. for joists, rafters and beams and Article 9.23.13.11. for trusses.)

9.3.2.3. Machine Stress Rated Lumber

1) Machine stress rated lumber shall conform to the requirements of Subsection 4.3.1.

9.3.2.4. OSB, Waferboard and Plywood Marking

1) OSB, waferboard and plywood used for roof sheathing, wall sheathing and subflooring shall be legibly identified on the face of the material indicating
a) the manufacturer of the material,
b) the standard to which it is produced, and
c) that the material is of an exterior type.

9.3.2.5. Moisture Content

1) Moisture content of lumber shall be not more than 19% at the time of installation.

9.3.2.6. Lumber Dimensions

1) Lumber dimensions referred to in this Part are actual dimensions determined in conformance with CAN/CSA-O141, “Softwood Lumber.”

9.3.2.7. Panel Thickness Tolerances

1) The thicknesses specified in this Part for plywood, hardboard, particleboard, OSB and waferboard shall be subject to the tolerances permitted in the standards referenced for these products unless specifically indicated herein.

9.3.2.8. Undersized Lumber

1) Joist, rafter, lintel and beam members up to 5% less than the actual Canadian standard sizes are permitted to be used provided the allowable spans for the grade and species of lumber under consideration are reduced 5% from those shown in the span tables for full size members. (See Appendix A.)

9.3.2.9. Termite and Decay Protection

1) In localities where termites are known to occur, the clearance between structural wood elements and the finished ground level directly below them shall be not less than 450 mm, unless the structural wood elements are pressure treated with a chemical that is toxic to termites. e2

Table 9.3.2.1.
Minimum Lumber Grades for Specific End Uses
Forming Part of Sentence 9.3.2.1.(1)

Use	Boards(1)			Framing
	Paragraph in the NLGA grading rules under which boards are graded			
	All Species		Eastern White Pine & Red Pine	All Species
	Para 113	Para 114	Para 118	
Stud wall framing (*loadbearing* members)	—	—	—	Stud, Standard, No. 2
Stud wall framing (non-*loadbearing* members)	—	—	—	Stud, Utility, No. 3
Plank frame construction (*loadbearing* members)	No. 3 Common	—	No. 3 Common	No. 2
Plank frame construction (non-*loadbearing* members)	No. 5 Common	—	No. 5 Common	Economy, No. 3
Posts and beams less than 114 mm in thickness	—	—	—	Standard, No. 2
Posts and beams not less than 114 mm in thickness	—	—	—	Standard
Roof sheathing	No. 3 Common	Standard	No. 4 Common	—
Subflooring	No. 3 Common	Standard	No. 3 Common	—
Wall sheathing when required as a nailing base	No. 4 Common	Utility	No. 4 Common	—
Wall sheathing not required as a nailing base	No. 5 Common	Economy	No. 5 Common	—

Notes to Table 9.3.2.1.:
(1) See Appendix A.

2) Structural wood elements shall be pressure treated with a preservative to resist decay where
a) the structural wood elements are in contact with the ground, or
b) the vertical clearance between structural wood elements and the finished ground level is less than 150 mm. (See also Articles 9.23.2.2. and 9.23.2.3.) e2

3) Where wood is required by this Article to be treated to resist termites or decay, such treatment shall be in accordance with the requirements of
a) CSA O80.1, "Preservative Treatment of All Timber Products by Pressure Processes," r
b) CSA O80.2, "Preservative Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Processes," r
c) CSA O80.9, "Preservative Treatment of Plywood by Pressure Processes," or r
d) CSA O80.15, "Preservative Treatment of Wood for Building Foundation Systems, Basements, and Crawl Spaces by Pressure Processes." r

9.3.3. Metal

9.3.3.1. Sheet Metal Thickness

1) Minimum thicknesses for sheet metal material given in this Part refer to the actual minimum thicknesses measured at any point of the material, and in the case of galvanized steel, include the thickness of the coating unless otherwise indicated.

9.3.3.2. Galvanized Sheet Metal

1) Where galvanized sheet metal is intended for use in locations exposed to the weather or as a flashing material, it shall have a zinc coating not less than the G90 coating designation in
a) ASTM A 653/A 653M, "Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process," or r
b) ASTM A 924/A 924M, "Steel Sheet, Metallic-Coated by the Hot-Dip Process." r

Section 9.4. Structural Requirements

(See Appendix A.)

9.4.1. General

9.4.1.1. Structural Design

1) Except as provided in Sentence (2), Sentence 9.23.4.2.(2) and Subsections 9.4.2. to 9.4.4., structural members and their connections shall be designed in conformance with Part 4.

2) Where structural members and their connections conform to the requirements listed elsewhere in this Part, it shall be deemed that the structural design requirements have been met.

9.4.1.2. Post, Beam and Plank Construction

1) Except for columns described in Section 9.17. and beams described in Subsection 9.23.4., post, beam and plank construction with the *loadbearing* framing members spaced more than 600 mm apart shall be designed in conformance with Subsection 4.3.1.

9.4.2. Specified Loads

9.4.2.1. Application

1) This Subsection applies to light-frame constructions where wall, floor and roof planes are generally comprised of frames of small repetitive structural members, and where r4

a) roof and wall planes are clad, sheathed or braced on at least one side,
b) the small repetitive structural members are spaced not more than 600 mm o.c.,
c) the span of any structural member does not exceed 12.20 m,
d) the maximum deflection of the structural roof members does not exceed the limits specified in Sentence 9.23.13.11.(1) based on the loads specified in that Sentence,
e) the maximum total roof area, notwithstanding any separation of adjoining *buildings* by *firewalls*, is 4 550 m^2, and
f) for flat roofs, there are no significant obstructions on the roof, such as parapet walls, spaced closer than the distance calculated by:

$$D_o = 10(H_o - 0.8S_s/\gamma)$$

where
D_o = the minimum distance between obstructions, m,
H_o = the height of the obstruction above the roof, m,
S_s = the ground snow load, kPa, and
γ = the unit weight of snow, kN/m^3.

(See Appendix A.)

9.4.2.2. Specified Snow Loads

1) Except as provided in Sentences (2) and (3), specified snow loads shall be not less than those calculated using the following formula:

$$S = C_b \bullet S_s + S_r$$

where
S = the specified snow load,
C_b = the basic snow load roof factor, which is 0.5 where the entire width of a roof does not exceed 4.3 m and 0.6 for all other roofs,
S_s = the ground snow load in kPa, determined according to Subsection 2.2.1., and
S_r = the associated rain load in kPa, determined according to Subsection 2.2.1.

2) In no case shall the specified snow load be less than 1 kPa.

3) Bow string, arch or semi-circular roof trusses having an unsupported span greater than 6 m shall be designed in conformance with the snow load requirements in Subsection 4.1.7.

9.4.2.3. Balconies

1) Residential balconies not used as passageways shall be designed to carry the specified roof snow load or 1.9 kPa, whichever is greater.

9.4.2.4. Attics

1) Residential attics having limited accessibility to preclude storage of equipment or material shall be designed for a total specified load of not less than 0.35 kPa, where the total specified load is the sum of the specified *dead load* plus the specified live ceiling load. (See Appendix A.) r2

9.4.3. Deflections

9.4.3.1. Deflections

1) The maximum deflection of structural members shall conform to Table 9.4.3.1.

2) *Dead loads* need not be considered in computing deflections referred to in Sentence (1).

9.4.4. Foundation Conditions

9.4.4.1. Allowable Bearing Pressures

1) Where footing sizes for *shallow foundations* are not determined in conformance with Section 9.15., footings may be designed using maximum allowable bearing pressures in Table 9.4.4.1.

Table 9.4.4.1.
Allowable Bearing Pressure for Soil or Rock
Forming Part of Sentence 9.4.4.1.(1)

Type and Condition of *Soil* or *Rock*	Maximum Allowable Bearing Pressure, kPa
Dense or compact sand or gravel(1)	150
Loose sand or gravel(1)	50
Dense or compact silt(1)	100
Stiff clay(1)	150
Firm clay(1)	75
Soft clay(1)	40
Till	200
Clay shale	300
Sound *rock*	500

Notes to Table 9.4.4.1.:
(1) See Appendix A.

9.4.4.2. Foundation Capacity in Weaker Soil and Rock

1) Where a *soil* or *rock* within a distance equal to twice the footing width below the *bearing surface* has a lower allowable bearing pressure than that at the *bearing surface* as shown in Article 9.4.4.1., the design capacity of the *foundation* shall not be greater than would cause the weakest *soil* or *rock* to be stressed beyond its allowable bearing pressure.

2) In calculating subsurface pressures referred to in Sentence (1), the loads from the footings shall be assumed to be distributed uniformly over a horizontal plane within a frustum extending downward from the footing at an angle of 60° to the horizontal.

9.4.4.3. High Water Table

1) Where a *foundation* bears on gravel, sand or silt, and the water table is within a distance below the *bearing surface* equal to the width of the *foundation*, the allowable bearing pressure shall be 50% of that determined in Article 9.4.4.1.

9.4.4.4. Soil Movement

1) Where a *foundation* is located in an area in which *soil* movement caused by changes in *soil* moisture content is known to occur to the extent that it will cause significant damage to a *building*, measures shall be taken to minimize the effect of such movement on the *building*.

9.4.4.5. Retaining Walls

1) Walls shall be designed to resist the lateral pressure of the retained material.

9.4.4.6. Walls Supporting Drained Earth

1) Walls supporting drained earth may be designed for pressure equivalent to that exerted by a fluid with a density of not less than 480 kg/m^3 and having a depth equal to that of the retained earth.

Table 9.4.3.1.
Maximum Deflections
Forming Part of Sentence 9.4.3.1.(1)

Structural Members	Type of Ceiling Supported	Max. Allowable Deflection as an Expressed Ratio of the Clear Span
Roof rafters, roof joists, roof beams and roof decking of plank and beam construction	No ceiling	1/180
	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Ceiling joists	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Floor beams, floor joists and floor decking	All cases	1/360

2) Any surcharge shall be in addition to the equivalent fluid pressure specified in Sentence (1).

Section 9.5. Design of Areas and Spaces

9.5.1. General

9.5.1.1. Method of Measurement

1) Unless otherwise indicated herein, dimensions of rooms or spaces shall be measured between finished wall surfaces and between finished floor and ceiling surfaces.

9.5.2. Barrier-Free Design

9.5.2.1. General

1) Except as provided in Articles 9.5.2.3. and 3.8.1.1., every *building* shall be designed in conformance with Section 3.8.

9.5.2.2. Protection on Floor Areas with a Barrier-Free Path of Travel

1) Where a *barrier-free* path of travel required in Article 9.5.2.1. is provided to any *storey* above the *first storey*, the requirements in Article 3.3.1.7. shall apply.

9.5.2.3. Exception for Apartment Buildings

1) Except as provided in Sentence (2), if the *building* is not equipped with an elevator, the *barrier-free* path of travel described in Section 3.8. need only be provided on the entrance level of an apartment *building*.

2) The *barrier-free* path of travel described in Section 3.8. need not be provided where the difference in floor elevation between the entrance level and every *dwelling unit* exceeds 600 mm.

9.5.3. Ceiling Heights

9.5.3.1. Heights of Rooms or Spaces

1) Heights of rooms or spaces in *residential occupancies* shall conform to Table 9.5.3.1.

2) Areas in rooms or spaces over which ceiling height is not less than the minimum specified in Table 9.5.3.1. shall be contiguous with the entry or entries to those rooms or spaces. r

9.5.3.2. Mezzanines

1) The clear height above and below a *mezzanine* floor assembly in all *occupancies* shall be not less than 2.1 m.

9.5.3.3. Storage Garages

1) The clear height in a *storage garage* shall be not less than 2 m.

Table 9.5.3.1.
Room Heights re2
Forming Part of Sentences 9.5.3.1.(1) and (2)

Room or Space	Minimum Heights, m	Minimum Area over which Minimum Height shall be Provided(1)
Living room or space	2.3	Lesser of area of the space or 10.0 m^2
Dining room or space	2.3	Lesser of 100% of actual floor area or 5.2 m^2
Kitchen or kitchen space	2.3	Lesser of 100% of actual floor area or 3.2 m^2
Master bedroom or bedroom space	2.3	Lesser of 100% of actual floor area or 4.9 m^2
Other bedroom or sleeping space	2.3	Lesser of 100% of actual floor area or 3.5 m^2
Unfinished *basement* including laundry area therein	1.95	Area under beams in laundry areas and in any location that would normally be used for passage to laundry and storage areas
Bathroom, water-closet room or laundry area above *grade*	2.1	Lesser of 100% of actual floor area or 2.2 m^2
Passage, hall or main entrance vestibule and finished rooms not specifically mentioned above	2.1	Area of the space

Notes to Table 9.5.3.1.:

(1) Area of the space shall be measured at floor level.

9.5.4. Hallways

9.5.4.1. Hallway Width

1) The unobstructed width of a hallway within a *dwelling unit* shall be not less than 860 mm, except that the hallway width is permitted to be 710 mm where
- a) there are only bedrooms and bathrooms at the end of the hallway furthest from the living area, and
- b) a second *exit* is provided
  - i) in the hallway near the end farthest from the living area, or
  - ii) in each bedroom served by the hallway.

Section 9.6. Doors

9.6.1. General

9.6.1.1. Application

1) This Section applies to doors, to glazed areas in doors and to sidelights for doors. (See also Sections 3.8., 9.9. and 9.10.)

9.6.2. Required Doors

9.6.2.1. Doors for Dwelling Units

1) A door shall be provided at each entrance to a *dwelling unit* and to each room containing a water closet within a *dwelling unit*. (See Sentence 9.10.9.16.(3) and Article 9.10.13.15.)

9.6.3. Doorway Sizes

9.6.3.1. Doorway Opening Sizes

1) Except as provided in Articles 9.6.3.3. and 9.9.6.4., doorway openings within *dwelling units* shall be designed to accommodate at least the door sizes in Table 9.6.3.1. for swing-type doors or folding doors.

9.6.3.2. Doors to Public Water-Closet Rooms

1) Doors to public water-closet rooms shall be not less than 810 mm wide and 2 030 mm high.

9.6.3.3. Doors to Bathrooms

1) Where one or more bathrooms is served by a hallway of not less than 860 mm, at least one of those bathrooms shall accommodate a door not less than 760 mm wide.

9.6.4. Door Sill Height

9.6.4.1. Height of Door Sills above Floors or Ground

1) Doors in *buildings* of *residential occupancy* shall conform to Sentence (2)where
- a) the sill of a door, including sliding doors, is located less than 200 mm above the finished floor on one side of the door, and
- b) the finished floor referred to in Clause (a) is more than 600 mm above the floor, landing, stair tread or ground level on the other side of the door.

Table 9.6.3.1.
Size of Doors
Forming Part of Sentence 9.6.3.1.(1)

At Entrance to:	Minimum Width, mm	Minimum Height, mm
Dwelling unit (required entrance) Vestibule or entrance hall	810	1 980
Stairs to a floor level that contains a finished space All doors in at least one line of passage from the exterior to the *basement* Utility rooms	810	1 980
Walk-in closet	610	1 980
Bathroom, water-closet room, shower room(1)	610	1 980
Rooms located off hallways that are permitted to be 710 mm wide	610	1 980
Rooms not mentioned above, exterior balconies	760	1 980

Notes to Table 9.6.3.1.:
(1) See Article 9.6.3.3.

2) Doors described in Sentence (1) shall be
a) permanently adjusted to prevent an opening greater than
   i) 200 mm where the height described in Clause (1)(b) is not more than 1.8 m, and
   ii) 100 mm where the height described in Clause (1)(b) is greater than 1.8 m, or
b) protected by a *guard* in accordance withSection 9.8.

9.6.5. Exterior Doors

9.6.5.1. Exterior Wood Doors

1) Exterior wood doors shall conform to CAN/CSA-O132.2 Series, "Wood Flush Doors."

2) Each door described in Sentence (1) shall indicate legibly
a) the name of the manufacturer,
b) the standard to which it is produced, and
c) that it is of an exterior type.

9.6.5.2. Sliding Doors

1) Sliding doors shall conform to CAN/CGSB-82.1-M, "Sliding Doors."

9.6.5.3. Insulated Steel Doors

1) Insulated steel doors shall conform to CAN/CGSB-82.5-M, "Insulated Steel Doors."

9.6.6. Glass

9.6.6.1. Maximum Area of Glass

1) The maximum area of individual panes of glass for doors shall conform to Table 9.6.6.1.

9.6.6.2. Glass in Doors and Sidelights

1) Glass in doors and in sidelights for doors shall conform to Sentence 9.7.3.1.(1).

2) Glass sidelights greater than 500 mm wide that could be mistaken for doors, glass in storm doors and glass in sliding doors within or at every entrance to a *dwelling unit* and in public areas shall be
a) safety glass of the tempered or laminated type conforming to CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass," or
b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass."

3) Except as provided in Article 9.7.5.2., glass in entrance doors to *dwelling units* and in public areas, other than the entrance doors described in Sentence (2), shall be safety glass or wired glass of the type described in Sentence (2) where the glass area exceeds 0.5 m² and extends to less than 900 mm from the bottom of the door.

9.6.6.3. Mirrored Glass Doors

1) Mirrored glass doors may be used only at the entrance to clothes closets and shall conform to the requirements of CAN/CGSB-82.6-M, "Doors, Mirrored Glass, Sliding or Folding, Wardrobe." (See Appendix A.)

9.6.6.4. Visibility of Glass or Transparent Doors

1) Except as provided in Article 9.7.5.2., every glass or transparent door accessible to the public shall be equipped with hardware, bars or other permanent fixtures designed so that the existence and position of such door will be readily apparent.

Table 9.6.6.1.
Glass Area for Doors
Forming Part of Sentence 9.6.6.1.(1)

Glass Thickness, mm	Maximum Glass Area, m²(1)					
	Type of Glass					
	Annealed	Annealed Multiple-Glazed Factory-Sealed Units	Laminated	Wired	Heat Strengthened	Fully Tempered
3	0.50	0.70	(2)	(2)	1.00	1.00
4	1.00	1.50	(2)	(2)	1.50	4.00
5	1.50	1.50	(2)	(2)	1.50	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit

Notes to Table 9.6.6.1.:
(1) See Appendix A.
(2) Not generally available.

9.6.6.5. Glass for Shower or Bathtub Enclosures

1) Glass other than safety glass shall not be used for a shower or bathtub enclosure.

9.6.6.6. Double Glazing

1) Except where a separate storm door is provided, glass in doors and adjacent sidelights separating heated space from unheated space or from the exterior shall be equipped with double glazing. (See A-9.6.6.6.(1) and A-9.7.1.5.(1) in Appendix A.)

9.6.7. Thermal Breaks

9.6.7.1. Application

1) This Subsection applies to doors and sidelights separating heated space from unheated space or the exterior.

9.6.7.2. Required Thermal Breaks

1) Except as provided in Sentence (2), metal frames for doors, for glazing in doors, and for sidelights for doors shall incorporate a thermal break.

2) Thermal breaks need not be installed in accordance with Sentence (1) where the doors are
- a) garage doors,
- b) storm doors, or
- c) doors that are required to have a *fire-resistance rating*.

9.6.8. Resistance to Forced Entry

9.6.8.1. Application

(See Appendix A.)

1) Except as permitted in Sentence (2), this Subsection applies to
- a) swinging entrance doors to *dwelling units*,
- b) swinging doors between *dwelling units* and attached garages or other ancillary spaces, and
- c) swinging doors which provide access directly or indirectly from a *storage garage* to a *dwelling unit*.

2) Sentence (1) does not apply to exterior doors to garages and to other ancillary spaces.

9.6.8.2. Wood Doors

1) Except as permitted in Article 9.6.8.10., wood doors as described in Sentence 9.6.8.1.(1) shall
- a) be solid core or stile and rail type,
- b) be not less than 45 mm thick, and
- c) if of the stile and rail panel type, have a panel thickness of not less than 19 mm, with a total panel area not more than half of the door area.

9.6.8.3. Deadbolt Lock

1) Except as permitted in Article 9.6.8.10., doors described in Sentence 9.6.8.1.(1) shall be provided with a deadbolt lock with a cylinder having no fewer than 5 pins and a bolt throw not less than 25 mm, protected with a solid or hardened free-turning ring or bevelled cylinder housing. (See Article 9.9.6.8.)

9.6.8.4. Double Doors

1) Except as permitted in Article 9.6.8.10., an inactive leaf in double doors used in locations specified in Sentence 9.6.8.1.(1) shall be provided with heavy duty bolts top and bottom having an engagement of not less than 15 mm.

9.6.8.5. Fastening of Hinges

1) Except as permitted in Article 9.6.8.10., hinges for doors described in Sentence 9.6.8.1.(1) shall be fastened to wood doors with wood screws not less than 25 mm long and to wood frames with wood screws so that at least 2 screws per hinge penetrate not less than 30 mm into solid wood. (See Appendix A.)

2) Except as permitted in Article 9.6.8.10., hinges for doors described in Sentence 9.6.8.1.(1) shall be fastened to metal doors and metal frames with machine screws not smaller than No. 10 and not less than 10 mm long.

9.6.8.6. Fastening of Strikeplates

1) Except as permitted in Article 9.6.8.10., strikeplates for deadbolts described in Article 9.6.8.3. shall be fastened to wood frames with wood screws that penetrate not less than 30 mm into solid wood. (See A-9.6.8.5.(1) in Appendix A.)

2) Except as permitted in Article 9.6.8.10., strikeplates for deadbolts described in Article 9.6.8.3. shall be fastened to metal frames with machine screws not smaller than No. 8 and not less than 10 mm long.

9.6.8.7. Outward Swinging Doors

1) Except for storm or screen doors, doors described in Sentence 9.6.8.1.(1) which swing outward shall be provided with hinges or pins so that the doors cannot be removed when they are in the closed position. (See Appendix A.)

9.6.8.8. Door Viewer

1) Main entrance doors to *dwelling units* shall be provided with
- a) a door viewer or transparent glazing in the door, or
- b) a sidelight.

9.6.8.9. Solid Blocking

1) Solid blocking shall be provided on both sides at the lock height between the jambs for doors described in Sentence 9.6.8.1.(1) and the structural framing so that the jambs will resist spreading by force.

9.6.8.10. Alternate Test Procedure

1) Doors, frames and hardware that conform to a security level of at least Grade 10 as described in the Annex to ASTM F 476, "Security of Swinging Door Assemblies," are not required to conform to Articles 9.6.8.2. to 9.6.8.6. (See Appendix A.)

Section 9.7. Windows and Skylights

9.7.1. General

9.7.1.1. Application

1) Windows shall conform to the requirements of this Section. (See also Sections 9.10. and 9.32. for fire protection and ventilation.)

9.7.1.2. Minimum Window Areas

1) Except as required in Article 9.7.1.3., the minimum window glass area for rooms in *buildings* of *residential occupancy* or that are used for sleeping shall conform to Table 9.7.1.2.

2) The unobstructed glass area of a door or skylight is considered equivalent to that of a window.

9.7.1.3. Bedroom Windows

1) Except where a bedroom door provides access directly to the exterior or the *suite* is *sprinklered*, each bedroom shall have at least one outside window openable from the inside without the use of tools or special knowledge. (See Appendix A.)

2) Windows referred to in Sentence (1) shall provide unobstructed openings with areas not less than 0.35 m^2 and with no dimension less than 380 mm. (See Article 9.7.1.4. and Appendix A.)

9.7.1.4. Window Opening into a Window-Well

1) Where a window required in Article 9.7.1.3. opens into a window-well, a clearance of not less than 550 mm shall be provided in front of the window.

2) Where the sash of a window referred to in Sentence (1) swings towards the window-well, the operation of the sash shall not reduce the clearance in a manner that would restrict escape in an emergency.

9.7.1.5. Double Glazing or Storm Sash

1) Windows which separate heated space from unheated space or from the exterior shall be provided with storm sash or double glazing. (See Appendix A.)

9.7.1.6. Height of Window Sills above Floors or Ground

(See Appendix A.)

1) Except as provided in Sentence (2), openable windows in *buildings* of *residential occupancy* shall be protected by
a) a *guard* , in accordance with Section 9.8., or
b) a mechanism capable of controlling the free swinging or sliding of the openable part of the window so as to limit any clear unobstructed opening to not more than 100 mm measured either vertically or horizontally where the other dimension is greater than 380 mm.

2) Windows need not be protected according to Sentence (1) where
a) the window serves a *dwelling unit* that is not located above another *suite*,

Table 9.7.1.2.
Glass Areas for Rooms of Residential Occupancy
Forming Part of Sentence 9.7.1.2.(1)

Location	Minimum Unobstructed Glass Area	
	With No Electric Lighting	With Electric Lighting
Laundry, *basement* recreation room, unfinished *basement*	4% of area served	Windows not required
Water-closet room	0.37 m^2	Windows not required
Kitchen, kitchen space, kitchen alcove	10% of area served	Windows not required
Living rooms and dining rooms	10% of area served	10% of area served
Bedrooms and other finished rooms not mentioned above	5% of area served(1)	5% of area served(1)

Notes to Table 9.7.1.2.:
(1) See Article 9.7.1.3.

b) the only opening greater than 100 mm by 380 mm is a horizontal opening at the top of the window,
c) the window sill is located more than 450 mm above the finished floor on one side of the window, or
d) the window is located in a room or space with the finished floor described in Clause (c) located less than 1 800 mm above the floor or ground on the other side of the window.

9.7.2. Window Standards

9.7.2.1. Window Standard r4

1) Except as provided in Sentence (2), windows shall conform to CSA A440, "Windows," but need not meet airtightness, watertightness and wind load resistance requirements more stringent than those for classifications A1, B1 and C1 in CSA A440, "Windows." (See Appendix A and Article 9.7.6.1.) r4

2) Windows need not comply with Clause 10.15 of CSA A440, "Windows," Energy Rating for Heating Conditions of Residential Windows. r4

9.7.3. Glass

9.7.3.1. Glass Standards

1) Glass shall conform to
a) CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass,"
b) CAN/CGSB-12.2-M, "Flat, Clear Sheet Glass,"
c) CAN/CGSB-12.3-M, "Flat, Clear Float Glass,"
d) CAN/CGSB-12.4-M, "Heat Absorbing Glass,"
e) CAN/CGSB-12.8, "Insulating Glass Units," r4
f) CAN/CGSB-12.10-M, "Glass, Light and Heat Reflecting," or
g) CAN/CGSB-12.11-M, "Wired Safety Glass."

9.7.3.2. Structural Design of Glass

1) Glass in windows, sloped glazing and skylights shall be designed in conformance with CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings." (See Appendix A.)

9.7.4. Caulking and Glazing

9.7.4.1. Sealing Compound

1) The sealing compound used to seal the glass component of a factory-sealed double-glazed unit to the sash component shall be compatible with the sealing compound used to edge seal the glass component.

9.7.4.2. Caulking Compound

1) Caulking shall be provided between window frames or trim and the exterior siding or masonry in conformance with Subsection 9.27.4.

9.7.5. Protection of Windows in Public Areas

9.7.5.1. Transparent Panels

1) Except as provided in Article 9.7.5.2., transparent panels that could be mistaken as a *means of egress* shall be protected by barriers or railings.

9.7.5.2. Sliding Glass Partitions

1) Sliding glass *partitions* that separate a *public corridor* from an adjacent *occupancy* and that are open during normal working hours need not conform to Article 9.7.5.1. and Sentence 9.6.6.2.(3), except that such *partitions* shall be suitably marked to indicate their existence and position.

9.7.5.3. Windows in Exit Stairways

1) Windows in *exit* stairways that extend to less than 1 070 mm above the landing shall be
a) protected by *guards*, in accordance with Section 9.8., or
b) non-openable and designed to withstand the specified lateral loads for balcony *guards* as provided in Part 4.

9.7.5.4. Windows above the Second Storey

1) Windows in public areas that extend to less than 1 m from the floor and are located above the second *storey* in *buildings* of *residential occupancy* shall be
a) protected by *guards* in accordance with Section 9.8., or
b) non-openable and designed to withstand the specified lateral loads for balcony *guards* as provided in Article 4.1.10.1.

9.7.6. Resistance to Forced Entry

9.7.6.1. Forced Entry through Windows

1) In *dwelling units*, windows, any part of which is located within 2 m of adjacent ground level, shall conform to the requirements for resistance to forced entry as described in Clause 10.13 of CSA A440, "Windows." (See Appendix A.) r4

9.7.7. Skylights

9.7.7.1. Plastic Skylights

1) Plastic skylights shall conform to CAN/CGSB-63.14-M, "Plastic Skylights."

9.7.7.2. Glass Skylights

1) Factory-built glass skylights shall meet the performance requirements of CAN/CGSB-63.14-M, "Plastic Skylights."

Section 9.8. Stairs, Ramps, Handrails and Guards

9.8.1. Scope

9.8.1.1. Application

1) This Section applies to the design and construction of interior and exterior stairs, steps, ramps, railings and *guards*.

9.8.1.2. Exit Stairs

1) Where the stair forms part of an *exit*, the appropriate requirements in Sections 9.9. and 9.10. shall also apply.

9.8.1.3. Escalators and Moving Walkways

1) Escalators and moving *walkways* shall conform to the appropriate requirements in Part 3.

9.8.2. General

9.8.2.1. Uniform Treads and Risers

1) Treads and risers shall have uniform rise and run in any one flight.

9.8.2.2. Minimum Number of Risers

1) Except for interior stairs within a *dwelling unit*, at least 3 risers shall be provided for interior stairs.

9.8.3. Stair Dimensions

9.8.3.1. Rise, Run and Tread Depth of Stairs

1) Except as provided in Subsection 9.8.5., the rise, run and tread depth of stairs shall conform to Table 9.8.3.1.

Table 9.8.3.1.
Rise, Run and Tread Depth of Stairs
Forming Part of Sentence 9.8.3.1.(1)

Stair Type	Rise, mm		Run, mm		Tread Depth, mm	
	max.	min.	max.	min.	max.	min.
Service[(1)]	no limit	125	355	no limit	355	no limit
Private[(2)]	200	125	355	210	355	235
Public[(3)]	200	125	355	230	355	250

Notes to Table 9.8.3.1.:

(1) Service stairs serve areas only used as service rooms or *service spaces*.

(2) Private stairs are interior stairs within *dwelling units* and exterior stairs serving a single *dwelling unit*.

(3) Public stairs are all stairs not described as service stairs or private stairs.

9.8.3.2. Nosings

1) Curved or bevelled leading edges of treads
a) shall not reduce the required tread depth by more than 15 mm, and
b) shall not, in any case, exceed 25 mm horizontally.

(See Appendix A.)

9.8.3.3. Stair Width

1) *Exit* stairs and stairs used by the public shall have a width, measured between wall faces or *guards*, of not less than 900 mm.

2) At least one stairway between each floor level in a *dwelling unit* shall have a width between wall faces of not less than 860 mm.

9.8.3.4. Head Room

1) The head room measured vertically from a line drawn through the outer edges of the nosings shall be not less than 1.95 m for stairs located in *dwelling units* and 2.05 m for all other stairs.

9.8.4. Landings

9.8.4.1. Dimensions of Landings

1) Landings shall be at least as wide and as long as the width of stairs in which they occur, except that
- a) the length of landing for exterior stairs serving not more than one *dwelling unit* need not exceed 900 mm, and
- b) the length of landing for all other stairs in a straight run need not exceed 1 100 mm.

(See also Articles 9.9.6.2. and 9.9.6.6. for landings in *exits*.)

9.8.4.2. Required Landings

1) Where a door swings towards a stair, the full arc of its swing shall be over a landing.

2) Except as provided in Sentence (3), a landing shall be provided at the top and bottom of each flight of interior stairs and where a doorway occurs in a stairway.

3) Where a door at the top of a stair in a *dwelling unit* swings away from the stair, no landing is required between the doorway and the stairs.

4) A landing shall be provided at the top of all exterior stairs, except that a landing may be omitted at a secondary entrance to a *building* containing a single *dwelling unit* provided the stair does not contain more than 3 risers.

9.8.4.3. Height between Landings

1) The vertical height between any landings shall not exceed 3.7 m.

9.8.4.4. Height over Landings

1) The clear height over landings shall be not less than 1.95 m in *dwelling units* and 2.05 m for other landings.

9.8.5. Curved Stairs and Winders

9.8.5.1. Curved Stairs in Exits

1) Curved stairs used in *exits* shall conform to the requirements of Article 3.4.6.8..

9.8.5.2. Curved Stairs not in Exits

1) Except as permitted in Article 9.8.5.3., a curved stair not required as an *exit* shall have an average run of not less than 200 mm and a minimum run of 150 mm and shall have risers conforming to Article 9.8.3.1.

9.8.5.3. Winders

1) Stairs within *dwelling units* may contain winders that converge to a centre point provided
- a) the winders turn through an angle of not more than 90°, and
- b) individual treads turn through an angle of 30° with no deviation above or below 30° except for that created by normal construction tolerances.

(See Appendix A.)

2) Only one set of winders described in Sentence (1) shall be permitted between floor levels.

9.8.6. Pedestrian Ramps

9.8.6.1. Ramps in a Barrier-Free Path of Travel

1) Ramps in a *barrier-free* path of travel shall conform to the requirements in Section 3.8.

9.8.6.2. Maximum Slope

1) Except as provided in Article 9.8.6.1., the slope of interior pedestrian ramps shall be not more than
- a) 1 in 10 for *residential occupancies*,
- b) 1 in 6 for *mercantile* or *industrial occupancies*, and
- c) 1 in 8 for all other *occupancies*.

2) Except as provided in Article 9.8.6.1., the slope of every exterior ramp shall be not more than 1 in 10.

9.8.6.3. Level Areas on Ramps

1) Except as provided in Article 9.8.6.1., where a doorway or stairway opens onto the side of a ramp, there shall be a level area extending across the full width of the ramp and for a distance of not less than 300 mm on either side of the wall opening.

2) Except as provided in Article 9.8.6.1., where a doorway or stairway opens onto the end of a ramp, there shall be a level area extending across the full width of the ramp and along it for not less than 900 mm.

9.8.7. Handrails

9.8.7.1. Required Handrails

1) Except as permitted in Sentences (2) and (3), a handrail shall be provided on
- a) at least one side of stairs less than 1 100 mm in width,

b) 2 sides of stairs 1 100 mm in width or greater, and
c) 2 sides of a curved stair used as an *exit*.

2) Handrails are not required for stairs within *dwelling units* having not more than 2 risers, or for exterior stairs having not more than 3 risers and serving not more than one *dwelling unit*.

3) Only one handrail is required on exterior stairs having more than 3 risers provided such stairs serve not more than one *dwelling unit*.

9.8.7.2. Continuous Handrail

1) Except as provided in Sentence (2), at least one handrail shall be continuous throughout the length of the stairway, including landings, except where interrupted by
a) doorways, or
b) newel posts at changes in direction.
(See A-3.4.6.4.(5) in Appendix A.)

2) For stairs serving only one *dwelling unit*, at least one handrail shall be continuous throughout the length of the stairway except where interrupted
a) by doorways,
b) by newel posts,
c) at landings, or
d) at changes in direction.

9.8.7.3. Termination of Handrails

1) Handrails shall be terminated in a manner that will not obstruct pedestrian travel or create a hazard. (See Appendix A.)

2) Except for stairways serving only one *dwelling unit*, at least one handrail at the sides of a stairway or ramp shall extend horizontally not less than 300 mm beyond the top and bottom of the stairway or ramp. (See A-3.4.6.4.(5) in Appendix A.)

9.8.7.4. Height of Handrails

1) Height of handrails on stairs and ramps shall be measured vertically from a line drawn
a) through the outside edges of the stair nosing, or
b) from the surface of the ramp, floor or landing below the handrail.

2) Except as provided in Sentences (3) and (4), the height of handrails on stairs and ramps shall be
a) not less than 800 mm, and
b) not more than 965 mm.

3) Where *guards* are required, handrails on landings are permitted to be not more than 1 070 mm in height.

4) Handrails not meeting the requirements of Sentences (2) and (3) are permitted provided they are installed in addition to the required handrails.

9.8.7.5. Ergonomic Design

1) A clearance of not less than 40 mm shall be provided between each handrail and the wall to which it is fastened.

2) Required handrails shall be constructed so as to be continually graspable along their entire length with no obstruction on or above them to break a handhold, except where the handrail is interrupted by newels at changes in direction.
(See Appendix A.)

9.8.7.6. Projections into Stairway

1) Handrails and constructions below handrails, including handrail supports and stair stringers, shall not project more than 100 mm into the required width of a stairway.

9.8.7.7. Handrails for Ramps

1) Where ramps are used in lieu of stairs, the handrail requirements for stairs in Articles 9.8.7.1. to 9.8.7.6. shall apply where the gradient exceeds 1 in 10.

9.8.7.8. Attachment of Handrails

(See Appendix A.)

1) Handrails shall be attached to wood studs, wood blocking, steel studs or masonry at points spaced not more than 1.2 m apart.

2) Attachment to wood studs and blocking required in Sentence (1) shall consist of not less than 2 wood screws at each point, penetrating not less than 32 mm into solid wood.

9.8.8. Guards

(See Appendix A regarding loads on guards.)

9.8.8.1. Required Guards

(See Appendix A.)

1) Every surface to which access is provided for other than maintenance purposes, including but not limited to exterior landings, porches, balconies, *mezzanines*, galleries, and raised *walkways*, shall be protected by a *guard* on each side that is not protected by a wall and where there is a difference in elevation to adjacent surfaces of more than 600 mm.

2) Every exterior stair with more than 6 risers and every ramp shall be protected with *guards* on all open sides where the difference in elevation between the adjacent ground level and the stair or ramp exceeds 600 mm.

3) When an interior stair has more than 2 risers, the sides of the stair and the landing or floor level around the stairwell shall be
a) enclosed by walls, or
b) protected by *guards*.

9.8.8.2. Height of Guards
(See Appendix A.)

1) Except as provided in Sentences (2) to (4), all *guards*, including those for balconies, shall be not less than 1 070 mm high.

2) *Guards* for porches, decks, landings and balconies are permitted to be a minimum of 900 mm high where
a) the walking surface of the porch, deck, landing or balcony served by the *guard* is not more than 1 800 mm above the finished ground level, and
b) the porch, deck, landing or balcony serves not more than one *dwelling unit*.

3) Except as provided in Sentence (4), *guards* for stairs shall be not less than 900 mm high measured vertically from a line drawn through the outside edges of the stair nosings, and 1 070 mm high at landings.

4) All required *guards* within *dwelling units* shall be not less than 900 mm high.

9.8.8.3. Guards for Floors and Ramps in Garages

1) Except for floors of garages referred to in Section 9.35., a continuous curb not less than 150 mm in height and a *guard* not less than 1 070 mm above the floor level shall be provided at every opening through a garage floor and around the perimeter of such floor and ramps where the exterior walls are omitted and where the top of the floor is 600 mm or more above an adjacent ground or floor level.

9.8.8.4. Openings in Guards

1) Except as provided in Sentence (2), openings through any *guard* that is required by Article 9.8.8.1. shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm unless it can be shown that the location and size of openings that exceed this limit do not represent a hazard. (See A-9.8.8.4.(1) and (2) in Appendix A.)

2) Openings through any *guard* that is required by Article 9.8.8.1. and that is installed in a *building* of *industrial occupancy* shall be of a size that will prevent the passage of a spherical object having a diameter of 200 mm unless it can be shown that the location and size of openings that exceed this limit do not represent a hazard. (See A-9.8.8.4.(1) and (2) in Appendix A.)

3) Unless it can be shown that the location and size of openings that do not comply with the following limits do not represent a hazard, openings through any *guard* that is not required by Article 9.8.8.1. and that serves a *building* of other than *industrial occupancy*, shall be of a size that: e
a) will prevent the passage of a spherical object having a diameter of 100 mm, or
b) will permit the passage of a spherical object having a diameter of 200 mm.
(See Appendix A.)

9.8.8.5. Design to Prevent Climbing
(See Appendix A.)

1) *Guards* required by Article 9.8.8.1. and serving *buildings* of *residential occupancy* shall be designed so that no member, attachment or opening located between 100 mm and 900 mm above the floor or walking surface protected by the *guard* will facilitate climbing.

9.8.8.6. Glass in Guards

1) Glass in *guards* shall be
a) safety glass of the laminated or tempered type conforming to CAN/CGSB-12.1-M, “Tempered or Laminated Safety Glass,” or
b) wired glass conforming to CAN/CGSB-12.11-M, “Wired Safety Glass.”

9.8.9. Construction

9.8.9.1. Exterior Concrete Stairs

1) Exterior concrete stairs with more than 2 risers and 2 treads shall be
a) supported on unit masonry or concrete walls or piers not less than 150 mm in cross section, or
b) cantilevered from the main *foundation* wall.

2) Stairs described in Sentence (1), when cantilevered from the *foundation* wall, shall be constructed and installed in conformance with Subsection 9.8.10.

3) The depth below ground level for *foundations* for exterior steps shall conform to the requirements in Section 9.12.

9.8.9.2. Exterior Wood Steps

1) Exterior wood steps shall not be in direct contact with the ground unless suitably treated with a wood preservative.

9.8.9.3. Wooden Stair Stringers

1) Wooden stair stringers shall
a) have a minimum effective depth of 90 mm and an over-all depth of not less than 235 mm,

b) be supported and secured top and bottom,
c) be not less than 25 mm actual thickness if supported along their length and 38 mm actual thickness if unsupported along their length, and
d) except as permitted in Sentence (2), be spaced not more than 900 mm o.c. for stairs serving not more than one *dwelling unit* and 600 mm o.c. in other stairs.

2) For stairs serving not more than one *dwelling unit* where risers support the front portion of the tread, the space between stringers shall be not more than 1 200 mm.

9.8.9.4. Treads

1) Stair treads of lumber, plywood or O-2 grade OSB within *dwelling units* shall be not less than 25 mm actual thickness, except that if open risers are used and the distance between stringers exceeds 750 mm, the treads shall be not less than 38 mm actual thickness.

2) Stair treads of plywood or OSB, not continuously supported by the riser, shall have their face grain or direction of face orientation at right angles to the stringers. r2

9.8.9.5. Finish for Treads and Landings

1) The finish for treads and landings of interior stairs in *dwelling units*, other than stairs to unfinished *basements*, shall consist of hardwood, vertical grain softwood, resilient flooring or other material providing equivalent performance.

2) Treads and landings of interior and exterior stairs and ramps, other than those within *dwelling units*, shall have a slip-resistant finish or be provided with slip-resistant strips that extend not more than 1 mm above the surface.

9.8.10. Cantilevered Precast Concrete Steps

9.8.10.1. Design

1) Exterior concrete steps and their anchorage system that are cantilevered from a *foundation* wall shall be designed and installed to support the loads to which they may be subjected.

9.8.10.2. Anchorage

1) Cantilevered concrete steps referred to in Article 9.8.10.1. shall be anchored to concrete *foundation* walls not less than 200 mm thick.

9.8.10.3. Prevention of Damage Due to Frost

1) Suitable precautions shall be taken during backfilling and grading operations to ensure that subsequent freezing of the *soil* will not cause uplift forces on the underside of cantilevered concrete steps to the extent that the steps or the walls to which they are attached will be damaged.

Section 9.9. Means of Egress

9.9.1. Scope

9.9.1.1. Application

1) Stairways, handrails and *guards* in a *means of egress* shall conform to the requirements in Section 9.8. as well as to the requirements in this Section.

9.9.1.2. Fire Protection

1) *Flame-spread ratings*, *fire-resistance ratings* and *fire-protection ratings* shall conform to Section 9.10.

9.9.1.3. Occupant Load

1) Except for *dwelling units*, the *occupant load* of a *floor area* or part of a *floor area* shall be the number of persons for which such areas are designed, but not fewer than that determined from Table 3.1.16.1., unless it can be shown that the area will be occupied by fewer persons.

2) The *occupant load* for *dwelling units* shall be based on 2 persons per bedroom or sleeping area.

9.9.2. General

9.9.2.1. Egress from Roof Area, Podiums, Terraces, Platforms and Contained Open Spaces

1) An *access to exit* shall be provided from every roof intended for *occupancy* and from every podium, terrace, platform or contained open space.

2) Where a roof is intended for an *occupant load* of more than 60 persons, at least 2 separate *means of egress* shall be provided from the roof to stairs designed in conformance with the requirements for *exit* stairs and located remote from each other.

3) Where a podium, terrace, platform or contained open space is provided, egress requirements shall conform to the appropriate requirements for rooms or *suites* in Article 9.9.7.3.

9.9.2.2. Types of Exits

1) Except as otherwise provided in this Section, an *exit* from any *floor area* shall be one of the following used singly or in combination: e2

a) an exterior doorway,
b) an exterior passageway,
c) an exterior ramp,
d) an exterior stairway,
e) a fire escape (as described in Subsection 3.4.7.),
f) a *horizontal exit*,
g) an interior passageway,
h) an interior ramp, or
i) an interior stairway.

9.9.2.3. Fire Escapes

1) Fire escapes may be used as *exits* on existing *buildings* provided they are designed and installed in conformance with Subsection 3.4.7.

2) Fire escapes shall not be installed on any new *building*.

9.9.2.4. Elevators, Slide Escapes and Windows

1) Elevators, slide escapes or windows shall not be considered as part of a required *means of egress*.

9.9.2.5. Purpose of Exits

1) An *exit* shall be designed for no purpose other than for exiting except that an *exit* may also serve as an access to a *floor area*.

9.9.2.6. Horizontal Exits

1) Where a *horizontal exit* is used, it shall conform to Sentence 3.4.1.6.(1) and Article 3.4.6.9. r2

9.9.3. Dimensions of Means of Egress

9.9.3.1. Application

1) This Subsection applies to every *means of egress* except *exits* that serve not more than one *dwelling unit* and *access to exits* within *dwelling units*.

9.9.3.2. Exit Width

1) Except for doors and corridors, the width of every *exit* facility shall be not less than 900 mm. (See Article 9.9.6.4. for doors and Subsection 9.8.3. for stairs.)

9.9.3.3. Width of Corridors

1) The width of every *public corridor*, corridor used by the public, and *exit* corridor shall be not less than 1 100 mm. (See also Subsection 9.9.5. for obstructions in corridors.)

9.9.3.4. Headroom Clearance

1) Except for stairways, doorways and *storage garages*, the minimum headroom clearance in *exits* and *access to exits* shall be 2.1 m. (See Articles 9.8.3.4. and 9.8.4.4. for stairways and Subsection 9.9.6. for doorways.)

2) The clear height of every *storey* in a *storage garage* shall be not less than 2 m.

9.9.4. Fire Protection of Exits

9.9.4.1. Application

1) Except as provided in Article 9.9.4.4., this Subsection applies to the fire protection of all *exits* except *exits* serving not more than one *dwelling unit*.

9.9.4.2. Fire Separations for Exits

1) Except as provided in Sentence (5) and Article 9.9.8.5., every *exit* other than an exterior doorway shall be separated from each adjacent *floor area* or from another *exit* by a *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly above the *floor area*. (See Article 9.10.9.10.)

2) Where there is no floor assembly above, the *fire-resistance rating* required in Sentence (1) shall not be less than that required by Subsection 9.10.8. for the floor assembly below, but in no case shall the *fire-resistance rating* be less than 45 min.

3) A *fire separation* common to 2 *exits* shall be smoke-tight and not be pierced by doorways, duct work, piping or any other opening that may affect the continuity of the separation.

4) A *fire separation* that separates an *exit* from the remainder of the *building* shall have no openings except those for electrical wiring, *noncombustible* conduit and *noncombustible* piping that serve only the *exit*, and for standpipes, sprinkler piping, *exit* doorways and wired glass and glass block permitted in Article 9.9.4.3.

5) The requirements in Sentence (1) do not apply to an exterior *exit* passageway provided the passageway has not less than 50% of its exterior sides open to the outdoors and is served by an *exit* stair at each end of the passageway.

9.9.4.3. Wired Glass or Glass Block

(See A-3.1.8.17.(1) in Appendix A.)

1) This Article applies to wired glass in doors, and wired glass or glass block in sidelights, where these are installed in *fire separations* between *exit* enclosures and *floor areas*.

2) Except as provided in Sentence (3), the combined area of glazing in doors and sidelights shall not exceed 0.8 m^2. r

3) Where an *exit* enclosure connects with a *floor area* through an enclosed vestibule or corridor separated from the *floor area* by *fire separations* having not less than a 45 min *fire-resistance rating*, the glazed areas described in Sentence (1) need not be limited as required in Sentence (2).

9.9.4.4. Openings Near Unenclosed Exit Stairs and Ramps

1) Where an unenclosed exterior *exit* stair or ramp provides the only *means of egress* from a *suite*, and is exposed to fire from openings in the exterior walls of another *fire compartment*, the openings in the exterior walls of the *building* shall be protected with wired glass in fixed steel frames or glass block conforming to Articles 9.10.13.5. and 9.10.13.7. when the openings in the exterior walls of the *building* are within 3 m horizontally and less than 10 m below or less than 5 m above the *exit* stair or ramp.

9.9.4.5. Openings in Exterior Walls of Exits

1) Either openings in exterior walls of an *exit* or openings in adjacent exterior walls of the *building* the *exit* serves shall be protected with wired glass in fixed steel frames or glass block installed in accordance with Articles 9.10.13.5. and 9.10.13.7., where

a) the *exit* enclosure has exterior walls that intersect the exterior walls of the *building* at an angle of less than 135° measured on the outside of the *building*, and

b) the openings in the exterior walls of the *building* are within 3 m horizontally and less than 2 m above the openings in the exterior walls of the *exit*.

(See Appendix A.)

9.9.4.6. Openings Near Exit Doors

1) Where an exterior *exit* door in one *fire compartment* is within 3 m horizontally of an *unprotected opening* in another *fire compartment* and the exterior walls of these *fire compartments* intersect at an exterior angle of less than 135°, the opening shall be protected with wired glass in fixed steel frames or glass block conforming to Articles 9.10.13.5. and 9.10.13.7.

9.9.4.7. Stairways in 2 Storey, Group D or E Buildings

1) Where a *suite* of Group D or E *occupancy* is located partly on the *first storey* and partly on the second *storey*, stairways serving the second *storey* of that *suite* need not be constructed as *exit* stairs provided,

a) the *building* is not greater than 2 *storeys* in *building height*,

b) the *suite* is separated from other *occupancies* by at least a 45 min *fire separation*,

c) the area occupied by the *suite* is not greater than 100 m^2 per *storey*,

d) the maximum travel distance from any point in the *suite* to an exterior *exit* is not greater than 25 m,

e) the floor assemblies have a *fire-resistance rating* of not less than 45 min or are of *noncombustible construction*, and

f) the *basement* and *first storey* are separated by a *fire separation* having a *fire-resistance rating* of not less than 45 min.

9.9.5. Obstructions and Hazards in Means of Egress

9.9.5.1. Application

1) This Subsection applies to obstructions and hazards in every *means of egress* except those within a *dwelling unit* or serving not more than one *dwelling unit*.

9.9.5.2. Occupancies in Public Corridors

1) Where a *public corridor* or a corridor used by the public contains an *occupancy*, such *occupancy* shall not reduce the unobstructed width of the corridor to less than the required width of the corridor.

9.9.5.3. Obstructions in Public Corridors

1) Except as permitted in Sentence (2), obstructions located within 1 980 mm of the floor shall not project horizontally more than 100 mm into *exit* passageways, corridors used by the public or *public corridors* in a manner that would create a hazard for visually impaired persons travelling adjacent to walls.

2) The horizontal projection of an obstruction referred to in Sentence (1) is permitted to exceed 100 mm where the obstruction extends to less than 680 mm above the floor. (See A-3.3.1.9.(4) in Appendix A.)

9.9.5.4. Obstructions in Exits

1) Except as permitted in Subsection 9.9.6. and Article 9.8.7.6., no fixture, turnstile or construction shall project within the required width of an *exit*.

9.9.5.5. Obstructions in Means of Egress

1) No obstructions such as posts or turnstiles shall be placed so as to restrict the width of a required *means of egress* from a *floor area* or part of a *floor area* to less than 750 mm unless an alternate unobstructed *means of egress* is provided adjacent to and plainly visible from the restricted egress.

2) Except as provided in Sentence (3), no obstructions, such as counter gates, that do not meet the requirements for *exit* doors, shall be placed in a required *means of egress* from a *floor area* or part of a *floor area* unless an alternate unobstructed *means of egress* is provided adjacent to and plainly visible from the restricted egress. e3

3) Obstructions, such as counter gates, that do not satisfy Sentence (2), are permitted to be placed in a required *means of egress* from a part of a *floor area* in *mercantile occupancies* and *business and personal services occupancies*, provided that the part of the *floor area* served by the obstructed *means of egress* is not generally accessible to the public. e3

9.9.5.6. Mirrors or Draperies

1) No mirror shall be placed in or adjacent to any *exit* so as to confuse the direction of *exit*, and no mirror or draperies shall be placed on or over *exit* doors.

9.9.5.7. Fuel-Fired Appliances

1) Fuel-fired *appliances* shall not be installed in an *exit* or corridor serving as an *access to exit*.

9.9.5.8. Service Rooms

1) *Service rooms* containing equipment subject to possible explosion, such as *boilers* designed to operate at a pressure in excess of 100 kPa, and certain types of refrigerating and transformer equipment, shall not be located under required *exits*.

9.9.5.9. Ancillary Rooms

1) Ancillary rooms such as storage rooms, washrooms, toilet rooms, laundry rooms and *service rooms* shall not open directly into an *exit*.

9.9.6. Doors in a Means of Egress

9.9.6.1. Application

1) This Subsection applies to all doors in a *means of egress* except doors within *dwelling units* and exterior doors serving not more than one *dwelling unit* unless otherwise stated herein.

9.9.6.2. Obstructions by Doors

1) *Exit* doors shall not decrease the required *exit* width by more than 100 mm in *exit* corridors, and not more than 50 mm for other *exit* facilities.

2) Doors in their swing shall not reduce the width of the path of travel to less than
- a) the required *exit* width in *exit* corridors and passageways, and
- b) 750 mm on *exit* stairs or landings.

9.9.6.3. Headroom Obstructions

1) No door closer or other device shall be installed in an *exit* in such a manner as to reduce the headroom clearance to less than 1 980 mm.

9.9.6.4. Door Sizes

1) Every *exit* door or door that opens into or is located within a *public corridor* or other facility that provides *access to exit* from a *suite* shall
- a) be not less than 2 030 mm high,
- b) be not less than 810 mm wide where there is only one door leaf, and
- c) have no single leaf less than 610 mm wide in any multiple leaf door.

9.9.6.5. Direction of Door Swing

1) Except as provided in Sentence 3.3.1.11.(1), every door that opens onto a corridor or other facility that provides *access to exit* from a room or *suite* having an *occupant load* of more than 60 persons, and every door that is located within a corridor that is required to be separated from the remainder of the *floor area* by a *fire separation* shall swing on a vertical axis in the direction of *exit* travel and shall not open onto a step.

2) Except as permitted in Sentence (5) and in Sentence 3.4.6.13.(1), every required *exit* door shall swing on its vertical axis.

3) Except as provided in Sentences (4) and (5), every required *exit* door shall open in the direction of *exit* travel.

4) An *exit* door serving not more than one *dwelling unit* is permitted to swing inward.

5) *Exit* doors serving a *storage garage* serving not more than one *dwelling unit*, or doors serving other accessory *buildings* where there is no danger to life safety, need not conform to Sentences (2) or (3).

9.9.6.6. Nearness of Doors to Stairs

1) Except as provided in Sentence (2), the distance between a stair riser and the leading edge of a door during its swing shall be not less than 300 mm.

2) Where there is a danger of blockage from ice or snow, an *exit* door may open onto not more than one step provided the riser of such step does not exceed 150 mm.

9.9.6.7. Revolving Doors

1) Revolving doors used as *exits* shall conform to Article 3.4.6.14.

9.9.6.8. Door Opening Mechanism

1) Except as provided in Sentence 3.4.6.15.(4) for electromagnetic locking systems, *exit* doors and doors to *suites*, including exterior doors to *dwelling units*, shall be openable from the inside without requiring keys, special devices or specialized knowledge of the door opening mechanism.

9.9.6.9. Automatic Locking Prohibited

1) Except for hotels and motels, a door opening onto a *public corridor* that provides *access to exit* from *suites* shall be designed not to lock automatically when such doors are equipped with automatic self-closing devices. (See A-3.3.4.5.(1) in Appendix A.)

9.9.6.10. Effort Required to Open

1) Every *exit* door shall be designed and installed so that when the latch is released the door will open in the direction of *exit* travel under a force of not more than 90 N applied at the knob or other latch releasing device. (See Sentence 3.8.3.3.(7) for door opening forces in a *barrier-free* path of travel.)

9.9.7. Access to Exits

9.9.7.1. Means of Egress from Suites

1) Except as required in Sentence 9.9.9.3.(1), each *suite* in a *floor area* occupied by more than one *suite* shall have e2
a) an exterior *exit* doorway,
b) a doorway to a *public corridor*, or
c) a doorway to an exterior passageway. e2

2) Except as provided in Sentences 9.9.7.2.(1) and 9.9.8.2.(2), from the point where a doorway described in Clauses (1)(b) or (c) enters the *public corridor* or exterior passageway, it shall be possible to go in opposite directions to each of 2 separate *exits*. e2

9.9.7.2. Dead-End Corridors

1) Except for a dead-end corridor that is entirely within a *suite* and except as permitted in Sentence 9.9.9.2.(1), a dead-end corridor is permitted provided it is not more than 6 m long.

9.9.7.3. Number and Spacing of Egress Doors

1) Except for *dwelling units*, at least 2 egress doors shall be provided when the area of a room or *suite*, or the distance measured from any point within the room or *suite* to the nearest egress door, exceeds the values in Table 9.9.7.3.

2) Doors required in Sentence (1) shall be spaced so that in the event that one door is made inaccessible by a fire within such room or *suite*, the other door will provide safe egress.

Table 9.9.7.3.
Maximum Areas and Travel Distances for Rooms and Suites with a Single Egress Door
Forming Part of Sentence 9.9.7.3.(1)

Occupancy of Room, *Suite* or *Floor Area*	Maximum Area of Room, *Suite* or *Floor Area*, m^2	Maximum Distance to Egress Door, m
Group C (except *dwelling units*)	100	15
Group D	200	25
Group E	150	15
Group F, Division 2	150	10
Group F, Division 3	200	15

9.9.7.4. Independent Access to Exit

1) Required *access to exit* from *suites* shall not be through any other *dwelling unit*, *service room* or other *occupancy*.

9.9.7.5. Travel Distance within Rooms and Suites

1) Except for *dwelling units*, the travel distance from any point within the room or *suite* to the nearest egress door shall not exceed the maximum travel distance in Article 9.9.8.2.

9.9.8. Exits from Floor Areas

9.9.8.1. Measurement of Travel Distance

1) Except as provided in Sentences (2) and (3), for the purposes of this Subsection, travel distance means the distance from any point in the *floor area* to an *exit* measured along the path of *exit* travel.

2) Where a room or *suite* is separated from the remainder of the *floor area* by a *fire separation* having a *fire-resistance rating* of at least 45 min or, in a *sprinklered building*, by a *fire separation* which is not required to have a *fire-resistance rating*, the travel distance may be measured from an egress door of the room or *suite* to the nearest *exit*.

3) Where a *public corridor* is not less than 9 m wide and conforms to Subclauses 3.4.2.5.(1)(d)(i) to (iv), the travel distance may be determined in accordance with those Subclauses.

9.9.8.2. Number of Required Exits

1) Except as provided in Sentence (2) and Subsection 9.9.9., at least 2 *exits* shall be provided from every *floor area*, spaced so that the travel distance to the nearest *exit* is not more than
a) 40 m in the case of *business and personal services occupancies*,

b) 45 m for all *occupancies* where the *floor area* is *sprinklered*, and
c) 30 m for all other *occupancies*.

2) Except as provided in Subsection 9.9.9., a single *exit* is permitted from each *storey* in *buildings* of 1 and 2 *storeys* in *building height* provided the *floor area* and travel distance requirements conform to those required in Article 9.9.7.3. and the total *occupant load* served by an *exit* facility does not exceed 60 persons.

9.9.8.3. Contribution of Each Exit

1) Where more than one *exit* is required from a *floor area*, each *exit* shall be considered as contributing not more than half the required *exit* width.

9.9.8.4. Location of Exits

1) Where more than one *exit* is required from a *floor area*, at least 2 *exits* shall be independent of each other and be placed remote from each other along the path of travel between them. (See Appendix A.)

9.9.8.5. Exiting through a Lobby

1) Not more than one *exit* from a *floor area* above or below the *first storey* is permitted to lead through a lobby.

2) The lobby referred to in Sentence (1) shall be not more than 4.5 m above *grade*, and the path of travel through the lobby to the outdoors shall not exceed 15 m.

3) The lobby referred to in Sentence (1) shall conform in all respects to the requirements for *exits*, except that rooms other than *service rooms*, storage rooms and rooms of *residential* or *industrial occupancy* are permitted to open directly onto such lobby.

4) Where the lobby referred to in Sentence (1) and adjacent *occupancies* that are permitted to open into the lobby are *sprinklered*, the *fire separation* between such *occupancies* and the lobby need not have a *fire-resistance rating*. (See A-3.4.4.2.(2)(e) in Appendix A.)

9.9.8.6. Exits for Mezzanines

1) A *mezzanine* shall be provided with *exits* on the same basis as required for a *floor area* where a *mezzanine* is considered to be a *storey* in Subsection 9.10.4. or is of a size required to have more than one *exit*.

9.9.9. Egress from Dwelling Units

9.9.9.1. Travel Limit to Exits or Egress Doors

1) Except as provided in Sentences (2) and (3), every *dwelling unit* containing more than 1 *storey* shall have *exits* or egress doors located so that it shall not be necessary to travel up or down more than 1 *storey* to reach a level served by
a) an egress door to a *public corridor*, enclosed *exit* stair or exterior passageway, or
b) an *exit* doorway not more than 1.5 m above adjacent ground level.

2) Where a *dwelling unit* is not located above or below another *suite*, the travel limit from a floor level in the *dwelling unit* to an *exit* or egress door may exceed 1 *storey* where that floor level is served by an openable window
a) providing an unobstructed opening of not less than 1 m in height and 0.55 m in width, and
b) located so that the sill is not more than
  i) 1 m above the floor, and
  ii) 7 m above adjacent ground level.

3) The travel limit from a floor level in a *dwelling unit* to an *exit* or egress door may exceed 1 *storey* where that floor level has direct access to a balcony.

9.9.9.2. Two Separate Exits

1) Except as provided in Sentence 9.9.7.2.(1), where an egress door from a *dwelling unit* opens onto a *public corridor* or exterior passageway it shall be possible from the location where the egress door opens onto the corridor or exterior passageway to go in opposite directions to 2 separate *exits* unless the *dwelling unit* has a second and separate *means of egress*.

9.9.9.3. Shared Egress Facilities

1) A *dwelling unit* shall be provided with a second and separate *means of egress* where an egress door from the *dwelling unit* opens onto
a) an *exit* stairway serving more than one *suite*,
b) a *public corridor* serving more than one *suite* and served by a single *exit* stairway,
c) an exterior passageway more than 1.5 m above adjacent ground level, serving more than one *suite* and served by a single *exit* stairway, or
d) a balcony more than 1.5 m above adjacent ground level, serving more than one *suite* and served by a single *exit* stairway.

9.9.10. Signage

9.9.10.1. Application

1) This Subsection applies to all *exits* except those serving not more than one *dwelling unit*.

9.9.10.2. Visibility of Exits

1) *Exits* shall be located so as to be clearly visible or their locations shall be clearly indicated.

9.9.10.3. Required Exit Signs

1) Except for the main entrance door to a *building*, every *exit* door in a *building* 3 *storeys* in *building height* or in a *building* having an *occupant load* greater than 150 shall have an *exit* sign over or adjacent to it.

9.9.10.4. Exit Direction Signs

1) *Exit* direction signs shall be placed in corridors and passageways where necessary to indicate the direction of *exit* travel.

9.9.10.5. Visibility of Exit Signs

1) *Exit* signs shall be installed so as to be visible from the *exit* approach and shall be illuminated continuously while the *building* is occupied.

9.9.10.6. Lettering

1) *Exit* signs shall have the word EXIT or SORTIE in red letters on a contrasting background or a red background with contrasting letters when the sign is internally lighted, and white letters on a red background or red letters on a white background when the sign is externally lighted.

2) Lettering referred to in Sentence (1) shall be made with not less than 19 mm wide strokes and be not less than 150 mm high when the sign is externally lighted, and not less than 114 mm high when the sign is internally lighted.

9.9.10.7. Illumination

1) Illumination of *exit* signs required in Article 9.9.10.3. shall conform to Sentences 9.9.11.3.(2) and (3).

2) Where illumination of *exit* signs required in Article 9.9.10.3. is provided by an electrical circuit, that circuit shall serve no equipment other than emergency equipment.

9.9.10.8. Exits Continuing to a Basement

1) In *buildings* 3 *storeys* in *building height*, any part of an *exit* ramp or stair that continues down to a *basement* past an exterior *exit* door shall be clearly marked to indicate that it does not lead to an *exit* where the portion below ground level may be mistaken as the direction of *exit* travel.

9.9.10.9. Floor Numbering

1) Arabic numerals indicating the assigned floor number shall be
- a) mounted permanently on the stair side of the wall at the latch side of doors to *exit* stair shafts,
- b) not less than 60 mm high, raised approximately 0.7 mm above the surface,
- c) located 1 500 mm from the finished floor and not more than 300 mm from the door, and
- d) contrasting in colour with the surface on which they are applied. (See A-3.4.6.18.(1)(d) in Appendix A.)

9.9.11. Lighting

9.9.11.1. Application

1) This Subsection applies to the lighting of all *exits* except those serving not more than one *dwelling unit*.

9.9.11.2. Required Lighting in Egress Facilities

1) Every *exit*, *public corridor* or corridor providing *access to exit* for the public shall be equipped to provide illumination to an average level of not less than 50 lx at floor or tread level and at all points such as angles and intersections at changes of level where there are stairs or ramps.

9.9.11.3. Emergency Lighting

1) Emergency lighting shall be provided in
- a) *exits*,
- b) principal routes providing *access to exit* in an open *floor area*,
- c) corridors used by the public,
- d) underground *walkways*, and
- e) *public corridors*.

2) Emergency lighting required in Sentence (1) shall be provided from a source of energy separate from the electrical supply for the *building*.

3) Lighting required in Sentence (1) shall be designed to be automatically actuated for a period of at least 30 min when the electric lighting in the affected area is interrupted.

4) Illumination from lighting required in Sentence (1) shall be provided to average levels of not less than 10 lx at floor or tread level.

5) Where incandescent lighting is provided, lighting equal to 1 W/m^2 of *floor area* shall be considered to meet the requirement in Sentence (4).

6) Where self-contained emergency lighting units are used, they shall conform to CSA C22.2 No. 141-M, “Unit Equipment for Emergency Lighting.”

Section 9.10. Fire Protection

9.10.1. General

9.10.1.1. Support of Noncombustible Construction

1) Where an assembly is required to be of *noncombustible* construction and to have a *fire-resistance* rating, it shall be supported by *noncombustible* construction.

9.10.1.2. Sloped Roofs

1) For the purposes of this Section, roofs with slopes of 60° or more to the horizontal and which are adjacent to a room or space intended for *occupancy* shall be considered as a wall.

9.10.1.3. Items under Part 3 Jurisdiction

1) Tents, *air-supported structures*, transformer vaults, *walkways*, elevators and escalators shall conform to Part 3.

2) Where rooms or spaces are intended for an *assembly occupancy*, such rooms or spaces shall conform to Part 3.

3) *Basements* containing more than 1 *storey* or exceeding 600 m^2 in area shall conform to Part 3.

4) Where rooms or spaces are intended for the storage, manufacture or use of hazardous or explosive material, such rooms or spaces shall conform to Part 3. (See A-3.3.1.2.(1) in Appendix A.)

5) Except as provided in Article 3.3.5.8., facilities for the dispensing of fuel shall not be installed in any *building*.

6) Openings through floors that are not protected by shafts or *closures* shall be protected in conformance with Subsection 3.2.8. (See also Sentence 9.9.4.7.(1).)

7) Chutes and shafts shall conform to Subsection 3.6.3. except where they are entirely contained within a *dwelling unit*.

8) Where sprinkler, standpipe and hose systems are installed, they shall be installed in conformance with Part 3.

9.10.1.4. Items under Part 3 or Part 6 Jurisdiction e

1) In kitchens containing commercial cooking equipment used in processes producing grease-laden vapours, the equipment shall be designed and installed in conformance with Article 6.2.2.6. (See Appendix A.)

2) Where fuel-fired *appliances* are installed on a roof, such *appliances* shall be installed in conformance with Article 3.6.1.4. e

9.10.2. Occupancy Classification

9.10.2.1. Occupancy Classification

1) Except as provided in Article 9.10.2.2., every *building* or part thereof shall be classified according to its *major occupancy* as belonging to one of the groups or divisions described in Table 9.10.2.1.

Table 9.10.2.1.
Occupancy Classifications
Forming Part of Sentence 9.10.2.1.(1)

Group	Division	Description of *Major Occupancies*(1)
C	—	*Residential occupancies*
D	—	*Business and personal services occupancies*
E	—	*Mercantile occupancies*
F	2	*Medium hazard industrial occupancies*
F	3	*Low hazard industrial occupancies* (Does not include *storage garages* serving individual *dwelling units*)

Notes to Table 9.10.2.1.:

(1) See A-3.1.2.1.(1) in Appendix A. e3

9.10.2.2. Custodial and Convalescent Homes

1) Children's custodial homes and convalescent homes for ambulatory occupants living as a single housekeeping unit in a *dwelling unit* with sleeping accommodation for not more than 10 persons are permitted to be classified as *residential occupancies* (Group C).

9.10.2.3. Major Occupancies above Other Major Occupancies

1) Except as permitted in Article 9.10.2.4., in any *building* containing more than one *major occupancy* in which one *major occupancy* is located entirely above another, the requirements of Article 9.10.8.1. for each portion of the *building* containing a *major occupancy* shall be applied to that portion as if the entire *building* was of that *major occupancy*.

9.10.2.4. Buildings Containing More Than One Major Occupancy

1) In a *building* containing more than one *major occupancy*, where the aggregate area of all *major occupancies* in a particular group or division does not exceed 10% of the *floor area* on the *storey* on which they are located, they need not be considered as *major occupancies* for the purposes of Articles 9.10.8.1. and 9.10.2.3. provided they are not classified as Group F, Division 2 *occupancies*.

9.10.3. Ratings

9.10.3.1. Fire-Resistance and Fire-Protection Ratings

1) Where a *fire-resistance rating* or a *fire-protection rating* is required in this Section for an element of a *building*, such rating shall be determined in conformance with the test methods described in Part 3, A-9.10.3.1. in Appendix A, or Appendix D.

9.10.3.2. Flame-Spread Ratings

1) Where a *flame-spread rating* is required in this Section for an element of a *building*, such rating shall be determined in accordance with the test methods described in Part 3, or in accordance with Appendix D.

2) Unless the *flame-spread rating* is referred to herein as a "surface *flame-spread rating*," it shall apply to any surface of the element being considered that would be exposed by cutting through it as well as to the exposed surface of the element.

9.10.3.3. Fire Exposure

1) Floor, roof and ceiling assemblies shall be rated for exposure to fire on the underside.

2) Exterior walls shall be rated for exposure to fire from inside the *building*, except that such walls need not comply with the temperature rise limitations required by the standard tests referred to in Article 9.10.3.1. if such walls have a *limiting distance* of not less than 1.2 m, and due allowance is made for the effects of heat radiation in accordance with the requirements in Part 3.

3) Interior vertical *fire separations* required to have *fire-resistance ratings* shall be rated for exposure to fire on each side.

9.10.3.4. Suspended Membrane Ceilings

1) Where a ceiling construction has a suspended membrane ceiling with lay-in panels or tiles which contribute to the required *fire-resistance rating*, hold down clips or other means shall be provided to prevent the lifting of such panels or tiles in the event of a fire.

9.10.4. Building Size Determination

9.10.4.1. Mezzanines not Considered as Storeys

(See A-3.2.1.1.(3) in Appendix A.)

1) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where the aggregate area of *mezzanine* floors does not exceed 10% of the *floor area* of the *storey* in which they are located.

2) *Mezzanines* shall not be considered as *storeys* for the purpose of determining *building height* where they occupy an aggregate area of less than 40% of the *floor area* of the *storey* in which they are located provided the space above the *mezzanine* floors and the floor below them have no visual obstructions more than 1 070 mm above such floors.

9.10.4.2. More Than One Level of Mezzanine

1) Where more than one level of *mezzanine* is provided in a *storey*, each level additional to the first shall be considered as a *storey*.

9.10.4.3. Basement Storage Garages

1) Where a *basement* is used primarily as a *storage garage*, the *basement* is permitted to be considered as a separate *building* for the purposes of this Section provided the floor above the *basement* and the exterior walls of the *basement* above the adjoining ground level are constructed as *fire separations* of masonry or concrete having a *fire-resistance rating* of not less than 2 h.

9.10.4.4. Roof-Top Enclosures

1) Roof-top enclosures provided for elevator machinery, stairways and *service rooms*, used for no purpose other than for service to the *building*, shall not be considered as a *storey* in calculating the *building height*.

9.10.5. Permitted Openings in Wall and Ceiling Membranes

9.10.5.1. Permitted Openings in Wall and Ceiling Membranes

1) Except as permitted in Sentences (2) and (4), a membrane forming part of an assembly required to have a *fire-resistance rating* shall not be pierced by openings into the assembly unless the assembly has been tested and rated for such openings.

2) A wall or ceiling membrane forming part of an assembly required to have a *fire-resistance rating* is permitted to be pierced by openings for electrical and similar service outlet boxes provided such outlet boxes are tightly fitted.

3) Where boxes referred to in Sentence (2) are located on both sides of walls required to provide a *fire-resistance rating*, they shall be offset where necessary to maintain the integrity of the *fire separation*.

4) A membrane ceiling forming part of an assembly assigned a *fire-resistance rating* on the basis of Table A-9.10.3.1.B. or Appendix D, is permitted to be pierced by openings leading to ducts within the ceiling space provided the ducts, the amount of openings and their protection conform to the requirements of Appendix D.

9.10.6. Construction Types

9.10.6.1. Combustible Elements in Noncombustible Construction

1) Where a *building* or part of a *building* is required to be of *noncombustible construction*, *combustible* elements shall be limited in conformance with the requirements in Subsection 3.1.5.

9.10.6.2. Heavy Timber Construction

1) *Heavy timber construction* shall be considered to have a 45 min *fire-resistance rating* when it is constructed in accordance with the requirements for *heavy timber construction* in Article 3.1.4.6.

9.10.7. Steel Members

9.10.7.1. Protection of Steel Members

1) Except as permitted in Article 3.2.2.3., structural steel members used in construction required to have a *fire-resistance rating* shall be protected to provide the required *fire-resistance rating*.

9.10.8. Fire Resistance in Relation to Occupancy and Height

9.10.8.1. Fire-Resistance Ratings for Floors and Roofs

1) Except as otherwise provided in this Subsection, the *fire-resistance ratings* of floors and roofs shall conform to Table 9.10.8.1. (See Subsection 9.10.2. for mixed *occupancies* and Subsection 9.10.20. for construction camps.)

9.10.8.2. Fire-Resistance Ratings in Sprinklered Buildings

1) The requirements in Table 9.10.8.1. for roof assemblies to have a *fire-resistance rating* are permitted to be waived in *sprinklered buildings* where

a) the sprinkler system is electrically supervised in conformance with Sentence 3.2.4.9.(2), and

b) the operation of the sprinkler system will cause a signal to be transmitted to the fire department in conformance with Sentence 3.2.4.7.(4).

9.10.8.3. Fire-Resistance Ratings for Walls, Columns and Arches

1) Except as otherwise provided in this Subsection, all *loadbearing* walls, columns and arches in the *storey* immediately below a floor or roof assembly shall have a *fire-resistance rating* of not less than that required for the supported floor or roof assembly.

9.10.8.4. Service Rooms

1) Construction supporting a *service room* need not conform to Article 9.10.8.3.

9.10.8.5. Mezzanines

1) *Mezzanines* required to be counted as *storeys* in Articles 9.10.4.1. and 9.10.4.2. shall be constructed in conformance with the requirements for "Floors Except Floors over Crawl Spaces" in Table 9.10.8.1.

Table 9.10.8.1.
Fire-Resistance Ratings for Structural Members and Assemblies
Forming Part of Sentence 9.10.8.1.(1)

Major Occupancy	Maximum *Building Height*, storeys	Minimum *Fire-Resistance Rating* by *Building* Element, min		
		Floors Except Floors over Crawl Spaces	*Mezzanine* Floors	Roofs
Residential (Group C)	3	45	45	—
All other *occupancies*	2	45	—	—
	3	45	45	45

9.10.8.6. Roofs Supporting an Occupancy

1) Where a portion of a roof supports an *occupancy*, that portion shall be constructed as a *fire separation* having a *fire-resistance rating* conforming to the rating for "Floors Except Floors over Crawl Spaces" in Table 9.10.8.1.

9.10.8.7. Floors of Exterior Passageways

1) Except as provided in Sentences (2) and (3), the floor assembly of every exterior passageway used as part of a *means of egress* shall have a *fire-resistance rating* of not less than 45 min or be of *noncombustible construction*.

2) No *fire-resistance rating* is required for floors of exterior passageways serving *buildings* of Group D, E or F *major occupancy* that are not more than 2 *storeys* in *building height*.

3) No *fire-resistance rating* is required for floors of exterior passageways serving a single *dwelling unit* where no *suite* is located above or below the *dwelling unit*.

9.10.8.8. Crawl Spaces

1) Where a crawl space exceeds 1.8 m in height or is used for any *occupancy* or as a *plenum* in *combustible construction* or for the passage of *flue pipes*, it shall be considered as a *basement* in applying the requirements in Article 9.10.8.1.

9.10.8.9. Application to Houses

1) Table 9.10.8.1. does not apply to a *dwelling unit* which has no other *dwelling unit* above or below it, or to a *dwelling unit* which is not above or below another *major occupancy*.

9.10.8.10. Part 3 as an Alternative

1) The *fire-resistance ratings* of floors, roofs, *loadbearing* walls, columns and arches need not conform to this Subsection if such assemblies conform in all respects to the appropriate requirements in Section 3.2.

9.10.9. Fire Separations between Rooms and Spaces within Buildings

9.10.9.1. Application

1) This Subsection applies to *fire separations* required between rooms and spaces in *buildings* except between rooms and spaces within a *dwelling unit*.

9.10.9.2. Continuous Barrier

1) Except as permitted in Article 9.10.9.3., a wall or floor assembly required to be a *fire separation* shall be constructed as a continuous barrier against the spread of fire. (See A-3.1.8.1.(1)(a) in Appendix A.)

9.10.9.3. Openings to be Protected with Closures

1) Except as permitted in Articles 9.10.9.5., 9.10.9.6. and 9.10.9.7., openings in required *fire separations* shall be protected with *closures* conforming to Subsection 9.10.13.

9.10.9.4. Floor Assemblies

1) Except as permitted in Sentences (2) to (4), all floor assemblies shall be constructed as *fire separations*.

2) Floor assemblies contained within *dwelling units* need not be constructed as *fire separations*.

3) Floor assemblies for which no *fire-resistance rating* is required by Subsection 9.10.8. and floors of *mezzanines* not required to be counted as *storeys* in Articles 9.10.4.1. and 9.10.4.2. need not be constructed as *fire separations*.

4) Where a crawl space is not required by Article 9.10.8.8. to be constructed as a *basement*, the floor above it need not be constructed as a *fire separation*.

9.10.9.5. Interconnected Floor Spaces

1) *Interconnected floor spaces* shall conform to Subsection 3.2.8.

9.10.9.6. Service Equipment Penetrating a Fire Separation

1) Piping, tubing, ducts, *chimneys*, wiring, conduit, electrical outlet boxes and other similar service equipment that penetrate a required *fire separation* shall be tightly fitted or fire stopped to maintain the integrity of the separation. (See Appendix A.)

2) Except as provided in Sentences (3) to (9) and Article 9.10.9.7., pipes, ducts, electrical boxes, totally enclosed raceways or other similar service equipment that partly or wholly penetrate an assembly required to have a *fire-resistance rating* shall be *noncombustible* unless the assembly has been tested incorporating such equipment.

3) Electrical wires or similar wiring enclosed in *noncombustible* totally enclosed raceways are permitted to partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2).

4) Electrical wires or cables, single or grouped, with *combustible* insulation or jacketting that is not totally enclosed in raceways of *noncombustible* material, are permitted to partly or wholly penetrate an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2), provided the overall diameter of the wiring is not more than 25 mm.

5) *Combustible* totally enclosed raceways which are embedded in a concrete floor slab are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2), where the concrete provides not less than 50 mm of cover between the raceway and the bottom of the slab.

6) *Combustible* outlet boxes are permitted in an assembly required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2), provided the opening through the membrane into the box does not exceed 160 cm^2.

7) *Combustible* water distribution piping that has an outside diameter not more than 30 mm is permitted to partly or wholly penetrate a vertical *fire separation* that is required to have a *fire-resistance rating* without being incorporated in the assembly at the time of testing as required in Sentence (2) provided the piping is sealed in conformance with Article 3.1.9.1.

8) *Combustible* sprinkler piping is permitted to penetrate a *fire separation* provided the *fire compartments* on each side of the *fire separation* are *sprinklered*.

9) *Combustible* piping for central vacuum systems is permitted to penetrate a *fire separation* provided the installation conforms to the requirements that apply to *combustible* drain, waste and vent piping specified in Sentences 9.10.9.7.(2) to (6).

9.10.9.7. Combustible Drain, Waste and Vent Piping

1) Except as permitted in Sentences (2) to (6), *combustible* piping shall not be used in any part of a drain, waste and vent piping system where any part of that system partly or wholly penetrates a *fire separation* required to have a *fire-resistance rating* or penetrates a membrane that contributes to the required *fire-resistance rating* of an assembly.

2) *Combustible* drain, waste and vent piping not located in a vertical shaft is permitted to penetrate a *fire separation* required to have a *fire-resistance rating* or a membrane that forms part of an assembly required to have a *fire-resistance rating* provided the piping is sealed at the penetration by a firestop system that has an F rating not less than the *fire-resistance rating* required for the *fire separation*.

3) The rating referred to in Sentence (2) shall be based on ULC-S115, "Fire Tests of Firestop Systems," with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side.

4) *Combustible* drain piping is permitted to penetrate a horizontal *fire separation* or a membrane that contributes to the required *fire-resistance rating* of a horizontal *fire separation*, provided it leads directly from a *noncombustible* watercloset through a concrete floor slab.

5) *Combustible* drain, waste and vent piping is permitted on one side of a vertical *fire separation* provided it is not located in a vertical shaft.

6) In *buildings* containing 2 *dwelling units* only, *combustible* drain, waste and vent piping is permitted on one side of a horizontal *fire separation*.

9.10.9.8. Collapse of Combustible Construction

1) *Combustible construction* that abuts on or is supported by a *noncombustible fire separation* shall be constructed so that its collapse under fire conditions will not cause collapse of the *fire separation*.

9.10.9.9. Reduction in Thickness of Fire Separation by Beams and Joists

1) Where pockets for the support of beams or joists are formed in a masonry or concrete *fire separation*, there shall be left a total thickness of solid masonry and/or grout and/or concrete not less than the required equivalent thickness shown for Type S monolithic concrete in Table D-2.1.1. in Appendix D for the required *fire-resistance rating*.

9.10.9.10. Concealed Spaces above Fire Separations

1) Except as provided in Sentence (2), a *horizontal service space* or other concealed space located above a required vertical *fire separation* shall be divided at the *fire separation* by an equivalent *fire separation* within the space.

2) Where a *horizontal service space* or other concealed space is located above a required vertical *fire separation* other than a vertical shaft, such space need not be divided as required in Sentence (1) provided the construction between such space and the space below is constructed as a *fire separation* having a *fire-resistance rating* not less than that required for the vertical *fire separation*, except that where the vertical *fire separation* is not required to have a *fire-resistance rating* greater than 45 min, the *fire-resistance rating* of the ceiling may be reduced to 30 min.

9.10.9.11. Separation of Residential Occupancies

1) Except as provided in Sentence (2), *residential occupancies* shall be separated from all other *major occupancies* by a *fire separation* having a *fire-resistance rating* of not less than 1 h.

2) Except as provided in Sentence (3), a *major occupancy* classified as a *residential occupancy* shall be separated from other *major occupancies* classified as *mercantile* or *medium hazard industrial occupancies* by a *fire separation* having a *fire-resistance rating* of not less than 2 h.

3) Where not more than 2 *dwelling units* are located in a *building* containing a *mercantile occupancy*, such *mercantile occupancy* shall be separated from the *dwelling units* by a *fire separation* having not less than 1 h *fire-resistance rating*.

9.10.9.12. Residential Suites in Industrial Buildings

1) Not more than one *suite* of *residential occupancy* shall be contained within a *building* classified as a Group F, Division 2 *major occupancy*.

9.10.9.13. Separation of Suites

1) Except as required in Article 9.10.9.14. and as permitted by Sentence (2), each *suite* in other than *business and personal services occupancies* shall be separated from adjoining *suites* by a *fire separation* having a *fire-resistance rating* of not less than 45 min.

2) In *sprinklered buildings*, *suites* of *business and personal services occupancy* and *mercantile occupancy* that are served by *public corridors* conforming with Sentence 3.3.1.4.(4) are not required to be separated from each other by *fire separations*.

9.10.9.14. Separation of Residential Suites

1) Except as provided in Sentences (2) and (3) and Article 9.10.20.2., *suites* in *residential occupancies* shall be separated from adjacent rooms and *suites* by a *fire separation* having a *fire-resistance rating* of not less than 45 min.

2) Sleeping rooms in boarding and lodging houses where sleeping accommodation is provided for not more than 8 boarders or lodgers need not be separated from the remainder of the *floor area* as required in Sentence (1) where the sleeping rooms form part of the proprietor's residence and do not contain cooking facilities.

3) *Dwelling units* that contain 2 or more *storeys* including *basements* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* of not less than 1 h. (See A-3.3.4.4.(1) in Appendix A.)

9.10.9.15. Separation of Public Corridors

1) Except as provided in Sentences (2) and (3), *public corridors* shall be separated from the remainder of the *building* by a *fire separation* having not less than a 45 min *fire-resistance rating*.

2) In other than *residential occupancies*, no *fire-resistance rating* is required for *fire separations* between a *public corridor* and the remainder of the *building* if

a) the *floor area* is *sprinklered*,
b) the sprinkler system is electrically supervised in conformance with Sentence 3.2.4.9.(2), and
c) the operation of the sprinkler system will cause a signal to be transmitted to the fire department in conformance with Sentence 3.2.4.7.(4).

3) In other than *residential occupancies*, no *fire separation* is required between a *public corridor* and the remainder of the *building* if

a) the *floor area* is *sprinklered*,
b) the sprinkler system is electrically supervised in conformance with Sentence 3.2.4.9.(2),
c) the operation of the sprinkler system will cause a signal to be transmitted to the fire department in conformance with Sentence 3.2.4.7.(4), and
d) the corridor exceeds 5 m in width.

9.10.9.16. Separation of Storage Garages

1) Except as provided in Sentences (2) and (3), a *storage garage* shall be separated from other *occupancies* by a *fire separation* having not less than a 1.5 h *fire-resistance rating*.

2) Except as permitted in Sentence (3), *storage garages* containing 5 motor vehicles or fewer shall be separated from other *occupancies* by a *fire separation* of not less than 1 h.

3) Where a *storage garage* serves only the *dwelling unit* to which it is attached or built in, it shall be considered as part of that *dwelling unit* and the *fire separation* required in Sentence (2) need not be provided between the garage and the *dwelling unit*. r3

4) Except as provided in Sentence (5), where a *storage garage* is attached to or built into a *building* of *residential occupancy*
a) an *air barrier system* conforming to Subsection 9.25.3. shall be installed between the garage and the remainder of the *building* to provide an effective barrier to gas and exhaust fumes, and
b) every door between the garage and the remainder of the *building* shall conform to Article 9.10.13.15.
(See Appendix A.) r3

5) Where membrane materials are used to provide the required airtightness in the *air barrier system*, all joints shall be sealed and structurally supported. r3

9.10.9.17. Separation of Repair Garages

1) Except as provided in Sentence (2), a *repair garage* shall be separated from other *occupancies* by a *fire separation* having a *fire-resistance rating* of not less than 2 h.

2) Ancillary spaces directly serving a *repair garage*, including waiting rooms, reception rooms, tool and parts storage areas and supervisory office space, need not be separated from the *repair garage* but shall be separated from other *occupancies* as required in Sentence (1).

3) Except as provided in Sentence (4), where a *building* containing a *repair garage* also contains a *dwelling unit*, an *air barrier system* conforming to Subsection 9.25.3. shall be installed between the *dwelling unit* and the *suite* containing the garage to provide an effective barrier to gas and exhaust fumes. (See A-9.10.9.16.(4) in Appendix A.) r3

4) Where membrane materials are used to provide the required airtightness in the *air barrier system*, all joints shall be sealed and structurally supported. r3

9.10.9.18. Exhaust Ducts Serving More Than One Fire Compartment

1) Where a *vertical service space* contains an *exhaust duct* that serves more than one *fire compartment*, the duct shall have a fan located at or near the exhaust outlet to ensure that the duct is under negative pressure.

2) Individual *fire compartments* referred to in Sentence (1) shall not have fans that exhaust directly into the duct in the *vertical service space*.

9.10.9.19. Central Vacuum Systems

1) A central vacuum system shall serve not more than one *suite*.

9.10.10. Service Rooms

9.10.10.1. Application

1) This Subsection applies to *service rooms* in all *buildings* except rooms located within a *dwelling unit*.

9.10.10.2. Service Room Floors

1) The *fire-resistance rating* requirements in this Subsection do not apply to the floor assembly immediately below a *service room*.

9.10.10.3. Separation of Service Rooms

1) Except as provided in Sentence (2) and Articles 9.10.10.5. and 9.10.10.6., *service rooms* shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* of not less than 1 h when the *floor area* containing the *service room* is not *sprinklered*.

2) Where a room contains a limited quantity of service equipment and the service equipment does not constitute a fire hazard, the requirements in Sentence (1) shall not apply.

9.10.10.4. Appliances and Equipment to be Located in a Service Room

1) Except as provided in Sentence (2) and Article 9.10.10.5., fuel-fired *appliances* other than fireplaces shall be located in a *service room* separated from the remainder of the *building* by a *fire separation* having not less than a 1 h *fire-resistance rating*.

2) Except as required in the *appliance* installation standards referenced in Sentences 6.2.1.5.(1), 9.33.5.2.(1) and 9.33.5.3.(1), fuel-fired *space-heating appliances*, space-cooling *appliances* and *service water heaters* need not be separated from the remainder of the *building* as required in Sentence (1), where the equipment serves
a) not more than one room or *suite*, or
b) a *building* with a *building area* of not more than 400 m² and a *building height* of not more than 2 *storeys*.

9.10.10.5. Incinerators

1) *Service rooms* containing incinerators shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* of not less than 2 h.

2) The design, construction, installation and *alteration* of each indoor incinerator shall conform to NFPA 82, "Incinerators and Waste and Linen Handling Systems and Equipment."

3) Every incinerator shall be connected to a *chimney flue* conforming to the requirements in Section 9.21. and serving no other *appliance*.

4) An incinerator shall not be located in a room with other fuel-fired *appliances*.

9.10.10.6. Storage Rooms

1) Rooms for the temporary storage of *combustible* refuse in all *occupancies* or for public storage in *residential occupancies* shall be separated from the remainder of the *building* by a *fire separation* having not less than a 1 h *fire-resistance rating*, except that a 45 min *fire separation* is permitted where the *fire-resistance rating* of the floor assembly is not required to exceed 45 min, or where such rooms are *sprinklered*.

9.10.11. Firewalls

9.10.11.1. Required Firewalls

1) Except as provided in Article 9.10.11.2., a *party wall* on a property line shall be constructed as a *firewall*.

9.10.11.2. Firewalls Not Required

1) In a *building* of *residential occupancy* in which there is no *dwelling unit* above another *dwelling unit*, a *party wall* on a property line between *dwelling units* need not be constructed as a *firewall* provided it is constructed as a *fire separation* having not less than a 1 h *fire-resistance rating*.

2) The wall described in Sentence (1) shall provide continuous protection from the top of the footings to the underside of the roof deck.

3) Any space between the top of the wall described in Sentence (1) and the roof deck shall be tightly filled with mineral wool or *noncombustible* material.

9.10.11.3. Construction of Firewalls

1) Where *firewalls* are used, the requirements in Part 3 shall apply.

9.10.12. Prevention of Fire Spread at Exterior Walls and between Storeys

9.10.12.1. Separation of Exterior Openings

1) In *buildings* of *mercantile* or *medium hazard industrial occupancy*, exterior openings in one *storey* shall be separated from exterior openings in an adjacent *storey* by
- a) a wall not less than 1 m in vertical dimension, or
- b) a canopy or balcony not less than 1 m in width.

2) The wall, canopy or balcony described in Sentence (1) shall have a *fire-resistance rating* not less than that required for the floor assembly separating the *storeys*, except that the rating need not exceed 1 h.

9.10.12.2. Termination of Floors or Mezzanines

1) Except as provided in Sentence (2) and in Articles 9.10.1.3. and 9.10.9.5., the portions of a *floor area* or *mezzanine* that do not terminate at an exterior wall, a *firewall* or a vertical shaft, shall terminate at a vertical *fire separation* having a *fire-resistance rating* not less than that required for the floor assembly that terminates at the separation.

2) A *mezzanine* need not terminate at a vertical *fire separation* where the *mezzanine* is not required to be considered as a *storey* in Articles 9.10.4.1. and 9.10.4.2.

9.10.12.3. Location of Skylights

1) Where a wall in a *building* is exposed to a fire hazard from an adjoining roof of a separate unsprinklered *fire compartment* in the same *building*, the roof shall contain no skylights within a horizontal distance of 5 m of the windows in the exposed wall.

9.10.12.4. Exterior Walls Meeting at an Angle

1) Except as provided in Article 9.9.4.5., where exterior walls of a *building* meet at an external angle of 135° or less, the horizontal distance from an opening in one wall to an opening in the other wall shall be not less than 1.2 m, where the openings are in different *fire compartments*.

2) The exterior wall of each *fire compartment* referred to in Sentence (1) within the 1.2 m distance shall have a *fire-resistance rating* not less than that required for the interior vertical *fire separation* between the compartment and the remainder of the *building*.

9.10.12.5. Protection of Soffits

1) Except as provided in Sentences (2) and (3), where a common *attic or roof space* spans more than 2 *suites* of *residential occupancy* and projects beyond the exterior wall of the *building*, the portion of any soffit or other surface enclosing the projection that is less than 2.5 m vertically above a window or door and less than 1.2 m from either side of the window or door, shall have no *unprotected openings* and shall be protected by
- a) *noncombustible* material having a minimum thickness of 0.38 mm and a melting point not below 650°C,
- b) not less than 12.7 mm thick gypsum soffit board or gypsum wallboard installed according to CSA A82.31-M, "Gypsum Board Application,"
- c) not less than 11 mm thick plywood,

d) not less than 12.5 mm thick OSB or waferboard, or
e) not less than 11 mm thick lumber.
(See Appendix A.)

2) Where the soffit or other surface described in Sentence (1) is completely separated from the remainder of the *attic or roof space* by fire stopping, the requirements in Sentence (1) do not apply.

3) Where all *suites* spanned by a common *attic or roof space* are *sprinklered*, the requirements in Sentence (1) do not apply provided that all rooms, including closets and bathrooms, having openings in the wall beneath the soffit are *sprinklered*, notwithstanding any exceptions in the sprinkler standards referenced in Article 3.2.5.13.

9.10.13. Doors, Dampers and Other Closures in Fire Separations

9.10.13.1. Closures

1) Except as provided in Article 9.10.13.2., openings in required *fire separations* shall be protected with a *closure* conforming to Table 9.10.13.1. and shall be installed in conformance with Chapters 2 to 14 of NFPA 80, "Fire Doors and Fire Windows," unless otherwise specified herein. (See also Article 9.10.3.1.)

Table 9.10.13.1.
Fire-Protection Ratings for Closures
Forming Part of Sentence 9.10.13.1.(1)

Required *Fire-Resistance Rating* of *Fire Separation*	Minimum *Fire-Protection Rating* of *Closure*
30 or 45 min	20 min(1)
1 h	45 min(1)
1.5 h	1 h
2 h	1.5 h
3 h	2 h
4 h	3 h

Notes to Table 9.10.13.1.:
(1) See Article 9.10.13.2.

9.10.13.2. Solid Core Wood Door as a Closure

1) A 45 mm thick solid core wood door is permitted to be used where a minimum *fire-protection rating* of 20 min is permitted or between a *public corridor* and a *suite* provided that the door conforms to CAN4-S113, "Wood Core Doors Meeting the Performance Required by CAN4-S104-77 for Twenty Minute Fire Rated Closure Assemblies." (See Appendix A.)

2) Doors described in Sentence (1) shall have not more than a 6 mm clearance beneath and not more than 3 mm at the sides and top.

3) Where a 45 mm thick solid core wood door is permitted in a required *fire separation*, the requirement for a *noncombustible* sill in NFPA 80, "Fire Doors and Fire Windows," shall not apply.

9.10.13.3. Unrated Wood Door Frames

1) Doors required to provide a 20 min *fire-protection rating* or permitted to be 45 mm solid core wood shall be mounted in a wood frame of not less than 38 mm thickness where the frame has not been tested and rated.

9.10.13.4. Doors as a Means of Egress

1) Doors forming part of an *exit* or a public *means of egress* shall conform to Subsection 9.9.6. in addition to this Subsection.

9.10.13.5. Wired Glass as a Closure

1) Wired glass conforming to Article 9.7.3.1. which has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a vertical *fire separation* required to have a *fire-resistance rating* of not more than 1 h provided such glass is not less than 6 mm thick and is mounted in conformance with Sentence (2).

2) Wired glass described in Sentence (1) shall be mounted in fixed steel frames having a metal thickness of not less than 1.35 mm and a glazing stop of not less than 20 mm on each side of the glass.

3) Individual panes of glass described in Sentence (1) shall not exceed 0.8 m^2 in area or 1.4 m in height or width, and the area of glass not structurally supported by mullions shall not exceed 7.5 m^2.

9.10.13.6. Steel Door Frames

1) Steel door frames forming part of a *closure* in a *fire separation*, including anchorage requirements, shall conform to CAN4-S105-M, "Fire Door Frames Meeting the Performance Required by CAN4-S104."

9.10.13.7. Glass Block as a Closure

1) Glass block that has not been tested in accordance with Article 9.10.3.1. is permitted as a *closure* in a *fire separation* required to have a *fire-resistance rating* of not more than 1 h. (See Article 9.20.9.6.)

9.10.13.8. Maximum Size of Opening

1) The size of an opening in an interior fire separation, even where protected with a *closure*, shall not exceed 11 m^2, with no dimension greater than 3.7 m, when the *fire compartments* on both sides of the *fire separation* are not *sprinklered*.

2) The size of an opening in an interior *fire separation*, even where protected with a *closure*, shall not exceed 22 m^2, with no dimension greater than 6 m, when the *fire compartments* on both sides of the *fire separation* are *sprinklered*.

9.10.13.9. Door Latch

1) Every swing type door in a *fire separation* shall be equipped with a latch.

9.10.13.10. Self-Closing Device

1) Except as described in Sentence (2), every door in a *fire separation* shall have a self-closing device.

2) Self-closing doors are not required between *public corridors* and *suites* in *business and personal services occupancies*, except in dead-end corridors.

9.10.13.11. Hold-Open Devices

1) Where hold-open devices are used on doors in required *fire separations*, they shall be installed in accordance with Article 3.1.8.12.

9.10.13.12. Service Room Doors

1) Swing-type doors shall open into *service rooms* containing fuel-fired equipment where such doors lead to *public corridors* or rooms used for assembly but shall swing outward from such rooms in all other cases.

9.10.13.13. Fire Dampers

1) Except as permitted in Sentences (2) to (5) and Sentence 9.10.5.1.(4), ducts that connect 2 *fire compartments* or penetrate an assembly required to be a *fire separation* with a *fire-resistance rating* shall be equipped with a *fire damper* in conformance with Article 3.1.8.9.

2) A *fire damper* is not required where a *noncombustible* branch duct pierces a required *fire separation* provided the duct
- a) has a melting point not below 760°C,
- b) has a cross-sectional area less than 130 cm^2, and
- c) supplies only air-conditioning units or combined air-conditioning and heating units discharging air at not more than 1.2 m above the floor.

3) A *fire damper* is not required where a *noncombustible* branch duct pierces a required *fire separation* around an *exhaust duct* riser in which the air flow is upward provided
- a) the melting point of the branch duct is not below 760°C,
- b) the branch duct is carried up inside the riser not less than 500 mm, and
- c) the *exhaust duct* is under negative pressure as described in Article 9.10.9.18.

4) *Noncombustible* ducts that penetrate a *fire separation* separating a *vertical service space* from the remainder of the *building* need not be equipped with a *fire damper* at the *fire separation* provided
- a) the ducts have a melting point above 760°C, and
- b) each individual duct exhausts directly to the outside at the top of the *vertical service space*.

5) A duct serving commercial cooking equipment and piercing a required *fire separation* need not be equipped with a *fire damper* at the *fire separation*. (See also Article 6.2.2.6.)

9.10.13.14. Fire Stop Flaps

1) *Fire stop flaps* in ceiling membranes required in Sentence 9.10.5.1.(4) shall be constructed in conformance with Appendix D, Fire-Performance Ratings.

9.10.13.15. Doors between Garages and Dwelling Units

1) A door between an attached or built-in garage and a *dwelling unit* shall be tight fitting and weather-stripped to provide an effective barrier against the passage of gas and exhaust fumes and shall be fitted with a self-closing device.

2) A doorway between an attached or built-in garage and a *dwelling unit* shall not be located in a room intended for sleeping.

9.10.13.16. Door Stops

1) Where a door is installed so that it may damage the integrity of a *fire separation* if its swing is unrestricted, door stops shall be installed to prevent such damage.

9.10.14. Spatial Separations between Buildings

9.10.14.1. Maximum Percentage Area of Unprotected Openings

1) Except as provided in Articles 9.10.14.3. to 9.10.14.11., the maximum percentage area of *unprotected openings* in an *exposing building face* shall conform to Table 9.10.14.1. or to Subsection 3.2.3., whichever is the least restrictive for the *occupancy* being considered.

9.10.14.2. Area of Exposing Building Face

1) The area of an *exposing building face* shall be calculated as the total area of exterior wall facing in one direction on any side of a *building* measured from the finished ground level to the uppermost ceiling, except that where a *building* is divided by *fire separations* into *fire compartments*, the area of *exposing building face* may be calculated for each *fire compartment* provided such separations have not less than a 45 min *fire-resistance rating*.

9.10.14.3. Inadequate Fire Fighting Facilities

1) Where there is no fire department or where a fire department is not organized, trained and equipped to meet the needs of the community, the *limiting distance* determined from Article 9.10.14.1. or required in Articles 9.10.14.12., 9.10.14.14. and 9.10.14.16. shall be doubled for a *building* that is not *sprinklered*.

9.10.14.4. Alternate Method of Determining Limiting Distance

1) The *limiting distance* shown in Table 9.10.14.1. may be reduced provided it is not less than the square root of

a) the aggregate area of *unprotected openings* in an *exposing building face* in *residential occupancies*, *business and personal services occupancies* and *low hazard industrial occupancies*, and

b) twice the aggregate area of *unprotected openings* in *mercantile occupancies* and *medium hazard industrial occupancies*.

9.10.14.5. Openings in Walls Having a Limiting Distance Less Than 1.2 m

1) Openings in a wall having a *limiting distance* of less than 1.2 m shall be protected by *closures*, of other than wired glass or glass block, whose *fire-protection rating* is in conformance with the *fire-resistance rating* required for the wall. (See Table 9.10.13.1.)

Table 9.10.14.1.
Maximum Percentage Area of Unprotected Openings in Exterior Walls
Forming Part of Sentence 9.10.14.1.(1)

Occupancy Classification of *Building*	Maximum Area of *Exposing Building Face*, m²	Maximum Aggregate Area of *Unprotected Openings*, % of *Exposing Building Face* Area											
		Limiting Distance, m											
		Less than 1.2	1.2	1.5	2.0	4.0	6.0	8.0	10.0	12.0	16.0	20.0	25.0
Residential, *business and personal services*, and *low hazard industrial*	30	0	7	9	12	39	88	100	—	—	—	—	—
	40	0	7	8	11	32	69	100	—	—	—	—	—
	50	0	7	8	10	28	57	100	—	—	—	—	—
	100	0	7	8	9	18	34	56	84	100	—	—	—
	Over 100	0	7	7	8	12	19	28	40	55	92	100	—
Mercantile and *medium hazard industrial*	30	0	4	4	6	20	44	80	100	—	—	—	—
	40	0	4	4	6	16	34	61	97	100	—	—	—
	50	0	4	4	5	14	29	50	79	100	—	—	—
	100	0	4	4	4	9	17	28	42	60	100	—	—
	Over 100	0	4	4	4	6	10	14	20	27	46	70	100

9.10.14.6. Allowance for Sprinklers and Wired Glass or Glass Block

(See A-3.2.3.11.(1) in Appendix A.) e3

1) The maximum area of *unprotected openings* is permitted to be doubled where the *building* is *sprinklered* provided all rooms, including closets and bathrooms, that are adjacent to the *exposing building face* and that have *unprotected openings* are *sprinklered*, notwithstanding any exemptions in the sprinkler standards referenced in Article 3.2.5.13.

2) The maximum area of *unprotected openings* is permitted to be doubled where the *unprotected openings* are glazed with wired glass in steel frames or glass blocks as described in Articles 9.10.13.5. and 9.10.13.7.

9.10.14.7. Exterior Wall Construction for Irregularly-Shaped or Skewed Walls

1) Except as provided in Sentence 9.10.14.12.(1), for the purpose of using Table 9.10.14.11. to determine the required type of construction, cladding and *fire-resistance rating* for an irregularly-shaped or skewed exterior wall, e
- a) the *exposing building face* shall be taken as the projection of the exterior wall onto a vertical plane located so that no portion of the *exposing building face* of the *building* is between the vertical plane and the line to which the *limiting distance* is measured, and
- b) the permitted area of *unprotected openings* shall be determined from Table 9.10.14.1. or Article 9.10.14.4., using the *limiting distance* measured from this *exposing building face*. (See A-3.2.3.1.(4) in Appendix A.)

9.10.14.8. Percentage of Unprotected Openings for Irregularly-Shaped or Skewed Walls

1) For the purpose of using Table 9.10.14.1. to determine the actual percentage of *unprotected openings* permitted in an irregularly-shaped or skewed exterior wall, the location of the *exposing building face* is permitted to be taken at a vertical plane located so that there are no *unprotected openings* between the vertical plane and the line to which the *limiting distance* is measured. (See A-3.2.3.1.(4) in Appendix A.)

9.10.14.9. Storeys at Street Level

1) The *exposing building face* of a *storey* that faces a *street* and is at the same level as the *street* is permitted to have unlimited *unprotected openings* if the *limiting distance* is not less than 9 m.

9.10.14.10. Open-Air Storage Garages

1) When a *storage garage* has all *storeys* constructed as *open-air storeys*, the *exposing building face* of such garage is permitted to have unlimited *unprotected openings* provided the *storage garage* has a *limiting distance* of not less than 3 m.

9.10.14.11. Construction of Exposing Building Face

1) Except as permitted in Sentence (2) and in Articles 9.10.14.12. to 9.10.14.16., each *exposing building face* and any exterior wall located above an *exposing building face* that encloses an *attic or roof space* shall be constructed in conformance with Table 9.10.14.11. and Subsection 9.10.8.

2) Cladding installed on *exposing building faces* and exterior walls located above *exposing building faces* that enclose an *attic or roof space* need not conform to "Type of Cladding Required" in Table 9.10.14.11. provided
- a) the *limiting distance* is not less than 0.6 m,
- b) the exposing face is constructed with no *unprotected openings*, and
- c) the cladding conforms to Clauses 9.10.14.12.(4)(a) to (d).

9.10.14.12. Alternate Approach to Exposing Building Face e2

1) For the purposes of this Article, where maximum area of glazed openings is determined using Table 9.10.14.1., an *exposing building face* may be considered to be made up of any number of separate portions and the requirements for *fire-resistance rating* and cladding material and the limits on glazed openings for each portion may be determined based on the *limiting distance* for that portion. (See Appendix A.) r3

2) Except as required in Article 9.10.14.3. and as provided in Sentence (4), in *buildings* containing only *dwelling units* in which there is no *dwelling unit* above another *dwelling unit*, the requirements of Article 9.10.14.11. do not apply provided that the *exposing building face*
- a) has a *fire-resistance rating* of not less than 45 min where the *limiting distance* is less than 1.2 m, and
- b) is clad with *noncombustible* material where the *limiting distance* is less than 0.6 m.

3) Glazed openings in the *exposing building face* referred to in Sentence (2)
- a) shall not be permitted where the *limiting distance* is less than 1.2 m, and
- b) shall be limited in conformance with the requirements for *unprotected openings* in Article 9.10.14.1., where the *limiting distance* is 1.2 m or greater.

Table 9.10.14.11.
Minimum Construction Requirements for Exposing Building Faces
Forming Part of Sentence 9.10.14.11.(1)

Occupancy Classification of *Building*	Maximum Area of *Unprotected Openings* Permitted, % of *Exposing Building Face* Area	Minimum Required *Fire-Resistance Rating*	Type of Construction Required	Type of Cladding Required
Residential, business and personal services, and *low hazard industrial*	0 - 10	1 h	*Noncombustible*	*Noncombustible*
	11 - 25	1 h	*Combustible* or *noncombustible*	*Noncombustible*
	26 - <100	45 min	*Combustible* or *noncombustible*	*Combustible* or *noncombustible*
Mercantile, and *medium hazard industrial*	0 - 10	2 h	*Noncombustible*	*Noncombustible*
	11 - 25	2 h	*Combustible* or *noncombustible*	*Noncombustible*
	26 - <100	1 h	*Combustible* or *noncombustible*	*Combustible* or *noncombustible*

4) Cladding on the *exposing building face* described in Sentence (2) may be vinyl when the *limiting distance* is less than 0.6 m provided the cladding
a) conforms to Subsection 9.27.13.,
b) is installed directly over 12.7 mm gypsum sheathing,
c) has a *flame-spread rating* not greater than 25 when tested in accordance with Sentence 3.1.12.1.(2), and
d) does not exceed 2 mm in thickness exclusive of fasteners, joints and local reinforcements.

9.10.14.13. Combustible Projections

1) Except for *buildings* containing 1 or 2 *dwelling units* only, *combustible* projections on the exterior of a wall that are more than 1 m above ground level, such as balconies, platforms, canopies, eave projections and stairs, and that could expose an adjacent *building* to fire spread, shall not be permitted within
a) 1.2 m of a property line or the centreline of a *public way*, or
b) 2.4 m of a *combustible* projection on another *building* on the same property.

9.10.14.14. Detached Garage Serving One Dwelling Unit

1) Except as required in Article 9.10.14.3., the *exposing building face* of a garage or accessory *building* that serves one *dwelling unit* only and is detached from any *building* shall have a *fire-resistance rating* of not less than 45 min, except that no *fire-resistance rating* is required where the *limiting distance* is 0.6 m or greater.

2) The exterior cladding of detached garages or accessory *buildings* described in Sentence (1) is not required to be *noncombustible* regardless of the *limiting distance*.

3) The percentage of window openings permitted in the *exposing building face* of detached garages or accessory *buildings* described in Sentence (1) shall conform to the requirements for *unprotected openings* in Article 9.10.14.1.

4) The requirements for *limiting distance* shall not apply between a detached garage or accessory *building* and a *dwelling unit* where
a) the detached garage or accessory *building* serves only one *dwelling unit*,
b) the detached garage or accessory *building* is located on the same property as that *dwelling unit*, and
c) the *dwelling unit* served by the detached garage or accessory *building* is the only *major occupancy* on the property.

9.10.14.15. Heavy Timber and Steel Columns

1) Heavy timber and steel columns need not conform to the requirements of Article 9.10.14.11. provided the *limiting distance* is not less than 3 m.

9.10.14.16. Low Fire Load Occupancies

1) Except as required in Article 9.10.14.3., in *buildings* of 1 *storey* in *building height* of *noncombustible construction* classified as *low hazard industrial occupancy* which are used only for low *fire load occupancies* such as power generating plants or plants for the manufacture or storage of *noncombustible* materials, non-*loadbearing* wall components need not have a minimum *fire-resistance rating* provided the *limiting distance* is 3 m or more.

9.10.15. Fire Stops

9.10.15.1. Required Fire Stops in Concealed Spaces

1) Vertical concealed spaces in interior walls and exterior walls shall be separated by fire stops
a) one from the other, and
b) from horizontal concealed spaces.

2) Horizontal concealed spaces in attics, roof spaces, ceilings, floors, and crawl spaces shall be separated by fire stops
a) one from the other, and
b) from vertical concealed spaces.

3) Fire stops shall be provided at all interconnections between concealed vertical and horizontal spaces in interior coved ceilings, drop ceilings and soffits where the exposed construction materials within the concealed spaces have a surface *flame-spread rating* greater than 25.

4) Fire stops shall be provided at the top and bottom of each run of stairs where they pass through a floor containing concealed space in which the exposed construction materials within the space have a surface *flame-spread rating* greater than 25.

5) In unsprinklered *buildings* of *combustible construction*, every concealed space created by a ceiling, roof space or unoccupied attic space shall be separated by fire stops into compartments
a) not more than 60 m in greatest dimension, and
b) where such space contains exposed construction materials having a surface *flame-spread rating* greater than 25, not more than 300 m² in area.

6) No dimension of the concealed space described in Clause (5)(b) shall exceed 20 m. **e**

7) Concealed spaces in mansard or gambrel style roofs, exterior cornices, balconies and canopies of *combustible construction* in which the exposed construction materials within the space have a surface *flame-spread rating* exceeding 25 shall have vertical fire stops at intervals of not more than 20 m and at points where such concealed spaces extend across the ends of required vertical *fire separations*.

9.10.15.2. Required Fire Stops in Wall Assemblies

1) Except as permitted in Sentence (2), fire stops shall be provided to block off concealed spaces within wall assemblies, including spaces created by furring,
a) at each floor level,
b) at each ceiling level where the ceiling contributes to part of the required *fire-resistance rating*, and
c) at other locations within the wall, so that the distance between fire stops does not exceed 20 m horizontally and 3 m vertically.

2) Fire stops described in Sentence (1) are not required provided
a) the width of the concealed wall space does not exceed 25 mm,
b) the exposed construction materials within the space are *noncombustible*,
c) the exposed construction materials within the space, including insulation, but not including wiring, piping or similar services, have a *flame-spread rating* of not more than 25, or
d) the concealed wall space is filled with insulation.

9.10.15.3. Fire Stop Materials

1) Fire stops shall be constructed of not less than
a) 0.38 mm sheet steel,
b) 6 mm asbestos board,
c) 12.7 mm gypsum wallboard,
d) 12.5 mm plywood, OSB or waferboard, with joints having continuous support,
e) 2 layers of 19 mm lumber with joints staggered,
f) 38 mm lumber, or
g) materials conforming to Sentence 3.1.11.7.(1).

9.10.15.4. Penetration of Fire Stops

1) Where fire stops are pierced by pipes, ducts or other elements, the effectiveness of the fire stops shall be maintained around such elements.

9.10.16. Flame Spread Limits

9.10.16.1. Flame Spread Rating of Interior Surfaces

1) Except as otherwise provided in this Subsection, the exposed surface of every interior wall and ceiling, including skylights and glazing, shall have a surface *flame-spread rating* of not more than 150.

2) Except as permitted in Sentence (3), doors need not conform to Sentence (1) provided they have a surface *flame-spread rating* of not more than 200.

3) Doors within *dwelling units*, other than garage doors, need not conform to Sentences (1) and (2).

9.10.16.2. Ceilings in Exits or Public Corridors

1) At least 90% of the exposed surface of every ceiling in an *exit* or unsprinklered ceiling in a *public corridor* shall have a surface *flame-spread rating* of not more than 25. (See Article 9.10.16.6.)

9.10.16.3. Walls in Exits

1) Except as provided in Sentence (2), at least 90% of the exposed surfaces of every wall in an *exit* shall have a surface *flame-spread rating* of not more than 25. (See Article 9.10.16.6.)

2) At least 75% of the wall surface of a lobby used as an *exit* in Article 9.9.8.5. shall have a surface *flame-spread rating* of not more than 25. (See Article 9.10.16.6.)

9.10.16.4. Exterior Exit Passageways

1) Where an exterior *exit* passageway provides the only *means of egress* from the rooms or *suites* it serves, the wall and ceiling finishes of that passageway, including the soffit beneath and the *guard* on the passageway, shall have a surface *flame-spread rating* of not more than 25, except that up to 10% of the total wall area and 10% of the total ceiling area is permitted to have a surface *flame-spread rating* of not more than 150.

9.10.16.5. Walls in Public Corridors

1) At least 90% of the total wall surface in any unsprinklered *public corridor* shall have a surface *flame-spread rating* of not more than 75, or at least 90% of the upper half of such walls shall have a surface *flame-spread rating* of not more than 25. (See Article 9.10.16.6.)

9.10.16.6. Calculation of Wall and Ceiling Areas

1) Skylights, glazing, *combustible* doors, and *combustible* light diffusers and lenses shall not be considered in the calculation of wall and ceiling areas in this Subsection.

9.10.16.7. Corridors Containing an Occupancy

1) Where a *public corridor* or a corridor used by the public contains an *occupancy*, the interior finish materials used on the walls or ceiling of such *occupancy*, shall have a surface *flame-spread rating* in conformance with that required for *public corridors*.

9.10.16.8. Light Diffusers and Lenses

1) Light diffusers and lenses having *flame-spread ratings* that exceed those permitted for the ceiling finish, shall conform to the requirements of Sentence 3.1.13.4.(1).

9.10.16.9. Combustible Skylights

1) Individual *combustible* skylights in corridors required to be separated from the remainder of the *building* by *fire separations* shall not exceed 1 m^2 in area and shall be spaced not less than 1.2 m apart.

9.10.16.10. Protection of Foamed Plastics

1) Except as provided in Sentence (2), foamed plastics which form part of a wall or ceiling assembly in *combustible construction* shall be protected from adjacent space in the *building*, other than adjacent concealed spaces within *attic or roof spaces*, crawl spaces, and wall assemblies, by
- a) one of the interior finishes described in Subsections 9.29.4. to 9.29.9.,
- b) sheet metal mechanically fastened to the supporting assembly independent of the insulation and having a thickness of not less than 0.38 mm and a melting point not below 650°C, provided the *building* does not contain a Group C *major occupancy*, or
- c) any thermal barrier that meets the requirements of Clause 3.1.5.11.(2)(e).

2) Thermosetting foamed plastic insulation having a *flame-spread rating* of not more than 200 is permitted to be used in factory-assembled doors in *storage garages* serving single *dwelling units* provided that
- a) the insulation is covered on the interior with a metallic foil,
- b) the assembly has a *flame-spread rating* of not more than 200, and
- c) the assembly incorporates no air spaces.

9.10.16.11. Walls and Ceilings in Bathrooms

1) The interior finish of walls and ceilings in bathrooms within *suites* of *residential occupancy* shall have a surface *flame-spread rating* of not more than 200.

9.10.16.12. Coverings or Linings of Ducts

1) Where a covering or a lining is used with a duct, such lining or covering shall have a *flame-spread rating* conforming to Article 3.6.5.4. or 9.33.6.4.

9.10.17. Alarm and Detection Systems

9.10.17.1. Access Provided through a Firewall

1) Where access is provided through a *firewall*, the requirements in this Subsection shall apply to the *floor areas* on both sides of the *firewall* as if they were in the same *building*.

9.10.17.2. Fire Alarm System Required

1) Except as provided in Sentence (2), a fire alarm system shall be installed
a) in every *building* that contains more than 3 *storeys*, including *storeys* below the *first storey*,
b) where the total *occupant load* exceeds 300, or
c) when the *occupant load* for any *major occupancy* in Table 9.10.17.2. is exceeded.

Table 9.10.17.2.
Maximum Occupant Load for Buildings without Fire Alarm Systems
Forming Part of Sentence 9.10.17.2.(1)

Major Occupancy Classification	*Occupant Load* Above which Fire Alarm System is Required
Residential	10 (sleeping accommodation)
Business and personal services, *Mercantile*	150 above or below the *first storey*
Low or *medium hazard industrial*	75 above or below the *first storey*

2) A fire alarm system is not required in a *residential occupancy* where an *exit* or *public corridor* serves not more than 4 *suites* or where each *suite* has direct access to an exterior *exit* facility leading to ground level.

9.10.17.3. Rooms and Spaces Requiring Heat Detectors or Smoke Detectors

1) Where a fire alarm system is required, every *public corridor* in *buildings* of *residential occupancy* and every *exit* stair shaft shall be provided with *smoke detectors*.

2) Except as provided in Sentence (3), *buildings* required to have a fire alarm system shall be equipped with *heat detectors* or *smoke detectors* in storage rooms, *service rooms*, elevator shafts, chutes, janitors' closets and any other rooms where hazardous substances are intended to be used or stored.

3) *Heat detectors* and *smoke detectors* described in Sentence (2) are not required in *dwelling units* or in *sprinklered buildings* in which the sprinkler system is electrically supervised and equipped with a water flow alarm.

9.10.17.4. Smoke Detectors in Recirculating Air Handling Systems

1) Except for a recirculating air system serving not more than one *dwelling unit*, where a fire alarm system is required to be installed, every recirculating air handling system shall be designed to prevent the circulation of smoke upon a signal from a duct-type *smoke detector* where such system supplies more than one *suite* on the same floor or serves more than 1 *storey*.

9.10.17.5. Portions of Buildings Considered as Separate Buildings

1) Except as provided in Sentence (2), where a vertical *fire separation* having a *fire-resistance rating* of not less than 1 h separates a portion of a *building* from the remainder of the *building* and there are no openings through the *fire separation* other than those for piping, tubing, wiring and conduit, the requirements for fire alarm and detection systems may be applied to each portion so separated as if it were a separate *building*.

2) The permission in Sentence (1) to consider separated portions of a *building* as separate *buildings* does not apply to *service rooms* and storage rooms.

9.10.17.6. Design and Installation Requirements

1) Fire alarm, fire detection and smoke detection devices and systems, and their installation, shall conform to Subsection 3.2.4.

9.10.17.7. Central Vacuum Systems

1) Central vacuum cleaning systems in *buildings* required to be equipped with a fire alarm system shall be designed to shut down upon activation of the fire alarm system.

9.10.17.8. Open-Air Storage Garages

1) A fire alarm system is not required in a *storage garage* conforming to Article 3.2.2.83. provided there are no other *occupancies* in the *building*.

9.10.18. Smoke Alarms

9.10.18.1. Required Smoke Alarms

1) *Smoke alarms* conforming to CAN/ULC-S531-M, "Smoke Alarms," shall be installed in each *dwelling unit* and in each sleeping room not within a *dwelling unit*.

9.10.18.2. Location of Smoke Alarms

1) Within *dwelling units*, sufficient *smoke alarms* shall be installed so that

a) there is at least one *smoke alarm* on each floor level, including *basements*, that is 900 mm or more above or below an adjacent floor level,
b) each bedroom is protected by a *smoke alarm* either inside the bedroom or, if outside, within 5 m, measured following corridors and doorways, of the bedroom door, and
c) the distance, measured following corridors and doorways, from any point on a floor level to a *smoke alarm* on the same level does not exceed 15 m.

(See Appendix A.)

2) *Smoke alarms* required in Article 9.10.18.1. and Sentence (1) shall be installed on or near the ceiling.

9.10.18.3. Power Supply

1) *Smoke alarms* shall be installed by permanent connections to an electrical circuit and shall have no disconnect switch between the overcurrent device and the *smoke alarm*.

2) Where the *building* is not supplied with electrical power, *smoke alarms* are permitted to be battery operated.

9.10.18.4. Interconnection of Smoke Alarms

1) Where more than one *smoke alarm* is required in a *dwelling unit*, the *smoke alarms* shall be wired so that the activation of one alarm will cause all alarms within the *dwelling unit* to sound.

9.10.18.5. Instructions for Maintenance and Care

1) Where instructions are necessary to describe the maintenance and care required for *smoke alarms* to ensure continuing satisfactory performance, they shall be posted in a location where they will be readily available to the occupants for reference.

9.10.19. Fire Fighting

9.10.19.1. Windows or Access Panels Required

1) Except as provided in Sentence (3), a window or access panel providing an opening not less than 1 100 mm high and 550 mm wide and having a sill height of not more than 900 mm above the floor shall be provided on the second and third *storeys* of every *building* in at least one wall facing on a *street* if such *storeys* are not *sprinklered*.

2) Access panels required in Sentence (1) shall be readily openable from both inside and outside or be glazed with plain glass.

3) Access panels required in Sentence (1) need not be provided in *buildings* containing only *dwelling units* where there is no *dwelling unit* above another *dwelling unit*.

9.10.19.2. Access to Basements

1) Except in *basements* serving not more than one *dwelling unit*, each unsprinklered *basement* exceeding 25 m in length or width shall be provided with direct access to the outdoors to at least one *street*.

2) Access required in Sentence (1) may be provided by a door, window or other means that provides an opening not less than 1 100 mm high and 550 mm wide, the sill height of which shall not be more than 900 mm above the floor.

3) Access required in Sentence (1) may also be provided by an interior stair accessible from the outdoors.

9.10.19.3. Fire Department Access to Buildings

1) Access for fire department equipment shall be provided to each *building* by means of a *street*, private roadway or yard. (See A-3.2.5.6.(1) and A-9.10.19.3.(1) in Appendix A.)

2) Where access to a *building* as required in Sentence (1) is provided by means of a roadway or yard, the design and location of such roadway or yard shall take into account connection with public thoroughfares, weight of fire fighting equipment, width of roadway, radius of curves, overhead clearance, location of fire hydrants, location of fire department connections and vehicular parking.

9.10.19.4. Portable Extinguishers

1) Portable extinguishers shall be installed in all *buildings*, except within *dwelling units*, in conformance with the appropriate provincial, territorial or municipal regulations or, in the absence of such regulations, the National Fire Code of Canada 1995.

9.10.19.5. Freeze Protection of Fire Protection Systems

1) Equipment forming part of a fire protection system that may be adversely affected by freezing temperatures and that is located in an unheated area shall be protected from freezing.

9.10.20. Fire Protection for Construction Camps

9.10.20.1. Requirements for Construction Camps

1) Except as provided in Articles 9.10.20.2. to 9.10.20.9., construction camps shall conform to Subsections 9.10.1. to 9.10.19.

9.10.20.2. Separation of Sleeping Rooms

1) Except for sleeping rooms within *dwelling units*, sleeping rooms in construction camps shall be separated from each other and from the remainder of the *building* by a *fire separation* having not less than a 30 min *fire-resistance rating*.

9.10.20.3. Floor Assemblies between the First and Second Storey

1) Except in a *dwelling unit*, a floor assembly in a construction camp *building* separating the *first storey* and the second *storey* shall be constructed as a *fire separation* having not less than a 30 min *fire-resistance rating*.

9.10.20.4. Walkways Connecting Buildings

1) *Walkways* of *combustible construction* connecting *buildings* shall be separated from each connected *building* by a *fire separation* having not less than a 45 min *fire-resistance rating*.

9.10.20.5. Spatial Separations

1) Construction camp *buildings* shall be separated from each other by a distance of not less than 10 m except as otherwise permitted in Subsection 9.10.14.

9.10.20.6. Flame-Spread Ratings

1) Except in *dwelling units* and except as provided in Sentence (2), the surface *flame-spread rating* of wall and ceiling surfaces in corridors and *walkways*, exclusive of doors, shall not exceed 25 over not less than 90% of the exposed surface area and not more than 150 over the remaining surface area.

2) Except within *dwelling units*, corridors that provide *access to exit* from sleeping rooms and that have a *fire-resistance rating* of not less than 45 min shall have a *flame-spread rating* conforming to the appropriate requirements in Subsection 9.10.16.

9.10.20.7. Smoke Detectors

1) Except in *dwelling units*, corridors providing *access to exit* from sleeping rooms in construction camp *buildings* with sleeping accommodation for more than 10 persons shall be provided with a *smoke detector* connected to the *building* alarm system.

9.10.20.8. Portable Fire Extinguishers

1) Each construction camp *building* shall be provided with portable fire extinguishers in conformance with the appropriate provincial or municipal regulations or, in the absence of such regulations, in conformance with the National Fire Code of Canada 1995.

9.10.20.9. Hose Stations

1) Every construction camp *building* providing sleeping accommodation for more than 30 persons shall be provided with a hose station that is protected from freezing and is equipped with a hose of sufficient length so that every portion of the *building* is within reach of a hose stream.

2) Hose stations required in Sentence (1) shall be located near an *exit*.

3) Hoses referred to in Sentence (1) shall be not less than 19 mm inside diam and shall be connected to a central water supply or to a storage tank having a capacity of not less than 4 500 L with a pumping system capable of supplying a flow of not less than 5 L/s at a gauge pressure of 300 kPa.

9.10.21. Fire Protection for Gas and Electric Ranges r

(See A-9.10.21. in Appendix A.)

9.10.21.1. Installation of Ranges

1) Except as required in Sentence (2), natural gas *ranges* shall be installed in accordance with CSA B149.1, “Natural Gas and Propane Installation Code.” (See Article 9.34.1.1.) r4

2) Clearances for gas and electric *ranges* shall be not less than those provided in Articles 9.10.21.2. and 9.10.21.3.

9.10.21.2. Vertical Clearances

1) Except as provided in Sentence (2), framing, finishes and cabinetry installed directly above the location of the *range* shall be not less than 750 mm above the level of *range* burners or elements.

2) The vertical clearance described in Sentence (1) for framing, finishes and cabinets located directly above the location of the *range* may be reduced to 600 mm above the level of the elements or burners provided the framing, finishes and cabinets
- a) are *noncombustible*, or
- b) are protected by
  - i) asbestos millboard not less than 6 mm thick, covered with sheet metal not less than 0.33 mm thick, or
  - ii) a metal hood with a 125 mm projection beyond the framing, finishes and cabinets.

9.10.21.3. Horizontal Clearances

1) Except as provided in Sentences (2) and (3), *combustible* wall framing, finishes or cabinets within 450 mm of the area where the *range* is to be located shall be protected above the level of the heating elements or burners by material providing fire resistance not less than that of a 9.5 mm thickness of gypsum board.

2) Counter-top splash boards or back plates that extend above the level of heating elements or burners need not be protected as described in Sentence (1).

3) Except for cabinetry described in Article 9.10.21.2., cabinetry located not less than 450 mm above the level of the heating elements or burners need not be protected as described in Sentence (1).

Section 9.11. Sound Control

9.11.1. Sound Transmission Class Rating (Airborne Sound)

9.11.1.1. Determination of Sound Transmission Class Ratings

1) Sound transmission class ratings shall be determined in accordance with ASTM E 413, "Classification for Rating Sound Insulation," using results from measurements in accordance with
a) ASTM E 90, "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements," or
b) ASTM E 336, "Measurement of Airborne Sound Insulation in Buildings."
(See Appendix A.)

9.11.2. Required Sound Control Locations (Airborne Sound)

9.11.2.1. Minimum Sound Transmission Class Ratings

1) Except as provided in Sentence (2), every *dwelling unit* shall be separated from every other space in a *building* in which noise may be generated by a construction providing a sound transmission class rating of at least 50, measured in accordance with Subsection 9.11.1. or as listed in A-9.10.3.1. in Appendix A.

2) Where a *dwelling unit* is adjacent to an elevator shaft or a refuse chute, the separating construction shall have a sound transmission class rating of at least 55, measured in accordance with Subsection 9.11.1. or as listed in A-9.10.3.1. in Appendix A.

Section 9.12. Excavation

9.12.1. General

9.12.1.1. Removal of Topsoil and Organic Matter

1) The topsoil and vegetable matter in all unexcavated areas under a *building* shall be removed.

2) In localities where termite infestation is known to be a problem, all stumps, roots and other wood debris shall be removed from the *soil* to a depth of not less than 300 mm in unexcavated areas under a *building*.

3) The bottom of every *excavation* shall be free of all organic material.

9.12.1.2. Standing Water

1) *Excavations* shall be kept free of standing water.

9.12.1.3. Protection from Freezing

1) The bottom of *excavations* shall be kept from freezing throughout the entire construction period.

9.12.2. Depth

9.12.2.1. Excavation to Undisturbed Soil

1) *Excavations* for *foundations* shall extend to undisturbed *soil*.

9.12.2.2. Minimum Depth of Foundations

1) Except as provided in Sentences (4) and (5), the minimum depth of *foundations* below finished ground level shall conform to Table 9.12.2.2.

2) Where a *foundation* is insulated in a manner that will reduce heat flow to the *soil* beneath the footings, the *foundation* depth shall conform to that required for *foundations* containing no heated space. (See Appendix A.)

3) The minimum depth of *foundations* for exterior concrete steps with more than 2 risers shall conform to Sentences (1) to (5).

4) Concrete steps with 1 and 2 risers are permitted to be laid on ground level.

5) The *foundation* depths required in Sentence (1) are permitted to be decreased where experience with local *soil* conditions shows that lesser depths are satisfactory, or where the *foundation* is designed for lesser depths.

Table 9.12.2.2.
Minimum Depths of Foundations
Forming Part of Sentence 9.12.2.2.(1)

Type of *Soil*	Minimum Depth of *Foundation* Containing Heated *Basement* or Crawl Space(1)		Minimum Depth of *Foundation* Containing No Heated Space(2)	
	Good *Soil* Drainage(3)	Poor *Soil* Drainage	Good *Soil* Drainage(3)	Poor *Soil* Drainage
Rock	No limit	No limit	No limit	No limit
Coarse grained *soils*	No limit	No limit	No limit	Below the depth of frost penetration
Silt	No limit	No limit	Below the depth of frost penetration	Below the depth of frost penetration
Clay or *soils* not clearly defined(4)	1.2 m	1.2 m	1.2 m but not less than the depth of frost penetration	1.2 m but not less than the depth of frost penetration

Notes to Table 9.12.2.2.:
(1) *Foundation* not insulated to reduce heat loss through the footings.
(2) Including *foundations* insulated to reduce heat loss through the footings.
(3) Good *soil* drainage to not less than the depth of frost penetration. e2
(4) See Appendix A.

6) The *foundation* depths required in Sentence (1) do not apply to *foundations* for r3
a) *buildings* that are not of masonry or masonry veneer construction and whose superstructure conforms with the requirements of the deformation resistance test in CAN/CSA-Z240.2.1, "Structural Requirements for Mobile Homes," and r3
b) *buildings* that are used as accessory *buildings* of not more than 1 *storey* in *building height* and not more than 55 m² in *building area* and that are not of masonry or masonry veneer construction. r3

9.12.3. Backfill

9.12.3.1. Placement of Backfill

1) Backfill shall be placed to avoid damaging the *foundation* wall, the drainage tile, externally applied thermal insulation and waterproofing or dampproofing of the wall.

9.12.3.2. Grading of Backfill

1) Backfill shall be *graded* to prevent drainage towards the *foundation* after settling.

9.12.3.3. Deleterious Debris and Boulders

1) Backfill within 600 mm of the *foundation* shall be free of deleterious debris and boulders larger than 250 mm diam.

9.12.4. Trenches beneath Footings

9.12.4.1. Support of Footings

1) The *soil* in trenches beneath footings for sewers and watermains shall be compacted by tamping up to the level of the footing base, or shall be filled with concrete having a strength not less than 10 MPa to support the footing.

Section 9.13. Dampproofing, Waterproofing and Soil Gas Control

9.13.1. General

9.13.1.1. Required Dampproofing

1) Except as provided in Article 9.13.1.2., where the exterior finished ground level is at a higher elevation than the ground level inside the *foundation* walls, exterior surfaces of *foundation* walls below ground level shall be dampproofed.

2) Except as provided in Sentence (3) and Article 9.13.1.2., floors-on-ground shall be dampproofed.

3) Floors in garages, floors in unenclosed portions of *buildings* and floors installed over granular *fill* in conformance with Article 9.16.2.1. need not be dampproofed.

9.13.1.2. Required Waterproofing

1) Where hydrostatic pressure occurs, floors-on-ground and exterior surfaces of walls below ground level shall be waterproofed.

2) Roofs of underground structures shall be waterproofed to prevent the entry of water into the structure.

9.13.1.3. Required Soil Gas Control

(See Appendix A.)

1) Except as provided in Sentence (2), all wall, roof and floor assemblies in contact with the ground shall be constructed to resist the leakage of *soil* gas from the ground into the *building*.

2) Construction to resist leakage of *soil* gas into the *building* is not required for
- a) garages and unenclosed portions of *buildings*,
- b) *buildings* constructed in areas where it can be demonstrated that *soil* gas does not constitute a hazard, or
- c) *buildings* that contain a single *dwelling unit* and are constructed to provide for sub-floor depressurization in accordance with Article 9.13.8.2.

9.13.1.4. Standards for Application

1) The method of application of all bituminous waterproofing and dampproofing materials shall conform to
- a) CAN/CGSB-37.3-M, “Application of Emulsified Asphalts for Dampproofing or Waterproofing,”
- b) CGSB 37-GP-12Ma, “Application of Unfilled Cutback Asphalt for Dampproofing,” or
- c) CAN/CGSB-37.22-M, “Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing.”

9.13.2. Material

9.13.2.1. Material Standards

1) Except as otherwise specified in this Section, materials used for exterior dampproofing or waterproofing shall conform to
- a) CAN/CGSB-37.1-M, “Chemical Emulsified Type, Emulsified Asphalt for Dampproofing,”
- b) CAN/CGSB-37.2-M, “Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings,”
- c) CGSB 37-GP-6Ma, “Asphalt, Cutback, Unfilled, for Dampproofing,”
- d) CAN/CGSB-37.16-M, “Filled, Cutback Asphalt for Dampproofing and Waterproofing,”
- e) CGSB 37-GP-18Ma, “Tar, Cutback, Unfilled, for Dampproofing,”
- f) CAN/CGSB-51.34-M, “Vapour Barrier, Polyethylene Sheet for Use in Building Construction,” or
- g) CSA A123.4, “Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems.” r4

2) Materials used to provide a barrier to *soil* gas ingress through floors-on-ground shall conform to CAN/CGSB-51.34-M, “Vapour Barrier, Polyethylene Sheet for Use in Building Construction.” r

9.13.3. Dampproofing of Walls

9.13.3.1. Preparation of Surface

1) Unit masonry walls to be dampproofed shall be
- a) parged on the exterior face below ground level with not less than 6 mm of mortar conforming to Section 9.20., and
- b) coved over the footing when the first course of block is laid.

2) Concrete walls to be dampproofed shall have holes and recesses resulting from the removal of form ties sealed with cement mortar or dampproofing material.

9.13.3.2. Application of Dampproofing Material

1) Dampproofing material shall be applied over the parging or concrete below ground level.

9.13.3.3. Interior Dampproofing of Walls

1) Where a separate interior finish is applied to a concrete or unit masonry wall that is in contact with the *soil*, or where wood members are placed in contact with such walls for the installation of insulation or finish, the interior surface of the *foundation* wall below ground level shall be dampproofed.

2) The dampproofing required in Sentence (1) shall extend from the *basement* floor and terminate at ground level.

3) No membrane or coating with a permeance less than 170 ng/(Pa•s•m²) shall be applied to the interior surface of the *foundation* wall above ground level between the insulation and the *foundation* wall. e

9.13.4. Dampproofing of Floors-on-Ground

9.13.4.1. Location of Dampproofing

1) When floors are dampproofed, the dampproofing shall be installed below the floor, except that where a separate floor is provided over a slab, the dampproofing is permitted to be applied to the top of the slab.

9.13.4.2. Dampproofing below the Floor

1) When installed below the floor, dampproofing membranes shall consist of polyethylene not less than 0.15 mm thick, or type S roll roofing.

2) Joints in dampproofing membranes described in Sentence (1) shall be lapped not less than 100 mm.

9.13.4.3. Dampproofing above the Slab

1) When installed above the slab, dampproofing shall consist of not less than
- a) 2 mopped-on coats of bitumen,
- b) 0.05 mm polyethylene, or
- c) other material providing equivalent performance.

9.13.5. Waterproofing of Walls

9.13.5.1. Preparation of Surface

1) Unit masonry walls to be waterproofed shall be parged on exterior surfaces below ground level with not less than 6 mm of mortar conforming to Section 9.20.

2) Concrete walls to be waterproofed shall have all holes and recesses resulting from removal of form ties sealed with mortar or waterproofing material.

9.13.5.2. Application of Waterproofing Membranes

1) Concrete or unit masonry walls to be waterproofed shall be covered with not less than 2 layers of bitumen-saturated membrane, with each layer cemented in place with bitumen and coated over-all with a heavy coating of bitumen.

9.13.6. Waterproofing of Floors-on-Ground

9.13.6.1. Floor Waterproofing System

1) *Basement* floors-on-ground to be waterproofed shall have a system of membrane waterproofing provided between 2 layers of concrete, each of which shall be not less than 75 mm thick, with the floor membrane mopped to the wall membrane to form a complete seal.

9.13.7. Soil Gas Control in Walls

(See A-9.13.7. and 9.13.8. in Appendix A.)

9.13.7.1. Sealing of Masonry Walls

1) Masonry walls required to provide a barrier to *soil* gas and that are not dampproofed on their interior surface as required in Sentence 9.13.3.3.(1) shall
- a) include a course of masonry units without voids, or
- b) be sealed with flashing material extending across the full width of the masonry
  - i) at or below the level of the adjoining floor slab, or
  - ii) in the absence of a floor slab, at the level of the ground cover required in Article 9.18.6.1.

9.13.8. Soil Gas Control in Floors

(See A-9.13.7. and 9.13.8. in Appendix A.)

9.13.8.1. Soil Gas Barriers

1) Except as provided in Article 9.13.8.2., a *soil* gas barrier shall be installed.

2) Where the floor-on-ground is a concrete slab, the *soil* gas barrier shall be
- a) installed below the slab, or
- b) applied to the top of the slab, provided a separate floor is installed over the slab.

(See A-9.13.8.1.(2) and (3) in Appendix A.)

3) When the *soil* gas barrier is installed below a slab-on-ground, joints in the barrier shall be lapped not less than 300 mm. (See A-9.13.8.1.(2) and (3) in Appendix A.)

4) When the *soil* gas barrier is installed above a slab-on-ground, joints in the barrier shall be sealed.

5) When installed in conjunction with a framed floor-on-ground, the *soil* gas barrier shall be installed in accordance with Articles 9.25.3.2. and 9.25.3.3.

9.13.8.2. Providing for Sub-Floor Depressurization

(See Appendix A.)

1) A *soil* gas barrier is permitted to be omitted provided the *building*,
- a) contains a single *dwelling unit* only, and
- b) is protected against *soil* gas ingress according to the requirements of this Article.

2) Except as required in Sentence (4), granular material shall be installed below the floor-on-ground according to Sentence 9.16.2.1.(1).

3) A pipe, not less than 100 mm in diameter, shall be installed vertically through the floor, at or near its centre, such that
a) its bottom end opens into the granular *fill* described in Sentence (2), and
b) its top end will permit connection to depressurization equipment.

4) The granular material described in Sentence (2), near the centre of the floor, shall be not less than 150 mm deep for a radius of not less than 300 mm centred on the pipe described in Sentence (3).

5) The upper end of the pipe described in Sentence (3) shall be provided with a removable seal.

6) The pipe described in Sentence (3) shall be clearly labelled to indicate that it is intended only for the removal of *soil* gas from below the floor-on-ground.

7) Except as provided in Sentence (9), when a *building* constructed in accordance with Sentences (2) to (6) is complete, testing shall be conducted according to the U.S. Environmental Protection Agency standard EPA 402-R-93-003, "Protocols for Radon and Radon Decay Product Measurements in Homes," to determine the radon concentration in the *building*. e r4

8) A copy of the results of testing required in Sentence (7) shall be provided by the *building owner* to the *authority having jurisdiction*.

9) The testing required in Sentence (7) shall include *basement* concentration measurements.

10) Where the radon concentration determined as described in Sentences (7) and (9) exceeds the Canadian Action Level for radon in residential indoor air, as specified in HC H46-2/90-156E, "Exposure Guidelines for Residential Indoor Air Quality," a sub-floor depressurization system shall be installed to reduce the radon concentration to a level below the Canadian Action Level. r4

11) Where a sub-floor depressurization system is installed,
a) make-up air shall be provided when and as specified in accordance with Article 9.32.3.8., and
b) measures shall be taken to ensure that any resultant decrease in *soil* temperature will not adversely affect the *foundation*.

9.13.8.3. Sealing of the Perimeter and Penetrations

(See A-9.13.7. and 9.13.8. in Appendix A.)

1) A floor-on-ground shall be sealed around its perimeter to the inner surfaces of adjacent walls using flexible sealant.

2) All penetrations of a floor-on-ground by pipes or other objects shall be sealed against *soil* gas leakage.

3) All penetrations of a floor-on-ground that are required to drain water from the floor surface shall be sealed in a manner that prevents the upward flow of *soil* gas without preventing the downward flow of liquid water.

Section 9.14. Drainage

9.14.1. Scope

9.14.1.1. Application

1) This Section applies to subsurface drainage and to surface drainage.

9.14.1.2. Crawl Spaces

1) Drainage for crawl spaces shall conform to Section 9.18.

9.14.1.3. Floors-on-Ground

1) Drainage requirements beneath floors-on-ground shall conform to Section 9.16.

9.14.2. Foundation Drainage

9.14.2.1. Foundation Wall Drainage

1) Unless it can be shown to be unnecessary, the bottom of every exterior *foundation* wall shall be drained by drainage tile or pipe laid around the exterior of the *foundation* in conformance with Subsection 9.14.3. or by a layer of gravel or crushed *rock* in conformance with Subsection 9.14.4.

2) Where mineral fibre insulation or crushed *rock* backfill is provided adjacent to the exterior surface of a *foundation* wall, it shall extend to the footing level to facilitate drainage of ground water to the *foundation* drainage system. (See Appendix A.)

9.14.3. Drainage Tile and Pipe

9.14.3.1. Material Standards

1) Drain tile and drain pipe for *foundation* drainage shall conform to
a) ASTM C 4, "Clay Drain Tile and Perforated Clay Drain Tile," r4
b) ASTM C 412M, "Concrete Drain Tile," r4
c) ASTM C 444M, "Perforated Concrete Pipe (Metric),"
d) ASTM C 700, "Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated,"
e) CAN/CGSB-34.22, "Asbestos-Cement Drain Pipe," r
f) CSA B182.1, "Plastic Drain and Sewer Pipe and Pipe Fittings," r

g) CSA G401, “Corrugated Steel Pipe Products,” or
h) NQ 3624-115, “Polyethylene (PE) Pipe and Fittings – Flexible Corrugated Pipes for Drainage – Characteristics and Test Methods.” r4

9.14.3.2. Minimum Size

1) Drain tile or pipe used for *foundation* drainage shall be not less than 100 mm in diam.

9.14.3.3. Installation

1) Drain tile or pipe shall be laid on undisturbed or well-compacted *soil* so that the top of the tile or pipe is below the bottom of the floor slab or crawl space.

2) Drain tile or pipe with butt joints shall be laid with 6 mm to 10 mm open joints.

3) The top half of joints referred to in Sentence (2) shall be covered with sheathing paper, 0.10 mm polyethylene or No. 15 asphalt or tar-saturated felt.

4) The top and sides of drain pipe or tile shall be covered with not less than 150 mm of crushed stone or other coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve.

9.14.4. Granular Drainage Layer

9.14.4.1. Type of Granular Material

1) Granular material used to drain the bottom of a *foundation* shall consist of a continuous layer of crushed stone or other coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve.

9.14.4.2. Installation

1) Granular material described in Article 9.14.4.1. shall be laid on undisturbed or compacted *soil* to a minimum depth of not less than 125 mm beneath the *building* and extend not less than 300 mm beyond the outside edge of the footings.

9.14.4.3. Grading

1) The bottom of an *excavation* drained by a granular layer shall be graded so that the entire area described in Article 9.14.4.2. is drained to a sump conforming to Article 9.14.5.2.

9.14.4.4. Wet Site Conditions

1) Where because of wet site conditions *soil* becomes mixed with the granular drainage material, sufficient additional granular material shall be provided so that the top 125 mm are kept free of *soil*.

9.14.5. Drainage Disposal

9.14.5.1. Drainage Disposal

1) *Foundation* drains shall drain to a sewer, drainage ditch or dry well.

9.14.5.2. Sump Pits

1) Where a sump pit is provided it shall be
a) not less than 750 mm deep,
b) not less than 0.25 m^2 in area, and
c) provided with a cover.

2) Covers for sump pits shall be designed to resist removal by children.

3) Where gravity drainage is not practical, an automatic sump pump shall be provided to discharge the water from the sump pit described in Sentence (1) into a sewer, drainage ditch or dry well.

9.14.5.3. Dry Wells

1) Dry wells may be used only when located in areas where the natural *groundwater level* is below the bottom of the dry well.

2) Dry wells shall be not less than 5 m from the *building foundation* and located so that drainage is away from the *building*.

9.14.6. Surface Drainage

9.14.6.1. Surface Drainage

1) The *building* shall be located or the *building* site graded so that water will not accumulate at or near the *building*.

9.14.6.2. Drainage away from Wells or Septic Disposal Beds

1) Surface drainage shall be directed away from the location of a water supply well or septic tank disposal bed.

9.14.6.3. Window Wells

1) Every window well shall be drained to the footing level or other suitable location.

9.14.6.4. Catch Basin

1) Where runoff water from a driveway is likely to accumulate or enter a garage, a catch basin shall be installed to provide adequate drainage.

9.14.6.5. Downspouts

1) Downspouts shall conform to Article 9.26.18.2.

Section 9.15. Footings and Foundations

9.15.1. Scope

9.15.1.1. Application

1) Except as provided in Articles 9.15.1.2., 9.15.1.3. and 9.15.1.4., this Section applies to concrete or unit masonry *foundation* walls and concrete footings on *soils* with an allowable bearing pressure of 75 kPa or greater for *buildings* of wood frame or masonry construction.

2) *Foundations* for applications other than as described in Sentence (1) shall be designed in accordance with Section 9.4.

9.15.1.2. Permafrost

1) *Buildings* erected on permafrost shall have *foundations* designed by a *designer* competent in this field in accordance with the appropriate requirements of Part 4.

9.15.1.3. Wood Frame Foundations

1) *Foundations* of wood frame construction are permitted to be used provided they conform to Sentence (2) or (3).

2) Except as provided in Sentence (3), wood frame *foundations* shall be designed in conformance with Part 4.

3) Wood frame *foundations* conforming to CAN/CSA-S406, "Construction of Preserved Wood Foundations," need not comply with Sentence (2) provided
- a) they are supported on *soil* with an allowable bearing pressure of not less than 75 kPa, and
- b) their configuration conforms with the design assumptions stated in the standard.

(See Appendix A.)

9.15.1.4. Foundations for Deformation Resistant Buildings

1) Where the superstructure of a detached *building* conforms to the requirements of the deformation resistance test in CAN/CSA-Z240.2.1, "Structural Requirements for Mobile Homes," the *foundation* is permitted to be constructed in conformance with CSA Z240.10.1, "Site Preparation, Foundation, and Anchorage of Mobile Homes."

9.15.2. General

9.15.2.1. Concrete

1) Concrete shall conform to Section 9.3.

9.15.2.2. Concrete Block

1) Concrete block shall conform to CSA A165.1, "Concrete Masonry Units," and shall have a compressive strength over the net area of the block of not less than 15 MPa.

9.15.2.3. Unit Masonry Construction

1) Mortar, mortar joints, corbelling and protection for unit masonry shall conform to Section 9.20.

9.15.2.4. Pier Type Foundations

1) Where pier type *foundations* are used, the piers shall be designed to support the applied loads from the superstructure.

2) Where piers are used as a *foundation* system in a *building* of 1 *storey* in *building height*, the piers shall be installed to support the principal framing members and shall be spaced not more than 3.5 m apart along the framing, unless the piers and their footings are designed for larger spacings.

3) The height of piers described in Sentence (2) shall not exceed 3 times their least dimension at the base of the pier.

4) Where concrete block is used for piers described in Sentence (2), they shall be laid with cores placed vertically, and when the width of the *building* is 4.3 m or less, placed with their longest dimension at right angles to the longest dimension of the *building*.

9.15.3. Footings

9.15.3.1. Footings Required

1) Footings shall be provided under walls, pilasters, columns, piers, fireplaces and *chimneys* that bear on *soil* or *rock*, except that footings may be omitted under piers or monolithic concrete walls if the safe *loadbearing* capacity of the *soil* or *rock* is not exceeded.

9.15.3.2. Support of Footings

1) Footings shall rest on undisturbed *soil*, *rock* or compacted granular *fill*.

9.15.3.3. Footing Sizes

1) Except as provided in Sentences (2) to (8) and in Articles 9.15.3.4. and 9.15.3.5., the minimum footing size shall be as shown in Table 9.15.3.3. provided the span of supported joists does not exceed 4.9 m and the specified *live load* on any floor supported by the footing does not exceed 2.4 kPa. (See Table 4.1.6.3.)

Table 9.15.3.3.
Minimum Footing Sizes
Forming Part of Sentence 9.15.3.3.(1)

No. of Floors Supported	Minimum Width of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3 m o.c.,(1) m^2
	Supporting Exterior Walls(2)	Supporting Interior Walls(3)	
1	250	200	0.4
2	350	350	0.75
3	450	500	1.0

Notes to Table 9.15.3.3.:
(1) See Sentence 9.15.3.3.(8).
(2) See Sentences 9.15.3.3.(5) and (6).
(3) See Sentence 9.15.3.3.(7).

2) Where the specified *live load* exceeds 2.4 kPa, footings shall be designed in accordance with Section 4.2.

3) Except as provided in Sentence (4), where the span of the supported joists exceeds 4.9 m, footings shall be designed in accordance with Section 4.2.

4) Where the supported joist span exceeds 4.9 m, footing sizes are permitted to be determined according to the calculation provided in Appendix A.

5) The strip footing sizes for exterior walls shown in Table 9.15.3.3. shall be increased by 65 mm for each *storey* of masonry veneer over wood frame construction supported by the *foundation* wall.

6) The strip footing sizes for exterior walls shown in Table 9.15.3.3. shall be increased by 130 mm for each *storey* of masonry construction supported by the *foundation* wall.

7) The minimum strip footing sizes for interior walls shown in Table 9.15.3.3. shall be increased by 100 mm for each *storey* of masonry construction supported by the footing.

8) The footing area for column spacings other than shown in Table 9.15.3.3. shall be adjusted in proportion to the distance between columns.

9.15.3.4. High Water Table

1) Where a *foundation* rests on gravel, sand or silt in which the water table level is less than the width of the footings below the *bearing surface*, the footing width shall be not less than twice the width required by Article 9.15.3.3.

9.15.3.5. Non-Loadbearing Walls

1) Footings for interior non-*loadbearing* masonry walls shall be not less than 200 mm wide for walls up to 5.5 m high and shall be increased by 100 mm for each additional 2.7 m of height.

9.15.3.6. Thickness

1) Footings shall be not less than 100 mm thick except when greater thicknesses are required because of the projection of the footing beyond the supported element.

9.15.3.7. Footing Projection

1) The projection of an unreinforced footing beyond the supported element shall be not greater than the thickness of the footing.

9.15.3.8. Step Footings

1) When step footings are used,
a) the vertical rise between horizontal portions shall not exceed 600 mm, and
b) the horizontal distance between risers shall not be less than 600 mm.

9.15.4. Foundation Walls

9.15.4.1. Foundation Wall Thickness

1) Where average stable *soils* are encountered, the thickness of *foundation* walls subject to lateral earth pressure shall conform to Table 9.15.4.1. for walls not exceeding 2.5 m in unsupported height.

Table 9.15.4.1.
Thickness of Foundation Walls
Forming Part of Sentence 9.15.4.1.(1)

Type of *Foundation* Wall	Minimum Wall Thickness, mm	Maximum Height of Finish Ground Above *Basement* Floor or Crawl Space Ground Cover, m	
		Foundation Wall Laterally Unsupported at the Top(1)	*Foundation* Wall Laterally Supported at the Top(1)
Solid concrete, 15 MPa min. strength	150	0.80	1.50
	200	1.20	2.15
	250	1.40	2.30
	300	1.50	2.30
Solid concrete, 20 MPa min. strength	150	0.80	1.80
	200	1.20	2.30
	250	1.40	2.30
	300	1.50	2.30
Unit masonry	140	0.60	0.80
	190 e	0.90 e	1.20 e
	240	1.20	1.80
	290	1.40	2.20

Notes to Table 9.15.4.1.:
(1) See Article 9.15.4.2.

9.15.4.2. Lateral Support

1) For the purposes of Article 9.15.4.1., *foundation* walls shall be considered laterally supported at the top if such walls support solid masonry superstructure or if the floor joists are embedded in the top of the *foundation* walls.

2) *Foundation* walls shall also be considered supported at the top if the floor system is anchored to the top of the *foundation* walls with anchor bolts, in which case the joists may run either parallel or perpendicular to the *foundation* wall.

3) When a *foundation* wall contains an opening more than 1.2 m long or contains openings in more than 25% of its length, that portion of the wall beneath such openings shall be considered laterally unsupported, unless the wall around the opening is reinforced to withstand the earth pressure.

4) When the length of solid wall between windows is less than the average length of the windows, the combined length of such windows shall be considered as a single opening for the purposes of Sentence (3).

9.15.4.3. Extension above Ground Level

1) Exterior *foundation* walls shall extend not less than 150 mm above finished ground level.

9.15.4.4. Reduction in Thickness

1) Where the top of a *foundation* wall is reduced in thickness to permit the installation of floor joists, the reduced section shall be not more than 350 mm high and not less than 90 mm thick.

2) Where the top of a *foundation* wall is reduced in thickness to permit the installation of a masonry exterior facing, the reduced section shall be
a) not less than 90 mm thick, and
b) tied to the facing material with metal ties conforming to Sentence 9.20.9.4.(3) spaced not more than e3
 i) 200 mm o.c. vertically, and
 ii) 900 mm o.c. horizontally.

3) The space between wall and facing described in Sentence (2) shall be filled with mortar.

9.15.4.5. Corbelling

1) Corbelling of masonry *foundation* walls supporting *cavity walls* shall conform to Article 9.20.12.2. e3

9.15.4.6. Crack Control Joints

1) Crack control joints shall be provided in *foundation* walls more than 25 m long at intervals of not more than 15 m.

2) Joints required in Sentence (1) shall be designed to resist moisture penetration and shall be keyed to prevent relative displacement of the wall portions adjacent to the joint.

9.15.4.7. Interior Masonry Walls

1) Interior masonry *foundation* walls not subject to lateral earth pressure shall conform to Section 9.20.

9.15.5. Support of Joists and Beams on Masonry Foundation Walls

9.15.5.1. Support of Floor Joists

1) Except as permitted in Sentence (2), *foundation* walls of hollow masonry units supporting floor joists shall be capped with not less than 50 mm of solid masonry or concrete, or have the top course filled with mortar or concrete.

2) Capping required in Sentence (1) need not be provided
a) in localities where termites are not known to occur,
b) when the joists are supported on a wood plate not less than 38 mm by 89 mm, and
c) when the siding overlaps the *foundation* wall not less than 12 mm.

9.15.5.2. Support of Beams

1) Not less than 190 mm depth of solid masonry shall be provided beneath beams supported on masonry.

2) Where the beam referred to in Sentence (1) is supported below the top of the *foundation* walls, the ends of such beams shall be protected from the weather.

9.15.5.3. Pilasters

1) Pilasters shall be provided under beams that frame into unit masonry *foundation* walls 140 mm or less in thickness.

2) Pilasters required in Sentence (1) shall be not less than 90 mm by 290 mm and shall be bonded or tied into the wall.

3) The top 200 mm of pilasters required in Sentence (1) shall be solid.

9.15.6. Parging and Finishing of Masonry Foundation Walls

9.15.6.1. Foundation Walls below Ground

1) Concrete block *foundation* walls shall be parged on the exterior face below ground level as required in Section 9.13.

9.15.6.2. Foundation Walls above Ground

1) Exterior surfaces of concrete block *foundation* walls above ground level shall have tooled joints, or shall be parged or otherwise suitably finished.

9.15.6.3. Form Ties

1) All form ties shall be removed at least flush with the concrete surface.

Section 9.16. Floors-On-Ground

9.16.1. Scope

9.16.1.1. Application

1) This Section applies to floors supported on ground or on granular *fill* that do not provide structural support for the superstructure.

9.16.1.2. Structural Floors

1) Floors-on-ground that support loads from the superstructure shall be designed in conformance with Part 4.

9.16.1.3. Required Floors-on-Ground

1) All spaces within *dwelling units*, except crawl spaces, shall be provided with a floor-on-ground, where
- a) access is provided to the space, and
- b) a floor supported by the structure is not provided.

9.16.1.4. Dampproofing and Waterproofing

1) Dampproofing and waterproofing shall conform to Section 9.13.

9.16.2. Material beneath Floors

9.16.2.1. Required Installation of Granular Material

1) Except as provided in Sentence (2), not less than 100 mm of coarse clean granular material containing not more than 10% of material that will pass a 4 mm sieve shall be placed beneath floors-on-ground. (See Clause 9.13.1.3.(2)(c), Article 9.13.8.2., and A-9.13.1.3. and A-9.13.8.2. in Appendix A.)

2) Granular material need not be installed under
- a) slabs in garages, carports or accessory *buildings*,
- b) *buildings* of *industrial occupancy* where the nature of the process contained therein permits or requires the use of large openings in the *building* envelope even during the winter, or
- c) *buildings* constructed in areas where it can be demonstrated that *soil* gas does not constitute a hazard.

9.16.2.2. Support of Floors

1) Except as provided in Sentence (2), fill beneath floors-on-ground shall be compacted.

2) Fill beneath floors-on-ground need not be compacted where the material is clean coarse aggregate containing not more than 10% of material that will pass a 4 mm sieve.

9.16.3. Drainage

9.16.3.1. Control of Water Ingress

1) Except as provided in Article 9.16.3.2. or where it can be shown to be unnecessary, ingress of water underneath a floor-on-ground shall be prevented by grading or drainage.

9.16.3.2. Hydrostatic Pressure

1) Where *groundwater levels* may cause hydrostatic pressure beneath a floor-on-ground, the floor-on-ground shall be e3
a) a poured concrete slab, and
b) designed to resist such pressures.

9.16.3.3. Floor Drains

1) When floor drains are required (see Section 9.31.), the floor surface shall be sloped so that no water can accumulate.

9.16.4. Concrete

9.16.4.1. Surface Finish

1) The finished surface of concrete floor slabs shall be trowelled smooth and even.

2) Dry cement shall not be added to the floor surfaces to absorb surplus water.

9.16.4.2. Topping Course

1) When a topping course is provided for a concrete floor slab, it shall consist of 1 part cement to 2.5 parts clean, well graded sand by volume, with a water/cement ratio approximately equal to that of the base slab.

2) When concrete topping is provided, it shall not be less than 20 mm thick.

9.16.4.3. Thickness

1) Concrete slabs shall not be less than 75 mm thick exclusive of concrete topping.

9.16.4.4. Bond Break

1) A bond-breaking material shall be placed between the slab and footings or *rock*.

9.16.5. Wood

9.16.5.1. Wood Frame Floors

1) Floors-on-ground constructed of wood shall conform to CAN/CSA-S406, "Construction of Preserved Wood Foundations."

Section 9.17. Columns

9.17.1. Scope

9.17.1.1. Application

1) This Section applies to columns used to support carport roofs (see Section 9.35.) and beams carrying loads from not more than 2 wood-frame floors where the supported length of joists bearing on such beams does not exceed 5 m and the *live load* on any floor does not exceed 2.4 kPa. (See Table 4.1.6.3.)

2) Columns for applications other than as described in Sentence (1) shall be designed in accordance with Part 4.

9.17.2. General

9.17.2.1. Location

1) Columns shall be centrally located on a footing conforming to Section 9.15.

9.17.2.2. Fastening

1) Columns shall be securely fastened to the supported member to prevent lateral movement.

9.17.3. Steel Columns

9.17.3.1. Size and Thickness

1) Except as permitted in Sentence (2), steel pipe columns shall have an outside diameter of not less than 73 mm and a wall thickness of not less than 4.76 mm.

2) Columns of sizes other than as specified in Sentence (1) are permitted to be used where the *loadbearing* capacities are shown to be adequate.

9.17.3.2. End Bearing Plates

1) Except as permitted in Sentence (2), steel columns shall be fitted with not less than 100 mm by 100 mm by 6.35 mm thick steel plates at each end, and where the column supports a wooden beam, the top plate shall extend across the full width of the beam.

2) The top plate required in Sentence (1) need not be provided where a column supports a steel beam and provision is made for the attachment of the column to the beam.

9.17.3.3. Paint

1) Steel columns shall be treated on the outside surface with at least one coat of rust-inhibitive paint.

9.17.3.4. Adjustable Steel Columns

1) Adjustable steel columns shall conform to CAN/CGSB-7.2, "Adjustable Steel Columns."

9.17.4. Wood Columns

9.17.4.1. Column Sizes

1) The width or diameter of a wood column shall be not less than the width of the supported member.

2) Except as provided in Article 9.35.4.2., columns shall be not less than 184 mm for round columns and 140 mm by 140 mm for rectangular columns, unless calculations are provided to show that lesser sizes are adequate.

9.17.4.2. Materials

1) Wood columns shall be either solid, glued-laminated or built-up.

2) Built-up columns shall consist of not less than 38 mm thick full-length members
- a) bolted together with not less than 9.52 mm diam bolts spaced not more than 450 mm o.c., or
- b) nailed together with not less than 76 mm nails spaced not more than 300 mm o.c.

3) Glued-laminated columns shall conform to Section 4.3.

9.17.4.3. Columns in Contact with Concrete

1) Wood columns shall be separated from concrete in contact with the ground by 0.05 mm polyethylene film or Type S roll roofing.

9.17.5. Unit Masonry Columns

9.17.5.1. Materials

1) Unit masonry columns shall be built of masonry units
- a) conforming to CSA A165.1, "Concrete Masonry Units," and
- b) having a compressive strength over the net area of the block of not less than 15 MPa.

9.17.5.2. Sizes

1) Unit masonry columns shall be not less than 290 mm by 290 mm or 240 mm by 380 mm in size.

9.17.6. Solid Concrete Columns

9.17.6.1. Materials

1) Concrete shall conform to Section 9.3.

9.17.6.2. Sizes

1) Concrete columns shall be not less than 200 mm by 200 mm for rectangular columns and 230 mm diam for circular columns.

Section 9.18. Crawl Spaces

9.18.1. General

9.18.1.1. Application

1) This Section applies to crawl spaces whose exterior walls have less than 25% of their total area above exterior ground level open to the outdoors.

9.18.1.2. Foundations

1) *Foundations* enclosing crawl spaces shall conform to Section 9.15.

9.18.1.3. Heated and Unheated Crawl Spaces

1) Crawl spaces shall be considered to be heated where the space
- a) is used as a hot air *plenum*,
- b) contains heating ducts that are not sealed and insulated to minimize heat loss to the space, or
- c) is not separated from heated space in accordance with Section 9.25.

2) Heating of heated crawl spaces shall conform to Section 9.33.

3) Insulation, an *air barrier system* and a *vapour barrier* shall be installed in the walls of heated crawl spaces in accordance with Section 9.25. e3

9.18.2. Access

9.18.2.1. Access Openings

1) An access opening of not less than 500 mm by 700 mm shall be provided to each crawl space where the crawl space serves a single *dwelling unit*, and not less than 550 mm by 900 mm for other crawl spaces.

2) Access openings shall be fitted with a door or hatch, except when the crawl space is heated and the access opening into the crawl space is from an adjacent heated space.

9.18.3. Ventilation

9.18.3.1. Ventilation of Unheated Crawl Spaces

1) Unheated crawl spaces shall be ventilated by natural or mechanical means.

2) Where an unheated crawl space is ventilated by natural means, ventilation shall be provided to the outside air by not less than 0.1 m^2 of unobstructed vent area for every 50 m^2 of *floor area*.

3) Vents shall be
- a) uniformly distributed on opposite sides of the *building*, and
- b) designed to prevent the entry of snow, rain and insects.

9.18.3.2. Ventilation of Heated Crawl Spaces

1) Heated crawl spaces shall be ventilated in accordance with Section 9.32.

9.18.4. Clearance

(See also Article 9.3.2.9.)

9.18.4.1. Access Way to Services

1) Where equipment requiring service such as plumbing cleanouts, traps and burners is located in crawl spaces, an access way with a height and width of not less than 600 mm shall be provided from the access door to the equipment and for a distance of 900 mm on the side or sides of the equipment to be serviced.

9.18.5. Drainage

9.18.5.1. Drainage

1) Except where it can be shown to be unnecessary, the ingress of water into a crawl space shall be controlled by grading or drainage.

2) Drainage of *foundation* walls shall conform to Article 9.14.2.1.

3) Drainage of the ground cover or floor-on-ground in the crawl space shall conform to Subsection 9.16.3. e

4) Drains shall conform to Section 9.14.

9.18.6. Ground Cover

9.18.6.1. Ground Cover in Unheated Crawl Spaces

1) Where a crawl space is unheated, a ground cover shall be provided consisting of not less than
- a) 50 mm of asphalt,
- b) 100 mm of 15 MPa Portland cement concrete,
- c) Type S roll roofing, or
- d) 0.10 mm polyethylene.

2) Joints in sheet-type ground cover required in Sentence (1) shall be lapped not less than 100 mm and weighted down.

9.18.6.2. Ground Cover in Heated Crawl Spaces

1) Where a crawl space is heated, a ground cover consisting of not less than 0.15 mm polyethylene sheet conforming to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction," shall be provided.

2) The ground cover required in Sentence (1) shall e
- a) have its joints lapped not less than 300 mm, and sealed and weighted down, or
- b) be covered with a concrete skim coat not less than 50 mm thick.

3) The perimeter of the ground cover required in Sentence (1) shall be sealed to the *foundation* wall. (See A-9.13.1.3., A-9.13.7. and 9.13.8., and A-9.13.8.1.(2) and (3) in Appendix A.)

9.18.7. Fire Protection

9.18.7.1. Crawl Spaces as Warm Air Plenums

1) Only crawl spaces under 1-*storey* portions of *dwelling units* shall be used as warm-air *plenums*.

2) Enclosing material in crawl spaces described in Sentence (1), including insulation, shall have a surface *flame-spread rating* not greater than 150.

3) *Combustible* ground cover in crawl spaces described in Sentence (1) shall be protected beneath each register opening with *noncombustible* material.

4) The *noncombustible* register protection described in Sentence (3) shall
- a) extend not less than 300 mm beyond the projection of the register opening, and
- b) have up-turned edges.

(See Appendix A.)

Section 9.19. Roof Spaces

9.19.1. Venting

9.19.1.1. Required Venting

1) Except where it can be shown to be unnecessary, where insulation is installed between a ceiling and the underside of the roof sheathing, a space shall be provided between the insulation and the sheathing, and vents shall be installed to permit the transfer of moisture from the space to the exterior. (See Appendix A.)

9.19.1.2. Vent Requirements

1) Except as provided in Sentence (2), the unobstructed vent area shall be not less than 1/300 of the insulated ceiling area.

2) Where the roof slope is less than 1 in 6 or in roofs that are constructed with roof joists, the unobstructed vent area shall be not less than 1/150 of the insulated ceiling area.

3) Required vents may be roof type, eave type, gable-end type or any combination thereof, and shall be distributed
- a) uniformly on opposite sides of the *building*,

b) with not less than 25% of the required openings located at the top of the space, and
c) with not less than 25% of the required openings located at the bottom of the space.

4) Except where each joist space is separately vented, roof joist spaces shall be interconnected by installing purlins not less than 38 mm by 38 mm on the top of the roof joists.

5) Vents shall be designed to prevent the entry of rain, snow and insects.

6) The unobstructed vent area required in Sentences (1) and (2) shall be determined in conformance with CAN3-A93-M, "Natural Airflow Ventilators for Buildings."

9.19.1.3. Clearances

1) Not less than 63 mm of space shall be provided between the top of the insulation and the underside of the roof sheathing.

2) Ceiling insulation shall be installed in a manner that will not restrict a free flow of air through roof vents or through any portion of the *attic or roof space*.

9.19.1.4. Mansard or Gambrel Roof

1) The lower portion of a mansard or gambrel style roof need not be ventilated.

2) The upper portion of roofs described in Sentence (1) shall be ventilated in conformance with Articles 9.19.1.1. to 9.19.1.3.

9.19.2. Access

9.19.2.1. Access

1) Every *attic or roof space* shall be provided with an access hatch where the *attic or roof space* measures:
a) not less than 3 m² in area,
b) not less than 1 m in length or width, and
c) not less than 600 mm in height over at least the area described in Clauses (a) and (b).

2) The hatch required in Sentence (1) shall be not less than 550 mm by 900 mm except that, where the hatch serves not more than one *dwelling unit*, the hatch may be reduced to 500 mm by 700 mm.

3) Hatchways to *attic or roof spaces* shall be fitted with doors or covers.

Section 9.20. Above-Grade Masonry

9.20.1. Scope

9.20.1.1. Application

1) Except as provided in Article 9.20.1.2., this Section applies to unreinforced masonry and masonry veneer in which the wall height above the *foundation* wall does not exceed 11 m, and in which the roof or floor system above the *first storey* is not of concrete construction.

2) For *buildings* other than described in Sentence (1), or where the masonry is designed on the basis of specified loads and allowable stresses, Subsection 4.3.2. shall apply.

9.20.1.2. Earthquake Reinforcement

(See Appendix A.)

1) In velocity- or acceleration-related seismic zones of 4 or greater, *loadbearing* elements of masonry *buildings* more than 1 *storey* in *building height* shall be reinforced with not less than the minimum amount of reinforcement required in Subsection 9.20.15.

2) In velocity- or acceleration-related seismic zones of 2 and 3, *loadbearing* elements of masonry *buildings* 3 *storeys* in *building height* shall be reinforced with not less than the minimum amount of reinforcement required in Subsection 9.20.15.

9.20.2. Masonry Units

9.20.2.1. Masonry Unit Standards

1) Masonry units shall comply with
a) ASTM C 126, "Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units,"
b) ASTM C 212, "Structural Clay Facing Tile,"
c) CAN/CSA-A82.1-M, "Burned Clay Brick (Solid Masonry Units Made from Clay or Shale),"
d) CSA A82.3-M, "Calcium Silicate (Sand-Lime) Building Brick,"
e) CSA A82.4-M, "Structural Clay Load-Bearing Wall Tile,"
f) CSA A82.5-M, "Structural Clay Non-Load-Bearing Tile,"
g) CAN3-A82.8-M, "Hollow Clay Brick,"
h) CSA A165.1, "Concrete Masonry Units,"
i) CSA A165.2, "Concrete Brick Masonry Units,"
j) CSA A165.3, "Prefaced Concrete Masonry Units," or
k) CAN3-A165.4-M, "Autoclaved Cellular Units."

9.20.2.2. Used Brick

1) Used bricks shall be free of old mortar, soot or other surface coating and shall conform to Article 9.20.2.1.

9.20.2.3. Glass Blocks

1) Glass blocks shall not be used as *loadbearing* units or in the construction of fireplaces or *chimneys*.

9.20.2.4. Cellular Concrete

1) Masonry made with cellular concrete shall not be used in contact with the *soil* or exposed to the weather.

9.20.2.5. Stone

1) Stone shall be sound and durable.

9.20.2.6. Concrete Blocks Exposed to the Weather

1) Concrete blocks exposed to the weather shall have weight and water absorption characteristics conforming to Classes A, B or C, described in CSA A165.1, "Concrete Masonry Units."

2) Where cellular concrete blocks are used in situations described in Sentence (1), allowance shall be made in the design for the shrinkage characteristics of the units to be used.

9.20.2.7. Compressive Strength

1) The compressive strength of concrete blocks shall conform to Table 9.20.2.7.

Table 9.20.2.7.
Compressive Strength of Concrete Blocks
Forming Part of Sentence 9.20.2.7.(1)

Type of Unit	Minimum Compressive Strength Over Net Area, MPa	
	Exposed to Weather	Not Exposed to Weather
Solid or hollow concrete blocks	15	10
Solid *loadbearing* cellular blocks	Not permitted	5
Solid non-*loadbearing* cellular blocks	Not permitted	2

9.20.3. Mortar

9.20.3.1. Mortar Materials

1) Cementitious materials and aggregates for mortar shall comply with
a) ASTM C 5, "Quicklime for Structural Purposes,"
b) ASTM C 207, "Hydrated Lime for Masonry Purposes,"
c) CSA A5, "Portland Cement," r4
d) CSA A8, "Masonry Cement," or r4
e) CSA A82.56-M, "Aggregate for Masonry Mortar."

2) Water and aggregate shall be clean and free of significant amounts of deleterious materials.

3) Lime used in mortar shall be hydrated.

4) If lime putty is used in mortar, it shall be made by slaking quicklime in water for not less than 24 h or soaking hydrated lime in water for not less than 12 h.

9.20.3.2. Mortar Mixes

1) Except as provided in Sentences (3) and (4), mortar mixes shall conform to Table 9.20.3.2.

2) Mortar containing Portland cement shall not be used later than 2.5 h after mixing.

3) Mortar for sand-lime brick and concrete brick is permitted to consist of 1 part of masonry cement to not less than 3 or not more than 3.5 parts of aggregate by volume in addition to those mixes permitted in Table 9.20.3.2.

4) Mortar for glass block shall consist of 1 part Portland cement and 1 part hydrated lime to not more than 4 parts aggregate by volume.

9.20.4. Mortar Joints

9.20.4.1. Thickness

1) Except as provided in Sentence (2), mortar joint thickness for burned clay brick and concrete masonry units shall be 10 mm.

2) Permitted tolerances in head and bed joints shall be not more than ± 5 mm.

9.20.4.2. Solid Masonry Units

1) Solid masonry units shall be laid with full head and bed joints.

9.20.4.3. Hollow Masonry Units

1) Hollow masonry units shall be laid with mortar applied to head and bed joints of both inner and outer face shells.

9.20.5. Masonry Support

9.20.5.1. Masonry Support

1) All masonry shall be supported on masonry, concrete or steel, except that masonry veneer walls may be supported on *foundations* of wood frame constructed in conformance with Sentence 9.15.1.3.(3).

Table 9.20.3.2.
Mortar Mix Proportions (by volume)
Forming Part of Sentence 9.20.3.2.(1)

Permissible Use of Mortar	Portland Cement	Masonry Cement	Lime	Aggregate
All locations but not for use with sand-lime or concrete brick	0.5 to 1 1	1 —	— 0.25 to 0.5	Not less than 2.25 and not more than 3 times the sum of the volumes of the cement and the lime
All locations except *foundation* walls and piers, but not for use with sand-lime or concrete brick	— 1	1 —	— 0.5 to 1.25	
All locations except *loadbearing* walls of hollow units, parapet walls and *chimneys*	1	—	1.25 to 2.5	
All non-*loadbearing* interior walls and all *loadbearing* walls of solid units, except *foundation* walls, parapet walls and *chimneys*	1 —	— —	2.25 to 4 1	

2) Every masonry wall shall be at least as thick as the wall it supports, except as otherwise permitted in Article 9.20.12.2.

9.20.5.2. Lintels or Arches

1) Masonry over openings shall be supported by steel, masonry or reinforced concrete lintels, or masonry arches.

2) Steel angle lintels supporting masonry veneer above openings shall
a) conform to Table 9.20.5.2., and
b) have a bearing length not less than 90 mm.

3) Steel angle lintels supporting masonry other than veneer, masonry and reinforced concrete lintels, and masonry arches shall be designed in accordance with Part 4 to support the imposed load.

4) Steel angle lintels supporting masonry shall be prime painted or otherwise protected from corrosion.

9.20.6. Thickness and Height

9.20.6.1. Thickness of Exterior Walls

1) Masonry exterior walls, other than *cavity walls*, in 1-*storey buildings* and the top *storeys* of 2- and 3-*storey buildings* shall be not less than 140 mm thick, provided the walls are not more than 2.8 m high at the eaves and 4.6 m high at the peaks of gable ends. e2

2) The exterior walls of the bottom *storeys* of 2-*storey buildings*, and exterior walls of the bottom 2 *storeys* of 3-*storey buildings* shall be not less than 190 mm thick.

3) In exterior walls composed of more than one wythe, each wythe shall be not less than 90 mm thick.

9.20.6.2. Cavity Walls

1) *Cavity walls* shall be made with not less than 90 mm wide units if the joints are raked and not less than 75 mm wide units if the joints are not raked. e2

2) The width of a cavity in a *cavity wall* shall be not less than 50 mm or greater than 150 mm. e2

Table 9.20.5.2.
Maximum Allowable Spans for Steel Lintels Supporting Masonry Veneer
Forming Part of Sentence 9.20.5.2.(2)

Minimum Angle Size, mm			Maximum Allowable Spans, m		
Vertical Leg	Horizontal Leg	Thickness	Supporting 75 mm Brick	Supporting 90 mm Brick	Supporting 100 mm Stone
90	75	6	2.55	—	—
90	90	6	2.59	2.47	2.30
100	90	6	2.79	2.66	2.48
125	90	8	3.47	3.31	3.08
125	90	10	3.64	3.48	3.24

3) The minimum thickness of *cavity walls* above the supporting base shall be 230 mm for the top 7.6 m and 330 mm for the remaining portion, except that where 75 mm wide units are used, the wall height above the top of the *foundation* wall shall not exceed 6 m. e2

9.20.6.3. Thickness of Interior Walls

1) The thickness of *loadbearing* interior walls shall be determined on the basis of the maximum lateral support spacing as provided in Sentences 9.20.10.1.(2) and (3).

2) The thickness of interior non-*loadbearing* walls shall be
- a) determined on the basis of the maximum lateral support spacing as provided in Sentences 9.20.10.1.(2) and (3), and
- b) in any case, not less than 65 mm.

9.20.6.4. Masonry Veneer Walls

1) Except for masonry veneer individually supported by the back-up material, masonry veneer shall be of solid units not less than 75 mm thick.

2) Veneer described in Sentence (1) over wood-frame walls shall have not less than a 25 mm air space behind the veneer.

3) Masonry veneer less than 90 mm thick shall have unraked joints.

4) Masonry veneer individually supported by the back-up material shall conform to Subsection 4.3.2.

9.20.6.5. Parapet Walls

1) The height of parapet walls above the adjacent roof surface shall be not more than 3 times the parapet wall thickness.

2) Parapet walls shall be solid from the top of the parapet to not less than 300 mm below the adjacent roof level.

9.20.6.6. Stone or Concrete Facings

1) Limestone slab facings and precast concrete panel facings shall conform to Subsection 4.3.2.

9.20.7. Chases and Recesses

9.20.7.1. Maximum Dimensions

1) Except as permitted in Sentence 9.20.7.2.(2) and Article 9.20.7.4., the depth of any chase or recess shall not exceed one third the thickness of the wall, and the width of the chase or recess shall not exceed 500 mm.

9.20.7.2. Minimum Wall Thickness

1) Except as permitted in Sentence (2) and Article 9.20.7.4., no chase or recess shall be constructed in any wall 190 mm or less in thickness.

2) Recesses may be constructed in 190 mm walls provided they do not exceed 100 mm in depth, 750 mm in height and 500 mm in width.

9.20.7.3. Separation of Chases or Recesses

1) Chases and recesses shall be not less than
- a) 4 times the wall thickness apart, measured from centre to centre, and
- b) 600 mm away from any pilaster, cross wall, buttress or other vertical element providing required lateral support for the wall.

9.20.7.4. Non-Conforming Chases or Recesses

1) Chases or recesses that do not conform to the limits specified in Articles 9.20.7.1. to 9.20.7.3. shall be considered as openings, and any masonry supported above such a chase or recess shall be supported by a lintel or arch as provided in Article 9.20.5.2.

9.20.7.5. Chases or Recesses Cut into Walls

1) Chases and recesses shall not be cut into walls made with hollow units after the masonry units are in place.

9.20.8. Support of Loads

9.20.8.1. Capping of Hollow Masonry Walls

1) Except as permitted in Sentence (2), *loadbearing* walls of hollow masonry units supporting roof or floor framing members shall be capped with not less than 50 mm of solid masonry or have the top course filled with concrete.

2) Capping required in Sentence (1) may be omitted where the roof framing is supported on a wood plate not less than 38 mm by 89 mm.

9.20.8.2. Cavity Walls Supporting Framing Members

1) Floor joists supported on *cavity walls* shall be supported on solid units not less than 57 mm high. e

2) Floor joists described in Sentence (1) shall not project into the cavity.

3) Roof and ceiling framing members bearing on *cavity walls* shall be supported on e
- a) not less than 57 mm of solid masonry, bridging the full thickness of the wall, or
- b) a wood plate not less than 38 mm thick, bearing not less than 50 mm on each wythe.

9.20.8.3. Bearing of Beams and Joists

1) The bearing area under beams and joists shall be sufficient to carry the supported load.

2) In no case shall the minimum length of end bearing of beams supported on masonry be less than 90 mm.

3) The length of end bearing of floor, roof or ceiling joists supported on masonry shall be not less than 40 mm.

9.20.8.4. Support of Beams and Columns

1) Beams and columns supported on masonry walls shall be supported on pilasters where the thickness of the masonry wall or wythe is less than 190 mm.

2) Not less than 190 mm depth of solid masonry or concrete shall be provided under the beam or column referred to in Sentence (1).

3) Pilasters required in Sentence (1) shall be bonded or tied to masonry walls.

4) Concrete pilasters required in Sentence (1) shall be not less than 50 mm by 300 mm.

5) Unit masonry pilasters required in Sentence (1) shall be not less than 100 mm by 290 mm.

9.20.8.5. Distance to Edge of Supporting Members

(See Appendix A.)

1) Masonry veneer of hollow units resting on a bearing support shall not project more than
- a) 30 mm beyond the supporting base where the veneer is not less than 90 mm thick, and
- b) 12 mm beyond the supporting base where the veneer is less than 90 mm thick.

2) Masonry veneer of solid units resting on bearing support shall not project more than one third of the width of the veneer.

3) Where the masonry veneer described in Sentence (2) is rough stone masonry,
- a) the projection shall be measured as the average projection of the units, and
- b) the width of the veneer shall be measured as the average width of the veneer.

9.20.9. Bonding and Tying

9.20.9.1. Joints to be Offset or Reinforced

1) Vertical joints in adjacent masonry courses shall be offset unless each wythe of masonry is reinforced with the equivalent of not less than 2 corrosion-resistant steel bars of 3.76 mm diam placed in the horizontal joints at vertical intervals not exceeding 460 mm.

2) Where joints in the reinforcing referred to in Sentence (1) occur, the bars shall be lapped not less than 150 mm.

9.20.9.2. Bonding or Tying of Other than Masonry Veneer

1) Masonry walls, other than masonry veneer walls, that consist of 2 or more wythes shall have the wythes bonded or tied together with masonry bonding units as described in Article 9.20.9.3. or with metal ties as described in Article 9.20.9.4.

9.20.9.3. Bonding

1) Where wythes are bonded together with masonry units, the bonding units shall comprise not less than 4% of the wall surface area.

2) Bonding units described in Sentence (1) shall be spaced not more than 600 mm vertically and horizontally in the case of brick masonry and 900 mm o.c. in the case of block or tile.

3) Units described in Sentence (1) shall extend not less than 90 mm into adjacent wythes.

9.20.9.4. Tying

1) Where 2 or more wythes are tied together with metal ties of the individual rod type, the ties shall conform to the requirements in Sentences (3) to (6).

2) Other ties may be used where it can be shown that such ties provide walls that are at least as strong and as durable as those made with the individual rod type.

3) Metal ties of the individual rod type shall
- a) be corrosion-resistant,
- b) have a minimum cross-sectional area of not less than 17.8 mm^2, and
- c) have not less than a 50 mm portion bent at right angles at each end.

4) Metal ties of the individual rod type shall
- a) extend from within 25 mm of the outer face of the wall to within 25 mm of the inner face of the wall,

b) be completely embedded in mortar except for the portion exposed in *cavity walls*, and e2
c) be staggered from course to course.

5) Where 2 or more wythes in walls other than *cavity walls* and masonry veneer/masonry back-up walls are tied together with metal ties of the individual rod type, the space between wythes shall be completely filled with mortar. e2

6) Ties described in Sentence (5) shall be
a) located within 300 mm of openings and spaced not more than 900 mm apart around openings, and
b) spaced not more than 900 mm apart horizontally and 460 mm apart vertically at other locations.

7) Except as required in Sentences (8) and (9), where the inner and outer wythes of *cavity walls* are tied with individual wire ties, the ties shall be spaced not more than 900 mm apart horizontally and 400 mm apart vertically. e2

8) Within 100 mm of the bottom of each floor or roof assembly where the cavity extends below the assemblies, the ties described in Sentence (7) shall be spaced not more than 600 mm apart horizontally.

9) Within 300 mm of any openings, the ties described in Sentence (7) shall be spaced not more than 900 mm apart.

9.20.9.5. Ties for Masonry Veneer

1) Masonry veneer 75 mm or more in thickness and resting on a bearing support shall be tied to masonry back-up or to wood framing members with straps that are
a) corrosion-resistant,
b) not less than 0.76 mm thick,
c) not less than 22 mm wide,
d) shaped to provide a key with the mortar, and
e) spaced in accordance with Table 9.20.9.5.

Table 9.20.9.5.
Veneer Tie Spacing
Forming Part of Sentence 9.20.9.5.(1)

Maximum Vertical Spacing, mm	Maximum Horizontal Spacing, mm
400	800
500	600
600	400

2) Straps described in Sentence (1) that are fastened to wood framing members shall be
a) bent at a right angle within 6 mm from the fastener, and
b) fastened with corrosion-resistant 3.18 mm diam screws or spiral nails having a wood penetration of not less than 63 mm.

3) Masonry veneer individually supported by masonry or wood-frame back-up shall be secured to the back-up in conformance with Subsection 4.3.2.

9.20.9.6. Reinforcing for Glass Block

1) Glass block shall have horizontal joint reinforcement of 2 corrosion-resistant bars of not less than 3.76 mm diam or expanded metal strips not less than 75 mm wide
a) spaced at vertical intervals of not more than 600 mm for units 190 mm or less in height, and
b) installed in every horizontal joint for units higher than 190 mm.

2) Reinforcement required in Sentence (1) shall be lapped not less than 150 mm.

9.20.10. Lateral Support

9.20.10.1. Lateral Support Required

1) Masonry walls shall be laterally supported by floor or roof construction or by intersecting masonry walls or buttresses.

2) The spacing of supports required in Sentence (1) shall be not more than e
a) 20 times the wall thickness for all *loadbearing* walls and exterior non-*loadbearing* walls, and
b) 36 times the wall thickness for interior non-*loadbearing* walls.

3) In applying Sentence (2), the thickness of *cavity walls* shall be taken as the greater of e
a) two-thirds of the sum of the thicknesses of the wythes, or
b) the thickness of the thicker wythe.

4) Floor and roof constructions providing lateral support for walls as required in Sentence (1) shall be constructed to transfer lateral loads to walls or buttresses approximately at right angles to the laterally supported walls.

9.20.11. Anchorage of Roofs, Floors and Intersecting Walls

9.20.11.1. Anchorage of Floor or Roof Assemblies

1) Where required to receive lateral support (see Subsection 9.20.10.), masonry walls shall be anchored to each floor or roof assembly at maximum intervals of 2 m, except that anchorage of floor joists not more than 1 m above *grade* may be omitted.

2) Anchors required in Sentence (1) shall be corrosion-resistant and be not less than the equivalent of 40 mm by 4.76 mm thick steel straps.

3) Anchors required in Sentence (1) shall be shaped to provide a mechanical key with the masonry and shall be securely fastened to the horizontal support to develop the full strength of the tie.

4) When joists are parallel to the wall, anchors required in Sentence (1) shall extend across not less than 3 joists.

9.20.11.2. Bonding and Tying Intersecting Masonry Walls

1) Where required to provide lateral support, intersecting walls shall be bonded or tied together.

2) Where bonding is used to satisfy the requirements of Sentence (1), 50% of the adjacent masonry units in the intersecting wall, distributed uniformly over the height of the intersection, shall be embedded in the laterally supported wall.

3) Where tying is used to satisfy the requirements of Sentence (1), the ties shall be
- a) corrosion-resistant metal,
- b) equivalent to not less than 4.76 mm by 40 mm steel strapping,
- c) spaced not more than 800 mm o.c. vertically, and
- d) shaped at both ends to provide sufficient mechanical key to develop the strength of the ties.

9.20.11.3. Wood Frame Walls Intersecting Masonry Walls

1) Wood-frame walls shall be tied to intersecting masonry walls with not less than 4.76 mm diam corrosion-resistant steel rods spaced not more than 900 mm o.c. vertically.

2) Ties required in Sentence (1) shall be anchored to the wood framing at one end and shaped to provide a mechanical key at the other end to develop the strength of the tie.

9.20.11.4. Wood Frame Roof Systems

1) Except as permitted in Sentence (2), roof systems of wood-frame construction shall be tied to exterior walls by not less than 12.7 mm diam anchor bolts,
- a) spaced not more than 2.4 m apart,
- b) embedded not less than 90 mm into the masonry, and
- c) fastened to a rafter plate of not less than 38 mm thick lumber.

2) The roof system described in Sentence (1) is permitted to be anchored by nailing the wall furring strips to the side of the rafter plate.

9.20.11.5. Cornices, Sills and Trim

1) Cornices, sills or other trim of masonry material which project beyond the wall face shall have not less than 65% of their mass, but not less than 90 mm, within the wall or shall be adequately anchored to the wall with corrosion-resistant anchors.

9.20.11.6. Piers

1) Where anchor bolts are to be placed in the top of a masonry pier, the pier shall conform to the requirements of Sentence 9.15.2.4.(4) and shall be capped with concrete or reinforced masonry not less than 200 mm thick.

9.20.12. Corbelling

9.20.12.1. Corbelling

1) All corbelling shall consist of solid units.

2) The units referred to in Sentence (1) shall be corbelled so that the horizontal projection of any unit does not exceed 25 mm and the total projection does not exceed one third of the total wall thickness.

9.20.12.2. Corbelling for Cavity Walls

1) *Cavity walls* of greater thickness than the *foundation* wall on which they rest shall not be corbelled but may project 25 mm over the outer face of the *foundation* wall disregarding parging. e2

2) Where the *foundation* wall referred to in Sentence (1) is unit masonry, it is permitted to be corbelled to meet flush with the inner face of a *cavity wall* provided e2
- a) the projection of each course does not exceed half the height or one third the width of the corbelled unit, and
- b) the total corbel does not exceed one third of the *foundation* wall thickness.

(See Appendix A.)

9.20.12.3. Corbelling for Masonry Veneer

1) Masonry veneer resting on a bearing support shall not project more than 25 mm beyond the supporting base where the veneer is not less than 90 mm thick, and 12 mm beyond the supporting base where the veneer is less than 90 mm thick.

2) In the case of rough stone veneer, the projection, measured as the average projection of the stone units, shall not exceed one-third the bed width beyond the supporting base.

9.20.13. Control of Rain Water Penetration

9.20.13.1. Materials for Flashing

1) Materials used for flashing shall conform to Table 9.20.13.1.

Table 9.20.13.1.
Flashing Materials
Forming Part of Sentence 9.20.13.1.(1)

Material	Minimum Thickness, mm	
	Exposed Flashing	Concealed Flashing
Aluminum	0.48	—
Copper	0.46 e	0.46 e
Copper or aluminum laminated to felt or kraft paper	—	0.05
Galvanized steel	0.33	0.33
Lead sheet	1.73	1.73
Polyethylene	—	0.50
Roll roofing, Type S	—	standard
Zinc	0.46	0.46

2) Aluminum flashing in contact with masonry or concrete shall be effectively coated or separated from the masonry or concrete by an impervious membrane.

9.20.13.2. Fastening of Flashing

1) Fastening devices for flashing shall be corrosion-resistant and, where metal flashing is used, shall be compatible with the flashing with respect to galvanic action.

9.20.13.3. Location of Flashing

1) Flashing shall be installed in masonry and masonry veneer walls
a) beneath jointed masonry window sills,
b) over the back and top of parapet walls,
c) over the heads of glass block panels,
d) beneath weep holes, and
e) over the heads of window or door openings in exterior walls when the vertical distance between the top of a window or door frame and the bottom edge of the eave exceeds one-quarter of the horizontal eave overhang.

9.20.13.4. Extension of Flashing

1) When installed beneath jointed masonry window sills or over the heads of openings, flashing shall extend from the front edge of the masonry up behind the sill or lintel.

9.20.13.5. Flashing for Weep Holes in Masonry/Masonry Walls

1) Flashing beneath weep holes in *cavity walls* and masonry veneer/masonry back-up walls shall e2
a) be bedded not less than 25 mm in the inside wythe,
b) extend to not less than 5 mm beyond the outer face of the *building* element below the flashing, and
c) be installed with a nominally horizontal slope toward the outside wythe.

9.20.13.6. Flashing for Weep Holes in Veneer

1) Flashing beneath weep holes in masonry veneer over masonry back-up walls shall conform to the flashing requirements for *cavity walls* and masonry veneer/masonry back-up walls in Article 9.20.13.5. e2

2) Flashing beneath weep holes in masonry veneer over wood-frame walls shall be installed so that it extends from a point not less than 5 mm beyond the outer face of the *building* element below the flashing to a point 150 mm up the wood frame wall.

3) Where the frame wall is sheathed with a sheathing membrane, a non-wood-based rigid exterior insulating sheathing or a semi-rigid insulating sheathing with an integral sheathing membrane, the flashing shall be installed behind the sheathing membrane or insulating sheathing.

4) Flashing described in Sentence (2) is permitted to conform to the requirements for concealed flashing in Table 9.20.13.1.

9.20.13.7. Flashing Joints

1) Joints in flashing shall be made watertight.

9.20.13.8. Required Weep Holes

1) Weep holes spaced not more than 800 mm apart shall be provided at the bottom of
a) cavities in *cavity walls*, and e2
b) cavities or air spaces in masonry veneer walls.

2) The cavities or air spaces described in Sentence (1) shall include those above lintels over window and door openings required to be flashed in conformance with Article 9.20.13.3.

9.20.13.9. Protection of Interior Finish

1) Except as provided in Sentence (3), where the interior finish of the exterior walls of a *building* is a type that may be damaged by moisture, exterior masonry walls, other than *cavity walls* or walls that are protected for their full height by a roof of a carport or porch, shall be covered on the interior surface with sheathing membrane conforming to CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type," lapped not less than 100 mm at the joints. e e2

2) In situations described in Sentence (1), flashing shall be provided where water will accumulate, to lead it to the exterior.

3) Where insulation that effectively limits the passage of water is applied by a waterproof adhesive or mortar directly to parged masonry, the requirements for sheathing membrane in Sentence (1) do not apply. (See Appendix A.) e3

9.20.13.10. Mortar Droppings

1) *Cavity walls* shall be constructed so that mortar droppings are prevented from forming a bridge to allow the passage of rain water across the cavity. e2

9.20.13.11. Caulking at Door and Window Frames

1) The junction of door and window frames with masonry shall be caulked in conformance with Subsection 9.27.4.

9.20.13.12. Drips beneath Window Sills

1) Where no flashing is installed beneath window sills, such sills shall be provided with a drip not less than 25 mm from the wall surface.

9.20.14. Protection during Work

9.20.14.1. Laying Temperature of Mortar and Masonry

1) Mortar and masonry shall be maintained at a temperature not below 5°C during installation and for not less than 48 h after installation.

2) No frozen material shall be used in mortar mix.

9.20.14.2. Protection from Weather

1) The top surface of uncompleted masonry exposed to the weather shall be completely covered with a waterproofing material when construction is not in progress.

9.20.15. Reinforcement for Earthquake Resistance

9.20.15.1. Amount of Reinforcement

1) Where reinforcement is required in this Section, masonry walls shall be reinforced horizontally and vertically with steel having a total cross-sectional area of not less than 0.002 times the horizontal cross-sectional area of the wall, so that not less than one-third of the required steel area is installed either horizontally or vertically and the remainder in the other direction.

9.20.15.2. Installation Standard

1) Where reinforcement for masonry is required in this Section, it shall be installed in conformance with the requirements for reinforced masonry as contained in CSA A371, "Masonry Construction for Buildings."

9.20.16. Corrosion Resistance

9.20.16.1. Corrosion Resistance of Connectors

1) Carbon steel connectors required to be corrosion-resistant shall be galvanized to at least the minimum standards in Table 9.20.16.1.

Table 9.20.16.1.
Minimum Requirements for Galvanizing
Forming Part of Sentence 9.20.16.1.(1)

Connector Material	ASTM Standard	Coating Class or Thickness
Wire ties and continuous reinforcing (hot-dipped galvanizing)	A 153/A 153M r4	Class B2 or 458 g/m²
Hardware and bolts	A 153/A 153M r4	See A 153/A 153M r4
Strip, plate, bars and rolled sections (not less than 3.18 mm thick)	A 123/ A 123M	610 g/m²
Sheet (less than 3.18 mm thick)	A 123/ A 123M	305 g/m² on material 0.76 mm thick(1)

Notes to Table 9.20.16.1.:

(1) ASTM A 123/A 123M does not apply to metal less than 3.18 mm thick. Galvanizing coatings may be interpolated for thicknesses between 3.18 mm and 0.76 mm.

Section 9.21. Chimneys and Flues

9.21.1. General

9.21.1.1. Application

1) Except when otherwise specifically stated herein, this Section applies to
a) rectangular *chimneys* of brick masonry or concrete not more than 12 m in height serving fireplaces or serving *appliances* having a combined total rated heat output of 120 kW or less, and
b) *flue pipes* serving *appliances* regulated by Article 9.33.5.3.

2) *Chimneys* and *flue pipes* other than those described in Sentence (1) shall conform to Section 6.3.

9.21.1.2. Factory-Built Chimneys

1) *Factory-built chimneys* serving solid-fuel burning *appliances*, and their installation, shall conform to CAN/ULC-S629-M, "650°C Factory-Built Chimneys." (See Appendix A.)

9.21.1.3. Chimneys, Gas Vents or Flue Pipes

1) Except as provided in Sentence (2), *chimneys* (other than those described in Sentences 9.21.1.1.(1) and 9.21.1.2.(1)), *gas vents* and *flue pipes* serving gas-, oil- or solid-fuel burning *appliances* and associated equipment shall conform to Subsection 9.33.10.

2) *Flue pipes* serving solid-fuel burning *stoves*, *ranges* and *space heaters* shall conform to CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment." r4

9.21.1.4. Chimney or Flue Pipe Walls

1) The walls of any *chimney* or *flue pipe* shall be constructed to be smoke- and flame-tight.

9.21.2. Chimney Flues

9.21.2.1. Chimney Flue Limitation

1) A *chimney flue* serving a fireplace or incinerator shall not serve any other *appliance*.

9.21.2.2. Connections of More Than One Appliance

1) Except as required in Article 9.21.2.1., two or more fuel-burning *appliances* are permitted to be connected to the same *chimney flue* provided adequate draft is maintained for the connected *appliances* and the connections are made as described in Sentences (2) and (3).

2) Where 2 or more fuel-burning *appliances* are connected to the same *chimney flue*, the *appliances* shall be located on the same *storey*.

3) The connection referred to in Sentence (2) for a solid-fuel burning *appliance* shall be below connections for *appliances* burning other fuels.

9.21.2.3. Inclined Chimney Flues

1) *Chimney flues* shall not be inclined more than 45° to the vertical.

9.21.2.4. Size of Chimney Flues

1) Except for *chimneys* serving fireplaces, the size of a *chimney flue* shall conform to the requirements of the *appliance* installation standards referenced in Sentences 9.33.5.2.(1) and 9.33.5.3.(1).

2) Where a *chimney flue* serves only one *appliance*, the *flue* area shall be at least equal to that of the *flue pipe* connected to it.

9.21.2.5. Fireplace Chimneys

1) The size of a *chimney flue* serving a masonry fireplace shall conform to Table 9.21.2.5.A. or Table 9.21.2.5.B.

Table 9.21.2.5.A.
Diameter of Round Flues for Fireplace Chimneys
Forming Part of Sentence 9.21.2.5.(1)

Fireplace Opening, m^2	Chimney Height, m							
	3.0 to 4.5		> 4.5 to 5.9		> 5.9 to 8.9		> 8.9 to 12	
	Flue Diameter, mm							
	min.	max.	min.	max.	min.	max.	min.	max.
up to 0.150	110	170	100	160	90	150	90	150
0.151 to 0.250	150	210	130	190	130	190	120	180
0.251 to 0.350	180	240	160	220	150	210	140	200
0.351 to 0.500	220	280	200	260	190	250	170	230
0.501 to 0.650	260	320	230	290	220	280	200	260
0.651 to 0.800	290	350	260	320	240	300	220	280
0.801 to 1.00	330	390	290	350	270	330	250	310
1.01 to 1.20	360	420	320	380	300	360	270	330
1.21 to 1.40	390	450	350	410	330	390	300	360
1.41 to 1.60	420	480	380	440	350	410	320	380
1.61 to 1.80	—	—	400	460	370	430	340	400
1.81 to 2.00	—	—	—	—	400	460	360	420
2.01 to 2.20	—	—	—	—	—	—	380	440

Table 9.21.2.5.B.
Rectangular Flue Sizes for Fireplace Chimneys
Forming Part of Sentence 9.21.2.5.(1)

Fireplace Opening, m^2	Chimney Height, m							
	3.0 to 4.5		> 4.5 to 5.9		> 5.9 to 8.9		> 8.9 to 12	
	Flue Size, mm							
	min.	max.	min.	max.	min.	max.	min.	max.
up to 0.150	200 x 200	200 x 200	100 x 200	100 x 200	100 x 200	100 x 200	100 x 200	100 x 200
0.151 to 0.250	200 x 200	200 x 200	200 x 200	200 x 200	200 x 200	200 x 200	200 x 200	200 x 200
0.251 to 0.350	200 x 300	200 x 300	200 x 200	200 x 300	200 x 200	200 x 200	200 x 200	200 x 200
0.351 to 0.500	300 x 300	300 x 300	200 x 300	200 x 300	200 x 300	200 x 300	200 x 200	200 x 300
0.501 to 0.650	300 x 300	300 x 400	300 x 300	300 x 300	300 x 300	300 x 300	200 x 300	200 x 300
0.651 to 0.800	300 x 400	300 x 400	300 x 300	300 x 400	300 x 300	300 x 300	300 x 300	300 x 300
0.801 to 1.00	400 x 400	400 x 400	300 x 400	300 x 400	300 x 400	300 x 400	300 x 300	300 x 300
1.01 to 1.20	400 x 400	400 x 400	400 x 400	400 x 400	300 x 400	300 x 400	300 x 400	300 x 400
1.21 to 1.40	—	—	400 x 400	400 x 400	400 x 400	400 x 400	300 x 400	300 x 400
1.41 to 1.60	—	—	—	—	400 x 400	400 x 400	400 x 400	400 x 400
1.61 to 1.80	—	—	—	—	—	—	400 x 400	400 x 400
1.81 to 2.00	—	—	—	—	—	—	400 x 400	400 x 400

9.21.2.6. Oval Chimney Flues

1) The width of an oval *chimney flue* shall be not less than two-thirds its breadth.

9.21.3. Chimney Lining

9.21.3.1. Lining Materials

1) Every *masonry or concrete chimney* shall have a lining of clay, concrete, firebrick or metal.

9.21.3.2. Joints in Chimney Liners

1) Joints of *chimney liners* shall be sealed to provide a barrier to the passage of *flue* gases and condensate into the cavity between the liner and the surrounding masonry.

2) Joints of clay, concrete or firebrick *chimney liners* shall be struck flush to provide a straight, smooth, aligned *chimney flue*.

9.21.3.3. Clay Liners

1) Clay liners shall conform to CAN/CSA-A324-M, "Clay Flue Liners."

2) Liners referred to in Sentence (1) shall be not less than 15.9 mm thick and shall be capable of resisting, without softening or cracking, a temperature of 1 100°C.

9.21.3.4. Firebrick Liners

1) Firebrick liners shall conform to ASTM C 27, "Classification of Fireclay and High-Alumina Refractory Brick."

2) Firebrick liners shall be laid with high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar."

9.21.3.5. Concrete Liners

1) Concrete *flue* liners shall conform to Clause 4.2.6.4. of CAN/CSA-A405-M, "Design and Construction of Masonry Chimneys and Fireplaces."

9.21.3.6. Metal Liners

1) Metal liners shall be constructed of not less than 0.3 mm thick stainless steel.

2) Metal liners referred to in Sentence (1) shall only be used in *chimneys* serving gas- or oil-burning *appliances*. (See Appendix A.)

9.21.3.7. Installation of Chimney Liners

1) *Chimney liners* shall be installed when the surrounding masonry or concrete is placed.

9.21.3.8. Spaces between Liners and Surrounding Masonry

1) A space not less than 10 mm wide shall be left between a *chimney liner* and surrounding masonry.

2) The space required in Sentence (1) shall not be filled with mortar.

9.21.3.9. Mortar for Chimney Liners

1) *Chimney liners* used in *chimneys* for solid-fuel burning *appliances* shall be laid in a full bed of

a) high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar," or
b) mortar consisting of 1 part Portland cement to 3 parts sand by volume.

2) *Chimney liners* used in *chimneys* for oil- or gas-burning *appliances* shall be laid in a full bed of mortar consisting of 1 part Portland cement to 3 parts sand by volume.

9.21.3.10. Extension of Chimney Liners

1) *Chimney liners* shall extend from a point not less than 200 mm below the lowest *flue pipe* connection to a point not less than 50 mm or more than 100 mm above the *chimney* cap.

9.21.4. Masonry and Concrete Chimney Construction

9.21.4.1. Unit Masonry

1) Unit masonry shall conform to Section 9.20.

9.21.4.2. Concrete

1) Concrete shall conform to Section 9.3.

9.21.4.3. Footings

1) Footings for *masonry chimneys* and *concrete chimneys* shall conform to Section 9.15.

9.21.4.4. Height of Chimney Flues

1) A *chimney flue* shall extend not less than

a) 900 mm above the highest point at which the *chimney* comes in contact with the roof, and
b) 600 mm above the highest roof surface or structure within 3 m of the *chimney*.

(See Appendix A.)

9.21.4.5. Lateral Stability

1) Except as provided in Sentence (2), *chimneys* shall be braced to provide lateral stability for wind loads in accordance with CAN3-S304-M, "Masonry Design for Buildings."

2) A *chimney* need not be laterally braced provided
a) no horizontal outside dimension is less than 400 mm, and
b) the *chimney* extends not more than 3.6 m above a roof or the masonry wall of which it forms a part.
(See Appendix A.)

9.21.4.6. Chimney Caps

1) The top of a *chimney* shall have a waterproof cap of reinforced concrete, masonry or metal.

2) The cap required in Sentence (1) shall slope from the lining and be provided with a drip not less than 25 mm from the *chimney* wall.

3) Cast-in-place concrete caps shall be separated from the *chimney liner* by a bond break and be sealed at that location.

4) Jointed precast concrete or masonry *chimney* caps shall have flashing installed beneath the cap extending from the liner to the drip edge.

9.21.4.7. Cleanout

1) A cleanout opening with a metal frame and a tight-fitting metal door shall be installed near the base of the *chimney flue*.

9.21.4.8. Wall Thickness

1) The walls of a masonry *chimney* shall be built of solid units not less than 75 mm thick.

9.21.4.9. Separation of Flue Liners

1) *Flue* liners in the same *chimney* shall be separated by not less than 75 mm of masonry or concrete exclusive of liners where clay liners are used, or 90 mm of firebrick where firebrick liners are used.

2) *Flue* liners referred to in Sentence (1) shall be installed to prevent significant lateral movement.

9.21.4.10. Flashing

1) Junctions with adjacent materials shall be adequately flashed to shed water.

9.21.5. Clearance from Combustible Construction

9.21.5.1. Clearance from Combustible Materials

1) The clearance between *masonry or concrete chimneys* and *combustible* framing shall be not less than
a) 50 mm for interior *chimneys*, and
b) 12 mm for exterior *chimneys*.
(See Appendix A.)

2) A clearance of not less than 150 mm shall be provided between a cleanout opening and *combustible* material.

3) *Combustible* flooring and subflooring shall have not less than a 12 mm clearance from *masonry or concrete chimneys*.

9.21.5.2. Sealing of Spaces

1) All spaces between *masonry or concrete chimneys* and *combustible* framing shall be sealed top or bottom with *noncombustible* material.

9.21.5.3. Support of Joists or Beams

1) Joists or beams may be supported on masonry walls which enclose *chimney flues* provided the *combustible* members are separated from the *flue* by not less than 290 mm of solid masonry.

Section 9.22. Fireplaces

9.22.1. General

9.22.1.1. Application

1) Except when otherwise specifically stated herein, this Section applies to masonry fireplaces constructed on-site.

9.22.1.2. Masonry and Concrete

1) Except as otherwise stated in this Section, unit masonry shall conform to Section 9.20. and concrete to Section 9.3.

2) Masonry above openings shall be supported by steel lintels conforming to Sentence 9.20.5.2.(2), reinforced concrete or a masonry arch.

9.22.1.3. Footings

1) Footings for masonry and concrete fireplaces shall conform to Section 9.15.

9.22.1.4. Combustion Air

1) Where a supply of combustion air is provided directly to the fire chamber of a fireplace, including a factory-built fireplace, the installation shall comply with the “Outdoor Air Supply” requirements provided in CAN/CSA-A405-M, “Design and Construction of Masonry Chimneys and Fireplaces.”

9.22.2. Fireplace Liners

9.22.2.1. Brick or Steel Liners

1) Except where a fireplace is equipped with a steel liner, every fireplace shall have a firebrick liner.

9.22.2.2. Firebrick Liners

1) Firebrick liners shall be not less than
a) 50 mm thick for the sides and back, and
b) 25 mm thick for the floor.

2) Firebrick liners shall be laid with high temperature cement mortar conforming to CAN/CGSB-10.3, "Air Setting Refractory Mortar."

3) Joints between a firebrick liner and the adjacent back-up masonry shall be offset.

9.22.2.3. Steel Liners

1) Steel liners for fireplaces shall conform to CAN/ULC-S639-M, "Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces," and shall be installed in accordance with the installation instructions in that standard.

9.22.3. Fireplace Walls

9.22.3.1. Thickness of Walls

1) Except as provided in Sentence (2), the thickness of the back and sides of a fireplace, including the thickness of any firebrick liner, shall be not less than 190 mm where a metal liner or a firebrick liner less than 51 mm thick is used.

2) When a steel fireplace liner is used with an air circulating chamber surrounding the firebox, the back and sides of the fireplace shall consist of
a) solid masonry units not less than 90 mm thick, or
b) hollow masonry units not less than 190 mm thick.

9.22.4. Fire Chamber

9.22.4.1. Fire Chamber Dimensions

1) The distance from the back of the fire chamber to the plane of the fireplace opening shall be not less than 300 mm.

9.22.5. Hearth

9.22.5.1. Hearth Extension

1) Except as required in Sentence (2), fireplaces shall have a *noncombustible* hearth extending not less than 400 mm in front of the fireplace opening and not less than 200 mm beyond each side of the fireplace opening.

2) Where the fire chamber floor is elevated more than 150 mm above the hearth, the dimension of the hearth measured perpendicular to the plane of the fireplace opening shall be increased by not less than
a) 50 mm for an elevation above 150 mm and not more than 300 mm, and
b) an additional 25 mm for every 50 mm in elevation above 300 mm.

9.22.5.2. Support of Hearth

1) Except as permitted in Sentence (2), the fire chamber floor and hearth shall be supported on a reinforced concrete slab not less than 100 mm thick at its supports and, if cantilevered, not less than 50 mm thick at its unsupported edge.

2) A hearth for a fireplace with an opening raised not less than 200 mm from a *combustible* floor is permitted to be supported on that floor provided the requirements of Clauses 5.3.6.5. to 5.3.6.7. of CAN/CSA-A405-M, "Design and Construction of Masonry Chimneys and Fireplaces," are followed.

9.22.6. Damper

9.22.6.1. Required Damper and Size

1) The throat of every fireplace shall be equipped with a metal damper sufficiently large to cover the full area of the throat opening.

9.22.7. Smoke Chamber

9.22.7.1. Slope of Smoke Chamber

1) The sides of the smoke chamber connecting a fireplace throat with a *flue* shall not be sloped at an angle greater than 45° to the vertical.

9.22.7.2. Wall Thickness

1) The thickness of masonry walls surrounding the smoke chamber shall be not less than 190 mm at the sides, front and back, except that the portions of the back exposed to the outside may be 140 mm thick.

9.22.8. Factory-Built Fireplaces

9.22.8.1. Conformance to Standard

1) Factory-built fireplaces and their installation shall conform to CAN/ULC-S610-M, "Factory-Built Fireplaces."

9.22.9. Clearance of Combustible Material

9.22.9.1. Clearance to the Fireplace Opening

1) *Combustible* material shall not be placed on or near the face of a fireplace within 150 mm of the fireplace opening, except that where the *combustible* material projects more than 38 mm out from the face of the fireplace above the opening, such material shall be not less than 300 mm above the top of the opening.

9.22.9.2. Metal Exposed to the Interior

1) Metal exposed to the interior of a fireplace such as the damper control mechanism shall have not less than a 50 mm clearance from any *combustible* material on the face of the fireplace where such metal penetrates through the face of the fireplace.

9.22.9.3. Clearance to Combustible Framing

1) Not less than a 100 mm clearance shall be provided between the back and sides of a fireplace and *combustible* framing, except that a 50 mm clearance is permitted where the fireplace is located in an exterior wall.

2) Not less than a 50 mm clearance shall be provided between the back and sides of the smoke chamber of a fireplace and *combustible* framing, except that a 25 mm clearance is permitted where the fireplace is located in an exterior wall.

9.22.9.4. Heat Circulating Duct Openings

1) The clearance of *combustible* material above heat-circulating duct openings from those openings shall be not less than

a) 300 mm where the *combustible* material projects not less than 38 mm from the face, and

b) 150 mm where the projection is less than 38 mm.

9.22.10. Fireplace Inserts and Hearth-Mounted Stoves

9.22.10.1. Appliance Standard

1) Fireplace inserts and hearth-mounted *stoves* vented through the throat of a fireplace shall conform to ULC-S628, "Fireplace Inserts."

9.22.10.2. Installation

1) The installation of fireplace inserts and hearth-mounted *stoves* vented through the throat of a fireplace shall conform to CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment." r4

Section 9.23. Wood-Frame Construction

9.23.1. Scope

9.23.1.1. Application

1) This Section applies to conventional wood-frame construction in which the framing members are spaced not more than 600 mm o.c.

2) The requirements in this Section with regard to floor framing, subflooring and their fastenings apply to floors for which the specified *live load* does not exceed 2.4 kPa.

3) The requirements in this Section with regard to wall framing and its fastenings apply to walls which support floors for which the specified *live load* does not exceed 2.4 kPa on any floor.

4) Where the conditions in Sentences (2) or (3) are exceeded, the design of the framing and fastening shall conform to Subsection 4.3.1.

9.23.1.2. Post, Beam and Plank Construction

1) Post, beam and plank construction and plank frame wall construction shall conform to Article 9.4.1.2.

9.23.2. General

9.23.2.1. Strength and Rigidity

1) All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

9.23.2.2. Protection from Decay

1) Ends of wood joists, beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

2) Air spaces required in Sentence (1) shall not be blocked by insulation, *vapour barriers* or airtight materials.

9.23.2.3. Protection from Dampness

1) Except as permitted in Sentence (2), wood framing members that are not pressure treated with a wood preservative and which are supported on concrete in contact with the ground or *fill* shall be separated from the concrete by not less than 0.05 mm polyethylene film or Type S roll roofing.

2) Dampproofing material referred to in Sentence (1) is not required where the wood member is at least 150 mm above the ground.

9.23.2.4. Lumber

1) Lumber shall conform to Subsection 9.3.2.

9.23.3. Fasteners

9.23.3.1. Standards for Nails and Screws

1) Unless otherwise indicated, nails specified in this Section shall be common steel wire nails or common spiral nails, conforming to CSA B111, "Wire Nails, Spikes and Staples."

2) Wood screws specified in this Section shall conform to ANSI B18.6.1, "Slotted and Recessed Wood Screws (Inch Series)." (See Appendix A.)

9.23.3.2. Length of Nails

1) All nails shall be long enough so that not less than half their required length penetrates into the second member.

9.23.3.3. Prevention of Splitting

1) Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges. (See Appendix A.)

9.23.3.4. Nailing of Framing

1) Except as provided in Sentence (2), nailing of framing shall conform to Table 9.23.3.4.

2) Where the bottom wall plate or sole plate of an exterior wall is not nailed to joists or blocking in conformance with Table 9.23.3.4., the exterior wall is permitted to be fastened to the floor framing by

- a) having plywood, OSB or waferboard sheathing extend down over floor framing and fastened to the floor framing by nails or staples conforming to Article 9.23.3.5., or
- b) tying the wall framing to the floor framing by galvanized-metal strips
  - i) 50 mm wide,
  - ii) not less than 0.41 mm thick,
  - iii) spaced not more than 1.2 m apart, and
  - iv) fastened at each end with at least two 63 mm nails.

Table 9.23.3.4.
Nailing for Framing
Forming Part of Sentence 9.23.3.4.(1)

Construction Detail	Minimum Length of Nails, mm	Minimum Number or Maximum Spacing of Nails
Floor joist to plate – toe nail	82	2
Wood or metal strapping to underside of floor joists	57	2
Cross bridging to joists	57	2 at each end
Double header or trimmer joists	76	300 mm (o.c.)
Floor joist to stud (balloon construction)	76	2
Ledger strip to wood beam	82	2 per joist
Joist to joist splice (see also Table 9.23.13.8.)	76	2 at each end
Tail joist to adjacent header joist	82	5
(end nailed) around openings	101	3
Each header joist to adjacent trimmer joist	82	5
(end nailed) around openings	101	3
Stud to wall plate (each end) toe nail	63	4
or end nail	82	2
Doubled studs at openings, or studs at walls or wall intersections and corners	76	750 mm (o.c.)
Doubled top wall plates	76	600 mm (o.c.)
Bottom wall plate or sole plate to joists or blocking (exterior walls)(1)	82	400 mm (o.c.)
Interior walls to framing or subflooring	82	600 mm (o.c.)
Horizontal member over openings in non-*loadbearing* walls – each end	82	2
Lintels to studs	82	2 at each end
Ceiling joist to plate – toe nail each end	82	2
Roof rafter, roof truss or roof joist to plate – toe nail	82	3
Rafter plate to each ceiling joist	101	2
Rafter to joist (with ridge supported)	76	3
Rafter to joist (with ridge unsupported)	76	see Table 9.23.13.8.
Gusset plate to each rafter at peak	57	4
Rafter to ridge board – toe nail – end nail	82	3
Collar tie to rafter – each end	76	3
Collar tie lateral support to each collar tie	57	2
Jack rafter to hip or valley rafter	82	2
Roof strut to rafter	76	3
Roof strut to *loadbearing* wall – toe nail	82	2
38 mm × 140 mm or less plank decking to support	82	2
Plank decking wider than 38 mm × 140 mm to support	82	3
38 mm edge laid plank decking to support (toe nail)	76	1
38 mm edge laid plank to each other	76	450 mm (o.c.)

Notes to Table 9.23.3.4.:
(1) See Sentence 9.23.3.4.(2).

9.23.3.5. Fasteners for Sheathing or Subflooring

1) Fastening of sheathing and subflooring shall conform to Table 9.23.3.5.

2) Staples shall not be less than 1.6 mm in diameter or thickness, with not less than a 9.5 mm crown driven with the crown parallel to framing.

3) Roofing nails for the attachment of fibreboard or gypsum sheathing shall not be less than 3.2 mm in diameter with a minimum head diameter of 11.1 mm.

4) Flooring screws shall not be less than 3.2 mm in diameter.

9.23.4. Maximum Spans

9.23.4.1. Application

1) Spans provided in this Subsection for joists, beams and lintels supporting floors shall apply only where

a) the floors serve residential areas as described in Table 4.1.6.3., or

b) the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

2) Spans for joists, beams and lintels supporting floors shall be determined according to Subsection 4.1.3. where the supported floors

a) serve other than residential areas, or

b) support a uniform *live load* in excess of that specified for residential areas.

9.23.4.2. Spans for Joists, Rafters and Beams

(See Appendix A.)

1) Except as required in Sentence (2), spans for wood joists and rafters shall conform to the spans shown in Tables A-1 to A-7 for the uniform *live loads* shown in the tables. (See Article 9.4.2.2.)

2) Spans for floor joists that are not selected from Tables A-1 and A-2 and that are required to be designed for the same loading conditions, shall not exceed the design requirements for uniform loading and vibration criteria. (See Appendix A.)

3) Spans for built-up wood and glued-laminated timber floor beams shall conform to the spans in Tables A-8 to A-11. (See Article 9.4.2.2.)

4) Spans for roof ridge beams shall conform to the spans in Table A-12 for the uniform snow load shown. (See Articles 9.4.2.2. and 9.23.13.8.)

9.23.4.3. Steel Beams

1) The spans for steel floor beams with laterally supported top flanges shall conform to Table 9.23.4.3. (See Appendix A.)

2) Beams described in Sentence (1) shall at least meet the requirements for Grade 350 W steel in CSA G40.21, "Structural Quality Steels." r2 r4

9.23.4.4. Concrete Topping

(See Appendix A.)

1) Except as permitted in Sentence (2), where a floor is required to support a concrete topping, the joist spans shown in Table A-1 or the spacing of the members shall be reduced to allow for the loads due to the topping.

Table 9.23.3.5.
Fasteners for Sheathing and Subflooring
Forming Part of Sentence 9.23.3.5.(1)

Element	Minimum Length of Fasteners, mm				Minimum Number or Maximum Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails or Screws	Roofing Nails	Staples	
Board lumber 184 mm or less wide	51	45	N/A	51	2 per support
Board lumber more than 184 mm wide	51	45	N/A	51	3 per support
Fibreboard sheathing up to 13 mm thick	N/A	N/A	44	28	150 mm (o.c.) along edges and 300 mm (o.c.) along intermediate supports e2
Gypsum sheathing up to 13 mm thick	N/A	N/A	44	N/A	
Plywood, OSB or waferboard up to 10 mm thick	51	45	N/A	38	
Plywood, OSB or waferboard from 10 mm to 20 mm thick	51	45	N/A	51	
Plywood, OSB or waferboard over 20 mm thick	57	51	N/A	N/A	

Table 9.23.4.3.
Maximum Spans for Steel Beams Supporting Floors in Dwelling Units[1] r2
Forming Part of Sentence 9.23.4.3.(1)

Section	Supported Joist Length, m (Half the sum of joist spans on both sides of the beam)						
	2.4	3.0	3.6	4.2	4.8	5.4	6.0
	One *Storey* Supported						
W150 x 22	5.5	5.2	4.9	4.8	4.6	4.5	4.3
W200 x 21	6.5	6.2	5.9	5.7	5.4	5.1	4.9
W200 x 27	7.3	6.9	6.6	6.3	6.1	5.9	5.8
W200 x 31	7.8	7.4	7.1	6.8	6.6	6.4	6.2
W250 x 24	8.1	7.6	7.3	7.0	6.6	6.2	5.9
W250 x 33	9.2	8.7	8.3	8.0	7.7	7.5	7.3
W250 x 39	10.0	9.4	9.0	8.6	8.4	8.1	7.9
W310 x 31	10.4	9.8	9.4	8.9	8.4	8.0	7.6
W310 x 39	11.4	10.7	10.2	9.8	9.5	9.2	9.0
	Two *Storeys* Supported						
W150 x 22	4.9	4.4	4.1	3.8	3.5	3.4	3.2
W200 x 21	5.6	5.1	4.6	4.3	4.1	3.8	3.7
W200 x 27	6.4	6.1	5.6	5.3	4.9	4.7	4.4
W200 x 31	6.9	6.5	6.2	5.8	5.4	5.1	4.9
W250 x 24	6.8	6.1	5.6	5.2	4.9	4.6	4.4
W250 x 33	8.2	7.7	7.0	6.5	6.1	5.8	5.5
W250 x 39	8.8	8.3	7.8	7.2	6.8	6.4	6.1
W310 x 31	8.7	7.8	7.2	6.7	6.2	5.9	5.6
W310 x 39	10.0	9.3	8.5	7.9	7.4	7.0	6.7

Notes to Table 9.23.4.3.:
(1) See Appendix A.

2) Where a floor is required to support a concrete topping, joist spans are permitted to be selected from Table A-2 provided the concrete
a) is 38 to 51 mm thick,
b) is normal weight,
c) is placed directly on the subflooring, and
d) has not less than 20 MPa compressive strength after 28 days.

3) Where a floor is required to support a concrete topping, the beam spans shown in Tables A-8 to A-11 or the supported length of the floor joists shall be reduced to allow for the loads due to the topping.

9.23.4.5. Heavy Roofing Materials

1) Where a roof is required to support an additional uniform *dead load* from roofing materials such as concrete roofing tile, or materials other than as specified in Section 9.27., such as clay roofing tiles, the additional load shall be allowed for by reducing
a) the spans for roof joists and rafters in Tables A-4 to A-7, or the spacing of the members, and
b) the spans for ridge beams and lintels in Tables A-12 to A-20. (See A-9.23.4.2. in Appendix A.)

9.23.5. Notching and Drilling

9.23.5.1. Holes Drilled in Framing Members

1) Holes drilled in roof, floor or ceiling framing members shall be not larger than one-quarter the depth of the member and shall be located not less than 50 mm from the edges, unless the depth of the member is increased by the size of the hole.

9.23.5.2. Notching of Framing Members

1) Floor, roof and ceiling framing members are permitted to be notched provided the notch is located on the top of the member within half the joist depth from the edge of bearing and is not deeper than one-third the joist depth, unless the depth of the member is increased by the size of the notch.

9.23.5.3. Wall Studs

1) Wall studs shall not be notched, drilled or otherwise damaged so that the undamaged portion of the stud is less than two-thirds the depth of the stud if the stud is *loadbearing* or 40 mm if the stud is non-*loadbearing*, unless the weakened studs are suitably reinforced.

9.23.5.4. Top Plates

1) Top plates in walls shall not be notched, drilled or otherwise weakened to reduce the undamaged width to less than 50 mm unless the weakened plates are suitably reinforced.

9.23.5.5. Roof Trusses

1) Roof truss members shall not be notched, drilled or otherwise weakened unless such notching or drilling is allowed for in the design of the truss.

9.23.6. Anchorage

9.23.6.1. Anchorage of Building Frames

1) *Building* frames shall be anchored to the *foundation* unless a structural analysis of wind and earth pressures shows anchorage is not required.

2) Except as provided in Article 9.23.6.3., anchorage shall be provided by embedding the ends of the first floor joists in concrete, or fastening the sill plate to the *foundation* with not less than 12.7 mm diam anchor bolts spaced not more than 2.4 m o.c.

3) Anchor bolts referred to in Sentence (2) shall be fastened to the sill plate with nuts and washers and shall be embedded not less than 100 mm in the *foundation* and so designed that they may be tightened without withdrawing them from the *foundation*.

9.23.6.2. Anchorage of Columns and Posts

1) Exterior columns and posts shall be anchored to resist uplift and lateral movement.

9.23.6.3. Anchorage of Smaller Buildings

1) *Buildings* not more than 4.3 m wide and not more than 1 *storey* in *building height* may be anchored in conformance with the requirements of CSA Z240.10.1, "Site Preparation, Foundation, and Anchorage of Mobile Homes."

9.23.7. Sill Plates

9.23.7.1. Size of Sill Plates

1) Where sill plates provide bearing for the floor system they shall be not less than 38 mm by 89 mm material.

9.23.7.2. Levelling of Sill Plates

1) Sill plates shall be levelled by setting them on a full bed of mortar, except that where the top of the *foundation* is level, they may be laid directly on the *foundation* provided the junction between the *foundation* and the sill plate is caulked or the sill plate is placed on a layer of mineral wool not less than 25 mm thick before being compressed. (See also Article 9.23.2.3.)

9.23.8. Beams to Support Floors

9.23.8.1. Bearing for Beams

1) Beams shall have even and level bearing and shall have not less than 89 mm length of bearing at end supports.

9.23.8.2. Priming of Steel Beams

1) Steel beams shall be shop primed.

9.23.8.3. Built-up Wood Beams

(See Appendix A.)

1) Where a beam is made up of individual pieces of lumber that are nailed together, the individual members shall be 38 mm or greater in thickness and installed on edge.

2) Except as permitted in Sentence (3), where individual members of a built-up beam are butted together to form a joint, the joint shall occur over a support.

3) Where a beam is continuous over more than one span, individual members are permitted to be butted together to form a joint at or within 150 mm of the end quarter points of the clear spans, provided the quarter points are not those closest to the ends of the beam.

4) Members joined at quarter points shall be continuous over adjacent supports.

5) Joints in individual members of a beam that are located at or near the end quarter points shall not occur in adjacent members at the same quarter point and shall not reduce the effective beam width by more than half.

6) Not more than one butt joint shall occur in any individual member of a built-up beam within any one span.

7) Except as provided in Sentence (8), where 38 mm members are laid on edge to form a built-up beam, individual members shall be nailed together with a double row of nails not less than 89 mm in length, spaced not more than 450 mm apart in each row with the end nails located 100 mm to 150 mm from the end of each piece.

8) Where 38 mm members in built-up wood beams are not nailed together as provided in Sentence (7), they shall be bolted together with not less than 12.7 mm diam bolts equipped with washers and spaced not more than 1.2 m o.c., with the end bolts located not more than 600 mm from the ends of the members.

9.23.9. Floor Joists

9.23.9.1. End Bearing for Joists

1) Except when supported on ribbon boards, floor joists shall have not less than 38 mm length of end bearing.

2) Ribbon boards referred to in Sentence (1) shall be not less than 19 mm by 89 mm lumber let into the studs.

9.23.9.2. Joists Supported by Beams

1) Floor joists may be supported on the tops of beams or may be framed into the sides of beams.

2) When framed into the side of a wood beam, joists referred to in Sentence (1) shall be supported on

a) joist hangers or other acceptable mechanical connectors, or
b) not less than 38 mm by 64 mm ledger strips nailed to the side of the beam, except that 38 mm by 38 mm ledger strips may be used provided each joist is nailed to the beam by not less than four 89 mm nails, in addition to the nailing for the ledger strip required in Table 9.23.3.4.

3) When framed into the side of a steel beam, joists referred to in Sentence (1) shall be supported on the bottom flange of the beam or on not less than 38 mm by 38 mm lumber bolted to the web with not less than 6.3 mm diam bolts spaced not more than 600 mm apart.

4) Joists referred to in Sentence (3) shall be spliced above the beam with not less than 38 mm by 38 mm lumber at least 600 mm long to support the flooring.

5) Not less than a 12 mm space shall be provided between the splice required in Sentence (4) and the beam to allow for shrinkage of the wood joists.

9.23.9.3. Restraint of Joist Bottoms

1) Except as provided in Sentence 9.23.9.4.(2), bottoms of floor joists shall be restrained from twisting at each end by toe-nailing to the supports, end-nailing to the header joists or by providing continuous strapping, blocking between the joists or cross-bridging near the supports.

9.23.9.4. Strapping and Bridging in Tables A1 and A2

(See A-9.23.4.2.(2) in Appendix A.) e3

1) Where a panel-type ceiling finish is attached to wood furring, the provisions of Article 9.23.9.5. shall apply.

2) Except as permitted in Sentence (5), where strapping is specified in Table A-1, it shall be

a) not less than 19 mm by 64 mm, nailed to the underside of floor joists,
b) located not more than 2 100 mm from each support or other rows of strapping, and
c) fastened at each end to a sill or header.

3) Where bridging is specified in Table A-1, it shall consist of not less than 19 mm by 64 mm or 38 mm by 38 mm cross bridging located not more than 2 100 mm from each support or other rows of bridging.

4) Where bridging and strapping are specified in Tables A-1 and A-2, they shall consist of

a) bridging as described in Sentence (3), together with wood strapping as described in Sentence (2), or
b) 38 mm solid blocking located not more than 2 100 mm from each support or other rows of bridging and securely fastened between the joists, together with wood strapping as defined in Sentence (2).

5) Strapping is not required if furring strips or a panel-type ceiling finish is attached directly to the joists.

9.23.9.5. Ceiling in Table A2

1) Where a ceiling is specified in Table A-2, it shall consist of gypsum board, plywood or OSB not less than 12.7 mm thick attached to

a) 19 mm by 89 mm wood furring spaced at not more than 600 mm o.c., or
b) 19 mm by 64 mm wood furring spaced at not more than 400 mm o.c.

9.23.9.6. Header Joists

1) Header joists around floor openings shall be doubled when they exceed 1.2 m in length.

2) The size of header joists exceeding 3.2 m in length shall be determined by calculations.

9.23.9.7. Trimmer Joists

1) Trimmer joists around floor openings shall be doubled when the length of the header joist exceeds 800 mm.

2) When the header joist exceeds 2 m in length the size of the trimmer joists shall be determined by calculations.

9.23.9.8. Support of Tail and Header Joists

1) When tail joists and header joists are supported by the floor framing, they shall be supported by suitable joist hangers or nailing in accordance with Table 9.23.3.4.

9.23.9.9. Support of Walls

1) Non-*loadbearing* walls parallel to the floor joists shall be supported by joists beneath the wall or on blocking between the joists.

2) Blocking referred to in Sentence (1) for the support of non-*loadbearing* walls shall be not less than 38 mm by 89 mm lumber, spaced not more than 1.2 m apart.

3) Non-*loadbearing* interior walls at right angles to the floor joists are not restricted as to location.

4) *Loadbearing* interior walls parallel to floor joists shall be supported by beams or walls of sufficient strength to transfer safely the specified *live loads* to the vertical supports.

5) *Loadbearing* interior walls at right angles to floor joists shall be located not more than 900 mm from the joist support when the wall does not support a floor, and not more than 600 mm from the joist support when the wall supports one or more floors, unless the joist size is designed to support such loads.

9.23.9.10. Cantilevered Floor Joists

1) Floor joists supporting roof loads shall not be cantilevered more than 400 mm beyond their supports where 38 mm by 184 mm joists are used and not more than 600 mm beyond their supports where 38 mm by 235 mm or larger joists are used.

2) The cantilevered portions referred to in Sentence (1) shall not support floor loads from other *storeys* unless calculations are provided to show that the design resistances of the cantilevered joists are not exceeded.

3) Where cantilevered floor joists described in Sentences (1) and (2) are at right angles to the main floor joists, the tail joists in the cantilevered portion shall extend inward away from the cantilever support a distance equal to not less than 6 times the length of the cantilever, and shall be end nailed to an interior doubled header joist in conformance with Table 9.23.3.4.

9.23.10. Wall Studs

9.23.10.1. Stud Size and Spacing

1) The size and spacing of studs shall conform to Table 9.23.10.1.

9.23.10.2. Bracing and Lateral Support

(See Appendix A.)

1) Except as provided in Sentence (2), each exterior wall in each *storey* shall be braced with at least one diagonal brace conforming to Sentence (3).

2) Bracing is not required where walls
- a) have an interior finish conforming to the requirements of Section 9.29., or
- b) where the walls are
  - i) clad with panel type siding,
  - ii) diagonally sheathed with lumber, or
  - iii) sheathed with plywood, OSB, waferboard, gypsum or fibreboard sheathing.

3) Where bracing is required, it shall
- a) consist of not less than 19 mm by 89 mm wood members,
- b) be applied to the studs at an angle of approximately 45° to the horizontal, and
- c) extend the full height of the wall on each *storey*.

4) Bracing described in Sentence (3) shall be nailed to each stud and wall plate by at least two 63 mm nails.

5) Where *loadbearing* interior walls are not finished in accordance with Sentence (2), blocking or strapping shall be fastened to the studs at midheight to prevent sideways buckling.

9.23.10.3. Orientation of Studs

1) Except as permitted in Sentences (2) and (3), all studs shall be placed at right angles to the wall face.

2) Studs on the flat are permitted to be used in gable ends of roofs that contain only unfinished space or in non-*loadbearing* interior walls within the limits described in Article 9.23.10.1.

Table 9.23.10.1.
Size and Spacing of Studs
Forming Part of Sentence 9.23.10.1.(1)

Type of Wall	Supported Loads (including *dead loads*)	Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Unsupported Height, m
Interior	No load	38 x 38	400	2.4
		38 x 89 flat(1)	400	3.6
	Attic not accessible by a stairway	38 x 64	600	3.0
		38 x 64 flat(1)	400	2.4
		38 x 89	600	3.6
		38 x 89 flat(1)	400	2.4
	Attic accessible by a stairway plus one floor Roof load plus one floor Attic not accessible by stairway plus 2 floors	38 x 89	400	3.6
	Roof load Attic accessible by a stairway Attic not accessible by a stairway plus one floor	38 x 64	400	2.4
		38 x 89	600	3.6
	Attic accessible by a stairway plus 2 floors Roof load plus 2 floors	38 x 89	300	3.6
		64 x 89	400	3.6
		38 x 140	400	4.2
	Attic accessible by a stairway plus 3 floors Roof load plus 3 floors	38 x 140	300	4.2
Exterior	Roof with or without attic storage	38 x 64	400	2.4
		38 x 89	600	3.0
	Roof with or without attic storage plus one floor	38 x 89	400	3.0
		38 x 140	600	3.0
	Roof with or without attic storage plus 2 floors	38 x 89	300	3.0
		64 x 89	400	3.0
		38 x 140	400	3.6
	Roof with or without attic storage plus 3 floors	38 x 140	300	1.8

Notes to Table 9.23.10.1.:
(1) See Article 9.23.10.3.

3) Wall studs that support only a load from an attic not accessible by a stairway are permitted to be placed on the flat within the limits permitted in Article 9.23.10.1. provided
a) the studs are clad on not less than one side with plywood, OSB or waferboard sheathing fastened to the face of the studs with a structural adhesive, and
b) the portion of the roof supported by the studs does not exceed 2.1 m in width.

9.23.10.4. Continuity of Studs

1) Wall studs shall be continuous for the full *storey* height except at openings and shall not be spliced except by fingerjoining with a structural adhesive. (See Appendix A.)

9.23.10.5. Support for Cladding, Sheathing and Finishing Materials

1) Corners and intersections shall be designed to provide adequate support for the vertical edges of interior finishes, sheathing and cladding materials, and in no instance shall exterior corners be framed with less than the equivalent of 2 studs.

2) Where the vertical edges of interior finishes at wall intersections are supported at vertical intervals by blocking or furring, the vertical distance between such supports shall not exceed the maximum distance between supports specified in Section 9.29.

9.23.10.6. Studs at Sides of Openings

1) Except as provided in Sentence (2), studs shall be doubled on each side of openings so that the inner studs extend from the lintel to the bottom wall plate and the outer studs extend from the top wall plate to the bottom wall plate.

2) Single studs are permitted to be used on either side of openings
- a) in non-*loadbearing* interior walls not required to have *fire-resistance ratings*, provided the studs extend from the top wall plate to the bottom wall plate, or
- b) in *loadbearing* or non-*loadbearing* interior or exterior walls, provided
  - i) the opening is less than and within the required stud spacing, and
  - ii) no 2 such openings of full stud-space width are located in adjacent stud spaces.

(See Appendix A.)

9.23.11. Wall Plates

9.23.11.1. Size of Wall Plates

1) Except as provided in Sentence (2), wall plates shall be
- a) not less than 38 mm thick, and
- b) not less than the required width of the wall studs.

2) In non-*loadbearing* walls and in *loadbearing* walls where the studs are located directly over framing members, the bottom wall plate is permitted to be 19 mm thick.

9.23.11.2. Bottom Wall Plates

1) A bottom wall plate shall be provided in all cases.

2) The bottom plate in exterior walls shall not project more than one-third the plate width over the support.

9.23.11.3. Top Plates

1) Except as permitted in Sentences (2) to (4), at least 2 top plates shall be provided in *loadbearing* walls.

2) A single top plate is permitted to be used in a section of a *loadbearing* wall containing a lintel provided the top plate forms a tie across the lintel.

3) A single top plate is permitted to be used in *loadbearing* walls where the concentrated loads from ceilings, floors and roofs are not more than 50 mm to one side of the supporting studs and in all non-*loadbearing* walls.

4) The top plates need not be provided in a section of *loadbearing* wall containing a lintel provided the lintel is tied to the adjacent wall section with not less than
- a) 75 mm by 150 mm by 0.91 mm thick galvanized steel, or
- b) 19 mm by 89 mm by 300 mm wood splice nailed to each wall section with at least three 63 mm nails.

9.23.11.4. Joints in Top Plates

1) Joints in the top plates of *loadbearing* walls shall be staggered not less than one stud spacing.

2) The top plates in *loadbearing* walls shall be lapped or otherwise tied at corners and intersecting walls in accordance with Sentence (4).

3) Joints in single top plates used with *loadbearing* walls shall be tied in accordance with Sentence (4).

4) Ties referred to in Sentences (2) and (3) shall be the equivalent of not less than 75 mm by 150 mm by 0.91 mm thick galvanized steel nailed to each wall with at least three 63 mm nails.

9.23.12. Framing over Openings

9.23.12.1. Openings in Non-Loadbearing Walls

1) Except as provided in Sentence (2), openings in non-*loadbearing* walls shall be framed with not less than 38 mm material the same width as the studs, securely nailed to adjacent studs.

2) Openings for doors in non-*loadbearing* walls required to be *fire separations* with a *fire-resistance rating* shall be framed with the equivalent of at least two 38 mm thick members that are the same width as the wall plates.

9.23.12.2. Openings in Loadbearing Walls

1) Openings in *loadbearing* walls greater than the required stud spacing shall be framed with lintels designed to carry the superimposed loads to adjacent studs. (See A-9.23.10.6.(2) in Appendix A.)

2) Except as provided in Sentence 9.23.12.3.(2), where 2 or more members are used in lintels, they shall be fastened together with not less than 82 mm nails in a double row, with nails not more than 450 mm apart in each row. e

3) Lintel members are permitted to be separated by filler pieces.

9.23.12.3. Lintel Spans and Sizes

1) Spans and sizes of wood lintels shall conform to the spans shown in Tables A-13 to A-20
- a) for *buildings* of *residential occupancy*,

b) where the wall studs exceed 38 mm by 64 mm in size,
c) where the spans of supported joists do not exceed 4.9 m, and
d) where the spans of trusses do not exceed 9.8 m.

2) In *loadbearing* exterior and interior walls of 38 mm by 64 mm framing members, lintels shall consist of
a) 64 mm thick members on edge, or
b) 38 mm thick and 19 mm thick members fastened together with a double row of nails not less than 63 mm long and spaced not more than 450 mm apart.

3) Lintels referred to in Sentence (2)
a) shall be not less than 50 mm greater in depth than those shown in Tables A-13 to A-20 for the maximum spans shown, and
b) shall not exceed 2.24 m in length.

9.23.13. Roof and Ceiling Framing

9.23.13.1. Continuity of Rafters and Joists

1) Roof rafters and joists and ceiling joists shall be continuous or shall be spliced over vertical supports that extend to suitable bearing.

9.23.13.2. Framing around Openings

1) Roof and ceiling framing members shall be doubled on each side of openings greater than 2 rafter or joist spacings wide.

9.23.13.3. End Bearing Length

1) The length of end bearing of joists and rafters shall be not less than 38 mm.

9.23.13.4. Location and Attachment of Rafters

1) Rafters shall be located directly opposite each other and tied together at the peak, or may be offset by their own thickness if nailed to a ridge board not less than 17.5 mm thick.

2) Except as permitted in Sentence (3), framing members shall be connected by gusset plates or nailing at the peak in conformance with Table 9.23.3.4.

3) Where the roof framing on opposite sides of the peak is assembled separately, such as in the case of factory-built houses, the roof framing on opposite sides is permitted to be fastened together with galvanized-steel strips not less than 200 mm by 75 mm by 0.41 mm thick spaced not more than 1.2 m apart and nailed at each end to the framing by at least two 63 mm nails.

9.23.13.5. Shaping of Rafters

1) Rafters shall be shaped at supports to provide even bearing surfaces and supported directly above the exterior walls.

9.23.13.6. Hip and Valley Rafters

1) Hip and valley rafters shall be not less than 50 mm greater in depth than the common rafters and not less than 38 mm thick, actual dimension.

9.23.13.7. Intermediate Support for Rafters and Joists

1) Ceiling joists and collar ties of not less than 38 mm by 89 mm lumber are permitted to be assumed to provide intermediate support to reduce the span for rafters and joists where the roof slope is 1 in 3 or greater.

2) Collar ties referred to in Sentence (1) more than 2.4 m long shall be laterally supported near their centres by not less than 19 mm by 89 mm continuous members at right angles to the collar ties.

3) Dwarf walls and struts are permitted to be used to provide intermediate support to reduce the span for rafters and joists.

4) When struts are used to provide intermediate support they shall be not less than 38 mm by 89 mm material extending from each rafter to a *loadbearing* wall at an angle of not less than 45° to the horizontal.

5) When dwarf walls are used for rafter support, they shall be framed in the same manner as *loadbearing* walls and securely fastened top and bottom to the roof and ceiling framing to prevent over-all movement.

6) Solid blocking shall be installed between floor joists beneath dwarf walls referred to in Sentence (5) that enclose finished rooms.

9.23.13.8. Ridge Support

1) Except as provided in Sentence (4), roof rafters and joists shall be supported at the ridge of the roof by
a) a *loadbearing* wall extending from the ridge to suitable bearing, or
b) a ridge beam supported by not less than 89 mm length of bearing.

2) Except as provided in Sentence (3), the ridge beam referred to in Sentence (1) shall conform to the sizes and spans shown in Table A-12, provided
a) the supported rafter or joist length does not exceed 4.9 m, and
b) the roof does not support any concentrated loads.

3) The ridge beam referred to in Sentence (1) need not comply with Sentence (2) where
a) the beam is of not less than 38 mm by 140 mm material, and
b) the beam is supported at intervals not exceeding 1.2 m by not less than 38 mm by 89 mm members extending vertically from the ridge to suitable bearing.

4) When the roof slope is 1 in 3 or more, ridge support need not be provided when the lower ends of the rafters are adequately tied to prevent outward movement.

5) Ties required in Sentence (4) are permitted to consist of tie rods or ceiling joists forming a continuous tie for opposing rafters and nailed in accordance with Table 9.23.13.8.

6) Ceiling joists referred to in Sentence (5) shall be fastened together with at least one more nail per joist splice than required for the rafter to joist connection shown in Table 9.23.13.8.

7) Members referred to in Sentence (6) are permitted to be fastened together either directly or through a gusset plate.

9.23.13.9. Restraint of Joist Bottoms

1) Roof joists supporting a finished ceiling, other than plywood, OSB or waferboard, shall be restrained from twisting along the bottom edges by means of furring, blocking, cross bridging or strapping conforming to Article 9.23.9.3.

9.23.13.10. Ceiling Joists Supporting Roof Load

1) Except as permitted in Sentence (2), ceiling joists supporting part of the roof load from the rafters shall be not less than 25 mm greater in depth than required for ceiling joists not supporting part of the roof load.

2) When the roof slope is 1 in 4 or less, the ceiling joist sizes referred to in Sentence (1) shall be determined from the span tables for roof joists.

9.23.13.11. Roof Trusses

1) Roof trusses which are not designed in accordance with Part 4 shall
a) be capable of supporting a total ceiling load (*dead load* plus *live load*) of 0.35 kPa plus two and two-thirds times the specified live roof load for 24 h, and e2
b) not exceed the deflections shown in Table 9.23.13.11. when loaded with the ceiling load plus one and one-third times the specified roof snow load for 1 h.

Table 9.23.13.8.
Rafter-to-Joist Nailing (Unsupported Ridge)
Forming Part of Sentences 9.23.13.8.(5) and (6)

Roof Slope	Rafter Spacing, mm	Minimum Number of Nails not less than 76 mm Long											
		Rafter Tied to every Joist						Rafter Tied to Joist every 1.2 m					
		Building Width up to 8 m			*Building* Width up to 9.8 m			*Building* Width up to 8 m			*Building* Width up to 9.8 m		
		Roof Snow Load, kPa			Roof Snow Load, kPa			Roof Snow Load, kPa			Roof Snow Load, kPa		
		1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more	1.0 or less	1.5	2.0 or more
1 in 3	400	4	5	6	5	7	8	11	—	—	—	—	—
	600	6	8	9	8	—	—	11	—	—	—	—	—
1 in 2.4	400	4	4	5	5	6	7	7	10	—	9	—	—
	600	5	7	8	7	9	11	7	10	—	—	—	—
1 in 2	400	4	4	4	4	4	5	6	8	9	8	—	—
	600	4	5	6	5	7	8	6	8	9	8	—	—
1 in 1.71	400	4	4	4	4	4	4	5	7	8	7	9	11
	600	4	4	5	5	6	7	5	7	8	7	9	11
1 in 1.33	400	4	4	4	4	4	4	4	5	6	5	6	7
	600	4	4	4	4	4	5	4	5	6	5	6	7
1 in 1	400	4	4	4	4	4	4	4	4	4	4	4	5
	600	4	4	4	4	4	4	4	4	4	4	4	5

Table 9.23.13.11.
Maximum Roof Truss Deflections
Forming Part of Sentence 9.23.13.11.(1)

Truss Span	Type of Ceiling	Maximum Deflection
4.3 m or less	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/180 of the span
Over 4.3 m	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/240 of the span

2) The joint connections used in trusses described in Sentence (1) shall be designed in conformance with the requirements in Subsection 4.3.1. (See Appendix A.)

3) Where the length of compression web members in roof trusses described in Sentence (1) exceeds 1.83 m, such web members shall be provided with continuous bracing to prevent buckling.

4) Bracing required in Sentence (3) shall consist of not less than 19 mm by 89 mm lumber nailed at right angles to the web members near their centres with at least two 63 mm nails for each member.

5) Where the ability of a truss design to satisfy the requirements of Sentence (1) is demonstrated by testing, it shall consist of a full scale load test carried out in conformance with CSA S307-M, "Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings."

6) Where the ability of a truss design to satisfy the requirements of Sentence (1) is demonstrated by analysis, it shall be carried out in accordance with good engineering practice such as described in "Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses," published by the Truss Plate Institute of Canada.

9.23.14. Subflooring

9.23.14.1. Subflooring Required

1) Subflooring shall be provided beneath finish flooring where the finish flooring does not have adequate strength to support the specified *live loads* (see Subsection 9.30.3.).

9.23.14.2. Material Standards

1) Except as provided in Sentence (2), wood-based panels for subfloors shall conform to
a) CSA O121-M, "Douglas Fir Plywood,"
b) CSA O151-M, "Canadian Softwood Plywood,"
c) CSA O153-M, "Poplar Plywood,"
d) CAN/CSA-O325.0, "Construction Sheathing," or
e) CSA O437.0, "OSB and Waferboard."

2) Particleboard subflooring may be used only where a *building* is constructed in a factory so that the subfloor will not be exposed to the weather.

3) Subflooring described in Sentence (2) shall conform to grade D-2 or D-3 in ANSI A208.1, "Particleboard."

4) Subflooring described in Sentence (2) shall have its upper surface and all edges treated to restrict water absorption where the subfloor is used in bathrooms, kitchens, laundry rooms or other areas subject to periodic wetting. (See Appendix A.)

9.23.14.3. Edge Support

1) Where the edges of panel-type subflooring are required to be supported (see Sentence 9.30.2.1.(2)), such support shall consist of tongue-and-groove panel edges or not less than 38 mm by 38 mm blocking securely nailed between framing members.

9.23.14.4. Direction of Installation

1) Plywood subflooring shall be installed with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.

2) OSB subflooring conforming to O-1 and O-2 grades in CSA O437.0, "OSB and Waferboard," and waferboard subflooring conforming to R-1 grade in CSA O437.0 shall be installed with the direction of face orientation at right angles to the joists and with joints parallel to floor joists staggered. (See Appendix A.)

9.23.14.5. Subfloor Thickness or Rating

1) Except as provided in Sentences (2) and (3), subfloors shall conform to either Table 9.23.14.5.A. or Table 9.23.14.5.B.

Table 9.23.14.5.A.
Thickness of Subflooring
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.6.(1)

Maximum Spacing of Supports, mm	Minimum Thickness, mm				
	Plywood and OSB, O-2 Grade	OSB, O-1 Grade, and Waferboard, R-1 Grade	Particleboard	Lumber
400	15.5	15.9	15.9	17.0
500	15.5	15.9	19.0	19.0
600	18.5	19.0	25.4	19.0

Table 9.23.14.5.B.
Rating for Subfloor when Applying CAN/CSA-O325.0
Forming Part of Sentences 9.23.14.5.(1) and 9.23.15.6.(1)

Maximum Spacing of Supports, mm	Panel Mark	
	Subfloor	Used with Panel-Type Underlay
400	1F16	2F16
500	1F20	2F20
600	1F24	2F24

2) Where the finished flooring consists of not less than 19 mm matched wood strip flooring laid at right angles to joists spaced not more than 600 mm o.c., subflooring shall be permitted to consist of not less than
a) 12.5 mm thick plywood,
b) 12.5 mm thick OSB conforming to O-2 grade,
c) 12.7 mm thick OSB conforming to O-1 grade, or
d) 12.7 mm thick waferboard conforming to R-1 grade.

3) Except where the flooring consists of ceramic tiles applied with adhesive, where a separate panel-type underlay or concrete topping is applied to a subfloor on joists spaced not more than 400 mm o.c., the subfloor is permitted to consist of not less than
a) 12.5 mm thick plywood,
b) 12.5 mm thick OSB conforming to O-2 grade,
c) 12.7 mm thick OSB conforming to O-1 grade, or
d) 12.7 mm thick waferboard conforming to R-1 grade.

9.23.14.6. Annular Grooved Nails

1) When resilient flooring is applied directly to an OSB, waferboard, particleboard or plywood subfloor, the subfloor shall be fastened to the supports with annular grooved nails.

9.23.14.7. Lumber Subflooring

1) Lumber subflooring shall be laid at an angle of not less than 45° to the joists.

2) Lumber subflooring shall be fully supported at the ends on solid bearing.

3) Lumber for subflooring shall be of uniform thickness and not more than 184 mm wide.

9.23.15. Roof Sheathing

9.23.15.1. Material Standards

1) Wood-based panels used for roof sheathing shall conform to the requirements of
a) CSA O121-M, "Douglas Fir Plywood,"
b) CSA O151-M, "Canadian Softwood Plywood,"
c) CSA O153-M, "Poplar Plywood,"
d) CAN/CSA-O325.0, "Construction Sheathing," or
e) CSA O437.0, "OSB and Waferboard."

9.23.15.2. Direction of Installation

1) Plywood roof sheathing shall be installed with the surface grain at right angles to the roof framing.

2) OSB roof sheathing conforming to O-1 and O-2 grades as specified in CSA O437.0, "OSB and Waferboard," shall be installed with the direction of face orientation at right angles to the roof framing members. (See A-9.23.14.4.(2) in Appendix A.)

9.23.15.3. Joints in Panel-Type Sheathing

1) Panel-type sheathing board shall be applied so that joints perpendicular to the roof ridge are staggered where
a) the sheathing is applied with the surface grain parallel to the roof ridge, and
b) the thickness of the sheathing is such that the edges are required to be supported.

2) A gap of not less than 2 mm shall be left between sheets of plywood, OSB or waferboard.

9.23.15.4. Lumber Roof Sheathing

1) Lumber roof sheathing shall not be more than 286 mm wide and shall be applied so that all ends are supported with end joints staggered.

9.23.15.5. Edge Support

1) Where panel-type roof sheathing requires edge support, the support shall consist of metal H clips or not less than 38 mm by 38 mm blocking securely nailed between framing members.

9.23.15.6. Thickness or Rating

1) The thickness or rating of roof sheathing on a flat roof used as a walking deck shall conform to either Table 9.23.14.5.A. or Table 9.23.14.5.B. for subfloors.

2) The thickness or rating of roof sheathing on a roof not used as a walking deck shall conform to either Table 9.23.15.6.A. or Table 9.23.15.6.B.

3) Asphalt-coated or asphalt-impregnated fibreboard not less than 11.1 mm thick conforming to CAN/CSA-A247-M, "Insulating Fibreboard," is permitted to be used as a roof sheathing over supports spaced not more than 400 mm o.c. provided the roofing consists of

a) a continuous sheet of galvanized steel not less than 0.33 mm in thickness, or

b) a continuous sheet of aluminum not less than 0.61 mm in thickness.

4) All edges of sheathing described in Sentence (3) shall be supported by blocking or framing.

Table 9.23.15.6.A.
Thickness of Roof Sheathing
Forming Part of Sentence 9.23.15.6.(2)

Maximum Spacing of Supports, mm	Minimum Thickness, mm				
	Plywood, and OSB, O-2 Grade		OSB, O-1 Grade, and Waferboard, R-1 Grade		Lumber
	Edges Supported	Edges Unsupported	Edges Supported	Edges Unsupported	
300	7.5	7.5	9.5	9.5	17.0
400	7.5	9.5	9.5	11.1	17.0
600	9.5	12.5	11.1	12.7	19.0

Table 9.23.15.6.B.
Rating for Roof Sheathing When Applying CAN/CSA-O325.0
Forming Part of Sentence 9.23.15.6.(2)

Maximum Spacing of Supports, mm	Panel Mark	
	Edges Supported	Edges Unsupported
400	2R16	1R16
500	2R20	1R20
600	2R24	1R24

9.23.16. Wall Sheathing

9.23.16.1. Required Sheathing

1) Exterior walls and gable ends shall be sheathed when the exterior cladding requires intermediate fastening between supports or if the exterior cladding requires solid backing.

9.23.16.2. Thickness, Rating and Material Standards

1) Where wall sheathing is required, it shall conform to either Table 9.23.16.2.A. or Table 9.23.16.2.B.

Table 9.23.16.2.A.
Wall Sheathing Thickness and Specifications
Forming Part of Sentence 9.23.16.2.(1)

Type of Sheathing	Minimum Thickness, mm(1)		Material Standards
	With Supports 400 mm o.c.	With Supports 600 mm o.c.	
Fibreboard (insulating)	9.5	11.1	CAN/CSA-A247-M
Gypsum sheathing	9.5	12.7	CAN/CSA-A82.27-M ASTM C 79/C 79M e r4
Lumber	17.0	17.0	See Table 9.3.2.1.
Mineral Fibre, Rigid Board, Type 2	25	25	CAN/ULC-S702 r
OSB, O-2 Grade	6.0	7.5	CSA O437.0
OSB, O-1 Grade, and Waferboard, R-1 Grade	6.35	7.9	CSA O437.0
Phenolic, faced	25	25	CAN/CGSB-51.25-M
Plywood (exterior type)	6.0	7.5	CSA O121-M CSA O151-M CSA O153-M
Polystyrene, expanded Types 1 and 2	38	38	CAN/ULC-S701 r
Polystyrene, expanded Types 3 and 4	25	25	CAN/ULC-S701 r
Urethane and Isocyanurate Types 1, 2 and 4	38	38	CGSB 51-GP-21M
Urethane and Isocyanurate Type 3	25	25	CGSB 51-GP-21M
Urethane and Isocyanurate Types 1 and 2, faced	25	25	CAN/CGSB-51.26-M

Notes to Table 9.23.16.2.A.:
(1) See also Sentences 9.27.5.1.(2) to (4).

Table 9.23.16.2.B.
Rating for Wall Sheathing when Applying CAN/CSA-O325.0 e
Forming Part of Sentence 9.23.16.2.(1)

Maximum Spacing of Supports, mm	Panel Mark
400	W16
500	W20
600	W24

9.23.16.3. Attachment of Cladding to Sheathing

1) Gypsum sheathing, rigid insulation and fibreboard shall not be used for the attachment of cladding materials.

9.23.16.4. Lumber Sheathing

1) Lumber wall sheathing shall be applied so that all ends are supported.

2) Where lumber wall sheathing is required to provide bracing according to Article 9.23.10.2., it shall be applied with end joints staggered.

9.23.16.5. Joints in Panel-Type Sheathing

1) A gap of not less than 2 mm shall be left between sheets of plywood, OSB, waferboard or fibreboard.

9.23.16.6. Mansard Style Roofs

1) Where the bottom portions of mansard style roofs are vented, the vertical framing members behind the sloping portions shall be considered on the same basis as exterior wall studs and shall conform to Subsection 9.23.17.

9.23.17. Wall Sheathing Membrane

9.23.17.1. Material Standard

1) Sheathing membrane shall conform to the performance requirements of CAN/CBSB-51.32-M, “Sheathing, Membrane, Breather Type.” e

9.23.17.2. Sheathing Membrane beneath Stucco

1) Tar-saturated felts or papers shall not be used as a sheathing paper beneath stucco. (See Appendix A.) r

9.23.17.3. Required Sheathing Membrane and Installation

1) Except as provided in Articles 9.23.17.4., 9.23.17.5. and 9.23.17.6., at least one layer of sheathing membrane shall be applied beneath siding, stucco or masonry veneer.

2) Sheathing membrane required in Sentence (1) shall be applied so that joints are lapped not less than 100 mm.

3) Where sheathing membrane required in Sentence (1) is applied horizontally, the upper sheets shall overlap the lower sheets.

9.23.17.4. Insulating Sheathing in Lieu of Sheathing Membrane

1) Where non-wood-based rigid exterior insulating sheathing, or exterior insulating sheathing with an integral sheathing membrane is installed, a separate sheathing membrane is not required.

2) Where insulating sheathing is installed as provided in Sentence (1),
- a) sheathing panels subject to moisture deterioration shall be sealed at all joints, and
- b) the joints of sheathing panels not subject to moisture deterioration shall be
  - i) sealed at all joints, or
  - ii) lapped or tongue and groove, and detailed to ensure drainage of water to the exterior.

(See Appendix A.)

9.23.17.5. Sheathing Membranes in Lieu of Sheathing

1) Except as provided in Article 9.23.17.6., where no sheathing is used, at least 2 layers of sheathing membrane shall be applied beneath the cladding. (See Article 9.23.16.1. and Appendix A.)

2) All joints in the sheathing membrane required in Sentence (1) shall occur over framing, and the membrane shall be fastened to the framing with roofing nails or staples spaced not more than 150 mm along the edges of the outer layer of sheathing membrane.

3) Wall sheathing is permitted to be used in lieu of one layer of sheathing membrane required in Sentence (1), and the thickness need not conform to Table 9.23.16.2.A.

9.23.17.6. Face Sealed Cladding

(See Appendix A.)

1) Sheathing membrane is permitted to be omitted beneath cladding when the joints in the cladding are formed to effectively prevent the passage of wind and rain in conformance with Sentences (2) or (4), as applicable.

2) Cladding consisting of sheets of plywood, hardboard, OSB, waferboard or asbestos cement is considered to meet the requirements in Sentence (1), provided the cladding is applied so that
- a) all edges are directly supported by framing, and
- b) the vertical joints between adjacent sheets are
  - i) covered with battens,
  - ii) shiplapped, or
  - iii) otherwise matched to provide weathertight joints.

3) Vertical joints between sheets described in Sentence (2) shall be caulked.

4) Metal siding consisting of sheets of metal is considered to meet the requirements of Sentence (1) where the joints between sheets are of the locked seam type.

Section 9.24. Sheet Steel Stud Wall Framing

9.24.1. General

9.24.1.1. Application

1) This Section applies to sheet steel studs for use in non-*loadbearing* exterior and interior walls.

2) Where *loadbearing* steel studs are used, they shall be designed in conformance with Part 4.

9.24.1.2. Material Standards

1) Steel studs and runners shall conform to CAN/CGSB-7.1-M, "Cold Formed Steel Framing Components."

9.24.1.3. Metal Thickness

1) Metal thickness specified in this Section shall be the minimum base steel thickness exclusive of coatings.

9.24.1.4. Screws

1) Screws for the application of cladding, sheathing or interior finish materials to steel studs, runners and furring channels shall conform to ASTM C 1002, "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs." r4

9.24.1.5. Cladding, Sheathing and Interior Finish Required

1) Cladding or sheathing, and interior finish shall be installed on steel stud framing and shall be fastened with screws
a) spaced at the appropriate spacing described in Section 9.29., and
b) penetrating not less than 10 mm through the metal.

9.24.2. Size of Framing

9.24.2.1. Size and Spacing of Studs in Interior Walls

1) Except as required in Articles 9.24.2.3. and 9.24.2.4., the size and spacing of steel studs for non-*loadbearing* interior walls shall conform to Table 9.24.2.1.

Table 9.24.2.1.
Steel Studs for Non-Loadbearing Interior Walls
Forming Part of Sentence 9.24.2.1.(1)

Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Wall Height, m
30 x 40	400	3.0
	600	2.7
30 x 63	400	4.0
	600	3.6
30 x 91	400	5.2
	600	4.9

9.24.2.2. Thickness of Studs

1) Except as required in Article 9.24.2.4., steel studs in non-*loadbearing* interior walls shall have a metal thickness of not less than 0.46 mm.

9.24.2.3. Runners

1) Runners for interior and exterior non-*loadbearing* walls shall have a thickness not less than the thickness of the corresponding studs and shall have not less than 30 mm flanges.

9.24.2.4. Openings in Fire Separations

1) Where openings for doors in non-*loadbearing fire separations* required to have a *fire-resistance rating* do not exceed 1 200 mm in width,
a) the width of steel studs shall be not less than 63 mm, and
b) the metal thickness shall be not less than 0.46 mm.

2) Where openings described in Sentence (1) exceed 1 200 mm in width,
a) the width of steel studs shall be not less than 91 mm, and
b) the metal thickness shall be not less than 0.85 mm.

3) The distance to the first stud beyond the jamb of any door opening in a *fire separation* required to have a *fire-resistance rating* shall not exceed 400 mm.

4) Where the distance between the framing over the opening referred to in Sentence (3) and the top runner exceeds 400 mm in such walls, intermediate support shall be installed at intervals of not more than 400 mm above the opening.

9.24.2.5. Size and Spacing of Studs in Exterior Walls

1) The size and spacing of non-*loadbearing* steel studs for exterior walls shall conform to Table 9.24.2.5.

9.24.3. Installation

9.24.3.1. Installation of Runners

1) Runners shall be provided at the tops and bottoms of walls.

2) Runners required in Sentence (1) shall be securely attached to the *building* at approximately 50 mm from the ends, and at intervals of not more than 600 mm o.c. for interior walls and 300 mm o.c. for exterior walls.

3) Fasteners used for attachment described in Sentence (2) shall consist of the equivalent of 63 mm nails or 25 mm screws.

4) Studs at openings and which are not full wall height shall be supported by a runner at the ends of the studs, securely fastened to the full length studs at the sides of the opening.

9.24.3.2. Fire-Rated Walls

1) Steel studs used in walls required to have a *fire-resistance rating* shall be installed so that there is not less than a 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire.

2) Except as provided in Article 9.24.3.6., studs in walls referred to in Sentence (1) shall not be attached to the runners in a manner that will prevent such expansion.

3) Framing above doors with steel door frames in non-*loadbearing fire separations* required to have a *fire-resistance rating* shall consist of 2 runners on the flat fastened back to back. (See Appendix A.)

4) The upper runner required in Sentence (3) shall be bent at each end to extend upwards not less than 150 mm and fastened to the adjacent studs.

5) A gypsum board filler piece, the width and length of the runner, shall be provided between the door frame referred to in Sentence (3) and the adjacent runner.

9.24.3.3. Orientation of Studs

1) Steel studs shall be installed with webs at right angles to the wall face and, except at openings, shall be continuous for the full wall height.

9.24.3.4. Support for Cladding Materials

1) Corners and intersections of walls shall be constructed to provide support for the cladding materials.

9.24.3.5. Framing around Openings

1) Studs shall be doubled on each side of every opening where such openings involve more than one stud space, and shall be tripled where the openings in exterior walls exceed 2.4 m in width.

2) Studs described in Sentence (1) shall be fastened together by screws, crimping or welding to act as a single structural unit in resisting transverse loads.

9.24.3.6. Attachment of Studs to Runners

1) Studs shall be attached to runners by screws, crimping or welding around wall openings and elsewhere where necessary to keep the studs in alignment during construction.

2) Where clearance for expansion is required in Article 9.24.3.2., attachment required in Sentence (1) shall be applied between studs and bottom runners only.

9.24.3.7. Openings for Fire Dampers

1) Openings for *fire dampers* in non-*loadbearing fire separations* required to have a *fire-resistance rating* shall be framed with double studs on each side of the opening.

Table 9.24.2.5.
Size and Spacing of Steel Studs for Non-Loadbearing Exterior Walls
Forming Part of Sentence 9.24.2.5.(1)

Minimum Stud Size, mm	Minimum Metal Thickness, mm	Maximum Stud Length, m Spacing of Studs 300 mm (o.c.)	400 mm (o.c.)	600 mm (o.c.)
30 × 91	0.53	3.0	2.4	—
30 × 91	0.69	3.3	2.7	2.4
30 × 91	0.85	3.6	3.0	2.7
30 × 91	1.0	4.0	3.3	3.0

2) The sill and header for openings described in Sentence (1) shall consist of a runner track with right angle bends made on each end so as to extend 300 mm above the header or below the sill and fastened to the studs.

3) The openings described in Sentence (1) shall be lined with a layer of gypsum board not less than 12.7 mm thick fastened to stud and runner webs.

Section 9.25. Heat Transfer, Air Leakage and Condensation Control

9.25.1. Scope

9.25.1.1. Application

1) This Section applies to thermal insulation and measures to control heat transfer, air leakage and condensation.

2) Insulation and sealing of heating and ventilating ducts shall conform to Sections 9.32. and 9.33.

9.25.1.2. General

(See Appendix A.)

1) Except as provided in Sentence (2), any sheet or panel type material with an air leakage characteristic less than 0.1 L/(s•m²) at 75 Pa and water vapour permeance less than 60 ng/(Pa•s•m²) and incorporated in a *building* assembly required by Article 9.25.2.1. to be insulated shall be installed

a) on the warm face of the assembly,

b) at a location where the ratio between the total thermal resistance of all materials outboard of its innermost impermeable surface and the total thermal resistance of all materials inboard of that surface is not less than required in Table 9.25.1.2., or

c) outboard of an air space that is vented to the outdoors and, for walls, drained.

Table 9.25.1.2.
Ratio of Outboard to Inboard Thermal Resistance
Forming Part of Article 9.25.1.2.

Heating Degree-Days of *Building* Location(1), Celsius degree-days	Minimum Ratio, Total Thermal Resistance Outboard of Material's Inner Surface to Total Thermal Resistance Inboard of Material's Inner Surface
up to 4 999	0.20
5 000 to 5 999	0.30
6 000 to 6 999	0.35
7 000 to 7 999	0.40
8 000 to 8 999	0.50
9 000 to 9 999	0.55
10 000 to 10 999	0.60
11 000 to 11 999	0.65
12 000 or higher	0.75

Notes to Table 9.25.1.2.:
(1) See Sentence 2.2.1.1.(1).

2) Wood-based sheathing materials installed so that, in each framing space, at least one of the gaps required by Article 9.23.15.3. and Sentence 9.23.16.5.(1) does not occur over framing need not comply with Sentence (1).

9.25.2. Thermal Insulation

9.25.2.1. Required Insulation

1) All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior *soil* shall be provided with sufficient thermal insulation to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants. (See A-9.1.1.1.(1) in Appendix A.) e3

9.25.2.2. Insulation Materials r2

1) Except as required in Sentence (2), thermal insulation shall conform to the requirements of

a) CGSB 51-GP-21M, "Thermal Insulation, Urethane and Isocyanurate, Unfaced,"

b) CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced,"

c) CAN/CGSB-51.26-M, "Thermal Insulation, Urethane and Isocyanurate, Boards, Faced,"

d) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill,"

e) CAN/CSA-A247-M, "Insulating Fibreboard,"

f) CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering," r

g) CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," or r e4
h) CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings, " or r4
i) CAN/ULC-S705.1, "Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Material Specification." r2

2) The *flame-spread ratings* requirements contained in the standards listed in Sentence (1) shall not apply. (See Appendix A.)

3) Insulation in contact with the ground shall be inert to the action of *soil* and water and shall be such that its insulative properties are not significantly reduced by moisture.

9.25.2.3. Installation of Thermal Insulation

1) Insulation shall be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area.

2) Insulation shall be applied to the full width and length of the space between furring or framing.

3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least one face is in full and continuous contact with an element with low air permeance. (See Appendix A.)

4) Insulation on the interior of *foundation* walls enclosing a crawl space shall be applied so that there is not less than 50 mm clearance above the crawl space floor, if the insulation is of a type that may be damaged by water.

5) Insulation around concrete slabs-on-ground shall be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

6) Where insulation is exposed to the weather and subject to mechanical damage, it shall be protected with not less than
a) 6 mm asbestos-cement board,
b) 6 mm preservative-treated plywood, or
c) 12 mm cement parging on wire lath applied to the exposed face and edge.

7) Insulation located in areas where it may be subject to mechanical damage shall be protected by a covering such as gypsum board, plywood, particleboard, OSB, waferboard or hardboard.

8) Insulation in factory-built *buildings* shall be installed so that it will not become dislodged during transportation.

9.25.2.4. Installation of Loose-Fill Insulation

1) Except as provided in Sentences (2) to (6), loose-fill insulation shall be used on horizontal surfaces only.

2) Where loose-fill insulation is installed in an unconfined sloped space such as an attic space over a sloped ceiling, the supporting slope shall not be more than r4
a) 4.5 in 12 for mineral fibre or cellulose fibre insulation, and
b) 2.5 in 12 for other types of insulation.

3) Loose-fill insulation is permitted to be used in wood frame walls of existing *buildings*. (See Appendix A.)

4) Blown-in insulation is permitted to be installed in above-ground wood frame walls of new *buildings* provided
a) the density of the installed insulation is sufficient to preclude settlement,
b) the material is installed behind a membrane that permits visual inspection prior to installation of the interior finish,
c) the material is installed in a manner that will not interfere with the installation of the interior finish, and
d) no water is added to the insulation, unless it can be shown that the added water will not adversely affect other materials in the assembly.

5) Water repellent loose-fill insulation is permitted to be used between the outer and inner wythes of masonry *cavity walls*. (See Appendix A.)

6) Where soffit venting is used, measures shall be taken
a) to prevent loose-fill insulation from blocking the soffit vents and to maintain an open path for circulation of air from the vents into the *attic or roof space*, and
b) to minimize air flow into the insulation near the soffit vents to maintain the thermal performance of the material. (See Article 9.19.1.3.)

9.25.2.5. Installation of Spray-Applied Polyurethane

1) Spray-applied polyurethane insulation shall be installed in accordance with CAN/ULC-S705.2, "Thermal Insulation–Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities–Specification." r2

9.25.3. Air Barrier Systems

9.25.3.1. Required Barrier to Air Leakage

1) Thermally insulated wall, ceiling and floor assemblies shall be constructed so as to include an *air barrier system* that will provide a continuous barrier to air leakage
- a) from the interior of the *building* into wall, floor, *attic or roof spaces*, sufficient to prevent excessive moisture condensation in such spaces during the winter, and
- b) from the exterior inward sufficient to prevent moisture condensation on the room side during winter and to ensure comfortable conditions for the occupants.

(See Appendix A.)

9.25.3.2. Air Barrier System Properties

(See Appendix A.)

1) *Air barrier systems* shall possess the characteristics necessary to provide an effective barrier to air infiltration and exfiltration under differential air pressure due to stack effect, mechanical systems or wind. e2

2) Where polyethylene sheet is used to provide airtightness in the *air barrier system*, it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

9.25.3.3. Continuity of the Air Barrier System

1) Where the *air barrier system* consists of an air-impermeable panel-type material, all joints shall be sealed to prevent air leakage.

2) Where the *air barrier system* consists of flexible sheet material, all joints shall be
- a) sealed, or
- b) lapped not less than 100 mm and clamped, such as between framing members, furring or blocking and rigid panels.

3) Where an interior wall meets an exterior wall, ceiling, floor or roof required to be provided with air barrier protection, the *air barrier system* shall extend across the intersection.

4) Where an interior wall projects through a ceiling or extends to become an exterior wall, spaces in the wall shall be blocked to provide continuity across those spaces with the *air barrier system* in the abutting walls or ceiling.

5) Where an interior floor projects through an exterior wall or extends to become an exterior floor, continuity of the *air barrier system* shall be maintained from the abutting walls across the floor assembly.

6) Penetrations of the *air barrier system*, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the *air barrier system* over the entire surface.

7) Access hatches installed through assemblies constructed with an *air barrier system* shall be weatherstripped around their perimeters to prevent air leakage.

8) Clearances between *chimneys* or *gas vents* and the surrounding construction that would permit air leakage from within the *building* into a wall or *attic or roof space* shall be sealed by *noncombustible* material to prevent such leakage.

9.25.4. Vapour Barriers

9.25.4.1. Required Barrier to Vapour Diffusion

1) Thermally insulated wall, ceiling and floor assemblies shall be constructed with a *vapour barrier* so as to provide a barrier to diffusion of water vapour from the interior into wall spaces, floor spaces or *attic or roof spaces*.

9.25.4.2. Vapour Barrier Materials

1) Except as required in Sentence (2), *vapour barriers* shall have an initial permeance not greater than 45 ng/(Pa•s•m^2).

2) When used where a high resistance to vapour movement is required, such as in wall constructions that incorporate exterior cladding or sheathing having a low water vapour permeance, *vapour barriers* shall have a permeance not greater than 15 ng/(Pa•s•m^2). (See Appendix A.)

3) Where polyethylene is installed as the *vapour barrier* required in Sentence (2), it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

4) Membrane-type *vapour barriers* other than polyethylene shall conform to the requirements of CAN/CGSB-51.33-M, "Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction."

5) Where a coating is applied to gypsum board to function as the *vapour barrier*, the permeance of the coating shall be determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard."

9.25.4.3. Installation of Vapour Barriers

1) *Vapour barriers* shall be installed to protect the entire surfaces of thermally insulated wall, ceiling and floor assemblies.

2) *Vapour barriers* shall be installed sufficiently close to the warm side of insulation to prevent condensation at design conditions. (See Appendix A.)

Section 9.26. Roofing

9.26.1. General

9.26.1.1. Purpose of Roofing

1) Roofs shall be protected with roofing, including flashing, installed to shed rain effectively and prevent water due to ice damming from entering the roof.

9.26.1.2. Alternate Installation Methods

1) Methods described in CAN3-A123.51-M, "Asphalt Shingle Application on Roof Slopes 1:3 and Steeper," or CAN3-A123.52-M, "Asphalt Shingle Application on Roof Slopes 1:6 to Less Than 1:3," are permitted to be used for asphalt shingle applications not described in this Section.

9.26.2. Roofing Materials

9.26.2.1. Material Standards

1) Roofing materials shall conform to

a) CAN/CGSB-37.4-M, "Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing,"
b) CAN/CGSB-37.5-M, "Cutback Asphalt Plastic Cement,"
c) CAN/CGSB-37.8-M, "Asphalt, Cutback, Filled, for Roof Coating,"
d) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"
e) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating,"
f) CAN/CGSB-37.50-M, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing,"
g) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
h) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane," r
i) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing,"
j) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"
k) CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type,"
l) CSA A123.1, "Asphalt Shingles Made From Organic Felt and Surfaced with Mineral Granules," r4
m) CSA A123.2-M, "Asphalt Coated Roofing Sheets,"
n) CSA A123.3, "Asphalt Saturated Organic Roofing Felt," r4
o) CSA A123.4, "Asphalt for Use in Construction of Built-Up Roof Coverings and Waterproofing Systems," r4
p) CSA A123.5, "Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules," r4
q) CSA A123.17, "Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs,"
r) CAN/CSA-A220.0-M, "Performance of Concrete Roof Tiles,"
s) CSA O118.1, "Western Cedars, Shakes and Shingles," or
t) CSA O118.2-M, "Eastern White Cedar Shingles."

9.26.2.2. Nails

1) Nails used for roofing shall be corrosion-resistant roofing or shingle nails conforming to CSA B111, "Wire Nails, Spikes and Staples."

2) Nails shall have sufficient length to penetrate through, or 12 mm into, roof sheathing.

3) Nails used with asphalt roofing shall have a head diameter of not less than 9.5 mm and a shank thickness of not less than 2.95 mm.

4) Nails used with wood shingles or shakes shall have a head diameter of not less than 4.8 mm and a shank thickness of not less than 2.0 mm and shall be stainless steel, aluminum or hot-dipped galvanized. (See Appendix A.)

9.26.2.3. Staples

1) Staples used to apply asphalt or wood shingles shall be corrosion-resistant and shall be driven with the crown parallel to the eaves.

2) Staples used with asphalt shingles shall be not less than 19 mm long, 1.6 mm diam or thickness, with not less than a 25 mm crown, except that an 11 mm crown may be used as provided in Sentence 9.26.7.4.(2).

3) Staples used with wood shingles shall be not less than 29 mm long, 1.6 mm diam or thickness, with not less than a 9.5 mm crown and shall be stainless steel or aluminum. (See A-9.26.2.2.(4) in Appendix A.)

9.26.3. Roof Slope

9.26.3.1. Slope

1) Except as provided in Sentences (2) and (3), the roof slopes on which roof coverings may be applied shall conform to Table 9.26.3.1.

2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in Sentence (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.

3) Sheet metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than required in Sentence (1).

9.26.4. Flashing at Intersections

9.26.4.1. Materials

1) Sheet metal flashing shall consist of not less than
a) 1.73 mm thick sheet lead,
b) 0.33 mm thick galvanized steel,
c) 0.46 mm thick copper,
d) 0.46 mm thick zinc, or
e) 0.48 mm thick aluminum.

9.26.4.2. Valley Flashing

1) Where sloping surfaces of shingled roofs intersect to form a valley, the valley shall be flashed.

2) Closed valleys shall not be used with rigid shingles on slopes of less than 1 in 1.2.

3) Open valleys shall be flashed with at least
a) one layer of sheet metal not less than 600 mm wide, or
b) 2 layers of roll roofing.

4) The bottom layer of roofing required in Sentence (3) shall consist of at least Type S smooth roll roofing or Type M mineral surface roll roofing (mineral surface down) not less than 457 mm wide, centred in the valley and fastened with nails spaced not more than 450 mm o.c. located 25 mm away from the edges.

Table 9.26.3.1.
Roofing Types and Slope Limits
Forming Part of Sentence 9.26.3.1.(1)

Type of Roofing	Minimum Slope	Maximum Slope
Built-up Roofing		
Asphalt base (gravelled)	1 in 50(1)	1 in 4
Asphalt base (without gravel)	1 in 25	1 in 2
Coal-tar base (gravelled)	1 in 50(1)	1 in 25
Cold process	1 in 25	1 in 1.33
Asphalt Shingles		
Normal application	1 in 3	no limit
Low slope application	1 in 6	no limit
Roll Roofing		
Smooth and mineral surfaced	1 in 4	no limit
480 mm wide selvage asphalt roofing	1 in 6	no limit
Cold application felt	1 in 50	1 in 1.33
Wood Shingles	1 in 4	no limit
Cedar Shakes e2	1 in 3	no limit
Asbestos-Cement Corrugated Sheets	1 in 4	no limit
Corrugated Metal Roofing	1 in 4	no limit
Sheet Metal Shingles e2	1 in 4(1)	no limit
Slate Shingles	1 in 2	no limit
Clay Tile	1 in 2	no limit
Glass Fibre Reinforced Polyester Roofing Panels	1 in 4	no limit

Notes to Table 9.26.3.1.:
(1) See Sentences 9.26.3.1.(2) and (3).

5) The top layer of roofing required in Sentence (3) shall consist of at least Type M mineral surface roll roofing (mineral surface up), 914 mm wide, centred in the valley, applied over a 100 mm wide strip of cement along each edge of the bottom layer, and fastened with a sufficient number of nails to hold it in place until the shingles are applied.

9.26.4.3. Intersection of Shingle Roofs and Masonry

1) The intersection of shingle roofs and masonry walls or *chimneys* shall be protected with flashing.

2) Counter flashing required in Sentence (1) shall be embedded not less than 25 mm in the masonry and shall extend not less than 150 mm down the masonry and lap the lower flashing not less than 100 mm.

3) Flashing along the slopes of a roof described in Sentence (1) shall be stepped so that there is not less than a 75 mm head lap in both the lower flashing and counter flashing.

4) Where the roof described in Sentence (1) slopes upwards from the masonry, the flashing shall extend up the roof slope to a point equal in height to the flashing on the masonry, but not less than 1.5 times the shingle exposure.

9.26.4.4. Intersection of Shingle Roofs and Walls other than Masonry

1) The intersection of shingle roofs and walls clad with other than masonry shall be protected with flashing.

2) Flashing required in Sentence (1) shall be installed so that it extends up the wall not less than 75 mm behind the sheathing paper, and extends not less than 75 mm horizontally.

3) Along the slope of the roof, the flashing required in Sentence (1) shall be stepped with not less than a 75 mm head lap.

9.26.4.5. Intersection of Built-Up Roofs and Masonry

1) The intersection of built-up roofs with masonry walls or *chimneys* shall have a cant strip at the intersection, and a roofing membrane shall be mopped over the cant strip and not less than 150 mm up the wall.

2) Counter flashing installed over the intersection referred to in Sentence (1) shall be embedded not less than 25 mm in the masonry, and shall be of sufficient length to extend down not less than 150 mm, lapping the membrane on the masonry not less than 100 mm.

9.26.4.6. Intersection of Built-Up Roofs and Walls other than Masonry

1) The intersection of built-up roofs with walls clad with other than masonry shall have a cant strip at the intersection.

2) The roofing membrane shall be mopped over the cant strip referred to in Sentence (1).

3) Flashing plies shall extend not less than 150 mm up the wall referred to in Sentence (1) behind the sheathing paper.

9.26.4.7. Chimney Saddles

1) Except as otherwise permitted in Sentence (5), *chimney* saddles shall be installed where the upper side of a *chimney* on a sloping roof is more than 750 mm wide.

2) *Chimney* saddles shall be covered with sheet metal or roofing material of weight and quality equivalent to the roofing.

3) Saddles shall be flashed where they intersect the roof.

4) The intersection of the saddle and the *chimney* shall be flashed and counterflashed as described in Article 9.26.4.3.

5) A *chimney* saddle need not be installed if the intersection between the *chimney* and roof is protected by sheet metal flashing that extends up the *chimney* to a height equal to at least one sixth the width of the *chimney*, but not less than 150 mm, and up the roof slope to a point equal in height to the flashing on the *chimney*, but not less than 1.5 times the shingle exposure.

6) Flashing described in Sentence (5) at the *chimney* shall be counterflashed as required by Article 9.26.4.3.

9.26.5. Eave Protection for Shingles and Shakes

9.26.5.1. Required Eave Protection

1) Except as provided in Sentence (2), eave protection shall be provided on shingle, shake or tile roofs, extending from the edge of the roof a minimum of 900 mm up the roof slope to a line not less than 300 mm inside the inner face of the exterior wall.

2) Eave protection is not required
a) over unheated garages, carports and porches,
b) where the roof overhang exceeds 900 mm measured along the roof slope from the edge of the roof to the inner face of the exterior wall,
c) on roofs of asphalt shingles installed in accordance with Subsection 9.26.8.,
d) on roofs with slopes of 1 in 1.5 or greater, or
e) in regions with 3 500 or fewer degree-days.

9.26.5.2. Materials

1) Eave protection shall be laid beneath the starter strip and shall consist of
- a) No. 15 asphalt-saturated felt laid in two plies lapped 480 mm and cemented together with lap cement,
- b) Type M or S roll roofing laid with not less than 100 mm head and end laps cemented together with lap cement,
- c) glass fibre or polyester fibre coated base sheets, or
- d) self-sealing composite membranes consisting of modified bituminous coated material.

9.26.6. Underlay beneath Shingles

9.26.6.1. Materials

1) Except as required in Sentence (2), when underlay is used beneath shingles, it shall be
- a) asphalt-saturated sheathing paper weighing not less than 0.195 kg/m^2, or
- b) No. 15 plain or perforated asphalt-saturated felt.

2) Underlay used beneath wood shingles shall be breather type.

9.26.6.2. Installation

1) When used with shingles, underlay shall be installed parallel to the eaves with head and end lap of not less than 50 mm.

2) The top edge of each strip of underlay referred to in Sentence (1) shall be fastened with sufficient roofing nails to hold it in place until the shingles are applied.

3) The underlay referred to in Sentence (1) shall overlap the eave protection by not less than 100 mm. (See Article 9.26.10.2. for underlay beneath wood shakes.)

9.26.7. Asphalt Shingles on Slopes of 1 in 3 or Greater

9.26.7.1. Coverage

1) Coverage shall be not less than 2 thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.7.2. Starter Strip

1) A starter strip shall be installed along the lower edge of the roof so that it extends approximately 12 mm beyond the eaves and rake of the roof and fastened along the bottom edge with nails spaced not more than 300 mm o.c.

2) Starter strips shall be at least Type M mineral-surfaced roll roofing not less than 300 mm wide, or shingles of the same weight and quality as those used as a roof covering with tabs facing up the roof slope.

3) Starter strips need not be provided where eave protection of not less than Type M mineral-surfaced roll roofing is provided.

9.26.7.3. Head Lap

1) Shingles shall have a head lap of not less than 50 mm.

9.26.7.4. Fasteners

1) Except as provided in Sentence (2), shingles shall be fastened with at least 4 nails or staples for 1 m wide shingles so that no nails or staples are exposed.

2) Where staples with an 11 mm crown are used, shingles shall be fastened with at least 6 staples.

3) Fasteners may be reduced for narrower shingles in proportion to the width of the shingle or when shingles incorporating interlocking devices are used.

4) Fasteners referred to in Sentences (1) and (2) shall be located 25 mm to 40 mm from each end of each strip shingle with other fasteners equally spaced between them.

5) Fasteners referred to in Sentences (1) and (2) shall be located not less than 12 mm above the tops of the cutouts.

9.26.7.5. Securing of Tabs

1) Shingle tabs shall be secured by a spot of plastic cement not exceeding 25 mm diam under the centre of each tab or by interlocking devices or self-sealing strips.

9.26.7.6. Hips and Ridges

1) Shingles on hips and ridges shall be applied so they extend not less than 100 mm on either side of the hip or ridge, and shall be lapped not less than 150 mm.

2) Shingles referred to in Sentence (1) shall be fastened with nails or staples on each side located not more than 25 mm from the edge and 25 mm above the butt of the overlying shingle.

9.26.7.7. Eave Protection

1) Eave protection shall conform to Subsection 9.26.5.

9.26.7.8. Flashing

1) Flashing shall conform to Subsection 9.26.4.

9.26.8. Asphalt Shingles on Slopes of less than 1 in 3

9.26.8.1. Coverage

1) Except for the first 2 courses, coverage shall be not less than 3 thicknesses of shingle over the entire roof, disregarding cutouts.

9.26.8.2. Starter Strip

1) A starter strip shall be installed as in Article 9.26.7.2.

2) Starter strips required in Sentence (1) shall be laid in a continuous band of cement not less than 200 mm wide.

9.26.8.3. Securing of Tabs

1) Shingle tabs shall be secured with cold application cement applied at the rate of not less than 0.5 L/m² of cemented area, or hot application asphalt applied at the rate of 1 kg/m² of cemented area.

9.26.8.4. Securing of Shingle Courses

1) The first course of shingles shall be secured by a continuous band of cement along the eaves applied so that the width of the band equals the shingle exposure plus 100 mm and the band is located not less than 50 mm above the lower edge of the starter strip.

2) The succeeding courses of shingles shall be secured by a continuous band of cement applied so that the width of the band equals the shingle exposure plus 50 mm.

3) The band required in Sentence (2) shall be located not less than 25 mm nor more than 50 mm above the butt of the overlying course of shingles.

9.26.8.5. Hips and Ridges

1) Shingles on hips and ridges shall be not less than 300 mm wide applied to provide triple coverage.

2) Shingles referred to in Sentence (1) shall be cemented to the roof shingles and to each other with a coat of cement 25 mm from the edges of the shingles and fastened with nails or staples located 40 mm above the butt of the overlying shingle and 50 mm from each edge.

9.26.8.6. Flashing

1) Flashing shall conform to Subsection 9.26.4.

9.26.8.7. Fastening

1) Shingles shall be fastened in accordance with Article 9.26.7.4.

9.26.9. Wood Roof Shingles

9.26.9.1. Decking

1) Decking for wood shingled roofs may be continuous or spaced.

9.26.9.2. Grade

1) Western cedar shingles shall be not less than No. 2 grade. e2

2) Eastern white cedar shingles shall be not less than B (clear) grade.

9.26.9.3. Size

1) Wood shingles shall be not less than 400 mm long and not less than 75 mm or more than 350 mm wide.

9.26.9.4. Spacing and Joints

1) Shingles shall be spaced approximately 6 mm apart and offset at the joints in adjacent courses not less than 40 mm so that joints in alternate courses are staggered.

9.26.9.5. Fastening

1) Shingles shall be fastened with 2 nails or staples located approximately 20 mm from the sides of the shingle and 40 mm above the exposure line.

9.26.9.6. Exposure

1) The exposure of wood roof shingles shall conform to Table 9.26.9.6.

Table 9.26.9.6.
Exposure of Wood Roof Shingles
Forming Part of Sentence 9.26.9.6.(1)

Roof Slope	Maximum Exposure, mm					
	No.1 or A Grade Length of Shingle, mm			No. 2 or B Grade Length of Shingle, mm		
	400	450	600	400	450	600
< 1 in 3	100	115	165	90	100	140
≥ 1 in 3	125	140	190	100	115	165

9.26.9.7. Flashing

1) Flashing shall conform to Subsection 9.26.4.

9.26.9.8. Eave Protection

1) Eave protection shall conform to Subsection 9.26.5.

9.26.10. Cedar Roof Shakes e2

9.26.10.1. Size and Thickness

1) Shakes shall be not less than 450 mm long and not less than 100 mm nor more than 350 mm wide with a butt thickness of not more than 32 mm and not less than 9 mm.

9.26.10.2. Underlay

1) Where eave protection is not provided, an underlay conforming to the requirements in Article 9.26.6.1. for wood shingles shall be laid as a strip not less than 900 mm wide along the eaves.

2) A strip of material similar to that described in Sentence (1) not less than 450 mm wide shall be interlaid between each course of shakes with the bottom edge of the strip positioned above the butt line at a distance equal to double the exposure of the shakes.

3) Interlaid strips referred to in Sentence (2) shall be lapped not less than 150 mm at hips and ridges in a manner that will prevent water from reaching the roof sheathing.

9.26.10.3. Spacing and Joints

1) Shakes shall be spaced 6 mm to 9 mm apart and the joints in any one course shall be separated not less than 40 mm from joints in adjacent courses.

9.26.10.4. Fastening

1) Shakes shall be fastened with nails located approximately 20 mm from the sides of the shakes and 40 mm above the exposure line.

9.26.10.5. Exposure

1) The exposure of wood shakes shall not exceed
a) 190 mm for shakes not less than 450 mm long, and
b) 250 mm for shakes not less than 600 mm long.

9.26.10.6. Flashing

1) Flashing shall conform to Subsection 9.26.4.

9.26.10.7. Eave Protection

1) Eave protection shall conform to Subsection 9.26.5.

9.26.10.8. Grade e2

1) Shakes shall be not less than No. 1 or Handsplit grade.

9.26.11. Built-Up Roofs

9.26.11.1. Quantity of Materials

1) The quantities of bituminous materials used on built-up roofs shall conform to Table 9.26.11.1.

Table 9.26.11.1.
Quantities of Bitumen for Built-up Roofs
Forming Part of Sentence 9.26.11.1.(1)

Type of Roof	Amount of Bitumen per Square Metre of Roof Surface	
	Mopping Coats between Layers	Flood Coat
Asphalt and aggregate	1 kg	3 kg
Coal-tar and aggregate	1.2 kg	3.6 kg
Cold process roofing	0.75 L cold process cement	2 L cold process top coating

9.26.11.2. Coal-Tar and Asphalt Products

1) Coal-tar products and asphalt products shall not be used together in built-up roof construction.

9.26.11.3. Roof Felts

1) Bitumen roofing felts shall be at least No. 15 felt.

9.26.11.4. Aggregate Surfacing

1) Aggregate used for surfacing built-up roofs shall be clean, dry and durable and shall consist of particles of gravel, crushed stone or air-cooled blast *furnace* slag having a size of from 6 mm to 15 mm.

2) The minimum amount of aggregate surfacing per square metre of roof surface shall be 15 kg gravel or crushed stone or 10 kg crushed slag.

9.26.11.5. Flashing

1) Flashing shall conform to Subsection 9.26.4.

9.26.11.6. Number of Layers

1) Built-up roofing shall consist of not less than 3 mopped-down layers of roofing felt flood coated with bitumen.

9.26.11.7. Installation of Layers

1) In hot process applications each layer of bitumen-saturated felt shall be laid while the bitumen is hot, with each layer overlapping the previous one.

2) The full width under each lap referred to in Sentence (1) shall be coated with bitumen so that in no place does felt touch felt.

3) Felt shall be laid free of wrinkles and shall be rolled directly into the hot bitumen and broomed forward and outward from the centre to ensure complete adhesion.

9.26.11.8. Roofing over Wood-Based Sheathing

1) Except as permitted in Sentence (2), built-up roofing applied over wood, plywood, OSB or waferboard roof sheathing shall be laid over an additional base layer of felt laid dry over the entire roof deck with not less than a 50 mm headlap and a 50 mm sidelap between each sheet.

2) Where plywood, OSB or waferboard roof sheathing is used, the dry layer of felt required in Sentence (1) may be omitted when the joints are taped and the sheathing is primed with asphalt.

9.26.11.9. Attachment to Decking

1) Roofing shall be securely attached to the decking or where insulation is applied above the deck, the insulation shall be securely attached to the deck before the first layer of felt is fastened to the insulation.

9.26.11.10. Cant Strips

1) Except as permitted in Sentence (4), a cant strip shall be provided at the edges of roofs.

2) At least 2 plies of the roofing membrane shall be carried over the top of the cant strip.

3) Flashing shall extend over the top of the cant strip and be shaped to form a drip.

4) The cant strip required in Sentence (1) need not be provided where a gravel stop is installed at the edge of roofs.

5) The roofing membranes shall be carried over the edge of the roof before the gravel stop referred to in Sentence (4) is fastened and 2 plies of roofing membrane mopped to the top surface of the gravel stop before the flood coat is applied.

6) The gravel stop referred to in Sentence (4) shall extend over the edge of the roof to form a drip or shall be flashed so that the flashing extends over the edge to form a drip.

9.26.12. Selvage Roofing

9.26.12.1. Coverage

1) Wide selvage asphalt roofing shall provide double coverage over the entire roof surface.

9.26.12.2. Joints

1) Plies of selvage roofing shall be cemented together to ensure a water tight joint.

9.26.13. Sheet Metal Roofing

9.26.13.1. Thickness

1) Sheet metal roofing shall be not less than
a) 0.33 mm thick galvanized steel,
b) 0.46 mm thick copper,
c) 0.46 mm thick zinc, or
d) 0.48 mm thick aluminum.

9.26.14. Glass Reinforced Polyester Roofing

9.26.14.1. Support

1) Where glass reinforced polyester roofing panels are not supported by roof decking but span between spaced supports, the panels shall be designed to support the specified live roof loads.

9.26.15. Hot Applied Rubberized Asphalt Roofing

9.26.15.1. Installation

1) Hot applied rubberized asphalt roofing shall be installed in accordance with CAN/CGSB-37.51-M, "Application for Hot-Applied Rubberized Asphalt, for Roofing and Waterproofing."

9.26.16. Polyvinyl Chloride Sheet Roofing

9.26.16.1. Installation

1) Polyvinyl chloride sheet applied roofing membrane shall be installed in accordance with CGSB 37-GP-55M, "Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane."

9.26.17. Concrete Roof Tiles

9.26.17.1. Installation

1) Concrete roof tiles shall be installed according to CAN/CSA-A220.1-M, "Installation of Concrete Roof Tiles." (See Appendix A.)

9.26.18. Roof Drains and Downspouts

9.26.18.1. Roof Drains

1) When roof drains are provided they shall conform to Part 7.

9.26.18.2. Downspouts

1) Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the *building* in a manner which will prevent *soil* erosion.

Section 9.27. Cladding

9.27.1. Scope

9.27.1.1. Application

1) This Section applies to exterior wall coverings of lumber, wood shingles, shakes, asbestos-cement shingles and sheets, plywood, OSB, waferboard, hardboard, asphalt shingles, vinyl, aluminum and steel, including trim, soffits and flashing.

9.27.1.2. Stucco and Masonry Veneer

1) Requirements for stucco shall conform to Section 9.28. and requirements for masonry veneer shall conform to Section 9.20.

9.27.1.3. Asphalt Shingles

1) Where asphalt shingles are used as cladding, they shall conform to the requirements in Section 9.26. for asphalt roof shingles.

9.27.2. General

9.27.2.1. Required Cladding

1) Exterior walls shall be protected with cladding, including flashing, trim and other special purpose accessory pieces required for the cladding system being used, to restrict the entry of rain and snow into the wall assembly.

9.27.2.2. Clearance from Ground

1) Not less than a 200 mm clearance shall be provided between the finished ground level and cladding that is adversely affected by moisture such as wood, plywood, OSB, waferboard and hardboard.

9.27.2.3. Clearance from Roof Surface

1) Not less than a 50 mm clearance shall be provided between a roof surface and cladding that is adversely affected by moisture such as wood, plywood, OSB, waferboard and hardboard.

9.27.2.4. Insulating Asphalt Cladding

1) Insulating asphalt cladding shall be ventilated by not less than a 10 mm air space behind the cladding. [See Sentence 9.25.1.2.(1).]

9.27.3. Flashing

9.27.3.1. Materials

1) Flashing shall consist of not less than
a) 1.73 mm thick sheet lead,
b) 0.33 mm thick galvanized steel,
c) 0.46 mm thick copper,
d) 0.46 mm thick zinc,
e) 0.48 mm thick aluminum, or
f) 1.02 mm thick vinyl.

9.27.3.2. Installation

1) Flashing shall be installed at every horizontal junction between 2 different exterior finishes, except where the upper finish overlaps the lower finish.

2) Except as provided in Sentence (4), flashing shall be applied over exterior wall openings where the vertical distance from the bottom of the eave to the top of the trim is more than one-quarter of the horizontal overhang of the eave.

3) Flashing shall be installed so that it extends upwards not less than 50 mm behind the sheathing paper and forms a drip on the outside edge.

4) Where a window or exterior door is designed to be installed without head flashing, the exterior flange of the window or door frame shall be bedded into a non-hardening caulking material and the exterior flange screwed down over the caulking material to the wall framing to form a waterproof joint.

9.27.4. Caulking

9.27.4.1. Required Caulking

1) Caulking shall be provided where required to prevent the entry of water into the structure.

2) Caulking shall be provided between masonry, siding or stucco and the adjacent door and window frames or trim, including sills, unless such locations are completely protected from the entry of rain.

3) Caulking shall be provided at vertical joints between different cladding materials unless the joint is suitably lapped or flashed to prevent the entry of rain. (See Articles 9.7.4.2., 9.20.13.12. and 9.28.1.5.)

9.27.4.2. Materials

1) Caulking shall be
a) a non-hardening type suitable for exterior use,
b) selected for its ability to resist the effects of weathering, and
c) compatible with and adhere to the substrate to which it is applied.

2) Caulking shall conform to
a) CGSB 19-GP-5M, “Sealing Compound, One-Component, Acrylic Base, Solvent Curing,”
b) CAN/CGSB-19.13-M, “Sealing Compound, One-Component, Elastomeric, Chemical Curing,”

c) CGSB 19-GP-14M, "Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing," or
d) CAN/CGSB-19.24-M, "Multicomponent, Chemical-Curing Sealing Compound."

9.27.5. Attachment of Cladding

9.27.5.1. Attachment

1) Except as permitted in Sentences (2) to (7), cladding shall be nailed to the framing members, furring members or to blocking between the framing members.

2) Vertical lumber and stucco lath or reinforcing are permitted to be attached to sheathing only where the sheathing consists of not less than
a) 14.3 mm lumber,
b) 12.5 mm plywood, or
c) 12.5 mm OSB or waferboard.

3) Vertically applied metal siding and wood shingles and shakes are permitted to be attached to the sheathing only where the sheathing consists of not less than
a) 14.3 mm lumber,
b) 7.5 mm plywood, or
c) 7.5 mm OSB or waferboard.

4) Asbestos-cement shingles are permitted to be attached to the sheathing only when the sheathing consists of not less than
a) 14.3 mm lumber,
b) 9.5 mm plywood, or
c) 9.5 mm OSB or waferboard.

5) Where wood shingles or shakes are applied to sheathing which is not suitable for attaching the shingles or shakes, the shingles or shakes are permitted to be attached to a wood lath not less than 38 mm by 9.5 mm thick securely nailed to the framing and applied as described in Article 9.27.7.5.

6) Where asbestos-cement shingles are applied to sheathing that is not suitable for attaching the shingles, the shingles are permitted to be fastened to a wood lath not less than 89 mm by 9.5 mm thick securely nailed to the framing.

7) Lath referred to in Sentence (6) shall be applied so that it overlaps the preceding shingle course by not less than 20 mm.

9.27.5.2. Blocking

1) Blocking for the attachment of cladding shall be not less than 38 mm by 38 mm lumber securely nailed to the framing and spaced not more than 600 mm o.c.

9.27.5.3. Furring

1) Except as permitted in Sentences 9.27.5.1.(5) and (6), furring for the attachment of cladding shall be not less than 19 mm by 38 mm lumber when applied over sheathing.

2) When applied without sheathing, furring referred to in Sentence (1) shall be not less than
a) 19 mm by 64 mm lumber on supports spaced not more than 400 mm o.c., or
b) 19 mm by 89 mm lumber on supports spaced not more than 600 mm o.c.

3) Furring referred to in Sentence (1) shall be
a) securely fastened to the framing, and
b) spaced not more than 600 mm o.c.

9.27.5.4. Size and Spacing of Fasteners

1) Nail or staple size and spacing for the attachment of cladding and trim shall conform to Table 9.27.5.4.

9.27.5.5. Fastener Materials

1) Nails or staples for the attachment of cladding and wood trim shall be corrosion-resistant and shall be compatible with the cladding material.

9.27.5.6. Expansion and Contraction

1) Fasteners for metal or vinyl cladding shall be positioned to permit expansion and contraction of the cladding.

9.27.5.7. Penetration of Fasteners

1) Fasteners for shakes and shingles shall penetrate through the nail-holding base or not less than 19 mm into the framing.

2) Fasteners for cladding other than that described in Sentence (1) shall penetrate through the nail-holding base or not less than 25 mm into the framing.

9.27.6. Lumber Siding

9.27.6.1. Materials

1) Lumber siding shall be sound, free of knot holes, loose knots, through checks or splits.

9.27.6.2. Thickness and Width

1) Drop, rustic, novelty, lapped board and vertical wood siding shall be not less than 14.3 mm thick and not more than 286 mm wide.

2) Bevel siding shall be
a) not less than 5 mm thick at the top, and
b) not less than
   i) 12 mm thick at the butt for siding 184 mm or less in width, and
   ii) 14.3 mm thick at the butt for siding wider than 184 mm.

Table 9.27.5.4.
Attachment of Cladding
Forming Part of Sentence 9.27.5.4.(1)

Type of Cladding	Minimum Nail or Staple Length, mm	Minimum Number of Nails or Staples	Maximum Nail or Staple Spacing, mm (o.c.)
Wood trim	51	—	600
Lumber siding or horizontal siding made from sheet material	51	—	600
Metal cladding	38	—	600 (nailed to framing) 400 (nailed to sheathing only)
Wood shakes e2			
up to 200 mm in width	51	2	—
over 200 mm in width	51	3	—
Wood shingles e2			
200 mm in width	32	2	—
over 200 mm in width	32	3	—
Asbestos-cement shingles	32	2	—
Panel or sheet type cladding			
up to 7 mm thick	38	—	150 (along edges)
more than 7 mm thick	51	—	300 (along intermediate supports)

3) Bevel siding shall be not more than 286 mm wide.

9.27.6.3. Joints

1) Lumber siding shall prevent water from entering at the joints by the use of lapped or matched joints or by vertical wood battens.

2) Siding shall overlap not less than 1 mm per 16 mm width of lumber, but not less than
a) 9.5 mm for matched siding,
b) 25 mm for lapped bevel siding, or
c) 12 mm for vertical battens.

9.27.7. Wood Shingles and Shakes e2

9.27.7.1. Materials

1) Shingles and shakes shall conform to
a) CSA O118.1, “Western Cedars, Shakes and Shingles,” or
b) CSA O118.2-M, “Eastern White Cedar Shingles.”

2) Western cedar shakes shall be not less than No. 1 or Handsplit grade, and western cedar shingles not less than No. 2 grade, except that No. 3 grade may be used for undercoursing. e2

3) Eastern white cedar shingles shall be at least B (clear) grade, except that C grade may be used for the lower course of double course applications.

9.27.7.2. Width

1) Shingles and shakes shall be not less than 65 mm or more than 350 mm wide.

9.27.7.3. Fasteners

1) Shingles or shakes shall be fastened with nails or staples located approximately 20 mm from each edge and not less than 25 mm above the exposure line for single-course applications, or approximately 50 mm above the butt for double-course applications.

9.27.7.4. Offsetting of Joints

1) In single-course application, joints in succeeding courses shall be offset not less than 40 mm so that joints in any 2 of 3 consecutive courses are staggered.

2) In double-course application, joints in the outer course shall be offset from joints in the under-course by not less than 40 mm, and joints in succeeding courses shall be offset not less than 40 mm.

9.27.7.5. Fastening to Lath

1) When lath is used with double-course application [see Sentence 9.27.5.1.(5)], it shall be spaced according to the exposure and securely fastened to the framing.

2) The butts of the under-course of the application referred to in Sentence (1) shall rest on the top edge of the lath.

3) The outer course of the application referred to in Sentence (1) shall be fastened to the lath with nails of sufficient length to penetrate through the lath.

4) The butts of the shingles or shakes shall be so located that they project not less than 12 mm below the bottom edge of the lath referred to in Sentence (1).

5) If wood lath is not used, the butts of the under-course shingles or shakes of the application referred to in Sentence (1) shall be located 12 mm above the butts of the outer course.

9.27.7.6. Exposure and Thickness

1) The exposure and butt thickness of shingles and shakes shall conform to Table 9.27.7.6.

Table 9.27.7.6.
Exposure and Thickness of Wood Shingles and Shakes e2
Forming Part of Sentence 9.27.7.6.(1)

Shake or Shingle Length, mm	Maximum Exposure, mm		Minimum Butt Thickness, mm
	Single Coursing	Double Coursing	
400	190	305	10
450	216	356	11
600	292	406	13

9.27.8. Asbestos-Cement Shingles and Sheets

9.27.8.1. Material Standards

1) Asbestos-cement shingles and sheets shall conform to
a) CAN/CGSB-34.4-M, "Siding, Asbestos-Cement, Shingles and Clapboards,"
b) CAN/CGSB-34.5-M, "Sheets, Asbestos-Cement, Corrugated,"
c) CAN/CGSB-34.14-M, "Sheets, Asbestos-Cement, Decorative,"
d) CAN/CGSB-34.16-M, "Sheets, Asbestos-Cement, Flat, Fully Compressed,"
e) CAN/CGSB-34.17-M, "Sheets, Asbestos-Cement, Flat, Semicompressed," or
f) CAN/CGSB-34.21-M, "Panels, Sandwich, Asbestos-Cement with Insulating Cores."

9.27.8.2. Weight and Thickness

1) Asbestos-cement shingles shall weigh not less than 8.06 kg/m^2.

2) Asbestos-cement sheet shall be not less than
a) 4.75 mm thick where applied to studs spaced not more than 400 mm o.c., and
b) 6 mm thick where applied to studs spaced not more than 600 mm o.c.

3) Where applied over sheathing, the thickness of asbestos-cement sheet shall be not less than 3.15 mm.

9.27.8.3. Fastening of Shingles

1) Asbestos-cement shingles shall be fastened with nails located not less than 25 mm above the exposure line.

9.27.8.4. Joints of Shingles

1) Asbestos-cement shingles shall be installed so that vertical joints in succeeding courses are staggered.

2) Asphalt-coated backer strips shall be installed behind each vertical joint.

3) Shingles referred to in Sentence (1) shall have not less than a 25 mm head lap.

9.27.8.5. Joints in Panels

1) Vertical joints of asbestos-cement panels shall be protected with batten strips, caulking or other suitable method.

2) Horizontal joints of asbestos-cement panels shall be lapped, flashed, caulked or otherwise suitably protected.

9.27.9. Plywood

9.27.9.1. Material Standards

1) Plywood cladding shall be exterior type conforming to
a) CSA O115-M, "Hardwood and Decorative Plywood,"
b) CSA O121-M, "Douglas Fir Plywood,"
c) CSA O151-M, "Canadian Softwood Plywood," or
d) CSA O153-M, "Poplar Plywood."

9.27.9.2. Thickness

1) Plywood cladding shall be not less than 6 mm thick when applied directly to sheathing.

2) When applied directly to framing or over furring strips, plywood cladding thickness shall conform to Table 9.27.9.2.

Table 9.27.9.2.
Minimum Plywood Cladding Thickness
Forming Part of Sentence 9.27.9.2.(2)

Spacing of Supports, mm	Minimum Thickness, mm	
	Face Grain Parallel to Supports	Face Grain Right Angles to Supports
400	8	6
600	11	8

3) The thickness of grooved or textured plywood cladding shall be measured at the point of least thickness.

9.27.9.3. Edge Treatment

1) The edges of plywood cladding shall be treated with a suitable paint or sealer.

9.27.9.4. Panel Cladding

1) Plywood applied in panels shall have all edges supported.

2) Not less than a 2 mm gap shall be provided between panels referred to in Sentence (1).

3) Vertical joints in cladding referred to in Sentence (1) shall be protected with batten strips or caulking when the plywood joints are not matched.

4) Horizontal joints in cladding referred to in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.9.5. Lapped Strip Siding

1) Plywood applied in horizontal lapped strips shall have not less than a 2 mm gap provided at the butted ends, which shall be caulked.

2) The horizontal joints of siding described in Sentence (1) shall be lapped not less than 25 mm.

3) Wedges shall be inserted under all vertical butt joints and at all corners when horizontal lapped plywood is applied without sheathing.

9.27.10. Hardboard

9.27.10.1. Material Standards

1) Factory-finished hardboard cladding shall conform to CAN/CGSB-11.5-M, "Hardboard, Precoated, Factory Finished, for Exterior Cladding."

2) Hardboard cladding that is not factory finished shall conform to Types 1, 2 or 5 in CAN/CGSB-11.3-M, "Hardboard."

9.27.10.2. Thickness

1) Type 1 or 2 hardboard cladding shall be not less than

a) 6 mm thick when applied over sheathing that provides continuous support, and

b) 7.5 mm thick when applied over furring or framing members not more than 400 mm o.c.

2) Type 5 hardboard cladding shall be not less than 9 mm thick when applied over sheathing that provides continuous support or over furring or framing members spaced not more than 400 mm o.c.

3) Where hardboard cladding is grooved, the grooves shall not extend more than 1.5 mm into the minimum required thickness. (See Appendix A.)

9.27.10.3. Panel Cladding

1) Hardboard cladding applied in panels shall have all edges supported with not less than a 5 mm gap provided between sheets.

2) Vertical joints in cladding described in Sentence (1) shall be protected with batten strips or caulking when the joints are not matched.

3) Horizontal joints in cladding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.10.4. Lapped Strip Siding

1) Hardboard applied in horizontal lapped strips shall have not less than a 5 mm gap provided at the butted ends, which shall be caulked or otherwise protected with suitable mouldings.

2) The horizontal joints of siding described in Sentence (1) shall overlap not less than 1 mm per 16 mm width of siding board but not less than 9.5 mm for matched joint siding or 25 mm for lapped siding.

9.27.10.5. Clearance

1) Not less than 3 mm clearance shall be provided between hardboard cladding and door or window frames.

9.27.11. OSB and Waferboard

9.27.11.1. Material Standard

1) OSB and waferboard cladding shall conform to CSA O437.0, "OSB and Waferboard."

9.27.11.2. Thickness

1) OSB conforming to O-2 grade shall be not less than 6.0 mm thick where applied directly to sheathing.

2) OSB conforming to O-2 grade applied directly to framing or over furring strips shall conform to the thickness shown for plywood in Table 9.27.9.2. (See Appendix A.)

3) OSB conforming to O-1 grade and waferboard conforming to R-1 grade shall be not less than 7.9 mm thick where applied directly to sheathing.

4) Where applied directly to framing or over furring strips, OSB conforming to O-1 grade and waferboard conforming to R-1 grade shall be not less than

a) 9.5 mm thick on supports spaced not more than 400 mm o.c., and
b) 12.7 mm thick on supports spaced not more than 600 mm o.c.

9.27.11.3. Panel Cladding

1) OSB and waferboard applied in panels shall have all edges supported and treated with a primer or sealer.

2) Not less than a 3 mm gap shall be provided between sheets in cladding described in Sentence (1).

3) Vertical joints in cladding described in Sentence (1) shall be protected with batten strips or caulking when the OSB and waferboard joints are not matched.

4) Horizontal joints in cladding described in Sentence (1) shall be lapped not less than 25 mm or shall be suitably flashed.

9.27.11.4. Clearance

1) Not less than a 3 mm clearance shall be provided between OSB and waferboard cladding and door or window frames.

9.27.12. Metal

9.27.12.1. Material Standards

1) Horizontal and vertical strip steel siding, including flashing and trim accessories, shall conform to CAN/CGSB-93.4, "Galvanized and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential."

2) Steel sheet cladding shall have a minimum thickness of 0.3 mm and conform to CAN/CGSB-93.3-M, "Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use."

3) Horizontal and vertical strip aluminum siding, including flashing and trim accessories, shall conform to CAN/CGSB-93.2-M, "Prefinished Aluminum Siding, Soffits and Fascia, for Residential Use."

4) Aluminum sheet cladding shall conform to CAN/CGSB-93.1-M, "Sheet, Aluminum Alloy, Prefinished, Residential," and shall have a thickness of not less than 0.58 mm, except that siding supported by backing or sheathing shall have a thickness of not less than 0.46 mm.

9.27.13. Vinyl Siding

9.27.13.1. Material Standard

1) Vinyl siding, including flashing and trim accessories, shall conform to CAN/CGSB-41.24, "Rigid Vinyl Siding, Soffits and Fascia."

9.27.13.2. Attachment

1) The attachment of vinyl siding shall conform to the requirements in Subsection 9.27.5. for metal siding.

Section 9.28. Stucco

9.28.1. General

9.28.1.1. Sheathing beneath Stucco

1) Sheathing shall be provided beneath stucco applied over wood-frame walls except as permitted in Article 9.28.4.2.

2) Where applied beneath stucco, sheathing shall conform to Subsection 9.23.16.

9.28.1.2. Lath and Reinforcing

1) Stucco lath or reinforcing shall be used to attach stucco to any substrate other than masonry.

2) Stucco lath or reinforcing shall be used to attach stucco to masonry where

a) the masonry is soft-burned tile or brick of less strength than the stucco, or
b) the masonry surface is not sound, clean and sufficiently rough to provide a good key.

3) Stucco applied over *masonry chimneys* shall be reinforced.

9.28.1.3. Concrete Masonry Units

1) Stucco finish shall not be applied over concrete masonry units less than one month old unless the units have been cured by the autoclave process.

9.28.1.4. Clearance over Ground Level

1) Stucco shall be not less than 200 mm above finished ground level except when it is applied over concrete or masonry.

9.28.1.5. Flashing and Caulking

1) Flashing and caulking used with stucco shall conform to Subsections 9.27.3. and 9.27.4., except that if aluminum flashing is used, it shall be separated from the stucco by an impervious membrane or coating. (See Article 9.7.4.2. for caulking around window frames.)

9.28.2. Stucco Materials

9.28.2.1. Portland Cement

1) Portland cement shall conform to CSA A5, "Portland Cement." r4

9.28.2.2. Aggregate

1) Aggregate shall be clean, well-graded natural sand or sand manufactured from crushed stone, gravel or air-cooled blast furnace slag and shall contain no significant amounts of deleterious material.

2) Aggregate grading shall conform to Table 9.28.2.2.

Table 9.28.2.2.
Aggregate Grading for Stucco
Forming Part of Sentence 9.28.2.2.(2)

Sieve Sizes, mm	% Aggregate Passing Sieve	
	Maximum	Minimum
4	—	100
2	—	90
1	90	60
0.5	60	45
0.25	30	10
0.125	5	—

9.28.2.3. Water

1) Water shall be clean and free of significant amounts of deleterious material.

9.28.3. Fasteners

9.28.3.1. Materials

1) Fasteners for stucco lath or reinforcing shall be corrosion-resistant and of a material other than aluminum.

9.28.3.2. Nails and Staples

1) Nails for stucco lath or reinforcing shall be not less than 3.2 mm diam with a head diameter of not less than 11.1 mm.

2) Staples for stucco lath or reinforcing shall be not less than 1.98 mm diam or thickness.

3) Staples and nails for attaching stucco lath or reinforcing to vertical surfaces shall be of sufficient length to penetrate 25 mm into framing members or to the full depth of the sheathing where the sheathing is used for attachment.

4) On horizontal surfaces nails for stucco lath or reinforcing shall be not less than 38 mm long.

9.28.4. Stucco Lath

9.28.4.1. Materials

1) Rib lath or expanded metal stucco mesh shall be
a) copper-alloy steel coated with rust-inhibitive paint after fabrication, or
b) galvanized.

2) Woven or welded wire mesh shall be galvanized.

9.28.4.2. No Sheathing Required

1) Sheathing need not be provided beneath stucco where not less than 1.19 mm diam galvanized wire is applied horizontally to the framing at vertical intervals of not more than 150 mm, or where paper-backed welded wire metal lath is used.

9.28.4.3. Stucco Lath Specifications

1) Stucco lath shall conform to Table 9.28.4.3.

9.28.4.4. Self-Furring Devices

1) Stucco lath shall be held not less than 6 mm away from the backing by means of suitable self-furring devices.

9.28.4.5. Application of Stucco Lath

1) Stucco lath shall be applied with the long dimension horizontal.

2) Horizontal and vertical joints in stucco lath shall be lapped not less than 50 mm.

3) End joints of stucco lath shall be staggered and shall occur over framing members.

4) External corners of stucco lath shall be reinforced with a vertical strip of lath or reinforcing extending not less than 150 mm on both sides of the corner, or the lath or reinforcing shall extend around corners not less than 150 mm.

9.28.4.6. Fastening

1) Stucco lath shall be fastened in conformance with Subsection 9.27.5.

Table 9.28.4.3.
Stucco Lath
Forming Part of Sentence 9.28.4.3.(1)

Location	Type of Lath	Minimum Diam of Wire, mm	Maximum Mesh Opening	Minimum Mass, kg/m²
Vertical surfaces	Welded or woven wire	1.19	25 mm	—
		1.35	38 mm	—
		1.60	51 mm	—
	Stucco mesh reinforcing (expanded metal)	—	25.8 cm²	0.98
Horizontal surfaces(1)	9.5 mm rib lath	—	—	1.84
	Cedar lath	—	—	—

Notes to Table 9.28.4.3.:
(1) See Appendix A.

2) Fasteners on vertical surfaces shall be spaced not more than
a) 150 mm o.c. vertically and 400 mm o.c. horizontally, or
b) 100 mm o.c. vertically and 600 mm o.c. horizontally.

3) Nailing patterns other than those required in Sentence (2) are permitted to be used provided there are at least 20 fasteners per square metre of wall surface.

4) Fasteners on horizontal surfaces shall be spaced not more than
a) 150 mm o.c. along the framing members when members are spaced not more than 400 mm o.c., and
b) 100 mm o.c. along members when members are spaced not more than 600 mm o.c.

9.28.5. Stucco Mixes

9.28.5.1. Mixes

1) Stucco mixes shall conform to Table 9.28.5.1.

Table 9.28.5.1.
Stucco Mixes
Forming Part of Sentence 9.28.5.1.(1)

Materials, volume			
Portland Cement	Masonry Cement	Lime	Aggregate
1	—	0.25 to 1	3.25 to 4 parts per part of cementitious material
1	1	—	

9.28.5.2. Pigments

1) Pigment if used shall consist of pure mineral oxides inert to the action of sun, lime and cement.

2) Pigment shall not exceed 6% of the Portland cement by weight.

9.28.5.3. Mixing

1) Materials shall be thoroughly mixed before and after water is added.

2) Stucco shall be applied not later than 3 h after the initial mixing.

9.28.6. Stucco Application

9.28.6.1. Low Temperature Conditions

1) The base for stucco shall be maintained above freezing.

2) Stucco shall be maintained at a temperature of not less than 10°C during application, and for not less than 48 h afterwards.

9.28.6.2. Number of Coats and Total Thickness

1) Stucco shall be applied with at least 2 base coats and one finish coat, providing a total thickness of not less than 15 mm, measured from the face of the lath or the face of the masonry where no lath is used.

9.28.6.3. First Coat

1) The first coat shall be not less than 6 mm thick, measured from the face of the lath or masonry, fully embedding the lath.

2) The surface of the first coat shall be scored to provide a key with the second coat.

9.28.6.4. Second Coat

1) The second coat shall be not less than 6 mm thick.

2) The surface of the second coat shall be lightly roughened to provide a key with the finish coat if the finish coat is other than stone dash.

9.28.6.5. Finish Coat

1) When the finish coat is other than stone dash, the base shall be dampened but not saturated before the finish coat is applied.

2) The thickness of the finish coat shall be not less than 3 mm.

3) When a stone dash finish is used, the stone shall be partially embedded in the second coat before the second coat starts to set or stiffen.

Section 9.29. Interior Wall and Ceiling Finishes

9.29.1. General

9.29.1.1. Fire Protection and Sound Control

1) A wall or ceiling finish shall also conform to the appropriate requirements in Sections 9.10. and 9.11., in addition to the requirements in this Section.

9.29.2. Waterproof Wall Finish

9.29.2.1. Where Required

1) Waterproof finish shall be provided to a height of not less than
a) 1.8 m above the floor in shower stalls,
b) 1.2 m above the rims of bathtubs equipped with showers, and
c) 400 mm above the rims of bathtubs not equipped with showers.

9.29.2.2. Materials

1) Waterproof finish shall consist of ceramic, plastic or metal tile, sheet vinyl, tempered hardboard, laminated thermosetting decorative sheets or linoleum.

9.29.3. Wood Furring

9.29.3.1. Size and Spacing of Furring

1) Wood furring for the attachment of wall and ceiling finishes shall conform to Table 9.29.3.1.

Table 9.29.3.1.
Size and Spacing of Furring
Forming Part of Sentence 9.29.3.1.(1)

Maximum Spacing of Furring, mm	Minimum Size of Furring, mm		
	Maximum Spacing of Furring Supports		
	Continuous Supports	400 mm (o.c.)	600 mm (o.c.)
300	19 x 38	19 x 38	19 x 64
400	19 x 38	19 x 38	19 x 64
600	19 x 38	19 x 64	19 x 89

9.29.3.2. Fastening

1) Furring shall be fastened to the framing or to wood blocks with not less than 51 mm nails.

9.29.4. Plastering

9.29.4.1. Application

1) Application of plaster wall and ceiling finishes, including installation of metal or gypsum lath, shall conform to CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering."

9.29.5. Gypsum Board Finish (Taped Joints)

9.29.5.1. Application

1) The requirements for application of gypsum board in this Subsection apply to the single layer application of gypsum board to wood furring or framing using nails or screws.

2) Gypsum board applications not described in this Subsection shall conform to CSA A82.31-M, "Gypsum Board Application."

9.29.5.2. Materials

1) Gypsum products shall conform to
a) CAN/CSA-A82.27-M, "Gypsum Board,"
b) ASTM C 36/C 36M, "Gypsum Wallboard," r4
c) ASTM C 37/C 37M, "Gypsum Lath," r4
d) ASTM C 442/C 442M, "Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board," r4
e) ASTM C 588/C 588M, "Gypsum Base for Veneer Plasters," r4
f) ASTM C 630/C 630M, "Water-Resistant Gypsum Backing Board," r
g) ASTM C 931/C 931M, "Exterior Gypsum Soffit Board," or r
h) ASTM C 960, "Predecorated Gypsum Board."

9.29.5.3. Maximum Spacing of Supports

1) Maximum spacing of supports for gypsum board applied as a single layer shall conform to Table 9.29.5.3.

Table 9.29.5.3.
Spacing of Supports for Gypsum Board
Forming Part of Sentence 9.29.5.3.(1)

Thickness, mm	Orientation of Board to Framing	Maximum Spacing of Supports, mm, o.c.		
		Walls	Ceilings	
			Painted Finish	Water-Based Texture Finish
9.5	parallel	—	—	—
	perpendicular	400	400	—
12.7	parallel	600	400	—
	perpendicular	600	600	400
15.9	parallel	600	400	—
	perpendicular	600	600	600

9.29.5.4. Support of Insulation

1) Gypsum board supporting insulation shall be not less than 12.7 mm thick.

9.29.5.5. Length of Fasteners

1) The length of fasteners for gypsum board shall conform to Table 9.29.5.5., except that lesser depths of penetration are permitted for assemblies required to have a *fire-resistance rating* provided it can be shown, on the basis of fire tests, that such depths are adequate for the required rating.

Table 9.29.5.5.
Fastener Penetration into Wood Supports
Forming Part of Sentence 9.29.5.5.(1)

Required *Fire-Resistance Rating* of Assembly	Minimum Penetration, mm			
	Walls		Ceilings	
	Nails	Screws	Nails	Screws
Not required	20	15	20	15
45 min	20	20	30	30
1 h	20	20	45	45
1.5 h	20	20	60	60

9.29.5.6. Nails

1) Nails for fastening gypsum board to wood supports shall conform to CSA B111, "Wire Nails, Spikes and Staples."

9.29.5.7. Screws

1) Screws for fastening gypsum board to wood supports shall conform to ASTM C 1002, "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs." r4

9.29.5.8. Spacing of Nails

1) For single-layer application, nails shall be spaced not more than 180 mm o.c. on ceiling supports and not more than 200 mm apart along vertical wall supports, except that nails may be spaced in pairs about 50 mm apart every 300 mm along such wall or ceiling supports.

2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to nailing at this location.

3) The uppermost wall nails shall be not more than 200 mm below the ceiling.

4) Nails shall be located not less than 10 mm from the side or edge of the board.

5) Nails shall be driven so that the heads are below the plane of the board surface but do not puncture the paper.

9.29.5.9. Spacing of Screws

1) Where gypsum board is applied with drywall screws, the screws shall be spaced not more than 300 mm o.c. along supports, except that on vertical surfaces the screws may be spaced 400 mm o.c. where the supports are not more than 400 mm o.c.

9.29.5.10. Low Temperature Conditions

1) In cold weather, heat shall be provided to maintain a temperature not below 10°C for 48 h prior to taping and finishing and maintained for not less than 48 h thereafter.

9.29.6. Plywood Finish

9.29.6.1. Thickness

1) Except as provided in Sentences (2) and (3), the minimum thickness of plywood interior finish shall conform to Table 9.29.6.1.

Table 9.29.6.1.
Thickness of Plywood Interior Finish
Forming Part of Articles 9.29.6.1. and 9.29.6.2.

Maximum Spacing of Supports, mm (o.c.)	Minimum Thickness, mm(1)	
	On Supports with no Horizontal Blocking	On Supports with Blocking at Vertical Intervals not Exceeding 1.2 m
400	4.7	4.0
600	8.0	4.7

Notes to Table 9.29.6.1.:
(1) Thickness limits shall apply to the net effective thickness (NET) of grooved, striated, textured and/or embossed panels and to the actual thickness of flat panels.

2) A manufacturing tolerance of – 0.4 mm may be applied to the thicknesses listed in Table 9.29.6.1.

3) No minimum thickness is required where plywood is applied over continuous backing.

9.29.6.2. Grooved Plywood

1) Except as permitted in Sentence (2), where plywood for interior finish is grooved, the grooves shall not extend through the face ply and into the plies below the face ply unless the groove is supported by framing or furring.

2) If the grain of the face ply is at right angles to the supporting members, the groove is permitted to extend into plies below the face ply provided the thickness of the plywood exceeds the value shown in Table 9.29.6.1. by an amount equal to not less than the depth of penetration of the grooves into the plies below the face ply.

9.29.6.3. Nails and Staples

1) Nails for attaching plywood finishes shall not be less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports, except that staples providing equivalent lateral resistance may also be used.

9.29.6.4. Edge Support

1) All plywood edges shall be supported by furring, blocking or framing.

9.29.7. Hardboard Finish

9.29.7.1. Material Standard

1) Hardboard shall conform to CAN/CGSB-11.3-M, "Hardboard."

9.29.7.2. Thickness

1) Hardboard shall be not less than
a) 3 mm thick where applied over continuous back-up,
b) 6 mm thick when applied over supports spaced not more than 400 mm o.c., and
c) 9 mm thick when applied over supports spaced not more than 600 mm o.c.

9.29.7.3. Nails

1) Nails for fastening hardboard shall be casing or finishing nails not less than 38 mm long, spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.7.4. Edge Support

1) All hardboard edges shall be supported by furring, blocking or framing where the back-up is not continuous.

9.29.8. Insulating Fibreboard Finish

9.29.8.1. Material Standard

1) Insulating fibreboard shall conform to CAN/CSA-A247-M, "Insulating Fibreboard."

9.29.8.2. Thickness

1) Insulating fibreboard sheets shall be not less than 11.1 mm thick on supports not more than 400 mm o.c.

2) Insulating fibreboard tile shall be not less than 12.7 mm thick on supports spaced not more than 400 mm o.c.

9.29.8.3. Nails

1) Nails for fastening fibreboard sheets shall be not less than 2.6 mm shank diameter casing or finishing nails of sufficient length to penetrate not less than 20 mm into the supports.

2) Nails shall be spaced not more than 100 mm o.c. along edge supports and 200 mm o.c. along intermediate supports.

9.29.8.4. Edge Support

1) All fibreboard edges shall be supported by blocking, furring or framing.

9.29.9. Particleboard, OSB or Waferboard Finish

9.29.9.1. Material Standard

1) Particleboard finish shall conform to ANSI A208.1, "Particleboard."

2) OSB or waferboard finish shall conform to CSA O437.0, "OSB and Waferboard."

9.29.9.2. Minimum Thickness

1) Except as provided in Sentences (2) and (3), the minimum thickness of O-2 grade OSB used as an interior finish shall conform to that shown for plywood in Table 9.29.6.1.

2) Thicknesses listed in Table 9.29.6.1. shall permit a manufacturing tolerance of – 0.4 mm.

3) No minimum thickness is required where O-2 grade OSB is applied over continuous backing.

4) OSB conforming to O–1 grade, waferboard conforming to R-1 grade and particleboard shall be
- a) not less than 6.35 mm thick on supports not more than 400 mm o.c.,
- b) not less than 9.5 mm thick on supports not more than 600 mm o.c., and
- c) not less than 6.35 mm thick on supports not more than 600 mm o.c. in walls where blocking is provided at midwall height.

9.29.9.3. Nails

1) Nails for fastening particleboard, OSB or waferboard shall be not less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

9.29.9.4. Edge Support

1) All particleboard, OSB or waferboard edges shall be supported by furring, blocking or framing.

9.29.10. Wall Tile Finish

9.29.10.1. Tile Application

1) Ceramic tile shall be set in a mortar base or applied with an adhesive.

2) Plastic tile shall be applied with an adhesive.

9.29.10.2. Mortar Base

1) When ceramic tile is applied to a mortar base the cementitious material shall consist of one part Portland cement to not more than one-quarter part lime by volume.

2) The cementitious material described in Sentence (1) shall be mixed with not less than 3 nor more than 5 parts of aggregate per part of cementitious material by volume.

3) Mortar shall be applied over metal lath or masonry.

4) Ceramic tile applied to a mortar base shall be thoroughly soaked and pressed into place forcing the mortar into the joints while the tile is wet.

9.29.10.3. Adhesives

1) Adhesives to attach ceramic and plastic tile shall be applied to the finish coat or brown coat of plaster that has been steel-trowelled to an even surface or to gypsum board or to masonry provided the masonry has an even surface.

9.29.10.4. Moisture Resistant Backing

1) Ceramic and plastic tile installed on walls around bathtubs or showers shall be applied over moisture resistant backing.

9.29.10.5. Joints between Tiles and Bathtub

1) The joints between wall tiles and a bathtub shall be suitably caulked with material conforming to CAN/CGSB-19.22-M, "Mildew-Resistant Sealing Compound for Tubs and Tiles."

Section 9.30. Flooring

9.30.1. General

9.30.1.1. Required Finished Flooring

1) Finished flooring shall be provided in all *residential occupancies*.

9.30.1.2. Water Resistance

1) Where water permeable finished flooring in bathrooms, kitchens, public entrance halls and laundry areas is supported by a subfloor of a type that would be damaged by water, such flooring shall be installed over a membrane with a water permeance not exceeding 18 ng/(Pa•s•m^2) when tested in accordance with ASTM E 96, "Water Vapor Transmission of Materials." (See Appendix A.) e

9.30.1.3. Sleepers

1) Wood sleepers supporting finished flooring over a concrete base supported on the ground shall be not less than 19 mm by 38 mm and shall be treated with a wood preservative.

9.30.1.4. Finish Quality

1) Finished flooring shall have a surface that is smooth, even and free from roughness or open defects.

9.30.2. Panel-Type Underlay

9.30.2.1. Required Underlay

1) A panel-type underlay shall be provided under resilient flooring, parquet flooring, ceramic tile, felted-synthetic-fibre floor coverings or carpeting laid over lumber subflooring. (See Sentence 9.30.3.2.(1).)

2) Panel-type underlay shall be provided under resilient flooring, parquet flooring, felted-synthetic-fibre floor coverings or carpeting on panel-type subflooring whose edges are unsupported. (See Article 9.23.14.3.)

3) Panel-type underlay shall be provided under ceramic tile applied with adhesive.

9.30.2.2. Materials and Thickness

1) Panel-type underlay shall be not less than 6 mm thick and shall conform to
- a) ANSI A208.1, "Particleboard,"
- b) CAN/CGSB-11.3-M, "Hardboard,"
- c) CSA O115-M, "Hardwood and Decorative Plywood,"
- d) CSA O121-M, "Douglas Fir Plywood,"
- e) CSA O151-M, "Canadian Softwood Plywood,"
- f) CSA O153-M, "Poplar Plywood," or
- g) CSA O437.0, "OSB and Waferboard."

2) Panel-type underlay under ceramic tile applied with adhesive shall be not less than
- a) 6 mm thick where the supports are spaced up to 300 mm o.c., and
- b) 11 mm thick where the supports are spaced wider than 300 mm o.c.

9.30.2.3. Fastening

1) Panel-type underlay shall be fastened to the subfloor with staples, annular grooved flooring nails or spiral nails, spaced not more than 150 mm o.c. along the edges and 200 mm o.c. both ways at other locations.

2) Nails for panel-type underlay shall be not less than 19 mm long for 6 mm thick underlay and 22 mm long for 7.9 mm thick underlay.

3) Staples for panel-type underlay shall
- a) have not less than a 1.2 mm shank diameter or thickness with a 4.7 mm crown, and
- b) be not less than
  - i) 22 mm long for 6 mm underlay, and
  - ii) 28 mm long for 7.9 mm and 9.5 mm underlay.

9.30.2.4. Joints Offset

1) Where panel-type underlay is required to be installed over plywood, OSB or waferboard, the joints in the underlay shall be offset not less than 200 mm from the joints in the underlying subfloor.

9.30.2.5. Surface Defects

1) Underlay beneath resilient or ceramic floors applied with an adhesive shall have all holes or open defects on the surface patched so that the defects will not be transmitted to the finished surface.

9.30.3. Wood Strip Flooring

9.30.3.1. Thickness

1) The thickness of wood strip flooring shall conform to Table 9.30.3.1.

Table 9.30.3.1.
Thickness of Wood Strip Flooring
Forming Part of Sentence 9.30.3.1.(1)

Type of Flooring	Max. Joist Spacing, mm	Minimum Thickness of Flooring, mm	
		With Subfloor	No Subfloor
Matched hardwood (interior use only)	400	7.9	19.0
	600	7.9	33.3
Matched softwood (interior or exterior use)	400	19.0	19.0
	600	19.0	31.7
Square edge softwood (exterior use only)	400	—	25.4
	600	—	38.1

9.30.3.2. Strip Direction and End Joints

1) Wood strip flooring shall not be laid parallel to lumber subflooring unless a separate underlay is provided.

2) If wood strip flooring is applied without a subfloor, it shall be laid at right angles to the joists so that the end joints are staggered and occur over supports or are end matched.

3) If the flooring is end matched, it shall be laid so that no 2 adjoining strips break joints in the same space between supports and each strip bears on no fewer than 2 supports.

9.30.3.3. Nailing

1) When nails are used, wood strip flooring shall be toe nailed or face nailed with not less than one nail per strip at the spacings shown in Table 9.30.3.3., except that face nailed strips more than 25 mm in width shall have at least 2 nails per strip.

Table 9.30.3.3.
Nailing of Wood Strip Flooring
Forming Part of Sentence 9.30.3.3.(1)

Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9	38[1]	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	600

Notes to Table 9.30.3.3.:
(1) See Article 9.30.3.4.

2) Face nails shall be countersunk and the holes filled with suitable filler.

9.30.3.4. Staples

1) Staples are permitted to be used to fasten wood strip flooring not more than 7.9 mm in thickness provided the staples are not less than 29 mm long with a shank diameter of 1.19 mm and with 4.7 mm crowns.

9.30.4. Parquet Flooring

9.30.4.1. Adhesive

1) Adhesive used to attach parquet block flooring shall be suitable for bonding wood to the applicable subfloor material.

9.30.5. Resilient Flooring

9.30.5.1. Materials

1) Resilient flooring used on concrete slabs supported on ground shall consist of asphalt, rubber, vinyl-asbestos, unbacked vinyl or vinyl with an inorganic type backing.

2) Flooring described in Sentence (1) shall be attached to the base with a suitable waterproof and alkali-resistant adhesive.

9.30.6. Ceramic Tile

9.30.6.1. Substrate

1) Ceramic tile shall be set in a mortar bed or applied to a sound smooth base with a suitable adhesive.

2) Panel-type subfloor to which ceramic tile is to be applied with adhesive shall have its edges supported according to Article 9.23.14.3.

Section 9.31. Plumbing Facilities

9.31.1. Scope

9.31.1.1. Application

1) This Section applies to the plumbing facilities and *plumbing systems* within *dwelling units*.

2) Plumbing facilities other than those required in *dwelling units* shall conform to Subsection 3.7.4. (See also Section 3.8. regarding *barrier-free* plumbing facilities.)

9.31.2. General

9.31.2.1. General

1) The construction, extension, *alteration*, renewal or repair of *plumbing systems* and sewage disposal systems shall conform to Part 7.

9.31.2.2. Corrosion Protection

1) Metal pipes in contact with cinders or other corrosive material shall be protected by a heavy coating of bitumen or other corrosion protection.

9.31.2.3. Grab Bars

1) When provided, grab bars shall be capable of resisting a load of not less than 1.3 kN applied vertically or horizontally.

9.31.3. Water Supply and Distribution

9.31.3.1. Required Water Supply

1) Every *dwelling unit* shall be supplied with potable water.

9.31.3.2. Required Connections

1) Where a piped water supply is available, piping for hot and cold water shall be connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area.

2) Piping for cold water shall be run to every water closet and hose bib.

9.31.4. Required Facilities

9.31.4.1. Required Fixtures

1) A kitchen sink, lavatory, bathtub or shower, and water closet shall be provided for every *dwelling unit* where a piped water supply is available.

9.31.4.2. Laundry Facilities

1) Laundry facilities or a space for laundry facilities shall be provided in every *dwelling unit*, or grouped elsewhere in the *building* in a location conveniently accessible to occupants of every *dwelling unit*.

9.31.4.3. Hot Water Supply

1) Where a piped water supply is available a hot water supply shall be provided in every *dwelling unit*.

9.31.4.4. Floor Drains

1) Where gravity drainage to a sewer, drainage ditch or dry well is possible, a floor drain shall be installed in a *basement* forming part of a *dwelling unit*.

2) A floor drain shall be provided in a garbage room, incinerator room or *boiler* room serving more than one *dwelling unit*.

9.31.5. Sewage Disposal

9.31.5.1. Building Sewer

1) Wastes from every plumbing fixture shall be piped to the *building* sewer.

9.31.5.2. Discharge of Sewage

1) *Building* sewers shall discharge into a public sewage system where such system is available.

2) Where a public sewage system is not available, the *building* sewer shall discharge into a *private sewage disposal system*.

9.31.6. Service Water Heating Facilities

9.31.6.1. Hot Water Temperature

1) Where a hot water supply is required by Article 9.31.4.3., equipment shall be installed that is capable of heating to at least 45°C but not above 60°C an adequate supply of service hot water for every *dwelling unit*.

9.31.6.2. Supply Source

1) Service hot water is permitted to be distributed from a centrally located heater to supply the entire *building* or may be supplied by an individual *service water heater* for each *dwelling unit*.

9.31.6.3. Equipment and Installation

1) *Service water heaters* shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to the National Plumbing Code of Canada 1995.

2) The installation of *service water heaters*, including provisions for mounting, clearances and air supply, shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to

a) CSA B51, "Boiler, Pressure Vessel, and Pressure Piping Code,"
b) CSA B139, "Installation Code for Oil-Burning Equipment," r4
c) CSA B149.1, "Natural Gas and Propane Installation Code," r4
d) CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment," or r4
e) CSA C22.1, "Canadian Electrical Code, Part I."

3) Where the *building* is located in seismic velocity or acceleration zones 4, 5 or 6, *service water heaters* shall be secured to the structure to prevent overturning. (See Appendix A.)

9.31.6.4. Corrosion-Resistant Coating

1) Where storage tanks for *service water heaters* are of steel, they shall be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material.

9.31.6.5. Fuel-Burning Heaters

1) Fuel-burning *service water heaters* shall be connected to a *chimney flue* conforming to Section 9.21.

9.31.6.6. Heating Coils

1) Heating coils of *service water heaters* shall not be installed in a *flue* or in the combustion chamber of a *boiler* or *furnace* heating a *building*.

Section 9.32. Ventilation

9.32.1. General

9.32.1.1. Application

1) This Section applies to the ventilation of rooms and spaces in *residential occupancies* by natural ventilation and to self-contained mechanical ventilation systems serving only one *dwelling unit*.

2) Mechanical ventilation systems other than self-contained systems serving single *dwelling units* shall conform to Part 6.

3) A *storage garage* for more than 5 motor vehicles shall be ventilated in accordance with Part 6.

9.32.1.2. Required Ventilation Provisions

1) Every *dwelling unit* shall incorporate provisions for non-heating-season ventilation in accordance with Subsection 9.32.2. and, if supplied with electrical power, provisions for heating season ventilation in accordance with Subsection 9.32.3.

9.32.2. Non-Heating-Season Ventilation

9.32.2.1. Required Ventilation

1) Rooms or spaces in *dwelling units* shall be ventilated during the non-heating season by

a) natural ventilation in accordance with Article 9.32.2.2., or

b) a mechanical ventilation system conforming to Part 6.

2) Where a habitable room or space is not provided with natural ventilation as described in Sentence (1), mechanical ventilation shall be provided to exhaust inside air from or to introduce outside air to that room or space at the rate of

a) one-half air change per hour if the room or space is mechanically cooled during the non-heating season, or

b) one air change per hour if it is not mechanically cooled during the non-heating season.

9.32.2.2. Natural Ventilation

1) The unobstructed openable ventilation area to the outdoors for rooms and spaces in residential *buildings* ventilated by natural means shall conform to Table 9.32.2.2.

2) Where a vestibule opens directly off a living or dining room within a *dwelling unit*, ventilation to the outdoors for such rooms may be through the vestibule.

3) Openings for natural ventilation other than windows shall be constructed to provide protection from the weather and insects.

4) Screening shall be of rust-proof material.

9.32.3. Heating Season (Mechanical) Ventilation

(See Appendix A.)

9.32.3.1. Required Ventilation

1) Every *dwelling unit* that is supplied with electrical power shall be provided with a mechanical ventilation system complying with

a) CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems," or

b) for mechanical ventilation systems coupled to forced air heating systems, the balance of this Subsection other than Article 9.32.3.7., or

c) for mechanical ventilation systems not coupled to forced air heating systems, the balance of this Subsection other than Article 9.32.3.6.

(See A-9.32.3. in Appendix A.)

9.32.3.2. Design and Installation

1) Aspects of mechanical ventilation systems not specifically described in this Subsection shall be designed, constructed and installed in accordance with good practice such as described in the ASHRAE Handbooks and Standards, the HRAI Digest, the Hydronics Institute Manuals and the SMACNA manuals.

Table 9.32.2.2.
Natural Ventilation Area
Forming Part of Sentence 9.32.2.2.(1)

Location		Minimum Unobstructed Area
Within *dwelling unit*	Bathrooms or water closet rooms	0.09 m²
	Unfinished *basement* space	0.2% of the *floor area* e3
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m² per room or combination of rooms
Other than within *dwelling unit*	Bathrooms or water closet rooms	0.09 m² per water closet
	Sleeping areas	0.14 m² per occupant
	Laundry rooms, kitchens, recreation rooms	4% of the *floor area* e3
	Corridors, storage rooms and other similar public rooms or spaces	2% of the *floor area* e3
	Unfinished *basement* space not used on a shared basis	0.2% of the *floor area* e3

9.32.3.3. Total Ventilation Capacity

1) The minimum total ventilation capacity of the ventilation system required in Clauses 9.32.3.1.(1)(b) and (c) shall be the sum of the individual room capacities given in Table 9.32.3.3.

2) In applying Sentence (1),
a) at least one bedroom in each *dwelling unit* shall be designated as the master bedroom,
b) ventilation capacities assigned to any combined living/dining or family/dining space shall be determined as if the spaces were individual rooms,
c) where a *basement* incorporates rooms of the types designated in Table 9.32.3.3., the assigned ventilation capacities for each room shall be as specified for those types of rooms,
d) *basement* areas used for other purposes that exceed 2/3 of the total *basement floor area* shall be assigned a fan capacity of 10 L/s,
e) *basement* areas used for other purposes that are 2/3 of the total area or less shall be assigned a ventilation capacity of 5 L/s, and
f) other habitable rooms, other than spaces intended solely for access, egress, storage or service equipment, shall be assigned a ventilation capacity of 5 L/s.

Table 9.32.3.3.
Ventilation Capacity
Forming Part of Sentence 9.32.3.3.(1)

Room	Capacity, L/s
Master bedroom	10
Other bedrooms	5
Living room	5
Dining room	5
Family room	5
Recreation room	5
Basement	10
Other habitable rooms	5
Kitchen	5
Bathroom or water closet room	5
Laundry	5
Utility room	5

9.32.3.4. Principal Exhaust

1) A principal exhaust fan shall be installed and shall be rated to provide not less than 50% of the total ventilation capacity required by Article 9.32.3.3. (See A-9.32.3. in Appendix A.)

2) Where the installed capacity of the principal exhaust fan exceeds the minimum capacity required by Sentence (1) by more than 50%, the control required in Sentence (4) shall include provision to allow reduction of its flow to within ± 10% of the required minimum capacity.

3) The requirement in Sentence (1) for a principal exhaust fan may be satisfied by a group of fans, provided all fans in the group are controlled simultaneously by a controller complying with Sentences (2), (4) and (5).

4) The principal exhaust fan required in Sentence (1) shall be controlled by a manual switch located centrally in the *dwelling unit* and clearly marked "Ventilation Fan." (See A-9.32.3. in Appendix A.)

5) Where a principal exhaust fan required by this Article is controlled by a dehumidistat or other automatic control in addition to the manual switch required by Sentence (4), the manual switch shall be capable of activating the fan regardless of the setting of the automatic control.

6) Where an exhaust air intake for the principal exhaust fan is connected directly to the duct system of a forced air heating system or other central air circulating system, it shall be connected
a) to the return air side of the system, and
b) not less than 1 m upstream from the outdoor air *supply duct* required in Sentence 9.32.3.6.(2) or 9.32.3.7.(10).

7) Where an exhaust air intake for the principal exhaust fan is located in the kitchen, it shall be located in the ceiling or on the wall within 300 mm of the ceiling. (See A-9.32.3. in Appendix A.)

8) Except as provided in Sentences (9) and (10), single or multiple *exhaust ducts* serving the principal exhaust fan required by Sentence (1) shall be sized according to Subsection 9.33.4.

9) Except as provided in Sentence (10), single or multiple *exhaust ducts* serving the principal exhaust fan required by Sentence (1) are permitted to be sized according to Table 9.32.3.4. where
a) the longest total duct length, from intake grille to outdoor hood, does not exceed 12 m but is not less than 6 m, and
b) the number of elbows does not exceed 4 but is not less than 2.

10) The *exhaust ducts* described in Sentences (8) and (9) shall not in any case be smaller than recommended by the manufacturer of the fan.

Table 9.32.3.4.
Principal Exhaust Duct Sizes
Forming Part of Sentence 9.32.3.4.(9)

Minimum Capacity of Principal Exhaust Fan as per Sentence 9.32.3.4.(1), L/s	Minimum Exhaust Duct Diameter, mm			
	Ducts connected to inlet and outlet of principal exhaust fan		Ducts connected to one side only of principal exhaust fan	
	smooth duct	flexible duct	smooth duct	flexible duct
20	125	125	125	125
25	125	125	125	150
30	125	125	150	150
35	150	150	150	150
40	150	150	150	175
> 40	design to Subsection 9.33.4.			

11) In applying Table 9.32.3.4.,
a) where there is more than one exhaust air inlet duct connected directly to the fan, the diameter of the inlet ducts is permitted to be decreased by 25 mm, and
b) where the *exhaust duct* is connected to the duct system of a forced air heating system, the duct diameter shall be increased by 25 mm.

9.32.3.5. Supplemental Exhaust

1) Where an exhaust air intake for the principal exhaust fan required in Article 9.32.3.4. is not located in a kitchen or where the principal exhaust fan has another air intake located in another room, a separate exhaust fan with a rated capacity not less than 50 L/s shall be installed in that kitchen.

2) Where an exhaust air intake for the principal exhaust fan required in Article 9.32.3.4. is not located in a bathroom or water closet room, a separate exhaust fan with a rated capacity not less than 25 L/s shall be installed in that bathroom or water closet room.

3) Additional supplemental exhaust fans shall be installed as necessary so that the total capacity of all kitchen, bathroom, water closet room and other supplemental exhaust fans is not less than the total ventilation capacity, as required in Article 9.32.3.3., minus the principal exhaust fan capacity, as required in Article 9.32.3.4.

4) Where the intake for a supplemental exhaust fan other than a *range* hood or *range*-top fan is installed in a kitchen, it shall be installed in the ceiling or on the wall within 300 mm of the ceiling.

5) Except as provided in Sentences (6) and (7), *exhaust ducts* serving the required kitchen, bathroom, water closet room and other supplemental exhaust fans shall be sized according to Subsection 9.33.4.

6) Except as provided in Sentence (7), *exhaust ducts* serving the required kitchen, bathroom, water closet room and other supplemental exhaust fans are permitted to be sized according to Table 9.32.3.5. where
a) the total duct length does not exceed 9 m, and
b) the number of elbows does not exceed 4.

7) *Exhaust ducts* described in Sentences (5) and (6) shall not be smaller than recommended by the manufacturers of the fans.

8) A supplemental exhaust fan required by this Article shall be provided with a manual switch located in the room served by the fan and separate from the light switch for the room.

9) Where a supplemental fan required by this Article is controlled by a dehumidistat or other automatic control in addition to the manual switch required by Sentence (8), the manual switch shall be capable of activating the fan regardless of the setting of the automatic control.

9.32.3.6. Ventilation Systems Coupled with Forced Air Heating Systems

1) Where the mechanical ventilation system required by Clause 9.32.3.1.(1)(b) is coupled to a forced air heating system, outdoor air shall be introduced to the return air *plenum* of the forced air system in compliance with this Article.

2) An outdoor air *supply duct* shall be installed between the outdoors and the return air *plenum* and shall be connected
a) not less than 3 m upstream of the *plenum* connection to the *furnace*, as measured along the length of the duct, or
b) through an acceptable mixing device installed in the return air *plenum* (see Appendix A-9.32.3.).

Table 9.32.3.5.
Kitchen, Bathroom and Water Closet Room Exhaust Duct Sizes
Forming Part of Sentence 9.32.3.5.(6)

Fan Capacity, L/s	Minimum Exhaust Duct Diameter, mm			
	Ducts on discharge side of fan only		Ducts on both sides of fan	
	smooth duct	flexible duct	smooth duct	flexible duct
25	125	150	125	125
30	125	150	125	125
35	150	150	125	150
40	150	150	150	150
45	150	175	150	150
50	150	175	150	150
55	175	175	150	175
60	175	175	150	175

3) The outdoor air duct shall not be connected upstream of any return branch connection.

4) The outdoor air duct shall be sized in accordance with Subsection 9.33.4., except that,
- a) the duct is permitted to be sized according to Table 9.32.3.6.A. where
  - i) the total duct length does not exceed 6 m, and
  - ii) the number of elbows does not exceed 2, or
- b) the duct is permitted to be sized according to Table 9.32.3.6.B. where
  - i) the total duct length does not exceed 8 m,
  - ii) the number of elbows does not exceed 3, and
  - iii) the duct is connected to an auxiliary supply fan with a rated capacity not less than the required minimum capacity of the principal exhaust fan required by Article 9.32.3.4. and not more than 150% of that capacity.

Table 9.32.3.6.A.
Minimum Outdoor Air Duct Sizes without Auxiliary Supply Fan
Forming Part of Sentence 9.32.3.6.(4)

Required Minimum Capacity of Principal Exhaust Fan as per Sentence 9.32.3.4.(1), L/s	Minimum Duct Diameter, mm	
	smooth duct	flexible duct
20	150	150
25	150	150
30	150	175
35	175	175
40	175	175
> 40	design to Subsection 9.33.4.	

5) The auxiliary supply fan required in Clause (4)(b) shall be a fan designated by the manufacturer for the handling of untempered outdoor air.

6) The outdoor air duct shall not be considered to provide combustion and/or dilution air to fuel-burning *appliances*.

7) The principal exhaust fan control required by Sentence 9.32.3.4.(4) shall be wired in such a way that activation of the principal exhaust fan automatically
- a) activates the *furnace* circulation fan, and
- b) where applicable, activates the auxiliary supply fan required in Clause (4)(b) and matches its flow to that of the principal exhaust fan.

Table 9.32.3.6.B.
Minimum Outdoor Air Duct Sizes with Auxiliary Supply Fan
Forming Part of Sentence 9.32.3.6.(4)

Required Minimum Capacity of Principal Exhaust Fan as per Sentence 9.32.3.4.(1), L/s	Minimum Duct Diameter, mm			
	Ducts connected to inlet and outlet of auxiliary fan		Ducts connected to one side only of auxiliary fan	
	smooth duct, mm	flexible duct, mm	smooth duct, mm	flexible duct, mm
20	100	100	100	125
25	100	125	125	125
30	125	125	125	125
35	125	125	125	150
40	125	125	125	150
> 40	design to Subsection 9.33.4.			

8) Where the outdoor air duct is not connected to an auxiliary supply fan, it shall incorporate a damper which
a) is accessible,
b) can be adjusted,
c) can be fixed in its adjusted position,
d) includes a device to indicate the position of the damper, and
e) includes a stop to prevent its being closed beyond 45°.

9) All connections between the ventilation system and the heating system shall be in accordance with Articles 9.33.4.1. and 9.33.5.2.

9.32.3.7. Ventilation Systems Not Coupled with Forced Air Heating Systems

1) Where the mechanical ventilation system required by Clause 9.32.3.1.(1)(c) is not coupled to a forced air heating system, outdoor air shall be introduced to and circulated throughout the *dwelling unit* in compliance with this Article.

2) A supply fan shall be installed with a rated capacity equal to the required minimum capacity of the principal exhaust fan required by Article 9.32.3.4.

3) Where the installed capacity of the supply fan required by Sentence (2) exceeds the required minimum capacity by more than 50%, the supply fan shall be provided with controls which allow reduction of its flow to within ±10% of the required minimum capacity.

4) The principal exhaust fan control required by Sentence 9.32.3.4.(4) shall be wired in such a way that activation of the principal exhaust fan automatically activates the supply fan required in Sentence (2) and matches its flow to that of the principal exhaust fan.

5) Except where a heat recovery ventilator is used to introduce the outdoor air, the outdoor air shall be tempered before being circulated to living spaces by passing it over an electric duct heater or hydronic heating coil with a rated capacity not less than that given in Table 9.32.3.7.A.

6) The duct heater or heating coil required by Sentence (5) shall be controlled so that the air temperature downstream of the heat source does not fall below 12°C.

7) The duct heater or heating coil required by Sentence (5) shall be installed in accordance with Articles 9.33.4.1. and 9.33.5.2.

8) Except as provided in Sentence (9), outdoor air shall be distributed by a ductwork system from the supply fan required in Sentence (2) to
a) each bedroom,
b) any *storey* without a bedroom, and
c) if there is no *storey* without a bedroom, to the principal living area.

9) In a *dwelling unit* in which there is no *storey* without a bedroom, if an exhaust air intake for the principal exhaust fan required by Article 9.32.3.4. is located in the principal living area and the principal exhaust fan has no more than 2 exhaust air intakes located in other rooms, distribution of outdoor air to the living area is not required.

10) A duct from the outdoors to the supply fan required by Sentence (2) and a main distribution trunk duct shall be provided and shall be sized according to Subsection 9.33.4., except that the outdoor air duct and main distribution trunk duct are permitted to be sized according to Table 9.32.3.7.B. where
a) the total duct length from the outdoor hood to any supply register does not exceed 21 m, and
b) the total number of fittings does not exceed 8.

Table 9.32.3.7.A.
Minimum Output Capacity of Duct Heater or Heating Coil
Forming Part of Sentence 9.32.3.7.(5)

Required Minimum Capacity of Principal Exhaust Fan as per Sentence 9.32.3.4.(1), L/s	Minimum Output Capacity, kW				
	Outdoor Winter Design Temperature as per Article 2.2.1.1., °C				
	-15 or above	-16 to -20	-21 to -25	-26 to -30	-31 or below
20	0.6	0.8	0.9	1.0	1.1
25	0.8	1.0	1.1	1.3	1.4
30	1.0	1.2	1.3	1.5	1.7
35	1.1	1.3	1.6	1.8	2.0
40	1.3	1.5	1.8	2.0	2.3
> 40	design to Subsection 9.33.4.				

Table 9.32.3.7.B.
Minimum Outdoor Air and Main Trunk Duct Sizes
Forming Part of Sentence 9.32.3.7.(10)

Required Minimum Capacity of Principal Exhaust Fan as per Sentence 9.32.3.4.(1), L/s	Minimum Outdoor Air and Main Distribution Trunk Duct Diameter, mm	
	smooth duct	flexible duct
20	125	125
25	125	125
30	125	150
35	150	150
40	150	150
> 40	design to Subsection 9.33.4.	

11) In applying Table 9.32.3.7.B., where a heat recovery ventilator provides the principal supply fan and flexible ducting is used, the flexible duct diameter shall be increased by 25 mm.

12) The outdoor air duct required by Sentence (10) shall not be considered to provide combustion and/or dilution air to fuel-burning *appliances*.

13) Branch *supply ducts* leading from the main distribution trunk duct required by Sentence (10) to the rooms to which outdoor air is to be distributed shall be provided and shall be sized according to Subsection 9.33.4., except that the branch *supply ducts* are permitted to be sized according to Table 9.32.3.7.C. where

a) the total duct length from outdoor hood to supply register does not exceed 21 m, and
b) the total number of fittings does not exceed 8.

Table 9.32.3.7.C.
Minimum Branch Supply Duct Sizes
Forming Part of Sentence 9.32.3.7.(13)

Room, Space or *Storey* Served	Minimum Branch Supply Duct Diameter (smooth or flexible duct), mm
Master bedroom	100
Other bedrooms	75
Storey with no bedrooms	100
Principal living area	100

14) All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops shall be supplied with dampers that

a) are accessible,
b) can be adjusted,
c) can be fixed in their adjusted positions, and
d) include devices to indicate the positions of the dampers.

15) The air supply outlets through which outdoor air is delivered to the rooms shall be located in the ceiling or in a wall within 300 mm of the ceiling and shall be designed to promote diffusion across the ceiling.

16) Provision shall be made for the free flow of air to all rooms by leaving gaps beneath doors, using louvred doors or installing grilles in doors.

9.32.3.8. Protection Against Depressurization

1) Except as provided in Sentence (9), any mechanical air exhausting device, or group of devices operated by a single control, with a net exhaust capacity greater than 75 L/s, shall be provided with make-up air where the *dwelling unit*

a) is located in an area where *soil* gas is deemed to be a problem and incorporates no *soil* gas mitigation system, or
b) contains a fuel-fired *appliance* that is required to be vented and is vented through a *chimney*.

2) Where make-up air is required to reduce the net exhaust capacity of an air exhausting device to comply with Sentence (1), outdoor air shall be provided by a supply fan rated to deliver outdoor air at a rate of not less than the amount by which the net exhaust rate of the device exceeds 75 L/s and not more than that amount plus 75 L/s.

3) The supply fan required by Sentence (2) shall be wired so that it is activated whenever the device that is required by Sentence (1) to be supplied with make-up air is activated.

4) The outdoor air required by Sentence (2) shall be

a) introduced to a normally unoccupied area in the *dwelling unit*, or
b) tempered to at least 12°C before being introduced to occupied areas or to a *supply duct* system.

5) If the outdoor air required by Sentence (2) is not tempered upstream of the supply fan, the supply fan required in Sentence (2) shall be a fan designated by the manufacturer for the handling of untempered outdoor air.

6) A carbon monoxide detector conforming to CAN/CGA-6.19-M, "Residential Carbon Monoxide Detectors," shall be installed on or near the ceiling in each room in which there is installed a solid-fuel burning *appliance* that does not incorporate doors that substantially close off the firebox opening when the *appliance* is in operation.

7) The carbon monoxide detector required by Sentence (6) shall be permanently connected to an electrical circuit and shall have no disconnect switch between the overcurrent device and the carbon monoxide detector.

8) The carbon monoxide detector required by Sentence (6) shall

a) incorporate an integral alarm that satisfies the audibility requirements of CAN/CGA-6.19-M, "Residential Carbon Monoxide Detectors," or
b) be wired so that its activation will activate the *smoke alarm* system required by Subsection 9.10.18.

9) In a *dwelling unit* that is not located in an area where *soil* gas is deemed to be a problem or that incorporates a *soil* gas mitigation system, if all fuel-fired *appliances* that are required to be vented and are vented through a *chimney* are solid-fuel burning *appliances*, the make-up air provisions of Sentences (1) to (5) need not be complied with provided carbon monoxide detectors complying with Sentences (6), (7) and (8) are installed.

9.32.3.9. Fan Ratings

1) Except as provided in Sentence (3), capacity and sound ratings for required fans shall be determined in accordance with CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment."

2) Capacity ratings for required fans shall be based on a static pressure differential of 50 Pa, 25 Pa or 7.5 Pa, depending on whether the fan is installed with ductwork connected on both sides, one side or neither side, respectively.

3) Heat recovery ventilators used to provide one or more required fans shall be rated in accordance with CSA C439, "Standard Laboratory Methods of Test for Rating the Performance of Heat/Energy-Recovery Ventilators." r4

4) Except for heat recovery ventilators, supply and exhaust fans required to make up any part of the total ventilation capacity required by Article 9.32.3.3. shall have a sound rating not greater than that specified in Table 9.32.3.9. (See A-9.32.3. in Appendix A.)

Table 9.32.3.9.
Fan Sound Ratings
Forming Part of Sentence 9.32.3.9.(4)

Type of Fan	Maximum Sound Ratings	
	Sone	dBA
Principal exhaust	2.0	53
Kitchen	3.5	60
Bathroom or water-closet room	2.0	53
Supply	2.0	53

5) Required fans shall be installed according to the manufacturers' recommendations.

6) Mechanical ventilation devices shall conform to CSA C22.2 No. 113-M, "Fans and Ventilators."

9.32.3.10. Ducts

1) Except as provided in Sentence (6), ventilation ducts and their fittings shall conform to the requirements of Section 9.33. for *supply ducts* except that *exhaust ducts* that serve only a bathroom or water closet room are permitted to be of *combustible* material, provided the duct is reasonably airtight and constructed of a material impervious to water.

2) *Exhaust ducts* shall not discharge into heated or unheated enclosed spaces.

3) Where an *exhaust duct* passes through or is adjacent to unheated space, the duct shall be insulated to not less than RSI 0.5.

4) Where a duct carrying outdoor air that is not tempered and not mixed with indoor air passes through heated space, it shall be insulated to not less than RSI 0.5 except that, where such a duct is exposed for more than 3 m of length in the heated space and supplies outdoor air to a heat recovery ventilator, it shall be insulated as shown in Table 9.32.3.10.A.

5) A kitchen *exhaust duct* not equipped with a filter at the intake end shall be designed and installed so that the entire duct can be cleaned.

Table 9.32.3.10.A.
Insulation of Outdoor Air Ducts Serving Heat Recovery Ventilators
Forming Part of Sentence 9.32.3.10.(4)

Outside Winter Design Temperature as per Article 2.2.1.1., °C	Minimum Thermal Resistance, $m^2 \cdot °C/W$
above -11	0.5
-12 to -17	0.9
-18 to -24	1.2
-25 to -29	1.4
-30 to -34	1.8
below -35	2.1

6) Ductwork for *range* hoods and *range*-top fans shall
a) be of *noncombustible*, corrosion-resistant material,
b) lead directly to the outdoors without connection to other exhaust fans or ducts, and
c) be equipped with a grease filter at the intake.

7) All ductwork shall be permanently supported or clipped to prevent sagging, excessive movement and vibration.

8) All ducting connected to supply and exhaust fans shall be constructed so as to inhibit air leakage at joints.

9) Where rectangular duct is used in place of round duct, it shall be selected according to Table 9.32.3.10.B.

9.32.3.11. Heat Recovery Ventilators

1) Where a heat recovery ventilator is installed to provide one or more of the fans required by Articles 9.32.3.4. and 9.32.3.5., this Article shall apply.

2) Where a heat recovery ventilator is connected to a forced air heating system, the supply side of the ventilator shall be directly connected to the return air side of the forced air heating system.

3) Two or more heat recovery ventilators shall not be connected in parallel air flow to a common air *supply duct* unless specifically recommended by the manufacturer.

4) Two or more heat recovery ventilators shall not be connected in parallel air flow to a common downstream *exhaust duct*.

5) Heat recovery ventilators installed in unheated spaces shall be installed so as to avoid condensation of moisture on fans and motors in exhaust air, in accordance with the manufacturer's instructions.

Table 9.32.3.10.B.
Equivalent Duct Sizes
Forming Part of Sentence 9.32.3.10.(9)

Required Round Duct Size, mm	Permitted Equivalent Rectangular Duct Size, mm			
	Stack duct	100 mm depth	125 mm depth	150 mm depth
75	75 x 150	50 x 100	—	—
100	75 x 250	75 x 100	75 x 125	75 x 150
125	75 x 250	125 x 100	100 x 125	100 x 150
150	75 x 300	200 x 100	150 x 125	125 x 150
175	75 x 350	275 x 100	200 x 125	175 x 150
> 175	design to Subsection 9.33.4.			

6) All start-up procedures recommended by the manufacturer including air balancing and air-flow determination shall be followed.

7) Free flow of condensate shall be provided in accordance with the manufacturer's recommendations or, in their absence, a condensate drain of minimum 1/2 inch nominal pipe size pitched in the direction of flow and complete with a trap or condensate pump with sufficient capacity, shall be installed.

8) The heat recovery ventilator and all condensate lines shall be installed in a space where the ambient temperature will not adversely affect the operation of the system.

9) When operating at the rate required in Article 9.32.3.4., the supply and exhaust airflow rates of the heat recovery ventilator shall be balanced so that the value of the lesser flow shall be at least 90% of the value of the greater flow, unless otherwise recommended by the manufacturer.

9.32.3.12. Outdoor Intake and Exhaust Openings

1) Air intake and exhaust outlet openings shall be installed so as to avoid contamination of the ventilation air by the exhaust air.

2) Intake openings shall be located so as to avoid contamination of the ventilation air from other local sources such as automobile exhausts and exhaust from adjacent *buildings*.

3) The distance from the bottom of an air intake opening to finished ground or to any nearer and lower permanent horizontal surface shall be not less than 450 mm or the depth of expected snow accumulation, whichever is greater.

4) The distance separating air intakes from *building* envelope penetrations that are potential sources of contaminants, such as *gas vents* or oil fill pipes, shall be not less than 900 mm.

5) Air intakes shall be clearly labeled as such for identification from locations outside the *dwelling unit*.

6) The distance from the bottom of an exhaust outlet to finished ground or to any nearer and lower permanent horizontal surface shall be not less than 100 mm.

7) Where air intake and exhaust openings are in exposed locations, provision shall be made to protect them from the entry of precipitation by the use of louvres, weather cowls or other suitable protection.

8) Air intake openings shall incorporate screens or grilles to protect against the entry of animals and insects.

9) Except for exhaust outlets serving heat recovery ventilators, exhaust outlets shall incorporate backdraft dampers.

10) Where a backdraft damper required by Sentence (9) is not located at the *building* envelope, the exhaust outlet shall incorporate a screen, located at the *building* envelope, to protect against the entry of animals.

11) Where a screen or grille required by Sentences (8) or (10) has a mesh size of less than 6 mm,
- a) the screen or grille shall be removable for cleaning without need for special tools, and
- b) its gross area shall be at least 3 times the area of the duct served.

12) Screens and grilles shall be of corrosion-resistant material.

13) The net free area of an air intake or exhaust outlet shall be equal to or greater than the cross-sectional area of the duct served.

9.32.3.13. Installation

1) Installation of fans and heat recovery ventilators shall be in accordance with manufacturers' instructions for minimizing noise and vibration transmission and achieving the required sound rating.

2) Where flow-regulating dampers are required, they shall be adjustable and accessible without requiring the removal of fans, motors, or insulating materials and without the need for specialized tools.

3) Ventilation equipment shall be accessible for inspection, maintenance, repair and cleaning.

4) Ventilation equipment installed in unheated spaces shall be installed so as to avoid condensation of moisture on fans and motors in accordance with the manufacturers' instructions.

Section 9.33. Heating and Air-Conditioning

9.33.1. General

9.33.1.1. Application

1) This Section applies to the design and installation of heating systems, including requirements for combustion air, and air-conditioning systems serving only one *dwelling unit*.

2) The design and installation of heating systems, including requirements for combustion air, and air-conditioning systems other than those serving individual *dwelling units* shall conform to Part 6. (See Appendix A and Subsection 9.10.10.)

9.33.2. Required Heating Systems

9.33.2.1. Required Heating Systems

1) Residential *buildings* intended for use in the winter months on a continuing basis shall be equipped with heating facilities conforming to this Section.

9.33.3. Design Temperatures

9.33.3.1. Indoor Design Temperatures

1) At the outside winter design temperature, required heating facilities shall be capable of maintaining an indoor air temperature of not less than
a) 22°C in all living spaces,
b) 18°C in unfinished *basements*, and
c) 15°C in heated crawl spaces.

9.33.3.2. Outdoor Design Temperatures

1) The outdoor conditions to be used in designing heating and air-conditioning systems shall be determined in conformance with Subsection 2.2.1.

9.33.4. General Requirements for Heating and Air-Conditioning Systems

9.33.4.1. Design of Heating and Air-Conditioning Systems

1) Heating and air-conditioning systems, including ducting, and mechanical heating and refrigeration equipment, shall be designed, constructed and installed to conform to the relevant provincial, territorial or municipal regulations or, in the absence of such regulations, with good practice such as described in the ASHRAE Handbooks and Standards, the HRAI Digest, the Hydronics Institute Manuals and the SMACNA Manuals. (See also Subsection 9.32.3. for the design of systems that also provide ventilation.)

9.33.4.2. Access

1) Equipment forming part of a heating or air-conditioning system, with the exception of embedded pipes or ducts, shall be installed with provision for access for inspection, maintenance, repair and cleaning.

9.33.4.3. Protection from Freezing

1) Equipment forming part of a heating or air-conditioning system that may be adversely affected by freezing temperatures and that is located in an unheated area shall be protected from freezing.

9.33.4.4. Expansion, Contraction and System Pressure

1) Heating and cooling systems shall be designed to allow for expansion and contraction of the heat transfer fluid and to maintain the system pressure within the rated working pressure limits of all components of the system.

9.33.4.5. Structural Movement

1) Mechanical systems and equipment shall be designed and installed to accommodate the maximum amount of structural movement provided for in the construction of the *building*.

9.33.4.6. Asbestos

1) Asbestos shall not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

9.33.4.7. Contaminant Transfer r3

1) Systems serving garages, and systems serving other occupied parts of the *dwelling unit* but located in or running through a garage, shall be designed and constructed in a manner such that means are not provided for the transfer of contaminants from the garage into other spaces in the *dwelling unit*.

9.33.5. Heating and Air-Conditioning Appliances

9.33.5.1. Capacity of Heating Appliances

1) The required capacity of heating *appliances* located in a *dwelling unit* and serving only that *dwelling unit*, shall be determined in accordance with CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances," except that the design temperatures shall conform to Subsection 9.33.3.

9.33.5.2. Appliance Installation Standards

1) Except as provided in Articles 9.33.5.3. and 9.33.5.4., the installation of heating and air-conditioning equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to
a) CSA B51, "Boiler, Pressure Vessel, and Pressure Piping Code,"
b) CSA B52, "Mechanical Refrigeration Code," r

c) CSA B139, "Installation Code for Oil-Burning Equipment," r4
d) CSA B149.1, "Natural Gas and Propane Installation Code," r4
e) CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment," r4
f) CSA C22.1, "Canadian Electrical Code, Part I," or
g) CAN/CSA-C445-M, "Design and Installation of Earth Energy Heat Pump Systems for Residential and Other Small Buildings."

9.33.5.3. Solid-Fuel Burning Stoves, Ranges and Space Heaters

1) The design and installation of solid-fuel burning stoves, *ranges* and *space heaters*, including the requirements for combustion air, shall conform to CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment." r4

9.33.5.4. Fireplaces

1) Fireplaces shall conform to Section 9.22.

9.33.6. Air Duct Systems

9.33.6.1. Application

1) The design, construction and installation of air duct distribution systems serving heating systems in which the rated heat input does not exceed 120 kW shall conform to this Subsection.

2) Air duct distribution systems in which the rated heat input exceeds 120 kW shall conform to Part 6 and Subsection 3.6.5.

9.33.6.2. Materials in Air Duct Systems

1) Except as provided in Sentences (2) to (5) and in Article 3.6.4.3., all ducts, duct connectors, associated fittings and *plenums* used in air duct systems shall be constructed of steel, aluminum alloy, copper, clay, asbestos-cement or similar *noncombustible* material.

2) Ducts, associated fittings and *plenums* are permitted to contain *combustible* material provided they
a) conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110-M, "Fire Tests for Air Ducts,"
b) conform to Article 3.1.5.14. and Subsection 3.1.9.,
c) are not used in vertical runs serving more than 2 *storeys*, and
d) are not used in air duct systems in which the air temperature may exceed 120°C.

3) Duct sealants shall have a *flame-spread rating* of not more than 25 and a smoke developed classification of not more than 50.

4) Duct connectors that contain *combustible* materials and that are used between ducts and air outlet units shall
a) conform to the appropriate requirements for Class 1 air duct materials in CAN/ULC-S110-M, "Fire Tests for Air Ducts,"
b) be limited to 4 m in length,
c) be used only in horizontal runs, and
d) not penetrate required *fire separations*.

5) *Combustible* ducts that are part of a duct system carrying only ventilation air and that are contained entirely within a *dwelling unit* need not comply with the requirements of Sentences (1) to (4).

6) Materials referred to in Sentences (1) to (5), when used in a location where they may be subjected to excessive moisture, shall
a) have no appreciable loss of strength when wet, and
b) be corrosion-resistant.

9.33.6.3. Tape

1) Tape used for sealing duct joints in air ducts, *plenums* and other parts of air duct systems shall meet the flame-resistance requirements for fabric in CAN/ULC-S109-M, "Flame Tests of Flame-Resistant Fabrics and Films."

9.33.6.4. Coverings, Linings, Adhesives and Insulation

1) Coverings, linings and associated adhesives and insulation of air ducts, *plenums* and other parts of air duct systems shall be of *noncombustible* material when exposed to heated air or radiation from heat sources that would result in the exposed surface exceeding a temperature of 120°C.

2) Except as provided in Sentence (3), when *combustible* coverings and linings, including associated adhesives and insulation, are used, they shall have
a) a *flame-spread rating* of not more than 25 on any exposed surface or any surface that would be exposed by cutting through the material in any direction, and
b) a smoke developed classification of not more than 50.

3) The outer covering of ducts, *plenums* and other parts of air duct systems used within an assembly of *combustible construction* are permitted to have
a) an exposed surface *flame-spread rating* of not more than 75, and
b) a smoke developed classification greater than 50.

4) *Combustible* coverings and linings described in Sentences (2) and (3) shall not flame, glow, smoulder or smoke when tested in accordance with the method of test in ASTM C 411, "Hot-Surface Performance of High-Temperature Thermal Insulation," at the maximum temperature to which the coverings and linings are to be exposed in service.

5) Except as provided in Sentence (6), foamed plastic insulation shall not be used as part of an air duct or for insulating an air duct.

6) Foamed plastic insulation is permitted to be used in a ceiling space that acts as a return air *plenum* provided the foamed plastic insulation is protected from exposure to the *plenum* in accordance with Sentence 3.1.5.11.(2). e2

7) *Combustible* coverings and linings of ducts, including associated adhesives and insulation, shall be interrupted
a) at the immediate area of operation of heat sources in a duct system, such as electric resistance heaters or fuel-burning heaters or *furnaces*, and
b) where the duct penetrates a *fire separation*.

8) Linings of ducts shall be installed so that they will not interfere with the operation of volume or balancing dampers or of *fire dampers*, *fire stop flaps* and other *closures*.

9.33.6.5. Galvanized Steel or Aluminum Supply Ducts

1) Galvanized steel or aluminum *supply ducts* shall conform to Table 9.33.6.5.

2) The design of fittings for ducts shall conform to SMACNA, "HVAC Duct Construction Standards – Metal and Flexible," except that metal thicknesses shall conform to Table 9.33.6.5.

9.33.6.6. Construction of Ducts and Plenums

1) Rectangular panels in *plenums* and ducts more than 300 mm wide shall be shaped to provide sufficient stiffness.

2) Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space shall be fire stopped with *noncombustible* material at each end.

3) Ducts shall be securely supported by metal hangers, straps, lugs or brackets, except that, where zero clearance is permitted, wooden brackets are permitted to be used.

4) All round duct joints shall be tight-fitting and lapped not less than 25 mm.

5) Rectangular duct connections shall be made with S and drive cleats or equivalent mechanical connections.

6) Duct systems shall have no openings other than those required for the proper operation and maintenance of the system.

9.33.6.7. Installation of Ducts and Plenums

1) Air duct systems serving garages shall not be interconnected with other parts of the *dwelling unit*.

2) Trunk *supply ducts* shall not be nailed directly to wood members.

3) Branch ducts shall be supported at suitable spacings to maintain alignment and prevent sagging.

4) Ducts passing through unheated spaces shall have all joints taped or otherwise sealed to ensure that the ducts are airtight throughout their length.

Table 9.33.6.5.
Minimum Metal Thickness of Ducts
Forming Part of Article 9.33.6.5.

Type of Duct	Maximum Diameter, mm	Maximum Width or Depth, mm	Minimum metal thickness, mm	
			Duct Material	
			Galvanized Steel	Aluminum
Round ducts serving single *dwelling units*	125 or less	—	0.254	0.30
Round	350	—	0.33	0.30
	Over 350	—	0.41	0.41
Rectangular, enclosed	—	350	0.33	0.30
	—	Over 350	0.41	0.41
Rectangular, not enclosed, for single *dwelling units*, with required clearance up to 12 mm	—	350	0.33	0.41
	—	Over 350	0.41	0.48
Rectangular, not enclosed, with required clearance of more than 12 mm	—	350	0.41	0.41
	—	Over 350	0.48	0.48

5) *Combustible* ducts in concrete slabs-on-ground that are connected to a *furnace* supply *plenum* shall be located not closer than 600 mm to that *plenum* and not less than 600 mm from its connection to a riser or register.

6) Ducts in or beneath concrete slabs-on-ground shall be watertight and corrosion-, decay-, and mildew-resistant.

7) Underground ducts shall
a) be constructed to provide interior drainage from and access to all low points, and
b) not be connected directly to a sewer.

9.33.6.8. Clearances of Ducts and Plenums

1) The clearance of *furnace plenums* from *combustible* material shall conform to the appropriate standards in Sentence 9.33.5.2.(1).

2) Where the *plenum* clearance required in Sentence (1) is 75 mm or less, the clearance between a *supply duct* and *combustible* material shall
a) be equal to the required *plenum* clearance within 450 mm of the *plenum*, and
b) be not less than 12 mm at a distance of 450 mm or more from the *plenum*, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger. (See A-3.6.5.6.(2) in Appendix A.)

3) Where the *plenum* clearance required in Sentence (1) is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be
a) equal to the required *plenum* clearance within a horizontal distance of 1.8 m of the *plenum*, and
b) not less than 12 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger. (See A-3.6.5.6.(3) in Appendix A.)

4) Where the *plenum* clearance required in Sentence (1) is more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be
a) equal to the required *plenum* clearance within a horizontal distance of 1 m of the *plenum*,
b) not less than 150 mm within a horizontal distance between 1 m and 1.8 m from the *plenum*, and
c) not less than 25 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger. (See A-3.6.5.6.(4) in Appendix A.)

5) Where a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted in lieu of the clearances listed in Sentences (2), (3) and (4).

9.33.6.9. Ducting in or beneath Slabs-on-Ground

1) Warm-air supply systems for residential *buildings* built on concrete slabs-on-ground shall be installed in or beneath the slab and shall be of the perimeter loop type or radial perimeter type.

9.33.6.10. Adjustable Dampers and Balance Stops

1) All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops shall be supplied with adjustable dampers and fitted with devices to indicate the positions of the dampers.

9.33.6.11. Warm-Air Supply Outlets and Return Inlets — General

1) Supply outlets and return openings in the *dwelling unit*, when located less than 2 m above the floor, shall be protected by grills having openings of a size that will not allow the passage of a 15 mm diam sphere.

2) *Combustible* grills, diffusers and other devices for the supply and return air openings installed in walls and ceilings shall have a *flame-spread rating* of
a) not more than 200 in bathrooms, and
b) not more than 150 in rooms or spaces other than bathrooms.

9.33.6.12. Warm-Air Supply Outlets

1) In a *dwelling unit*, a warm-air supply outlet shall be provided in each finished room that is located adjacent to unheated space.

2) Except as provided in Sentence (3), when a room described in Sentence (1) is located adjacent to exterior walls, such outlet shall be located so as to bathe at least one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical.

3) Where the heating system is also designed to provide ventilation air, ceiling outlets or outlets located high on interior walls are permitted to be installed, provided the outlets are designed for this purpose and are installed with diffusers.

4) At least one warm-air supply outlet shall be provided for each 40 m² of floor surface area in unfinished *basements* serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm air throughout the *basement*.

5) At least one warm-air supply outlet shall be provided for each 80 m² of floor surface area in heated crawl spaces serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm air throughout the crawl space.

6) Except for pipeless *furnaces*, the capacity of warm-air supply outlets serving *dwelling units* shall be not less than the design heat loss from the area served and shall not exceed 3 kW per outlet.

7) In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces is permitted to be considered in calculating the design heat loss.

8) The temperature of supply air at warm-air supply outlets shall not exceed 70°C.

9) Warm-air supply outlets located in finished areas shall be provided with diffusers and adjustable openings and shall not be located on a *furnace plenum*.

9.33.6.13. Return-Air Inlets

1) Return-air inlets shall not be installed in an enclosed room or crawl space that provides combustion air to a *furnace*.

2) Except for unfinished areas and floor levels which are less than 900 mm above or below an adjacent floor level which is provided with a return-air inlet, at least one return-air inlet shall be provided in each floor level in a *dwelling unit*.

3) Provision shall be made for the return of air from all rooms by leaving gaps beneath doors, using louvred doors or installing *return duct* inlets.

9.33.6.14. Return-Air System

(See Appendix A.)

1) The return-air system shall be designed to handle the entire air supply.

2) Where any part of a *return duct* will be exposed to radiation from the *furnace* heat exchanger or other radiating part within the *furnace*, such part of a *return duct* directly above or within 600 mm of the outside *furnace* casing shall be *noncombustible*.

3) *Return ducts* serving solid-fuel fired *furnaces* shall be constructed of *noncombustible* material.

4) *Combustible return ducts* shall be lined with *noncombustible* material

a) below floor registers,
b) at the bottom of vertical ducts, and
c) under *furnaces* having a bottom return.

5) Spaces between studs used as *return ducts* shall be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

6) A vertical *return duct* shall have openings to return air on not more than one floor.

7) The return-air system shall be designed so that the negative pressure from the circulating fan cannot

a) affect the *furnace* combustion air supply, nor
b) draw combustion products from joints or openings in the *furnace* or *flue pipe*.

9.33.6.15. Filters and Odour Removal Equipment

1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in ULC-S111, "Fire Tests for Air Filter Units."

2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or, in *dwelling units*, when the *furnace* circulating fan is not operating.

3) When odour removal equipment of the adsorption type is used it shall be

a) installed to provide access so that adsorption material can be reactivated or renewed, and
b) protected from dust accumulation by air filters installed on the inlet side.

9.33.7. Radiators and Convectors

9.33.7.1. Recessed Radiators and Convectors

1) Every steam or hot water radiator and convector located in a recess or concealed space or attached to the face of a wall of *combustible construction* shall be provided with a *noncombustible* lining or backing.

9.33.7.2. Surface Temperature

1) The exposed surface temperature of a steam or hot water radiator shall not exceed 70°C unless precautions are taken to prevent human contact.

9.33.8. Piping for Heating and Cooling Systems

9.33.8.1. Piping Materials and Installation

1) Piping shall be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system. (See Articles 3.1.5.15., 3.1.9.1. and 9.10.9.6. for fire safety requirements.)

2) Every pipe used in a heating or air-conditioning system shall be installed to allow for expansion and contraction due to temperature changes.

3) Supports and anchors for piping in a heating or air-conditioning system shall be designed and installed to ensure that undue stress is not placed on the supporting structure.

9.33.8.2. Insulation and Coverings

1) Insulation and coverings on pipes shall be composed of material suitable for the operating temperature of the system to withstand deterioration from softening, melting, mildew and mould.

2) Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C
- a) shall be made of *noncombustible* material, or
- b) shall not flame, glow, smoulder or smoke when tested in accordance with ASTM C 411, "Hot-Surface Performance of High-Temperature Thermal Insulation," at the maximum temperature to which such insulation or covering is to be exposed in service.

3) Except as provided in Sentence (6), where *combustible* insulation is used on piping in a horizontal or *vertical service space*, the insulation and coverings on such pipes shall have a *flame-spread rating* throughout the material of not more than
- a) 25 in *buildings* of *noncombustible construction*, and
- b) 75 in *buildings* of *combustible construction*.

4) Except as provided in Sentence (6), insulation and coverings on piping located in rooms and spaces other than the *service spaces* described in Sentence (3) shall have a *flame-spread rating* not more than that required for the interior finish for the ceiling of the room or space.

5) Pipes that are exposed to human contact shall be insulated so that the exposed surface does not exceed 70°C. (See A-6.2.9.2.(2) in Appendix A.)

6) No *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is
- a) located within a concealed space in a wall,
- b) located in a floor slab, or
- c) enclosed in a *noncombustible* raceway or conduit.

9.33.8.3. Clearances

1) Clearances between *combustible* material and bare pipes carrying steam or hot water shall conform to Table 9.33.8.3.

Table 9.33.8.3.
Clearance between Steam or Hot Water Pipes and Combustible Material
Forming Part of Sentence 9.33.8.3.(1)

Steam or Water Temperature, °C	Minimum Clearance, mm
up to 120	15
above 120	25

9.33.8.4. Protection

1) Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction shall be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

2) Unprotected steam or hot water pipes that pass through a storage space shall be covered with not less than 25 mm thickness of *noncombustible* insulation to prevent direct contact with the material stored.

9.33.9. Refrigerating Systems and Equipment for Air-Conditioning

9.33.9.1. Cooling Units

1) Where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, the cooling unit shall be installed
- a) in parallel with the heating *furnace*,
- b) upstream of the *furnace*, provided the *furnace* is designed for such application, or
- c) downstream of the *furnace*, provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

9.33.10. Chimneys and Venting Equipment

9.33.10.1. Requirement for Venting

1) Except as provided in Article 9.33.10.2., the products of combustion from oil-, gas- and solid-fuel burning *appliances* shall be vented in conformance with the applicable *appliance* installation standard listed in Sentences 9.33.5.2.(1) and 9.33.5.3.(1).

9.33.10.2. Masonry or Concrete Chimneys

1) *Masonry or concrete chimneys* shall conform to Section 9.21.

Section 9.34. Electrical Facilities

9.34.1. General

9.34.1.1. Standard for Electrical Installations

1) Electrical installations, including the service capacity of the installation and the number and distribution of circuits and receptacles, shall meet the requirements of the appropriate provincial, territorial or municipal legislation or, in the absence of such legislation, shall conform to CSA C22.1, "Canadian Electrical Code, Part I."

9.34.1.2. Required Facilities

1) Where electrical services are available, electrical facilities shall be provided for every *building* in conformance with this Section.

9.34.1.3. Location of Equipment in Public Areas

1) Entrance switches, meters, panel boxes, splitter boxes, time clocks and other similar equipment shall not be located in any public area unless adequate precautions are taken to prevent interference with the equipment.

9.34.1.4. Recessed Lighting Fixtures

1) Recessed lighting fixtures shall not be located in insulated ceilings unless the fixtures are designed for such installations.

9.34.1.5. Wiring and Cables

1) Except as required in Sentence (2), electrical wiring and cables installed in *buildings* permitted to be of *combustible construction* shall conform to Sentence 3.1.4.3.(1).

2) Where a concealed space in a floor or ceiling assembly is used as a *plenum*, electrical wiring and cables within the *plenum* shall conform to Clause 3.6.4.3.(1)(a).

9.34.2. Lighting Outlets

9.34.2.1. Lighting of Entrances

1) An exterior lighting outlet with fixture controlled by a wall switch located within the *building* shall be provided at every entrance to *buildings* of *residential occupancy*.

9.34.2.2. Outlets in Dwelling Units

1) Except as provided in Sentence (2), a lighting outlet with fixture controlled by a wall switch shall be provided in kitchens, bedrooms, living rooms, utility rooms, laundry rooms, dining rooms, bathrooms, water-closet rooms, vestibules and hallways in *dwelling units*.

2) Where a receptacle controlled by a wall switch is provided in bedrooms or living rooms, such rooms need not conform to the requirements in Sentence (1).

9.34.2.3. Stairways

1) Every stairway shall be lighted.

2) Except as provided in Sentence (3), 3-way wall switches located at the head and foot of every stairway shall be provided to control at least one lighting outlet with fixture for stairways with 4 or more risers in *dwelling units*.

3) The stairway lighting for *basements* that do not contain finished space or lead to an outside entrance or built-in garage and which serve not more than one *dwelling unit* is permitted to be controlled by a single switch located at the head of the stairs.

9.34.2.4. Basements

1) A lighting outlet with fixture shall be provided for each 30 m^2 or fraction thereof of *floor area* in unfinished *basements*.

2) The outlet required in Sentence (1) nearest the stairs shall be controlled by a wall switch located at the head of the stairs.

9.34.2.5. Storage Rooms

1) A lighting outlet with fixture shall be provided in storage rooms.

9.34.2.6. Garages and Carports

1) A lighting outlet with fixture shall be provided for an attached, built-in or detached garage or carport.

2) Except as provided in Sentence (3), outlets required in Sentence (1) shall be controlled by a wall switch near the doorway.

3) Where the outlet and fixture required in Sentence (1) are ceiling mounted above an area not normally occupied by a parked car, or are wall mounted, a fixture with a built-in switch accessible to an adult of average height is permitted to be used.

4) Where a carport is lighted by a light at the entrance to a *dwelling unit*, additional carport lighting is not required.

9.34.2.7. Public and Service Areas

1) Every public or service area in *buildings* shall be provided with lighting outlets with fixtures controlled by a wall switch or panel to illuminate every portion of such areas.

2) When provided by incandescent lighting, illumination required in Sentence (1) shall conform to Table 9.34.2.7. (See Article 9.9.11.2. for lighting in *means of egress*.)

3) When other types of lighting are used, illumination equivalent to that shown in Table 9.34.2.7. shall be provided.

Table 9.34.2.7.
Lighting for Public Areas
Forming Part of Sentences 9.34.2.7.(2) and (3)

Room or Space	Minimum Illumination, lx	Minimum Lighting Power Density, W/m² of *floor area* (incandescent lighting)
Storage rooms	50	5
Service rooms and laundry areas	200	20
Garages	50	5
Public water closet rooms	100	10
Service hallways and stairways	50	5
Recreation rooms	100	10

9.34.3. Emergency Lighting

9.34.3.1. Criteria for Emergency Lighting

1) Emergency lighting shall conform to Subsection 9.9.11.

Section 9.35. Garages and Carports

9.35.1. Scope

9.35.1.1. Application

1) This Section applies to garages and carports serving not more than one *dwelling unit*.

9.35.1.2. Construction Requirements

1) The construction of a garage or carport shall conform to the requirements for other *buildings* in this Part except as provided in this Section.

9.35.2. General

9.35.2.1. Carport Considered to be Garage

1) Where a roofed enclosure used for the storage or parking of motor vehicles has more than 60% of the total perimeter enclosed by walls, doors or windows, the enclosure shall be considered a garage.

9.35.2.2. Garage Floor

1) Where an attached or built-in garage is provided, the garage floor shall be sloped to the outdoors.

9.35.3. Foundations

9.35.3.1. Foundation Required

1) Except as permitted in this Subsection, *foundations* conforming to Sections 9.12. and 9.15. shall be provided for the support of carport and garage super-structures, including that portion beneath garage doors.

9.35.3.2. Protection from Damage due to Soil Movement

1) In clay-type *soils* subject to significant movement with a change in *soil* moisture content, the *foundation* depth of carports or garages connected to a *dwelling unit* directly or by a breezeway shall be approximately the same depth as the main *building foundation*.

2) Where slab-on-ground construction is used, a construction joint shall be provided between the main *building* slab and a slab serving an attached garage, breezeway or carport.

3) Except as provided in Section 9.12., *foundations* for attached unheated garages or carports shall be below frost level.

9.35.3.3. Small Garages

1) Detached garages of less than 55 m² *floor area* and not more than 1 *storey* in height are permitted to be supported on wood mud sills provided the garage is not of masonry or masonry veneer construction.

9.35.3.4. Column Piers

1) Piers for the support of carport columns shall extend not less than 150 mm above ground level.

2) Piers referred to in Sentence (1) shall project not less than 25 mm beyond the base of the column but in no case be less than 190 mm by 190 mm in size.

9.35.4. Walls and Columns

9.35.4.1. Interior Finish

1) Interior finish need not be applied to garage and carport walls.

9.35.4.2. Columns

1) Columns for garages and carports shall conform to Section 9.17., except that 89 mm by 89 mm wood columns may be used.

9.35.4.3. Anchorage

1) Garage or carport walls and columns shall be anchored to the *foundation* to resist wind uplift in conformance with Subsection 9.23.6., except that where a garage is supported on the surface of the ground, ground anchors shall be provided to resist wind uplift.

Span Tables

Table A-1
Maximum Spans for Floor Joists – General Cases(1)
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			With Strapping			With Bridging			With Strapping and Bridging		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	2.13	1.97	1.73	2.19	1.99	1.73	2.19	1.99	1.73
		38 x 140	3.23	3.07	2.73	3.44	3.12	2.73	3.44	3.12	2.73
		38 x 184	3.88	3.69	3.51	4.18	3.92	3.59	4.37	4.07	3.59
		38 x 235	4.57	4.34	4.13	4.86	4.57	4.29	5.05	4.70	4.39
		38 x 286	5.21	4.95	4.71	5.49	5.16	4.85	5.66	5.28	4.92
	No. 1 and No. 2	38 x 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 x 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 x 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 x 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 x 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 x 89	1.90	1.69	1.38	1.95	1.69	1.38	1.95	1.69	1.38
		38 x 140	2.78	2.41	1.97	2.78	2.41	1.97	2.78	2.41	1.97
		38 x 184	3.38	2.93	2.39	3.38	2.93	2.39	3.38	2.93	2.39
		38 x 235	4.14	3.58	2.93	4.14	3.58	2.93	4.14	3.58	2.93
		38 x 286	4.80	4.16	3.39	4.80	4.16	3.39	4.80	4.16	3.39
	Construction	38 x 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 x 89	1.81	1.63	1.33	1.88	1.63	1.33	1.88	1.63	1.33
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	2.08	1.93	1.71	2.16	1.96	1.71	2.16	1.96	1.71
		38 x 140	3.18	3.03	2.69	3.39	3.08	2.69	3.39	3.08	2.69
		38 x 184	3.82	3.64	3.46	4.12	3.87	3.54	4.31	4.02	3.54
		38 x 235	4.50	4.28	4.08	4.80	4.51	4.23	4.98	4.64	4.33
		38 x 286	5.14	4.89	4.65	5.42	5.09	4.78	5.59	5.21	4.86
	No. 1 and No. 2	38 x 89	2.00	1.85	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 x 140	3.09	2.91	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 x 184	3.71	3.53	3.36	4.00	3.76	3.44	4.19	3.90	3.44
		38 x 235	4.38	4.16	3.96	4.66	4.38	4.11	4.84	4.51	4.20
		38 x 286	4.99	4.75	4.52	5.26	4.94	4.65	5.43	5.06	4.72
	No. 3	38 x 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
		38 x 140	2.99	2.78	2.43	3.19	2.90	2.43	3.19	2.90	2.43
		38 x 184	3.60	3.42	2.95	3.88	3.61	2.95	4.06	3.61	2.95
		38 x 235	4.24	4.03	3.61	4.51	4.24	3.61	4.68	4.37	3.61
		38 x 286	4.84	4.60	4.19	5.10	4.79	4.19	5.26	4.90	4.19
	Construction	38 x 89	1.90	1.77	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 x 89	1.81	1.68	1.39	1.96	1.71	1.39	1.96	1.71	1.39

Table A-1 (Continued)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			With Strapping			With Bridging			With Strapping and Bridging		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	1.95	1.81	1.64	2.06	1.87	1.64	2.06	1.87	1.64
		38 x 140	3.05	2.85	2.57	3.24	2.95	2.57	3.24	2.95	2.57
		38 x 184	3.66	3.48	3.31	3.94	3.70	3.38	4.12	3.84	3.38
		38 x 235	4.31	4.10	3.90	4.59	4.31	4.05	4.76	4.44	4.14
		38 x 286	4.91	4.67	4.45	5.18	4.87	4.57	5.34	4.98	4.64
	No. 1 and No. 2	38 x 89	1.86	1.72	1.58	1.99	1.81	1.58	1.99	1.81	1.58
		38 x 140	2.92	2.71	2.49	3.14	2.85	2.49	3.14	2.85	2.49
		38 x 184	3.54	3.36	3.20	3.81	3.58	3.27	3.99	3.72	3.27
		38 x 235	4.17	3.96	3.77	4.44	4.17	3.92	4.60	4.29	4.00
		38 x 286	4.75	4.52	4.30	5.01	4.71	4.42	5.17	4.82	4.49
	No. 3	38 x 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
		38 x 140	2.84	2.64	2.43	3.08	2.80	2.43	3.08	2.80	2.43
		38 x 184	3.47	3.30	2.95	3.74	3.52	2.95	3.92	3.61	2.95
		38 x 235	4.09	3.89	3.61	4.36	4.09	3.61	4.52	4.22	3.61
		38 x 286	4.67	4.44	4.19	4.92	4.62	4.19	5.08	4.73	4.19
	Construction	38 x 89	1.81	1.68	1.55	1.96	1.78	1.55	1.96	1.78	1.55
	Standard	38 x 89	1.70	1.58	1.44	1.88	1.71	1.44	1.88	1.71	1.44
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	1.65	1.53	1.42	1.84	1.68	1.46	1.84	1.68	1.46
		38 x 140	2.59	2.41	2.24	2.90	2.63	2.30	2.90	2.63	2.30
		38 x 184	3.27	3.11	2.94	3.52	3.31	3.03	3.69	3.44	3.03
		38 x 235	3.85	3.66	3.48	4.10	3.85	3.62	4.26	3.97	3.70
		38 x 286	4.39	4.18	3.97	4.63	4.35	4.09	4.78	4.45	4.15
	No. 1 and No. 2	38 x 89	1.59	1.48	1.37	1.80	1.64	1.43	1.80	1.64	1.43
		38 x 140	2.51	2.33	2.16	2.83	2.57	2.25	2.83	2.57	2.25
		38 x 184	3.19	3.04	2.84	3.44	3.23	2.96	3.60	3.36	2.96
		38 x 235	3.76	3.58	3.41	4.01	3.77	3.54	4.16	3.88	3.62
		38 x 286	4.29	4.08	3.88	4.53	4.25	4.00	4.67	4.35	4.06
	No. 3	38 x 89	1.54	1.43	1.32	1.74	1.57	1.36	1.76	1.60	1.36
		38 x 140	2.42	2.24	1.94	2.74	2.38	1.94	2.75	2.38	1.94
		38 x 184	3.12	2.90	2.37	3.35	2.90	2.37	3.35	2.90	2.37
		38 x 235	3.67	3.49	2.89	3.91	3.54	2.89	4.06	3.54	2.89
		38 x 286	4.19	3.98	3.36	4.42	4.11	3.36	4.55	4.11	3.36
	Construction	38 x 89	1.54	1.43	1.32	1.74	1.57	1.40	1.76	1.60	1.40
	Standard	38 x 89	1.48	1.37	1.15	1.63	1.41	1.15	1.63	1.41	1.15

Notes to Table A-1:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-2
Maximum Spans for Floor Joists – Special Cases(1)
Forming Part of Sentences 9.23.4.2.(1) and 9.23.4.4.(2)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Joists with Ceilings Attached to Wood Furring						Joists with Concrete Topping		
			Without Bridging			With Bridging			With or Without Bridging(2)		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	2.19	1.99	1.73	2.19	1.99	1.73	2.19	1.99	1.73
		38 x 140	3.44	3.12	2.73	3.44	3.12	2.73	3.44	3.12	2.73
		38 x 184	4.24	3.99	3.59	4.52	4.11	3.59	4.52	4.11	3.59
		38 x 235	4.98	4.69	4.29	5.47	5.20	4.58	5.77	5.24	4.58
		38 x 286	5.67	5.34	4.88	6.19	5.89	5.54	6.83	6.37	5.58
	No. 1 and No. 2	38 x 89	2.09	1.90	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 x 140	3.29	2.99	2.62	3.29	2.99	2.62	3.29	2.99	2.55
		38 x 184	4.06	3.83	3.44	4.33	3.93	3.44	4.33	3.81	3.11
		38 x 235	4.78	4.50	4.11	5.24	4.98	4.31	5.37	4.65	3.80
		38 x 286	5.44	5.12	4.68	5.93	5.64	5.00	6.24	5.40	4.41
	No. 3	38 x 89	1.95	1.69	1.38	1.95	1.69	1.38	1.72	1.49	1.21
		38 x 140	2.78	2.41	1.97	2.78	2.41	1.97	2.45	2.12	1.73
		38 x 184	3.38	2.93	2.39	3.38	2.93	2.39	2.98	2.58	2.11
		38 x 235	4.14	3.58	2.93	4.14	3.58	2.93	3.65	3.16	2.58
		38 x 286	4.80	4.16	3.39	4.80	4.16	3.39	4.23	3.66	2.99
	Construction	38 x 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 x 89	1.88	1.63	1.33	1.88	1.63	1.33	1.66	1.44	1.17
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	2.16	1.96	1.71	2.16	1.96	1.71	2.16	1.96	1.71
		38 x 140	3.39	3.08	2.69	3.39	3.08	2.69	3.39	3.08	2.69
		38 x 184	4.18	3.94	3.54	4.46	4.05	3.54	4.46	4.05	3.54
		38 x 235	4.92	4.63	4.23	5.39	5.13	4.52	5.69	5.17	4.52
		38 x 286	5.60	5.27	4.82	6.10	5.81	5.47	6.74	6.28	5.50
	No. 1 and No. 2	38 x 89	2.09	1.90	1.66	2.09	1.90	1.66	2.09	1.90	1.66
		38 x 140	3.29	2.99	2.62	3.29	2.99	2.62	3.29	2.99	2.62
		38 x 184	4.06	3.83	3.44	4.33	3.93	3.44	4.33	3.93	3.26
		38 x 235	4.78	4.50	4.11	5.24	4.98	4.39	5.53	4.88	3.99
		38 x 286	5.44	5.12	4.68	5.93	5.64	5.25	6.54	5.66	4.63
	No. 3	38 x 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.83	1.50
		38 x 140	3.19	2.90	2.43	3.19	2.90	2.43	3.02	2.62	2.14
		38 x 184	3.94	3.61	2.95	4.17	3.61	2.95	3.68	3.18	2.60
		38 x 235	4.63	4.36	3.61	5.08	4.42	3.61	4.50	3.89	3.18
		38 x 286	5.27	4.96	4.19	5.74	5.13	4.19	5.22	4.52	3.69
	Construction	38 x 89	2.03	1.84	1.61	2.03	1.84	1.61	2.03	1.84	1.61
	Standard	38 x 89	1.96	1.71	1.39	1.96	1.71	1.39	1.74	1.50	1.23

Table A-2 (Continued)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Joists with Ceilings Attached to Wood Furring						Joists with Concrete Topping		
			Without Bridging			With Bridging			With or Without Bridging(2)		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	2.06	1.87	1.64	2.06	1.87	1.64	2.06	1.87	1.64
		38 x 140	3.24	2.95	2.57	3.24	2.95	2.57	3.24	2.95	2.57
		38 x 184	4.00	3.77	3.38	4.26	3.87	3.38	4.26	3.87	3.38
		38 x 235	4.70	4.43	4.05	5.16	4.91	4.32	5.45	4.95	4.32
		38 x 286	5.35	5.04	4.61	5.84	5.55	5.23	6.45	6.01	5.26
	No. 1 and No. 2	38 x 89	1.99	1.81	1.58	1.99	1.81	1.58	1.99	1.81	1.58
		38 x 140	3.14	2.85	2.49	3.14	2.85	2.49	3.14	2.85	2.49
		38 x 184	3.87	3.64	3.27	4.12	3.75	3.27	4.12	3.75	3.27
		38 x 235	4.55	4.28	3.91	4.99	4.75	4.18	5.27	4.79	4.13
		38 x 286	5.18	4.88	4.46	5.65	5.37	5.06	6.23	5.81	4.79
	No. 3	38 x 89	1.96	1.78	1.55	1.96	1.78	1.55	1.96	1.78	1.50
		38 x 140	3.08	2.80	2.43	3.08	2.80	2.43	3.02	2.62	2.14
		38 x 184	3.80	3.58	2.95	4.05	3.61	2.95	3.68	3.18	2.60
		38 x 235	4.47	4.21	3.61	4.90	4.42	3.61	4.50	3.89	3.18
		38 x 286	5.09	4.79	4.19	5.55	5.13	4.19	5.22	4.52	3.69
	Construction	38 x 89	1.96	1.78	1.55	1.96	1.78	1.55	1.96	1.78	1.55
	Standard	38 x 89	1.88	1.71	1.44	1.88	1.71	1.44	1.80	1.56	1.27
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	1.84	1.68	1.46	1.84	1.68	1.46	1.84	1.68	1.46
		38 x 140	2.90	2.63	2.30	2.90	2.63	2.30	2.90	2.63	2.30
		38 x 184	3.58	3.37	3.03	3.81	3.46	3.03	3.81	3.46	3.03
		38 x 235	4.20	3.96	3.62	4.61	4.39	3.86	4.87	4.42	3.86
		38 x 286	4.79	4.51	4.12	5.22	4.96	4.68	5.76	5.37	4.54
	No. 1 and No. 2	38 x 89	1.80	1.64	1.43	1.80	1.64	1.43	1.80	1.64	1.43
		38 x 140	2.83	2.57	2.25	2.83	2.57	2.25	2.83	2.57	2.23
		38 x 184	3.50	3.29	2.96	3.72	3.38	2.96	3.72	3.32	2.71
		38 x 235	4.11	3.87	3.54	4.51	4.29	3.76	4.69	4.06	3.31
		38 x 286	4.68	4.40	4.03	5.10	4.85	4.36	5.44	4.71	3.84
	No. 3	38 x 89	1.76	1.60	1.36	1.76	1.60	1.36	1.70	1.47	1.20
		38 x 140	2.75	2.38	1.94	2.75	2.38	1.94	2.42	2.10	1.71
		38 x 184	3.35	2.90	2.37	3.35	2.90	2.37	2.95	2.55	2.08
		38 x 235	4.01	3.54	2.89	4.09	3.54	2.89	3.61	3.12	2.55
		38 x 286	4.56	4.11	3.36	4.75	4.11	3.36	4.18	3.62	2.96
	Construction	38 x 89	1.76	1.60	1.40	1.76	1.60	1.40	1.76	1.60	1.37
	Standard	38 x 89	1.63	1.41	1.15	1.63	1.41	1.15	1.44	1.25	1.02

Notes to Table A-2:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

(2) No bridging is assumed for spans for floor joists with concrete topping.

Table A-3
Maximum Spans for Ceiling Joists – Attic not Accessible by a Stairway
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m Joist Spacing, mm 300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	3.41	3.10	2.71
		38 x 140	5.37	4.88	4.26
		38 x 184	7.05	6.41	5.60
		38 x 235	9.01	8.18	7.15
		38 x 286	10.96	9.96	8.70
	No. 1 and No. 2	38 x 89	3.27	2.97	2.59
		38 x 140	5.14	4.67	4.08
		38 x 184	6.76	6.14	5.36
		38 x 235	8.63	7.84	6.85
		38 x 286	10.50	9.54	8.34
	No. 3	38 x 89	3.17	2.88	2.42
		38 x 140	4.89	4.23	3.46
		38 x 184	5.95	5.15	4.20
		38 x 235	7.27	6.30	5.14
		38 x 286	8.44	7.31	5.97
	Construction	38 x 89	3.17	2.88	2.51
	Standard	38 x 89	3.06	2.78	2.34
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	3.36	3.06	2.67
		38 x 140	5.29	4.81	4.20
		38 x 184	6.96	6.32	5.52
		38 x 235	8.88	8.07	7.05
		38 x 286	10.81	9.82	8.58
	No. 1 and No. 2	38 x 89	3.27	2.97	2.59
		38 x 140	5.14	4.67	4.08
		38 x 184	6.76	6.14	5.36
		38 x 235	8.63	7.84	6.85
		38 x 286	10.50	9.54	8.34
	No. 3	38 x 89	3.17	2.88	2.51
		38 x 140	4.98	4.53	3.95
		38 x 184	6.55	5.95	5.19
		38 x 235	8.36	7.60	6.34
		38 x 286	10.18	9.01	7.36
	Construction	38 x 89	3.17	2.88	2.50
	Standard	38 x 89	3.06	2.78	2.43

Table A-3 (Continued)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m Joist Spacing, mm 300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	3.22	2.92	2.55
		38 x 140	5.06	4.60	4.02
		38 x 184	6.65	6.05	5.28
		38 x 235	8.50	7.72	6.74
		38 x 286	10.34	9.40	8.21
	No. 1 and No. 2	38 x 89	3.11	2.83	2.47
		38 x 140	4.90	4.45	3.89
		38 x 184	6.44	5.85	5.11
		38 x 235	8.22	7.47	6.52
		38 x 286	10.00	9.09	7.94
	No. 3	38 x 89	3.06	2.78	2.43
		38 x 140	4.81	4.37	3.82
		38 x 184	6.32	5.74	5.02
		38 x 235	8.07	7.33	6.34
		38 x 286	9.82	8.93	7.36
	Construction	38 x 89	3.06	2.78	2.43
	Standard	38 x 89	2.94	2.67	2.33
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	2.88	2.61	2.28
		38 x 140	4.53	4.11	3.59
		38 x 184	5.95	5.40	4.72
		38 x 235	7.60	6.90	6.03
		38 x 286	9.25	8.40	7.34
	No. 1 and No. 2	38 x 89	2.81	2.55	2.23
		38 x 140	4.42	4.02	3.51
		38 x 184	5.81	5.28	4.61
		38 x 235	7.42	6.74	5.89
		38 x 286	9.03	8.21	7.17
	No. 3	38 x 89	2.74	2.49	2.18
		38 x 140	4.31	3.92	3.42
		38 x 184	5.67	5.09	4.16
		38 x 235	7.19	6.23	5.08
		38 x 286	8.34	7.23	5.90
	Construction	38 x 89	2.74	2.49	2.18
	Standard	38 x 89	2.67	2.43	2.03

Span Tables

Table A-4
Maximum Spans for Roof Joists – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	2.71	2.46	2.15	2.37	2.15	1.88	2.15	1.95	1.71
		38 x 140	4.26	3.87	3.38	3.72	3.38	2.95	3.38	3.07	2.68
		38 x 184	5.60	5.09	4.44	4.89	4.44	3.88	4.44	4.04	3.53
		38 x 235	7.15	6.49	5.67	6.24	5.67	4.96	5.67	5.15	4.50
		38 x 286	8.70	7.90	6.91	7.60	6.91	6.03	6.91	6.27	5.48
	No. 1 and No. 2	38 x 89	2.59	2.36	2.06	2.27	2.06	1.80	2.06	1.87	1.63
		38 x 140	4.08	3.71	3.24	3.57	3.24	2.83	3.24	2.94	2.57
		38 x 184	5.36	4.87	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 x 235	6.85	6.22	5.44	5.98	5.44	4.74	5.44	4.94	4.22
		38 x 286	8.34	7.57	6.40	7.28	6.62	5.50	6.62	6.00	4.90
	No. 3	38 x 89	2.49	2.16	1.76	2.14	1.85	1.51	1.91	1.65	1.35
		38 x 140	3.56	3.08	2.51	3.06	2.65	2.16	2.72	2.36	1.92
		38 x 184	4.33	3.75	3.06	3.72	3.22	2.63	3.31	2.87	2.34
		38 x 235	5.29	4.58	3.74	4.55	3.94	3.22	4.05	3.51	2.86
		38 x 286	6.14	5.32	4.34	5.28	4.57	3.73	4.70	4.07	3.32
	Construction	38 x 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
	Standard	38 x 89	2.41	2.08	1.70	2.07	1.79	1.46	1.84	1.60	1.30
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	2.67	2.43	2.12	2.33	2.12	1.85	2.12	1.93	1.68
		38 x 140	4.20	3.82	3.33	3.67	3.33	2.91	3.33	3.03	2.65
		38 x 184	5.52	5.02	4.38	4.82	4.38	3.83	4.38	3.98	3.48
		38 x 235	7.05	6.41	5.60	6.16	5.60	4.89	5.60	5.09	4.44
		38 x 286	8.58	7.80	6.81	7.50	6.81	5.95	6.81	6.19	5.41
	No. 1 and No. 2	38 x 89	2.59	2.36	2.06	2.27	2.06	1.80	2.06	1.87	1.63
		38 x 140	4.08	3.71	3.24	3.57	3.24	2.83	3.24	2.94	2.57
		38 x 184	5.36	4.87	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 x 235	6.85	6.22	5.44	5.98	5.44	4.75	5.44	4.94	4.32
		38 x 286	8.34	7.57	6.62	7.28	6.62	5.77	6.62	6.01	5.25
	No. 3	38 x 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
		38 x 140	3.95	3.59	3.10	3.45	3.14	2.67	3.14	2.85	2.37
		38 x 184	5.20	4.62	3.77	4.54	3.97	3.24	4.09	3.54	2.89
		38 x 235	6.53	5.65	4.61	5.61	4.86	3.97	5.00	4.33	3.53
		38 x 286	7.57	6.56	5.35	6.51	5.64	4.60	5.80	5.02	4.10
	Construction	38 x 89	2.51	2.28	1.99	2.20	1.99	1.74	1.99	1.81	1.58
	Standard	38 x 89	2.43	2.18	1.78	2.12	1.88	1.53	1.93	1.67	1.36

Table A-4 (Continued)

Commercial Designation	Grade	Joist Size, mm	Maximum Span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	2.55	2.32	2.03	2.23	2.03	1.77	2.03	1.84	1.61
		38 x 140	4.02	3.65	3.19	3.51	3.19	2.79	3.19	2.90	2.53
		38 x 184	5.28	4.80	4.19	4.61	4.19	3.66	4.19	3.81	3.33
		38 x 235	6.74	6.13	5.35	5.89	5.35	4.68	5.35	4.86	4.25
		38 x 286	8.21	7.46	6.52	7.17	6.52	5.69	6.52	5.92	5.17
	No. 1 and No. 2	38 x 89	2.47	2.24	1.96	2.16	1.96	1.71	1.96	1.78	1.56
		38 x 140	3.89	3.53	3.08	3.40	3.08	2.69	3.08	2.80	2.45
		38 x 184	5.11	4.64	4.05	4.46	4.05	3.54	4.05	3.68	3.22
		38 x 235	6.52	5.93	5.18	5.70	5.18	4.52	5.18	4.70	4.11
		38 x 286	7.94	7.21	6.30	6.94	6.30	5.50	6.30	5.73	5.00
	No. 3	38 x 89	2.43	2.20	1.93	2.12	1.93	1.68	1.93	1.75	1.53
		38 x 140	3.82	3.47	3.03	3.33	3.03	2.65	3.03	2.75	2.37
		38 x 184	5.02	4.56	3.77	4.38	3.97	3.24	3.98	3.54	2.89
		38 x 235	6.41	5.65	4.61	5.60	4.86	3.97	5.00	4.33	3.53
		38 x 286	7.57	6.56	5.35	6.51	5.64	4.60	5.80	5.02	4.10
	Construction	38 x 89	2.43	2.20	1.93	2.12	1.93	1.68	1.93	1.75	1.53
	Standard	38 x 89	2.33	2.12	1.85	2.04	1.85	1.59	1.85	1.68	1.41
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	2.28	2.07	1.81	1.99	1.81	1.58	1.81	1.65	1.44
		38 x 140	3.59	3.26	2.85	3.14	2.85	2.49	2.85	2.59	2.26
		38 x 184	4.72	4.29	3.75	4.12	3.75	3.27	3.75	3.40	2.97
		38 x 235	6.03	5.48	4.79	5.27	4.79	4.18	4.79	4.35	3.80
		38 x 286	7.34	6.67	5.82	6.41	5.82	5.09	5.82	5.29	4.62
	No. 1 and No. 2	38 x 89	2.23	2.03	1.77	1.95	1.77	1.55	1.77	1.61	1.41
		38 x 140	3.51	3.19	2.79	3.07	2.79	2.43	2.79	2.53	2.21
		38 x 184	4.61	4.19	3.66	4.03	3.66	3.20	3.66	3.33	2.91
		38 x 235	5.89	5.35	4.68	5.15	4.68	4.09	4.68	4.25	3.68
		38 x 286	7.17	6.52	5.58	6.26	5.69	4.80	5.69	5.17	4.27
	No. 3	38 x 89	2.18	1.98	1.73	1.90	1.73	1.50	1.73	1.57	1.33
		38 x 140	3.42	3.05	2.49	2.99	2.62	2.14	2.69	2.33	1.90
		38 x 184	4.28	3.71	3.03	3.68	3.19	2.60	3.28	2.84	2.32
		38 x 235	5.23	4.53	3.70	4.50	3.90	3.18	4.01	3.47	2.83
		38 x 286	6.07	5.26	4.29	5.22	4.52	3.69	4.65	4.03	3.29
	Construction	38 x 89	2.18	1.98	1.73	1.90	1.73	1.51	1.73	1.57	1.37
	Standard	38 x 89	2.09	1.81	1.48	1.80	1.56	1.27	1.60	1.38	1.13

Table A-5
Maximum Spans for Roof Joists – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Joist Size, mm	Maximum span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	1.99	1.81	1.58	1.88	1.71	1.49
		38 x 140	3.14	2.85	2.49	2.95	2.68	2.34
		38 x 184	4.12	3.75	3.27	3.88	3.53	3.08
		38 x 235	5.27	4.79	4.18	4.96	4.50	3.93
		38 x 286	6.41	5.82	5.09	6.03	5.48	4.79
	No. 1 and No. 2	38 x 89	1.91	1.74	1.52	1.80	1.63	1.43
		38 x 140	3.01	2.73	2.39	2.83	2.57	2.25
		38 x 184	3.95	3.59	3.14	3.72	3.38	2.90
		38 x 235	5.05	4.59	3.84	4.75	4.32	3.55
		38 x 286	6.14	5.46	4.46	5.78	5.05	4.12
	No. 3	38 x 89	1.74	1.50	1.23	1.60	1.39	1.13
		38 x 140	2.48	2.15	1.75	2.29	1.98	1.62
		38 x 184	3.01	2.61	2.13	2.79	2.41	1.97
		38 x 235	3.69	3.19	2.61	3.41	2.95	2.41
		38 x 286	4.28	3.70	3.03	3.95	3.42	2.79
	Construction	38 x 89	1.85	1.68	1.47	1.74	1.58	1.38
	Standard	38 x 89	1.68	1.45	1.19	1.55	1.34	1.10
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	1.97	1.79	1.56	1.85	1.68	1.47
		38 x 140	3.10	2.81	2.46	2.91	2.65	2.31
		38 x 184	4.07	3.70	3.23	3.83	3.48	3.04
		38 x 235	5.20	4.72	4.12	4.89	4.44	3.88
		38 x 286	6.32	5.75	5.02	5.95	5.41	4.72
	No. 1 and No. 2	38 x 89	1.91	1.74	1.52	1.80	1.63	1.43
		38 x 140	3.01	2.73	2.39	2.83	2.57	2.25
		38 x 184	3.95	3.59	3.14	3.72	3.38	2.95
		38 x 235	5.05	4.59	4.01	4.75	4.32	3.72
		38 x 286	6.14	5.58	4.68	5.78	5.25	4.32
	No. 3	38 x 89	1.85	1.68	1.47	1.74	1.58	1.38
		38 x 140	2.91	2.65	2.16	2.74	2.45	2.00
		38 x 184	3.72	3.22	2.63	3.44	2.98	2.43
		38 x 235	4.55	3.94	3.22	4.20	3.64	2.97
		38 x 286	5.28	4.57	3.73	4.88	4.22	3.45
	Construction	38 x 89	1.85	1.68	1.47	1.74	1.58	1.38
	Standard	38 x 89	1.76	1.52	1.24	1.62	1.40	1.15

Table A-5 (Continued)

Commercial Designation	Grade	Joist Size, mm	Maximum span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Joist Spacing, mm			Joist Spacing, mm		
			300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	1.88	1.71	1.49	1.77	1.61	1.41
		38 x 140	2.96	2.69	2.35	2.79	2.53	2.21
		38 x 184	3.89	3.54	3.09	3.66	3.33	2.91
		38 x 235	4.97	4.52	3.94	4.68	4.25	3.71
		38 x 286	6.05	5.50	4.80	5.69	5.17	4.52
	No. 1 and No. 2	38 x 89	1.82	1.65	1.44	1.71	1.56	1.36
		38 x 140	2.86	2.60	2.27	2.69	2.45	2.14
		38 x 184	3.76	3.42	2.99	3.54	3.22	2.81
		38 x 235	4.81	4.37	3.82	4.52	4.11	3.59
		38 x 286	5.85	5.31	4.64	5.50	5.00	4.37
	No. 3	38 x 89	1.79	1.62	1.42	1.68	1.53	1.34
		38 x 140	2.81	2.56	2.16	2.65	2.40	2.00
		38 x 184	3.70	3.22	2.63	3.44	2.98	2.43
		38 x 235	4.55	3.94	3.22	4.20	3.64	2.97
		38 x 286	5.28	4.57	3.73	4.88	4.22	3.45
	Construction	38 x 89	1.79	1.62	1.42	1.68	1.53	1.34
	Standard	38 x 89	1.72	1.56	1.29	1.62	1.46	1.19
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	1.68	1.53	1.34	1.58	1.44	1.26
		38 x 140	2.65	2.40	2.10	2.49	2.26	1.98
		38 x 184	3.48	3.16	2.76	3.27	2.97	2.60
		38 x 235	4.44	4.04	3.53	4.18	3.80	3.32
		38 x 286	5.41	4.91	4.29	5.09	4.62	4.04
	No. 1 and No. 2	38 x 89	1.64	1.49	1.31	1.55	1.41	1.23
		38 x 140	2.59	2.35	2.05	2.43	2.21	1.93
		38 x 184	3.40	3.09	2.70	3.20	2.91	2.53
		38 x 235	4.34	3.94	3.35	4.09	3.71	3.10
		38 x 286	5.28	4.76	3.89	4.97	4.40	3.59
	No. 3	38 x 89	1.60	1.46	1.21	1.51	1.37	1.12
		38 x 140	2.45	2.12	1.73	2.26	1.96	1.60
		38 x 184	2.98	2.58	2.11	2.76	2.39	1.95
		38 x 235	3.65	3.16	2.58	3.37	2.92	2.38
		38 x 286	4.23	3.66	2.99	3.91	3.39	2.76
	Construction	38 x 89	1.60	1.46	1.27	1.51	1.37	1.20
	Standard	38 x 89	1.46	1.26	1.03	1.34	1.16	0.95

Table A-6
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 1.0 to 2.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Rafter Spacing, mm			Rafter Spacing, mm			Rafter Spacing, mm		
			300	400	600	300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	3.41	3.10	2.71	2.98	2.71	2.37	2.71	2.46	2.15
		38 x 140	5.37	4.88	4.26	4.69	4.26	3.72	4.26	3.87	3.38
		38 x 184	7.05	6.41	5.60	6.16	5.60	4.89	5.60	5.09	4.44
		38 x 235	9.01	8.18	7.15	7.87	7.15	6.24	7.15	6.49	5.62
		38 x 286	10.96	9.96	8.70	9.58	8.70	7.40	8.70	7.90	6.52
	No. 1 and No. 2	38 x 89	3.27	2.97	2.59	2.86	2.59	2.27	2.59	2.36	2.06
		38 x 140	5.14	4.67	3.95	4.49	4.08	3.34	4.08	3.60	2.94
		38 x 184	6.76	5.88	4.80	5.74	4.97	4.06	5.06	4.38	3.58
		38 x 235	8.30	7.19	5.87	7.02	6.08	4.96	6.19	5.36	4.38
		38 x 286	9.63	8.34	6.81	8.14	7.05	5.76	7.18	6.22	5.08
	No. 3	38 x 89	2.65	2.30	1.87	2.24	1.94	1.58	1.98	1.71	1.40
		38 x 140	3.78	3.28	2.68	3.20	2.77	2.26	2.82	2.44	1.99
		38 x 184	4.61	3.99	3.26	3.89	3.37	2.75	3.43	2.97	2.43
		38 x 235	5.63	4.88	3.98	4.76	4.12	3.37	4.20	3.64	2.97
		38 x 286	6.53	5.66	4.62	5.52	4.78	3.91	4.87	4.22	3.44
	Construction	38 x 89	3.17	2.88	2.42	2.77	2.50	2.04	2.51	2.21	1.80
	Standard	38 x 89	2.56	2.22	1.81	2.17	1.88	1.53	1.91	1.65	1.35
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	3.36	3.06	2.67	2.94	2.67	2.33	2.67	2.43	2.12
		38 x 140	5.29	4.81	4.20	4.62	4.20	3.67	4.20	3.82	3.33
		38 x 184	6.96	6.32	5.52	6.08	5.52	4.82	5.52	5.02	4.38
		38 x 235	8.88	8.07	7.05	7.76	7.05	6.16	7.05	6.41	5.54
		38 x 286	10.81	9.82	8.58	9.45	8.58	7.28	8.58	7.80	6.42
	No. 1 and No. 2	38 x 89	3.27	2.97	2.59	2.86	2.59	2.27	2.59	2.36	2.06
		38 x 140	5.14	4.67	4.08	4.49	4.08	3.50	4.08	3.71	3.08
		38 x 184	6.76	6.14	5.04	5.90	5.21	4.26	5.31	4.60	3.75
		38 x 235	8.63	7.54	6.16	7.36	6.37	5.20	6.49	5.62	4.59
		38 x 286	10.11	8.75	7.15	8.54	7.40	6.04	7.53	6.52	5.33
	No. 3	38 x 89	3.17	2.83	2.31	2.76	2.39	1.95	2.44	2.11	1.72
		38 x 140	4.67	4.04	3.30	3.95	3.42	2.79	3.48	3.01	2.46
		38 x 184	5.68	4.92	4.02	4.80	4.16	3.40	4.23	3.67	2.99
		38 x 235	6.95	6.02	4.91	5.87	5.08	4.15	5.18	4.48	3.66
		38 x 286	8.06	6.98	5.70	6.81	5.90	4.82	6.01	5.20	4.25
	Construction	38 x 89	3.17	2.88	2.51	2.77	2.51	2.14	2.51	2.28	1.89
	Standard	38 x 89	2.68	2.32	1.90	2.27	1.96	1.60	2.00	1.73	1.41

Table A-6 (Continued)

Commercial Designation	Grade	Rafter Size, mm	Maximum span, m								
			Specified Snow Load, kPa								
			1.0			1.5			2.0		
			Rafter Spacing, mm			Rafter Spacing, mm			Rafter Spacing, mm		
			300	400	600	300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	3.22	2.92	2.55	2.81	2.55	2.23	2.55	2.32	2.03
		38 x 140	5.06	4.60	4.02	4.42	4.02	3.51	4.02	3.65	3.19
		38 x 184	6.65	6.05	5.28	5.81	5.28	4.61	5.28	4.80	4.19
		38 x 235	8.50	7.72	6.74	7.42	6.74	5.89	6.74	6.13	5.35
		38 x 286	10.34	9.40	8.21	9.03	8.21	7.17	8.21	7.46	6.52
	No. 1 and No. 2	38 x 89	3.11	2.83	2.47	2.72	2.47	2.16	2.47	2.24	1.96
		38 x 140	4.90	4.45	3.89	4.28	3.89	3.40	3.89	3.53	3.08
		38 x 184	6.44	5.85	5.11	5.62	5.11	4.41	5.11	4.64	3.89
		38 x 235	8.22	7.47	6.38	7.18	6.52	5.39	6.52	5.82	4.75
		38 x 286	10.00	9.06	7.40	8.74	7.66	6.25	7.80	6.76	5.52
	No. 3	38 x 89	3.06	2.78	2.31	2.67	2.39	1.95	2.43	2.11	1.72
		38 x 140	4.67	4.04	3.30	3.95	3.42	2.79	3.48	3.01	2.46
		38 x 184	5.68	4.92	4.02	4.80	4.16	3.40	4.23	3.67	2.99
		38 x 235	6.95	6.02	4.91	5.87	5.08	4.15	5.18	4.48	3.66
		38 x 286	8.06	6.98	5.70	6.81	5.90	4.82	6.01	5.20	4.25
	Construction	38 x 89	3.06	2.78	2.43	2.67	2.43	2.12	2.43	2.20	1.93
	Standard	38 x 89	2.78	2.41	1.97	2.35	2.04	1.66	2.07	1.79	1.47
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	2.88	2.61	2.28	2.51	2.28	1.99	2.28	2.07	1.81
		38 x 140	4.53	4.11	3.59	3.95	3.59	3.14	3.59	3.26	2.85
		38 x 184	5.95	5.40	4.72	5.20	4.72	4.12	4.72	4.29	3.68
		38 x 235	7.60	6.90	6.03	6.64	6.03	5.11	6.03	5.48	4.51
		38 x 286	9.25	8.40	7.01	8.08	7.26	5.93	7.34	6.40	5.23
	No. 1 and No. 2	38 x 89	2.81	2.55	2.23	2.46	2.23	1.95	2.23	2.03	1.77
		38 x 140	4.42	4.02	3.44	3.86	3.51	2.91	3.51	3.14	2.56
		38 x 184	5.81	5.13	4.19	5.00	4.33	3.54	4.41	3.82	3.12
		38 x 235	7.24	6.27	5.12	6.12	5.30	4.33	5.40	4.67	3.82
		38 x 286	8.40	7.27	5.94	7.10	6.15	5.02	6.26	5.42	4.43
	No. 3	38 x 89	2.62	2.27	1.85	2.22	1.92	1.57	1.95	1.69	1.38
		38 x 140	3.74	3.24	2.65	3.16	2.74	2.24	2.79	2.42	1.97
		38 x 184	4.56	3.94	3.22	3.85	3.33	2.72	3.40	2.94	2.40
		38 x 235	5.57	4.82	3.94	4.71	4.08	3.33	4.15	3.60	2.94
		38 x 286	6.46	5.60	4.57	5.46	4.73	3.86	4.82	4.17	3.41
	Construction	38 x 89	2.74	2.49	2.11	2.40	2.18	1.90	2.18	1.93	1.57
	Standard	38 x 89	2.22	1.93	1.57	1.88	1.63	1.33	1.66	1.44	1.17

Table A-7
Maximum Spans for Roof Rafters – Specified Roof Snow Loads 2.5 and 3.0 kPa
Forming Part of Sentence 9.23.4.2.(1)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Rafter Spacing, mm			Rafter Spacing, mm		
			300	400	600	300	400	600
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	38 x 89	2.51	2.28	1.99	2.37	2.15	1.88
		38 x 140	3.95	3.59	3.14	3.72	3.38	2.95
		38 x 184	5.20	4.72	4.12	4.89	4.44	3.83
		38 x 235	6.64	6.03	5.08	6.24	5.67	4.68
		38 x 286	8.08	7.23	5.90	7.60	6.65	5.43
	No. 1 and No. 2	38 x 89	2.41	2.19	1.86	2.27	2.06	1.71
		38 x 140	3.76	3.26	2.66	3.46	3.00	2.45
		38 x 184	4.58	3.96	3.24	4.21	3.65	2.98
		38 x 235	5.60	4.85	3.96	5.15	4.46	3.64
		38 x 286	6.50	5.63	4.59	5.98	5.17	4.23
	No. 3	38 x 89	1.79	1.55	1.26	1.64	1.42	1.16
		38 x 140	2.55	2.21	1.80	2.35	2.03	1.66
		38 x 184	3.10	2.69	2.20	2.86	2.47	2.02
		38 x 235	3.80	3.29	2.68	3.49	3.02	2.47
		38 x 286	4.41	3.82	3.12	4.05	3.51	2.87
	Construction	38 x 89	2.30	2.00	1.63	2.12	1.84	1.50
	Standard	38 x 89	1.73	1.50	1.22	1.59	1.38	1.12
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	38 x 89	2.48	2.25	1.97	2.33	2.12	1.85
		38 x 140	3.90	3.54	3.10	3.67	3.33	2.91
		38 x 184	5.13	4.66	4.07	4.82	4.38	3.77
		38 x 235	6.55	5.95	5.01	6.16	5.60	4.61
		38 x 286	7.97	7.12	5.81	7.50	6.55	5.34
	No. 1 and No. 2	38 x 89	2.41	2.19	1.91	2.27	2.06	1.80
		38 x 140	3.79	3.42	2.79	3.57	3.14	2.57
		38 x 184	4.80	4.16	3.40	4.42	3.83	3.12
		38 x 235	5.87	5.08	4.15	5.40	4.68	3.82
		38 x 286	6.81	5.90	4.82	6.27	5.43	4.43
	No. 3	38 x 89	2.21	1.91	1.56	2.03	1.76	1.43
		38 x 140	3.15	2.73	2.23	2.90	2.51	2.05
		38 x 184	3.83	3.32	2.71	3.52	3.05	2.49
		38 x 235	4.68	4.06	3.31	4.31	3.73	3.05
		38 x 286	5.43	4.71	3.84	5.00	4.33	3.54
	Construction	38 x 89	2.33	2.09	1.71	2.20	1.93	1.57
	Standard	38 x 89	1.81	1.57	1.28	1.66	1.44	1.18

Table A-7 (Continued)

Commercial Designation	Grade	Rafter Size, mm	Maximum Span, m					
			Specified Snow Load, kPa					
			2.5			3.0		
			Rafter Spacing, mm			Rafter Spacing, mm		
			300	400	600	300	400	600
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	38 x 89	2.37	2.15	1.88	2.23	2.03	1.77
		38 x 140	3.73	3.39	2.96	3.51	3.19	2.79
		38 x 184	4.90	4.45	3.89	4.61	4.19	3.66
		38 x 235	6.26	5.69	4.97	5.89	5.35	4.68
		38 x 286	7.62	6.92	5.90	7.17	6.52	5.43
	No. 1 and No. 2	38 x 89	2.29	2.08	1.82	2.16	1.96	1.71
		38 x 140	3.61	3.28	2.86	3.40	3.08	2.66
		38 x 184	4.74	4.31	3.52	4.46	3.96	3.23
		38 x 235	6.06	5.27	4.30	5.59	4.84	3.96
		38 x 286	7.06	6.11	4.99	6.49	5.62	4.59
	No. 3	38 x 89	2.21	1.91	1.56	2.03	1.76	1.43
		38 x 140	3.15	2.73	2.23	2.90	2.51	2.05
		38 x 184	3.83	3.32	2.71	3.52	3.05	2.49
		38 x 235	4.68	4.06	3.31	4.31	3.73	3.05
		38 x 286	5.43	4.71	3.84	5.00	4.33	3.54
	Construction	38 x 89	2.25	2.05	1.77	2.12	1.93	1.63
	Standard	38 x 89	1.87	1.62	1.33	1.72	1.49	1.22
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	38 x 89	2.12	1.93	1.68	1.99	1.81	1.58
		38 x 140	3.33	3.03	2.65	3.14	2.85	2.49
		38 x 184	4.38	3.98	3.33	4.12	3.75	3.07
		38 x 235	5.60	4.99	4.08	5.27	4.59	3.75
		38 x 286	6.69	5.79	4.73	6.15	5.33	4.35
	No. 1 and No. 2	38 x 89	2.07	1.88	1.62	1.95	1.77	1.49
		38 x 140	3.26	2.84	2.32	3.02	2.61	2.13
		38 x 184	3.99	3.46	2.82	3.67	3.18	2.60
		38 x 235	4.88	4.23	3.45	4.49	3.89	3.17
		38 x 286	5.66	4.90	4.00	5.21	4.51	3.68
	No. 3	38 x 89	1.77	1.53	1.25	1.63	1.41	1.15
		38 x 140	2.52	2.19	1.78	2.32	2.01	1.64
		38 x 184	3.07	2.66	2.17	2.82	2.45	2.00
		38 x 235	3.76	3.25	2.66	3.45	2.99	2.44
		38 x 286	4.36	3.77	3.08	4.01	3.47	2.83
	Construction	38 x 89	2.01	1.74	1.42	1.85	1.60	1.31
	Standard	38 x 89	1.50	1.30	1.06	1.38	1.19	0.98

Table A-8
Maximum Spans for Built-up Floor Beams Supporting not more than One Floor(1)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, m(2)(3)	Maximum Span, m(4)(5)								
			Size of Built-up Beam, mm								
			3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	3.84	4.43	4.96	4.70	5.42	6.06	5.45	6.29	7.03
		3.0	3.43	3.97	4.43	4.20	4.85	5.42	4.87	5.63	6.29
		3.6	3.14	3.62	4.05	3.83	4.43	4.95	4.45	5.14	5.74
		4.2	2.90	3.35	3.75	3.55	4.10	4.58	4.12	4.76	5.32
		4.8	2.72	3.14	3.51	3.32	3.83	4.29	3.85	4.45	4.97
		5.4	2.56	2.96	3.31	3.13	3.61	4.04	3.63	4.19	4.69
		6.0	2.43	2.80	3.14	2.97	3.43	3.83	3.34	3.98	4.45
	No. 1 and No. 2	2.4	2.99	3.45	3.86	3.66	4.22	4.72	4.24	4.90	5.48
		3.0	2.67	3.09	3.45	3.27	3.78	4.22	3.79	4.38	4.90
		3.6	2.44	2.82	3.15	2.98	3.45	3.85	3.46	4.00	4.47
		4.2	2.26	2.61	2.92	2.76	3.19	3.57	3.21	3.70	4.14
		4.8	2.11	2.44	2.73	2.59	2.98	3.34	3.00	3.46	3.87
		5.4	1.99	2.30	2.57	2.44	2.81	3.15	2.83	3.27	3.65
		6.0	1.89	2.18	2.44	2.31	2.67	2.98	2.68	3.10	3.46
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	3.78	4.37	4.88	4.62	5.34	5.97	5.37	6.20	6.93
		3.0	3.38	3.91	4.37	4.14	4.78	5.34	4.80	5.54	6.20
		3.6	3.09	3.57	3.99	3.78	4.36	4.87	4.35	5.06	5.66
		4.2	2.86	3.30	3.69	3.39	4.04	4.51	3.81	4.68	5.24
		4.8	2.55	3.09	3.45	3.03	3.78	4.22	3.40	4.35	4.90
		5.4	2.31	2.91	3.25	2.74	3.50	3.98	3.09	3.93	4.62
		6.0	2.12	2.70	3.09	2.52	3.20	3.78	2.84	3.59	4.35
	No. 1 and No. 2	2.4	3.14	3.62	4.05	3.83	4.43	4.95	4.45	5.14	5.74
		3.0	2.80	3.24	3.62	3.43	3.96	4.43	3.98	4.60	5.14
		3.6	2.56	2.96	3.31	3.13	3.61	4.04	3.63	4.19	4.69
		4.2	2.37	2.74	3.06	2.90	3.35	3.74	3.36	3.88	4.34
		4.8	2.22	2.56	2.86	2.71	3.13	3.50	3.15	3.63	4.06
		5.4	2.09	2.41	2.70	2.56	2.95	3.30	2.97	3.42	3.83
		6.0	1.98	2.29	2.56	2.42	2.80	3.13	2.81	3.25	3.63

Table A-8 (Continued)

Commercial Designation	Grade	Supported Length, m(2)(3)	Maximum Span, m(4)(5)								
			Size of Built-up Beam, mm								
			3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	3.84	4.43	4.96	4.70	5.42	6.06	5.45	6.29	7.03
		3.0	3.43	3.97	4.43	4.20	4.85	5.42	4.87	5.63	6.29
		3.6	3.14	3.62	4.05	3.83	4.43	4.95	4.45	5.14	5.74
		4.2	2.90	3.35	3.75	3.55	4.10	4.58	4.12	4.76	5.32
		4.8	2.72	3.14	3.51	3.31	3.83	4.29	3.72	4.45	4.97
		5.4	2.53	2.96	3.31	3.00	3.61	4.04	3.37	4.19	4.69
		6.0	2.31	2.80	3.14	2.74	3.43	3.83	3.09	3.93	4.45
	No. 1 and No. 2	2.4	3.25	3.75	4.19	3.97	4.59	5.13	4.61	5.32	5.95
		3.0	2.90	3.35	3.75	3.55	4.10	4.59	4.12	4.76	5.32
		3.6	2.65	3.06	3.42	3.24	3.74	4.19	3.76	4.34	4.86
		4.2	2.45	2.83	3.17	3.00	3.47	3.88	3.48	4.02	4.50
		4.8	2.30	2.65	2.96	2.81	3.24	3.63	3.26	3.76	4.21
		5.4	2.17	2.50	2.80	2.65	3.06	3.42	3.07	3.55	3.97
		6.0	2.05	2.37	2.65	2.51	2.90	3.24	2.91	3.37	3.76
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	3.08	3.55	3.97	3.76	4.35	4.86	4.37	5.04	5.64
		3.0	2.75	3.18	3.55	3.37	3.89	4.35	3.91	4.51	5.04
		3.6	2.51	2.90	3.24	3.07	3.55	3.97	3.57	4.12	4.60
		4.2	2.33	2.69	3.00	2.85	3.29	3.67	3.30	3.81	4.26
		4.8	2.18	2.51	2.81	2.66	3.07	3.44	3.09	3.57	3.99
		5.4	2.05	2.37	2.65	2.51	2.90	3.24	2.91	3.36	3.76
		6.0	1.95	2.25	2.51	2.38	2.75	3.07	2.76	3.19	3.57
	No. 1 and No. 2	2.4	2.61	3.01	3.36	3.19	3.68	4.11	3.70	4.27	4.77
		3.0	2.33	2.69	3.01	2.85	3.29	3.68	3.31	3.82	4.27
		3.6	2.13	2.46	2.75	2.60	3.00	3.36	3.02	3.49	3.90
		4.2	1.97	2.27	2.54	2.41	2.78	3.11	2.80	3.23	3.61
		4.8	1.84	2.13	2.38	2.25	2.60	2.91	2.61	3.02	3.38
		5.4	1.74	2.01	2.24	2.12	2.45	2.74	2.47	2.85	3.18
		6.0	1.65	1.90	2.13	2.02	2.33	2.60	2.34	2.70	3.02

Notes to Table A-8:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

(2) Supported length means half the sum of the joist spans on both sides of the beam.

(3) Straight interpolation may be used for other supported lengths.

(4) Spans are clear spans between supports. For total span, add two bearing lengths.

(5) Provide minimum 89 mm of bearing.

Table A-9
Maximum Spans for Built-up Floor Beams Supporting not more than Two Floors(1)
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, m(2)(3)	Maximum Span, m(4)(5)								
			Size of Built-up Beam, mm								
			3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	2.91	3.36	3.76	3.56	4.11	4.60	4.13	4.77	5.34
		3.0	2.61	3.01	3.36	3.19	3.68	4.11	3.70	4.27	4.77
		3.6	2.38	2.75	3.07	2.87	3.36	3.76	3.23	3.90	4.36
		4.2	2.13	2.54	2.84	2.53	3.11	3.48	2.85	3.61	4.04
		4.8	1.91	2.38	2.66	2.27	2.87	3.25	2.56	3.23	3.77
		5.4	1.74	2.19	2.51	2.07	2.60	3.07	2.34	2.93	3.52
		6.0	1.60	2.01	2.38	1.91	2.39	2.87	2.17	2.70	3.23
	No. 1 and No. 2	2.4	2.27	2.62	2.93	2.77	3.20	3.58	3.22	3.72	4.16
		3.0	2.03	2.34	2.62	2.48	2.86	3.20	2.88	3.32	3.72
		3.6	1.85	2.14	2.39	2.26	2.62	2.92	2.63	3.03	3.39
		4.2	1.71	1.98	2.21	2.10	2.42	2.71	2.43	2.81	3.14
		4.8	1.60	1.85	2.07	1.96	2.26	2.53	2.28	2.63	2.94
		5.4	1.51	1.75	1.95	1.85	2.14	2.39	2.15	2.48	2.77
		6.0	1.43	1.66	1.85	1.75	2.03	2.26	2.04	2.35	2.63
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	2.87	3.31	3.70	3.42	4.05	4.53	3.83	4.70	5.26
		3.0	2.38	2.96	3.31	2.83	3.61	4.05	3.18	4.05	4.70
		3.6	2.05	2.61	3.02	2.43	3.09	3.70	2.75	3.47	4.19
		4.2	1.81	2.29	2.77	2.15	2.72	3.28	2.44	3.06	3.68
		4.8	1.63	2.05	2.47	1.94	2.43	2.93	2.20	2.75	3.29
		5.4	1.49	1.86	2.23	1.78	2.22	2.65	2.02	2.50	2.99
		6.0	1.37	1.71	2.05	1.65	2.04	2.43	1.88	2.31	2.75
	No. 1 and No. 2	2.4	2.38	2.75	3.07	2.91	3.36	3.76	3.38	3.90	4.36
		3.0	2.13	2.46	2.75	2.60	3.00	3.36	3.02	3.49	3.90
		3.6	1.94	2.24	2.51	2.38	2.74	3.07	2.75	3.18	3.56
		4.2	1.80	2.08	2.32	2.15	2.54	2.84	2.44	2.95	3.29
		4.8	1.63	1.94	2.17	1.94	2.38	2.66	2.20	2.75	3.08
		5.4	1.49	1.83	2.05	1.78	2.22	2.50	2.02	2.50	2.91
		6.0	1.37	1.71	1.94	1.65	2.04	2.38	1.88	2.31	2.75

Table A-9 (Continued)

Commercial Designation	Grade	Supported Length, m(2)(3)	Maximum Span, m(4)(5) Size of Built-up Beam, mm: 3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	2.91	3.36	3.76	3.56	4.11	4.60	4.13	4.77	5.34
		3.0	2.61	3.01	3.36	3.09	3.68	4.11	3.47	4.27	4.77
		3.6	2.23	2.75	3.07	2.65	3.36	3.76	2.99	3.79	4.36
		4.2	1.97	2.50	2.84	2.34	2.96	3.48	2.64	3.33	4.02
		4.8	1.77	2.23	2.66	2.11	2.65	3.20	2.38	2.99	3.59
		5.4	1.61	2.03	2.44	1.93	2.41	2.90	2.18	2.72	3.26
		6.0	1.49	1.86	2.23	1.78	2.22	2.65	2.02	2.50	2.99
	No. 1 and No. 2	2.4	2.46	2.85	3.18	3.01	3.48	3.89	3.50	4.04	4.51
		3.0	2.20	2.55	2.85	2.70	3.11	3.48	3.13	3.61	4.04
		3.6	2.01	2.32	2.60	2.46	2.84	3.18	2.85	3.30	3.69
		4.2	1.86	2.15	2.40	2.28	2.63	2.94	2.64	3.05	3.41
		4.8	1.74	2.01	2.25	2.11	2.46	2.75	2.38	2.85	3.19
		5.4	1.61	1.90	2.12	1.93	2.32	2.59	2.18	2.69	3.01
		6.0	1.49	1.80	2.01	1.78	2.20	2.46	2.02	2.50	2.85
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	2.34	2.70	3.02	2.86	3.30	3.69	3.31	3.83	4.28
		3.0	2.09	2.41	2.70	2.55	2.95	3.30	2.96	3.42	3.83
		3.6	1.91	2.20	2.46	2.33	2.69	3.01	2.71	3.12	3.49
		4.2	1.77	2.04	2.28	2.15	2.49	2.79	2.44	2.89	3.23
		4.8	1.63	1.91	2.13	1.94	2.33	2.61	2.20	2.71	3.03
		5.4	1.49	1.80	2.01	1.78	2.20	2.46	2.02	2.50	2.85
		6.0	1.37	1.71	1.91	1.65	2.04	2.33	1.88	2.31	2.71
	No. 1 and No. 2	2.4	1.98	2.28	2.55	2.42	2.79	3.12	2.81	3.24	3.62
		3.0	1.77	2.04	2.28	2.16	2.50	2.79	2.51	2.90	3.24
		3.6	1.61	1.86	2.08	1.97	2.28	2.55	2.29	2.65	2.96
		4.2	1.49	1.73	1.93	1.83	2.11	2.36	2.12	2.45	2.74
		4.8	1.40	1.61	1.81	1.71	1.97	2.21	1.98	2.29	2.56
		5.4	1.32	1.52	1.70	1.61	1.86	2.08	1.87	2.16	2.42
		6.0	1.25	1.44	1.61	1.53	1.77	1.97	1.77	2.05	2.29

Notes to Table A-9:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.
(2) Supported length means half the sum of the joist spans on both sides of the beam.
(3) Straight interpolation may be used for other supported lengths.
(4) Spans are clear spans between supports. For total span, add two bearing lengths.
(5) Provide minimum 89 mm of bearing.

Table A-10
Maximum Spans for Built-up Floor Beams Supporting not more than Three Floors[1]
Forming Part of Sentence 9.23.4.2.(3)

Commercial Designation	Grade	Supported Length, m[2][3]	Maximum Span, m[4][5]								
			Size of Built-up Beam, mm								
			3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	Select Structural	2.4	2.44	2.82	3.15	2.99	3.45	3.85	3.37	4.00	4.47
		3.0	2.10	2.52	2.82	2.49	3.08	3.45	2.81	3.56	4.00
		3.6	1.81	2.29	2.57	2.16	2.72	3.15	2.44	3.06	3.65
		4.2	1.60	2.01	2.38	1.92	2.40	2.88	2.17	2.70	3.24
		4.8	1.45	1.81	2.17	1.73	2.16	2.58	1.97	2.44	2.90
		5.4	1.33	1.65	1.97	1.59	1.97	2.34	1.82	2.23	2.64
		6.0	1.23	1.52	1.81	1.48	1.82	2.16	1.69	2.06	2.44
	No. 1 and No. 2	2.4	1.90	2.19	2.45	2.32	2.68	3.00	2.70	3.11	3.48
		3.0	1.70	1.96	2.19	2.08	2.40	2.68	2.41	2.79	3.11
		3.6	1.55	1.79	2.00	1.90	2.19	2.45	2.20	2.54	2.84
		4.2	1.44	1.66	1.86	1.76	2.03	2.27	2.04	2.35	2.63
		4.8	1.34	1.55	1.74	1.64	1.90	2.12	1.91	2.20	2.46
		5.4	1.27	1.46	1.64	1.55	1.79	2.00	1.80	2.08	2.32
		6.0	1.20	1.39	1.55	1.47	1.70	1.90	1.69	1.97	2.20
Hem – Fir (includes Western Hemlock and Amabilis Fir)	Select Structural	2.4	2.14	2.72	3.10	2.54	3.23	3.80	2.86	3.62	4.39
		3.0	1.78	2.25	2.72	2.13	2.68	3.23	2.40	3.01	3.62
		3.6	1.55	1.94	2.33	1.85	2.31	2.77	2.10	2.61	3.12
		4.2	1.38	1.71	2.05	1.65	2.05	2.44	1.88	2.32	2.75
		4.8	1.25	1.55	1.84	1.50	1.85	2.19	1.72	2.10	2.48
		5.4	1.15	1.42	1.68	1.39	1.70	2.00	1.59	1.93	2.27
		6.0	1.07	1.31	1.55	1.30	1.57	1.85	1.49	1.79	2.10
	No. 1 and No. 2	2.4	1.99	2.30	2.57	2.44	2.81	3.15	2.83	3.27	3.65
		3.0	1.78	2.06	2.30	2.13	2.52	2.81	2.40	2.92	3.27
		3.6	1.55	1.88	2.10	1.85	2.30	2.57	2.10	2.61	2.98
		4.2	1.38	1.71	1.95	1.65	2.05	2.38	1.88	2.32	2.75
		4.8	1.25	1.55	1.82	1.50	1.85	2.19	1.72	2.10	2.48
		5.4	1.15	1.42	1.68	1.39	1.70	2.00	1.59	1.93	2.27
		6.0	1.07	1.31	1.55	1.30	1.57	1.85	1.49	1.79	2.10

Table A-10 (Continued)

Commercial Designation	Grade	Supported Length, m(2)(3)	Maximum Span, m(4)(5)								
			Size of Built-up Beam, mm								
			3 – 38x184	4 – 38x184	5 – 38x184	3 – 38x235	4 – 38x235	5 – 38x235	3 – 38x286	4 – 38x286	5 – 38x286
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	Select Structural	2.4	2.33	2.82	3.15	2.77	3.45	3.85	3.12	3.96	4.47
		3.0	1.94	2.46	2.82	2.31	2.92	3.45	2.61	3.29	3.96
		3.6	1.68	2.11	2.55	2.00	2.51	3.02	2.27	2.83	3.40
		4.2	1.49	1.86	2.24	1.78	2.22	2.66	2.03	2.51	2.99
		4.8	1.35	1.68	2.00	1.62	2.00	2.39	1.84	2.27	2.69
		5.4	1.24	1.53	1.82	1.49	1.83	2.17	1.70	2.08	2.46
		6.0	1.15	1.42	1.68	1.39	1.70	2.00	1.59	1.93	2.27
	No. 1 and No. 2	2.4	2.06	2.38	2.67	2.52	2.92	3.26	2.93	3.38	3.78
		3.0	1.85	2.13	2.38	2.26	2.61	2.92	2.61	3.03	3.38
		3.6	1.68	1.95	2.18	2.00	2.38	2.66	2.27	2.76	3.09
		4.2	1.49	1.80	2.02	1.78	2.20	2.46	2.03	2.51	2.86
		4.8	1.35	1.68	1.88	1.62	2.00	2.30	1.84	2.27	2.67
		5.4	1.24	1.53	1.78	1.49	1.83	2.17	1.70	2.08	2.46
		6.0	1.15	1.42	1.68	1.39	1.70	2.00	1.59	1.93	2.27
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	Select Structural	2.4	1.96	2.26	2.53	2.39	2.76	3.09	2.78	3.21	3.58
		3.0	1.75	2.02	2.26	2.13	2.47	2.76	2.40	2.87	3.21
		3.6	1.55	1.85	2.06	1.85	2.26	2.52	2.10	2.61	2.93
		4.2	1.38	1.71	1.91	1.65	2.05	2.34	1.88	2.32	2.71
		4.8	1.25	1.55	1.79	1.50	1.85	2.18	1.72	2.10	2.48
		5.4	1.15	1.42	1.68	1.39	1.70	2.00	1.59	1.93	2.27
		6.0	1.07	1.31	1.55	1.30	1.57	1.85	1.49	1.79	2.10
	No. 1 and No. 2	2.4	1.66	1.91	2.14	2.03	2.34	2.62	2.35	2.72	3.04
		3.0	1.48	1.71	1.91	1.81	2.09	2.34	2.10	2.43	2.72
		3.6	1.35	1.56	1.75	1.65	1.91	2.14	1.92	2.22	2.48
		4.2	1.25	1.45	1.62	1.53	1.77	1.98	1.78	2.05	2.29
		4.8	1.17	1.35	1.51	1.43	1.65	1.85	1.66	1.92	2.15
		5.4	1.10	1.28	1.43	1.35	1.56	1.74	1.57	1.81	2.02
		6.0	1.05	1.21	1.35	1.28	1.48	1.65	1.49	1.72	1.92

Notes to Table A-10:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.
(2) Supported length means half the sum of the joist spans on both sides of the beam.
(3) Straight interpolation may be used for other supported lengths.
(4) Spans are clear spans between supports. For total span, add two bearing lengths.
(5) Provide minimum 89 mm of bearing.

Table A-11
Maximum Spans for Glued-Laminated Floor Beams – 20f-E Grade[1]
Forming Part of Sentence 9.23.4.2.(3)

Number of *Storeys* Supported	Beam Width, mm	Supported Length, m[2][3]	Maximum Span, m[4][5][6][7]						
			Beam Depth, mm						
			228	266	304	342	380	418	456
1	80	2.4	4.32	5.04	5.76	6.48	7.20	7.92	8.64
		3.0	3.87	4.51	5.15	5.80	6.44	7.09	7.73
		3.6	3.53	4.12	4.70	5.29	5.88	6.47	7.06
		4.2	3.27	3.81	4.36	4.90	5.44	5.99	6.53
		4.8	3.06	3.57	4.07	4.58	5.09	5.60	6.11
		5.4	2.88	3.36	3.84	4.32	4.80	5.28	5.76
		6.0	2.73	3.19	3.64	4.10	4.56	5.01	5.47
	130	2.4	5.51	6.43	7.35	8.26	9.18	10.10	11.02
		3.0	4.93	5.75	6.57	7.39	8.21	9.03	9.86
		3.6	4.50	5.25	6.00	6.75	7.50	8.25	9.00
		4.2	4.16	4.86	5.55	6.25	6.94	7.64	8.33
		4.8	3.90	4.54	5.19	5.84	6.49	7.14	7.79
		5.4	3.67	4.28	4.90	5.51	6.12	6.73	7.35
		6.0	3.48	4.07	4.65	5.23	5.81	6.39	6.97
2	80	2.4	3.28	3.83	4.37	4.92	5.47	6.01	6.56
		3.0	2.93	3.42	3.91	4.40	4.89	5.38	5.87
		3.6	2.68	3.12	3.57	4.02	4.46	4.91	5.36
		4.2	2.48	2.89	3.31	3.72	4.13	4.54	4.96
		4.8	2.32	2.71	3.09	3.48	3.86	4.25	4.64
		5.4	2.19	2.55	2.91	3.28	3.64	4.01	4.37
		6.0	2.07	2.42	2.77	3.11	3.46	3.80	4.15
	130	2.4	4.18	4.88	5.57	6.27	6.97	7.66	8.36
		3.0	3.74	4.36	4.99	5.61	6.23	6.85	7.48
		3.6	3.41	3.98	4.55	5.12	5.69	6.26	6.83
		4.2	3.16	3.69	4.21	4.74	5.27	5.79	6.32
		4.8	2.96	3.45	3.94	4.43	4.93	5.42	5.91
		5.4	2.79	3.25	3.72	4.18	4.64	5.11	5.57
		6.0	2.64	3.08	3.53	3.97	4.41	4.85	5.29

Table A-11 (Continued)

Number of *Storeys* Supported	Beam Width, mm	Supported Length, m(2)(3)	Maximum Span, m(4)(5)(6)(7)						
			Beam Depth, mm						
			228	266	304	342	380	418	456
3	80	2.4	2.75	3.21	3.66	4.12	4.58	5.04	5.50
		3.0	2.46	2.87	3.28	3.69	4.10	4.51	4.92
		3.6	2.24	2.62	2.99	3.37	3.74	4.11	4.49
		4.2	2.08	2.42	2.77	3.12	3.46	3.81	4.15
		4.8	1.94	2.27	2.59	2.91	3.24	3.56	3.89
		5.4	1.83	2.14	2.44	2.75	3.05	3.36	3.66
		6.0	1.74	2.03	2.32	2.61	2.90	3.19	3.48
	130	2.4	3.50	4.09	4.67	5.25	5.84	6.42	7.01
		3.0	3.13	3.66	4.18	4.70	5.22	5.74	6.27
		3.6	2.86	3.34	3.81	4.29	4.77	5.24	5.72
		4.2	2.65	3.09	3.53	3.97	4.41	4.85	5.30
		4.8	2.48	2.89	3.30	3.72	4.13	4.54	4.95
		5.4	2.34	2.72	3.11	3.50	3.89	4.28	4.67
		6.0	2.22	2.58	2.95	3.32	3.69	4.06	4.43

Notes to Table A-11:

(1) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

(2) Supported length means half the sum of the joist spans on both sides of the beam.

(3) Straight interpolation may be used for other supported lengths.

(4) Spans are valid for glued-laminated timber conforming to CAN/CSA-O122-M and CAN/CSA-O177-M.

(5) Spans are clear spans between supports. For total span, add two bearing lengths.

(6) Provide a minimum bearing length of 89 mm. (Alternatively, the bearing length may be designed in accordance with Part 4.)

(7) Top edge of beam assumed to be fully laterally supported by joists.

Table A-12
Maximum Spans for Built-Up Roof Ridge Beams – No. 1 or No. 2 Grade e
Forming Part of Sentence 9.23.4.2.(4)

Commercial Designation	Beam Size, mm	Maximum Span, m(1)(2)				
		Specified Snow Load, kPa				
		1.0	1.5	2.0	2.5	3.0
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	3 – 38 x 184	2.42	2.08	1.86	1.69	1.56
	4 – 38 x 184	2.80	2.41	2.14	1.95	1.80
	5 – 38 x 184	3.13	2.69	2.40	2.18	2.01
	3 – 38 x 235	2.96	2.55	2.27	2.06	1.91
	4 – 38 x 235	3.42	2.94	2.62	2.38	2.20
	5 – 38 x 235	3.83	3.29	2.93	2.67	2.46
	3 – 38 x 286	3.44	2.96	2.63	2.40	2.21
	4 – 38 x 286	3.97	3.41	3.04	2.77	2.56
	5 – 38 x 286	4.44	3.82	3.40	3.09	2.86
Hem – Fir (includes Western Hemlock and Amabilis Fir)	3 – 38 x 184	2.54	2.18	1.95	1.77	1.64
	4 – 38 x 184	2.93	2.52	2.25	2.05	1.89
	5 – 38 x 184	3.28	2.82	2.51	2.29	2.11
	3 – 38 x 235	3.11	2.67	2.38	2.17	2.00
	4 – 38 x 235	3.59	3.08	2.75	2.50	2.31
	5 – 38 x 235	4.01	3.45	3.07	2.80	2.58
	3 – 38 x 286	3.61	3.10	2.76	2.51	2.32
	4 – 38 x 286	4.16	3.58	3.19	2.90	2.68
	5 – 38 x 286	4.66	4.00	3.56	3.24	3.00
Spruce – Pine - Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	3 – 38 x 184	2.63	2.26	2.02	1.83	1.69
	4 – 38 x 184	3.04	2.61	2.33	2.12	1.96
	5 – 38 x 184	3.40	2.92	2.60	2.37	2.19
	3 – 38 x 235	3.22	2.77	2.46	2.24	2.07
	4 – 38 x 235	3.72	3.20	2.85	2.59	2.39
	5 – 38 x 235	4.16	3.57	3.18	2.90	2.68
	3 – 38 x 286	3.73	3.21	2.86	2.60	2.40
	4 – 38 x 286	4.31	3.71	3.30	3.01	2.78
	5 – 38 x 286	4.82	4.15	3.69	3.36	3.10
Northern Species (includes any Canadian species covered by the NLGA Standard Grading Rules)	3 – 38 x 184	2.11	1.82	1.62	1.47	1.36
	4 – 38 x 184	2.44	2.10	1.87	1.70	1.57
	5 – 38 x 184	2.73	2.34	2.09	1.90	1.76
	3 – 38 x 235	2.58	2.22	1.98	1.80	1.66
	4 – 38 x 235	2.98	2.56	2.28	2.08	1.92
	5 – 38 x 235	3.33	2.87	2.55	2.32	2.15
	3 – 38 x 286	3.00	2.58	2.29	2.09	1.93
	4 – 38 x 286	3.46	2.98	2.65	2.41	2.23
	5 – 38 x 286	3.87	3.33	2.96	2.70	2.49

Table A-12 (Continued)

Notes to Table A-12:

(1) The spans are calculated based on a maximum supported length of 4.9 m, where supported length means half the sum of the rafter, joist or truss spans on both sides of the beam. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m.

(2) Provide minimum 89 mm bearing.

Table A-13
Maximum Spans for Douglas Fir – Larch Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(1)	Maximum Span, m(2)(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 x 89	This Area Intentionally Left Blank					1.25
	2 – 38 x 140						1.78
	2 – 38 x 184						2.17
	2 – 38 x 235						2.65
	2 – 38 x 286						3.08
Roof and ceiling only	2 – 38 x 89	1.25	1.07	0.96	0.87	0.80	0.87
	2 – 38 x 140	1.78	1.53	1.36	1.24	1.15	1.24
	2 – 38 x 184	2.17	1.86	1.66	1.51	1.40	1.51
	2 – 38 x 235	2.65	2.28	2.03	1.85	1.71	1.85
	2 – 38 x 286	3.08	2.64	2.35	2.14	1.98	2.14
Roof, ceiling and 1 *storey*(5)	2 – 38 x 89	0.96	0.88	0.82	0.77	0.73	0.68
	2 – 38 x 140	1.37	1.26	1.17	1.10	1.04	0.97
	2 – 38 x 184	1.67	1.53	1.42	1.34	1.26	1.18
	2 – 38 x 235	2.04	1.88	1.74	1.63	1.54	1.44
	2 – 38 x 286	2.37	2.18	2.02	1.90	1.79	1.67
Roof, ceiling and 2 *storeys*(5)	2 – 38 x 89	0.86	0.81	0.77	0.73	0.70	0.61
	2 – 38 x 140	1.23	1.16	1.09	1.04	0.99	0.87
	2 – 38 x 184	1.50	1.41	1.33	1.27	1.21	1.06
	2 – 38 x 235	1.84	1.72	1.63	1.55	1.48	1.30
	2 – 38 x 286	2.13	2.00	1.89	1.80	1.72	1.51
Roof, ceiling and 3 *storeys*(5)	2 – 38 x 89	0.81	0.77	0.73	0.71	0.68	0.57
	2 – 38 x 140	1.15	1.10	1.05	1.01	0.97	0.82
	2 – 38 x 184	1.40	1.33	1.28	1.22	1.18	1.00
	2 – 38 x 235	1.71	1.63	1.56	1.50	1.44	1.22
	2 – 38 x 286	1.99	1.89	1.81	1.74	1.67	1.41

Notes to Table A-13:

(1) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(2) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(3) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for “Roof, ceiling and 1 *storey*,” by 20% for “Roof, ceiling and 2 *storeys*” and by 25% for “Roof, ceiling and 3 *storeys*.”

(4) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(5) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-14
Maximum Spans for Douglas Fir – Larch Lintels – No. 1 or No. 2 Grade – Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)(5)				
		Exterior Walls				
		Specified Snow Load, kPa				
		1.0	1.5	2.0	2.5	3.0
Roof and ceiling only	2 – 38 x 89	1.46	1.25	1.12	1.02	0.94
	2 – 38 x 140	2.08	1.79	1.59	1.45	1.34
	2 – 38 x 184	2.53	2.18	1.94	1.76	1.63
	2 – 38 x 235	3.09	2.66	2.37	2.16	1.99
	2 – 38 x 286	3.59	3.09	2.75	2.50	2.31
Roof, ceiling and 1 *storey*(6)	2 – 38 x 89	1.12	1.03	0.96	0.90	0.85
	2 – 38 x 140	1.60	1.47	1.37	1.28	1.21
	2 – 38 x 184	1.95	1.79	1.66	1.56	1.47
	2 – 38 x 235	2.39	2.19	2.03	1.91	1.80
	2 – 38 x 286	2.77	2.54	2.36	2.21	2.09
Roof, ceiling and 2 *storeys*(6)	2 – 38 x 89	1.01	0.95	0.90	0.85	0.81
	2 – 38 x 140	1.44	1.35	1.28	1.21	1.16
	2 – 38 x 184	1.75	1.64	1.55	1.48	1.41
	2 – 38 x 235	2.14	2.01	1.90	1.81	1.73
	2 – 38 x 286	2.49	2.33	2.21	2.10	2.00
Roof, ceiling and 3 *storeys*(6)	2 – 38 x 89	0.94	0.90	0.86	0.82	0.79
	2 – 38 x 140	1.35	1.28	1.22	1.18	1.13
	2 – 38 x 184	1.64	1.56	1.49	1.43	1.38
	2 – 38 x 235	2.00	1.91	1.82	1.75	1.68
	2 – 38 x 286	2.32	2.21	2.11	2.03	1.95

Notes to Table A-14:

(1) A minimum 9.5 mm thick structural panel conforming to CSA O121-M, CSA O151-M, CAN/CSA-O325.0 or CSA O437.0 shall be fastened with at least 2 rows of fasteners conforming to Table 9.23.3.5. to the exterior face of the lintel, and a single row to the top plates and studs.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(4) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 *storey*," by 20% for "Roof, ceiling and 2 *storeys*" and by 25% for "Roof, ceiling and 3 *storeys*."

(5) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(6) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-15
Maximum Spans for Hem – Fir Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(1)	Maximum Span, m(2)(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 x 89	This Area Intentionally Left Blank					1.31
	2 – 38 x 140						1.87
	2 – 38 x 184						2.27
	2 – 38 x 235						2.78
	2 – 38 x 286						3.23
Roof and ceiling only	2 – 38 x 89	1.31	1.13	1.00	0.91	0.84	0.91
	2 – 38 x 140	1.87	1.61	1.43	1.30	1.20	1.30
	2 – 38 x 184	2.27	1.95	1.74	1.58	1.42	1.58
	2 – 38 x 235	2.78	2.39	2.13	1.92	1.71	1.92
	2 – 38 x 286	3.23	2.77	2.47	2.17	1.94	2.17
Roof, ceiling and 1 *storey*(5)	2 – 38 x 89	1.01	0.93	0.86	0.81	0.76	0.69
	2 – 38 x 140	1.44	1.32	1.23	1.14	1.05	0.95
	2 – 38 x 184	1.75	1.61	1.47	1.34	1.23	1.12
	2 – 38 x 235	2.14	1.96	1.76	1.60	1.48	1.35
	2 – 38 x 286	2.49	2.22	2.00	1.82	1.69	1.55
Roof, ceiling and 2 *storeys*(5)	2 – 38 x 89	0.91	0.85	0.80	0.76	0.72	0.60
	2 – 38 x 140	1.29	1.21	1.13	1.05	0.98	0.82
	2 – 38 x 184	1.57	1.44	1.33	1.24	1.16	0.98
	2 – 38 x 235	1.90	1.73	1.60	1.49	1.40	1.19
	2 – 38 x 286	2.15	1.97	1.82	1.70	1.60	1.37
Roof, ceiling and 3 *storeys*(5)	2 – 38 x 89	0.85	0.81	0.77	0.74	0.69	0.55
	2 – 38 x 140	1.21	1.14	1.06	1.00	0.95	0.76
	2 – 38 x 184	1.43	1.33	1.25	1.18	1.12	0.91
	2 – 38 x 235	1.72	1.60	1.50	1.42	1.35	1.10
	2 – 38 x 286	1.95	1.82	1.72	1.63	1.55	1.27

Notes to Table A-15:

(1) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(2) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(3) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 *storey*," by 20% for "Roof, ceiling and 2 *storeys*" and by 25% for "Roof, ceiling and 3 *storeys*."

(4) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(5) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-16
Maximum Spans for Hem – Fir Lintels – No. 1 or No. 2 Grade – Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)(5)				
		Exterior Walls				
		Specified Snow Load, kPa				
		1.0	1.5	2.0	2.5	3.0
Roof and ceiling only	2 – 38 x 89	1.47	1.29	1.17	1.07	0.98
	2 – 38 x 140	2.18	1.88	1.67	1.52	1.40
	2 – 38 x 184	2.65	2.28	2.03	1.85	1.71
	2 – 38 x 235	3.25	2.79	2.49	2.26	2.08
	2 – 38 x 286	3.77	3.24	2.88	2.62	2.35
Roof, ceiling and 1 *storey*(6)	2 – 38 x 89	1.18	1.08	1.00	0.94	0.89
	2 – 38 x 140	1.68	1.54	1.43	1.34	1.27
	2 – 38 x 184	2.05	1.88	1.74	1.63	1.49
	2 – 38 x 235	2.50	2.30	2.13	1.94	1.78
	2 – 38 x 286	2.91	2.66	2.42	2.20	2.03
Roof, ceiling and 2 *storeys*(6)	2 – 38 x 89	1.06	0.99	0.94	0.89	0.85
	2 – 38 x 140	1.51	1.42	1.34	1.27	1.19
	2 – 38 x 184	1.84	1.73	1.62	1.50	1.40
	2 – 38 x 235	2.25	2.11	1.93	1.79	1.68
	2 – 38 x 286	2.61	2.38	2.19	2.03	1.91
Roof, ceiling and 3 *storeys*(6)	2 – 38 x 89	0.99	0.94	0.90	0.86	0.83
	2 – 38 x 140	1.41	1.34	1.28	1.22	1.15
	2 – 38 x 184	1.72	1.62	1.52	1.43	1.35
	2 – 38 x 235	2.09	1.94	1.81	1.71	1.62
	2 – 38 x 286	2.37	2.20	2.06	1.94	1.84

Notes to Table A-16:

(1) A minimum 9.5 mm thick structural panel conforming to CSA O121-M, CSA O151-M, CAN/CSA-O325.0 or CSA O437.0 shall be fastened with at least 2 rows of fasteners conforming to Table 9.23.3.5. to the exterior face of the lintel, and a single row to the top plates and studs.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(4) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 *storey*," by 20% for "Roof, ceiling and 2 *storeys*" and by 25% for "Roof, ceiling and 3 *storeys*."

(5) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(6) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-17
Maximum Spans for Spruce – Pine – Fir Lintels – No. 1 or No. 2 Grade – Non-Structural Sheathing
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(1)	Maximum Span, m(2)(3)(4)					
		Exterior Walls					Interior Walls
		Specified Snow Load, kPa					
		1.0	1.5	2.0	2.5	3.0	
Limited attic storage and ceiling	2 – 38 x 89	This Area Intentionally Left Blank					1.27
	2 – 38 x 140						1.99
	2 – 38 x 184						2.51
	2 – 38 x 235						3.07
	2 – 38 x 286						3.57
Roof and ceiling only	2 – 38 x 89	1.27	1.11	1.01	0.93	0.87	0.93
	2 – 38 x 140	1.93	1.66	1.48	1.35	1.25	1.35
	2 – 38 x 184	2.35	2.02	1.80	1.64	1.52	1.64
	2 – 38 x 235	2.88	2.47	2.20	2.01	1.84	2.01
	2 – 38 x 286	3.34	2.87	2.56	2.33	2.09	2.33
Roof, ceiling and 1 *storey*(5)	2 – 38 x 89	1.05	0.96	0.89	0.84	0.79	0.74
	2 – 38 x 140	1.49	1.37	1.27	1.19	1.13	1.02
	2 – 38 x 184	1.82	1.67	1.55	1.44	1.33	1.20
	2 – 38 x 235	2.22	2.04	1.89	1.73	1.59	1.45
	2 – 38 x 286	2.58	2.36	2.15	1.96	1.81	1.66
Roof, ceiling and 2 *storeys*(5)	2 – 38 x 89	0.94	0.88	0.83	0.79	0.76	0.64
	2 – 38 x 140	1.34	1.26	1.19	1.13	1.06	0.88
	2 – 38 x 184	1.63	1.53	1.44	1.33	1.25	1.05
	2 – 38 x 235	1.99	1.87	1.72	1.60	1.50	1.27
	2 – 38 x 286	2.31	2.12	1.96	1.82	1.71	1.45
Roof, ceiling and 3 *storeys*(5)	2 – 38 x 89	0.88	0.83	0.80	0.77	0.74	0.59
	2 – 38 x 140	1.25	1.19	1.14	1.08	1.02	0.81
	2 – 38 x 184	1.52	1.44	1.35	1.27	1.21	0.97
	2 – 38 x 235	1.86	1.73	1.62	1.53	1.45	1.17
	2 – 38 x 286	2.11	1.96	1.84	1.74	1.66	1.35

Notes to Table A-17:

(1) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(2) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(3) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for "Roof, ceiling and 1 *storey*," by 20% for "Roof, ceiling and 2 *storeys*" and by 25% for "Roof, ceiling and 3 *storeys*."

(4) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(5) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-18
Maximum Spans for Spruce – Pine – Fir Lintels – No. 1 or No. 2 Grade – Structural Sheathing(1)
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Supporting	Lintel Size, mm(2)	Maximum Span, m(3)(4)(5) Exterior Walls Specified Snow Load, kPa				
		1.0	1.5	2.0	2.5	3.0
Roof and ceiling only	2 – 38 x 89	1.40	1.23	1.11	1.03	0.97
	2 – 38 x 140	2.21	1.93	1.73	1.57	1.45
	2 – 38 x 184	2.75	2.36	2.10	1.92	1.77
	2 – 38 x 235	3.36	2.89	2.57	2.34	2.16
	2 – 38 x 286	3.90	3.35	2.99	2.72	2.51
Roof, ceiling and 1 *storey*(6)	2 – 38 x 89	1.16	1.08	1.01	0.96	0.92
	2 – 38 x 140	1.74	1.60	1.48	1.39	1.32
	2 – 38 x 184	2.12	1.95	1.81	1.69	1.60
	2 – 38 x 235	2.59	2.38	2.21	2.07	1.93
	2 – 38 x 286	3.01	2.76	2.56	2.38	2.19
Roof, ceiling and 2 *storeys*(6)	2 – 38 x 89	1.09	1.03	0.97	0.92	0.88
	2 – 38 x 140	1.56	1.47	1.39	1.32	1.26
	2 – 38 x 184	1.90	1.79	1.69	1.61	1.51
	2 – 38 x 235	2.33	2.19	2.07	1.94	1.81
	2 – 38 x 286	2.70	2.54	2.37	2.20	2.05
Roof, ceiling and 3 *storeys*(6)	2 – 38 x 89	1.02	0.97	0.93	0.89	0.86
	2 – 38 x 140	1.46	1.39	1.33	1.28	1.23
	2 – 38 x 184	1.78	1.69	1.62	1.54	1.46
	2 – 38 x 235	2.17	2.07	1.96	1.84	1.74
	2 – 38 x 286	2.52	2.38	2.22	2.09	1.98

Notes to Table A-18:

(1) A minimum 9.5 mm thick structural panel conforming to CSA O121-M, CSA O151-M, CAN/CSA-O325.0 or CSA O437.0 shall be fastened with at least 2 rows of fasteners conforming to Table 9.23.3.5. to the exterior face of the lintel, and a single row to the top plates and studs.

(2) A single piece of 89 mm thick lumber may be used in lieu of 2 pieces of 38 mm thick lumber on edge.

(3) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 5% for supported lengths not more than 4.3 m, or by 10% for supported lengths not more than 3.7 m. Supported length means half the span of the longest supported members.

(4) If floor joists span the full width of the *building* without support, lintel spans shall be reduced by 15% for “Roof, ceiling and 1 *storey*,” by 20% for “Roof, ceiling and 2 *storeys*” and by 25% for “Roof, ceiling and 3 *storeys*.”

(5) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

(6) Spans apply only where the floors serve residential areas as described in Table 4.1.6.3., or the uniformly distributed *live load* on the floors does not exceed that specified for residential areas as described in Table 4.1.6.3.

Table A-19
Maximum Spans for Built-up Lintels – Roof and Ceiling Load Only – No. 1 or No. 2 Grade
Forming Part of Sentences 9.23.12.3.(1) and (3)

Commercial Designation	Lintel Size, mm	Maximum Span, m(1)(2) Specified Snow Load, kPa 1.0	1.5	2.0	2.5	3.0
Douglas Fir – Larch (includes Douglas Fir and Western Larch)	3 – 38 x 184	2.76	2.38	2.12	1.93	1.78
	4 – 38 x 184	3.19	2.74	2.44	2.22	2.05
	5 – 38 x 184	3.57	3.07	2.73	2.49	2.30
	3 – 38 x 235	3.38	2.90	2.59	2.35	2.18
	4 – 38 x 235	3.90	3.35	2.99	2.72	2.51
	5 – 38 x 235	4.36	3.75	3.34	3.04	2.81
	3 – 38 x 286	3.92	3.37	3.00	2.73	2.52
	4 – 38 x 286	4.53	3.89	3.47	3.15	2.91
	5 – 38 x 286	5.06	4.35	3.87	3.53	3.26
Hem – Fir (includes Western Hemlock and Amabilis Fir)	3 – 38 x 184	2.90	2.49	2.22	2.02	1.87
	4 – 38 x 184	3.35	2.88	2.56	2.33	2.15
	5 – 38 x 184	3.73	3.22	2.86	2.61	2.41
	3 – 38 x 235	3.54	3.05	2.71	2.47	2.28
	4 – 38 x 235	4.09	3.52	3.13	2.85	2.63
	5 – 38 x 235	4.57	3.93	3.50	3.19	2.95
	3 – 38 x 286	4.11	3.53	3.15	2.87	2.62
	4 – 38 x 286	4.75	4.08	3.63	3.31	3.06
	5 – 38 x 286	5.31	4.56	4.06	3.70	3.42
Spruce – Pine – Fir (includes Spruce (all species except Coast Sitka Spruce) Jack Pine, Lodgepole Pine, Balsam Fir and Alpine Fir)	3 – 38 x 184	3.00	2.58	2.30	2.09	1.93
	4 – 38 x 184	3.30	2.88	2.62	2.42	2.23
	5 – 38 x 184	3.55	3.10	2.82	2.62	2.46
	3 – 38 x 235	3.67	3.15	2.81	2.56	2.36
	4 – 38 x 235	4.21	3.64	3.24	2.95	2.73
	5 – 38 x 235	4.54	3.96	3.60	3.30	3.05
	3 – 38 x 286	4.26	3.66	3.26	2.97	2.74
	4 – 38 x 286	4.92	4.23	3.76	3.43	3.17
	5 – 38 x 286	5.49	4.73	4.21	3.83	3.54

Notes to Table A-19:

(1) Spans are calculated based on a maximum supported joist or rafter length of 4.9 m and a maximum supported truss length of 9.8 m. Spans may be increased by 15% for supported lengths not more than 3.7 m, or by 35% for supported lengths not more than 2.4 m. Supported length means half the span of the trusses, roof joists or rafters supported by the lintel plus the length of the overhang beyond the lintel.

(2) For ends of lintels fully supported by walls, provide minimum 38 mm of bearing for lintel spans up to 3 m, or minimum 76 mm of bearing for lintel spans greater than 3 m.

Table A-20
Maximum Spans for Glued-Laminated Timber Lintels – 20f-E Stress Grade – Exterior Walls – Roof and Ceiling Load Only
Forming Part of Sentences 9.23.12.3.(1) and (3)

Lintel Size, mm	Maximum Span, m(1)(2)(3)														
	Specified Snow Load, kPa														
	1.0			1.5			2.0			2.5			3.0		
	Supported length, m(4)(5)			Supported length, m(4)(5)			Supported length, m(4)(5)			Supported length, m(4)(5)			Supported length, m(4)(5)		
	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8	2.4	3.6	4.8
130 x 304	6.23	5.63	5.24	5.63	5.09	4.73	5.24	4.73	4.40	4.95	4.48	4.17	4.73	4.28	3.87
80 x 380	6.52	5.89	5.48	5.89	5.32	4.96	5.48	4.96	4.52	5.19	4.69	4.11	4.96	4.39	3.80
130 x 342	6.80	6.15	5.72	6.15	5.56	5.17	5.72	5.17	4.81	5.41	4.89	4.55	5.17	4.67	4.35
80 x 418	7.00	6.33	5.89	6.33	5.72	5.32	5.89	5.32	4.96	5.57	5.03	4.52	5.32	4.81	4.18
130 x 380	7.36	6.65	6.19	6.65	6.01	5.59	6.19	5.59	5.21	5.86	5.29	4.92	5.59	5.06	4.70
80 x 456	7.48	6.76	6.29	6.76	6.10	5.68	6.29	5.68	5.29	5.95	5.37	4.93	5.68	5.13	4.56
130 x 418	7.91	7.15	6.65	7.15	6.46	6.01	6.65	6.01	5.59	6.29	5.68	5.29	6.01	5.43	5.05
80 x 494	7.94	7.17	6.68	7.17	6.48	6.03	6.68	6.03	5.61	6.31	5.71	5.31	6.03	5.45	4.94
80 x 532	8.39	7.58	7.06	7.58	6.85	6.38	7.06	6.38	5.93	6.67	6.03	5.61	6.38	5.76	5.32
130 x 456	8.44	7.63	7.10	7.63	6.89	6.41	7.10	6.41	5.97	6.71	6.07	5.65	6.41	5.80	5.39

Notes to Table A-20:

(1) Spans are valid for glued-laminated timber conforming to CAN/CSA-O122-M and CAN/CSA-O177-M.
(2) Provide minimum 89 mm bearing. (Alternatively, the bearing length may be calculated in accordance with Part 4.)
(3) Top edge of lintel assumed to be fully laterally supported.
(4) Supported length means half the length of trusses or rafters, plus the length of the overhang beyond the wall.
(5) For intermediate supported lengths, straight interpolation may be used.

Appendix A
Explanatory Material for the National Building Code of Canada 1995

A-1.1.2.1. Application to Existing Buildings. This Code is most often applied to existing buildings when an owner wishes to rehabilitate a building, change its use, or build an addition; or when an enforcement authority decrees that a building, or a class of buildings, be altered for reasons of public safety. It is not intended that the National Building Code of Canada 1995 be used to enforce the retrospective application of new requirements to existing buildings, unless specifically required by local regulations or bylaws. Although the National Fire Code of Canada 1995 could be interpreted to require the installation of fire alarm, standpipe and hose and automatic sprinkler systems in an existing building for which there were no requirements at the time of construction, it is the intent of the Canadian Commission on Building and Fire Codes that the National Fire Code of Canada 1995 not be applied in this manner to these buildings unless the authority having jurisdiction has determined that there is an inherent threat to occupant safety and has issued an order to eliminate the unsafe condition, or where substantial changes or additions are being made to an existing building.

Whatever the reason, Code application to existing buildings requires careful consideration of the level of safety needed for that building. This consideration involves an analytical process similar to that required to assess alternative design proposals for new construction. First the objective of the Code requirements must be established. To assist the Code user in this regard, Appendix notes are included to clarify the intent of certain requirements. In addition, commentaries on the more complicated Code issues are available. Once the objective is defined, it must then be determined to what extent the existing building must be altered to meet the objective.

In developing Code requirements for new buildings, consideration has been given to the cost they impose on a design in relation to the perceived benefits in terms of safety. The former is definable; the latter difficult to establish on a quantitative basis. In applying the Code requirements to an existing building, the benefits derived are the same as in new buildings. On the other hand, the increased cost of implementing in an existing building a design solution that would normally be intended for a new building may be prohibitive.

The successful application of Code requirements to existing construction becomes a matter of balancing the cost of implementing a requirement with the relative importance of that requirement to the overall Code objectives. The degree to which any particular requirement can be relaxed without affecting the intended level of safety of the Code requires considerable judgment on the part of both the designer and the authority having jurisdiction. Further information on the application of Code requirements to existing buildings may be found in "Guidelines for Application of Part 3 of the National Building Code of Canada to Existing Buildings" NRCC No. 35951, the Commentary "Application of NBC Part 4 for the Structural Evaluation and Upgrading of Existing Buildings" of Structural Commentaries on the National Building Code of Canada 1995, and in Canadian Building Digest No. 230, "Applying Building Codes to Existing Buildings," available from the Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario K1A 0R6.

A-1.1.3.2. Exit. Exits include doors or doorways leading directly into an exit stair or directly to the outside. In the case of an exit leading to a separate building, exits also include vestibules, walkways, bridges and balconies.

A-1.1.3.2. Farm Building. Farm buildings as defined in Article 1.1.3.2. include but are not limited to produce storage and packing facilities, livestock and poultry housing, milking centres, manure storage facilities, grain bins, silos, feed preparation centres, farm workshops, greenhouses, farm retail centres, and horse riding, exercise and training facilities. Farm buildings may be classed as low or high human occupancy, depending on the occupant load.

Examples of farm buildings likely to be classed as low human occupancy as defined in Article 1.2.1.2. of the National Farm Building Code of Canada are livestock

This Appendix is included for explanatory purposes only and does not form part of the requirements. The bold-face reference numbers that introduce each item apply to the requirements in the Code.

and poultry housing, manure and machinery storage facilities and horse exercise and training facilities where no bleachers or viewing area are provided.

Examples of buildings that would be classed as other than low human occupancy include farm retail centres for feeds, horticultural and livestock produce, auction barns and show areas where bleachers or other public facilities are provided. Farm work centres where the number of workers frequently exceeds the limit for low human occupancy will also be in this category.

It is possible to have areas of both high and low human occupancy in the same building provided that the structural safety and fire separation requirements for high human occupancy are met in the part thus designated.

A-1.1.3.2. Fire Separation. A fire separation may or may not have a fire-resistance rating.

A-1.1.3.2. Public Corridor. A covered mall is considered to be a public corridor and, as such, is subject to the same requirements as a public corridor.

A-1.1.3.2. Service Room. Typical examples of service rooms include boiler rooms, furnace rooms, incinerator rooms, garbage handling rooms, and rooms to accommodate air-conditioning or heating appliances, pumps, compressors and electrical equipment. Rooms such as elevator machine rooms and common laundry rooms are not considered to be service rooms.

A-1.1.3.2. Suite. Tenancy in the context of the term “suite” applies to both rental and ownership tenure. In a condominium arrangement, for example, dwelling units are considered separate suites even though they are individually owned. In order to be of complementary use, a series of rooms that constitute a suite are in reasonably close proximity to each other and have access to each other either directly by means of a common doorway or indirectly by a corridor, vestibule or other similar arrangement.

The term “suite” does not apply to rooms such as service rooms, common laundry rooms and common recreational rooms that are not leased or under a separate tenure in the context of the Code. Similarly, the term “suite” is not normally applied in the context of buildings such as schools and hospitals, since the entire building is under a single tenure. A rented room in a nursing home could be considered as a suite if the room was under a separate tenure. A hospital bedroom on the other hand is not considered to be under a separate tenure, since the patient has little control of that space, even though he pays the hospital a per diem rate for the privilege of using the hospital facilities, which include the sleeping areas.

For certain requirements in the Code the expression “room or suite” is used (e.g. travel distance). This means that the requirement applies within the rooms of suites as well as to the suite itself and to rooms that may be located outside the suite. In other places the expression “suite, and rooms not located within a suite” is used (e.g. for the installation of smoke and heat detectors). This means that the requirement applies to individual suites as defined, but not to each room within the suite. The rooms “not within a suite” would include common laundry rooms, common recreational rooms and service rooms, that are not considered as tenant occupied space.

A-2 Relationship of the NBC to Standards Development and Conformity Assessment.

The development of many requirements in the National Building Code and the assessment of conformity to those requirements are supported by several of the member organizations of Canada’s National Standards System (NSS).

The NSS is a federation of accredited organizations concerned with standards development, certification, testing, and quality systems registration, established under the auspices of the Standards Council of Canada Act. Activities of the NSS are coordinated by the Standards Council of Canada (SCC), which has to date accredited 5 standards development organizations, 11 certification organizations, 9 registration organizations and almost 150 calibration and testing laboratories.

The SCC is a federal non-profit crown corporation responsible for the coordination of voluntary standardization in Canada. It also has responsibilities for Canada’s activities in voluntary international standardization.

Canadian Standards

The NBC contains many references to standards published by accredited standards development organizations in Canada. As part of the accreditation requirements, these organizations adhere to the principles of consensus. This generally means substantial majority agreement of a committee comprising a balance of producer, user and general interest members and the consideration of all negative comments. The organizations also have formal procedures for second level review of the technical preparation and balloting of standards prepared under their auspices. Standards prepared in this way are eligible for designation by SCC as National Standards of Canada. (The Canadian Commission on Building and Fire Codes follows these same principles of consensus in the operation of its Codes development process.) The following organizations are accredited as standards development organizations in Canada:

Bureau de normalisation du Québec (BNQ)
Canadian Gas Association (CGA)
Canadian General Standards Board (CGSB)
Canadian Standards Association (CSA)
Underwriters' Laboratories of Canada (ULC)

Table 2.7.3.2. lists the standards referred to in the NBC. When a standard is to be referred to in the NBC, the committee responsible for the relevant section reviews the content of the standard to ensure that it is compatible with the code. Thereafter, referenced standards are annually reviewed in two ways. The originating organization is asked to confirm the status of the original, amended or new edition of the standard and the relevant standing committee is canvassed for any known problems associated with the standard; the standing committee does not necessarily review in detail revised editions of referenced standards but counts on the consensus process involved in the maintenance of these standards and the extensive knowledge and backgrounds of committee members and NRC staff to identify changes in the standards that might create problems in the codes.

The NBC also contains references to standards published by these organizations that are not designated as National Standards of Canada. These standards have been reviewed by the relevant code committee before being incorporated into the Code.

Non-Canadian Standards

A number of subject areas are covered by the NBC where the Canadian standards development organizations have chosen not to develop standards. In these cases, the Code often makes reference to standards developed by organizations in other countries, such as the American Society for Testing and Materials (ASTM) and the National Fire Protection Association (NFPA). These standards are developed using processes that may differ from those used by the Canadian standards development organizations; nevertheless these standards have been reviewed by the relevant standing committees and found acceptable.

Conformity Assessment

The National Building Code is a set of minimum requirements contained within its own text or that of referenced documents. The process of assessing conformity to the requirements during construction is the responsibility of the authority having jurisdiction and the supervising professional designers.

Those persons responsible for ensuring that a material, appliance, system or equipment meets the performance requirements of this Code have several means available to assist them. These means vary from on-site inspection to the use of certification services provided by accredited third party organizations. Test reports or mill certificates provided by manufacturers or suppliers can also assist in the acceptance of products. Engineering reports may be required on more complex products.

Testing

The accreditation programs of the SCC include one for testing and calibration laboratories. Almost 150 organizations are accredited, with 51 accredited as capable of reliably testing building products to specified standards. The test results produced by these organizations can be used in the evaluation, qualification and certification of building products to Code requirements.

Certification

Certification is the confirmation, by an independent organization, that a product or service meets a requirement. Certification of a product, process, or system entails physical examination, testing as specified in appropriate standards, plant examination and follow-up unannounced plant inspections. This procedure leads to the issuing of a formal assurance or declaration, by means of a certification mark or certificate, that the product, process or system is in full conformity with specified requirements.

In some cases, a product for which no standard exists can be certified using procedures and criteria developed by the accredited certifying organization and specifically designed to measure the performance of that product.

The following organizations are accredited by the SCC to provide certification services in the field of building products/facilities. They publish lists of certified products and companies.
American Plywood Association (APA)
Bureau de normalisation du Québec (BNQ)
Canadian Gas Association (CGA)
Canadian General Standards Board (CGSB)
Canadian Standards Association (CSA)
Canadian Welding Bureau (CWB)
Council of Forest Industries (COFI)
Inchcape Testing Services/ETL
Intertek Testing Services NA Ltd. (ITS) e2
Underwriters Laboratories Incorporated (UL)
Underwriters' Laboratories of Canada (ULC)

Facsimiles of the registered certification marks of these organizations are shown in the following illustration:

GC00047A

Figure A-2
Registered certification marks

Registration

Quality Registration Organizations assess a company's conformance to quality assurance standards like the International Organization for Standardization ISO 9000.

Evaluation

Evaluation is a written opinion by an independent professional organization that a product will perform its intended function in a building. Evaluation is very often done to determine equivalency of performance of an innovative product to the intent of a Code requirement. Follow-up plant inspections are not normally part of the evaluation process.

Several organizations, including the Canadian Construction Materials Centre (CCMC) offer evaluation services. To encourage the use of new and innovative proprietary products, CCMC and most of the above listed certification organizations evaluate the equivalency of such products to the Code requirements. CCMC also evaluates products for which a standard exists but for which no other industry supported service is available. It operates with endorsements from the Provincial/Territorial Committee on Building Standards (PTCBS), Canada Mortgage and Housing Corporation (CMHC) and Public Works and Government Services Canada (PWGSC). CCMC publishes lists of evaluated products.

Qualification

Qualification of building products also evaluates the ability of a product to perform its intended function by verifying that it meets the requirements of a standard. Qualification normally includes some follow-up plant inspection. Some organizations publish lists of qualified products that meet the specified requirements. Some organizations qualify manufacturing and/or testing facilities for building products for compliance with the Code and relevant standards.

Equivalence

Article 2.5.1.3. permits equivalence to be determined by past performance, test or evaluation. The determination of the equivalence of materials, appliances, systems, equipment and methods of design and construction not specifically described in the Code usually requires specialized knowledge and evaluation methods. Equivalence can be determined, therefore, through the certification, evaluation and qualification processes described herein.

A-2.1.4.1.(1) Factory-Built Houses. The National Building Code applies the same requirements to site-built and factory-built houses. However, it can often be difficult determining whether a factory-built house complies with these requirements once it has been delivered to its construction site because many of the wall, roof and floor assemblies are closed in and their components cannot be inspected. CSA standard CSA A277, "Procedure for Certification of Factory-Built Houses," was developed to address this problem. It describes a procedure whereby an independent certification agency can review the quality control procedures of a housing factory and make periodic, unannounced inspections of its products and thus, through suitable labelling, provide assurance to authorities at the final site that those components which cannot be inspected on site comply with the code indicated on the label. It is not a building code, only a procedure for certifying compliance of factory-built components with a building code or other standard. If a factory-built house bears a label of a creditable certification agency indicating that compliance with the National Building Code has been certified using the A277 procedure, the accepting authority will have some assurance that the hidden components do not need to be inspected again on site. r4

On the other hand, portions of the CAN/CSA-Z240 MH series of standards on mobile homes do resemble a building code. These portions contain requirements in many of the areas where the NBC also has requirements and frequently the requirements are different. Because it would be illogical to have two different sets of requirements for houses, one set which applies to site-built houses and one set which applies to factory-built houses, the NBC does not make reference to these portions of the Z240 standards. Other portions of the Z240 standards deal with special requirements for mobile homes related to the fact that these houses must be moved over roads.

The NBC does not have requirements in this area. Therefore, labelling that indicates that a factory-built house complies with the Z240 standards can NOT be taken as an indication that the house complies with the NBC.

A-2.1.6.1.(1) Buildings Divided by Firewalls. This concept relates to the provisions directly regulated by this Code and does not apply to electrical service entrance requirements which are regulated by other documents.

A-2.1.6.2.(1) Buildings on Sloping Sites. Application of the definition of grade to stepped buildings on sloping sites often results in such buildings being designated as being greater than 3 storeys in building height even though there may be only 2 or 3 storeys at any one location. The diagrams below illustrate this application compared to a similar building on a flat site.

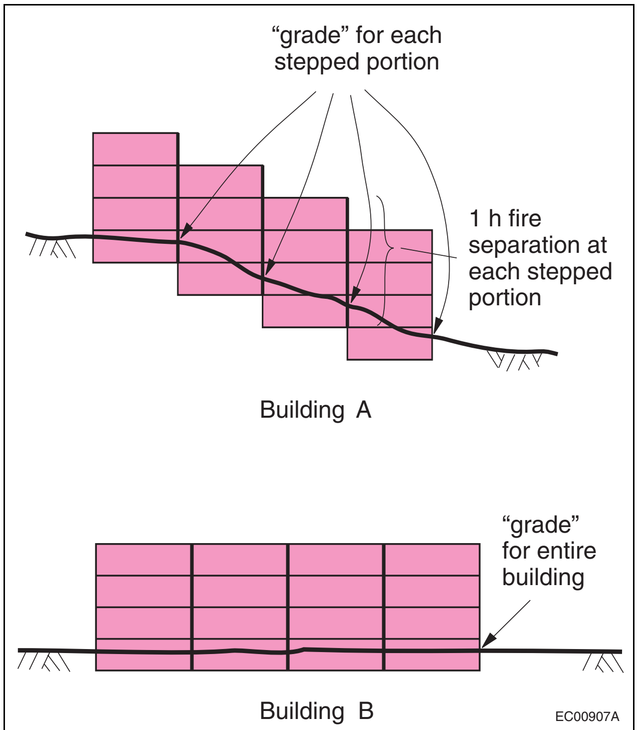


Figure A-2.1.6.2.
Application of the definition of grade

Under this Sentence, Building A can be considered as being 3 storeys in building height instead of 6 storeys in building height. Both Building A and Building B are comparable with regard to fire safety and egress.

This relaxation applies to the determination of building height only. All other requirements continue to apply as appropriate.

A-2.2.1.1.(1) Climatic Values. Data for municipalities not listed in Appendix C may be obtained by writing to: Head, Energy and Industrial Application Section, Atmospheric Environment Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4.

A-2.2.1.1.(2) Winter Design Temperatures. The 2.5% values stated in Sentence 2.2.1.1.(2) are the least restrictive temperatures that can be used. If a designer chooses to use the 1% values given in Appendix C, they would be in excess of the Code minimums and would be considered acceptable.

A-2.3.5.2.(1) Information on Drawings. Examples of information that should be shown on architectural plans and plans for heating, ventilating and air-conditioning systems are:

(a) the name, type and location of the building,
(b) the name of the owner,
(c) the name of the architect,
(d) the name of the engineer or designer,

(e) the north point,
(f) the dimensions and height of all rooms,
(g) the intended use of all rooms,
(h) the details or description of the wall, roof, ceiling and floor construction, including insulation,
(i) the details or description of the windows and outside doors, including the size, weatherstripping, storm sashes, sills and storm doors,
(j) the size and continuity of all pipes, ducts, shafts, flues and fire dampers,
(k) the location, size, capacity and type of all principal units of equipment,
(l) the size, shape and height of all chimneys and gas vents,
(m) the size and location of all combustion air and ventilation openings, and
(n) the location and fire-resistance rating of required fire separations.

A-2.5.2. Structural Equivalents. Subsection 2.5.2. provides for the use of design methods not specified in Part 4 of the Code. These include full scale testing and model analogues. Normally this provision is used to permit acceptance of new and innovative structures or to permit acceptance of model tests such as those used to determine structural behavior or snow or wind loads. Subsection 2.5.2. specifically requires a level of safety and performance at least equivalent to that provided by design to Part 4 and requires loadings and design requirements to conform to Section 4.1.

Subsection 2.5.2. or other parts of Section 2.5. are not intended to allow structural design using design standards other than those listed in Part 4. The acceptance of structures which have been designed to other design standards would require the designer to prove to the appropriate authority that the structure provides the required level of safety and performance. The equivalence of safety can only be established by analyzing the structure for the loads and load factors set out in Section 4.1. and demonstrating that the structure at least meets the requirements of the design standards listed in Sections 4.3. and 4.4.

A-2.7.3.2. Applicable Editions. Where documents are referenced in this Appendix, Appendix B or Appendix C, they shall be the editions designated in Table A-2.7.3.2.

Table A-2.7.3.2.
Documents Referenced in Appendices A, B and C of the National Building Code of Canada 1995

Issuing Agency	Document Number	Title of Document	Code Reference
ANSI	B18.6.1-1981	Slotted and Recessed Wood Screws (Inch Series)	A-9.23.3.1.(2)
ANSI/ ASCE	8-90	Design of Cold Formed Stainless Steel Structural Members	A-4.3.4.2.(1)
ASTM	C 516-80 ◾	Vermiculite Loose Fill Thermal Insulation	A-9.25.2.4.(5)
ASTM	D 1037-96a ◾	Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials	A-9.23.14.2.(4)
ASTM	D 1143-81	Piles Under Static Axial Compressive Load	A-4.2.7.2.(2)
ASTM	E 336-97 ◾	Measurement of Airborne Sound Insulation in Buildings	A-9.11.1.1.(1)
ASTM	E 492-90	Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using The Tapping Machine	A-9.11.1.1.(1)
ASTM	E 597-95 ◾	Determining a Single Number Rating of Airborne Sound Insulation in Multi-Unit Building Specifications	A-9.11.1.1.(1)
ASTM	E 1007-97 ◾	Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures	A-9.11.1.1.(1)
ASTM	F 476-84 ◾	Security of Swinging Door Assemblies	A-9.6.8.10.(1)
CCBFC	NRCC 30629	Supplement to the National Building Code of Canada 1990	Appendix C

Table A-2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CCBFC	NRCC 38727	National Fire Code of Canada 1995	A-1.1.2.1. A-3.1.2.3.(1) A-3.2.4.6.(2) A-3.2.7.8.(3) A-3.3.1.4.(1) A-3.3.1.7.(1) A-3.3.3.1.(1) B-3.2.6.
CCBFC	NRCC 38728	National Plumbing Code of Canada 1995	Appendix C
CCBFC	NRCC 38732	National Farm Building Code of Canada 1995	A-1.1.3.2. A-5.1.1.1.(1)
CCBFC	NRCC 38826 e	Structural Commentaries on the National Building Code of Canada 1995	A-1.1.2.1. A-4.1.1.3.(1) A-4.1.1.5.(1) A-4.1.1.5.(4) A-4.1.1.6.(1) A-4.1.1.6.(2) A-4.1.2.1.(1) A-4.1.3. A-4.1.4.3.(1) A-4.1.6.9. A-4.1.7. A-4.1.7.1. A-4.1.7.2.(2) A-4.1.7.3.(1) A-4.1.8.1.(1) and (2) A-4.1.8.1.(5)(c) A-4.1.8.1.(6)(a) A-4.1.8.1.(6)(d) and 4.1.8.2.(1)(b) A-4.1.8.3.(1) A-4.1.9.1.(2) A-4.1.9.1.(3) A-4.1.9.1.(8) and A-Table 4.1.9.1.B. A-4.1.9.1.(13)(b) A-Table 4.1.9.1.D. A-Table 4.1.9.1.E. A-4.1.9.1.(28) A-4.1.9.1.(29) A-4.1.9.4.(5) A-4.1.10.4. A-4.1.10.6.(1) A-4.2.4.4.(1) A-4.2.4.5.(1) A-4.2.5.1.(1) A-4.2.6.1.(1) A-4.2.7.2.(1) A-5.1.4.2. Appendix C
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	A-9.7.3.2.(1)
CGSB	37-GP-52M-1984 e	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	A-5.8.2.2.(6)

Table A-2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CGSB	37-GP-56M-1985	Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing	A-5.6.1.2.(1) and (3)
CGSB	CAN/CGSB-51.34-M86 r (Amended 1988)	Vapour Barrier, Polyethylene Sheet for Use in Building Construction	A-5.5.1.2.(2)
CGSB	CAN/CGSB-71.26-M88	Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems	Table A-9.23.4.2.C.
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Sliding or Folding, Wardrobe	A-9.6.6.3.(1)
CMHC		Testing of Fresh Air Mixing Devices (1993)	A-9.32.3.
CMHC		Air Permeance of Building Materials (1988)	A-5.4.1.2.(1) and (2)
CSA	A23.3-94	Design of Concrete Structures	A-4.3.3.1.(1)
CSA	A23.4-00 r4	Precast Concrete – Materials and Construction	A-4.3.3.1.(1)
CSA	CAN/CSA-A82.1-M87	Burned Clay Brick (Solid Masonry Units Made from Clay or Shale)	A-5.6.1.2.(1) and (3)
CSA	A82.31-M80	Gypsum Board Application	Table A-9.10.3.1.A. Table A-9.10.3.1.B.
CSA	A277-01 r4	Procedure for Certification of Factory-Built Houses	A-2.1.4.1.(1)
CSA	A370-94	Connectors for Masonry	A-9.21.4.5.(2)
CSA	A371-94	Masonry Construction for Buildings	A-5.6.1.2.(1) and (3)
CSA	A440-00 r4	Windows	A-5.4.1.2.(3) A-9.7.2.1.(1)
CSA	A440.1-00 r4	User Selection Guide to A440	A-9.7.2.1.(1)
CSA	B44-00 r r4	Safety Code for Elevators	A-3.5.2.1.(1)
CSA	B149.1-00 r4	Natural Gas and Propane Installation Code	A-9.10.21.
CSA	B365-01 r4	Installation Code for Solid-Fuel-Burning Appliances and Equipment	A-9.33.1.1.(2)
CSA	C22.1-98 e2 r4	Canadian Electrical Code, Part I	A-3.1.4.3.(1)(b)(i) A-9.10.21.
CSA	CAN/CSA-F326-M91	Residential Mechanical Ventilation Systems	A-9.32.3. A-9.33.6.14.
CSA	O86-01 r4	Engineering Design in Wood	A-9.15.1.3.(3) A-9.23.4.2.
CSA	CAN/CSA-O141-91	Softwood Lumber	A-9.3.2.1.(1)
CSA	O437.0-93	OSB and Waferboard	A-9.23.14.4.(2)
CSA	CAN/CSA-S6-00 e r4	Canadian Highway Bridge Design Code	A-Table 4.1.6.10.
CSA	S16-01 r5	Limit States Design of Steel Structures	A-4.3.4.1.(1)
CSA	CAN/CSA-S406-92	Construction of Preserved Wood Foundations	A-9.15.1.3.(3)
CSA	CAN/CSA-Z32.4-M86	Essential Electrical Systems for Hospitals	A-3.2.7.6.(1)
CSA	CAN/CSA-Z240 e MH Series-92	Mobile Homes	A-2.1.4.1.(1)

Table A-2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
CWC		The Span Book 1995, Revised 1999 r4	A-9.23.4.2.
FCC	Project 03-50-10-008	Serviceability Criteria for Residential Floors Based on a Field Study of Consumer Response (1985)	A-9.23.4.2.(2)
FMRC	FM 2008	Early Suppression-Fast Response Sprinklers (1996) r4	A-3.2.5.13.(7)
FPS		Performance Criteria for Residential Floors Based on Consumer Responses (1988)	A-9.23.4.2.(2)
HC	H46-2/90-156E r4	Exposure Guidelines for Residential Indoor Air Quality	A-9.13.8.2.
IRC	BPN 61	Shear Resistance of Wood Frame Walls	A-9.23.10.2.
IRC	CBD 222	Airtight Houses and Carbon Monoxide Poisoning	A-9.33.1.1.(2)
IRC	CBD 230	Applying Building Codes to Existing Buildings	A-1.1.2.1.
IRC	CBD 231	Moisture Problems in Houses	A-9.25.3.1.(1)
IRC	NRCC 28822	Performance and Acceptability of Wood Floors – Forintek Studies	A-9.23.4.2.(2)
ISO	7731:1986	Danger signals for work places – auditory danger signals	A-3.2.4.22.(1)(b)
ISO	8201:1987	Acoustics – Audible emergency evacuation signal	A-3.2.4.19.(2)
NFPA	13-1999 r r4	Installation of Sprinkler Systems	A-3.2.4.9.(2)(f) A-3.2.5.13.(1) A-3.2.5.13.(6) A-3.2.5.13.(7) A-3.2.5.14.(1) A-3.2.8.2.(3)
NFPA	13D-1999 r r4	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	A-3.2.5.13.(7) A-3.2.5.14.(1)
NFPA	13R-1999 r r4	Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height	A-3.2.5.13.(7) A-3.2.5.14.(1)
NFPA	20-1999 r r4	Installation of Stationary Pumps for Fire Protection	A-3.2.4.9.(2)(f) A-3.2.5.19.(1)
NFPA	30-2000 r r4	Flammable and Combustible Liquids Code	A-6.2.2.5.(1)
NFPA	32-2000 r r4	Drycleaning Plants	A-6.2.2.5.(1)
NFPA	33-2000 r r4	Spray Application Using Flammable or Combustible Materials	A-6.2.2.5.(1)
NFPA	34-2000 r r4	Dipping and Coating Processes Using Flammable or Combustible Liquids	A-6.2.2.5.(1)
NFPA	35-1999 r r4	Manufacture of Organic Coatings	A-6.2.2.5.(1)
NFPA	36-2001 r r4	Solvent Extraction Plants	A-6.2.2.5.(1)
NFPA	40-1997 r	Storage and Handling of Cellulose Nitrate Motion Picture Film	A-6.2.2.5.(1)
NFPA	50A-1999 r4	Gaseous Hydrogen Systems at Consumer Sites	A-6.2.2.5.(1)
NFPA	50B-1999 r4	Liquefied Hydrogen Systems at Consumer Sites	A-6.2.2.5.(1)
NFPA	51-1997 r	Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes	A-6.2.2.5.(1)
NFPA	51A -1996 r	Acetylene Cylinder Charging Plants	A-6.2.2.5.(1)

Table A-2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
NFPA	61-1999 r r4	Prevention of Fires and Dust Explosions in Agricultural and Food Products Facilities	A-6.2.2.5.(1)
NFPA	65-1993	Processing and Finishing of Aluminum	A-6.2.2.5.(1)
NFPA	68-1998 r r4	Venting of Deflagrations	A-6.2.2.5.(1)
NFPA	69-1997 r	Explosion Prevention Systems	A-6.2.2.5.(1)
NFPA	80-1999 r r4	Fire Doors and Fire Windows	A-3.1.8.1.(2) A-3.2.8.2.(3)
NFPA	80A-1996 r	Protection of Buildings from Exterior Fire Exposures	A-3
NFPA	81-1986	Fur Storage, Fumigation and Cleaning	A-6.2.2.5.(1)
NFPA	86-1999 r r4	Ovens and Furnaces	A-6.2.2.5.(1)
NFPA	88A-1998 r r4	Parking Structures	A-6.2.2.5.(1)
NFPA	88B-1997 r	Repair Garages	A-6.2.2.5.(1)
NFPA	91-1999 r r4	Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids	A-6.2.2.5.(1)
NFPA	96-1998 e r4	Ventilation Control and Fire Protection of Commercial Cooking Operations	A-3.3.1.2.(2) A-6.2.2.5.(1) A-9.10.1.4.(1)
NFPA	204M-1991	Guide for Smoke and Heat Venting	A-6.2.2.5.(1)
NFPA	303-2000 r r4	Marinas and Boatyards	A-6.2.2.5.(1)
NFPA	307-2000 r r4	Construction and Fire Protection of Marine Terminals, Piers, and Wharfs	A-6.2.2.5.(1)
NFPA	325-1994 r	Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids	A-6.2.2.5.(1)
NFPA	326-1999 e r4	Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair	A-8.2.2.12.(3)
NFPA	327-1993	Cleaning or Safeguarding Small Tanks and Containers Without Entry	A-8.2.2.12.(3)
NFPA	395-1993	Storage of Flammable and Combustible Liquids at Farms and Isolated Sites	A-6.2.2.5.(1)
NFPA	409-1995 r	Aircraft Hangars	A-6.2.2.5.(1)
NFPA	415-1997 r	Airport Terminal Buildings, Fueling, Ramp Drainage, Loading Walkways	A-6.2.2.5.(1)
NFPA	480-1998 r4	Storage, Handling and Processing of Magnesium Solids and Powders	A-6.2.2.5.(1)
NFPA	481-2000 r r4	Production, Processing, Handling, and Storage of Titanium	A-6.2.2.5.(1)
NFPA	482-1996 r	Production, Processing, Handling and Storage of Zirconium	A-6.2.2.5.(1)
NFPA	490-1998 r4	Storage of Ammonium Nitrate	A-6.2.2.5.(1)
NFPA	650-1998 r4	Pneumatic Conveying Systems for Handling Combustible Particulate Solids	A-6.2.2.5.(1)
NFPA	651-1998 r4	Machining and Finishing of Aluminum and the Production and Handling of Aluminum Powders	A-6.2.2.5.(1)

Table A-2.7.3.2. (Continued)

Issuing Agency	Document Number	Title of Document	Code Reference
NFPA	654-2000 r r4	Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids	A-6.2.2.5.(1)
NFPA	655-1993	Prevention of Sulfur Fires and Explosions	A-6.2.2.5.(1)
NFPA	664-1998 r4	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	A-6.2.2.5.(1)
NFPA	8503-97 r	Pulverized Fuel Systems	A-6.2.2.5.(1)
NLGA		Standard Grading Rules for Canadian Lumber (2000) r4	A-9.3.2.1.(1) Table A-9.3.2.1.A. A-9.3.2.8.(1) A-9.23.10.4.(1)
NLGA	SPS-1-2000 r4	Fingerjoined Structural Lumber	A-9.23.10.4.(1)
NLGA	SPS-3-2000 r4	Fingerjoined "Vertical Stud Use Only" Lumber	A-9.23.10.4.(1)
ONHWP		Details of Air Barrier Systems for Houses (1993)	Table A-9.25.1.2.B.
UL	ANSI/UL 199 (1997) r4	Automatic Sprinklers for Fire-Protection Service	A-3.2.5.13.(7)
UL	UL 1626 (1994)	Residential Sprinklers for Fire-Protection Service	A-3.2.5.13.(7)
ULC	CAN/ULC-S101-M89	Fire Endurance Tests of Building Construction and Materials	A-3.1.5.11.(2)(e) B-3.2.6.5.(6)(b)
ULC	CAN/ULC-S112-M90	Fire Test of Fire Damper Assemblies	Table B-3.2.6.6.C.
ULC	CAN4-S113-79	Wood Core Doors Meeting the Performance Required by CAN4-S104-77 for Twenty Minute Fire Rated Closure Assemblies	A-9.10.13.2.(1)
ULC	CAN4-S114-M80	Test for the Determination of Non-Combustibility in Building Materials	A-3.1.5.2.(1)(b)
ULC	CAN4-S124-M85	Test for the Evaluation of Protective Coverings for Foamed Plastics	A-3.1.5.11.(2)(e)
ULC	ULC-S332-93 r	Burglary Resisting Glazing Material	A-9.6.8.1.
ULC	CAN/ULC-S526-M87	Visual Signal Appliances for Fire Alarm Systems	A-3.2.4.20.(1)
ULC	CAN/ULC-S702-97 r	Mineral Fibre Thermal Insulation for Buildings e4	A-5.3.1.2.(2)
WCLIB	No. 17 (2000) e r4	Standard Grading Rules	A-Table 9.3.2.1.
WWPA	1998 e r4	Western Lumber Grading Rules	A-Table 9.3.2.1.

A-3 Application of Part 3. In applying the requirements of this Part, it is intended that they be applied with discretion to buildings of unusual configuration that do not clearly conform to the specific requirements, or to buildings in which processes are carried out which make compliance with particular requirements in this Part impracticable. The definition of "building" as it applies to this Code is general and encompasses most structures, including those which would not normally be considered as buildings in the layman's sense. This occurs more often in industrial uses, particularly those involving manufacturing facilities and equipment that require specialized design that may make it impracticable to follow the specific requirements of this Part. Steel mills, aluminum plants, refining, power generation and liquid storage facilities are examples. A water tank or an oil refinery, for example, has no floor area, so it is obvious that requirements for exits from floor areas would not apply. Requirements for structural fire protection in large steel mills and pulp and paper mills, particularly in certain portions, may not be practicable to achieve in terms of the construction normally used and the operations for which the space is to be used. In other portions of the same building, however, it may be quite reasonable to require that the provisions of this Part be applied (e.g., the office portions). Similarly, areas of industrial occupancy which may be occupied only periodically by service staff, such as equipment penthouses, normally would not need to have the same type of exit facility as floor areas occupied on a continuing basis. It is expected that judgment will be exercised in evaluating the application of a requirement in those cases when extenuating circumstances require special consideration, provided the occupants' safety is not endangered.

The provisions in this Part for fire protection features installed in buildings are intended to provide a minimum acceptable level of public safety. It is intended that all fire protection features of a building, whether required or not, will be designed in conformance with good fire protection engineering practice and will meet the appropriate installation requirements in relevant standards. Good design is necessary to ensure that the level of public safety established by the Code requirements will not be reduced by a voluntary installation.

Fire Fighting Assumptions

The requirements of this Part are based on the assumption that fire fighting capabilities are available in the event of a fire emergency. These fire fighting capabilities may take the form of a paid or volunteer public fire department or in some cases a private fire brigade. If these fire fighting capabilities are not available, additional fire safety measures may be required.

Fire fighting capability can vary from municipality to municipality. Generally, larger municipalities have greater fire fighting capability than smaller ones. Similarly, older, well established municipalities may have better fire fighting facilities than newly formed or rapidly growing ones. The level of municipal fire protection considered to be adequate will normally depend on both the size of the municipality (i.e., the number of buildings to be protected) and the size of buildings within that municipality. Since larger buildings tend to be located in larger municipalities, they are generally, but not always, favoured with a higher level of municipal protection.

Although it is reasonable to consider that some level of municipal fire fighting capability was assumed in developing the fire safety provisions in Part 3, this was not done on a consistent or defined basis. The requirements in the Code, while developed in the light of commonly prevailing municipal fire protection levels, do not attempt to relate the size of building to the level of municipal protection. The responsibility for controlling the maximum size of building to be permitted in a municipality in relation to local fire fighting capability rests with the municipality. If a proposed building is too large, either in terms of floor area or building height, to receive reasonable protection from the municipal fire department, fire protection requirements in addition to those prescribed in this Code, may be necessary to compensate for this deficiency. Automatic sprinkler protection may be one option to be considered.

Alternatively, the municipality may, in light of its fire fighting capability, elect to introduce zoning restrictions to ensure that the maximum building size is related to available municipal fire protection facilities. This is, by necessity, a somewhat arbitrary decision and should be made in consultation with the local fire fighting service, who should have an appreciation of their capability to fight fires.

The requirements of Subsection 3.2.3. are intended to prevent fire spread from thermal radiation assuming there is adequate fire fighting available. It has been found that periods of from 10 to 30 minutes usually elapse between the outbreak of fire in a building that is not protected with an automatic sprinkler system and the attainment of high radiation levels. During this period, the specified spatial separations should prove adequate to inhibit ignition of an exposed building face or the interior of an adjacent building by radiation. Subsequently, however, reduction of the fire intensity by fire fighting and the protective wetting of the exposed building face will often be necessary as supplementary measures to inhibit fire spread.

In the case of a building that is sprinklered throughout, the automatic sprinkler system should control the fire to an extent that radiation to neighbouring buildings should be minimal. Although there will be some radiation effect on a sprinklered building from a fire in a neighbouring building, the internal sprinkler system should control any fires that might be ignited in the building and thereby minimize the possibility of the fire spreading into the exposed building. NFPA 80A, "Protection of Buildings from Exterior Fire Exposures," provides additional information on the possibility of fire spread at building exteriors.

The water supply requirements for fire protection installations depend on the requirements of any automatic sprinkler installations and also on the number of fire streams that may be needed at any fire, having regard to the length of time the streams will have to be used. Both these factors are largely influenced by the conditions at the building to be equipped, and the quantity and pressure of water needed for the protection of both the interior and exterior of the building must be ascertained before the water supply is decided upon. Acceptable water supplies may be a public waterworks system that has adequate pressure and discharge capacity, automatic fire pumps, pressure tanks, manually controlled fire pumps in combination with pressure tanks, gravity tanks, and manually controlled fire pumps operated by remote control devices at each hose station.

A-3.1.2. Use Classification. The purpose of classification is to determine which requirements apply. This Code requires classification in accordance with every major occupancy for which the building is used or intended to be used. Where necessary, an application clause has been inserted in this Part to explain how to choose between the alternative requirements which multiple occupancy classification may present.

A-3.1.2.1.(1) Major Occupancy Classification. The following are examples of the major occupancy classifications described in Table 3.1.2.1.:

Group A, Division 1
- Motion picture theatres
- Opera houses
- Television studios admitting a viewing audience
- Theatres, including experimental theatres

Group A, Division 2
- Art galleries
- Auditoria
- Bowling alleys
- Churches and similar places of worship
- Clubs, nonresidential
- Community halls
- Courtrooms
- Dance halls
- Exhibition halls (other than classified in Group E)
- Gymnasia
- Lecture halls
- Libraries
- Licensed beverage establishments
- Museums
- Passenger stations and depots
- Recreational piers
- Restaurants
- Schools and colleges, nonresidential
- Undertaking premises

Group A, Division 3
- Arenas
- Indoor swimming pools, with or without spectator seating
- Rinks

Group A, Division 4
- Amusement park structures (not elsewhere classified)
- Bleachers
- Grandstands
- Reviewing stands
- Stadia

Group B, Division 1
- Jails
- Penitentiaries
- Police stations with detention quarters
- Prisons
- Psychiatric hospitals with detention quarters
- Reformatories with detention quarters

Group B, Division 2
- Children's custodial homes
- Convalescent homes
- Hospitals
- Infirmaries
- Nursing homes
- Orphanages
- Psychiatric hospitals without detention quarters
- Reformatories without detention quarters
- Sanitoria without detention quarters

Group C
- Apartments
- Boarding houses
- Clubs, residential
- Colleges, residential
- Convents
- Dormitories
- Hotels
- Houses
- Lodging houses
- Monasteries
- Motels
- Schools, residential

Group D
- Banks
- Barber and hairdressing shops
- Beauty parlours
- Dental offices
- Dry cleaning establishments, self-service, not using flammable or explosive solvents or cleaners
- Laundries, self-service
- Medical offices
- Offices
- Police stations without detention quarters
- Radio stations
- Small tool and appliance rental and service establishments

Group E
- Department stores
- Exhibition halls
- Markets
- Shops
- Stores
- Supermarkets

Group F, Division 1
- Bulk plants for flammable liquids
- Bulk storage warehouses for hazardous substances
- Cereal mills
- Chemical manufacturing or processing plants
- Distilleries

- Dry cleaning plants
- Feed mills
- Flour mills
- Grain elevators
- Lacquer factories
- Mattress factories
- Paint, varnish and pyroxylin product factories
- Rubber processing plants
- Spray painting operations
- Waste paper processing plants

Group F, Division 2

- Aircraft hangars
- Box factories
- Candy plants
- Cold storage plants
- Dry cleaning establishments not using flammable or explosive solvents or cleaners
- Electrical substations
- Factories
- Freight depots
- Helicopter landing areas on roofs
- Laboratories
- Laundries, except self-service
- Mattress factories
- Planing mills
- Printing plants
- Repair garages
- Salesrooms
- Service stations
- Storage rooms
- Television studios not admitting a viewing audience
- Warehouses
- Wholesale rooms
- Woodworking factories
- Workshops

Group F, Division 3

- Creameries
- Factories
- Laboratories
- Power plants
- Salesrooms
- Sample display rooms
- Storage garages, including open air parking garages
- Storage rooms
- Warehouses
- Workshops

A-3.1.2.3.(1) Arena Regulation. The use of an arena is regulated in the National Fire Code of Canada 1995.

A-3.1.4.2.(1)(c) Thermal Barrier in Combustible Construction. Any thermal barrier that is accepted under the requirements of Sentence 3.1.5.11.(2) for noncombustible construction is also acceptable for combustible construction.

A-3.1.4.3.(1) Wire and Cable Equivalence. Electrical wires and cables that conform to the requirements of Sentence 3.1.5.17.(1) are deemed to satisfy the requirements of Sentence 3.1.4.3.(1).

A-3.1.4.3.(1)(b)(i) Raceway Definition. The term raceway is defined in CSA C22.1, "Canadian Electrical Code, Part I," and includes both rigid and flexible conduit.

A-3.1.5.2.(1)(b) Gypsum Board. Gypsum board of the typical thickness used in building construction and that is paper faced will not generally comply with the criteria in CAN4-S114-M, "Test for the Determination of Non-Combustibility in Building Materials," for noncombustible materials even though there are no combustible components in the core. Gypsum board has satisfactory properties for resisting the spread of fire and Clause 3.1.5.2.(1)(b) has been included to specifically permit the use of paper faced gypsum board in a building of noncombustible construction.

A-3.1.5.4.(1) Skylight Spacing. The minimum spacing dimensions for skylight assemblies are based on the distance that flame must travel along a flat ceiling surface. If ceilings have projecting beams or other features that would increase the distance the flame would have to travel along the surface, the distances specified may be measured accordingly.

A-3.1.5.5.(1) Combustible Cladding. These requirements allow for exterior wall assemblies incorporating combustible cladding elements on buildings of noncombustible construction. Since the tested assemblies must be representative of actual construction, the performance of the entire assembly is assessed with regard to its ability to resist flame propagation up the outside of a building. The thermal barrier protection limits the impact of an interior fire on the wall assembly.

These requirements, in combination, thus allow for wall assemblies containing both combustible cladding elements and non-loadbearing combustible framing members. These wall assemblies can be used as infill or panel type walls between structural elements, or attached directly to a loadbearing noncombustible structural system. These requirements, however, do not waive others specifically intended for the protection of combustible insulation in buildings of noncombustible construction.

These requirements are predicated upon the assumption that the manufacturing process and field installation procedure are both carried out under an independent quality assurance program designed to confirm that the product and its application are consistent with the system as tested.

A-3.1.5.5.(2) Flame Spread Distance. The maximum flame spread distance refers to the distance between the top of the opening and the highest observable instance of flaming along the wall assembly and thus allows intermittent flaming to a height of 5 m above the opening.

A-3.1.5.5.(3) Heat Flux Measurement. The heat flux to the assembly referred to in Sentence 3.1.5.5.(3) is the maximum one-minute averaged heat flux measured by transducers located 3.5 m above the top of the opening. The intent of this criterion is to limit the spread of fire on the wall assembly to a height of 3.5 m above the opening. Since the exact location of flaming on the exterior surface of a wall assembly can be influenced by the presence of furring strips, cavities, etc., in the assembly, which could channel the flame away from a heat flux transducer, sufficient transducers should be located at any given height to intercept any flaming that could occur along the assembly. The exact position of the transducers will depend on the location of cavities, joints, studs or furring strips in the assembly.

A-3.1.5.11.(2)(e) Foamed Plastic Insulation Protection. The standard fire exposure temperature in CAN/ULC-S101-M, “Fire Endurance Tests of Building Construction and Materials,” is the same as in CAN4-S124-M, “Test for the Evaluation of Protective Coverings for Foamed Plastics.” A thermal barrier that, when tested in conformance with CAN/ULC-S101-M, “Fire Endurance Tests of Building Construction and Materials,” will not exceed an average temperature rise of 140°C on its unexposed face after a period of 10 min satisfies this requirement.

A-3.1.5.17.(1) Wire and Cable Flammability. In regulating the flammability characteristics of electrical wires and cables installed in a building, it is intended that the requirements of this Sentence and of other similar Sentences in the Code apply to wires and cables that are essentially a part of the distribution systems for power or communications. These distribution systems will normally include branch circuits that terminate at an outlet box in the space to be served and at that location cable terminators or plugs for individual items of equipment will be plugged in.

A-3.1.6. Tents and Air-Supported Structures. The requirements in this Subsection are intended to be limited to certain types of structure. For instance, the word “tent” as used in the Code is intended to refer to a temporary shelter which is used at an open air event such as a fair or an exhibition. A tent will normally be constructed of a fabric held up by poles and attached to the ground by ties. The requirements for tents, however, are not intended to be applied to fabric structures located on buildings.

The term “air-supported structure,” as used in the Code, refers to an envelope which is held up by air pressure alone and which is erected on the ground or above a basement. The structure will usually require ballast or a positive ground anchorage system around the entire perimeter to secure it to the ground or basement. To reinforce this intent, the Code prohibits the location of an air-supported structure above the first storey of any building.

The requirements of Subsection 3.1.6. are not intended to apply to air-supported roof assemblies on buildings, such as domed stadia, or to other types of air-supported structures, such as those over swimming pools situated on the roofs of buildings, which would not be anchored at or near ground level. These assemblies or structures are normally designed and evaluated on the basis of equivalents as permitted by Section 2.5.

A-3.1.8.1.(1)(a) Fire Separation Continuity. The continuity of a fire separation where it abuts against another fire separation, a floor, a ceiling or an exterior wall assembly is maintained by filling all openings at the juncture of the assemblies with a material that will ensure the integrity of the fire separation at that location.

A-3.1.8.1.(1)(b) Barrier to Control Smoke Spread. Although a fire separation is not always required to have a fire-resistance rating, the fire separation should act as a barrier to the spread of smoke and fire until some response is initiated. If the fire-resistance rating of a fire separation is waived on the basis of the presence of an automatic sprinkler system, it is intended that the fire separation will be constructed so that it will remain in place and act as a barrier against the spread of smoke for a period of time until the sprinklers have actuated and controlled the fire.

A-3.1.8.1.(2) Installation of Closures. Although there is no explicit performance statement in the NBC that means of egress should be free of smoke, it is the intent that during the period when occupants are using a means of egress to evacuate from a floor area, the smoke contamination should not reach levels that would inhibit movement to the exit. This is particularly critical for persons with disabilities, who may not move at the same rate as other persons and who could be more susceptible to the effects of smoke contamination. NFPA 80, “Fire

Doors and Fire Windows," requires that a fire door protecting a means of egress be designed to minimize the possibility of smoke passing through the opening.

Although self-closing devices are not required for all doors in a fire separation (see Article 3.1.8.11.), it is assumed that in a fire situation every door in a fire separation is closed. Article 3.3.3.5. prohibits grilles and similar openings for certain doors in hospitals and nursing homes.

Although fire dampers that release on the fusion of a fusible link will help to control the spread of fire, a substantial quantity of smoke could have passed through the opening before that event. They are frequently located below the upper levels of a room and so the release of the fusible link of the fire damper that protects an opening will be delayed until the temperature at the level of the opening becomes high enough to fuse the link.

Similar concern has to be considered for other closure devices that are permitted to remain open on fusible links, and their location should be restricted in accordance with NFPA 80, "Fire Doors and Fire Windows," and the NBC, except where their installation in another location will not allow the products of combustion to spread into means of egress.

A-3.1.8.9.(5) Fire Damper Access. It is intended that an access door be provided in the duct and, if the duct is enclosed with an architectural finish, that a second access door be provided through that finish.

A-3.1.8.16.(1) Wired Glass and Glass Block. The permission to include wired glass and glass block in doors and fire separations between an exit and the adjacent floor area does not permit the inclusion of those items in fire separations between exits and other parts of the building that are not included in the floor area. Examples include other exit facilities and vertical service spaces, including those used for building services and elevator hoistways.

A-3.1.8.17.(1) Fire-Protection Rating for Doors. The provisions in Articles 3.1.8.15., 3.1.8.16. and 3.1.8.17. do not waive a requirement for a door to have a fire-protection rating. To achieve this rating in a door test, it may be necessary to limit the area of glass in the door. If this area is less than the area limits of Article 3.1.8.16., it is the governing criterion. Conversely, if the area limits of Article 3.1.8.16. are less than the area required to achieve a fire-protection rating, then the area limits of this Article govern.

A-3.1.11.5.(1) Fire Stopping in Combustible Construction. Combustible construction referred to in Sentence 3.1.11.5.(1) includes all types of construction that do not comply with the requirements for noncombustible construction. All the elements within the concealed space can be combustible, unless required to be of noncombustible materials (e.g., certain categories of pipework and ducts), but the value of the flame-spread rating of the combustible materials determines the permitted extent of the concealed space between fire stops. The materials to be considered include all construction materials regulated by this Code, including the framing and building services that are located in the concealed space.

A-3.1.13.2.(2) Folding Partition. Folding partitions used to divide a space into separate rooms are not considered as doors for the purposes of this Sentence.

A-3.2.1.1.(3) Building Height. If mezzanines are located at the same level but in different portions of a building, it is the intent of this Sentence that the aggregate area of all mezzanines be used in relation to the area of the storey in which they are located. For example, mezzanines in suites of residential occupancy are visually obstructed by interior partitions or fire separations between suites; thus, the criteria in Sentence 3.2.1.1.(3) normally are not satisfied. If the aggregate area of a mezzanine, consisting of a number of mezzanines in separate suites, exceeds 10% of the area of the storey in which it is located, that mezzanine is considered as an additional storey in the determination of building height.

A-3.2.1.1.(7) Accessible Service Space. These service spaces are often referred to as interstitial spaces and are designed to allow service personnel to enter and undertake maintenance or installation within the space. Catwalks or flooring are usually included to provide a walking or access surface. Even when flooring is included, it is not intended that the interstitial space should be considered as a storey for the purposes of the Code unless the space is used for purposes other than servicing or the storage of materials and equipment to be used for building services within that space.

A-3.2.2.2.(1) Special and Unusual Structures. Examples of structures which cannot be identified with the descriptions of buildings in Articles 3.2.2.20. to 3.2.2.83. include grain elevators, refineries and towers. Publications that may be consulted to establish good engineering practice for the purposes of Article 3.2.2.2. include the NFPA Fire Protection Handbook, Factory Mutual Data Sheets, and publications of the Society for Fire Protection Engineering.

A-3.2.2.18.(2) Sprinkler Extent. A literal interpretation of Article 3.2.2.6. and Sentences 3.2.2.4.(1) and (2) could require installation of an automatic sprinkler system throughout all storeys of a building regardless of options in Articles 3.2.2.20. to 3.2.2.83. to construct one or more storeys without installation of sprinklers. It is the intent of the Code that all storeys below a storey in which an automatic sprinkler system is installed should also be protected by an automatic sprinkler system to ensure that a fire in a lower storey does not incapacitate the automatic sprinkler system or overwhelm an automatic sprinkler system in an upper storey. Persons in an upper storey in which waivers or reductions of other fire safety systems are permitted would be exposed to an increased risk from a fire on a lower storey. This concept also applies to situations in which an automatic sprinkler system has been installed within a floor area in order to modify other safety requirements applying within the floor area. If the uppermost storey or storeys of a building can be constructed without the installation of an automatic sprinkler system it is not necessary that an automatic sprinkler system required in a lower storey be extended into the upper storey or storeys.

A-3.2.2.35.(4) Sprinkler Requirements. Spaces in a building of Group A, Division 4 occupancy that are intended to be equipped with sprinklers include, but are not limited to, dressing and changing rooms, concession stands and areas, toilet rooms, locker rooms, storage areas, service rooms, offices and other spaces that provide service to the building. The enclosure of seating areas with glazing needs special consideration in determining the requirements for sprinklers. For example, if the enclosed area is used for the consumption of food and beverages, it should be classified as Group A, Division 2 and the appropriate requirements of that classification applied. Enclosure of limited spaces above seating areas for press and media purposes is not considered to require the installation of sprinklers.

A-3.2.3.1.(4) Spatial Separation Design. In the application of Sentences 3.2.3.1.(3) and (4) it is intended that Sentence (3) be used first to establish the basic requirements for the exterior wall in terms of fire-resistance rating, type of construction and type of cladding. The percentage of unprotected openings determined from the application of Sentence (3) would be unnecessarily restrictive if the actual unprotected openings occur in a plane that is set back from the front of the building face.

Sentence (4) applies to the calculation of the allowable percentage of unprotected openings based upon projection onto a plane that is in front of all unprotected openings. The application of these two Sentences is shown in Figure A-3.2.3.1.(4). The modifications permitted by Article 3.2.3.11. would be applied, if applicable, to the area of unprotected openings derived from Sentence (4).

A-3.2.3.7.(9) Noncombustible Cladding. The requirement for the exterior protection of foamed plastic insulation in an exposing building face is intended to limit the exposure of the insulation to flames, thereby reducing the possibility of increased radiation to an exposed building. The permission to use combustible cladding systems conforming to Article 3.1.5.5. does not waive the requirements for noncombustible construction or noncombustible cladding in Sentences 3.2.3.7.(1) and (4).

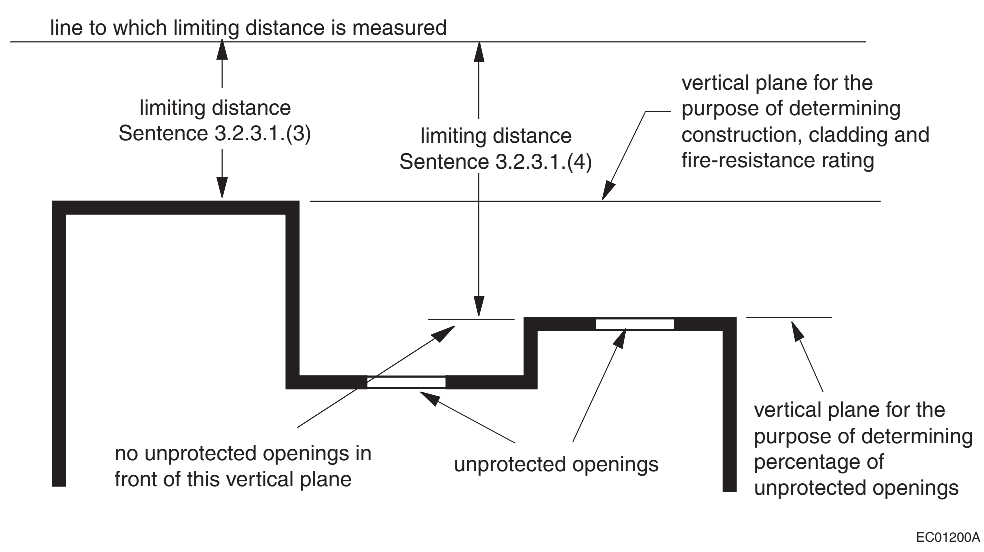


Figure A-3.2.3.1.(4)
Spatial separation design

A-3.2.3.11.(1) Increased Openings Permitted. No increase of the maximum area of unprotected openings in an exposing building face should be applied until the requirements of Article 3.2.3.7. have been satisfied in determining the construction of the exposing building face.

A-3.2.3.13.(1) Wall Exposed to Another Wall. The requirements of this Article are to ensure that the control of fire spread by the interior fire separations between fire compartments is not defeated through the spread of fire by thermal radiation outside the building. Minimum spatial separations are specified between the openings in separate fire compartments where the exterior faces of these compartments are deemed to expose each other to a thermal radiation hazard. This situation may arise where the angle, θ, between the intersecting planes of the exposing building faces is 135° or less. Examples are shown in Figures A-3.2.3.13.(1).A., A-3.2.3.13.(1).B. and A-3.2.3.13.(1).C. of situations which would be addressed by this Article.

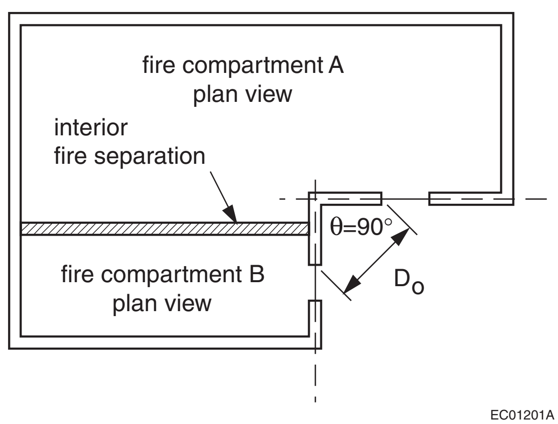


Figure A-3.2.3.13.(1).A.
Openings in walls at a right-angle corner

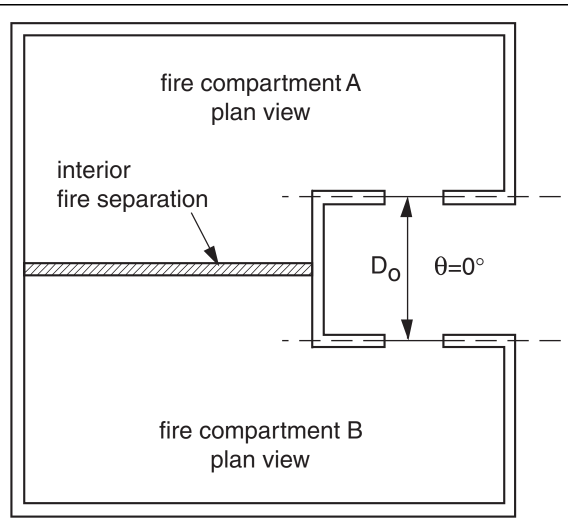


Figure A-3.2.3.13.(1).B.
Openings in walls which are parallel to one another

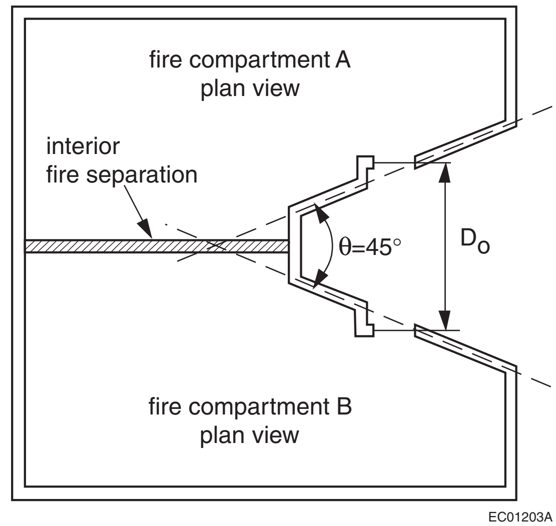


Figure A-3.2.3.13.(1).C.
Openings in walls with an included angle of 45°

A-3.2.4. Fire Alarm System. The term "fire alarm system" used in this Subsection applies to fire alarm systems with or without voice communication capability.

A-3.2.4.4.(1) Single Stage Fire Alarm System. This requirement, in combination with Article 3.2.4.22., is intended to allow for the provision of voice communication capability as an integral part of a single stage fire alarm system.

A-3.2.4.4.(2) Two Stage Fire Alarm System. This requirement, in combination with Article 3.2.4.22., is intended to allow for the provision of voice communication capability as an integral part of a 2 stage fire alarm system. The key or special device referred to in Clause 3.2.4.4.(2)(c) should be immediately available to all persons on duty who have been given authority to sound an alarm signal.

A-3.2.4.6.(2) Access to Silencing Switches. This requirement is intended to prevent easy access to silencing switches. The satisfactory operation of a fire alarm system to alert the occupants of a building to an emergency is predicated on the assumption that the alarm signal will be silenced only after responsible staff have verified that no emergency exists. Details on the emergency procedures to be used in case of fire are contained in the National Fire Code of Canada 1995.

A-3.2.4.7.(6) Emergency Telephone Number. In many municipalities an emergency telephone number, for example 911, is used for all emergency services and it is preferable to post that number.

A-3.2.4.8.(2) Fire Alarm Zones. Alarm initiating devices referred to in this Sentence include fire detectors, waterflow switches and manual pull stations. If a room or space in a building extends through more than one storey of the building, as in the case of multi-level dwelling units and machinery rooms, judgment must be exercised in the zoning and annunciation of the fire detectors in that room or space. In general, the lowest storey on which access is provided into the room or space should be indicated on the annunciator to avoid unnecessary delays for the responding fire fighters. Consideration should also be given to the use of numbers or letters on the annunciator that correspond to those used in the building elevators.

A-3.2.4.8.(8) Indicator Devices. It is permissible to install the fire alarm control unit in close proximity to the building entrance to meet the requirement for an annunciator. All signals required for the annunciator must be present at the control unit. In systems that include both control unit and annunciator, the signals must be routed to the annunciator through the control unit and the same functionality must be available at the control unit for operation and maintenance functions.

A-3.2.4.9.(2)(f) Supervision for Fire Pumps. Specific electrical supervision for fire pumps is stated in NFPA 20, “Installation of Stationary Pumps for Fire Protection,” which is referenced in NFPA 13, “Installation of Sprinkler Systems.” r4

A-3.2.4.11.(1) e3 Smoke Detector Location. In the design and installation of the smoke detection system, consideration must be given to all features which could have a bearing on the location and sensitivity of the detectors, including ceiling height, sloped ceilings, diffusion from air conditioning and ventilating currents, obstructions, baffles, and other pertinent physical configurations that might interfere with the proper operation of the system.

A-3.2.4.17.(1) Manual Pull Station. Only one manual pull station need be provided near a group of doors serving as a principal entrance or as a single exit facility.

A-3.2.4.19. Acoustic Measurement and Terminology. The following notes on acoustic measurement and terminology are intended to assist in the application of the requirements for audibility of fire alarm system sounding devices.

The background or ambient measurement should be a spatial averaged A-weighted equivalent sound level measured for 60 s. This can be obtained using an integrating sound level meter with the integration time set to 60 s. During the measurement period the meter should be slowly moved about so as to sample the space uniformly but coming no closer than 0.5 m from any solid wall, floor or ceiling. Alternatively, measurements can be made at 3 or more positions throughout the space and an energy average calculated.

The measurement of the alarm level depends on the type of alarm signal. If the signal is a continuous signal from a bell or siren, the spatial averaged A-weighted equivalent sound level should be obtained. The integration time should be long enough to obtain a reasonable spatial average of the space, but not less than 10 s.

If the alarm has a temporal pattern, then the A-weighted sound level should be measured using the ‘fast’ time constant during the ‘on’ part of the cycle. In this situation it is not appropriate to use an integrating sound level meter. Since the duty cycle of the alarm is only 37.5% at best, that type of meter would give a reading that is 4 or more decibels lower than the level while the alarm is ‘on.’ A number of measurements should be made about the space in question and the average value used to obtain a good spatial representation. Strictly speaking, the energy average of the measurements should be used; however, the frequency spectrum associated with most alarms is of a type that should give little variation about the space. If the measured levels don’t vary by more than 2 to 3 dB, then an arithmetic average rather than an energy average can be used.

Effect of Furnishings

The final inspection of a fire alarm system is seldom made when the building is furnished and ready for occupancy. This results in measured levels which may be several decibels higher than will be found in the occupied building. The importance of this difference depends on the situation.

If the building is complete except for furnishings, so that the sources of ambient noise are present, then the amount by which the alarm signal exceeds the ambient level will not change appreciably with the introduction of furnishings. In this case both levels will be reduced by about the same amount.

If the primary source of ambient noise will be office equipment and workers, as would be expected in an open plan office, then measurements made prior to occupancy may differ substantially from those made afterwards. This may be true for both the absolute sound levels and the difference between the alarm level and the ambient.

A problem arises in trying to estimate what the absolute sound levels will be after the building is occupied.

In general, if the measurement is made in a totally bare room then the level will be about 3 dB higher than if the room were carpeted, assuming a reasonable carpet with an underlay. In most cases this will account for most of the absorption in the room and no further correction will be necessary. Adding heavy drapes and absorptive furnishings to a carpeted room can reduce the sound level by a further 2 to 3 dB.

Commercial buildings are more problematic. For example, if an open plan office is measured before any office screens are installed, there could be a substantial difference in the before and after levels, depending on the distance to the nearest alarm device.

Glossary of Acoustical Terms

Audible: A signal is usually considered to be clearly audible if the A-weighted sound level exceeds the level of ambient noise by 15 dB or more.

Awakening threshold: The level of sound that will awaken a sleeping subject 50% of the time.

A-weighted: A frequency weighting network which emphasizes the middle frequency components similar to the response of the human ear. The A-weighted sound level correlates well with subjective assessment of the disturbing effects of sounds. The quantity is expressed in dBA.

Masked threshold: The level of sound at which a signal is just audible in ambient noise.

Sound level: A sound pressure level obtained using a signal to which a standard frequency-weighting has been applied.

Sound pressure: A fluctuating pressure superimposed on the static pressure by the presence of sound. The unqualified term means the root-mean-square sound pressure. In air, the static pressure is barometric pressure.

Sound pressure level: Ten times the common logarithm of the ratio of the square of the sound pressure under consideration to the square of the standard reference pressure of 20 mPa. The quantity obtained is expressed in decibels.

A-3.2.4.19.(1) Alert and Alarm Signals. Alert signals are part of a 2 stage fire alarm system. The intent of the first, alert, stage is to notify persons in authority of a potential threat to building occupants. If a continuously staffed location is available, the alert signal can be restricted to that location.

A-3.2.4.19.(2) Alarm Signal Temporal Pattern. The temporal pattern of an alarm signal relates to the time during which the signal is produced and the intervals between the individual signal pulses. The international standard ISO 8201, "Acoustics – Audible emergency evacuation signal," includes a pattern that is becoming widely used in different countries and it is appropriate for this pattern to be adopted in Canada. The temporal pattern can be produced on most signalling devices. Most existing alarm systems can be modified, and this pattern could be phased in when the systems require modification. The characteristic of the pattern is a 3-pulse phase followed by an off phase. The 3 pulses each consist of an on phase lasting for 0.5 ± 0.05 s followed by an off phase lasting for 0.5 ± 0.05 s sounded for 3 successive on periods and then followed by an off phase lasting for 1.5 ± 0.15 s. Figure A-3.2.4.19.(2).A. indicates the pattern that is intended.

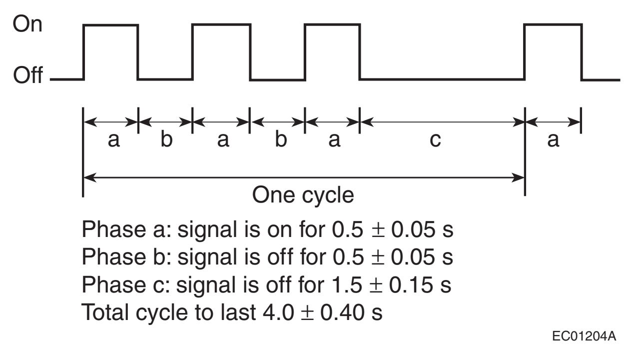


Figure A-3.2.4.19.(2).A.
Temporal pattern for fire alarm signal

Although the diagram shows a square wave form, the wave can have other shapes that produce a similar effect.

If single stroke bells are to be used, the temporal pattern can be produced by having the bell struck three times at a rate of one stroke per second followed by an interval of 2 s of silence. Figure A-3.2.4.19.(2).B. shows the pattern that results.

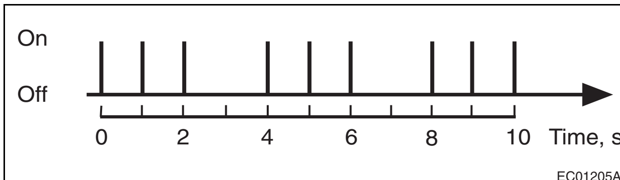


Figure A-3.2.4.19.(2).B.
Temporal pattern imposed on a single stroke bell or chime

Note to Figure A-3.2.4.19.(2).B.: e

(1) The on phase represents the time that the striker mechanism is actuated. The sound produced by the bell or chime will continue at a level that decreases until the striker mechanism is re-actuated.

A-3.2.4.19.(4) Sound Pressure Level. For the purposes of this requirement, an audible signalling device should not produce a sound pressure level more than 110 dBA when measured at a distance of 3 m.

A-3.2.4.19.(5) Residential Sound Level. In a building in which corridors or hallways serve more than one suite or dwelling unit, there will be situations in which an audible signal device cannot be placed in the corridor or hallway to alert persons sleeping in suites and dwelling units, because the sound level in the vicinity of the device would exceed that permitted by Sentence 3.2.4.19.(4). In these situations it will be necessary to supplement the building fire alarm system with an audible signal device in the suite or dwelling unit. These devices could be piezoelectric devices similar to the sounding units in many smoke alarms, subject to the device emitting the appropriate temporal pattern required by Sentence 3.2.4.19.(2).

A-3.2.4.19.(9) Disconnect Device for Dwelling Units. In order to minimize the annoyance caused by false and unwanted alarms, the disconnect will permit a person to silence the local audible device within the dwelling unit. At that time the person would be aware of sounds from devices in common spaces and could plan appropriate action. The disconnect will reduce the possibility of tampering with the audible devices.

A-3.2.4.20.(1) Visual Alarm Pattern. CAN/ULC S526-M, "Visual Signal Appliances for Fire Alarm Systems," published by Underwriters' Laboratories of Canada, applies to visual signalling units. This document is referenced by the most recent standard for the installation of fire alarm systems and would automatically apply. Current Canadian technology does not integrate visual and audible alarms to have the same temporal pattern. Visual and audible alarms should have as close a temporal pattern as possible but without interference beats that might have a deleterious effect on some persons. Visual signalling devices with the same temporal pattern as required for audible devices are available from some sources and they should become available in Canada. Not all units that comply with the ULC standard will have sufficient power to adequately cover large areas; care will have to be taken to specify units with adequate power when large spaces are being designed.

A-3.2.4.20.(2) Visual Signal. If staff located in each zone or compartment can see each sleeping room door, visual signals could be located above each door. If staff cannot see every door, it is intended that the visual signals be provided at the location where the staff are normally in attendance.

A-3.2.4.21.(5) Smoke Alarm Installation. The Canadian Electrical Code permits a smoke alarm to be installed on most residential circuits that carry lighting outlets and receptacles. It is the intent of the National Building Code that any other item on a circuit with a smoke alarm should be unlikely to be overloaded and trip the breaker with a resultant loss of power that is not sufficiently annoying for the breaker to be restored to the on position. It is considered that an interior bathroom light or a kitchen light fulfills this intent, but that circuits restricted to receptacles do not fulfill this intent.

A-3.2.4.22.(1)(b) Voice Messages. The concept of intelligibility expressed in Clause 3.2.4.22.(1)(b) is intended to mean that a person with average hearing and cognitive abilities is able to understand the messages that are transmitted into the space occupied by the person. There is no absolute measure to predetermine the effect of loudspeakers and it may be necessary, once the building has been furnished and occupied, to increase the number of loudspeakers to improve the quality of the messages. The intelligibility of the message depends on the speech level, the background level, and the reverberation time of the space. ISO 7731, "Danger signals for work places – Auditory danger signals," addresses audibility. The standard suggests that an A-weighted sound level at least 15 dB above the ambient is required for audibility, but allows for more precise calculations using octave or 1/3 octave band frequencies to tailor the alarm signal for particular ambient noise conditions. Design of the alarm system is limited to ensuring that all areas receive an adequately loud alarm signal. If a public address system is to be used to convey instructions during an emergency, then the requirements of the system are less straightforward. In general, however, a larger number of speakers operating at lower sound levels would be required.

A-3.2.5.4.(1) Fire Department Access for Detention Buildings. Buildings of Group B, Division 1 used for housing persons who are under restraint include security measures that would prevent normal access by local fire departments. These security measures include fencing around the building site, exterior walls without openings or openings which are either very small or fitted with bars, and doors that are equipped with security hardware that would prevent easy entry. These buildings would have fire fighting equipment installed and the staff would be trained to handle any small incipient fires. It is expected that appropriate fire safety planning would be undertaken in conjunction with local fire departments in order that special emergencies could be handled in a cooperative manner.

A-3.2.5.6.(1) Fire Department Access Route. The design and construction of fire department access routes involves the consideration of many variables, some of which are specified in the requirements in the Code. All these variables should be considered in relation to the type and size of fire department vehicles available in the municipality or area where the building will be constructed. It is appropriate, therefore, that the local fire department be consulted prior to the design and construction of access routes.

A-3.2.5.9.(5)(c) Fire Department Pumping Equipment. Availability of appropriate pumping equipment from the local fire department or, in the case of industrial plants or complexes, from their fire brigade, is considered sufficient to meet the intent of this requirement.

A-3.2.5.13.(1) Sprinkler System Design. In NFPA 13, "Installation of Sprinkler Systems," reference is made to other NFPA standards that contain additional sprinkler design criteria. These criteria apply to industrial occupancies with high fire loads, including warehouses with high piled storage, and industrial occupancies intended for the use, manufacture or storage of highly flammable materials. Therefore, while only NFPA 13 is called up directly by Sentence 3.2.5.13.(1), the additional criteria in the other NFPA standards are included automatically.

In some NFPA standards, certain aspects of sprinkler protection are dependent on the fire-resistance rating of the vertical structural members. In these cases, the sprinkler system design options can be affected by the fire-resistance rating of these elements. For example, in buildings used for the storage of rubber tires, sprinklers directed at the sides of a column are required if the column does not have the required fire-resistance rating.

Other NFPA standards may require that certain occupancies be sprinklered in conformance with NFPA 13, as in the case of some garages. These requirements do not supersede the requirements in the Code. An occupancy is required to be sprinklered only when this is specified in the Code, but when it is so required, it must be sprinklered in conformance with NFPA 13 and its referenced standards.

A-3.2.5.13.(6) Sprinklering of Roof Assembly. Sprinkler protection for roof assemblies in lieu of fire resistance is based on the assumption that the sprinklers will protect the roof assembly from the effects of fire in spaces below the roof. If a ceiling membrane is provided, the sprinklers would have to be located below the membrane in order to react quickly to the fire. In certain instances, however, sprinklers may be required within the concealed spaces as well as below the membrane. NFPA 13, "Installation of Sprinkler Systems," requires sprinklers in certain concealed spaces. In addition, sprinkler protection is required within all rooms and closets immediately below the roof to control any fire that might start in that space and thereby reduce the probability of the fire spreading into the roof assembly.

A-3.2.5.13.(7) Fast Response Sprinklers. Several types of sprinkler will respond to a fire faster than a conventional standard response sprinkler. The Response Time Index (RTI) is used to quantify the sensitivity of the sprinkler link for any given sprinkler. The RTI for the group of fast response sprinklers described below will on average range from 22 $s^{0.5}\bullet m^{0.5}$ to 33 $s^{0.5}\bullet m^{0.5}$. RTI values for standard response sprinklers will typically be in the range of 83 $s^{0.5}\bullet m^{0.5}$ to 110 $s^{0.5}\bullet m^{0.5}$.

Any confusion as to the appropriate type of fast response sprinkler for different types of building should be alleviated by considering the testing criteria described below and the reference to the appropriate NFPA installation standards.

Although the Code specifies where fast response sprinklers are required it does not prevent the appropriate use of fast response sprinklers in other occupancies.

Residential sprinklers are tested in accordance with UL 1626, "Residential Sprinklers for Fire-Protection Service." They are installed in accordance with NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," with NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes," and with Section 4-3.6 of NFPA 13, "Installation of Sprinkler Systems," for residential occupancies and for dwelling units.

Quick-response sprinklers are tested in accordance with ANSI/UL 199, "Automatic Sprinklers for Fire-Protection Service." They are installed in accordance with NFPA 13, "Installation of Sprinkler Systems," for spacing, density and location. They are acceptable for limited use as described in NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," but are not permitted for use under NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes."

Early suppression fast response sprinklers are tested in accordance with FM 2008, "Early Suppression-Fast Response Sprinklers." They are installed in accordance with NFPA 13, "Installation of Sprinkler Systems," but are not accepted for use under either NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four

Stories in Height," or NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes."

Quick response extended coverage sprinklers are tested in accordance with ANSI/UL 199, "Automatic Sprinklers for Fire-Protection Service." They are installed in accordance with NFPA 13, "Installation of Sprinkler Systems," for spacing, density and location. They are acceptable for limited use as permitted by NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," but are not permitted for use under NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes."

A-3.2.5.13.(8) Sprinkler Rating. The requirements of this Sentence can be met by using sprinklers with a rating of 79°C to 107°C.

A-3.2.5.14.(1) Hazard Classification for Sprinkler Selection. The reference to light hazard occupancies is based on the descriptions of these occupancies given in NFPA 13, "Installation of Sprinkler Systems," and is intended only for use in the design of sprinkler systems. These descriptions should not be confused with the occupancy classifications in the Code.

In NFPA 13 a light hazard occupancy is one in which the quantity or combustibility of contents is low and fires with relatively low rates of heat release are expected. Typical buildings or parts of buildings include: churches; clubs; eaves and overhangs, if of combustible construction with no combustibles beneath; educational buildings; hospitals; institutional buildings; libraries, except very large stack rooms; museums; nursing or convalescent homes; offices, including data processing rooms; residential buildings; restaurant seating areas; theatres and auditoria, excluding stages and proscenia; and unused attics.

Although NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," and NFPA 13D, "Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes," as referenced by NFPA 13, are concerned with specific types of residential occupancy, namely apartment buildings up to four storeys, one and two family dwellings, and mobile homes, for the purpose of acceptance of combustible sprinkler piping these occupancies are considered to be included in the category of residential buildings under light hazard occupancies.

A-3.2.5.19.(1) Fire Pumps. In order to ensure an adequate water supply, it may be necessary to install a fire pump for a building that has either a standpipe system or an automatic sprinkler system installed. Reference to NFPA 20, "Installation of Stationary Pumps for Fire Protection," provides the necessary guidance to designers. r4

A-3.2.7.4.(1) Emergency Power Reliability. In some areas power outages are frequent and may be of long duration. These local conditions should be taken into account in determining the type of system for supplying emergency power for lighting. This should be studied at the planning stage of a building project in conjunction with the local fire safety and building officials.

A-3.2.7.6.(1) Hospital Emergency Power. CAN/CSA-Z32.4-M, "Essential Electrical Systems for Hospitals," contains requirements other than those that relate specifically to the installation of emergency equipment. Compliance with these other requirements is not intended by the reference in this Article. Although the standard was not developed to apply to nursing homes, it is the intent of the Code that the requirements for hospitals should be applied to nursing homes.

A-3.2.7.8.(3) Emergency Power Duration. The times indicated in this Sentence are the durations for which emergency power must be available for a building under fire emergency conditions. Additional fuel for generators or additional battery capacity is required to handle normal testing of the equipment, as indicated in the National Fire Code of Canada 1995. If the operation of emergency generators or batteries is intended for other than fire emergency conditions, such as power failures, fuel supplies or battery capacity must be increased to compensate for that use.

A-3.2.7.9.(1) Emergency Power Reliability. In some areas power outages are frequent and may be of long duration. These local conditions should be taken into account in determining the type of system for supplying emergency power for building services. This should be studied at the planning stage of a building project in conjunction with the local fire safety and building officials.

A-3.2.8.2.(3) Special Protection of Opening. In manufacturing operations involving the use of conveyor systems to transport material through fire separations, it may not be possible to use standard closure devices. NFPA 80, "Fire Doors and Fire Windows," includes appendix information concerning protection of openings through vertical fire separations. NFPA 13, "Installation of Sprinkler Systems," includes methods of protecting openings through floor assemblies, however, it is assumed by that standard that the remainder of the building would be sprinklered. Combinations of methods may be required to ensure that the level of safety inherent in the requirements of the Code is maintained.

A-3.2.8.2.(6)(b) Stairway Opening. The phrase "used only for stairways, escalators or moving walks" is intended to restrict a floor opening to the size that is necessary to accommodate the stairway, escalator or moving walk.

A-3.2.8.2.(6)(c) Waiver of Occupancy Separation Continuity. The typical application of this Sentence is to buildings with a mixture of occupancies that are randomly located throughout the building. Examples include shopping centres, podia of large commercial and business complexes, and recreational buildings that are combined with mercantile and business operations. A shopping mall with two interconnected storeys is an example that is frequently encountered in many jurisdictions. The permission to breach the floor assembly between the storeys does not override requirements for separation of specific suites or occupancies. For instance, although storage garages are Group F, Division 3 occupancies, the requirement in Article 3.3.5.6. for the storage garage to be separated from other occupancies by a fire separation with at least a 1.5 h fire-resistance rating must be observed. In a similar manner, a theatre or cinema (Group A, Division 1 occupancy) must be separated from other occupancies in accordance with Sentence 3.3.2.2.(1) and seats in an arena type building (Group A, Division 3) must be separated from space below in accordance with Sentence 3.3.2.2.(3).

A-3.2.8.8.(1) Smoke Exhaust System. The mechanical exhaust system is intended as an aid to fire fighters in removing smoke and is to be designed to be actuated manually by the responding fire department. Although smoke is normally removed from the top of the interconnected floor space, exhaust outlets at other locations may be satisfactory.

A-3.3. Safety Within Floor Area. Section 3.3. regulates safety within floor areas including rooms or other spaces within a building, with the exception of service rooms and service spaces that are regulated by Section 3.6. The requirements are grouped according to the occupancy of the floor area, room or space. The occupancy of these floor areas and other spaces is not necessarily the major occupancy for which the building is classified. For example, a building may be classified by major occupancy as an office building and the provisions for structural fire protection and fire protection equipment for office buildings prescribed in Section 3.2. apply. Within that building, a room or floor area may be used for mercantile, care or detention, business, residential, industrial or other occupancy.

Life safety for the occupants of any floor area depends in the first instance on the use or occupancy of that floor area. The risks to the occupants occur in the early stages of a fire. These special life risks differ from one occupancy to another and, consequently, must be regulated differently. Section 3.3. regulates risks within floor areas, and these requirements apply regardless of the major occupancy of the building that contains them. For example, an assembly room must comply with the requirements for assembly occupancy whether it is contained in an office building, hospital, hotel, theatre, industrial building or other major occupancy.

A-3.3.1.2.(1) Hazardous Substance. Examples of hazardous substances include radioactive materials, corrosive liquids, poisonous gases, reactive substances and explosive or highly flammable materials.

A-3.3.1.2.(2) Cooking Equipment Ventilation. Cooking equipment manufactured for use in dwelling units and other residential suites is often installed in buildings used for assembly and care or detention purposes. It is not obvious from the Code requirements or those of NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," whether a ventilation and grease removal system is required in all assembly and care or detention uses. If the equipment is to be used in a manner that will produce grease-laden vapours that are substantially more than would be produced in a normal household environment, then it would be appropriate to apply the requirements of NFPA 96. If the equipment is used primarily for reheating food prepared elsewhere or is used occasionally for demonstration or educational purposes, there would be no expectation of applying the requirements of NFPA 96. In all cases the circumstances should be reviewed with the authority having jurisdiction.

A-3.3.1.4.(1) Occupancy in Corridor. Since this Code regulates new construction, alterations and changes of occupancy, kiosks in public corridors are required to be constructed on the same basis as the remainder of the building. This means that the construction of kiosks and similar structures must take into consideration all the requirements which apply to the remainder of the building, including structural fire protection, construction type, finish materials, egress widths and sprinkler installations. Special activities of an occasional nature which were not contemplated in the original design of a public corridor, and which represent only a temporary change in occupancy, are regulated in the National Fire Code of Canada 1995. These regulations include maintaining egress paths clear of obstructions, controlling combustible contents and providing measures to ensure quick response for fire fighting.

A-3.3.1.7.(1) Temporary Refuge for Persons with Disabilities. These measures are intended to provide temporary refuge for persons with disabilities. It is acknowledged, however, that the measures cannot provide absolute safety for all occupants in the fire area. It may, therefore, be necessary to develop special arrangements in the fire safety plan to evacuate persons with disabilities from these areas. Details for a suitable plan are contained in the National Fire Code of Canada 1995.

The protected elevator referred to in Clause 3.3.1.7.(1)(a) is intended to be used by fire fighters as a means for evacuating persons with disabilities. It is not intended that this elevator be used by persons with disabilities as a means of egress without the assistance of fire fighters.

If an estimate is to be made of the number of persons with disabilities in a floor area who can be accommodated in each zone in Clause 3.3.1.7.(1)(b), this estimate may be based on Table 3.8.2.1., which is used to determine the minimum number of spaces to be provided for wheelchair occupants in fixed seating areas. If more precise information is available, it should be used for sizing the zones.

A-3.3.1.9.(4) Obstruction in Corridor. The sweep of a cane used by blind or visually impaired persons normally detects obstructions that are within 680 mm of the floor. Any obstruction above this height would not normally be detected and can, therefore, create a hazard if it projects more than 100 mm into the path of travel.

A-3.3.1.11.(3) Movable Partitions. Should an emergency situation arise outside of normal working hours but when occupants are still in the space, they could be left without a clear way out. This could occur during inventory or after closing time when all occupants have not yet left, but staff close the door to prevent other persons from entering. In many small tenant areas, the movable partitions (store fronts) provide the only way out. There should always be a second way out or a swinging door within or adjacent to the sliding partitions.

A-3.3.1.12.(4) Door Hardware. The permission to have additional door releasing devices is intended to allow the use of a security chain, night latch or dead bolt to supplement the normal door latching device. These are permitted for dwelling units and locations where guests in a hotel or motel require additional security. The height of these items is also governed by the maximum height stipulated in Sentence 3.3.1.12.(5) to ensure that they can be operated by persons with physical disabilities. This additional hardware should not require appreciable dexterity by the user and the general requirements on the ability to operate the device without the use of keys, special tools or specialized knowledge still apply.

A-3.3.1.12.(6) Controlled Egress Doors. It is intended that Sentence 3.3.1.12.(6) apply to doors used at the perimeter of a contained use area or an impeded egress zone. If the contained use area consists of a single room, the requirements would apply to that room. In the case of individual cells within a contained use area, exterior keyed locks could be used on the cell doors consistent with the fire safety plan and continuous supervision by staff who can release the doors in an emergency.

A-3.3.1.22. Obstructions in Means of Egress. Obstructions including posts, counters or turnstiles should not be located in a manner that would restrict the width of a normal means of egress from a floor area or part of a floor area unless an alternative means of egress is provided adjacent to and plainly visible from the restricted means of egress.

A-3.3.2.3.(2) Tablet Arms. Although it is intended that the motion to raise the tablet arm be essentially a single fluid motion, it is acceptable that the motion be a compound motion of raising the tablet arm and including an articulation to allow the tablet to fall back alongside the arm rest.

A-3.3.3.1.(1) e3 Safety in a Care or Detention Occupancy. Fire safety for patients in bedroom areas in hospitals and nursing homes is predicated on the ability of staff to carry out at all times essential life safety functions in accordance with the fire safety plan. Details for a plan are contained in the National Fire Code of Canada 1995.

Many factors may affect the ability of staff to carry out life safety functions, including the mobility of patients who cannot fend for themselves and the built-in protection for patients who cannot be moved except under exceptional circumstances.

Should a patient area in a hospital or nursing home contain factors which would increase the time normally required for staff to evacuate patients or to undertake other life safety measures, consideration should be given to providing additional fire protection measures to ensure that equivalent safety is available.

A-3.3.3.4.(1) e3 Doorway Width. The 1 050 mm minimum clear width of doorways accounts for door stops and, thus, is intended to allow for the use of 1 100 mm doors.

A-3.3.3.5.(1) Hospitals and Nursing Homes. The basis for the requirements in this Article is that staff will be in attendance at all times on the same storey, either in each fire compartment or in a fire compartment immediately adjacent.

A nursing home occupancy is intended to include nursing and convalescent homes, skilled nursing facilities, intermediate care facilities and some homes for the aged. Occupants of nursing homes are assumed to be, for the most part, non-ambulatory. The use of physical restraints and tranquilizing drugs which may render occupants immobile are also factors which should be considered.

Although the age of patients by itself is not sufficient justification for a floor area to be included in a nursing home occupancy, it should be recognized that many homes for the aged are in fact nursing homes. The factor that determines whether or not a home for the aged is a nursing home and, therefore, a care or detention occupancy as opposed to a residential occupancy, is whether or not continuous nursing care is required for the occupants. If it is not required, then the occupancy would normally be classified as residential rather than care or detention.

A-3.3.3.5.(6) Weatherstripping. "Weatherstripped or otherwise" is intended to provide for adequate draft resistant sealing material to retard the passage of smoke through closure assemblies used in fire separations.

A-3.3.3.5.(11) Intercommunicating Rooms. Rooms that are interconnected can include more than one sleeping room, together with ensuite toilet rooms, shower rooms, and storage closets used for the storage of personal items of the persons occupying the sleeping rooms. It is not intended that storage rooms for other purposes be included within the group of interconnected rooms.

A-3.3.3.5.(14) Grilles and Louvres. In order to permit the supply of make-up air to compensate for the removal of exhaust air from these toilet rooms, shower rooms and similar spaces, it is permitted to incorporate grilles and louvres for the transfer of air provided the air movement cannot allow smoke to pass through these spaces to other parts of the building. It is considered that in normal designs the air is exhausted directly to the exterior and is not circulated. If air is to be circulated back to other parts of the building, smoke operated dampers should be included in the air circulating system.

A-3.3.4.4.(1) Landing in Egress Stairway. A landing level used in an egress stairway from a dwelling unit is not considered to be a storey of that dwelling unit if the landing is used only for pedestrian travel purposes.

A-3.3.4.5.(1) e3 Automatic Locking Prohibited. Doors that must be manually reset to lock them when they are opened from the inside meet the intent of this requirement.

A-3.3.4.6.(1) Sound Transmission. The Tables referenced by Appendix Note A-9.10.3.1. provide information on a number of building assemblies with respect to typical sound transmission class ratings. In the absence of test information or results for a specific assembly of materials, the values in Table A-9.10.3.1.A. are considered to satisfy the intent of Sentence 3.3.4.6.(1).

A-3.4.1.1.(1) Type of Exit Facility. The requirements for exits in Section 3.4. were developed for new construction. If alterations are made to an existing building or changes of occupancy occur, other design solutions than those in Section 3.4. may have to be developed to maintain an acceptable level of safety if it is not practicable to fully conform to the requirements of this Section. In some cases the use of fire escapes to supplement the existing exit facilities may be the only practicable solution. Because of the variety of conditions that may be encountered in existing buildings, it is difficult to standardize or codify such requirements. Alternative means of providing acceptable levels of safety may have to be tailored to the particular building design. In all cases, however, the requirements described in Section 3.4. are intended to provide the level of safety to be achieved. If alternative measures are used, they should develop the level of safety implied in these requirements.

A-3.4.1.6.(2) Sleeping Area. Areas serving patients' sleeping rooms include sleeping areas and areas where patients are taken for treatment.

A-3.4.2.3.(1) Least Distance Between Exits. The least distance measurement does not apply to each combination of exits on a multi-exit storey. It only applies to at least 2 of the required exits from that storey.

A-3.4.3.1.(2) Door Width. The clear width values of exit doorways in Clauses 3.4.3.1.(2)(d) and (e) account for door stops and are intended to allow for the use of 1 100 mm doors in Clause 3.4.3.1.(2)(d) and 810 mm doors in Clause 3.4.3.1.(2)(e).

A-3.4.3.3.(2) Evacuation of Interconnected Floor Space. This Sentence ensures that egress facilities allow for the simultaneous evacuation of all portions of an interconnected floor space. It does not contemplate the phased evacuation of occupants; thus in buildings where that type of evacuation is intended, fire protection requirements in addition to those prescribed in the Code may be necessary.

In the first instance, this Sentence provides for cumulative exiting that can accommodate the efficient movement of all occupants in the exit stairs. Clause 3.4.3.3.(2)(a) permits an alternative approach that will accommodate all the occupants in the stairs but will restrict the egress flow rate. Clause 3.4.3.3.(2)(b) provides a second alternative that assumes the occupants must queue before entering the stair. A "protected floor space" conforming to Article 3.2.8.6. is intended to provide an intermediate area of safety that is protected from the hazards of the interconnected floor space. It does not provide a holding or refuge area for all occupants of a floor area for an extended period of time.

To ensure that evacuation is not unduly delayed and that queuing of the occupants in the protected floor space can be accommodated, requires careful consideration in the design of the interface between the interconnected floor space/protected floor space/exit.

It is not appropriate, for example, to share a common vestibule in complying with Sentences 3.2.8.5.(1) and 3.2.8.6.(1). Under evacuation conditions, occupants entering the vestibule would flow towards the exit, as opposed to the protected floor space, thus resulting in queuing outside the vestibule and potential exposure to fire. To comply with the intent, it is necessary to design the egress path such that the occupants enter the protected floor space through a vestibule, then in turn enter the exit stair from the protected floor space. In addition, sufficient space should be provided between the vestibule and the exit to allow for the queuing of occupants in the protected floor space.

A-3.4.3.3.(2)(a) Temporary Safety Area. The objective of Clause 3.4.3.3.(2)(a) is to provide an area of temporary safety in the exit stair shafts for the occupants of the interconnected floor space. This requirement is considered to be met if 0.3 m^2 per person is provided in the stair shaft between the floor level served and the floor level immediately beneath it.

A-3.4.4.2.(2)(e) Requirements for Lobby. If an exit is permitted to lead through a lobby, the lobby must provide a level of protection approaching that of the exit. As well as meeting the width and height requirements for exits, the lobby must be separated from the remainder of the building by a fire separation having a fire-resistance rating at least equal to that required for the exit, unless one of the exceptions in this Clause is applied.

A-3.4.6. Application to Means of Egress. The requirements in Subsection 3.4.6. apply to interior and exterior exits, as well as to ramps, stairways and passageways used by the public as access to exit. The treads, risers, landings, handrails and guards for the latter access to exit facilities must thus be provided in conformance with the appropriate requirements for exit facilities.

A-3.4.6.4.(5) Continuity of Handrail. Blind or visually-impaired persons rely on handrails to guide them on stairways. A continuous handrail will assist them in negotiating stairs at changes in direction. The extended handrail is useful to persons with physical disabilities to steady themselves before using the stairs. Handrails should, however, return to the wall, floor or post, so as not to constitute a hazard to blind or visually-impaired persons.

A-3.4.6.7.(3) Stair Tolerances. The term "uniform run and rise" assumes normal construction tolerances.

A-3.4.6.9.(5) Door Swing. Although it is required that the door on the right hand side of a pair of doors shall swing in the direction of travel through the exit, the direction of swing of the door on the left side will depend on the function of the horizontal exit. If the horizontal exit provides for movement from one building to the adjacent building but does not require movement in the reverse direction, both doors must swing in the direction of travel to the adjacent building. If the design is based upon both buildings providing complementary movement in either direction, then the doors must swing in opposite directions. Location of a required exit sign directly above a door that swings in the direction of travel is deemed to meet the intent of Clause 3.4.6.9.(5)(b).

A-3.4.6.10.(3) Exit Concealment. Hangings or draperies placed over exit doors may conceal or obscure them.

A-3.4.6.15.(1) Fastening Device. Turnpieces of a type which must be rotated through an angle of more than 90° before releasing a locking bolt are not considered to be readily openable. The release of a locking bolt should allow the door to open without having to operate other devices on the door.

A-3.4.6.15.(4) Electromagnetic Lock. Electromagnetic locks are intended for use where there is a need for security additional to that provided by traditional exit hardware. They are not intended for indiscriminate use as alternative locking devices. The design of these devices requires evaluation to ensure that their operation will be fail-safe in allowing exiting in the event of foreseeable emergencies. If more than one locking device is used in a building, it is expected that one switch will release and reset all devices simultaneously.

A-3.4.6.16.(1) Special Security for Doors. The need for security in banks and in mercantile occupancies requires the ability to use positive locking devices on doors that may not readily be opened from inside the building. In a fully sprinklered building, the risk to persons inside the building is substantially reduced. The provisions of Sentences 3.4.6.16.(2) to (9) assume that the area is illuminated and that a means of communication is available to any occupant during times that the doors are locked.

A-3.4.6.18.(1)(d) Colour Contrast. The identification of floor and other signs intended to facilitate orientation for visually-impaired persons should offer maximum colour contrast to be effective. For this reason, it is recommended that white on black or black on white be used, as this combination produces the best legibility. It is also recommended that the sign surfaces be processed to prevent glare.

A-3.5.2.1.(1) Elevator Design. The reference to CSA B44, "Safety Code for Elevators," in this Sentence implies conformance with all requirements of that standard for elevator cars, hoistways, pits and machine rooms, including restrictions on other services in these areas and detailed design criteria. r4

A-3.5.4.1.(1) Elevator Car Dimensions. In some circumstances it is necessary to maintain a patient on a stretcher in the prone position during transit to a hospital or to treatment facilities. Inclining the stretcher to load it into an elevator could be fatal or at the very least detrimental to the patient's health. Many ambulance services use a mobile patient stretcher whose size is 2 010 mm long and 610 mm wide. As well as space for the stretcher in the elevator, there should be sufficient additional space for at least two attendants who may also be providing treatment during transit. Common elevator units that can satisfy this requirement include:

- a 1 134 kg elevator car with minimum interior dimensions of 2 032 mm wide and 1 295 mm deep with a right or left hand access door. The minimum access door width is 1 067 mm and it must be on the 2 032 mm side of the car.
- a 1 134 kg elevator car with minimum interior dimensions of 2 032 mm deep and 1 295 mm wide with a minimum 915 mm wide access door located on the 1 295 mm side.

A-3.6.2.1.(1) Location of Fuel-Fired Appliances. Sentence 3.6.2.1.(1) requires that fuel-fired appliances be located in service rooms. It does not allow for their installation in service spaces.

A-3.6.2.6.(1) Combustible Refuse Storage. Storage of refuse consisting of combustible materials including waste paper, cardboard and plastic, and noncombustible materials such as glass and metallic containers can be accumulated in these rooms for the purpose of recycling. This storage is allowed in consideration of a less stringent collection schedule when compared to that of garbage or refuse, which is collected regularly.

A-3.6.3.1.(1) Vertical Service Spaces. Sentence 3.6.3.1.(1) does not prohibit the internal subdivision of a vertical service space to allow different building services to be installed in physically separated spaces unless other requirements apply (see, for example, Article 3.2.6.9.). Fire separation requirements apply to the perimeter of the group of service spaces. Article 3.6.3.3. has special requirements for linen chutes and refuse chutes.

A-3.6.4.2.(2) Ceiling Membrane Rating. In construction assemblies that utilize membrane ceiling protection and have been assigned a fire-resistance rating on the basis of a fire test, the membrane is only one of the elements that contribute to the performance of the assembly and does not in itself provide the protection implied by the rating. For the fire-resistance rating of membrane materials used in this form of construction, reference should be made to the results of fire tests which have been conducted to specifically evaluate the performance of this element.

A-3.6.5.6.(2) Clearance for Warm-Air Supply Ducts. Applicable to forced-air furnaces where permissible clearance C above plenum is 75 mm or less.

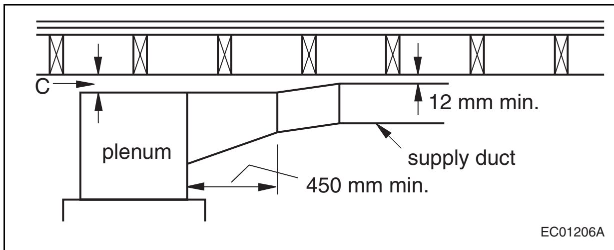


Figure A-3.6.5.6.(2)
Clearance for warm-air supply ducts

A-3.6.5.6.(3) Clearance for Warm-Air Supply Ducts. Applicable to forced-air furnaces where permissible clearance C above plenum is more than 75 mm but not more than 150 mm.

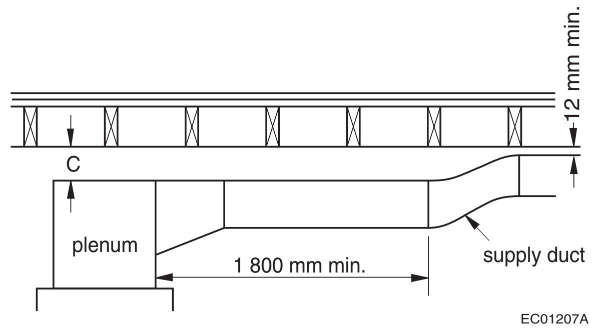


Figure A-3.6.5.6.(3)
Clearance for warm-air supply ducts

A-3.6.5.6.(4) Clearance for Warm-Air Supply Ducts. Applicable to forced-air furnaces where permissible clearance C above plenum is more than 150 mm.

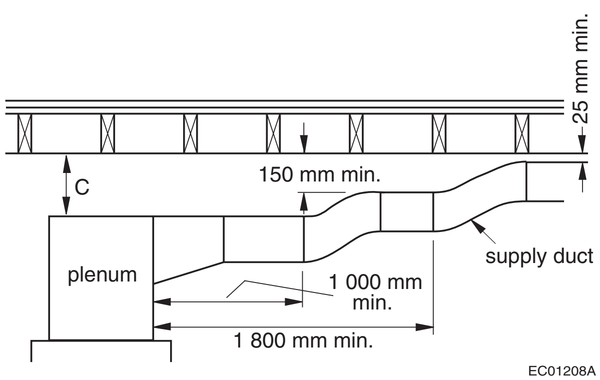


Figure A-3.6.5.6.(4)
Clearance for warm-air supply ducts

A-3.7.2.1.(1) e3 Window Area Limit. Part 9 requirements for windows cover a number of subjects, however, this Article refers only to the area limits.

A-3.7.4.2.(1) Water Closets. Sentence 3.7.4.2.(1) assumes that there will be a sufficient number of persons in the building to justify the provision of separate water closet facilities for both males and females. In some circumstances overall low occupant loads would not require more than one water closet for males and one water closet for females and yet the building has more than one storey. It is deemed that rooms each containing a single water closet available for both males and females would satisfy the intent of the Code. The total number of water closets must be adequate for the total number of occupants. Requirements for barrier free accessibility also need to be considered. If the entrance storey is accessible and the upper storeys are not required to be accessible, a room in the accessible storey must meet the requirements of Section 3.8. and can serve both males and females. If provided, a nonaccessible room, designed to serve both males and females, in each nonaccessible upper storey would be acceptable. Sentence 3.7.4.2.(4) permits a single water closet to serve both males and females if the total occupant load is low.

A-3.8.1.1. Accessibility. Industrial buildings often pose a greater risk to their occupants due to the presence of significant quantities of dangerous materials or the use of hazardous processes. For example, plants which are classified as Group F, Division 2 or 3, may store and use toxic or highly flammable substances in significant quantities, or house processes which involve very high temperatures and which have a high degree of automation. In some facilities, particularly in primary industries such as forestry and metallurgy, the construction normally used and the operations carried out within the space can make compliance with the requirements of Section 3.8. impracticable. It is therefore intended that these requirements be applied with discretion in buildings of Group F, Division 2 or 3 major occupancy. However, where industrial buildings contain subsidiary occupancies, such as offices or showrooms, it is reasonable to require that accessibility be provided in these spaces.

A-3.8.1.2. Entrances. An accessible route should exist from the sidewalk or roadway and parking area to an accessible building entrance. This route should be located so that persons with physical disabilities do not have to pass behind parked cars.

To provide more general access to buildings, not less than 50% of the pedestrian entrances are required to be barrier-free. This should include a principal entrance. If the 50% calculation results in a fraction, the number of barrier-free entrances should be the next higher unit value. For the purpose of determining the number of entrances to a building, several adjacent doors in a bank of doors are considered to be a single entrance.

A-3.8.1.4.(1) e3 Access to Storeys Served by Escalators. Some buildings located on a sloping site are accessible from street level on more than one floor. This arrangement does not meet the intent of the requirement. A wheelchair user should not be required to travel outside the building in order to gain access to another level. The location of elevators should be clearly indicated from each entrance to the building.

A-3.8.2.1. Access to Rooms and Facilities. If barrier-free access is required into suites or rooms in Subsection 3.8.2., it is intended that access be provided, with some exceptions identified in Sentence 3.8.2.1.(2), throughout each room or suite. Some examples of where barrier-free access is required are as follows:

- within each suite (subject to Clauses 3.8.2.1.(2)(j) to (l),
- within rooms or areas that serve the public or are designated for use by visitors, including areas in assembly occupancies with fixed seats, display areas and merchandising departments,
- within rooms or areas for student use in assembly occupancies,
- within general work areas, including office areas,
- within general use or general service areas, including shared laundry areas in residential occupancies, recreational areas, cafeterias, lounge rooms, lunch rooms and infirmaries,
- within sleeping rooms in hospitals and nursing homes,
- (if installed), into at least one passenger elevator or elevating device conforming to Article 3.8.3.5.,
- into washrooms described in Article 3.8.2.3.,
- to any facility required by this Section to be designed to accommodate persons with physical disabilities,
- onto every balcony provided in conformance with Clause 3.3.1.7.(1)(c), and e
- to service counters used by the general public (examples include ticket counters, refreshment stands, drinking fountains, cafeteria counters, checkout counters and bank service counters).

The permission to waive a barrier-free path of travel for wheelchair access to certain specified areas of a building is not intended to waive accessibility requirements for persons whose physical disabilities do not require special provision for access to raised or sunken levels. Persons with visual or hearing disabilities that do not require the use of a wheelchair can be expected to move throughout a building.

The concept of providing similar amenities and facilities applies, among other things, to food, beverage, and entertainment facilities within restaurants, to smoking and non-smoking areas permitted in accordance with local regulations, and to window areas providing a view of an exterior attraction.

Availability of specific spaces depends on reservation policy and the sequence in which patrons arrive at a restaurant or other facility, and therefore is beyond the scope of this Code.

Accessibility “within” a floor area means that in general all normally occupied spaces are to be accessible, except those areas which are deemed not to require barrier-free access. Examples of excluded floor areas are small raised office areas in retail and industrial premises and storage platforms in industrial and other occupancies.

The concept of wheelchair accessibility does not extend to building service facilities, nor to all floor levels within a storey, e.g., mezzanines not served by an elevator. Mezzanines that are accessible by an elevator are therefore not excluded.

A-3.8.2.2.(1) Parking Areas. e3 In localities where local regulations or by-laws do not govern the provision of or dimensions of barrier-free parking spaces, the following provides guidance to determine appropriate provisions. If more than 50 parking spaces are provided, parking spaces for use by persons with physical disabilities should be provided in the ratio of one for every 100 parking spaces or part thereof. Parking spaces for use by persons with physical disabilities should

(1) be not less than 2 400 mm wide and provided on one side with an access aisle not less than 1 500 mm wide,
(2) have a firm, slip-resistant and level surface,
(3) be located close to an entrance required to conform to Article 3.8.1.2.,
(4) be clearly marked as being for the use of persons with physical disabilities, and
(5) be identified by a sign located not less than 1 500 mm above ground level, with the international symbol of accessibility and the words “Permit Required” (Figure A-3.8.2.2.(1).A.).

Asphalt, concrete and gravel are acceptable parking surfaces. Curb ramps should be not less than 920 mm wide. Parallel parking spaces should be not less than 7 000 mm long. If more than one parking space is provided for persons with physical disabilities, a single access aisle can serve two adjacent parking spaces. The arrangement shown in Figure A-3.8.2.2.(1).B. allows the shared use of an access aisle to serve two adjacent parking spaces provided for use by persons with physical disabilities.

Figure A-3.8.2.2.(1).A. *e3*
Permit Required sign

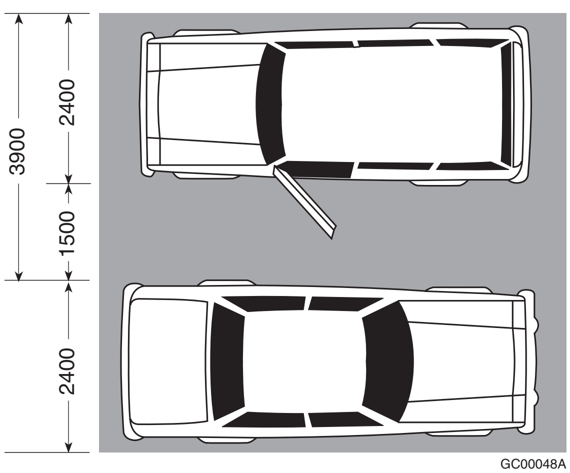


Figure A-3.8.2.2.(1).B. *e3*
Shared access aisle

A-3.8.2.2.(1)(a) Access to Exterior Parking. It is not intended that a separate accessible entrance must be provided from the exterior parking area. The designer may choose to designate the entrance leading to the exterior parking area as the required entrance or to provide a properly identified and unobstructed path of travel from the parking area to the entrance which is accessible. The entrance chosen should, in any case, be one normally used by the occupants of the building. Long paths of travel are not recommended.

A-3.8.2.3. Washrooms. The primary intent of this requirement is that all regular washrooms be made accessible to all persons, including persons with disabilities, primarily persons who must use a wheelchair. Well-designed washrooms which can accommodate disabled persons need not be much larger than conventional washrooms.

The exception in Clause 3.8.2.3.(2)(b) recognizes situations where several washrooms may be provided on a large floor area. In such a case, not all washrooms need to be barrier-free, provided that a barrier-free washroom is available within a reasonable distance (45 m) of one that is not and that the location of that barrier-free washroom is clearly indicated as required by Sentence 3.8.3.1.(3).

Clause 3.8.2.3.(2)(c) is intended to address “strip malls” (a shopping mall with no public corridor). Section 3.7., which requires plumbing facilities, does not address the concept of suite and could permit, for instance, a shopping mall containing only Group E occupancies (assuming the mall is more than 100 m^2) to have only one washroom for each sex located in any one of the suites. It is desirable, however, that washrooms be located so as to be accessible at all times, since the owner or tenant of one suite has no control over the activities of another. These buildings may have either public barrier-free washrooms in a central location or washrooms which can accommodate persons with physical disabilities in each suite. This arrangement relieves any one tenant from having to provide “public” washrooms. Hence, the exception for suites of less than 500 m^2 is meant as a relaxation to avoid an unnecessary burden on small facilities but should not be construed as meaning that these buildings need not provide accessible washrooms.

Sentence 3.8.2.3.(4) clarifies that special washrooms (“unisex”) should not be used as a substitute for making regular washrooms accessible. These washrooms are an alternative which the authority having jurisdiction could require in the course of renovations to an existing building to satisfy the requirements of Sentence 3.8.2.3.(1), where modifying existing washrooms proves impracticable or where Section 3.7. permits the use of a single washroom for both sexes. This does not preclude the provision of special washrooms in addition to barrier-free regular washrooms; “unisex” washrooms are desirable in large shopping complexes and multiple use complexes, as well as transportation terminals, where persons must be accompanied by an attendant because of their degree of disability. These facilities are convenient because they may be used regardless of the gender of the disabled person or the attendant.

A-3.8.3.1.(1) to (3) Accessibility Signs. The official symbol, shown in Figure A-3.8.3.1.(1), indicates to persons with physical disabilities that they will have reasonable freedom of movement within a building so signed. The symbol is usually white on a blue background; where these colours do not stand out, the sign can be set on a white background. An arrow can be added to indicate direction or the location of an accessible space or facility.

Figure A-3.8.3.1.(1)
Signs indicating accessible facilities

A-3.8.3.1.(4) Signs for Assistive Listening Facilities. An international sign, shown in Figure A-3.8.3.1.(4), indicating accessibility for persons with hearing disabilities, should be used to indicate the availability of variable volume controls on telephones, assistive listening systems, and text telephones (TT). These latter devices may also be referred to as teletypewriters (TTY) or telecommunications devices for the deaf (TTD).

Figure A-3.8.3.1.(4)
Signs for assistive listening facilities

A-3.8.3.3.(1) Doorway Width. Standard wheelchair width specifications indicate a range of sizes from 584 mm overall to 685 mm overall. Every doorway that is located in a barrier-free path of travel must have a clear width of not less than 800 mm when the door is in the open position and therefore it is important that this dimension be measured correctly. Figure A-3.8.3.3.(1) shows a door opened to 90°. It is clear that the door, and to a lesser extent the stop, impinges on the space within the door frame. The clear width of not less than 800 mm is measured from the face of the door to the outside edge of the stop on the door frame. It is not sufficient just to measure the inside width of the door frame. Other factors, including location of door stops other than on the door frame, and the installation of door closers and exit devices, should be taken into account. The intrusion of a door handle into the space is of lesser importance. It is recognized that there are many types of door frame and door mounts but the overall objective is to maintain a clear width of not less than 800 mm. The diagram depicts a somewhat restrictive scenario, as many doors can open wider than 90°, however, a door smaller than 864 mm would not be wide enough to ensure the minimum clear width of 800 mm that is required.

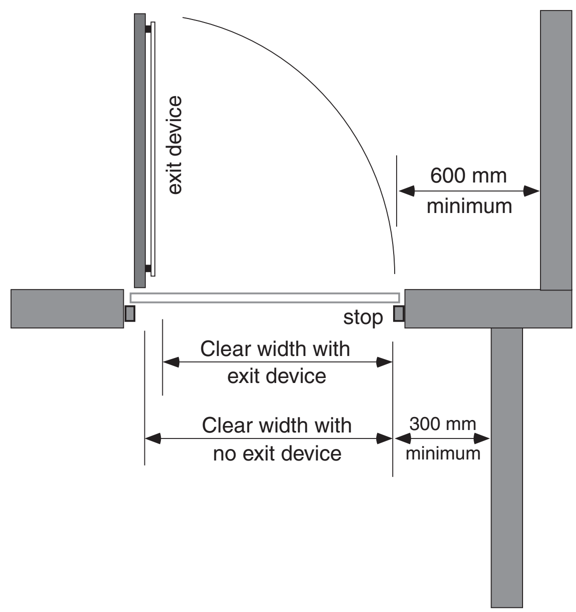


Figure A-3.8.3.3.(1)
Clear doorway width

A-3.8.3.3.(2) Washrooms in Residential Occupancies. This requirement ensures that the doorway to the washroom in a dwelling unit or a hotel or motel suite is at least large enough to accommodate someone using a wheelchair. The Code does not require these washrooms to be barrier-free, in order to avoid a set of prescriptive requirements which could limit design flexibility. It is relatively simple to make washrooms accessible through careful planning and positioning of fixtures and this can be achieved in an area not much larger than that of conventional washrooms.

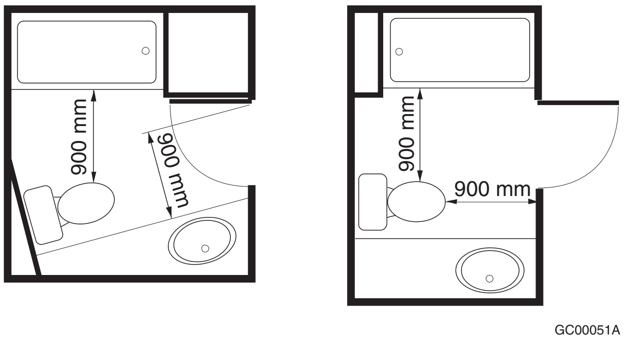


Figure A-3.8.3.3.(2)
Residential washrooms

A-3.8.3.3.(3) Lever Handles. Lever handles are usable by most persons with limited hand mobility and will meet the intent of this requirement. Lever handles with an end return towards the door are less prone to catch the clothing of someone passing through the doorway.

A-3.8.3.3.(5) Doors with Power Operators. Doors equipped with a power operator actuated by a pressure plate identified with the international symbol for accessibility or, where security is required, by a key, card or radio transmitter, and that can otherwise be opened manually, meet the intent of the requirement. The location of these actuating devices should ensure that a wheelchair will not interfere with the operation of the door once it is actuated. Swinging doors equipped with power operators which are actuated automatically and open into passing pedestrian traffic should be provided with a guard or other device designed to prevent pedestrians from stepping in the swing area of the door. These guards or devices should be detectable by blind persons. For example, inverted U-shaped guards should have an additional rail at a height not more than 680 mm so that it is detectable by the long cane. These doors should also have a device (mat or other sensor) on the swing side to prevent the door from opening if someone is standing in the swing area.

A-3.8.3.3.(8) Air Pressure Differences. Differences in air pressure on opposite sides of a door may be due to the operation of mechanical systems such as those associated with smoke control. So-called "stack action" in buildings in winter can also cause differential pressures due to the buoyancy of warm air. Stack action is usually most noticeable between stairwells and the remainder of the building, and at the entrances to buildings; the taller the building, the greater the effect. Doors with automatic closers have to operate with sufficient opening force to allow the return action to overcome the differential pressure.

A-3.8.3.3.(9) Delayed Action on Door Closers. In some circumstances, closers with a delay feature which keeps the door open for several seconds before it begins to close might be desirable. However, closers with this feature have limited back-check, a feature of a normal door closer where resistance to opening increases as the door reaches the full arc of swing. Doors equipped with a delayed action closer are therefore more susceptible to damage should the door be opened with too much force or should someone try to force it closed, thinking the closer has failed to operate. Delayed action closers are not recommended for such occupancies as schools.

A-3.8.3.3.(10) Clearances at Doorways. e
Sufficient clearance must be provided on the latch side of doors for a user to operate the door opening mechanism and open the door without interference from the wheelchair. This is particularly important where the door swings towards the approach side. Although the requirement applies only to doors equipped with closers, this clearance should be provided for all doors.

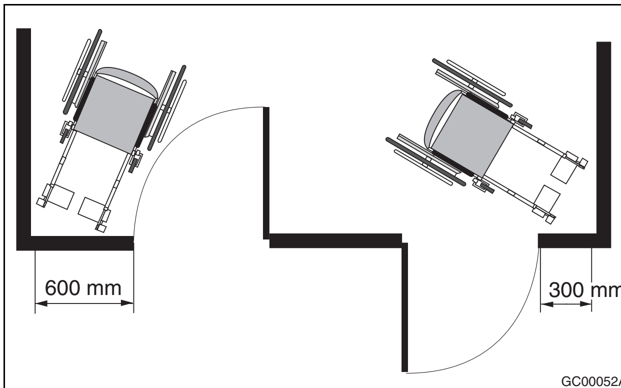


Figure A-3.8.3.3.(10)
Doorway clearance

A-3.8.3.4.(1)(b) Ramp Slopes. Ramps with a slope of more than 1 in 16 can be very difficult for persons with physical disabilities with upper body mobility to manage. Even though they pose less of a problem for persons in motorized wheelchairs, these ramps can be unsafe to descend, especially in cold climates. Although Article 3.8.3.4. permits slopes on ramps as great as 1 in 12 for distances of up to 9 m, slopes of 1 in 20 are safer and less strenuous. When limited space is available, as may be the case during renovations, ramps with a slope of up to 1 in 12 should be restricted to lengths not exceeding 3 m whenever possible. A strip contrasting in colour and texture should be used at the top and bottom of ramps to warn blind and visually impaired persons.

A-3.8.3.4.(1)(c) Landing Design at Doorways Leading to Ramps.

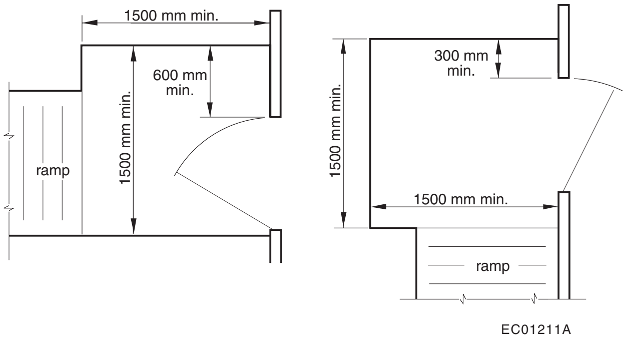


Figure A-3.8.3.4.(1)(c)
Landing design at doorways leading to ramps

A-3.8.3.7. Assistive Listening Systems. Wireless sound transmission systems, including FM, infrared or magnetic induction loop systems, improve sound reception for persons with hearing disabilities by providing amplification which can be adjusted by each user while blocking out unwanted background noise. These systems transmit a signal that is picked up by a special receiver available for use by a person with a hearing disability, whether or not a hearing aid is used. Neither system interferes with the listening enjoyment of others.

The transmitter can be jacked into an existing P.A. system amplifier or used independently with microphones. The induction loop system requires users to sit in the area circumscribed by the loop; though installation of the loop is relatively simple, the installer should be knowledgeable about these systems if proper functioning is to be achieved. FM or infrared systems can be designed to broadcast signals which cover the entire room and thus do not restrict seating to any one area. Figures A-3.8.3.7.A. and A-3.8.3.7.B. show the general configuration of FM and infrared systems. Although portable systems (FM in particular) are available, these are best suited to small audiences. Generally, the systems installed in church halls, auditoria, theatres and similar places of assembly are not easily portable, as they are installed in a fixed location by a sound technician and form an integral part of the P.A. system of the room or building.

Hard-wired systems (where a jack is provided at a particular seat) will not meet this requirement unless adequate provisions are made to accommodate persons with hearing aids. In choosing the most appropriate system, a number of factors must be taken into account including cost, installation and maintenance, suitability to the audience, ease of operation and the need for privacy. Information on designers and suppliers of these systems may be obtained from the Canadian Hearing Society.

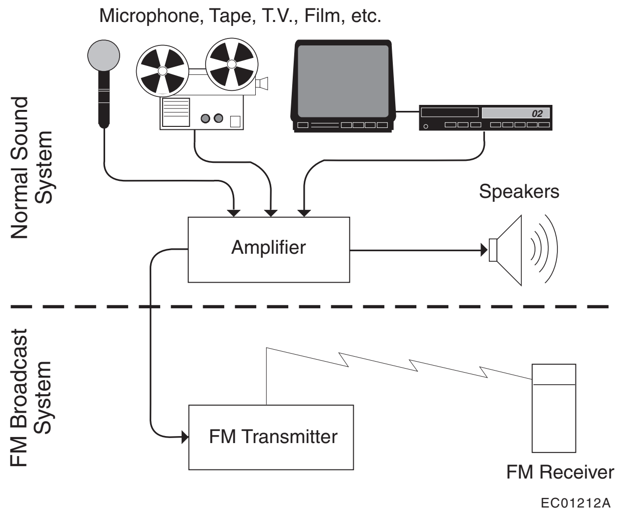


Figure A-3.8.3.7.A.
FM sound transmission system

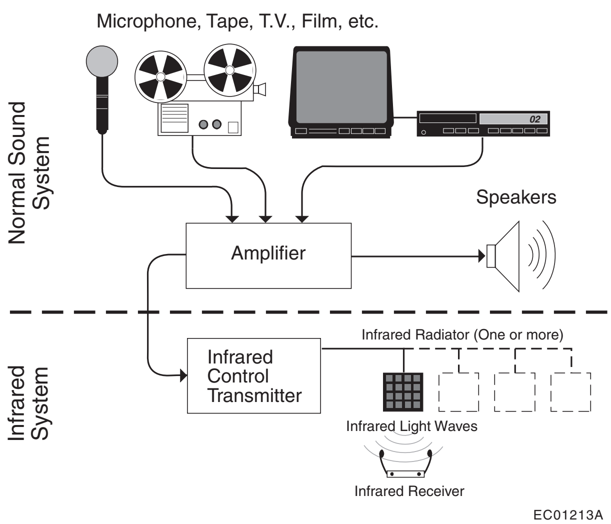


Figure A-3.8.3.7.B.
Infrared sound transmission system

A-3.8.3.8.(1)(b)(iii) Water Closet Stalls. Doors to water closet stalls for persons with physical disabilites should swing outward, preferably against a side wall.

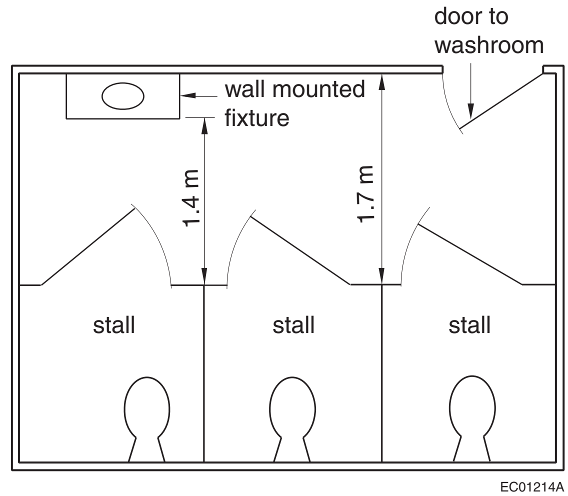


Figure A-3.8.3.8.(1)(b)(iii)
Water closet stalls

A-3.8.3.8.(1)(b)(iv) Door Pulls. The door pull should consist of a D-shaped handle mounted either horizontally or vertically. The centerlines are the lines drawn through the long axis and the short axis of the handle. If the handle is installed in the horizontal position, the short or transverse axis is the centerline which must be located at between 200 and 300 mm from the hinged side of the door, and the long or longitudinal axis is the one which is located between 900 and 1 000 mm from the floor. If the handle is installed in the vertical position, the distance is measured from the longitudinal axis to the hinged side of the door, while the distance from the floor is measured to the transverse axis.

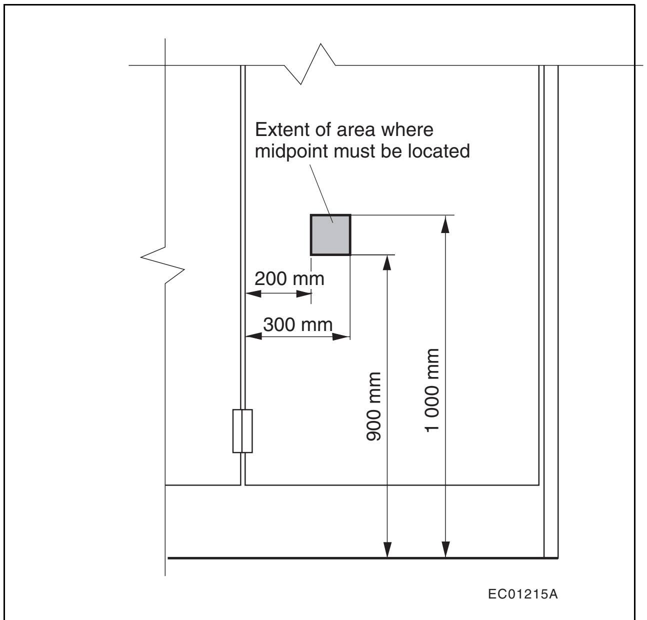


Figure A-3.8.3.8.(1)(b)(iv).A.
Door pull location

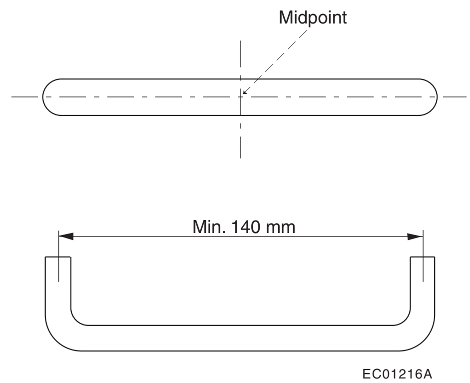


Figure A-3.8.3.8.(1)(b)(iv).B.
Door pull details

A-3.8.3.8.(1)(d)(i) Additional Grab Bars. Required grab bars must be mounted horizontally. It is the designer's prerogative to exceed the minimum requirements found in the NBC and specify the installation of additional grab bars in other locations. These additional grab bars may be of different configurations and can be installed in other orientations.

A-3.8.3.9.(1) e3 Water Closets. Wall-mounted water closets or floor models with receding bases are preferable because they provide the least amount of obstruction.

A-3.8.3.11.(1)(c) Clearances Beneath a Lavatory.

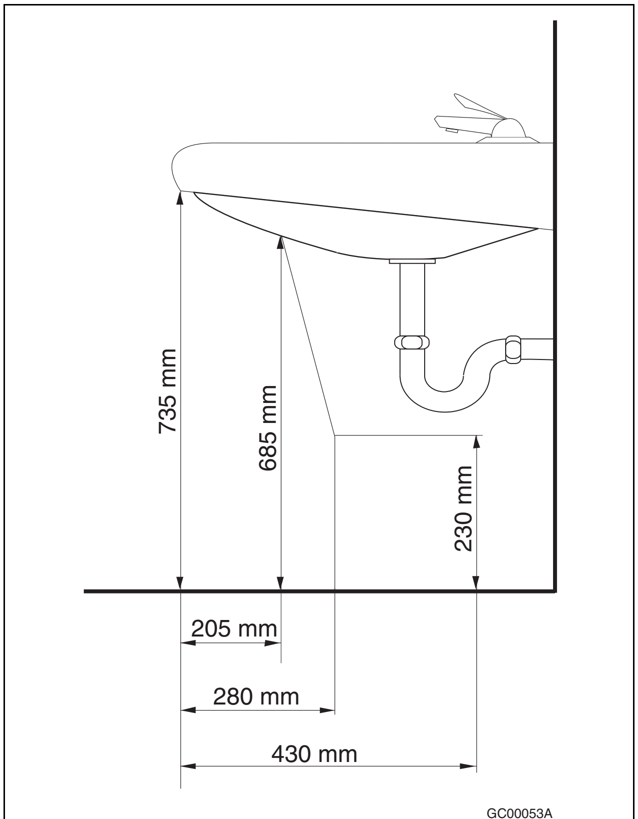


Figure A-3.8.3.11.
Clearances beneath a lavatory

A-3.8.3.11.(1)(d) Pipe Protection. The pipes referred to in Clause 3.8.3.11.(1)(d) include both supply and waste pipes. The hazard can be prevented by insulating the pipes, by locating the pipes in enclosures, or avoided by limiting the temperature of the hot water to a maximum of 45°C.

A-3.8.3.12. Special Washrooms. Unobstructed areas in front of the lavatory, in front of the water closet and on one side of the water closet are necessary for maneuverability of a wheelchair. Although outward swinging doors are preferable for accessibility, inward swinging doors are also permitted. Figures A-3.8.3.12.A. and A-3.8.3.12.B. show design options that meet the intent of Article 3.8.3.12.

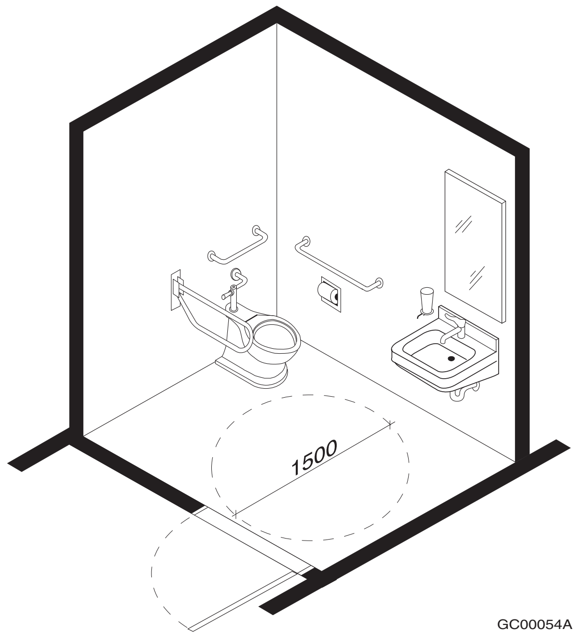


Figure A-3.8.3.12.A.
Special washroom with outward swinging door

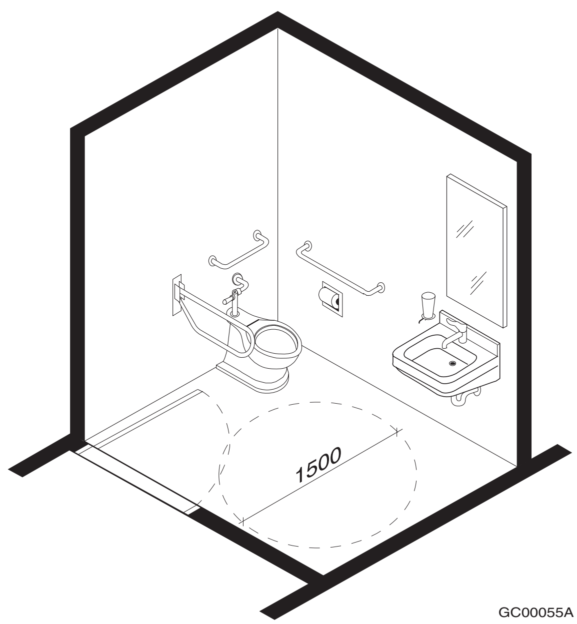


Figure A-3.8.3.12.B.
Special washroom with inward swinging door

A-3.8.3.13.(1)(b) Clear Space at Entrances to Showers. The clear space at the entrance to a shower may be encroached upon by fixtures such as a wall hung sink which does not interfere with the leg rests of the wheelchair. However, this sink could restrict movement for persons who need to make a lateral transfer if it were installed at the seat end of the shower.

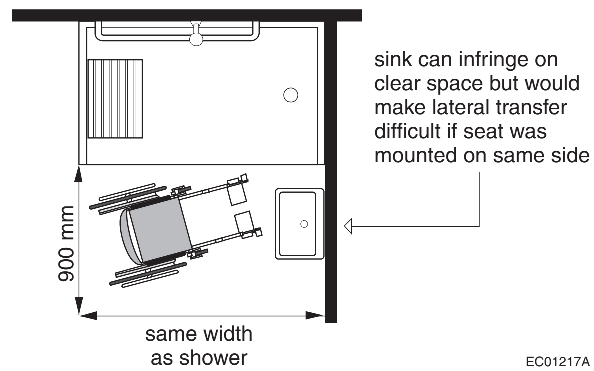


Figure A-3.8.3.13.(1)(b)
Shower design

A-3.8.3.13.(1)(f) Grab Bars. One horizontal grab bar is required to be installed on the wall next to the seat. A grab bar behind the seat would prevent the user from leaning back against the wall, while one located on the wall opposite the seat cannot be reached from the seated position. The seat itself may be used in conjunction with the bar for transfer. If design flexibility is required, fold away grab bars can be used as an alternative.

A-3.8.3.14.(1) Counter Accessibility. It is not intended that all counters be accessible, but that sufficient counter space be accessible to permit use by persons in wheelchairs.

A-3.8.3.15. Telephone Shelves or Counters. Built-in shelves or counters for public telephones must be designed to accommodate persons using text telephones (TT). These devices may also be referred to as teletypewriters (TTY) or telecommunication devices for the deaf (TDD). These devices require a level surface at least 305 mm deep by 250 mm wide with no obstruction above that space within 250 mm. If a wall-hung telephone or other obstruction extends to less than 250 mm from the shelf or counter, an equivalent clear space must be provided on either side of each telephone. At least one telephone should be equipped with a volume control on a receiver that generates a magnetic field compatible with the T-switch of a hearing aid. The lower portion of the shelf or counter is intended for persons using a wheelchair; therefore all parts of the operating mechanism of the telephone above this portion should be within reach of a wheelchair user.

A-4.1.1.2.(2) Structural Designer. Part 4 has been written on the assumption that structural design will be carried out by a professional who is qualified for such design. Sentence 4.1.1.2.(2) is not intended to imply that a professional may not also be required in the application of requirements in other Parts of the NBC.

A-4.1.1.3.(1) Structural Integrity. The requirements of Part 4 of the National Building Code, including the CSA design standards, generally provide a satisfactory level of structural integrity. Additional considerations may, however, be required for building systems made of components of different materials, whose interconnection is not covered by existing CSA design standards, buildings outside the scope of existing CSA design standards, and buildings exposed to severe accidental loads such as vehicle impact or explosion. Further guidance can be found in the Commentary on Structural Integrity in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.1.5.(1) Deflections. Information on deflections can be found in the Commentary on Serviceability Criteria for Deflections and Vibrations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.1.5.(4) Lateral Deflection of Tall Buildings. The limitation of 1/500 drift per storey may be exceeded if it can be established that the drift as calculated will not result in damage to non-structural elements. Information on lateral deflection of tall buildings may be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.1.6.(1) Floor Vibration. Information on floor vibration can be found in the Commentary on Serviceability Criteria for Deflections and Vibrations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.1.6.(2) Lateral Vibrations and Acceleration under Dynamic Wind Loads. Information on lateral vibrations and accelerations under dynamic wind loads can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.2.1.(1) Temperature Changes. Information on effects due to temperature changes can be found in the Commentary on Effects of Deformations in Building Components in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.3. Limit States Design. Information on limit states design can be found in the Commentary on Limit States Design in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.3.2.(7) Importance Factor. Examples of buildings where it can be shown that collapse is not likely to cause injury or other serious consequences are buildings of low human occupancy, such as farm buildings, certain temporary facilities and minor storage facilities.

A-4.1.4.3.(1) e3 Load Combinations. Information on load combinations can be found in the Commentary on Load Combinations in Structural Commentaries on the National Building Code of Canada 1995.

A-Table 4.1.6.3. Floor Areas That Could Be Used As Viewing Areas. Some interior balconies, mezzanines, corridors, lobbies and aisles that are not intended to be used by an assembly of people as viewing areas are sometimes used as such and, consequently, are subject to loadings much higher than those for the occupancies they serve. Floor areas which may be subject to such higher loads must, therefore, be designed for a loading of 4.8 kPa.

A-4.1.6.9. Tributary Area. Information on tributary area can be found in the Commentary on Tributary Area in Structural Commentaries on the National Building Code of Canada 1995.

A-Table 4.1.6.10. Loads Due to Concentrations. Special study is required to determine concentrated loads for the design of floors and areas used by vehicles exceeding 9 000 kg gross weight and driveways and sidewalks over areaways and basements. Where appropriate the designer should refer to CAN/CSA-S6, “Canadian Highway Bridge Design Code.” r4

A-4.1.7. Live Loads Due to Snow, Ice and Rain. Information on live loads due to snow, ice and rain can be found in the Commentary on Snow Loads in the Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.7.1. e3 Coefficients for Snow Loads on Roofs. Information on coefficients for snow loads on roofs can be found in the Commentary on Snow Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.7.2.(2) Full and Partial Loading under Snow Loads. Information on full and partial snow loading on roofs can be found in the Commentary on Snow Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.7.3.(1) Rain Loads. Information on rain loads can be found in the Commentary on Rain Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.8.1.(1) and (2) Pressure Coefficients for Wind Loads. Information on pressure coefficients can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.8.1.(5)(c) Dynamic Approach for Wind Loads. Information on a dynamic approach can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.8.1.(6)(a) Gust Factors for Calculation of Internal Pressures. Information on gust factors for the calculation of internal pressures can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.8.1.(6)(d) and 4.1.8.2.(1)(b) Dynamic Approach to the Action of Wind Gusts. Information on a dynamic approach to the action of wind gusts can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.8.3.(1) Full and Partial Loading under Wind Loads. Information on full and partial loading under wind loads can be found in the Commentary on Wind Loads in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(2) Definition of e_x. Information on the calculation of torsional moments can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(2) Definition of W. For the purpose of computing “W,” a storage garage, usually referred to as a parking garage, need not be considered as an area used for storage.

A-4.1.9.1.(3) Direction of Forces. Information on the direction of earthquake forces can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(8) and A-Table 4.1.9.1.B. Force Modification Factor, R. Explanatory notes on the various cases can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(11) and A-Table 4.1.9.1.C. Foundation Factor. The foundation factor, F, accounts for the effects of soil conditions on the intensity of shaking of structures. The foundation soils are assumed to maintain their integrity. For all types of foundations, including deep ones, the possibility of ground failure due to excessive settlements in loose sands, liquefaction of saturated sands, fault displacements and loss of strength of sensitive clays should be considered by a person competent in this field of work.

A-4.1.9.1.(13)(b) Dynamic Analysis for Vertical Distribution of Lateral Seismic Forces. Information on a dynamic approach for the vertical distribution of the lateral seismic force, V, can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-Table 4.1.9.1.D. Horizontal Force Factor, S_p. Lower values of S_p may be used for towers, chimneys, smokestacks and penthouses when connected to or forming part of a building if the lower values can be proven by analysis. Information on the seismic design of towers, chimneys, smokestacks and penthouses can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-Table 4.1.9.1.E. Seismic Coefficient, C_p. Lower values of C_p may be used for machinery, fixtures and equipment, pipes and tanks, when connected to or forming part of a building if the lower values can be proven by analysis. Information on the seismic design of machinery, fixtures and equipment, pipes and tanks can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(28) Modal Coupling. Severe modal coupling may occur in symmetrical or nearly symmetrical structures when the fundamental lateral and torsional periods are almost equal. Information on this phenomenon is given in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.1.(29) Setbacks. A definition of setback together with a recommended design procedure for buildings having setbacks is contained in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.9.4.(3) Alternative Foundation Ties. Alternative methods of tying foundations together, such as a properly reinforced floor slab capable of resisting the required tension and compression forces, may be used. Passive soil pressure against buried pile caps may not be used to resist these forces.

A-4.1.9.4.(5) Seismic Lateral Pressures from Backfill or Natural Ground. Information on methods of computing the seismic lateral pressures from backfill or natural ground can be found in the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.10.1. and 4.1.10.2.(1) e3 Design of Guards. In the design of guards, due consideration should be given to the durability of the members and their connections.

A-4.1.10.4. Loads on Firewalls. Information on loads on firewalls can be found in the Commentary on Structural Integrity of Firewalls in Structural Commentaries on the National Building Code of Canada 1995.

A-4.1.10.6.(1) Dynamic Analyses of Floor Vibrations. Information on a dynamic analysis of floor vibrations from rhythmic activities can be found in the Commentary on Serviceability Criteria for Deflections and Vibrations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.2.1.(1) e3 Subsurface Investigation. Where acceptable information on subsurface conditions already exists, the investigation may not require further physical subsurface exploration or testing.

A-4.2.2.3.(1) Responsibilities of the Designer as Defined in Part 4. Under some situations, such as highly technical designs, it may be necessary for the "other suitably qualified person" to be someone responsible to the designer. In these cases the authority having jurisdiction may wish to order that the review be done by the designer.

A-4.2.4.1.(1) Innovative Designs. It is important that innovative approaches to foundation design be carried out by a person especially qualified in the specific method applied and that the design gives a level of safety and performance at least equivalent to that provided for or implicit in the design carried out by the methods referred to in Part 4. Provision must be made for monitoring the subsequent performance of such structures so that the long term sufficiency of the design can be evaluated.

A-4.2.4.4.(1) e3 Limit States Design of Foundations. Information on limit states design of foundations, including terminology and resistance factors, is contained in the Commentary on Foundations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.4.5.(1) e3 Design of Foundations for Differential Movements. Information on design of foundations for differential movements is contained in the Commentary on Foundations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.4.6.(1) Depth of Foundations. When adfreezing has occurred and subsequent freezing results in soil expansion beneath this area, the resulting uplift effect is sometimes referred to as frost jacking.

A heated building insulated to prevent heat loss through the foundation walls should be considered as an unheated structure unless the effect of the insulation is taken into account in determining the maximum depth of frost penetration.

A-4.2.5.1.(1) e3 Excavations. Information on excavations can be found in the Commentary on Foundations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.6.1.(1) e3 Shallow Foundations. Information on shallow foundations can be found in the Commentary on Foundations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.7.1.(1) e3 Deep Foundation Units. A deep foundation unit can be pre-manufactured or cast-in-place; it can be driven, jacked, jetted, screwed, bored or excavated; it can be of wood, concrete or steel or a combination thereof.

A-4.2.7.2.(1) Deep Foundations. Information on deep foundations can be found in the Commentary on Foundations in Structural Commentaries on the National Building Code of Canada 1995.

A-4.2.7.2.(2) Load Testing of Piles. ASTM D 1143, "Piles Under Static Axial Compressive Load," defines routine load test procedures which have been used extensively.

A-4.3.3.1.(1) e3 **Precast Concrete.** CSA A23.3, "Design of Concrete Structures," requires precast concrete members to conform to CSA A23.4, "Precast Concrete – Materials and Construction."

A-4.3.4.1.(1) e3 **Welded Construction.** Qualification for fabricators and erectors of welded construction is found in Clause 23.3 of CSA S16, "Limit States Design of Steel Structures." r5

A-4.3.4.2.(1) e3 **Cold Formed Stainless Steel Members.** Currently there is no Canadian standard for the design of cold formed stainless steel structural members. As an interim measure, design may be carried out using the limits states design provisions of ANSI/ASCE 8, "Design of Cold Formed Stainless Steel Structural Members," except that load factors, load combinations and load combination factors shall be in accordance with Article 4.1.4.2.

A-5 Environmental Separation. The requirements provided in Part 5 pertain to the separation of environmentally dissimilar spaces. Most obvious is the need to separate indoor conditioned spaces from unconditioned spaces, the outdoors or the ground. There are also cases where separation is needed between interior spaces which are intended to provide different environments. (See also Appendix notes A-5.1.1.1.(1) and A-5.1.2.1.(1).)

A-5.1.1.1.(1) Scope. Part 5 provides explicit requirements related to the transfer of heat, air and moisture in various forms. Control of ingress of radon and other soil gases is addressed by the requirements related to air leakage. r3

A-5.1.2.1.(1) Application. r3 Section 2.1. specifies that the requirements of Part 5 apply to all buildings except those within the scope of Part 9 or the scope of the National Farm Building Code of Canada. Because of their intended use, many buildings need only provide a limited degree of separation from the outdoor environment or the ground, or between interior spaces. The requirements of Part 5 are written to allow exemptions for these buildings.

The requirements in Part 5 apply to building elements that separate dissimilar environments and to site conditions that may affect environmental loading on the building envelope.

The requirements address
- the design and construction, or selection, of building components such as windows and doors,
- the design and construction of building assemblies such as walls, floors and roofs,
- the design and construction of the interfaces between the elements identified in the previous points, and
- the design or selection, and installation, of site materials, components and assemblies, such as back-fill and drainage, and grading.

The requirements apply not only to building elements that separate indoor space from outdoor space, but also to those elements that separate indoor space from the ground and that separate adjacent indoor spaces that have significantly different environments.

Indoor spaces that would require separation include interior conditioned spaces adjacent to indoor unconditioned spaces, and adjacent interior conditioned spaces that are intended to provide different environments. An extreme example of the last would be a wall that separates an indoor ice rink from a swimming pool.

Some building elements are exposed to exterior environmental loads but do not separate dissimilar environments. Solid guards on exterior walkways are one example. Such constructions are subject to the requirements in Part 5.

A-5.1.4.2. Deterioration. Environmental loads that must be considered include but are not limited to: sound, light and other types of radiation, temperature, moisture, air pressure, acids and alkalis. Requirements related to sound are provided in Part 3.

Mechanisms of deterioration include:
- structural (impact, air pressure)
- hygrothermal (freeze-thaw, differential movement due to thermal expansion and contraction, ice lensing)
- electrochemical (oxidation, electrolytic action, galvanic action, solar deterioration)
- biochemical (biological attack, intrusion by insects and rodents).

Information on the effects of deformations in building elements can be found in Effects of Deformations in Building Components in the Structural Commentaries on the National Building Code of Canada 1995.

Resistance to deterioration may be determined based on field performance, accelerated testing or compliance with guidelines provided by evaluation agencies recognized by the authority having jurisdiction.

Building components must be designed with some understanding of the length of time over which they will effectively perform their intended function. Actual service life will depend on the materials used and the environment to which they are exposed. The design should take into consideration these factors, the particular function of the component and the implications of premature failure, the ease of access for maintenance, repair or replacement, and the cost of repair or replacement.

In cases where it is known or expected that maintenance, repair or replacement is likely to be required for certain elements before the building is subject to a major retrofit, special consideration should be given to providing easy access to those elements.

Where the use of a building or space, or the services for a building or space, are changed significantly, an assessment of the impact of the changes on the environmental separators should be conducted to preclude premature failures that could create hazardous conditions.

A-5.2.1.1.(3) Soil Temperatures. In theory, soil temperatures are needed to determine the conformance of a design to the requirements related to heat transfer and vapour diffusion. In practice, standard construction in a particular area may have proven to perform quite adequately and detailed calculations of soil temperature are unnecessary. (See also Sentence 5.2.2.1.(1).)

A-5.2.1.2.(1) Interior Environmental Loads. The interior environmental conditions required depend on the intended use of the spaces in the building as defined in the building program. Spaces in different types of buildings and different spaces within a single building may impose different loads on the separators between interior and exterior spaces and between adjacent interior spaces. The separators must be designed to withstand the expected loads.

A-5.3. Heat Transfer. In addressing issues related to health and safety, Section 5.3. calls up levels of thermal resistance needed to minimize condensation on or within environmental separators, and to ensure thermal conditions appropriate for the building use. Energy regulations, where they exist, specify levels of thermal resistance required for energy efficiency or call up energy performance levels, which relate to levels of thermal resistance.

Where Part 5 calls for levels of thermal resistance higher than those required by the energy regulations, the requirements of Part 5 take precedence.

A-5.3.1.1. Required Resistance to Heat Transfer. The control of heat flow is required wherever there is an intended temperature difference across the building assembly. The use of the term "intended" is important since, whenever interior space is separated from exterior space, temperature differences will occur.

The interior of an unheated warehouse, for example, will often be at a different temperature from the exterior due to solar radiation, radiation from the building to the night sky and the time lag in temperature change due to the thermal mass of the building and its contents. If this temperature difference is not "intended," no special consideration need be given to the control of heat flow.

If the warehouse is heated or cooled, thus making the temperature difference "intended," some consideration would have to be given to the control of heat flow.

It should be noted, however, that in many cases, such as with adjacent interior spaces, there will be an intended temperature difference but the difference will not be great. In these cases, the provisions to control heat flow may be little or no more than would be provided by any standard interior separator. That is, materials typically used in the construction of partitions may provide the separation needed to meet the requirements of Section 5.3. without adding what are generally considered to be "insulating" materials.

A-5.3.1.2. Material and Component Properties and Condensation. Total prevention of condensation is generally unnecessary and its achievement is rarely a certainty at design conditions. Part 5, therefore, requires that condensation be minimized. The occurrence of condensation should be sufficiently rare, or the quantities accumulated should be sufficiently small and dry rapidly enough, to avoid material deterioration and the growth of mould and fungi.

A-5.3.1.2.(2) Materials Providing Resistance to Heat Transfer. It is important to note that Sentence 5.3.1.2.(2), pertaining to materials intended to provide resistance to heat transfer, is stated in such a fashion that the selection of materials is not limited to those traditionally recognized as insulation materials or those for which a standard is identified. This approach permits more flexibility than is provided by the equivalent requirements in Part 9. So long as the selected material meets the performance requirements provided elsewhere in the Section, the material may be used to provide the necessary resistance to heat transfer.

Where the selected material falls within the scope of any of the standards that have been listed, however, the material must also comply with that standard. For example, if some resistance to heat transfer is required between two interior spaces and standard partition construction will provide the necessary resistance, the installation of one of the "thermal insulation" materials identified in the standard list is not required. If, on the other hand, one decides to install glass fibre insulation, the material must conform to CAN/ULC-S702.

A-5.3.1.2.(5) Heat Transfer through Fire Rated Glazed Assemblies. Thermal bridging through fire rated glazed assemblies should not be ignored; measures should be taken to minimize condensation consistent with the intent of Sentence 5.3.1.2.(4).

A-5.3.1.3.(2) Position of Materials Providing Thermal Resistance. For a material providing thermal resistance to be effective, it must not be short-circuited by convective air flow through or around the material. The material must therefore be either

- the component of the air barrier system providing principal resistance to air leakage, or
- installed in full and continuous contact with a continuous low air permeance component.

A-5.4.1.1. Resistance to Air Leakage. The air barrier system in above grade building components and assemblies separating conditioned space from the exterior will reduce the likelihood of condensation due to air leakage, discomfort from drafts, infiltration of dust and other pollutants, and interference in the performance of building services such as HVAC and plumbing. These can all lead to serious health or safety hazards.

Currently, the most obvious and significant problems are due to moisture-related material deterioration such as rot and corrosion, which can lead to failure of component connections. Infiltration of dust and other pollutants can lead to a wide range of health problems. Where the separator is subject to high moisture levels, the pollutants may include fungus spores. Interference with the performance of building services can lead to unhealthy conditions, and potentially hazardous conditions during the heating season in many regions of the country.

Where adjacent interior environments are sufficiently different, control of air flow between those spaces is necessary to maintain conditions.

An air barrier system may be required in components and assemblies in contact with the ground to control the transfer of soil gases such as radon and methane.

A-5.4.1.2.(1) and (2) Air Leakage through the Air Barrier System.

Material Requirements

The current requirements specify only a maximum air leakage rate for the material in the air barrier system that provides the principal resistance to air leakage.

The report, "Air Permeance of Building Materials," prepared by AIR-INS Inc. for CMHC (1988) identifies, from 36 common building materials, 19 that would comply with the leakage limit of 0.02 L/(s • m^2) at 75 Pa. Air leakage characteristics greater than the maximum of 0.02 L/(s • m^2) at 75 Pa may be acceptable where

- exterior temperatures are mild,
- the moisture content of the indoor air is low,
- the assembly is resistant to moisture-related deterioration,
- higher vapour permeance materials are installed toward the cold side of the assembly, or
- the air barrier system separates two interior spaces that are not intended to provide significantly different environments.

System Requirements

Ideally, a maximum air leakage rate for the complete air barrier system would be specified. The maximum acceptable rate would ultimately depend on warm and cold side temperature and humidity conditions, and on the susceptibility of the environmental separator to moisture deterioration. Recommended maximum leakage rates for the air barrier system in an exterior envelope in most locations in Canada, depending on indoor relative humidity, are as shown in Table A-5.4.1.2.

Table A-5.4.1.2.
Recommended Maximum Air Leakage Rates

Warm side relative humidity at 21°C	Recommended maximum system air leakage rate, L/(s • m^2) at 75 Pa
< 27%	0.15
27 to 55%	0.10
> 55%	0.05

Determining the leakage rate of a particular assembly, however, is problematic. There is little information available on the airtightness of the many air barrier systems used in building construction, and testing requires specialized equipment and expertise. Depending on the type of test,

- testing may not represent the performance of the complete installed system
- location of deficiencies may be difficult to identify
- rectification of deficiencies may not be feasible.

Despite the difficulties, it is recommended, when using a system whose performance is not known, that tests be conducted. Testing options include:

- laboratory tests of small sections of the air barrier system, including joints and intersections of different assemblies
- laboratory tests of large wall sections
- in-situ tests of characteristic envelope areas.

A-5.4.1.2.(3) Airtightness of Components. It is important to note that Sentence 5.4.1.2.(3), pertaining to components of the air barrier system, is stated in such a fashion that the selection of components is not limited to those for which a standard is identified. This approach permits more flexibility than is provided by similar requirements in Part 9. So long as the selected component meets the performance requirements provided elsewhere in the Section, the component may be used to provide the necessary resistance to air leakage.

Where the selected component falls within the scope of any of the standards listed, however, the component must also comply with that standard. For example, if curtain wall is selected to clad a residential building, the glazed areas of the wall constitute part of the air barrier system and must provide the required airtightness. As curtain wall is not within the scope of the CSA A440 standard, these glazed areas need not comply with that standard. If, on the other hand, one decides to install standard residential windows, these must conform to CSA A440. r4

A-5.4.1.2.(6) Airtightness of Wired Glass Windows. Fixed wired glass assemblies are sometimes permitted as closures in vertical fire separations. The exception to the airtightness requirements for these windows recognizes that the availability of assemblies which would meet the requirements of the window standards and requirements for fire resistance may be limited. Control of air leakage should not be ignored; measures should be taken to attempt to comply with the requirements in Sentence 5.4.1.2.(5).

A-5.5.1.2.(1) Vapour Barrier Materials and Installation. In the summer, many buildings are subject to conditions where the interior temperature is lower than the exterior temperature. Vapour transfer during these periods is from the exterior to the interior. In general, in Canada, the duration of these periods is sufficiently short, the driving forces are sufficiently low, and assemblies are constructed such that any accumulated moisture will dissipate before deterioration will occur.

Buildings such as freezer plants, however, may operate for much of the year at temperatures that are below the ambient exterior temperature. In these cases, the “warm” side of the assembly would be the exterior and a detailed analysis on an annual basis is required.

Steady state heat transfer and vapour diffusion calculations may be used to determine acceptable permeance levels for the vapour barrier and to identify appropriate positions for the vapour barrier within the building assembly.

A-5.5.1.2.(2) Vapour Barriers. It is important to note that Sentence 5.5.1.2.(2), pertaining to materials intended to provide resistance to vapour diffusion, is stated in such a fashion that the selection of materials is not limited to those traditionally recognized as vapour barrier materials or those for which a standard is identified. This approach permits more flexibility than is provided by the equivalent requirements in Part 9. So long as the selected material meets the performance requirements provided elsewhere in the Section, the material may be used to provide the necessary resistance to vapour diffusion.

Where the selected material falls within the scope of either of the standards listed, however, the material must comply with that standard. For example, if a peel-and-stick modified bituminous membrane is selected and will provide the necessary vapour diffusion resistance, the installation of one of the ‘vapour barrier’ materials identified in the standard list is not required. If, on the other hand, one decides to install polyethylene as the vapour barrier, the material must conform to CAN/CGSB-51.34-M.

A-5.6.1.1. Required Protection from Precipitation. Windows, cast-in-place concrete walls, and metal and glass curtain wall systems are examples of components and assemblies that, properly designed and constructed, would be expected to prevent ingress of precipitation into a building. Assemblies such as roofs and veneer walls have materials installed in the assembly specifically for the purpose of screening precipitation.

Components and assemblies separating interior conditioned space from the exterior are generally required to provide protection from ingress of precipitation. Components and assemblies separating interior unconditioned space from the exterior may or may not be required to provide protection from ingress of precipitation. Buildings such as stadia, parking garages and some seasonally occupied buildings, for example, may not require complete protection from precipitation.

A-5.6.1.2.(1) and (3) Roofing and Cladding. It is important to note that Sentences 5.6.1.2.(1) and (3), pertaining to materials intended to provide protection from precipitation, are stated in such a fashion that the selection of materials is not limited to those traditionally recognized as roofing or cladding materials or those for which a standard is identified. This approach permits more flexibility than is provided by the equivalent requirements in Part 9. So long as the selected material meets the performance requirements provided elsewhere in the Section, the material may be used to provide the necessary protection from precipitation.

For example, if a chlorosulphonated polyethylene (CSPE) roofing membrane is selected and will provide the necessary resistance, the installation of one of the roofing materials identified in the standard list is not required. If, on the other hand, one decides to install a prefabricated reinforced modified bituminous membrane, the material must conform to CGSB 37-GP-56M. If acrylic stucco has been selected and has been detailed to provide the necessary resistance, the installation of one of the cladding materials identified in the standard list is not required. If, on the other hand, one decides to install burned clay brick, the material must conform to CAN/CSA-A82.1-M as specified in Section 4 of CSA A371.

A-5.6.1.2.(5) Watertightness of Wired Glass Windows. Fixed wired glass windows are sometimes permitted as closures in vertical fire separations. The exception to the watertightness requirements for these windows recognizes that the availability of assemblies which would meet the requirements of the window standards and requirements for fire resistance may be limited. Control of water leakage through these windows should not be ignored; measures should be taken toward compliance with the requirements in Sentence 5.6.1.2.(4).

A-5.6.2.1. Sealing and Drainage. e Providing a surface-sealed, durable, watertight cover on the outside of a building is difficult. Where there is a likelihood of some penetration by precipitation into a component or assembly, drainage is generally required to direct the moisture to the exterior.

Information on the installation of flashing to drain water to the exterior of roof and wall assemblies may be found in a number of publications including, but not limited to:

- "Architectural Sheet Metal," Sheet Metal and Air-Conditioning Contractor's National Association, Inc.
- "High-Rise Residential Construction Guide 1995," Ontario New Home Warranty Program e
- "Technical Notes," National Concrete Masonry Association
- "Roofing Specifications," Canadian Roofing Contractors' Association
- "Roofing and Waterproofing Manual," National Roofing Contractors Association
- "Technical Notes on Brick Construction," Brick Institute of America.

A-5.8.1.1.(1) Required Drainage. A wall or floor located below the water table or in the path of a watercourse will be subject to continuous hydrostatic pressure. In such cases, the provision of drainage will be ineffective and the wall or floor must be made waterproof to prevent water ingress.

Where a wall or floor is subject to intermittent hydrostatic pressure, as may result from seasonal flooding, proper drainage will facilitate the drying out of the soil. In some cases, reducing exposure to high moisture levels will extend the life of the moisture protection.

Where a wall or floor is not subject to hydrostatic pressure, drainage again reduces the exposure to high moisture levels and allows less than waterproof treatment of the wall or floor.

A-5.8.2. Moisture Protection. Moisture protection for building elements in contact with the ground is generally categorized as either waterproofing or dampproofing. Waterproofing provides a continuous protection against water ingress and is intended to resist hydrostatic load. Dampproofing, on the other hand, does not provide a seal against water ingress and cannot withstand hydrostatic pressure.

In general, Part 5 requires walls, floors and roofs in contact with the ground to be waterproofed. Properties of waterproofing are specified in Sentences 5.8.2.2.(2) to (5), and waterproofing material standards are referenced in Sentence 5.8.2.2.(6). Materials intended to be used as dampproofing rather than waterproofing are generally not permitted [Sentence 5.8.2.2.(7)]. Standards for installing waterproofing are also specified [Sentence 5.8.2.3.(1)].

Part 5 does permit the use of dampproofing in lieu of waterproofing where the substrate is cast-in-place concrete, a drainage layer is installed and where the assembly will not be exposed to hydrostatic pressure. Material standards are referenced in Clause 5.8.2.2.(8)(b) and installation methods in Sentence 5.8.2.3.(2).

A-5.8.2.2.(6) Protective Materials. It is important to note that Sentence 5.8.2.2.(6), pertaining to waterproofing materials intended to provide protection from moisture in the ground, is stated in such a fashion that the selection of materials is not limited to those traditionally recognized as waterproofing or dampproofing, or those for which a standard is identified. This approach permits more flexibility than is provided by the equivalent requirements in Part 9. So long as the selected material meets the performance requirements provided elsewhere in the Section, the material may be used to provide the necessary protection from moisture in the ground.

Where the selected material falls within the scope of any of the standards listed, however, the material must comply with that standard. For example, if bentonite clay panels are selected and will provide the necessary resistance, the installation of one of the waterproofing materials listed in Sentence 5.8.2.2.(6) is not required. If, on the other hand, one decides to install an elastomeric membrane, the material must conform to CGSB 37-GP-52M.

A-5.8.2.2.(8) Drainage Layers. Drainage layers reduce both structural and moisture loading on the building envelope by breaking capillary flow and allowing water to percolate quickly to the drainage system. A drainage layer may consist of permeable materials including granular backfill, geosynthetic drainage products or mineral fibreboard with oriented fibres to facilitate drainage. Where a granular material is used, it should be protected from contamination by fines from the adjacent native soil or additional material should be installed to ensure that an adequate thickness of the granular material remains free of fines.

A-6.2.1.4. Structural Movement. This article is intended to remind designers and installers of mechanical systems of one aspect of the "good engineering practice" referred to in Article 6.2.1.1.

In determining how to accomodate structural movement, there are 2 important principles to bear in mind:

- The prime concern of the NBC is the safety of people in and around the building, as opposed to protection of the mechanical systems and equipment.
- The nature of the accomodation will vary with the type of movement being considered, taking into account particularly how often the movement is likely to be encountered over the life of the building.

For example, a gas line supported on columns that also support a crane must be installed in such a way that the movement of the columns, which occurs many times daily, does not cause the lines to break, thus creating a hazard. Even if the gas line installation could somehow be designed to break in a non-hazardous manner, it would hardly be recognized as good engineering practice if movement that occurs so frequently could disrupt the operation of the mechanical system.

On the other hand, earthquakes occur far less frequently and it would not be surprising to have a non-critical mechanical system fail as a result of an earthquake. However, even in this situation, the failure must occur in a manner that does not create a hazard to building occupants. For example, heavy mechanical equipment should be properly anchored so that it does not topple on building occupants during an earthquake. The design of the anchors should take into account accelerations consistent with the seismic data given in Appendix C for the location of the building. Part 4 provides guidance on the calculation of the loads such equipment would exert on the building structure during an earthquake; these same loads can be used in designing the anchors.

Some mechanical equipment can be an important component of post-disaster life safety systems. In these cases, the measures needed to accommodate the movements caused by an earthquake become even more critical since failure of the equipment would not be acceptable.

Clearly, complying with this requirement will, in most cases, necessitate close coordination between the mechanical designer and the structural designer.

A-6.2.1.9.(1) Installation General. Ducts or pipes without dampers or valves are generally not considered to constitute "equipment" and are therefore not subject to this requirement.

A-6.2.2.4.(3) Minimizing Growth of Micro-organisms. Sources for microbial growth causing hypersensitivity, pneumonitis and humidifier fever include drain pans, spray-water air-washers, contaminated filters, poorly maintained cooling coils, water incursion into ductwork, cafeteria dishwasher drainage leaks, high humidity and stagnant water. Some of the control measures are as follows:

(a) Drain pans should be pitched toward the drain outlet and the outlet bottom should be flush with the drain pan bottom, otherwise there will be standing water in the pan, exposed to the supply air passing through the cooling section of the air-handling unit.
(b) Access into air-handling equipment should be provided for maintenance of filters, cooling coils and condensate drain pans located below the cooling coils. Access doors should be large and easy to open to facilitate thorough and regular maintenance. Hinged access doors are preferable to bolted access panels.

(c) If moisture is added to commercial building ventilation air (such as in hospital operating rooms and dedicated computer rooms) to maintain humidity levels in a designated range (for example, 40% to 50% relative humidity), humidifiers that inject steam or water vapour into central air-handling units or main supply ducts are normally used. Injection nozzles should not be located in air-handling unit plenums or ductwork that is insulated with internal fibrous lining. If the lining becomes wet, conditions conducive to microbial growth will result.

The above only addresses built-in features of an HVAC system that can help to minimize growth of micro-organisms. Even more important than the built-in features is a program of regular maintenance and cleaning of those portions of the system where such growth is likely to occur.

A-6.2.2.5.(1) e3 NFPA Publications Pertaining to the Heating, Ventilating and Air-Conditioning of Spaces Containing Hazardous Gases, Dusts or Liquids.

NFPA 30, "Flammable and Combustible Liquids Code"
NFPA 32, "Drycleaning Plants"
NFPA 33, "Spray Application Using Flammable or Combustible Materials"
NFPA 34, "Dipping and Coating Processes Using Flammable or Combustible Liquids"
NFPA 35, "Manufacture of Organic Coatings"
NFPA 36, "Solvent Extraction Plants"
NFPA 40, "Storage and Handling of Cellulose Nitrate Motion Picture Film"
NFPA 50A, "Gaseous Hydrogen Systems at Consumer Sites"
NFPA 50B, "Liquefied Hydrogen Systems at Consumer Sites"
NFPA 51, "Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes"
NFPA 51A, "Acetylene Cylinder Charging Plants"
NFPA 61, "Prevention of Fires and Dust Explosions in Agricultural and Food Products Facilities" r
NFPA 65, "Processing and Finishing of Aluminum"
NFPA 68, "Venting of Deflagrations"
NFPA 69, "Explosion Prevention Systems"
NFPA 81, "Fur Storage, Fumigation and Cleaning"
NFPA 86, "Ovens and Furnaces"
NFPA 88A, "Parking Structures"
NFPA 88B, "Repair Garages"
NFPA 91, "Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids" r4
NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations"
NFPA 204M, "Guide for Smoke and Heat Venting"
NFPA 303, "Marinas and Boatyards"
NFPA 307, "Construction and Fire Protection of Marine Terminals, Piers, and Wharfs"
NFPA 325, "Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids"
NFPA 395, "Storage of Flammable and Combustible Liquids at Farms and Isolated Sites"
NFPA 409, "Aircraft Hangars"
NFPA 415, "Airport Terminal Buildings, Fueling, Ramp Drainage, Loading Walkways" r
NFPA 480, "Storage, Handling and Processing of Magnesium Solids and Powders"
NFPA 481, "Production, Processing, Handling, and Storage of Titanium"
NFPA 482, "Production, Processing, Handling and Storage of Zirconium"
NFPA 490, "Storage of Ammonium Nitrate"
NFPA 650, "Pneumatic Conveying Systems for Handling Combustible Particulate Solids" r4
NFPA 651, "Machining and Finishing of Aluminum and the Production and Handling of Aluminum Powders" r4
NFPA 654, "Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids"
NFPA 655, "Prevention of Sulfur Fires and Explosions"
NFPA 664, "Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities"
NFPA 8503, "Pulverized Fuel Systems" r

A-6.2.3.9.(5) and (6) Exhausting to Garages. A frequent practice in the design of ventilation systems serving buildings which have associated parking garages is to discharge exhaust air from the building to the garage in order to reduce the cost of heating the garage or reduce the length of the exhaust ducts. However, this practice entails a certain amount of risk since, when the exhaust system is not running, stack effect may turn the exhaust outlets into intakes and exhaust fumes (including carbon monoxide) can be drawn from the garage into the building. Incorporating a backdraft damper at the exhaust outlet provides some additional protection but backdraft dampers are generally not regarded as being very reliable. Therefore this practice is only permitted in very limited circumstances.

A-6.2.9.2.(2) Temperature of Exposed Piping. Normally piping carrying steam or high-temperature hot water at pressures above atmospheric (corresponding temperature 100°C or above) will be insulated to reduce heat losses as an economy measure. Above a temperature of approximately 70°C, however, a bare pipe can cause a burn to human flesh coming in contact with the pipe. If pipes above this temperature are normally out of reach of all persons other than maintenance personnel or are properly guarded, it would be expected that no insulation would be needed for public safety.

A-8.1.2.1.(1) Application. The use of streets or public property and vehicular traffic during construction or demolition is normally controlled by regulations of authorities other than the building department (e.g., police department).

A-8.2.2.1.(1) Demolition during Renovation. When renovation is taking place, only the portion of the building undergoing demolition is covered by this Subsection. The requirements for the portion undergoing construction are covered by Subsection 8.2.3.

A-8.2.2.1.(2) Demolition. In certain buildings which do not pose an exposure hazard to other buildings, or in which there is little fire hazard to staff, such as in small buildings, the degree of application of this Subsection may be minimal. The degree of application should be determined in advance in conjunction with the authority having jurisdiction.

A-8.2.2.3.(2) Access for Fire Fighting. Fire fighting in storeys above the first requires prompt vertical movement by fire department personnel. Provision should be made for the use of elevators, hoists or lifts to assist such personnel in reaching upper storeys of the building.

A-8.2.2.5.(1) Standpipe System. During freezing conditions, the standpipe may be drained to prevent damage to the equipment. It is not anticipated that hose will be available in the building being demolished, but that it will be brought to the relevant floor by the responding fire department.

A-8.2.2.12.(3) Purging of Tanks. Guidance on methods of rendering inert tanks, piping and machinery reservoirs is available in NFPA 326, “Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair,” or NFPA 327, “Cleaning or Safeguarding Small Tanks and Containers Without Entry.” r4

A-8.2.3.1.(1) Construction Sites. Construction sites can range from a large multi-storey building to small single-storey residences and may include additions or renovations to an existing building. The degree to which this Subsection should apply to each site should be determined in advance, as part of the fire safety plan for the construction site, taking into consideration such issues as the size of the project and condition of the site.

A-9.1.1.1.(1) Application of Part 9 to Seasonally and Intermittently Occupied Buildings. The National Building Code does not provide separate requirements which would apply to seasonally or intermittently occupied buildings. Without compromising the basic health and safety provisions, however, various requirements in Part 9 recognize that leniency may be appropriate in some circumstances. With greater use of “cottages” through the winter months, the proliferation of seasonally occupied multiple-dwelling buildings and the increasing installation of modern conveniences in these buildings, the number and extent of possible exceptions is reduced.

Thermal Insulation

Article 9.25.2.1. specifies that insulation is to be installed in walls, ceilings and floors which separate heated space from unheated space. Cottages intended for use only in the summer and which, therefore, have no space heating appliances, would not be required to be insulated. Should a heating system be installed at some later date, insulation should also be installed at that time. In the case of row units intended for intermittent winter use, the walls between the dwelling units may at times separate heated space from unheated space. In this case, the installation of insulation might be considered.

Air Barrier Systems and Vapour Barriers

Articles 9.25.3.1. and 9.25.4.1. require the installation of air barrier systems and vapour barriers only where insulation is installed. Dwellings with no heating system would thus be exempt from these requirements.

Interior Wall and Ceiling Finishes

The choice of interior wall and ceiling finishes has implications for fire safety. Where a dwelling is a detached building, there are no fire resistance requirements for the walls or ceilings within the dwelling. The exposed surfaces of walls and ceilings are required to have a flame-spread rating not greater than 150 (Subsection 9.10.16.). There is, therefore, considerable flexibility, even in continuously occupied dwellings, with respect to the materials used to finish these walls. Except where waterproof finishes are required (Subsection 9.29.2.), ceilings and walls may be left unfinished. Where two units adjoin, however, additional fire resistance requirements may apply to interior loadbearing walls, floors and the shared wall (Article 9.10.8.3., and Subsections 9.10.9. and 9.10.11.).

Plumbing and Electrical Facilities

Plumbing fixtures are required only where a piped water supply is available (Subsection 9.31.4.), and electrical facilities only where electrical services are available (Article 9.34.1.2.).

A-Table 9.3.2.1. Lumber Grading. To identify board grades the paragraph number of the NLGA rules under which the lumber is graded must be shown in the grade mark. Paragraph 113 is equivalent to WWPA rules and paragraph 114 is equivalent to WCLIB rules. When graded in accordance with WWPA or WCLIB rules, the grade mark will not contain a paragraph number.

A-9.3.2.1.(1) Grade Marking of Lumber. Lumber is generally grouped for marketing into the species combinations contained in Table A-9.3.2.1.A. The maximum allowable spans for those combinations are listed in the span tables for joists, rafters and beams. Some species of lumber are also marketed individually. Since the allowable span for the northern species combination is based on the weakest species in the combination, the use of the span for this combination is permitted for any individual species not included in the Spruce-Pine-Fir, Douglas Fir-Larch and Hemlock-Fir combinations.

Facsimiles of typical grade marks of lumber associations and grading agencies accredited by the Canadian Lumber Standards (CLS) Accreditation Board to grade mark lumber in Canada are shown in Table A-9.3.2.1.B. Accreditation by the CLS Accreditation Board applies to the inspection, grading and grade marking of lumber, including mill supervisory service, in accordance with CAN/CSA-O141, "Softwood Lumber."

The grade mark of a CLS accredited agency on a piece of lumber indicates its assigned grade, species or species combination, moisture condition at the time of surfacing, the responsible grader or mill of origin and the CLS accredited agency under whose supervision the grading and marking was done.

Table A-9.3.2.1.A.
Species Designations and Abbreviations

Commercial Designation of Species or Species Combination	Abbreviation Permitted on Grade Stamps	Species Included
Douglas Fir – Larch	D Fir – L (N)	Douglas Fir, Western Larch
Hemlock – Fir	Hem – Fir (N)	Western Hemlock, Amabilis Fir
Spruce – Pine – Fir	S – P – F or Spruce – Pine – Fir	White Spruce, Engelmann Spruce, Black Spruce, Red Spruce, Lodgepole Pine, Jack Pine, Alpine Fir, Balsam Fir
Northern Species	North Species	Any Canadian softwood covered by the NLGA Standard Grading Rules

Canadian lumber is graded to the NLGA Standard Grading Rules for Canadian Lumber, published by the National Lumber Grades Authority. The NLGA rules specify standard grade names and grade name abbreviations for use in grade marks to provide positive identification of lumber grades. In a similar fashion, standard species names or standard species abbreviations, symbols or marks are provided in the rules for use in grade marks.

Grade marks denote the moisture content of lumber at the time of surfacing. "S-Dry" in the mark indicates the lumber was surfaced at a moisture content not exceeding 19%. "MC 15" indicates a moisture content not exceeding 15%. "S-GRN" in the grade mark signifies that the lumber was surfaced at a moisture content higher than 19% at a size to allow for natural shrinkage during seasoning.

Each mill or grader is assigned a permanent number. The point of origin of lumber is identified in the grade mark by use of a mill or grader number or by the mill name or abbreviation. The CLS certified agency under whose supervision the lumber was grade marked is identified in the mark by the registered symbol of the agency.

Table A-9.3.2.1.B.
Facsimiles of Grade Marks Used by Canadian Lumber Manufacturing Associations and Agencies Authorized to Grade Mark Lumber in Canada

Facsimiles of Grade Mark	Association or Agency
A.F.P.A.® 00 S – P – F S-DRY STAND GC00056A	Alberta Forest Products Association 200-11738 Kingsway Avenue Edmonton, Alberta T5G 0X5
C L®A 100 SPRUCE PINE FIR NO.1 S-DRY GC00059A	Canadian Lumbermen's Association 27 Goulburn Avenue Ottawa, Ontario K1N 8C7
COFI® No 1 S - DRY 100 HEM - FIR (N) GC00062A	Canadian Mill Services Association 1200-555 Burrard Street Vancouver, British Columbia V7X 1S7
CLMA® 1 S-GRN 1 1 D FIR (N) GC00061A	Cariboo Lumber Manufacturers' Association 205-197 North 2nd Avenue Williams Lake, British Columbia V2G 1Z5
CFPA® 00 S-P-F S-DRY CONST GC00058A	Central Forest Products Association Inc. P.O. Box 1169 Hudson Bay, Saskatchewan S0E 0Y0
CLIB® 10 S-P-F NO. 1 S-DRY GC00060A	Coniferous Lumber Inspection Bureau 6-383 John Street North Arnprior, Ontario K7S 2P8

Table A-9.3.2.1.B. (Continued)

Facsimiles of Grade Mark	Association or Agency
ILMA® S-DRY 1 00 S-P-F GC00063A	Interior Lumber Manufacturers' Association 360-1855 Kirschner Road Kelowna, British Columbia V1Y 4N7
0 No 1 0 S-DRY D FIR (N) GC00064A	MacDonald Inspection Division of Intertek Testing Services NA Ltd. e2 211 Schoolhouse Street Coquitlam, British Columbia V3K 4X9
M S-P-F L® No. 1 S-DRY B MILL 9 GC00065A	Maritime Lumber Bureau P.O. Box 459 Amherst, Nova Scotia B4H 4A1
NFLD. LUMBER NLPA NORTH SPECIES STUD S-GRN MILL 9 GC00066A	Newfoundland Lumber Producers Association P.O. Box 8 Glovertown, Newfoundland A0G 2L0
NFPA® S-P-F S-DRY 100 No1 GC00057A	Northern Forest Products Association 400-1488 Fourth Avenue Prince George, British Columbia V2L 4Y2
NWT 10 CONST S-P-F S-GRN GC00067A	N.W.T. Forest Industries Association Box 1033 Hay River, Northwest Territories X0E 0R0
O.L.M.A.® 01-1 CONST. S-DRY SPRUCE - PINE - FIR GC00068A	Ontario Lumber Manufacturers' Association 55 University Avenue, Suite 1105, Box 8 Toronto, Ontario M5J 2H7

Table A-9.3.2.1.B. (Continued)

Facsimiles of Grade Mark	Association or Agency
PLIB® NLGA RULE NO 1 S-DRY 00 S—P—F GC00069A	Pacific Lumber Inspection Bureau P.O. Box 7235 Bellevue, Washington 98008-1235 USA British Columbia Division: P.O. Box 19118 Fourth Avenue Postal Outlet Vancouver, British Columbia V6C 4R8
® S.P.F. 1 000 S - GRN GC00070A	Quebec Lumber Manufacturers' Association Association des manufacturiers de bois de sciage du Québec 5055, boul. Hamel ouest, bureau 200 Québec (Québec) G2E 2G6

A-9.3.2.8.(1) Non-Standard Lumber. The NLGA "Standard Grading Rules for Canadian Lumber" permit lumber to be dressed to sizes below the standard sizes (38 × 89, 38 × 140, 38 × 184, etc.) provided the grade stamp shows the reduced size. This Sentence permits the use of the span tables for such lumber, provided the size indicated on the stamp is not less than 95% of the corresponding standard size. Allowable spans in the tables must be reduced a full 5% even if the undersize is less than the 5% permitted.

A-9.4. Structural Requirements. Section 9.4. establishes the principle that the design of structural members of Part 9 buildings must either be based on the specific requirements in Part 9, such as the span tables, or be in accordance with Part 4. Usually a combination of the two approaches is used. For example, even if the snow load on a wood roof truss is based on Subsection 9.4.2., the joints must be designed in accordance with Part 4.

The only explicit treatment of structural loads in Section 9.4. is for gravity loads; wind and earthquake loads are dealt with implicitly in the body of Part 9 and are not used as inputs to any of the span tables. There may therefore be a tendency to assume that wind and earthquake loads do not need to be considered in the design of Part 9 buildings. In most cases this is true: the majority of low rise, wood frame buildings have a great deal of structural redundancy and continuity and have more than enough capacity to resist lateral loads due to wind and earthquake.

For example, in a traditional house configuration, even if there are large openings in the exterior walls for picture windows and sliding doors, the many interior partitions act as shear walls and provide adequate lateral stability. This may not be the case for some newer house designs.

However, this does not apply to all building configurations or details that might be found in Part 9 buildings. For example, a mercantile building might be long and narrow with almost entirely windowed walls on the ends and few structurally attached interior partitions. In such a case, wind and earthquake loads would have to be considered in the design of the long structural walls and their foundations.

Another example is the practice, in some parts of the country, of building houses on crawl spaces with perimeter walls consisting of short, wood frame "knee" or "pony" walls and with no lateral bracing or interior partitions in the crawl space. The only structural continuity in the foundation-to-knee-wall and knee-wall-to-floor joints comes from nailing and this is inadequate to resist lateral loads from significant earthquakes.

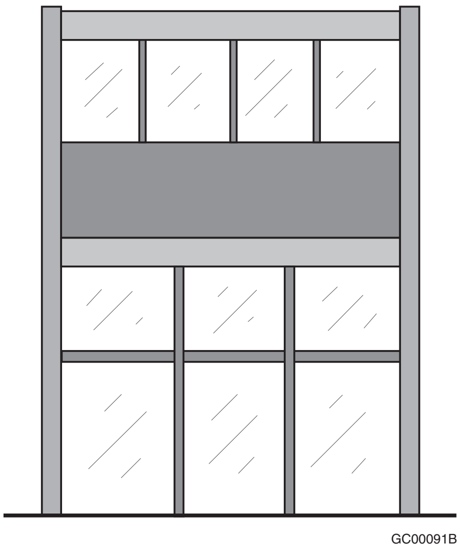


Figure A-9.4.A.
Mercantile building with little resistance to lateral loading

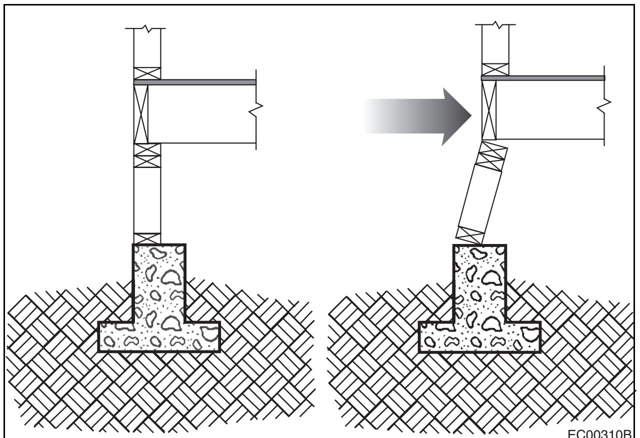


Figure A-9.4.B.
Crawl space knee-wall with little resistance to lateral loading

Thus Part 9 buildings are not exempt from having to comply with the wind and earthquake loading requirements of Part 4. In many cases, these considerations can safely be ignored but, in certain configurations, the building's resistance to wind and earthquake loads must be carefully considered.

See also A-9.23.10.2.

A-9.4.2.1.(1) r4 Application of Simplified Part 9 Snow Loads. The simplified specified snow loads described in Article 9.4.2.2. may be used where the structure is of the configuration that is typical of traditional wood-frame residential construction and its performance. This places limits on the spacing of joists, rafters and trusses, the spans of these members and supporting members, deflection under load, overall dimensions of the roof and the configuration of the roof. It assumes considerable redundancy in the structure.

Because very large buildings may be constructed under Part 9 by constructing firewalls to break up the building area, it is possible to have Part 9 buildings with very large roofs. The simplified specified snow loads may not be used when the total roof area of the overall structure exceeds 4 550 m^2. Thus, the simplified specified snow load calculation may be used for typical town-house construction but would not be appropriate for much larger commercial or industrial buildings, for example.

The simplified specified snow loads are also not designed to take into account roof configurations that seriously exacerbate snow accumulation. This does not pertain to typical projections above a sloped roof such as dormers, nor does it pertain to buildings with higher and lower roofs. Although two-level roofs generally lead to drift loading, smaller light-frame buildings constructed according to Part 9 have not failed under these loads. Consequently, the simplified calculation may be used in these cases. Rather, this limitation on application of the simplified calculation pertains to roofs with high parapets or significant other projections above the roof, such as elevator penthouses, mechanical rooms or larger equipment that would effectively collect snow and preclude its blowing off the roof.

The reference to Sentence 9.23.13.11.(1) invokes, for roof assemblies other than common lumber trusses, the same performance criteria.

The unit weight of snow on roofs, γ, obtained from measurements at a number of weather stations across Canada varied from about 1.0 to 4.5 kN/m^3. An average value for use in design in lieu of better local data is $\gamma = 3.0$ kN/m^3. In some locations the unit weight of snow may be considerably greater than 3.0 kN/m^3. Such locations include regions where the maximum snow load on the roof is reached only after contributions from many snowstorms, coastal regions, and regions where winter rains are considerable and where a unit weight as high as 4.0 kN/m^3 may be appropriate.

A-9.4.2.4.(1) r2 Specified Loads for Attics with Limited Accessibility. Typical residential roofs are framed with roof trusses and the ceiling is insulated.

Residential trusses are placed at 600 mm on centre with web members joining top and bottom chords. Lateral web bracing is installed perpendicular to the span of the trusses. As a result, there is limited room for movement inside the attic space or for storage of material. Access hatches are generally built to the minimum acceptable dimensions of 500 mm by 700 mm, further limiting the size of material that can be moved into the attic.

With exposed insulation in the attic, access is not recommended unless protective clothing and breathing apparatus are worn.

Thus the attic space is recognized as uninhabitable and loading can be based on actual dead load. In emergency situations or for the purpose of inspection, it is possible for a person to access the attic without over-stressing the truss or causing damaging deflections.

A-Table 9.4.4.1. Classification of Soils. Sand or gravel may be classified by means of a picket test in which a 38 mm by 38 mm picket bevelled at the end at 45° to a point is pushed into the soil. Such material is classified as "dense or compact" if a man of average weight cannot push the picket more than 200 mm into the soil and "loose" if the picket penetrates 200 mm or more.

Clay and silt may be classified as "stiff" if it is difficult to indent by thumb pressure, "firm" if it can be indented by moderate thumb pressure, "soft" if it can be easily penetrated by thumb pressure, where this test is carried out on undisturbed soil in the wall of a test pit.

A-Table 9.6.6.1. Glass in Doors. Maximum areas in Table 9.6.6.1. for other than fully tempered glazing are cut off at 1.50 m², as this would be the practical limit after which safety glass would be required by Sentence 9.6.6.2.(3).

A-9.6.6.3.(1) Mirrored Glass Doors. Standard CAN/CGSB-82.6-M covers mirrored glass doors for use on reach-in closets. It specifies that such doors are not to be used for walk-in closets.

A-9.6.6.6.(1) Double Glazing for Glass Doors and Glass in Doors. Where a door consists of a large area of glass held in a frame, for example, sliding patio doors, the glass is considered to be glass in a door and would be required to be double glazed. Only where a door is solid glass and has no frame would the glass not be required to be double glazed.

A-9.6.8.1. Forced Entry Via Glazing in Doors and Sidelights. There is no mandatory requirement that special glass be used in doors or sidelights, primarily because of cost. It is, however, a common method of forced entry to break glass in doors and sidelights to gain access to door hardware and unlock the door from the inside. Although insulated glass provides increased resistance over single glazing, the highest resistance is provided by laminated glass. Tempered glass, while stronger against static loads, is prone to shattering under high, concentrated impact loads.

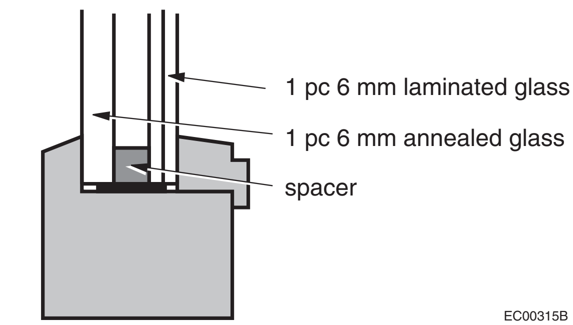


Figure A-9.6.8.1.
Combined laminated/annealed glazing

Laminated glass is more expensive than annealed glass and must be used in greater thicknesses. Figure A-9.6.8.1. shows an insulated sidelight made of one pane of laminated glass and one pane of annealed glass. This method reduces the cost premium that would result if both panes were laminated.

Consideration should be given to using laminated glazing in doors and accompanying sidelights regulated by Article 9.6.6.1., in windows located within 900 mm of locks in such doors, and in basement windows.

Underwriters' Laboratories of Canada have produced a document ULC-S332, "Burglary Resisting Glazing Material," which provides a test procedure to evaluate the resistance of glazing to attacks by thieves. While it is principally intended for plate glass show windows, it may be of value for residential purposes.

A-9.6.8.5.(1) Door Fasteners. The purpose of the requirement for 30 mm screw penetration into solid wood is to prevent the door from being dislodged from the jamb due to impact forces. It is not the intent to prohibit other types of hinges or strikeplates that are specially designed to provide equal or greater protection.

A-9.6.8.7.(1) Hinged Doors. Methods of satisfying this Sentence include either using non-removable pin hinges or modifying standard hinges by screw fastening a metal pin in a screw hole in one half of the top and bottom hinges. When the door is closed, the projecting portion of the pin engages in the corresponding screw hole in the other half of the hinge and then, even if the hinge pin is taken out, the door cannot be removed.

A-9.6.8.10.(1) Resistance of Doors to Forced Entry. This Sentence designates standard ASTM F 476, “Security of Swinging Door Assemblies,” as an alternate to compliance with the prescriptive requirements for doors and hardware. The annex to the standard provides four security classifications, with acceptance criteria, depending on the type of building and the crime rate of the area in which it is located. The NBC has only specified Grade 10, the minimum level. The annex suggests the following guidelines be followed when selecting security levels for door assemblies:

Grade 10: This is the minimum security level and is quite adequate for single-family residential buildings located in stable, low-crime areas.

Grade 20: This is the low–medium security level and is designed to provide security for residential buildings located in average crime-rate areas and for apartments in both low and average crime-rate areas.

Grade 30: This is the medium–high security level and is designed to provide security for residential buildings located in higher than average crime-rate areas or for small commercial buildings in average or low crime-rate areas.

Grade 40: This is the high security level and is designed for small commercial buildings located in high crime-rate areas. This level could also be used for residential buildings having an exceptionally high incidence of semi-skilled burglary attacks.

All these grades satisfy the Code and can be considered for use where a higher level of security is desired or warranted.

A-9.7.1.3.(1) Bedroom Window Height. Sentence 9.7.1.3.(1) requires every bedroom that does not have an exterior door to have at least one window that is large enough and easy enough to open that it can be used as an exit in case of a fire that prevents use of the normal building exits. However, the Article does not set a maximum sill height for such a window; it is therefore possible to install a window or skylight which satisfies the requirements of the Article but defeats the Article’s intent by virtue of being so high that it cannot be reached for exit purposes. It is recommended that the sills of windows intended for use as emergency exits be not higher than 1.5 m above the floor. Sometimes it is difficult to avoid having the sill higher than this; e.g., skylights, windows in basement bedrooms. In these cases, it is recommended that access to the window be improved by some means such as built-in furniture installed below the window.

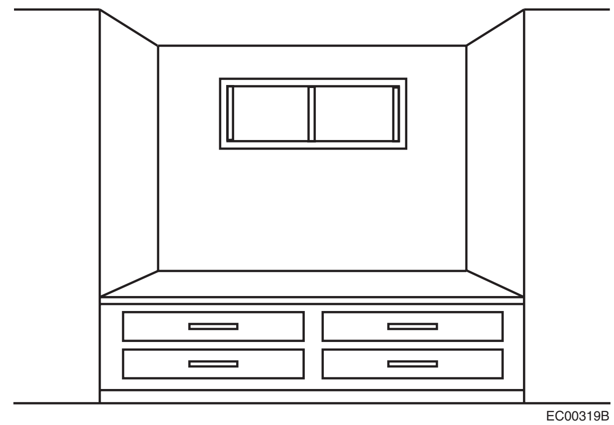


Figure A-9.7.1.3.A.
Built-in furniture to improve access to a window

A-9.7.1.3.(2) Bedroom Window Opening Areas and Dimensions. Although the minimum opening dimensions required for height and width are 380 mm, a window opening that is 380 mm by 380 mm would not comply with the minimum area requirements. (See Figure A-9.7.1.3.B.)

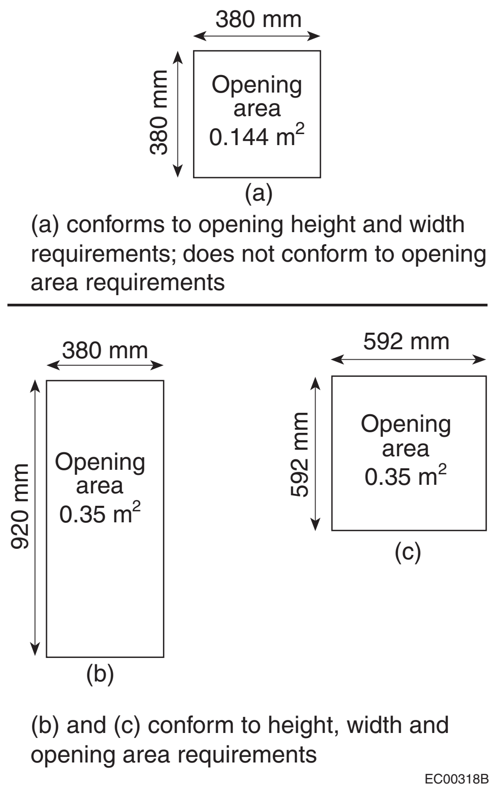


Figure A-9.7.1.3.B.
Window opening areas and dimensions

A-9.7.1.5.(1) Double Glazing. In a cold climate such as Canada's, windows which separate heated space from unheated space or the exterior must be at least double glazed to prevent the accumulation of significant amounts of condensation on the inside surface of the glazing. Although glazing materials are generally unharmed by such condensation, the water can run down and damage the materials in the window frame and in the wall below the window. Water accumulating in these materials can also lead to the growth of moulds.

Because of the potential for damage to the structure, this measure is required in any heated building, whether or not there is normally human occupancy.

A-9.7.1.6. Height of Window Sills above Floors or Ground. The primary intent of the requirement is to minimize the likelihood of small children falling significant heights from open windows. Reflecting reported cases, the requirement applies only to dwelling units and generally those located on the second floor or higher of residential or mixed use buildings where the windows are essentially free-swinging or free-sliding.

Free-swinging or free-sliding means that a window that has been cracked open can be opened further by simply pushing on the openable part of the window. Care must be taken in selecting windows, as some with special operating hardware can still be opened further by simply pushing on the window.

Casement windows with crank operators would be considered to conform to Clause (1)(b). To provide additional safety, where slightly older children are involved, occupants can easily remove the crank handles from these windows. Awning windows with scissor hardware, however, may not keep the window from swinging open once it is unlatched. Hopper windows would be affected only if an opening is created at the bottom as well as at the top of the window. The requirement will impact primarily on the use of sliding windows which do not incorporate devices in their construction that can be used to limit the openable area of the window.

The 100 mm opening limit is consistent with widths of openings that small children can fall through. It is only invoked, however, where the other dimension of the opening is more than 380 mm. Again, care must be taken in selecting a window. At some position, scissor hardware on an awning window may break up the open area such that there is no unobstructed opening with dimensions greater than 380 mm and 100 mm. At another position, however, though the window is not open much more, the hardware may not adequately break up the opening. The 450 mm height off the floor recognizes that furniture is often placed under windows and small children are often good climbers.

A-9.7.2.1.(1) Window Standard. CSA standard CSA A440, "Windows," includes a window classification system that rates the assembly according to airtightness, watertightness and wind load resistance. The ratings achieved by each window are marked on the window and indicate the level of performance that can be expected. Article 9.7.2.1. has specified the lowest classifications (A1, B1, C1) since the NBC is a collection of minimum requirements only. However, designers or builders should consider windows with higher ratings, based on the height of the window above grade, climatic conditions, and occupancy classification. CSA publishes a companion document to CSA A440 entitled CSA A440.1, "User Selection Guide to A440." This guide is intended to assist specifiers, manufacturers, and general users in selecting the window ratings appropriate for a particular building, based on its geographic location and height. r4

A-9.7.3.2.(1) Maximum Glass Area.
Tables A-9.7.3.2.A., A-9.7.3.2.B. and A-9.7.3.2.C. may be used to select glass thickness for windows subject to the following restrictions:

- The building has essentially uniform distribution of openings, i.e., no large opening, such as a loading door.
- The building height is 12 m or less from grade to the uppermost roof.
- The building is not in an exposed location such as a hilltop or the shore of a large body of water.

These tables are based on standard CAN/CGSB-12.20-M. In many cases, glass design based on these tables will be conservative due to conservative assumptions on which the tables are based. More exact design using the standard directly could result in reduced glass thickness.

Table A-9.7.3.2.A.
Maximum Glass Area for Windows in Areas for which the 1-in-10 Wind Pressure (Q_{10}) is less than 0.40 kPa(1)

Type of Glass	Maximum Glass Area, m²							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.67	1.09	1.65	2.25	3.09	4.91	6.78	9.87
Factory-sealed IG units	1.20	1.98	2.97	4.05	5.56	8.04	10.06	13.96
Heat strengthened or tempered	1.47	2.08	2.73	3.34	4.13	5.69	7.12	9.87
Wired	0.31	0.49	0.76	1.04	1.44	2.26	3.13	5.00

Notes to Table A-9.7.3.2.A.:
(1) The maximum hourly wind pressure with one chance in ten of being exceeded in any one year, as provided in Appendix C.

Table A-9.7.3.2.B.
Maximum Glass Area for Windows in Areas for which the 1-in-10 Wind Pressure (Q_{10}) is less than 0.60 kPa(1)

Type of Glass	Maximum Glass Area, m²							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.42	0.66	1.02	1.40	1.93	3.05	4.20	6.65
Factory-sealed IG units	0.75	1.22	1.86	2.52	3.49	5.52	7.61	11.40
Heat strengthened	0.86	1.40	2.13	2.73	3.37	4.65	5.81	8.06
Tempered	1.20	1.70	2.24	2.73	3.37	4.65	5.81	9.06
Wired	0.20	0.32	0.50	0.68	0.95	1.50	2.06	3.32

Notes to Table A-9.7.3.2.B.:
(1) The maximum hourly wind pressure with one chance in ten of being exceeded in any one year, as provided in Appendix C.

Table A-9.7.3.2.C.
Maximum Glass Area for Windows in Areas for which the 1-in-10 Wind Pressure (Q_{10}) is less than 0.80 kPa(1)

Type of Glass	Maximum Glass Area, m²							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.30	0.50	0.76	1.05	1.45	2.32	3.21	5.11
Factory-sealed IG units	0.54	0.88	1.35	1.82	2.51	4.04	5.54	8.77
Heat strengthened	0.67	1.08	1.65	2.25	2.92	4.02	5.03	6.98
Tempered	1.04	1.47	1.93	2.37	2.92	4.02	5.03	9.06
Wired	0.14	0.24	0.37	0.51	0.70	1.14	1.57	2.53

Notes to Table A-9.7.3.2.C.:
(1) The maximum hourly wind pressure with one chance in ten of being exceeded in any one year, as provided in Appendix C.

A-9.7.6.1.(1) Resistance of Windows to Forced Entry. Although this Sentence only applies to windows within 2 m of adjacent ground level, certain house and site features, such as balconies or canopy roofs, allow for easy access to windows at higher elevations. Consideration should be given to specifying break-in resistant windows in such locations.

This Sentence does not apply to windows that do not serve the interior of the dwelling unit, such as windows to garages, sun rooms or greenhouses, provided connections between these spaces and the dwelling unit are secure.

One method that is often used to improve the resistance of windows to forced entry is the installation of metal "security bars." However, while many such installations are effective in increasing resistance to forced entry, they may also reduce or eliminate the usefulness of the window as an exit in case of fire or other emergency that prevents use of the normal building exits. Indeed, unless such devices are easily openable from the inside, their installation in some cases would contravene the requirements of Article 9.7.1.3., which requires every bedroom that does not have an exterior door to have at least one window that is large enough and easy enough to open that it can be used as an exit in case of emergency. Thus an acceptable security bar system should be easy to open from the inside while still providing increased resistance to entry from the outside.

A-9.8.3.2.(1) Nosings.

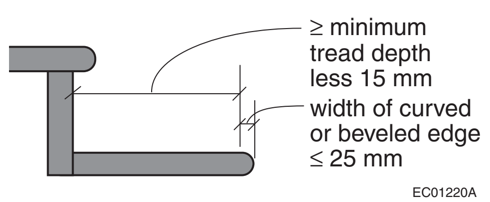


Figure A-9.8.3.2.
Tread depth and treatment of leading edge

A-9.8.5.3.(1) Winders. Where a stair must turn, the safest method of incorporating the turn is to use a landing. Within a dwelling unit, however, where occupants are familiar with their environment, winders are an acceptable method of reducing the amount of floor area devoted to the stair and have been shown to be no more hazardous than a straight run of steps. Nevertheless, care is required to ensure that winders are as safe as possible. Experience has shown that 30° winders are the best compromise and require the least change in the natural gait of the stair user. The Code, therefore, permits only this angle. Although it is normal Code practice to specify upper and lower limits, in this case it is necessary to limit the winders to one specific angle with no tolerance above or below this angle other than normal construction tolerances. One result of this requirement is that winder-type turns in stairs are limited to 30° (one winder), 60° (two winders), or 90° (three winders).

A-9.8.7.3.(1) Termination of Handrails. Handrails are required to be installed so as not to obstruct pedestrian travel. To achieve this end, the rail should not extend so far into a hallway as to reduce the clear width of the hallway to less than the required width. Where the stair terminates in a room or other space, likely paths of travel through that room or space should be assessed to ensure that any projection of the handrail beyond the end of the stair will not interfere with pedestrian travel. As extensions of handrails beyond the first and last riser are not required in dwelling units (see Article 9.8.7.4.) and as occupants of dwellings are generally familiar with their surroundings, the design of dwellings would not generally be affected by this requirement.

Handrails are also required to terminate in a manner that will not create a safety hazard to blind or visually impaired persons, children whose heads may be at the same height as the end of the rail, or persons wearing loose clothing or carrying items that might catch on the end of the rail. One approach to reducing potential hazards is returning the handrail to a wall, floor or post. Again, within dwelling units, where occupants are generally familiar with their surroundings, returning the handrail to a wall, floor or post may not be necessary. For example, where the handrail is fastened to a wall and does not project past the wall into a hallway or other space, a reasonable degree of safety is assumed to be provided; other alternatives may provide an equivalent level of protection.

A-9.8.7.5.(2) Handrail Sections. Handrails are intended to provide guidance and support to stair users. To fulfil this intent, handrails must be "graspable." Acceptable handrail sections include, but are not limited to, those shown below.

A-9.8.7.8. Attachment of Handrails. Handrails are intended to provide guidance and support to the stair user and to arrest falls. The loads on handrails may therefore be considerable. Handrails may be accepted on the basis of experience or structural design. See also A-9.8.8. Loads on Guards.

A-9.8.8. Loads on Guards. Guards should be constructed so as to be strong enough to provide protection from falling under normal use. Such guards may be accepted on the basis of experience or by structural design. Loading criteria for the structural design of guards can be found in Article 4.1.10.1.

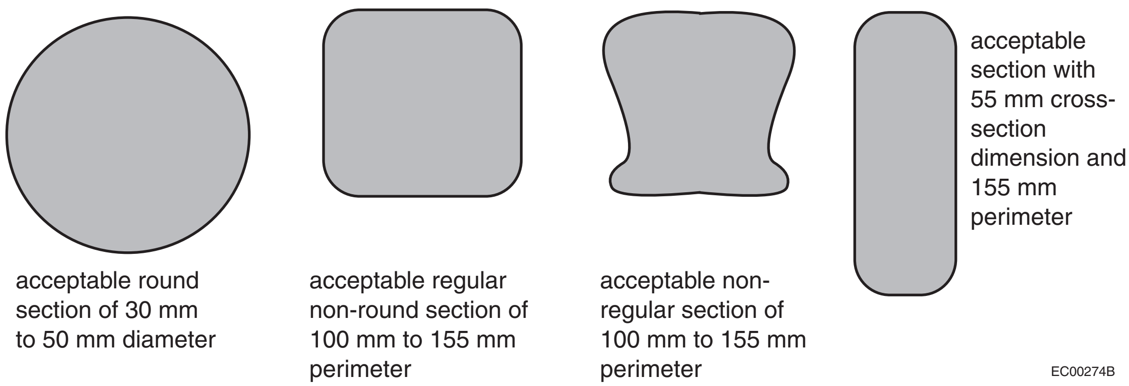


Figure A-9.8.7.5.
Handrail sections

A-9.8.8.1. Required Guards. The requirements for guards in Part 9 are based on the premise that, wherever there is a difference in elevation of 600 mm or more between two floors or between a floor or other walking surface and the next lower surface, the risk of injury in a fall from the higher surface is sufficient that there must be some kind of barrier to reduce the chances of such a fall. Where there is a wall along the edge of the higher surface, this will obviously prevent such a fall, provided the wall is sufficiently strong that a person cannot fall through it. Where there is no wall, a guard is used. A guard clearly provides less protection than a wall; therefore additional requirements apply to guards to ensure that a minimum level of protection is provided. These relate to the characteristics described in A-9.8.8.2., A-9.8.8.4.(1) and (2), A-9.8.8.4.(3), and A-9.8.8.5.

A-9.8.8.2. Minimum Heights. Guard heights are generally based on the waist heights of average persons. Generally, lower heights are permitted in dwelling units because the occupants become familiar with the potential hazards, and situations which lead to pushing and jostling under crowded conditions are less likely to arise.

A-9.8.8.4.(1) and (2) Risk of Falling through Guards. The risk of falling through a guard is especially prevalent for children. Therefore the requirements are stringent for guards in all buildings except industrial buildings, where children are unlikely to be present except under strict supervision.

A-9.8.8.4.(3) Risk of Children Getting Their Heads Stuck between Balusters. The requirements to prevent children falling through guards also serve to provide adequate protection against this problem. However, guards are often installed where they are not required by the Code; i.e., in places where the difference in elevation is less than 600 mm. In these cases, there is no need to require the openings between balusters to be less than 100 mm. However, there is a range of openings between 100 mm and 200 mm in which children can get their heads stuck. Therefore, openings in this range are not permitted except in buildings of industrial occupancy, where children are unlikely to be present except under strict supervision.

A-9.8.8.5. Risk of Children Climbing Over Guards. Guards are sometimes constructed with horizontal or near-horizontal members between balusters such that a ladder effect is achieved; this can be very tempting for young children to climb, thus exposing themselves to risk of falling over the guard. Such construction is not permitted for required guards in buildings of residential occupancy.

A-9.9.4.5.(1) Openings in Exterior Walls of Exits.

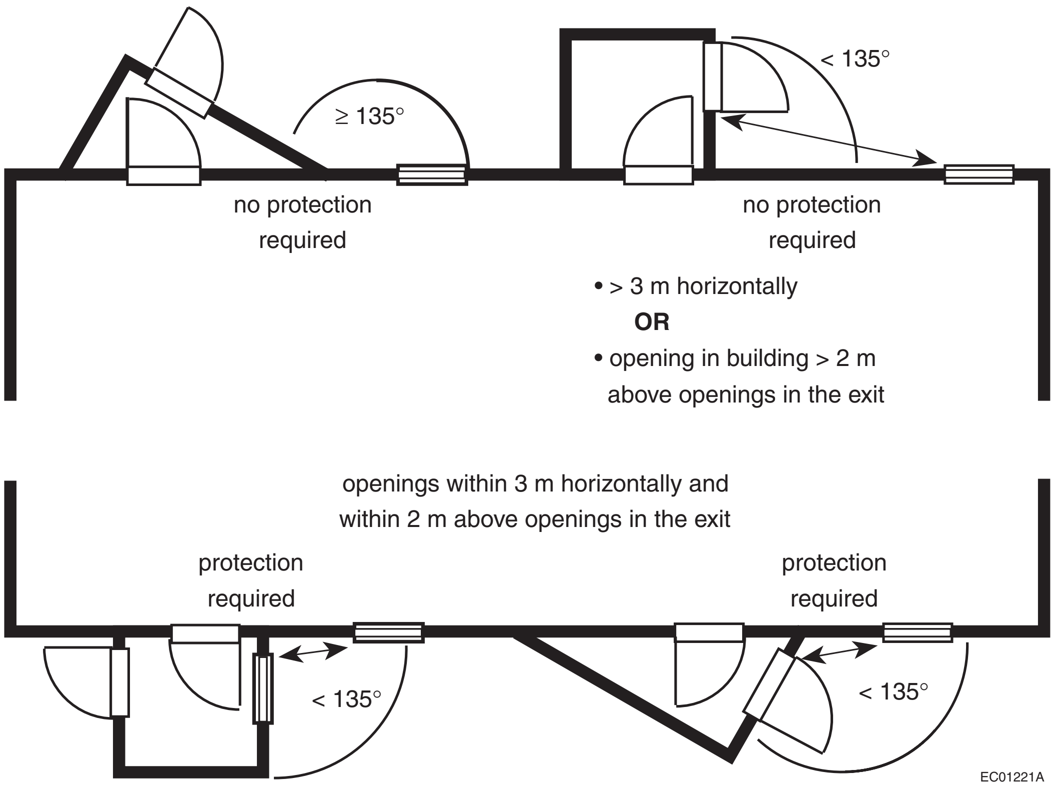


Figure A-9.9.4.5.
Protection of openings in exterior walls of exits

A-9.9.8.4.(1) Independent and Remote Exits. Subsection 9.9.8. requires that some floor areas have more than one exit. The intent is to ensure that, if one exit is made untenable or inaccessable by a fire, one or more other exits will be available to permit the occupants to escape. However, if the exits are close together, all exits might be made untenable or inaccessable by the same fire. Sentence 9.9.8.4.(1) therefore requires at least two of the exits to be located remotely from each other. This is not a problem in many buildings falling under Part 9. For instance, apartment buildings usually have exits located at either end of long corridors. However, in other types of buildings (e.g. dormitory and college residence buildings) this is often difficult to accomplish and problems arise in interpreting the meaning of the word "remote." Article 3.4.2.3. is more specific, generally requiring the distance between exits to be one half the diagonal dimension of the floor area or at least 9 m. However, it is felt that such criteria would be too restrictive to impose on the design of all the smaller buildings which come under Part 9. Nevertheless, the exits should be placed as far apart as possible and the Part 3 criteria should be used as a target. Designs in which the exits are so close together that they will obviously both become contaminated in the event of a fire are not acceptable.

A-9.10.1.4.(1) Commercial Cooking Equipment. Part 6 refers to NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," which in turn references "Commercial Cooking Equipment." However, the deciding factor as to whether or not NFPA 96 applies is the potential for production of grease-laden vapours and smoke, rather than the type of equipment used. While NFPA 96 does not apply to domestic equipment for normal residential family use, it should apply to domestic equipment used in commercial, industrial, institutional and similar cooking applications where the potential for the production of smoke and grease-laden vapours exceeds that for normal residential family use.

A-9.10.3.1. r4 Fire and Sound Resistance of Building Assemblies. The following tables may be used to select building assemblies for compliance with Article 9.10.3.1. and Subsection 9.11.2.

Tables A-9.10.3.1.A. and A-9.10.3.1.B. have been developed from information gathered from tests. While a large number of the assemblies listed were tested, the fire-resistance and acoustical ratings for others were assigned on the basis of extrapolation of information from tests of similar assemblies. Where there was enough confidence relative to the fire performance of an assembly, the fire-resistance ratings were assigned relative to the commonly used minimum ratings of 30 min, 45 min and 1 h, including a designation of "< 30 min" for assemblies that are known not to meet the minimum 30-minute rating. Where there was not enough comparative information on an assembly to assign to it a rating with confidence, its value in the tables has been left blank (hyphen), indicating that its rating remains to be assessed through another means. Future work is planned to develop much of this additional information.

These tables are provided only for the convenience of Code users and do not limit the number of assemblies permitted to those in the tables. Assemblies not listed or not given a rating in these tables are equally acceptable provided their fire and sound resistance can be demonstrated to meet the above-noted requirements either on the basis of tests referred to in Article 9.10.3.1. and Subsection 9.11.1. or by using the data in Appendix D, Fire-Performance Ratings. It should be noted, however, that Tables A-9.10.3.1.A. and A-9.10.3.1.B. are not based on the same assumptions as those used in Appendix D. Assemblies in Tables A-9.10.3.1.A. and A-9.10.3.1.B. are described through their generic descriptions and variants and include details given in the notes to the tables. Assumptions for Appendix D include different construction details that must be followed rigorously for the calculated ratings to be expected. These are two different methods of choosing assemblies that meet required fire ratings.

Table A-9.10.3.1.A.
Fire and Sound Resistance of Walls

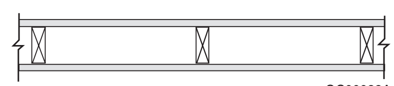
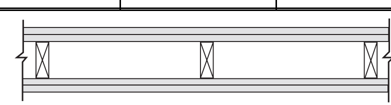
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
• Wood Studs	**W1**	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side	 GC00032A		
• Single Row	W1a	W1 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	1 h	1 h	36
• Loadbearing or Non-Loadbearing	W1b	W1 with • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	45 min [1 h(6)]	45 min [1 h(6)]	34
	W1c	W1 with • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)(7)	30 min	30 min [45 min(6)]	32
	W1d	W1 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	1 h	32
	W1e	W1 with • no absorptive material • 12.7 mm Type X gypsum board(5)	45 min	45 min	32
	W2	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side	 GC00033A		
	W2a	W2 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	38

Table A-9.10.3.1.A. (Continued)

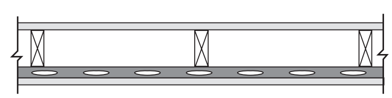
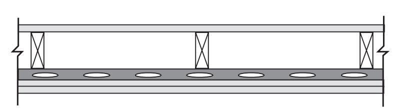
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	W2b	W2 with • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	38
	W2c	W2 with • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	45 min	1 h	36
	W2d	W2 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	36
	W2e	W2 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	35
	W2f	W2 with • no absorptive material • 12.7 mm regular gypsum board(5)	45 min	1 h	34
	W3	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on each side	 GC00034A		
	W3a	W3 with • studs spaced 400 mm o.c. • 15.9 mm Type X gypsum board(5)	45 min	1 h	45
	W3b	W3 with • studs spaced 600 mm o.c. • 15.9 mm Type X gypsum board(5)	45 min	1 h	48
	W3c	W3 with • studs spaced 400 mm or 600 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min	45 min	43
	W4	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on resilient metal channel side • 1 layer of gypsum board on other side	 GC00035A		
	W4a	W4 with • studs spaced 400 mm o.c. • 15.9 mm Type X gypsum board(5)	1 h	1 h [1.5 h(6)]	51
	W4b	W4 with • studs spaced 600 mm o.c. • 15.9 mm Type X gypsum board(5)	1 h	1 h [1.5 h(6)]	54
	W4c	W4 with • studs spaced 400 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min [1 h(6)]	1 h	49
	W4d	W4 with • studs spaced 600 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min [1 h(6)]	1 h	53

Table A-9.10.3.1.A. (Continued)

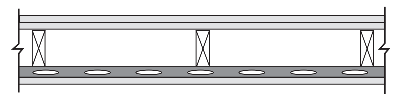
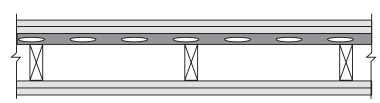
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	W5	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on resilient metal channel side • 2 layers of gypsum board on other side			
	W5a	W5 with • studs spaced 400 mm o.c. • 15.9 mm Type X gypsum board(5)	45 min	1 h	51
	W5b	W5 with • studs spaced 600 mm o.c. • 15.9 mm Type X gypsum board(5)	45 min	1 h	54
	W5c	W5 with • studs spaced 400 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min	1 h	49
	W5d	W5 with • studs spaced 600 mm o.c. • 12.7 mm Type X gypsum board(5)	45 min	1 h	53
	W6	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • resilient metal channels on one side • 2 layers of gypsum board on each side			
	W6a	W6 with • studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	55
	W6b	W6 with • studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	58
	W6c	W6 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	53
	W6d	W6 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	1.5 h	55
	W6e	W6 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55

Table A-9.10.3.1.A. (Continued)

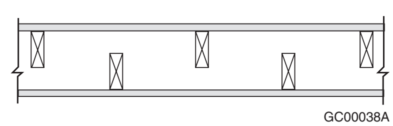
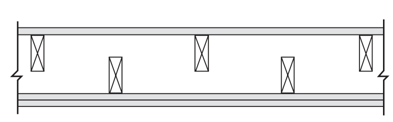
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3]
			Loadbearing	Non-Loadbearing	
	W6f	W6 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	58
	W6g	W6 with • studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board[5]	45 min	1 h	50
	W6h	W6 with • studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material[4] • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board[5]	45 min	1 h	52
	W6i	W6 with • studs spaced 400 mm or 600 mm o.c. • no absorptive material • resilient metal channels spaced 400 mm or 600 mm o.c. • 15.9 mm Type X gypsum board[5]	1.5 h	2 h	47
	W6j	W6 with • studs spaced 400 mm or 600 mm o.c. • no absorptive material • resilient metal channels spaced 400 mm or 600 mm o.c. • 12.7 mm Type X gypsum board[5]	1 h	1.5 h	46
• Wood Studs • Two Rows Staggered on 38 mm × 140 mm Plate • Loadbearing or Non-Loadbearing	**W7**	• two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side[4] • 1 layer of gypsum board on each side			
	W7a	W7 with • 15.9 mm Type X gypsum board[5]	1 h	1 h	47
	W7b	W7 with • 12.7 mm Type X gypsum board[5]	45 min [1 h[6]]	45 min [1 h[6]]	45
	W7c	W7 with • 12.7 mm regular gypsum board[5][7]	30 min	30 min [45 min[6]]	42
	W8	• Two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side[4] • 2 layers of gypsum board on one side • 1 layer of gypsum board on other side			
	W8a	W8 with • 15.9 mm Type X gypsum board[5]	1 h	1.5 h	52
	W8b	W8 with • 12.7 mm Type X gypsum board[5]	45 min	1 h	50

Table A-9.10.3.1.A. (Continued)

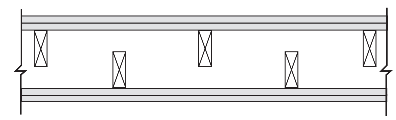
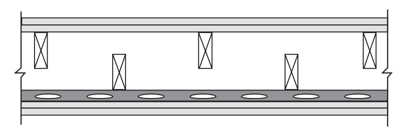
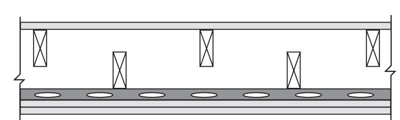
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	W9	• two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • with or without absorptive material • 2 layers of gypsum board on each side			
	W9a	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	56
	W9b	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55
	W9c	W9 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm regular gypsum board(5)	45 min	1 h	53
	W9d	W9 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	48
	W10	• two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • with or without absorptive material • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on each side			
	W10a	W10 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	62
	W10b	W10 with • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	60
	W10c	W10 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	50
	W10d	W10 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	48
	W11	• two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on resilient channel side • 1 layer of gypsum board on other side	 e		
	W11a	W11 with • 15.9 mm Type X gypsum board(5)	1 h	1 h	56

Table A-9.10.3.1.A. (Continued)

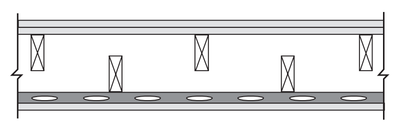
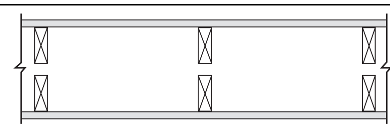
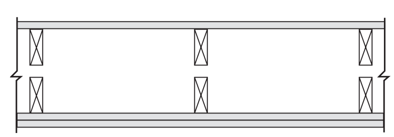
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1) Loadbearing	Fire-Resistance Rating(1) Non-Loadbearing	Typical Sound Transmission Class(1)(2)(3)
	W11b	W11 with • 12.7 mm Type X gypsum board(5)	45 min [1 h(6)]	1 h	54
	W12	• two rows 38 mm x 89 mm studs each spaced 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate • 89 mm thick absorptive material on one side or 65 mm thick on each side(4) • resilient metal channels on one side spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on resilient metal channel side • 2 layers of gypsum board on other side	 GC00043A		
	W12a	W12 with • 15.9 mm Type X gypsum board(5)	45 min	1 h	56
	W12b	W12 with • 12.7 mm Type X gypsum board(5)	45 min	1 h	54
• Wood Studs • Two Rows on Separate Plates • Loadbearing or Non-Loadbearing	**W13**	• two rows 38 mm x 89 mm studs, each spaced 400 mm or 600 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 1 layer of gypsum board on each side	 GC00044A		
	W13a	W13 with • 89 mm thick absorptive material on each side(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h	57
	W13b	W13 with • 89 mm thick absorptive material on each side(4)(8) • 12.7 mm Type X gypsum board(5)	45 min [1 h(6)]	45 min [1 h(6)]	57
	W13c	W13 with • 89 mm thick absorptive material on one side only(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h	54
	W13d	W13 with • 89 mm thick absorptive material on one side only(4)(8) • 12.7 mm Type X gypsum board(5)	45 min	45 min	53
	W13e	W13 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	1 h	45
	W13f	W13 with • no absorptive material • 12.7 mm Type X gypsum board(5)	45 min	45 min	45
	W14	• two rows 38 mm x 89 mm studs, each spaced 400 mm or 600 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 2 layers of gypsum board on one side • 1 layer of gypsum board on other side	 GC00045A		
	W14a	W14 with • 89 mm thick absorptive material on each side(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h [1.5 h(6)]	61

Table A-9.10.3.1.A. (Continued)

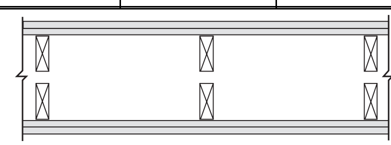
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	W14b	W14 with • 89 mm thick absorptive material on each side(4)(8) • 12.7 mm Type X gypsum board(5)	45 min	1 h	61
	W14c	W14 with • 89 mm thick absorptive material on one side only(4)(8) • 15.9 mm Type X gypsum board(5)	1 h	1 h	57
	W14d	W14 with • 89 mm thick absorptive material on one side only(4)(8) • 12.7 mm Type X gypsum board(5)	45 min	1 h	57
	W14e	W14 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1 h	1 h	51
	W14f	W14 with • no absorptive material • 12.7 mm Type X gypsum board(5)	45 min	1 h	51
	W15	• two rows 38 mm x 89 mm studs, each spaced 400 mm or 600 mm o.c. on separate 38 mm x 89 mm plates set 25 mm apart • with or without absorptive material • 2 layers of gypsum board on each side	 GC00046A		
	W15a	W15 with • 89 mm thick absorptive material on each side(4)(8) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	66
	W15b	W15 with • 89 mm thick absorptive material on each side(4)(8) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	65
	W15c	W15 with • 89 mm thick absorptive material on each side(4)(8) • 12.7 mm regular gypsum board(5)	45 min	1 h	61
	W15d	W15 with • 89 mm thick absorptive material on one side only(4)(8) • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	62
	W15e	W15 with • 89 mm thick absorptive material on one side only(4)(8) • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	60
	W15f	W15 with • 89 mm thick absorptive material on one side only(4)(8) • 12.7 mm regular gypsum board(5)	45 min	1 h	57
	W15g	W15 with • no absorptive material • 15.9 mm Type X gypsum board(5)	1.5 h	2 h	56
	W15h	W15 with • no absorptive material • 12.7 mm Type X gypsum board(5)	1 h	1.5 h	55

Table A-9.10.3.1.A. (Continued)

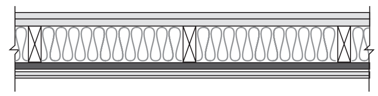
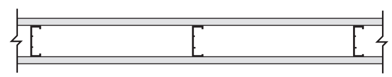
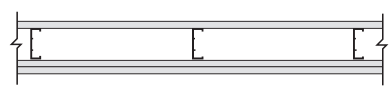
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	W15i	W15 with • no absorptive material • 12.7 mm regular gypsum board(5)	45 min	1 h	51
• Exterior Wood Studs • Single Row	**EW1**	• 38 mm x 89 mm studs spaced 400 mm or 600 mm o.c. • 89 mm thick absorptive material(6) • 1 or 2 layers of gypsum board on inside • exterior sheathing and siding	 GC00011A		
• Loadbearing and Non-Loadbearing	EW1a	EW1 with • 15.9 mm Type X gypsum board(5)(9)	1 h	1 h	N/A
	EW1b	EW1 with • 12.7 mm Type X gypsum board(5)(9)	45 min	45 min	N/A
	EW1c	EW1 with • 2 layers of 12.7 mm regular gypsum board(5)(9)	45 min	45 min	N/A
• Non-Loadbearing Steel Studs	**S1**	• 31 mm x 64 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side	 GC00018A		
• 0.46 mm (25 Gauge)	S1a	S1 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	45 min [1 h(6)]	43
	S1b	S1 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	45 min [1 h(6)]	39
	S1c	S1 with • studs spaced 400 mm or 600 mm o.c. • no absorptive material •15.9 mm Type X gypsum board(5)	–	45 min	35
	S2	• 31 mm x 64 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side	 GC00019A		
	S2a	S2 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	1 h	50
	S2b	S2 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	1 h	44
	S2c	S2 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1 h	50
	S2d	S2 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1 h	42

Table A-9.10.3.1.A. (Continued)

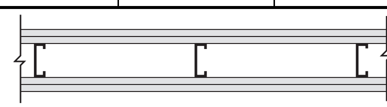
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3]
			Loadbearing	Non-Loadbearing	
	S2e	S2 with • studs spaced 600 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	1 h	41
	S2f	S2 with • studs spaced 400 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	1 h	37
	S2g	S2 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	–	1 h	40
	S2h	S2 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	–	1 h	35
	S3	• 31 mm x 64 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side	 GC00020A		
	S3a	S3 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	–	2 h	54
	S3b	S3 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	–	2 h	51
	S3c	S3 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	–	1.5 h	53
	S3d	S3 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	–	1.5 h	47
	S3e	S3 with • studs spaced 600 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm regular gypsum board[5]	–	1 h	49
	S3f	S3 with • studs spaced 400 mm o.c. • 65 mm thick absorptive material[4] • 12.7 mm regular gypsum board[5]	–	1 h	41
	S3g	S3 with • studs spaced 600 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	2 h	45
	S3h	S3 with • studs spaced 400 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	2 h	42

Table A-9.10.3.1.A. (Continued)

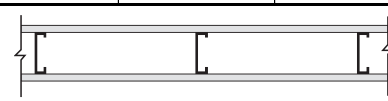
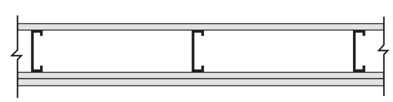
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	S3i	S3 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1.5 h	44
	S3j	S3 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1.5 h	39
	S3k	S3 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm regular gypsum board(5)	–	1 h	40
	S3l	S3 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm regular gypsum board(5)	–	1 h	37
	S4	• 31 mm x 92 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side	 GC00021A		
	S4a	S4 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	45 min [1 h(6)]	48
	S4b	S4 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	45 min [1 h(6)]	47
	S4c	S4 with • studs spaced 600 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	–	45 min	38
	S4d	S4 with • studs spaced 400 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	–	45 min	38
	S5	• 31 mm x 92 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side	 GC00022A		
	S5a	S5 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	1 h [1.5 h(6)]	53
	S5b	S5 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	1 h [1.5 h(6)]	52

Table A-9.10.3.1.A. (Continued)

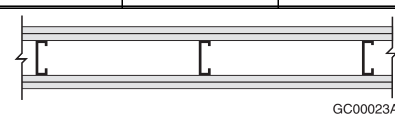
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	S5c	S5 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1 h [1.5 h(6)]	51
	S5d	S5 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1 h [1.5 h(6)]	50
	S5e	S5 with • studs spaced 600 mm o.c. • no absorptive material •15.9 mm Type X gypsum board(5)	–	1 h	43
	S5f	S5 with • studs spaced 400 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board(5)	–	1 h	42
	S5g	S5 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1 h	41
	S5h	S5 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1 h	40
	S6	• 31 mm x 92 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side	 e		
	S6a	S6 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	2 h	56
	S6b	S6 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	2 h	55
	S6c	S6 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1.5 h	55
	S6d	S6 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1.5 h	54
	S6e	S6 with • studs spaced 600 mm o.c. • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	–	1 h	50

Table A-9.10.3.1.A. (Continued)

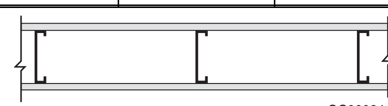
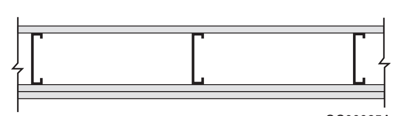
Type of Wall	Wall Number	Description	Fire-Resistance Rating[1]		Typical Sound Transmission Class[1][2][3]
			Loadbearing	Non-Loadbearing	
	S6f	S6 with • studs spaced 400 mm o.c. • 89 mm thick absorptive material[4] • 12.7 mm regular gypsum board[5]	–	1 h	48
	S6g	S6 with • studs spaced 600 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	2 h	47
	S6h	S6 with • studs spaced 400 mm o.c. • no absorptive material • 15.9 mm Type X gypsum board[5]	–	2 h	45
	S6i	S6 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	–	1.5 h	45
	S6j	S6 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm Type X gypsum board[5]	–	1.5 h	44
	S6k	S6 with • studs spaced 600 mm o.c. • no absorptive material • 12.7 mm regular gypsum board[5]	–	1 h	41
	S6l	S6 with • studs spaced 400 mm o.c. • no absorptive material • 12.7 mm regular gypsum board[5]	–	1 h	39
	S7	• 31 mm x 152 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on each side			
	S7a	S7 with • 150 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	–	45 min [1 h[6]]	51
	S7b	S7 with • no absorptive material • 15.9 mm Type X gypsum board[5]	–	45 min	41
	S8	• 31 mm x 152 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer of gypsum board on one side • 2 layers of gypsum board on other side			
	S8a	S8 with • 150 mm thick absorptive material[4] • 15.9 mm Type X gypsum board[5]	–	1 h [1.5 h[6]]	55
	S8b	S8 with • 150 mm thick absorptive material[4] • 12.7 mm Type X gypsum board[5]	–	1 h [1.5 h[6]]	54
	S8c	S8 with • no absorptive material • 15.9 mm Type X gypsum board[5]	–	1 h	45

Table A-9.10.3.1.A. (Continued)

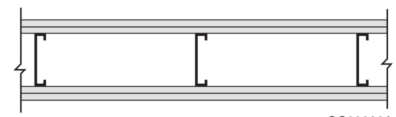
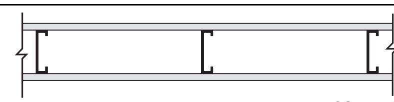
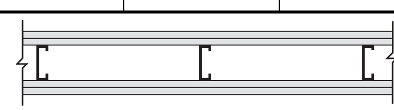
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1) Loadbearing	Fire-Resistance Rating(1) Non-Loadbearing	Typical Sound Transmission Class(1)(2)(3)
	S8d	S8 with • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1 h	44
	S9	• 31 mm x 152 mm steel studs spaced 400 mm or 600 mm o.c. • with or without absorptive material • 2 layers of gypsum board on each side	 GC00026A		
	S9a	S9 with • 150 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	2 h	59
	S9b	S9 with • 150 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	1.5 h	57
	S9c	S9 with • 150 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	–	1 h	53
	S9d	S9 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	2 h	49
	S9e	S9 with • no absorptive material • 12.7 mm Type X gypsum board(5)	–	1.5 h	47
	S9f	S9 with • no absorptive material • 12.7 mm regular gypsum board(5)	–	1 h	43
• Loadbearing Steel Studs	**S10**	• 92 mm loadbearing steel studs spaced 400 mm o.c. • with or without absorptive material • 1 layer gypsum board on each side	 GC00027A		
• 0.91 mm or 1.22 mm Thickness (18 or 20 Gauge)	S10a	S10 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	–	34
	S10b	S10 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	–	32
	S11	• 92 mm loadbearing steel studs spaced 400 mm o.c. • with or without absorptive material • 2 layers gypsum board on each side	 GC00028A		
	S11a	S11 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	–	38
	S11b	S11 with • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	–	38
	S11c	S11 with • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	–	–	36

Table A-9.10.3.1.A. (Continued)

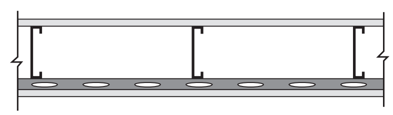
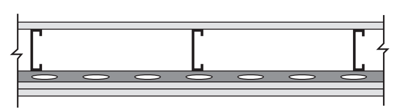
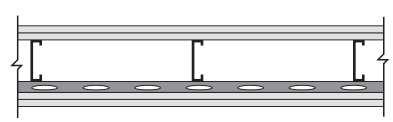
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	S11d	S11 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	–	36
	S11e	S11 with • no absorptive material • 12.7 mm Type X gypsum board(5)	–	–	35
	S11f	S11 with • no absorptive material • 12.7 mm regular gypsum board(5)	–	–	34
	S12	• 92 mm loadbearing steel studs spaced 400 mm o.c. • with or without absorptive material • resilient metal channels on one side spaced at 600 mm o.c. • 1 layer gypsum board on each side	 GC00029A		
	S12a	S12 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	–	49
	S12b	S12 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	–	39
	S13	• 92 mm loadbearing steel studs spaced 400 mm o.c. • with or without absorptive material • resilient metal channels on one side spaced at 600 mm o.c. • 2 layers gypsum board on resilient channel side • 1 layer gypsum board on other side	 GC00030A		
	S13a	S13 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	–	54
	S13b	S13 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	–	44
	S14	• 92 mm loadbearing steel studs spaced 400 mm o.c. • with or without absorptive material • resilient metal channels on one side spaced at 600 mm o.c. • 2 layers gypsum board on each side	 GC00031A		
	S14a	S14 with • 89 mm thick absorptive material(4) • 15.9 mm Type X gypsum board(5)	–	–	61
	S14b	S14 with • 89 mm thick absorptive material(4) • 12.7 mm Type X gypsum board(5)	–	–	59
	S14c	S14 with • 89 mm thick absorptive material(4) • 12.7 mm regular gypsum board(5)	–	–	54
	S14d	S14 with • no absorptive material • 15.9 mm Type X gypsum board(5)	–	–	51

Table A-9.10.3.1.A. (Continued)

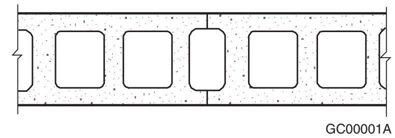
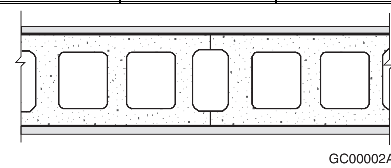
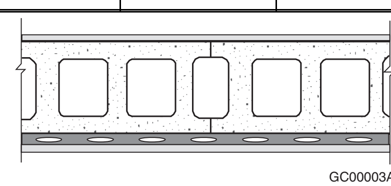
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	S14e	S14 with • no absorptive material • 12.7 mm Type X gypsum board(5)	–	–	49
	S14f	S14 with • no absorptive material • 12.7 mm regular gypsum board(5)	–	–	45
• Hollow Concrete Block (Normal Weight Aggregate)	**B1**	• 140 mm or 190 mm concrete block			
	B1a	• 140 mm bare concrete block(3)	1 h	1 h	48
	B1b	• 190 mm bare concrete block(3)	1.5 h	1.5 h	50
	B2	•140 mm or 190 mm concrete block • no absorptive material • 1 layer gypsum-sand plaster or gypsum board on each side			
	B2a	B2 with • 140 mm concrete block • 12.7 mm gypsum-sand plaster	2 h	2 h	50
	B2b	B2 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board(5)	2 h	2 h	47
	B2c	B2 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)	1.5 h	1.5 h	46
	B2d	B2 with • 190 mm concrete block • 12.7 mm gypsum-sand plaster	2.5 h	2.5 h	51
	B2e	B2 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	50
	B2f	B2 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	49
	B2g	B2 with • 190 mm concrete block • 12.7 mm regular gypsum board(5)	2 h	2 h	48
	B3	• 140 mm or 190 mm concrete block • resilient metal channels on one side spaced at 400 mm or 600 mm o.c. • absorptive material filling resilient metal channel space(4) • 1 layer gypsum board on each side			
	B3a	B3 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board(5)	2 h	2 h	51

Table A-9.10.3.1.A. (Continued)

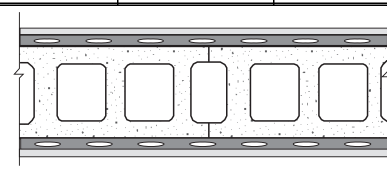
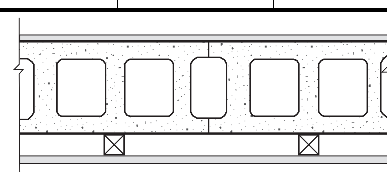
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	B3b	B3 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)(7)	1.5 h	1.5 h	48
	B3c	B3 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	54
	B3d	B3 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	53
	B3e	B3 with • 190 mm concrete block • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	51
	B4	•140 mm or 190 mm concrete block • resilient metal channels on each side spaced at 400 mm or 600 mm o.c. • with or without absorptive material • 1 layer gypsum board on each side	 GC00004A		
	B4a	B4 with • 140 mm concrete block •12.7 mm Type X gypsum board(5), or 15.9 mm Type X gypsum board(5)	2 h	2 h	47
	B4b	B4 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)(7)	1.5 h	1.5 h	42
	B4c	B4 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	50
	B4d	B4 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	49
	B4e	B4 with •190 mm concrete block •12.7 mm regular gypsum board(5)(7)	2 h	2 h	45
	B5	• 190 mm concrete block • 38 mm x 38 mm horizontal or vertical wood strapping on one side spaced at 600 mm o.c. • with or without absorptive material • 1 layer gypsum board on each side	 GC00005A		
	B5a	B5 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	54
	B5b	B5 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	53
	B5c	B5 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	51

Table A-9.10.3.1.A. (Continued)

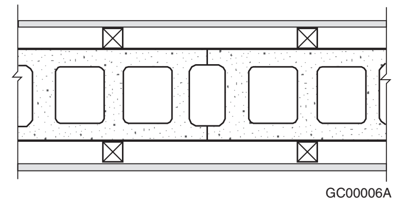
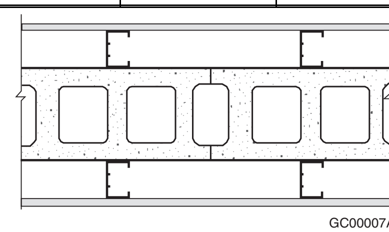
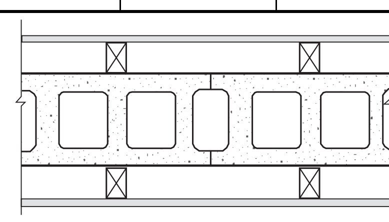
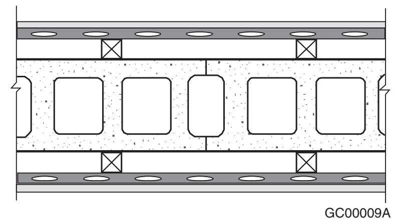
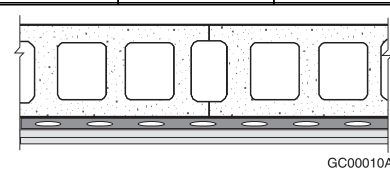
Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	B6	• 140 mm or 190 mm concrete block • 38 mm x 38 mm horizontal or vertical wood strapping on each side spaced at 600 mm o.c. • absorptive material filling strapping space on each side(4) • 1 layer gypsum board on each side			
	B6a	B6 with • 140 mm concrete block • 12.7 mm Type X gypsum board or 15.9 mm Type X gypsum board(5)	2 h	2 h	57
	B6b	B6 with • 140 mm concrete block • 12.7 mm regular gypsum board(5)(7)	1.5 h	1.5 h	56 e
	B6c	B6 with • 190 mm concrete block • 15.9 mm Type X gypsum board(5)	3 h	3 h	60
	B6d	B6 with • 190 mm concrete block • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	59
	B6e	B6 with • 190 mm concrete block • 12.7 regular gypsum board(5)(7)	2 h	2 h	57 e
	B7	• 190 mm concrete block • 65 mm steel studs each side spaced at 600 mm o.c. • absorptive material filling stud space on each side(4) • 1 layer gypsum board on each side			
	B7a	B7 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	71
	B7b	B7 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	70
	B7c	B7 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	69
	B8	• 190 mm concrete block • 38 mm x 64 mm wood studs on each side spaced at 600 mm o.c. • absorptive material filling stud space on each side(4) • 1 layer gypsum board on each side			
	B8a	B8 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	71
	B8b	B8 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	70
	B8c	B8 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	69

Table A-9.10.3.1.A. (Continued)

Type of Wall	Wall Number	Description	Fire-Resistance Rating(1)		Typical Sound Transmission Class(1)(2)(3)
			Loadbearing	Non-Loadbearing	
	B9	• 190 mm concrete block • 50 mm metal Z-bars on each side spaced at 600 mm o.c. (or 38 mm x 38 mm horizontal or vertical wood strapping plus resilient metal channels) • absorptive material filling Z-bar space on each side(4) • 1 layer gypsum board on each side			
	B9a	B9 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	65
	B9b	B9 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	64
	B9c	B9 with • 12.7 mm regular gypsum board(5)(7)	2 h	2 h	63
	B10	• 190 mm concrete block • resilient metal channels on one side spaced at 600 mm o.c. • absorptive material filling resilient metal channel space(4) • 2 layers gypsum board on one side only			
	B10a	B10 with • 15.9 mm Type X gypsum board(5)	3 h	3 h	56
	B10b	B10 with • 12.7 mm Type X gypsum board(5)	2.5 h	2.5 h	55
	B10c	B10 with • 12.7 mm regular gypsum board(5)	2 h	2 h	54

Notes to Table A-9.10.3.1.A.:

(1) Fire-resistance and STC ratings of wood frame construction were evaluated only for 38 mm x 89 mm constructions. The fire-resistance ratings and STC ratings provided for 38 mm x 89 mm wood frame construction, however, may be applied to 38 mm x 140 mm wood frame construction; in some cases the ratings may be conservative. Where 38 mm x 140 mm framing is used and absorptive material is called for, the absorptive material must be 140 mm thick.

(2) Sound ratings listed are based on the most reliable laboratory test data available for specimens conforming to installation details required by CSA A82.31–M, "Gypsum Board Application." Results of specific tests may differ slightly because of measurement precision and minor variations in construction details. These results should only be used where the actual construction details, including spacing of fasteners and supporting framing, correspond exactly to the details of the test specimens on which the ratings are based. Assemblies with sound transmission class ratings of 50 or more require acoustical sealant applied around electrical boxes and other openings, and at the junction of intersecting walls and floors, except intersection of walls constructed of concrete or solid brick.

(3) Sound ratings are only valid where there are no discernible cracks or voids in the visible surfaces. For concrete blocks, surfaces must be sealed by at least 2 coats of paint or other surface finish described in Section 9.29. to prevent sound leakage.

(4) Sound absorptive material includes fibre processed from rock, slag, glass or cellulose fibre. It must fill at least 90% of the cavity thickness for the wall to have the listed STC value. The absorptive material should not overfill the cavity to the point of producing significant outward pressure on the finishes; such an assembly will not achieve the STC rating. Where the absorptive material used with steel stud assemblies is in batt form, "steel stud batts," which are wide enough to fill the cavity from the web of one stud to the web of the adjacent stud, must be used.

(5) The complete descriptions of indicated finishes are as follows:
- 12.7 mm regular gypsum board – 12.7 mm regular gypsum board conforming to Article 9.29.5.2.
- 12.7 mm Type X gypsum board – 12.7 mm special fire-resistant Type X gypsum board conforming to Article 9.29.5.2.
- 15.9 mm Type X gypsum board – 15.9 mm special fire-resistant Type X gypsum board conforming to Article 9.29.5.2.
- Except for exterior walls (see Note 2), the outer layer of finish on both sides of the wall must have its joints taped and finished.
- Fastener types and spacing must conform to CSA A82.31–M, "Gypsum Board Application."

(6) Absorptive material required for the higher fire-resistance rating is mineral fibre processed from rock or slag with a mass of at least 4.8 kg/m² for 150 mm thickness, 2.8 kg/m² for 89 mm thickness and 2.0 kg/m² for 65 mm thickness and completely filling the wall cavity. For assemblies with double wood studs on separate plates, absorptive material is required in the stud cavities on both sides.

(7) Regular gypsum board used in single layer assemblies must be installed so all edges are supported.

Table A-9.10.3.1.A. (Continued)

(8) Where bracing material, such as diagonal lumber or plywood, OSB, gypsum board or fibreboard sheathing is installed on the inner face of one row of studs in double stud assemblies, the STC rating will be reduced by 3 for any assemblies containing absorptive material in both rows of studs or in the row of studs opposite to that to which the bracing material is attached. Attaching such layers on both inner faces of the studs may drastically reduce the STC value but enough data to permit assignment of STC ratings for this situation is not available. The fire-resistance rating is not affected by the inclusion of such bracing.

(9) For exterior walls, the finish joints must be taped and finished for the outer layer of the interior side only. The gypsum board on the exterior side may be replaced with gypsum sheathing of the same thickness and type (regular or Type X).

Table A-9.10.3.1.B. r4
Fire and Sound Resistance of Floors, Ceilings and Roofs

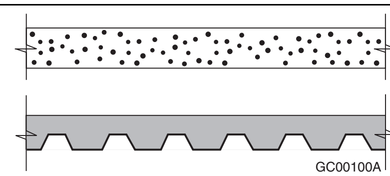
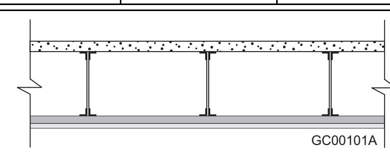
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
Floors and Ceilings					
Concrete Slabs	**F1**	• concrete floors			
	F1a	• 90 mm reinforced concrete with 20 mm minimum cover over reinforcing steel	1 h	48	23
	F1b	• 130 mm reinforced concrete with 25 mm minimum cover over reinforcing steel	2 h	52	27
	F1c	• pre-stressed hollow core slab 200 mm deep with 25 mm minimum cover over reinforcing steel	1 h	50	28
	F1d	• 150 mm composite slab on 75 mm steel deck with 152 x 152 x MW3.8 x MW3.8 wire mesh	-	51	21
	F1e	• 150 mm composite slab on 75 mm steel deck with 152 x 152 x MW3.8 x MW3.8 wire mesh • resilient metal channels 400 mm or 600 mm o.c. • 2 layers of 12.7 mm Type X gypsum board or 2 layers of 15.9 mm Type X gypsum board	1.5 h	57	36
Open Web Steel Joists	**F2**	• open web steel joists with concrete floor			
	F2a	• 50 mm thick concrete deck • on open web steel joists spaced 400 mm o.c. • furring channels spaced not more than 600 mm o.c. wired to underside of joists • 1 layer of 15.9 mm Type X gypsum board on ceiling side	45 min	53	27
	F2b	• 65 mm regular concrete minimum 155 kg/m^2 • on composite steel joists spaced 1250 mm o.c. • furring channels spaced not more than 600 mm o.c. wired to underside of joists • 1 layer of 12.7 mm or 15.9 mm Type X gypsum board on ceiling side	1.5 h	53	28

Table A-9.10.3.1.B. (Continued)

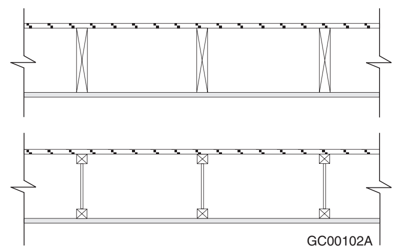
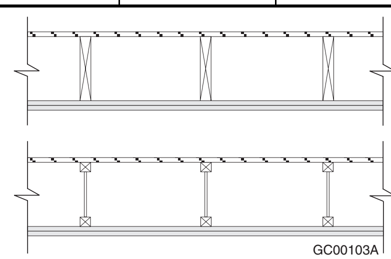
Type of Assembly	Assembly Number	Description[(1)(2)(3)]	Fire-Resistance Rating[(4)(5)(6)]	Typical Sound Transmission Class[(4)(5)(7)(8)] (STC)	Typical Impact Insulation Class[(4)(7)(9)] (IIC)
Wood Floor Joists (Wood Joists minimum 38 x 235 mm, Wood I-Joists minimum 38 x 38 mm flange 9.5 mm OSB or plywood web, minimum 241 mm deep)	**F3**	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F3a	F3 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	33	28
	F3b	F3 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	34	30
	F3c	F3 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	32	27
	F3d	F3 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	33	29
	F3e	F3 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	31	26
	F3f	F3 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	32	28
	F4	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F4a	F4 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	36	31
	F4b	F4 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	37	33
	F4c	F4 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	35	30
	F4d	F4 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	36	32

Table A-9.10.3.1.B. (Continued)

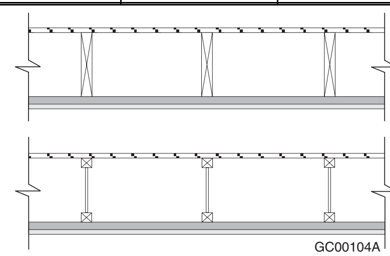
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F4e	F4 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	34	29
	F4f	F4 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	35	31
	F5	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F5a	F5 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum	-	38	31
	F5b	F5 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c • 15.9 mm Type X gypsum board	-	39	32
	F5c	F5 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](10)	41	34
	F5d	F5 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](10)	42	35
	F5e	F5 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	37	30
	F5f	F5 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	38	31
	F5g	F5 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min](10)	40	33
	F5h	F5 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min](10)	41	34

Table A-9.10.3.1.B. (Continued)

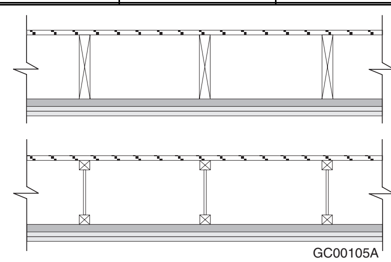
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F5i	F5 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	36	29
	F5j	F5 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	37	30
	F5k	F5 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	39	32
	F5l	F5 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	40	33
	F6	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F6a	F6 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum boad	1 h	41	34
	F6b	F6 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	42	35
	F6c	F6 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	44	37
	F6d	F6 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	45	38
	F6e	F6 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	40	33
	F6f	F6 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	41	34

Table A-9.10.3.1.B. (Continued)

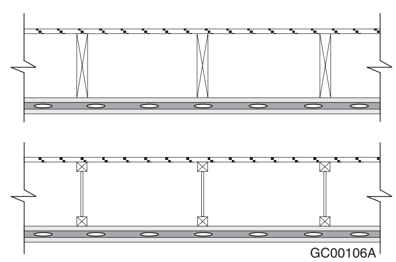
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F6g	F6 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	43	36
	F6h	F6 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	44	37
	F6i	F6 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	39	32
	F6j	F6 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	40	33
	F6k	F6 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	42	35
	F6l	F6 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	43	36
	F7	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board attached directly to joists on ceiling side • resilient metal channels spaced 400 mm or 600 mm o.c. attached to joists through gypsum board • 1 layer of gypsum board attached to resilient channel			
	F7a	F7 with • no absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	1 h	35	27
	F7b	F7 with • absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	1 h	37	30
	F7c	F7 with • no absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	1 h	35	27

Table A-9.10.3.1.B. (Continued)

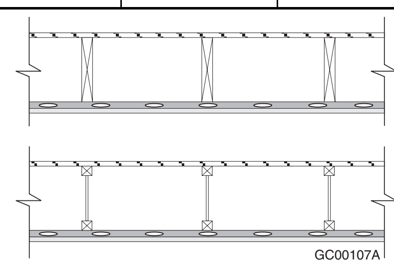
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F7d	F7 with • absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	1 h	37	30
	F7e	F7 with • no absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	32	26
	F7f	F7 with • absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	35	28
	F8	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F8a	F8 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	39	32
	F8b	F8 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F8c	F8 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](10)	48(8)	40
	F8d	F8 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](10)	49(8)	42
	F8e	F8 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	30 min	39	32
	F8f	F8 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	30 min	41	34

Table A-9.10.3.1.B. (Continued)

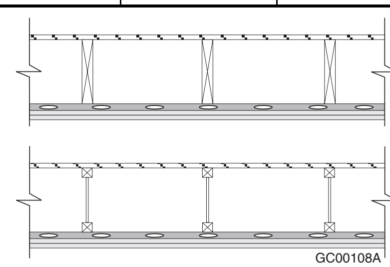
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F8g	F8 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][10]	48[8]	39
	F8h	F8 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][10]	49[8]	42
	F8i	F8 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	37	31
	F8j	F8 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	39	33
	F8k	F8 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	45	37
	F8l	F8 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	47	40
	F9	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F9a	F9 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	47	38
	F9b	F9 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	48[8]	40
	F9c	F9 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	54	47
	F9d	F9 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	55	49

Table A-9.10.3.1.B. (Continued)

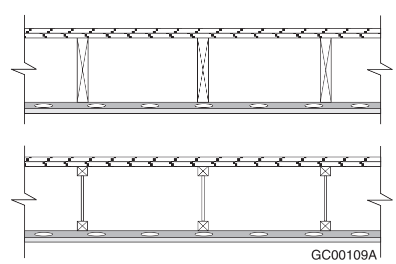
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F9e	F9 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	47	38
	F9f	F9 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	48[8]	40
	F9g	F9 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	54	47
	F9h	F9 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	55	49
	F9i	F9 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	45	36
	F9j	F9 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	46	37
	F9k	F9 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	52	45
	F9l	F9 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F10	• one subfloor layer of 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F10a	F10 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F10b	F10 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	42	35

Table A-9.10.3.1.B. (Continued)

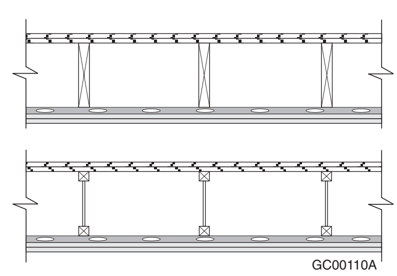
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F10c	F10 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][10][11]	50	43
	F10d	F10 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	51	44
	F10e	F10 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F10f	F10 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	42	35
	F10g	F10 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	50	43
	F10h	F10 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	51	44
	F10i	F10 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	40	32
	F10j	F10 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	41	33
	F10k	F10 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	48[8]	40
	F10l	F10 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	49[8]	41
	F11	• one subfloor layer of 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F11a	F11 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	50	41
	F11b	F11 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	51	42
	F11c	F11 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	57	50
	F11d	F11 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	58	51
	F11e	F11 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	50	41
	F11f	F11 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	51	42
	F11g	F11 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	57	50
	F11h	F11 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	58	51
	F11i	F11 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	46	39
	F11j	F11 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	47	41
	F11k	F11 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F11l	F11 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	54	47

Table A-9.10.3.1.B. (Continued)

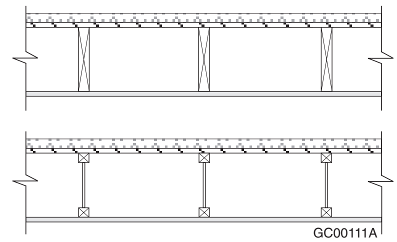
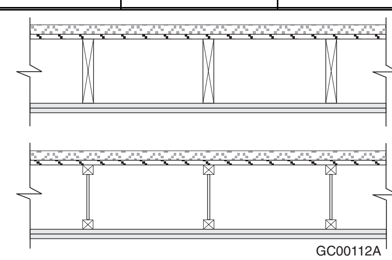
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F12	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F12a	F12 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	39	26
	F12b	F12 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	40	28
	F12c	F12 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	39	26
	F12d	F12 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	40	28
	F12e	F12 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	36	25
	F12f	F12 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	38	26
	F13	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F13a	F13 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	41	30
	F13b	F13 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	43	32
	F13c	F13 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	41	30
	F13d	F13 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	43	32

Table A-9.10.3.1.B. (Continued)

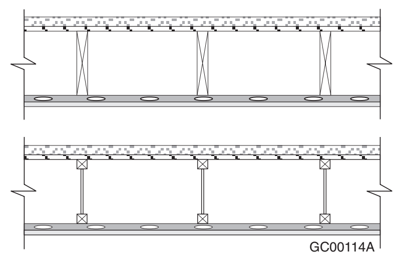
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F13e	F13 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	38	29
	F13f	F13 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	40	30
	F14	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F14a	F14 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	51	20
	F14b	F14 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	53	22
	F14c	F14 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](10)(11)	57	24
	F14d	F14 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	58	26
	F14e	F14 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	51	20
	F14f	F14 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	53	22
	F14g	F14 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	24
	F14h	F14 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	58	26

Table A-9.10.3.1.B. (Continued)

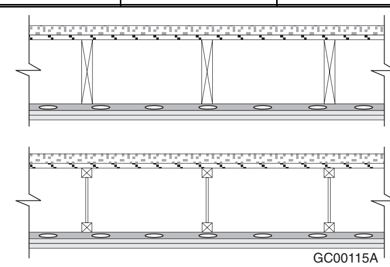
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F14i	F14 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	19
	F14j	F14 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	51	21
	F14k	F14 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	54	22
	F14l	F14 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	24
	F15	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F15a	F15 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h(11)	55	26
	F15b	F15 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	57	28
	F15c	F15 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	61	30
	F15d	F15 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	62	32
	F15e	F15 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h(11)	55	26
	F15f	F15 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	57	28

Table A-9.10.3.1.B. (Continued)

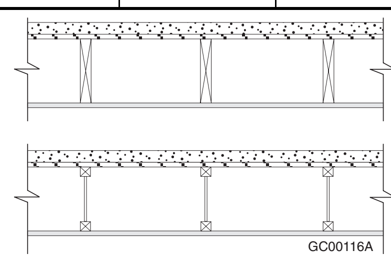
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F15g	F15 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	61	30
	F15h	F15 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	62	32
	F15i	F15 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	25
	F15j	F15 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	27
	F15k	F15 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	58	28
	F15l	F15 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	59	30
	F16	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side	 		
	F16a	F 16 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	46	25
	F16b	F16 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	48(8)	28
	F16c	F16 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	46	25
	F16d	F16 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	48(8)	28
	F16e	F16 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	42	24

Table A-9.10.3.1.B. (Continued)

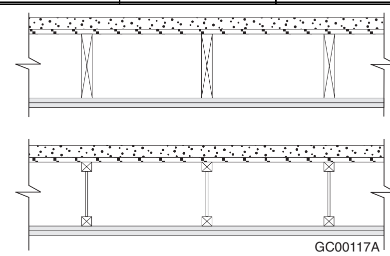
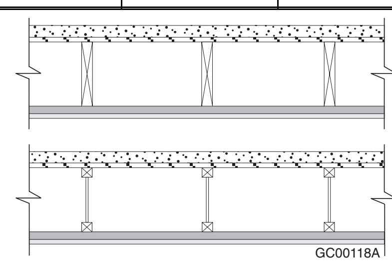
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F16f	F16 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	44	25
	F17	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F17a	F17 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	47	30
	F17b	F17 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	49(8)	32
	F17c	F17 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	47	30
	F17d	F17 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	49(8)	32
	F17e	F17 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	43	29
	F17f	F17 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	45	30
	F18	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F18a	F18 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	51	27
	F18b	F18 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	52	27

Table A-9.10.3.1.B. (Continued)

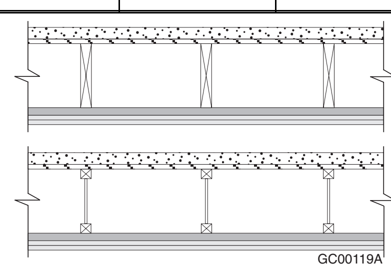
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F18c	F18 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	53	30
	F18d	F18 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	54	30
	F18e	F18 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	51	27
	F18f	F18 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	52	27
	F18g	F18 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	53	30
	F18h	F18 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	54	30
	F18i	F18 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	47	25
	F18j	F18 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	48(8)	25
	F18k	F18 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	29
	F18l	F18 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	50	29
	F19	• 38 mm concrete topping (at least 70 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F19a	F19 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	52	31
	F19b	F19 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	53	32
	F19c	F19 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	54	34
	F19d	F19 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	55	35
	F19e	F19 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	52	31
	F19f	F19 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	53	32
	F19g	F19 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	54	34
	F19h	F19 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	55	35
	F19i	F19 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	50	30
	F19j	F19 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	51	31
	F19k	F19 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	52	33
	F19l	F19 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	53	34

Table A-9.10.3.1.B. (Continued)

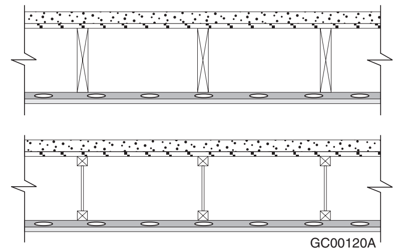
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F20	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F20a	F20 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	45 min[11]	57	28
	F20b	F20 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	59	30
	F20c	F20 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][10][11]	64	35
	F20d	F20 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F20e	F20 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	28
	F20f	F20 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	59	30
	F20g	F20 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	64	35
	F20h	F20 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38
	F20i	F20 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	55	27
	F20j	F20 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	57	29

Table A-9.10.3.1.B. (Continued)

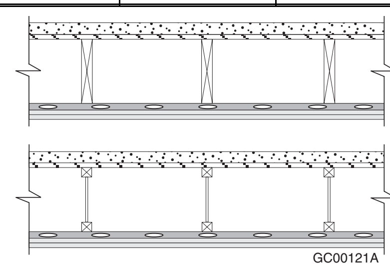
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F20k	F20 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F20l	F20 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	37
	F21	• 38 mm concrete topping (at least 70 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F21a	F21 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	64	36
	F21b	F21 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F21c	F21 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	69	44
	F21d	F21 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	70	46
	F21e	F21 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	64	36
	F21f	F21 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38
	F21g	F21 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	69	44
	F21h	F21 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	70	46

Table A-9.10.3.1.B. (Continued)

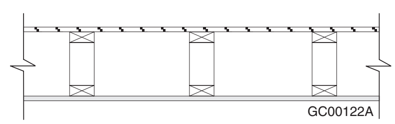
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F21i	F21 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F21j	F21 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	35
	F21k	F21 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	67	42
	F21l	F21 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	68	43
Wood Floor Trusses (wood framing members not less than 38 mm x 89 mm with metal connector plates not less than 1 mm thick with teeth not less than 8 mm in length – minimum 235 mm depth)	**F22**	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer gypsum board on ceiling side			
	F22a	F22 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	33	28
	F22b	F22 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	34	30
	F22c	F22 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	32	27
	F22d	F22 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	33	29
	F22e	F22 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	31	26
	F22f	F22 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	32	28

Table A-9.10.3.1.B. (Continued)

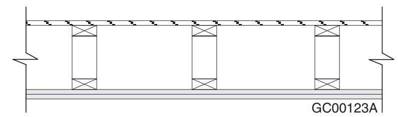
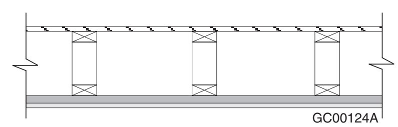
Type of Assembly	Assembly Number	Description[(1)(2)(3)]	Fire-Resistance Rating[(4)(5)(6)]	Typical Sound Transmission Class[(4)(5)(7)(8)] (STC)	Typical Impact Insulation Class[(4)(7)(9)] (IIC)
	F23	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F23a	F23 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	36	31
	F23b	F23 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	37	33
	F23c	F23 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	35	30
	F23d	F23 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	36	32
	F23e	F23 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	34	29
	F23f	F23 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	35	31
	F24	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F24a	F24 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	38	31
	F24b	F24 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	39	32
	F24c	F24 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F24d	F24 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	42	35

Table A-9.10.3.1.B. (Continued)

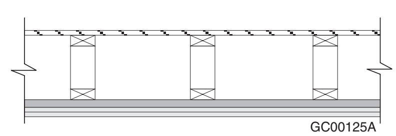
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F24e	F24 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	37	30
	F24f	F24 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	38	31
	F24g	F24 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	40	33
	F24h	F24 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F24i	F24 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	36	29
	F24j	F24 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	37	30
	F24k	F24 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	39	32
	F24l	F24 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	40	33
	F25	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F25a	F25 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F25b	F25 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	42	35

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F25c	F25 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	44	37
	F25d	F25 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	45	38
	F25e	F25 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	40	33
	F25f	F25 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F25g	F25 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	43	36
	F25h	F25 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	44	37
	F25i	F25 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	39	32
	F25j	F25 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	40	33
	F25k	F25 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	42	35
	F25l	F25 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	43	36

Table A-9.10.3.1.B. (Continued)

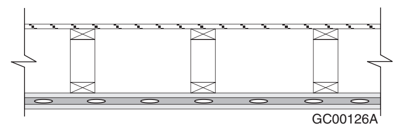
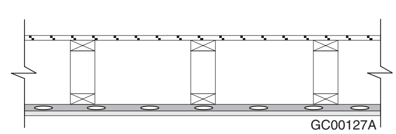
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F26	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board attached directly to trusses on ceiling side • resilient metal channels spaced 400 mm or 600 mm o.c. attached to trusses through the gypsum board • 1 layer of gypsum board attached to resilient channel			
	F26a	F26 with • no absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	-	35	27
	F26b	F26 with • absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	-	37	30
	F26c	F26 with • no absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	-	35	27
	F26d	F26 with • absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	-	37	30
	F26e	F26 with • no absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	32	26
	F26f	F26 with • absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	35	28
	F27	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F27a	F27 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	39	32
	F27b	F27 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F27c	F27 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][12]	48[8]	39
	F27d	F27 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	49[8]	42
	F27e	F27 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	40	34
	F27f	F27 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F27g	F27 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	48[8]	39
	F27h	F27 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	49[8]	42
	F27i	F27 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	37	31
	F27j	F27 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	39	33
	F27k	F27 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	45	37
	F27l	F27 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	47	40

Table A-9.10.3.1.B. (Continued)

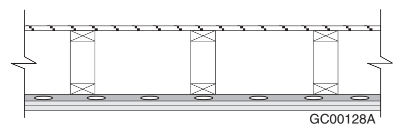
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F28	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F28a	F28 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	47	38
	F28b	F28 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	48[8]	40
	F28c	F28 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	54	47
	F28d	F28 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	55	49
	F28e	F28 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	47	38
	F28f	F28 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	48[8]	40
	F28g	F28 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	54	47
	F28h	F28 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	55	49
	F28i	F28 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	45	36
	F28j	F28 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	46	37

Table A-9.10.3.1.B. (Continued)

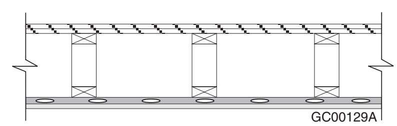
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F28k	F28 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	52	45
	F28l	F28 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F29	• one subfloor layer 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F29a	F29 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	42	34
	F29b	F29 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	43	35
	F29c	F29 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][12]	50	43
	F29d	F29 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	51	44
	F29e	F29 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	42	34
	F29f	F29 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	43	35
	F29g	F29 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	50	43

Table A-9.10.3.1.B. (Continued)

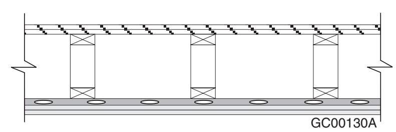
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F29h	F29 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	51	44
	F29i	F29 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	40	32
	F29j	F29 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	41	33
	F29k	F29 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	48(8)	40
	F29l	F29 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	41
	F30	• one subfloor layer 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F30a	F30 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	49(8)	40
	F30b	F30 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	50	43
	F30c	F30 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	57	50
	F30d	F30 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	58	51

Table A-9.10.3.1.B. (Continued)

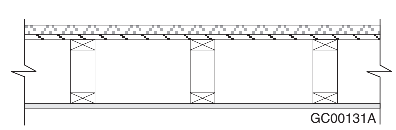
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F30e	F30 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	50	41
	F30f	F30 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	50	41
	F30g	F30 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	50
	F30h	F30 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	58	51
	F30i	F30 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	46	39
	F30j	F30 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	47	41
	F30k	F30 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F30l	F30 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	54	47
	F31	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F31a	F31 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	39	26
	F31b	F31 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	40	28
	F31c	F31 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	39	26

Table A-9.10.3.1.B. (Continued)

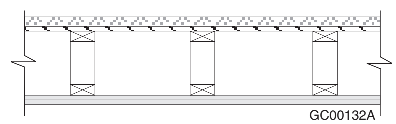
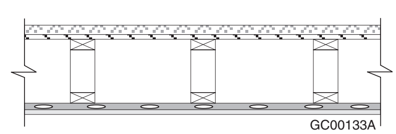
Type of Assembly	Assembly Number	Description[(1)(2)(3)]	Fire-Resistance Rating[(4)(5)(6)]	Typical Sound Transmission Class[(4)(5)(7)(8)] (STC)	Typical Impact Insulation Class[(4)(7)(9)] (IIC)
	F31d	F31 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	40	28
	F31e	F31 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	36	25
	F31f	F31 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	38	26
	F32	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F32a	F32 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	41	30
	F32b	F32 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	43	32
	F32c	F32 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	41	30
	F32d	F32 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	43	32
	F32e	F32 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	38	29
	F32f	F32 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	40	30
	F33	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F33a	F33 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	51	20

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F33b	F33 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	53	22
	F33c	F33 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](12)	57	24
	F33d	F33 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	58	26
	F33e	F33 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	51	20
	F33f	F33 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	53	22
	F33g	F33 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	24
	F33h	F33 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	58	26
	F33i	F33 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	19
	F33j	F33 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	51	21
	F33k	F33 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	54	22
	F33l	F33 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	24

Table A-9.10.3.1.B. (Continued)

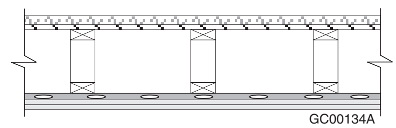
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F34	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F34a	F34 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	55	26
	F34b	F34 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	57	28
	F34c	F34 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	61	30
	F34d	F34 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	62	32
	F34e	F34 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	45 min	55	26
	F34f	F34 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	57	28
	F34g	F34 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	61	30
	F34h	F34 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	62	32
	F34i	F34 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	25
	F34j	F34 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	27

Table A-9.10.3.1.B. (Continued)

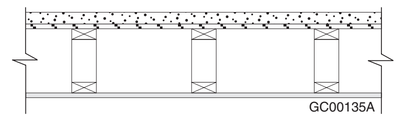
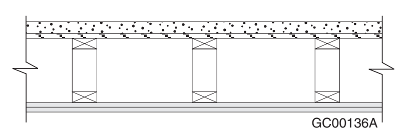
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F34k	F34 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	58	28
	F34l	F34 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	59	30
	F35	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F35a	F35 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	46	25
	F35b	F35 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	48[8]	28
	F35c	F35 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	46	25
	F35d	F35 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	48[8]	28
	F35e	F35 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	42	24
	F35f	F35 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	44	25
	F36	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F36a	F36 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	47	30
	F36b	F36 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	49[8]	32
	F36c	F36 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	47	30

Table A-9.10.3.1.B. (Continued)

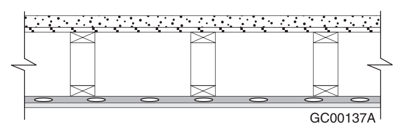
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F36d	F36 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	49(8)	32
	F36e	F36 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	43	29
	F36f	F36 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	45	30
	F37	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F37a	F37 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	45 min	57	28
	F37b	F37 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	59	30
	F37c	F37 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](12)	64	35
	F37d	F37 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F37e	F37 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	28
	F37f	F37 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	59	30
	F37g	F37 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	64	35
	F37h	F37 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38

Table A-9.10.3.1.B. (Continued)

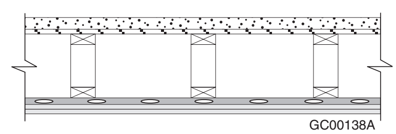
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F37i	F37 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	55	27
	F37j	F37 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	57	29
	F37k	F37 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F37l	F37 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	37
	F38	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on wood trusses spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F38a	F38 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	64	36
	F38b	F38 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F38c	F38 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	69	44
	F38d	F38 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	70	46
	F38e	F38 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	45 min	64	36
	F38f	F38 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38

Table A-9.10.3.1.B. (Continued)

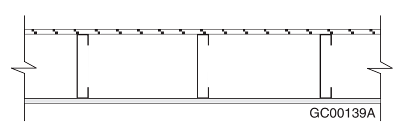
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F38g	F38 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	69	44
	F38h	F38 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	70	46
	F38i	F38 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F38j	F38 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	35
	F38k	F38 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	67	42
	F38l	F38 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	68	43
Cold Formed Steel Floor Joists (minimum 41 mm x 203 mm x 1.22 mm)	**F39**	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F39a	F39 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	33	28
	F39b	F39 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	34	30
	F39c	F39 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	32	27
	F39d	F39 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	33	29
	F39e	F39 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	31	26
	F39f	F39 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	32	28

Table A-9.10.3.1.B. (Continued)

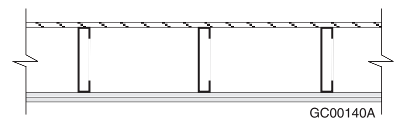
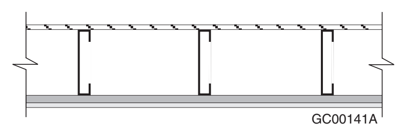
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F40	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F40a	F40 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	36	31
	F40b	F40 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	37	33
	F40c	F40 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	35	30
	F40d	F40 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	36	32
	F40e	F40 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	34	29
	F40f	F40 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	35	31
	F41	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F41a	F41 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	38	31
	F41b	F41 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	39	32
	F41c	F41 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](12)	41	34
	F41d	F41 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min](12)	42	35

Table A-9.10.3.1.B. (Continued)

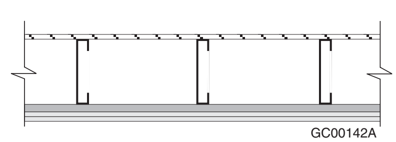
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F41e	F41 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	37	30
	F41f	F41 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	38	31
	F41g	F41 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][12]	40	33
	F41h	F41 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][12]	41	34
	F41i	F41 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	36	29
	F41j	F41 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	37	30
	F41k	F41 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	39	32
	F41l	F41 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	40	33
	F42	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • metal furring channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F42a	F42 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	41	34
	F42b	F42 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	42	35

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F42c	F42 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	44	37
	F42d	F42 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	45	38
	F42e	F42 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	40	33
	F42f	F42 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	41	34
	F42g	F42 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	43	36
	F42h	F42 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	44	37
	F42i	F42 with • no absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	39	32
	F42j	F42 with • no absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	40	33
	F42k	F42 with • absorptive material in cavity • metal furring channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	42	35
	F42l	F42 with • absorptive material in cavity • metal furring channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	43	36

Table A-9.10.3.1.B. (Continued)

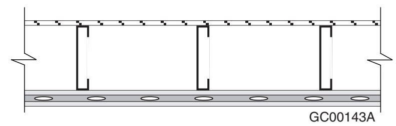
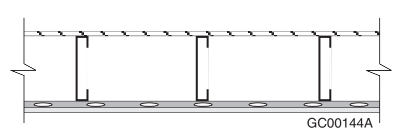
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F43	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board attached directly to joists on ceiling side • resilient metal channels spaced 400 mm or 600 mm o.c. attached to joists through the gypsum board • 1 layer of gypsum board attached to resilient channels			
	F43a	F43 with • no absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	1 h	35	27
	F43b	F43 with • absorptive material in cavity • 15.9 mm Type X gypsum board • resilient metal channels • 15.9 mm Type X gypsum board	1 h	37	30
	F43c	F43 with • no absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	1 h	35	27
	F43d	F43 with • absorptive material in cavity • 12.7 mm Type X gypsum board • resilient metal channels • 12.7 mm Type X gypsum board	1 h	37	30
	F43e	F43 with • no absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	32	26
	F43f	F43 with • absorptive material in cavity • 12.7 mm regular gypsum board • resilient metal channels • 12.7 mm regular gypsum board	-	35	28
	F44	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F44a	F44 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	39	32
	F44b	F44 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F44c	F44 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][12]	48[8]	40
	F44d	F44 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	30 min [45 min][12]	49[8]	42
	F44e	F44 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	39	32
	F44f	F44 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F44g	F44 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][12]	48[8]	39
	F44h	F44 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	30 min [45 min][12]	49[8]	42
	F44i	F44 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	37	31
	F44j	F44 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	39	33
	F44k	F44 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	< 30 min	45	37
	F44l	F44 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	< 30 min	47	40

Table A-9.10.3.1.B. (Continued)

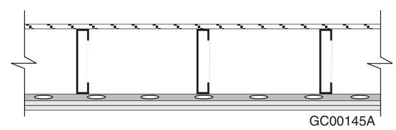
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F45	• subfloor of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F45a	F45 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	47	38
	F45b	F45 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	48(8)	40
	F45c	F45 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	54	47
	F45d	F45 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	55	49
	F45e	F45 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	47	38
	F45f	F45 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	48(8)	40
	F45g	F45 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	54	47
	F45h	F45 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	55	49
	F45i	F45 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	45	36
	F45j	F45 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	46	37

Table A-9.10.3.1.B. (Continued)

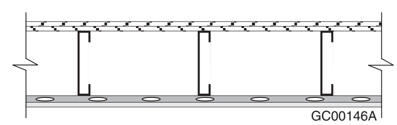
Type of Assembly	Assembly Number	Description[1][2][3]	Fire-Resistance Rating[4][5][6]	Typical Sound Transmission Class[4][5][7][8] (STC)	Typical Impact Insulation Class[4][7][9] (IIC)
	F45k	F45 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	52	45
	F45l	F45 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F46	• one subfloor layer of 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F46a	F46 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	41	34
	F46b	F46 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	42	35
	F46c	F46 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	50	43
	F46d	F46 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	51	44
	F46e	F46 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	41	34
	F46f	F46 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	42	35
	F46g	F46 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	50	43
	F46h	F46 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	51	44

Table A-9.10.3.1.B. (Continued)

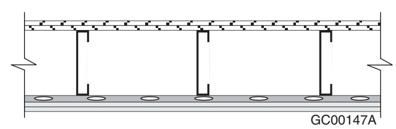
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F46i	F46 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	40	32
	F46j	F46 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	41	33
	F46k	F46 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	48(8)	40
	F46l	F46 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	41
	F47	• one subfloor layer of 11 mm sanded plywood, or OSB or waferboard • one subfloor layer of 15.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side	 GC00147A		
	F47a	F47 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	50	41
	F47b	F47 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	51	42
	F47c	F47 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	57	50
	F47d	F47 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	58	51
	F47e	F47 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	50	41
	F47f	F47 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	51	42

Table A-9.10.3.1.B. (Continued)

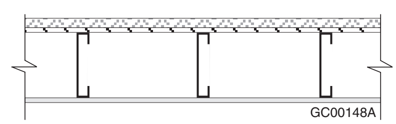
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F47g	F47 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	57	50
	F47h	F47 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	58	51
	F47i	F47 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	46	39
	F47j	F47 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	47	41
	F47k	F47 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	46
	F47l	F47 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	54	47
	F48	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 1 layer of gypsum board on ceiling side			
	F48a	F48 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	39	26
	F48b	F48 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	40	28
	F48c	F48 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	39	26
	F48d	F48 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	40	28
	F48e	F48 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	36	25
	F48f	F48 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	38	26

Table A-9.10.3.1.B. (Continued)

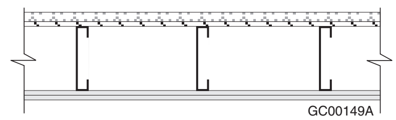
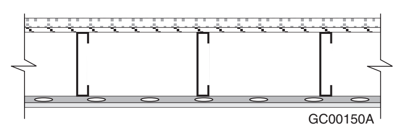
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F49	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • 2 layers of gypsum board on ceiling side			
	F49a	F49 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	41	30
	F49b	F49 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	43	32
	F49c	F49 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	41	30
	F49d	F49 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	43	32
	F49e	F49 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	38	29
	F49f	F49 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	40	30
	F50	• 25 mm gypsum-concrete topping (at least 44 kg/m²) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F50a	F50 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	51	20
	F50b	F50 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	53	22
	F50c	F50 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	57	24
	F50d	F50 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	58	26

Table A-9.10.3.1.B. (Continued)

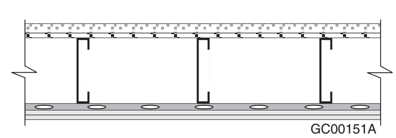
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F50e	F50 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	51	20
	F50f	F50 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	53	22
	F50g	F50 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	24
	F50h	F50 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	58	26
	F50i	F50 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	49(8)	19
	F50j	F50 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	51	21
	F50k	F50 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	54	22
	F50l	F50 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	24
	F51	• 25 mm gypsum-concrete topping (at least 44 kg/m^2) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F51a	F51 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	55	26
	F51b	F51 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	57	28

Table A-9.10.3.1.B. (Continued)

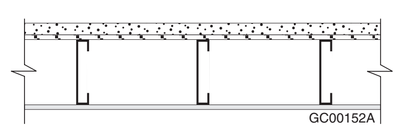
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F51c	F51 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	61	30
	F51d	F51 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	45 min [1 h](12)	62	32
	F51e	F51 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	55	26
	F51f	F51 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	57	28
	F51g	F51 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	61	30
	F51h	F51 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	45 min [1 h](12)	62	32
	F51i	F51 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	53	25
	F51j	F51 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	55	27
	F51k	F51 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	58	28
	F51l	F51 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	59	30
	F52	• 38 mm concrete topping (at least 70 kg/m^2) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F52a	F52 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	46	25

Table A-9.10.3.1.B. (Continued)

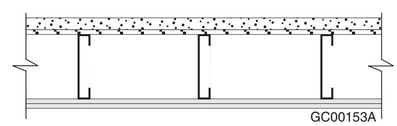
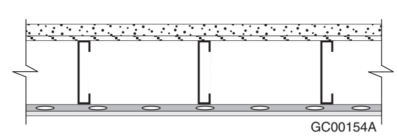
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F52b	F52 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	48(8)	28
	F52c	F52 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	46	25
	F52d	F52 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	48(8)	28
	F52e	F52 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	42	24
	F52f	F52 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	44	25
	F53	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F53a	F53 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	47	30
	F53b	F53 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	49(8)	32
	F53c	F53 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	47	30
	F53d	F53 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	49(8)	32
	F53e	F53 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	43	29
	F53f	F53 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	45	30
	F54	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side			

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F54a	F54 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	57	28
	F54b	F54 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	59	30
	F54c	F54 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	64	35
	F54d	F54 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F54e	F54 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	28
	F54f	F54 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	59	30
	F54g	F54 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	64	35
	F54h	F54 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38
	F54i	F54 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	55	27
	F54j	F54 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	57	29
	F54k	F54 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F54l	F54 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	37

Table A-9.10.3.1.B. (Continued)

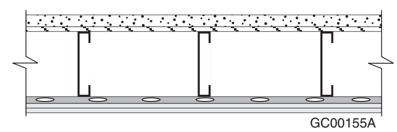
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F55	• 38 mm concrete topping (at least 70 kg/m²) • subfloor of 12.5 mm plywood, OSB or waferboard, or 17 mm tongue and groove lumber • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F55a	F55 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	64	36
	F55b	F55 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	65	38
	F55c	F55 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	69	44
	F55d	F55 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	45 min [1 h](12)	70	46
	F55e	F55 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	64	36
	F55f	F55 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	65	38
	F55g	F55 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	69	44
	F55h	F55 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	45 min [1 h](12)	70	46
	F55i	F55 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F55j	F55 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	35

Table A-9.10.3.1.B. (Continued)

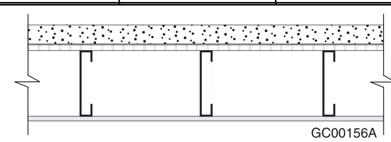
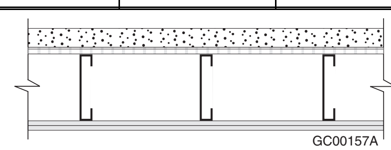
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F55k	F55 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	67	42
	F55l	F55 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	68	43
	F56	• 50 mm concrete • 0.46 mm metal pan with a 19 mm rib • on steel joists spaced not more than 600 mm o.c. • 1 layer of gypsum board on ceiling side			
	F56a	F56 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	46	25
	F56b	F56 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	48(8)	28
	F56c	F56 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	46	25
	F56d	F56 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	48(8)	28
	F56e	F56 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	42	24
	F56f	F56 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	44	25
	F57	• 50 mm concrete • 0.46 mm metal pan with a 19 mm rib • on steel joists spaced not more than 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F57a	F57 with • no absorptive material in cavity • 15.9 mm Type X gypsum board	-	47	30
	F57b	F57 with • absorptive material in cavity • 15.9 mm Type X gypsum board	-	49(8)	32
	F57c	F57 with • no absorptive material in cavity • 12.7 mm Type X gypsum board	-	47	30
	F57d	F57 with • absorptive material in cavity • 12.7 mm Type X gypsum board	-	49(8)	32

Table A-9.10.3.1.B. (Continued)

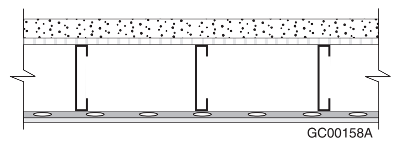
Type of Assembly	Assembly Number	Description[(1)(2)(3)]	Fire-Resistance Rating[(4)(5)(6)]	Typical Sound Transmission Class[(4)(5)(7)(8)] (STC)	Typical Impact Insulation Class[(4)(7)(9)] (IIC)
	F57e	F57 with • no absorptive material in cavity • 12.7 mm regular gypsum board	-	43	29
	F57f	F57 with • absorptive material in cavity • 12.7 mm regular gypsum board	-	45	30
	F58	• 50 mm concrete • 0.46 mm metal pan with a 19 mm rib • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 1 layer of gypsum board on ceiling side	 GC00158A		
	F58a	F58 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	57	28
	F58b	F58 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	59	30
	F58c	F58 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	-	64	35
	F58d	F58 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	-	65	38
	F58e	F58 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	57	28
	F58f	F58 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	59	30
	F58g	F58 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	-	64	35
	F58h	F58 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	-	65	38
	F58i	F58 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	55	27

Table A-9.10.3.1.B. (Continued)

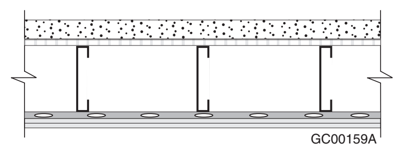
Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F58j	F58 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	57	29
	F58k	F58 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F58l	F58 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	37
	F59	• 50 mm concrete • 0.46 mm metal pan with a 19 mm rib • on steel joists spaced not more than 600 mm o.c. • with or without absorptive material in cavity • resilient metal channels spaced 400 mm or 600 mm o.c. • 2 layers of gypsum board on ceiling side			
	F59a	F59 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	64	36
	F59b	F59 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	1 h	65	38
	F59c	F59 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 15.9 mm Type X gypsum board	1 h	69	44
	F59d	F59 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 15.9 mm Type X gypsum board	45 min [1 h](12)	70	46
	F59e	F59 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1h	64	36
	F59f	F59 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	1 h	65	38
	F59g	F59 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm Type X gypsum board	1 h	69	44

Table A-9.10.3.1.B. (Continued)

Type of Assembly	Assembly Number	Description(1)(2)(3)	Fire-Resistance Rating(4)(5)(6)	Typical Sound Transmission Class(4)(5)(7)(8) (STC)	Typical Impact Insulation Class(4)(7)(9) (IIC)
	F59h	F59 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm Type X gypsum board	45 min [1 h](12)	70	46
	F59i	F59 with • no absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	62	34
	F59j	F59 with • no absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	63	35
	F59k	F59 with • absorptive material in cavity • resilient metal channels spaced 400 mm o.c. • 12.7 mm regular gypsum board	-	67	42
	F59l	F59 with • absorptive material in cavity • resilient metal channels spaced 600 mm o.c. • 12.7 mm regular gypsum board	-	68	43
Roofs					
Wood Roof Trusses	R1	• wood trusses spaced not more than 600 mm o.c. • 1 layer 15.9 mm Type X gypsum board	45 min	-	-
Rating Provided by Membrane Only					
	M1	• supporting members spaced not more than 600 mm o.c. • 1 layer 15.9 mm Type X gypsum board	30 min	-	-
	M2	• supporting members spaced not more than 600 mm o.c. • 2 layers 15.9 mm Type X gypsum board	1 h	-	-

Notes to Table A-9.10.3.1.B.:

(1) For systems with a ceiling of a single layer of gypsum board on resilient channels, the resilient channel arrangement at the gypsum board butt end joints is to be as shown in Figure A-9.10.3.1.B.(a).

(2) For systems with a ceiling of 2 layers of gypsum board on resilient channels, the fastener and resilient channel arrangement at the gypsum board butt end joints are to be as shown in Figure A-9.10.3.1.B.(b).

(3) STC values given are for the minimum thickness of subfloor as shown. Minimum subfloor thickness required is determined by joist or truss spacing - see Table 9.23.14.5.A. Thicker subflooring is also acceptable.

(4) Sound absorptive material includes fibre processed from rock, slag, or glass, or cellulose fibre either loose-fill or spray-applied. To obtain the listed STC rating, the nominal insulation thickness is 150 mm for rock, slag, or glass fibres or loose-fill cellulose fibre, and 90 mm for spray-applied cellulose fibre. Absorptive material will affect the STC by approximately adding or subtracting 1 per 50 mm change of thickness.

(5) The fire and sound ratings are based on the spacing of ceiling supports as noted. A narrower spacing will be detrimental to the sound rating but not to the fire rating.

(6) Type and spacing of fasteners shall be in accordance with Subsection 9.29.5. or CSA A82.31-M:
   (i) fastener distance to board edges and butt ends shall be no less than 38 mm, except for fasteners on the butt ends of the base layer in ceilings with two layers (see Figure A-9.10.3.1.B.(b)); and
   (ii) fasteners shall not be spaced more than 300 mm o.c.

Table A-9.10.3.1.B. (Continued)

(7) STC values given are for depth of framing member noted. For shallower members, subtract 1 from the STC for each 50 mm reduction in framing depth. For framing members deeper than noted, add 1 to the STC for each 50 mm increase in framing depth.
(8) STC values given reflect results for joist spacing of at least 400 mm o.c. unless otherwise specified. For joist spacing of at least 600 mm o.c., add 2 to the STC values given in the Table.
(9) IIC values given are for floors tested with no finished flooring.
(10) The fire rating value within square brackets is achieved only where absorptive material includes:
  (i) fibre processed from rock or slag with a thickness of 90 mm and 2.8 kg/m^2; or
  (ii) cellulose fibre spray-applied with a minimum depth of 90 mm on the underside of the deck and 90 mm on the sides of the floor joists, and a minimum density of 50 kg/m^3.
(11) The fire-resistance rating values given only apply to systems with solid wood joists spaced not more than 400 mm o.c. No information is available on wood I-joists for these cases.
(12) The fire rating value within square brackets is achieved only where absorptive material includes fibre processed from rock or slag with a thickness of 90 mm and 2.8 kg/m^2.

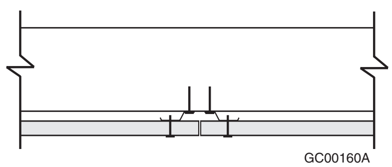


Figure A-9.10.3.1.B.(a)
Single Layer Butt Joint Details

Notes to Figure A-9.10.3.1.B.(a):

(1) Figure is for illustration purposes only and is not to scale.
(2) The structural member can be any one of the types described in the Table.
(3) Adjacent gypsum board butt ends are to be attached to separate resilient channels using regular Type S screws, located a minimum of 38 mm from the butt end.

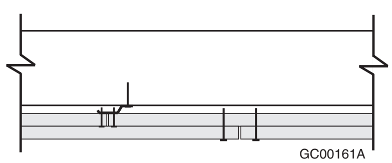


Figure A-9.10.3.1.B.(b)
Double Layer Butt Joint Details

Notes to Figure A-9.10.3.1.B.(b):

(1) Figure is for illustration purposes only and is not to scale.
(2) The structural member can be any one of the types described in the Table.
(3) Base layer butt ends can be attached to a single resilient channel using regular Type S screws.
(4) Type G screws measuring a minimum of 32 mm in length and located a minimum of 38 mm from the butt end are to be used to fasten the butt ends of the face layer to the base layer.

A-9.10.9.6.(1) Penetration of Fire-Rated Assemblies by Service Equipment. This Sentence, together with Article 3.1.9.1., is intended to ensure that the integrity of fire-rated assemblies is maintained where they are penetrated by various types of service equipment.

For buildings regulated by the requirements in Part 3, fire stop materials used to seal openings around building services, such as pipes, ducts and electrical outlet boxes, must meet a minimum level of performance demonstrated by standard test criteria.

This is different from the approach in Part 9. Because of the type of construction normally used for buildings regulated by the requirements in Part 9, it is assumed that this requirement is satisfied by the use of generic fire stop materials such as mineral wool, gypsum plaster or Portland cement mortar.

A-9.10.9.16.(4) r3 Separation between Dwelling Units and Storage or Repair Garages. The gas-tight barrier between a dwelling unit and an attached garage is intended to provide protection from carbon monoxide and gasoline fumes entering the dwelling unit. Building assemblies incorporating an air barrier system will perform adequately with respect to gas tightness, provided all joints in the airtight material are sealed and reasonable care is exercised where the wall or ceiling is pierced by building services. Where a garage is open to the adjacent attic space above the dwelling unit it serves, a gas-tight barrier in the ceiling of the dwelling unit will also provide protection. Unit masonry walls forming the separation between a dwelling unit and an adjacent garage should be provided with two coats of sealer or plaster, or covered with gypsum wallboard on the side of the wall exposed to the garage. All joints must be sealed to ensure continuity of the barrier. (See also Sentences 9.25.3.3.(3) to (8).)

A-9.10.12.5.(1) Protection of Overhang of Common Roof Space.

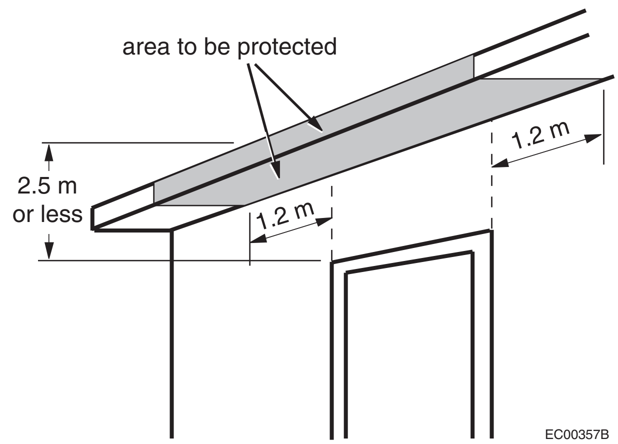
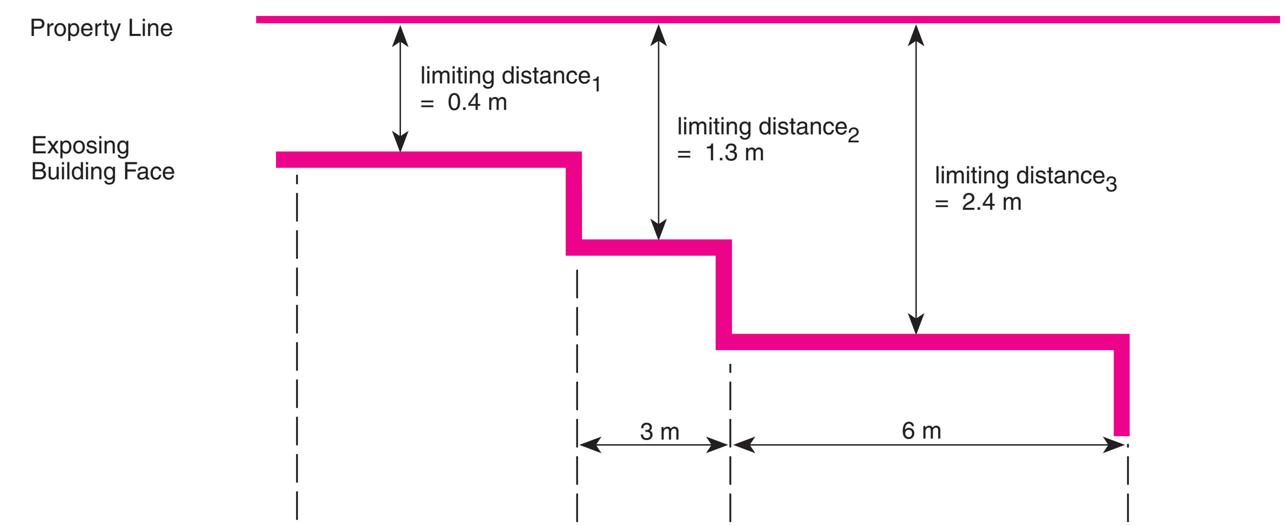


Figure A-9.10.12.5.
Protection of overhang of common roof space

A-9.10.13.2.(1) Wood Doors in Fire Separations. CAN4-S113 provides construction details to enable manufacturers to build wood core doors that will provide a 20 min fire-protection rating without the need for testing. The standard requires each door to be marked with

(1) the manufacturer's or vendor's name or identifying symbol,
(2) the words "Fire Door," and
(3) a reference to the fire-protection rating of 20 min.

A-9.10.14.12.(1) Staggered or Skewed Exposing Building Faces of Houses. Studies at the National Fire Laboratory of the National Research Council have shown that, where an exposing building face is stepped back from the property line or is at an angle to the property line, it is possible to increase the percentage of glazing in those portions of the exposing building face further from the property line without increasing the amount of radiated energy that would reach the property line in the event of a fire in such a building. The following illustrations show how Sentence 9.10.14.12.(1) could be applied to exposing building faces that are stepped back from or not parallel to the property line.

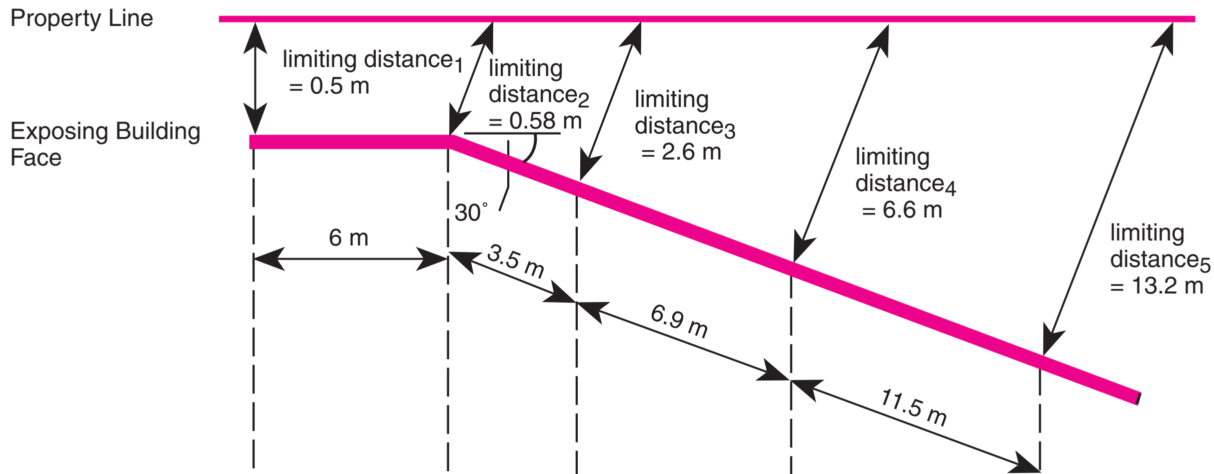


45 min. fire-resistance rating	required	not required	not required
Noncombustible cladding	required	not required	not required
Permitted % of glazed openings	0%	7%	12%
Permitted area of glazed openings	0	3 x 2.4 x 0.07 = 0.5 m^2	6 x 2.4 x 0.12 = 1.7 m^2

EC00417A

Figure A-9.10.14.12.A.
Example of determination of criteria for the exposing building face of a staggered wall

A-9.10.14.12.(1)



45 min fire-resistance rating	required	required	not required	not required	not required
Noncombustible cladding	required	required	not required	not required	not required
Permitted % of glazed openings	0%	0%	12%	88%	100%
Permitted area of glazed openings	0	0	6.9 x 2.4 x 0.12 = 2.0 m^2	11.5 x 2.4 x 0.88 = 24.3 m^2	

EC00378A

Figure A-9.10.14.12.B.
Example of determination of criteria for the exposing building face of a skewed wall with one arbitrary division of the wall

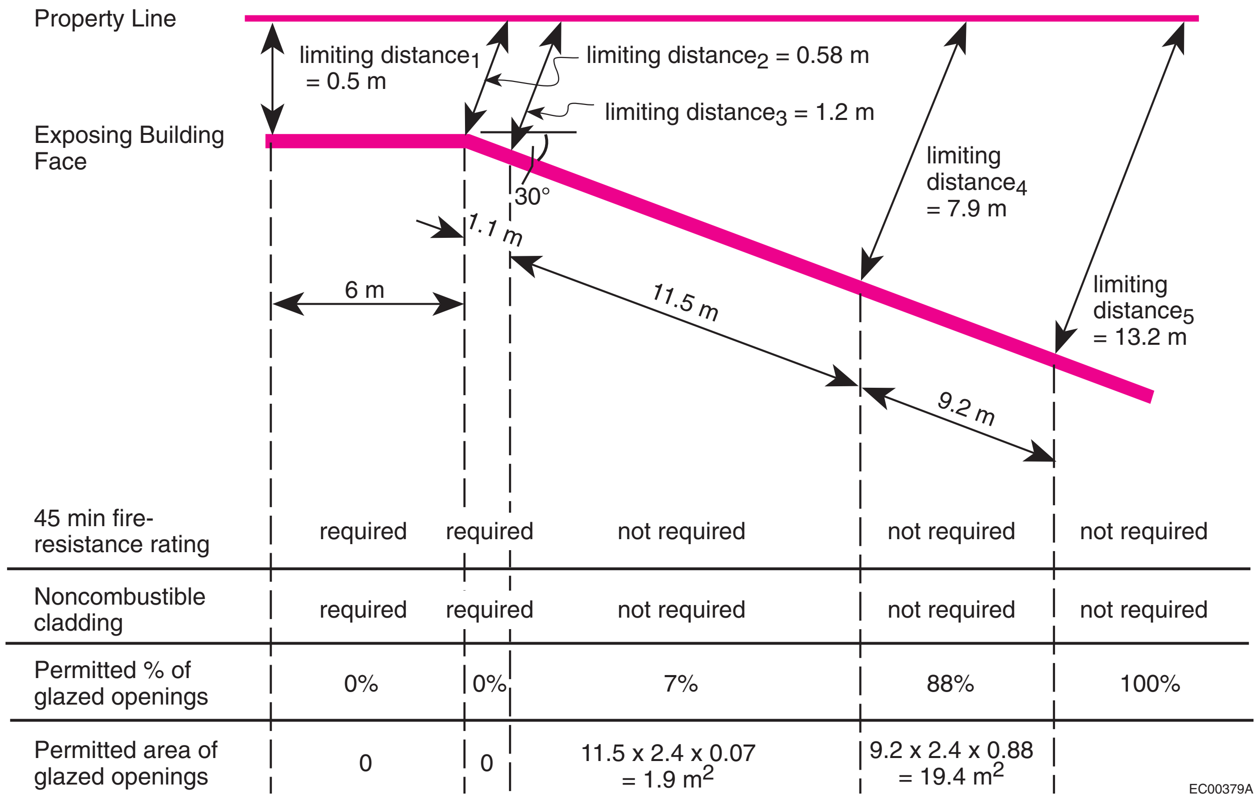


Figure A-9.10.14.12.C.
Example of determination of criteria for the exposing building face of a skewed wall with a different arbitrary division of the wall

A-9.10.18.2.(1) Location of Smoke Alarms. There are two important points to bear in mind when considering where to locate smoke alarms in dwelling units:

- The most frequent point of origin for fires in dwelling units is the living area.
- The main concern in locating smoke alarms is to provide warning to people asleep in bedrooms.

Thus a smoke alarm located in the living area and wired so as to sound another smoke alarm located near the bedrooms is the ideal solution. However, it is difficult to define exactly what is meant by "living area." It is felt to be too stringent to require a smoke alarm in every part of a dwelling unit that could conceivably be considered a "living area" (living room, family room, study, etc.). Sentence 9.10.18.2.(1) therefore addresses these issues by requiring at least one smoke alarm on every storey and setting a maximum distance that any point on a floor level can be from a smoke alarm. Thus, in a dwelling unit complying with Sentence 9.10.18.2.(1), every living area will probably be located within a reasonable distance of a smoke alarm. Nevertheless, where a choice arises as to where on a storey to locate the required smoke alarm or alarms, one should be located as close as possible to a living area, provided the requirement for proximity to bedrooms is also satisfied.

Regarding location of smoke alarms in bedroom areas, generally the most economical choice will be to locate one alarm in a hallway serving several bedrooms. However, in a small dwelling where the bedrooms may be close to cooking areas, placing one alarm inside each bedroom may be a better choice as it makes them less prone to false alarms.

A-9.10.19.3.(1) Fire Department Access Route Modification. In addition to other considerations taken into account in the planning of fire department access routes, special variations could be permitted for a house or residential building that is protected with an automatic sprinkler system. The sprinkler system must be designed in accordance with the appropriate NFPA standard and there must be assurance that water supply pressure and quantity are unlikely to fail. These considerations could apply to buildings that are located on the sides of hills and are not conveniently accessible by roads designed for fire fighting equipment and also to infill housing units that are located behind other buildings on a given property.

A-9.10.21. Clearances from Gas and Electric Ranges. CSA C22.1, "Canadian Electrical Code, Part 1," referenced in Article 9.34.1.1., and CSA B149.1, "Natural Gas and Propane Installation Code," referenced in Article 9.10.21.1., address clearances directly above, in front of, behind and beside the appliance. Where side clearances are zero, the standards do not address clearances to building elements located both above the level of the range elements or burners and to the side of the appliance. Through reference to the Canadian Electrical Code and the Natural Gas Installation Code and the requirements in Articles 9.10.21.2. and 9.10.21.3., the NBC addresses all clearances. Where clearances are addressed by the NBC and the Canadian Electrical Code or Natural Gas Installation Code, conformance with all relevant criteria is achieved by compliance with the most stringent criteria. r r4

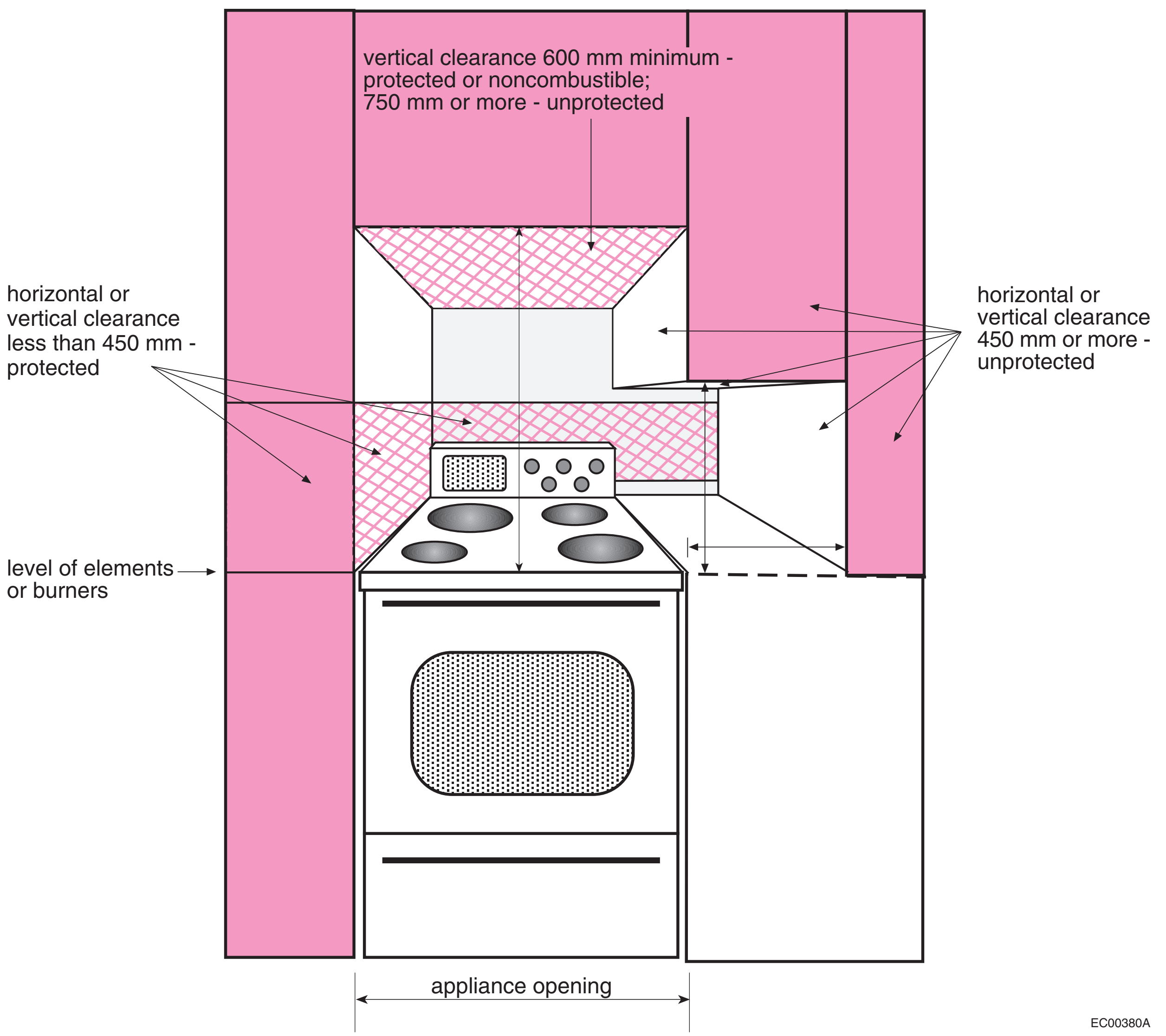


Figure A-9.10.21. r
Clearances from ranges to walls and cabinetry

A-9.11.1.1.(1) Sound Transmission Class Ratings. The specified STC rating of 50 is considered the minimum acceptable value, but many builders prefer to design for STC 55 or more in high quality accommodation.

Another reason to choose assemblies rated higher than STC 50 is that the STC ratings of assemblies are based on laboratory tests, but the sound transmission of any assembly as constructed in the field may be significantly less than its rating. This can be due to sound leaks, departures from design, poor workmanship or indirect (flanking) transmission paths overlooked in design. To provide a margin of safety to compensate for these, builders often select wall and floor systems that have been rated at least 5 points higher than the design STC rating in laboratory tests.

Sound leaks can occur where one wall meets another, the floor, or the ceiling. Leaks may also occur where the wall finish is cut for the installation of equipment or services. Avoid back-to-back electrical outlets or medicine cabinets. Carefully seal cracks or openings so structures are effectively airtight. Apply sealant below the plates in stud walls, between the bottom of drywall sheets and the structure behind, around all penetrations for services and, in general, wherever there is a crack, a hole or the possibility of one developing. Sound-absorbing material inside a well-designed wall decreases sound transmission. It has another advantage; it also helps to reduce the effects of leaks due, perhaps, to poor workmanship.

Indirect or flanking transmission arises where the parts of a building are rigidly connected together and where cavities in hollow walls or floors, or continuous lightweight layers connect apartments. Sound travels in cavities, as vibration along surfaces and through walls, ceilings and floors to adjacent rooms. Many paths other than the direct one through the party wall or floor may be involved. To achieve good sound insulation, transmission along flanking paths must be minimized by introducing breaks and resilient connections in the construction. Some examples of bad and good details are shown in Figure A-9.11.1.1.

Changes to constructions should not be made without consultation with someone competent in the field of acoustical design. Adding extra layers of drywall to walls in an attempt to reduce sound transmission, can actually increase it if done incorrectly. For example, attaching drywall on resilient channels directly to an existing wall or ceiling usually increases low frequency sound transmission. Adding an additional layer of drywall inside a double layer wall will also seriously increase sound transmission. Adding blocking inside walls to reduce the risk of fire spread should be done so it does not increase vibration transmission from one part of a wall or floor to the other.

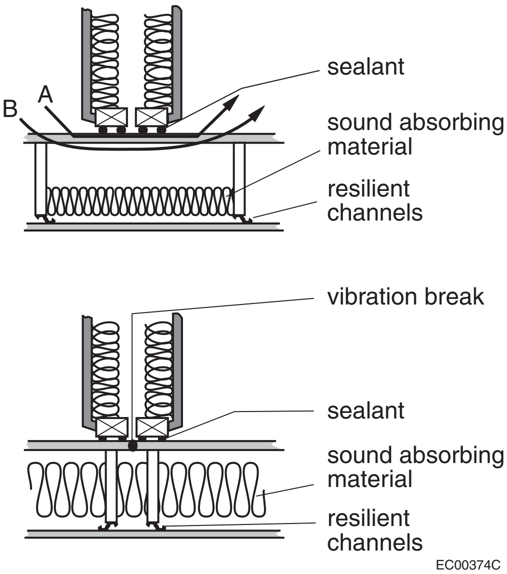


Figure A-9.11.1.1.
Cross section through wall/floor junctions

To verify that acoustical privacy is being achieved, a field test can be done at an early stage in the construction; ASTM E 336 will give a complete measurement. A simpler and less expensive method is ASTM E 597, “Determining a Single Number Rating of Airborne Sound Insulation in Multi-Unit Building Specifications.” The rating provided by this test is usually within 2 points of the STC obtained from ASTM E 336. It is useful for verifying performance and finding problems during construction. Alterations can then be made prior to project completion.

Impact Noise

Section 9.11. has no requirements for control of impact noise transmission. Footstep and other impacts can cause severe annoyance in multi-family residences. Builders concerned about quality and reducing occupant complaints will ensure that floors are designed to minimize impact transmission. A recommended criterion is that bare floors (tested without a carpet) should achieve an impact insulation class (IIC) of 55. Some lightweight floors that satisfy this requirement may still cause complaints about low frequency impact noise transmission. Adding carpet to a floor will always increase the IIC rating but will not necessarily reduce low frequency noise transmission. Good footstep noise rejection requires fairly heavy floor slabs or floating floors. Impact noise requirements are being considered for inclusion in future versions of the NBC.

Most frequently used methods of test for impact noise are ASTM E 492, “Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using The Tapping Machine,” or

ASTM E 1007, "Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures."

Machinery Noise

Elevators, garbage chutes, plumbing, fans, and heat pumps are common sources of noise in buildings. To reduce annoyance from these, they should be placed as far as possible from sensitive areas. Vibrating parts should be isolated from the building structure using resilient materials such as neoprene or rubber.

A-9.12.2.2. Minimum Depths of Foundations. The requirements for clay soils or soils not clearly defined are intended to apply to those soils that are subject to significant volume changes with changes in moisture content.

A-9.12.2.2.(2) Depth and Insulation of Foundations.

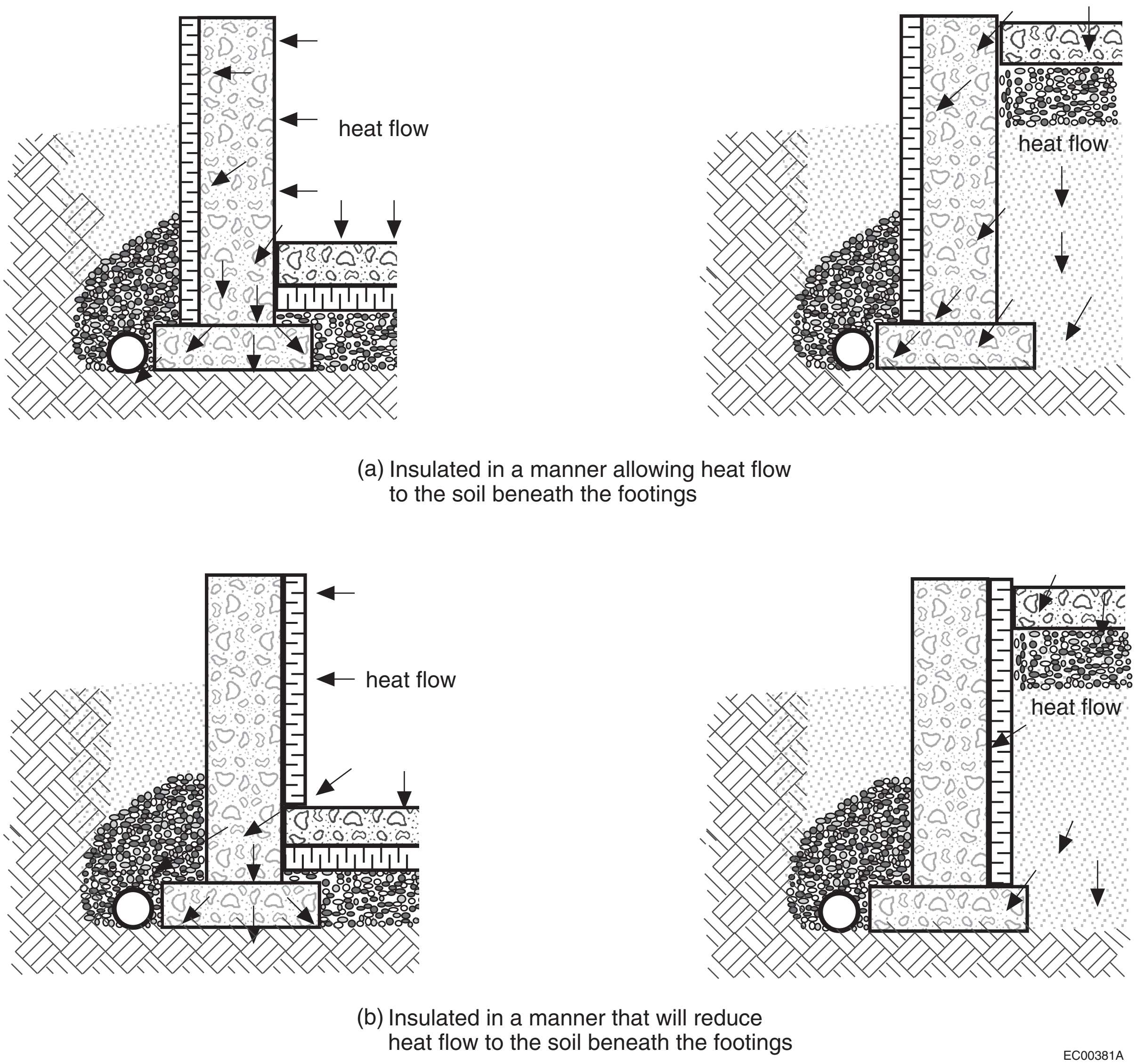


Figure A-9.12.2.2. e3
Foundation insulation and heat flow to footings

A-9.13.1.3. Exclusion of Soil Gas. Outdoor air entering a dwelling through above-grade leaks in the building envelope normally improves the indoor air quality in the dwelling by reducing the concentrations of pollutants and water vapour. It is only undesirable because it cannot be controlled. On the other hand, air entering a dwelling through below-grade leaks in the envelope may increase the water vapour content of the indoor air and may also bring in a number of pollutants which it picks up from the soil. This mixture of air, water vapour and pollutants is sometimes referred to as "soil gas." One pollutant often found in soil gas is radon.

Radon is a colourless, odourless, radioactive gas that occurs naturally as a result of the decay of radium. It is found to varying degrees as a component of soil gas in all regions of Canada and is known to enter dwelling units by infiltration into basements and crawl spaces. The presence of radon in sufficient quantity can lead to increased risk of lung cancer. e3

The potential for high levels of radon infiltration is very difficult to evaluate prior to construction and thus a radon problem may only become apparent once the building is completed and occupied. Therefore various sections of Part 9 require the application of certain radon exclusion measures in all dwellings. These measures are

- low in cost,
- difficult to retrofit, and
- desirable for other benefits they provide.

There are two principal methods of excluding soil gas:

- Sealing the interface between the soil and the occupied space, so far as is reasonably practicable. Sections 9.13. and 9.18. include requirements for soil gas barriers in crawl spaces. Providing control joints to reduce cracking of foundation walls and airtight covers for sump pits are other measures which can help achieve this objective. The requirements provided in Subsection 9.13.7., Soil Gas Control in Walls, Article 9.13.8.1., Soil Gas Barriers, and Article 9.13.8.3., Sealing of the Perimeter and Penetrations, are described in Appendix Notes A-9.13.7. and 9.13.8., and A-9.13.8.1.(2) and (3).
- Ensuring that the pressure difference across the soil/space interface is positive (i.e., towards the outside) so that inward soil gas flow through any remaining leaks will be prevented. The requirements provided in Article 9.13.8.2., Providing for Sub-Floor Depressurization, are described in Appendix Note A-9.13.8.2.

A-9.13.7. and 9.13.8. Soil Gas Barriers. The requirements provided in Subsection 9.13.7., Soil Gas Control in Walls, Article 9.13.8.1., Soil Gas Barriers, and Article 9.13.8.3., Sealing of the Perimeter and Penetrations, are illustrated in Figures A-9.13.7.A. and B.

The requirement in Sentence 9.13.8.3.(2) regarding sealing of penetrations of the slab also applies to hollow metal and masonry columns. Not only the perimeters but also the centres of such columns must be sealed or blocked.

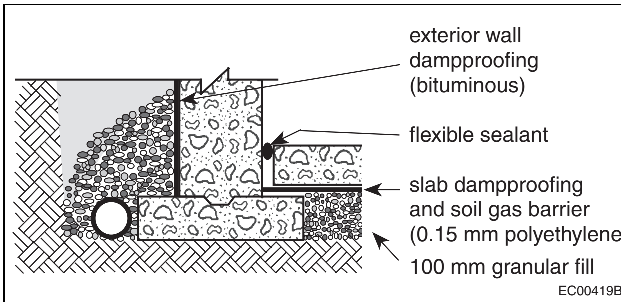


Figure A-9.13.7.A.
Dampproofing and soil gas control at foundation wall/floor junctions with solid walls

The requirement in Sentence 9.13.8.3.(3) regarding drainage openings in slabs can be satisfied with any of a number of proprietary devices which prevent soil gas entry through floor drains. Some types of floor drains incorporate a trap which is connected to a nearby tap so that the trap is filled every time the tap is used. This is intended to prevent the entry of sewer gas but would be equally effective against the entry of soil gas.

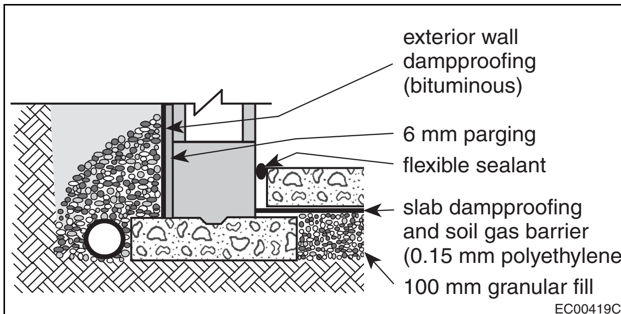


Figure A-9.13.7.B.
Dampproofing and soil gas control at foundation wall/floor junctions with hollow walls

A-9.13.8.1.(2) and (3) Polyethylene Soil Gas Barriers under Slabs-on-Ground. Floors-on-ground serving all types of occupancies other than garages must be constructed to reduce the potential for entry of radon or other soil gases. In most cases, this will be accomplished by placing 0.15 mm polyethylene under the floor.

Finishing a concrete slab placed directly on polyethylene can, in many cases, cause problems for the inexperienced finisher. A rule of finishing, whether concrete is placed on polyethylene or not, is to never finish or "work" the surface of the slab while bleed water is present or before all the bleed water has risen to the surface and evaporated. If finishing operations are performed too early, such as before all the bleed water has risen and evaporated, surface defects such as blisters, crazing, scaling and dusting can result. This is often the case with slabs placed directly on polyethylene. The amount of bleed water that may come to the surface and the time required for this to happen is increased from that of a slab placed on a compacted granular base. The excess water in the mix from the bottom portion of the slab cannot bleed downward and out of the slab and be absorbed into the granular material below, because of the polyethylene. Therefore, all bleed water, including that from the bottom of the slab, must now rise through the slab to the surface. Quite often in such cases, finishing operations are begun too soon and surface defects result.

One solution that is often suggested is to place a layer of sand between the polyethylene and the concrete. However, this is not an acceptable solution for the following reason: it is unlikely that the polyethylene will survive the slab pouring process entirely intact. Nevertheless, the polyethylene will still be effective in retarding the flow of soil gas if it is in intimate contact with the concrete; soil gas will only be able to penetrate where a break in the polyethylene coincides with a crack in the concrete. The majority of concrete cracks will probably be underlain by intact polyethylene. On the other hand, if there is an intervening layer of a porous medium, such as sand, soil gas will be able to travel laterally from a break in the polyethylene to the nearest crack in the concrete and the total system will be much less resistant to soil gas penetration.

To reduce and/or control the cracking of concrete slabs, it is necessary to understand the nature and causes of volume changes of concrete and in particular those relating to drying shrinkage. The total amount of water in a mix is by far the largest contributor to the amount of drying shrinkage and resulting potential cracking that may be expected from a given concrete. The less total amount of water in the mix, the less volume change (due to evaporation of water), which means the less drying shrinkage that will occur. To lessen the volume change and potential cracking due to drying shrinkage, a mix with the lowest total amount of water that is practicable should always be used. To lower the water content of a mix, superplasticizers are often used to provide the needed workability of the concrete during the placing operation. High water/cementing materials ratio concretes usually have high water content mixes. They should be avoided to minimize drying shrinkage and cracking of the slab. The water/cementing materials ratio for slabs-on-ground should be no higher than 0.55.

A-9.13.8.2. Soil Gas Control by Depressurization. As noted in Appendix Note A-9.13.1.3., one method of excluding soil gas from below-grade living space is to ensure that the pressure difference across the soil/space interface is positive (i.e., towards the outside) so that inward soil gas flow through any leaks will be prevented. This requires consideration of the air pressure on the inside of the envelope and the pressure within the soil. Each is affected by quite different factors.

There is a safe range for the interior pressure in a house. The upper limit is primarily due to the need to minimize outward leakage of the warm, moist interior air through leaks in the building envelope. The lower limit depends on the type of combustion heating equipment present in the house, as discussed in Appendix Note A-9.33.1.1.(2). It also follows from the need to avoid drawing in soil gas, as discussed in Appendix Note A-9.13.1.3.

Controlling the entry of soil gas by house or basement pressurization is therefore problematic, since it could lead to exfiltration-caused condensation problems in the building envelope. This leaves the option of reducing the pressure outside the envelope as the most practical method of achieving the desired outward pressure difference.

Sub-floor depressurization systems have been found to be very effective for controlling soil gas entry into houses. At least in areas which are prone to higher than normal radon levels, or other ground pollutants, this practice is recommended.

Article 9.13.8.2. provides for depressurization as an alternative to the installation of polyethylene below floor slabs. Using this option, a vent pipe for use with a sub-floor depressurization system is installed through the floor but is only connected if soil gas levels are found to be excessive.

Radon testing must be performed on the house and copies of the results provided to the home owner and the authority having jurisdiction. Since the radon level in a house can vary significantly during the year, the test should be of sufficient duration to provide a reasonable indication of the concentration. The minimum period for testing should be three months or as recommended by the authority having jurisdiction. The preferred testing location is centrally in the basement or the main floor for houses without basements.

The current Canadian Action Level for radon, as specified by Health Canada, is 800 Bq/m^3 (see H46-2/90-156E, "Exposure Guidelines for Residential Indoor Air Quality"). If the results of the test indicate a concentration exceeding the Canadian Action Level, the rest of the sub-slab depressurization system must be installed. (It may be noted that Canadian and U.S. action levels are likely to differ.) r4

Installation of the sub-slab depressurization system requires that the pipe cast through the slab to the sub-slab space be uncapped and connected to a ventilation system exhausting to the outside. Exhaust pipes passing through unheated spaces should be insulated. The exhaust fan should be located outside the occupied space where noise will not be a nuisance. It is also best to locate the fan as close to the final outlet end of the ventilation system as possible so that the pressurized portion of the system downstream of the fan will not be located in or adjacent to the living space. If the pressurized portion of the system were to pass through the living space, then any leak in the system would have the potential to spill high concentration soil gas into the living space, thus exacerbating the situation the system was intended to correct. The fan should be of a type suitable for the application and capable of continuous operation.

Since radon concentration of the vent gases can become quite high, soil gases collected by the sub-slab depressurization system should be vented at the roof level. Therefore, it may be desirable to take some simple steps to facilitate future installation of the system. This could include locating the slab vent pipe below a suitable interior partition, through which the vertical riser could be run, and pre-drilling the partition top and bottom plates, particularly those not accessible from a basement or attic.

The house should be re-tested for radon after completion of the depressurization system.

A-9.14.2.1.(2) Insulation Applied to the Exterior of Foundation Walls. In addition to the prevention of heat loss, some types of mineral fibre insulation, such as rigid glass fibre, are installed on the exterior of basement walls for the purpose of moisture control. This is sometimes used instead of crushed rock as a drainage layer between the basement wall and the surrounding soil in order to facilitate the drainage of soil moisture. Water drained by this drainage layer must be carried away from the foundation by the footing drains or the granular drainage layer in order to prevent it from developing hydro-static pressure against the wall. Provision must be made to permit the drainage of this water either by extending the insulation or crushed rock to the drain or by the installation of granular material connecting the two. The installation of such drainage layer does not eliminate the need for normal waterproofing or dampproofing of walls as specified in Section 9.13.

A-9.15.1.3.(3) Preserved Wood Foundations – Design Assumptions. Tabular data and figures in CAN/CSA-S406, "Construction of Preserved Wood Foundations," are based upon the general principles provided in CSA O86, "Engineering Design in Wood," with the following assumptions: e r4

- soil bearing capacity: 75 kPa or more,
- clear spans for floors: 5 000 mm or less,
- floor loadings: 1.9 kPa for first floor and suspended floor, and 1.4 kPa for second storey floor,
- foundation wall heights: 2 400 mm for slab floor, 3 000 mm for suspended wood floor, e2
- top of granular layer to top of suspended wood floor: 600 mm,
- lateral load from soil pressure: equivalent to fluid pressure of 4.7 kPa per metre of depth,
- ground snow load: 3 kPa,
- basic snow load coefficient: 0.6,
- roof loads are carried to the exterior wall,
- dead loads:

roof	0.50 kPa,
floor	0.47 kPa,
wall (with siding)	0.32 kPa,
wall (with masonry veneer)	1.94 kPa,
foundation wall	0.27 kPa,
partitions	0.20 kPa.

A-9.15.3.3.(4) Footing Sizes. The footing sizes in Table 9.15.3.3. are based on typical construction consisting of a roof, not more than 3 storeys, and centre bearing walls or beams. For this reason, Sentence (1) stipulates a maximum supported joist span of 4.9 m.

It has become common to use flat wood trusses or wood I-joists to span greater distances in floors of small buildings. Where these spans exceed 4.9 m, minimum footing sizes may be based on the following method:

(a) Determine for each storey the span of joists that will be supported on a given footing. Sum these lengths (sum_1).
(b) Determine the product of the number of storeys times 4.9 m (sum_2).
(c) Determine the ratio of sum_1 to sum_2.
(d) Multiply this ratio by the minimum footing sizes in Table 9.15.3.3. to get the required minimum footing size.

Example: A 2-storey house is built using wood I-joists spanning 6 m.

(a) $sum_1 = 6 + 6 = 12$ m
(b) $sum_2 = 4.9 \times 2 = 9.8$ m
(c) ratio $sum_1/sum_2 = 12/9.8 = 1.22$
(d) required minimum footing size = 1.22 x 350 mm (minimum footing size provided in Table 9.15.3.3.) = 427 mm.

A-9.18.7.1.(4) Protection of Ground Cover in Warm Air Plenums. The purpose of the requirement is to protect combustible ground cover from smoldering cigarette butts that may drop through air registers. The protective material should extend beyond the opening of the register and have up-turned edges, as a butt may be deflected sideways as it falls.

A-9.19.1.1.(1) Venting of Attic or Roof Spaces. *e e2* Controlling the flow of moisture by air leakage and vapour diffusion into attic or roof spaces is necessary to limit moisture-induced deterioration. Given that imperfections normally exist in the vapour barriers and air barrier systems, recent research indicates that venting of attic or roof spaces is generally still required. The exception provided in Article 9.19.1.1. recognizes that some specialized ceiling-roof assemblies, such as those used in some factory-built buildings, have, over time, demonstrated that their construction is sufficiently tight to prevent excessive moisture accumulation. In these cases, ventilation would not be required.

A-9.20.1.2. Seismic Zones. Information on seismic zones for various localities can be found in Appendix C, Climatic Information for Building Design in Canada.

A-9.20.8.5. Distance from Edge of Masonry to Edge of Supporting Members.

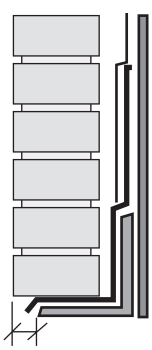


Figure A-9.20.8.5.
Maximum projection of masonry beyond its support

A-9.20.12.2.(2) Corbelling of Masonry Foundation Walls.

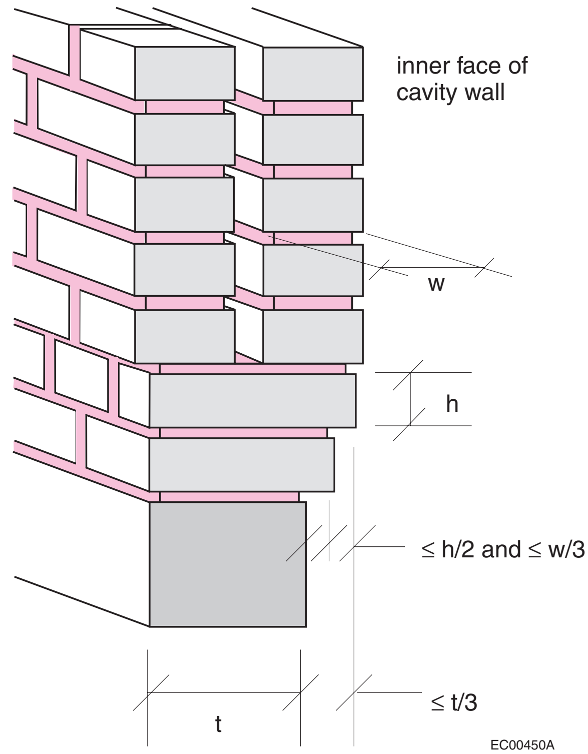


Figure A-9.20.12.2.
Maximum corbel dimensions

A-9.20.13.9.(3) Dampproofing of Masonry Walls. The reason for installing sheathing paper behind masonry walls is to prevent rainwater from reaching the interior finish if it should leak past the masonry. The sheathing paper intercepts the rainwater and leads it to the bottom of the wall where the flashing directs it to the exterior via weep holes. If the insulation is a type that effectively resists the penetration of water, and is installed so that water will not collect behind it, then there is no need for sheathing paper. If water that runs down between the masonry and the insulation is able to leak out at the joints in the insulation, such insulation will not act as a substitute for sheathing paper. If water cannot leak through the joints in the insulation but collects in cavities between the masonry and insulation, subsequent freezing could damage the wall. Where sheathing paper is not used, therefore, the adhesive or mortar should be applied to form a continuous bond between the masonry and the insulation. If this is not practicable because of an irregular masonry surface, then sheathing paper is necessary.

A-9.21.1.2.(1) Factory-Built Chimneys. Under the provisions of Section 2.5., certain solid-fuel burning appliances may be connected to factory-built chimneys other than those specified in Sentence 9.21.1.2.(1) if tests show that the use of such a chimney will provide an equivalent level of safety.

A-9.21.3.6.(2) Metal Chimney Liners. Under the provisions of Section 2.5., masonry chimneys with metal liners may be permitted to serve solid-fuel burning appliances if tests show that such liners will provide an equivalent level of safety.

A-9.21.4.4.(1) Location of Chimney Top.

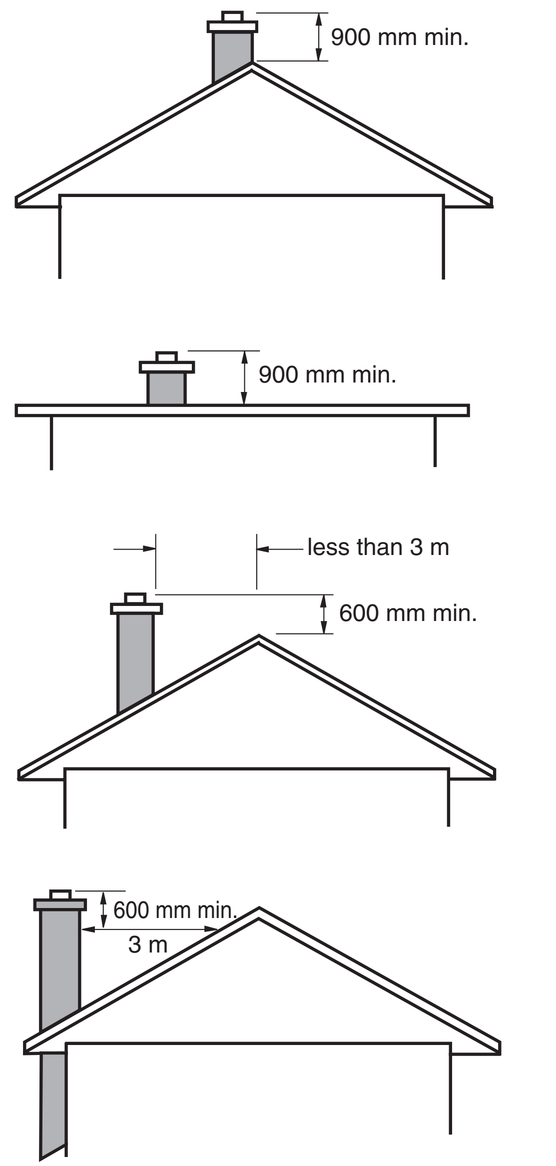


Figure A-9.21.4.4.
Vertical and horizontal distance from chimney top to roof

A-9.21.4.5.(2) Lateral Support for Chimneys. Where a chimney is fastened to the house framing with metal anchors, in accordance with CSA standard A370, "Connectors for Masonry," it is considered to have adequate lateral support. The portion of the chimney stack above the roof is considered as free standing and may require additional lateral support.

A-9.21.5.1.(1) Clearance from Combustible Materials. For purposes of this Sentence, an exterior chimney can be considered to be one which has at least one surface exposed to the outside atmosphere or unheated space over the majority of its height. All other chimneys should be considered to be interior.

A-9.23.3.1.(2) Standard for Screws. The requirement that wood screws conform to ANSI B18.6.1., "Slotted and Recessed Wood Screws (Inch Series)," is not intended to preclude the use of Robertson head screws. The requirement is intended to specify the mechanical properties of the fastener, not to restrict the means of driving the fastener.

A-9.23.3.3.(1) Prevention of Splitting. The intent of the phrase "staggering the nails in the direction of the grain" is illustrated below.

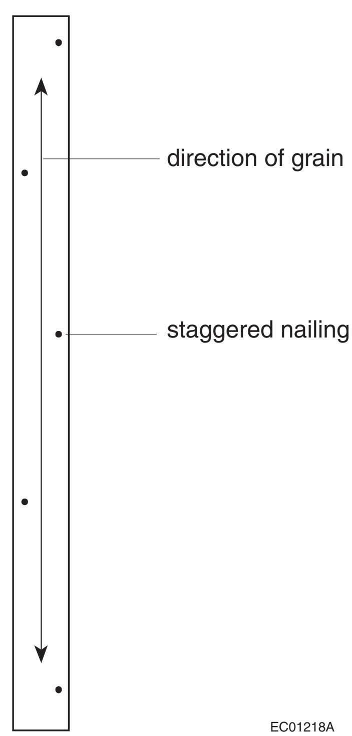


Figure A-9.23.3.3.
Staggered nailing

A-9.23.4.2. Span Tables for Wood Joists, Rafters and Beams. In these span tables the term "rafter" refers to a sloping wood framing member which supports the roof sheathing and encloses an attic space but does not support a ceiling. The term "roof joist" refers to a horizontal or sloping wood framing member that supports the roof sheathing and the ceiling finish but does not enclose an attic space.

Where rafters or roof joists are intended for use in a locality having a higher specified roof snow load than shown in the tables, the maximum member spacing may be calculated as the product of the member spacing and specified snow load shown in the span tables divided by the specified snow load for the locality being considered. The following examples show how this principle can be applied:

(a) For a 3.5 kPa specified snow load, use spans for 2.5 kPa and 600 mm o.c. spacing but space members 400 mm o.c.

(b) For a 4.0 kPa specified snow load, use spans for 2.0 kPa and 600 mm o.c. spacing but space members 300 mm o.c.

The maximum spans in the span tables are measured from the inside face or edge of support to the inside face or edge of support.

In the case of sloping roof framing members, the spans are expressed in terms of the horizontal distance between supports rather than the length of the sloping member. The snow loads are also expressed in terms of the horizontal projection of the sloping roof. Spans for odd size lumber may be estimated by straight line interpolation in the tables.

These span tables may be used where members support a uniform live load only. Where the members are required to be designed to support a concentrated load, they must be designed in conformance with Subsection 4.3.1.

Supported joist length in Tables A-8, A-9 and A-10 means half the sum of the joist spans on both sides of the beam. For supported joist lengths between those shown in the tables, straight line interpolation may be used in determining the maximum beam span.

Tables A-1 to A-20 cover only the most common configurations. Especially in the area of floors, a wide variety of other configurations is possible: glued subfloors, concrete toppings, machine stress rated lumber, etc. The Canadian Wood Council publishes "The Span Book," a compilation of span tables covering many of these alternative configurations. Although these tables have not been subject to the formal committee review process, the Canadian Wood Council generates, for the CCBFC, all of the Code's span tables for wood structural components; thus Code users can be confident that the alternative span tables in "The Span Book" are consistent with the span tables in the Code and with relevant Code requirements.

Spans for wood joists, rafters and beams which fall outside the scope of these tables, including those for U.S. species and individual species not marketed in the commercial species combinations described in the span tables, can be calculated in conformance with CSA O86, "Engineering Design in Wood." r4

A-9.23.4.2.(2) Numerical Method to Establish Vibration-Controlled Spans for Wood Frame Floors. In addition to the normal strength and deflection analyses, the calculations on which the floor joist span tables are based include a method of ensuring that the spans are not so long that floor vibrations could lead to occupants perceiving the floors as too "bouncy" or "springy." Limiting deflection under the normal uniformly distributed loads to 1/360 of the span does not provide this assurance.

Normally, vibration analysis requires detailed dynamic modelling. However, the calculations for the span tables use the following simplified static analysis method of estimating vibration-acceptable spans:

- The span which will result in a 2 mm deflection of a single joist supporting a 1 kN concentrated midpoint load is calculated.
- This span is multiplied by a factor, K, to determine the "vibration-controlled" span for the entire floor system. If this span is less than the strength- or deflection-controlled span under uniformly distributed load, the vibration-controlled span becomes the maximum span.
- The K factor is determined from the following relationship:

$$\ln(\mathrm{K}) = \mathrm{A} - \mathrm{B} \bullet \ln(\mathrm{S_i}/\mathrm{S_{184}}) + \mathrm{G}$$

where

A, B = constants, the values of which are determined from Tables A-9.23.4.2.A. or B.

G = constant, the value of which is determined from Table A-9.23.4.2.C.

S_i = span which results in a 2 mm deflection of the joist in question under a 1 kN concentrated midpoint load

S_{184} = span which results in a 2 mm deflection of a 38 x 184 mm joist of same species and grade as the joist in question under a 1 kN concentrated midpoint load.

For a given joist species and grade, the value of K shall not be greater than K_3, the value which results in a vibration-controlled span of exactly 3 m. This means that for vibration-controlled spans 3 m or less, K always equals K_3, and for vibration-controlled spans greater than 3 m, K is as calculated.

Note that, for a sawn lumber joist, the ratio S_i/S_{184} is equivalent to its depth (mm) divided by 184.

Due to rounding differences, the method, as presented here, might produce results slightly different from those produced by the computer program used to generate the span tables.

Table A-9.23.4.2.A.
Constants A and B for Calculating Vibration-Controlled Floor Joist Spans – General Cases

Subfloor Thickness, mm	With Strapping(1)			With Bridging			With Strapping and Bridging		
	Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
	300	400	600	300	400	600	300	400	600
Constant A									
15.5	0.30	0.25	0.20	0.37	0.31	0.25	0.42	0.35	0.28
19.0	0.36	0.30	0.24	0.45	0.37	0.30	0.50	0.42	0.33
Constant B									
	0.33			0.38			0.41		

Notes to Table A-9.23.4.2.A.:

(1) Gypsum board attached directly to joists can be considered equivalent to strapping.

Table A-9.23.4.2.B.
Constants A and B for Calculating Vibration-Controlled Floor Joist Spans – Special Cases

Subfloor Thickness, mm	Joists with Ceiling Attached to Wood Furring(1)						Joists with Concrete Topping(2)		
	Without Bridging			With Bridging			With or Without Bridging		
	Joist Spacing, mm			Joist Spacing, mm			Joist Spacing, mm		
	300	400	600	300	400	600	300	400	600
Constant A									
15.5	0.39	0.33	0.24	0.49	0.44	0.38	0.58	0.51	0.41
19.0	0.42	0.36	0.27	0.51	0.46	0.40	0.62	0.56	0.47
Constant B									
	0.34			0.37			0.35		

Notes to Table A-9.23.4.2.B.:

(1) Wood furring means 19 x 89 mm boards not more than 600 mm o.c., or 19 x 64 mm boards not more than 300 mm o.c. For all other cases, see Table A-9.23.4.2.A.

(2) 30 mm to 51 mm normal weight concrete (not less than 20 MPa) placed directly on the subflooring.

Table A-9.23.4.2.C.
Constant G for Calculating Vibration-Controlled Floor Joist Spans

Floor Description	Constant G
Floors with nailed(1) subfloor	0.00
Floor with nailed and field-glued(2) subfloor, vibration-controlled span greater than 3 m	0.10
Floor with nailed and field-glued(2) subfloor, vibration-controlled span 3 m or less	0.15

Table A-9.23.4.2.C. (Continued)

Notes to Table A-9.23.4.2.C.:

(1) Common wire nails, spiral nails or wood screws can be considered equivalent for this purpose.

(2) Subfloor field-glued to floor joists with elastomeric adhesive complying with standard CAN/CGSB-71.26-M, “Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.”

Additional background information on this method can be found in the following publications:

- Onysko, D.M. Serviceability Criteria for Residential Floors Based on a Field Study of Consumer Response. Project 03-50-10-008. Forintek Canada Corp., Ottawa, Canada 1985.
- Onysko, D.M. Performance Criteria for Residential Floors Based on Consumer Responses. 1988 International Conference on Timber Engineering, Seattle, September 19-22, Forest Products Research Society, Vol.1, 1988, pp. 736-745.
- Onysko, D.M. Performance and Acceptability of Wood Floors – Forintek Studies. Proceedings of Symposium/Workshop on Serviceability of Buildings, Ottawa, May 16-18, National Research Council of Canada, Ottawa, 1988.

A-9.23.4.3.(1) Maximum Spans for Steel Beams Supporting Floors in Dwellings. A beam may be considered to be laterally supported if wood joists bear on its top flange at intervals of 600 mm or less over its entire length, if all the load being applied to this beam is transmitted through the joists and if 19 mm by 38 mm wood strips in contact with the top flange are nailed on both sides of the beam to the bottom of the joists supported. Other additional methods of positive lateral support are acceptable.

For supported joist lengths intermediate between those in the table, straight line interpolation may be used in determining the maximum beam span.

A-Table 9.23.4.3. Spans for Steel Beams. The spans are based on the following assumptions:

- Simply supported beam spans
- Laterally supported top flange
- Yield strength 300 MPa
- Deflection limit L/360
- Live load = 1.9 kPa/1st floor, 1.4 kPa/2nd floor
- Dead load 1.5 kPa.

A-9.23.4.4. Concrete Topping. Vibration-controlled spans given in Table A-2 for concrete topping are based on a partial composite action between the concrete, subflooring and joists. Normal weight concrete having a compressive strength of not less than 20 MPa, placed directly on the subflooring, provides extra stiffness and results in increased capacity. The use of a bond breaker between the topping and the subflooring, or the use of lightweight concrete topping limits the composite effects.

Where either a bond breaker or lightweight topping is used, Table A-1 may be used but the additional dead load imposed by the concrete must be considered. The addition of 51 mm of concrete topping can impose an added load of 0.8 to 1.2 kPa, depending on the density of the concrete.

Example

Assumptions:

- basic dead load	= 0.5 kPa
- topping dead load	= 0.8 kPa
- total dead load	= 1.3 kPa
- live load	= 1.9 kPa
- vibration limit	per A-9.23.4.2.(2)
- deflection limit	= 1/360
- ceiling attached directly to joists, no bridging	

The spacing of joists in the span tables can be conservatively adjusted to allow for the increased load by using the spans in Table A-1 for 600 mm spacing, but spacing the joists 400 mm apart. Similarly, floor beam span tables can be adjusted by using 4.8 m supported length spans for cases where the supported length equals 3.6 m.

A-9.23.8.3. Joint Location in Built-Up Beams.

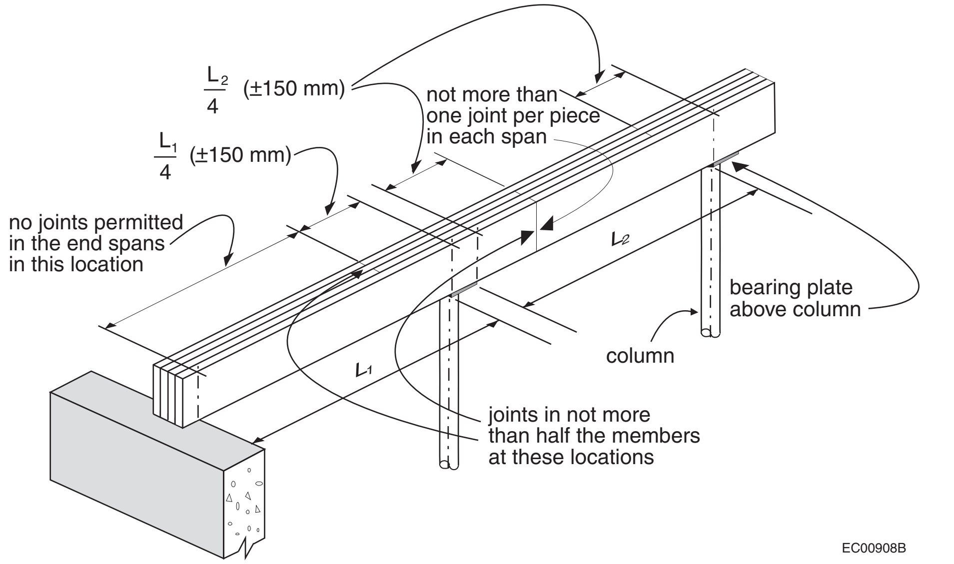


Figure A-9.23.8.3.
Joint location in built-up beams

A-9.23.10.2. Bracing. Traditionally, diagonal bracing has been provided at the corners of wood framed walls to provide resistance against wind racking forces. Laboratory tests have indicated, however, that the bracing that had been traditionally used contributed relatively little to the overall strength of the wall. Most of the racking resistance was in effect provided by the interior finish. Because of this, the requirements for bracing were deleted in the late 1950's. (See "Shear Resistance of Wood Frame Walls," by A.T. Hansen, Building Practice Note 61, Institute for Research in Construction, National Research Council, Ottawa.)

Where the interior is not finished, however, bracing is necessary if the siding itself or the sheathing does not provide the required racking strength. If panel type siding is used, or if the sheathing consists of plywood, OSB, waferboard, gypsum board, diagonal lumber, or fibreboard sheathing, additional bracing is not considered necessary because of the wind bracing provided by these materials.

Where bracing is provided, it must be installed at roughly a 45° angle on each wall and in each storey, extending the full height of the storey. This type of bracing provides considerably greater resistance to wind forces than the traditional bracing, which was found to be relatively ineffective.

The permission to omit bracing assumes typical house designs. Some buildings may have reduced resistance to racking forces as a result of their configuration. These include tall narrow buildings in exposed locations with large door or window openings located in the short sides. In such cases, racking resistance can be improved by ensuring that paneled sections are placed adjacent to the openings.

The Code does not address the issue of bracing of the structure during construction. It is often necessary to provide temporary bracing until the interior finish or sheathing is installed; however, this is not a Code requirement.

A-9.23.10.4.(1) Fingerjoined Lumber. The NLGA "Standard Grading Rules for Canadian Lumber," referenced in Article 9.3.2.1. refers to two special product standards, SPS-1,"Fingerjoined Structural Lumber," and SPS-3, "Fingerjoined "Vertical Stud Use Only" Lumber," produced by NLGA. Material identified as conforming to these standards is considered to meet the requirements in this Sentence for joining with a structural adhesive. Lumber fingerjoined in accordance with SPS-3 should be used as a vertical end-loaded member in compression only, where sustained bending or tension-loading conditions are not present, and where the moisture content of the wood will not exceed 19%. Fingerjoined lumber may not be visually regraded or remanufactured into a higher stress grade even if the quality of the lumber containing fingerjoints would otherwise warrant such regrading. r4

A-9.23.10.6.(2) Single Studs at Sides of Openings.

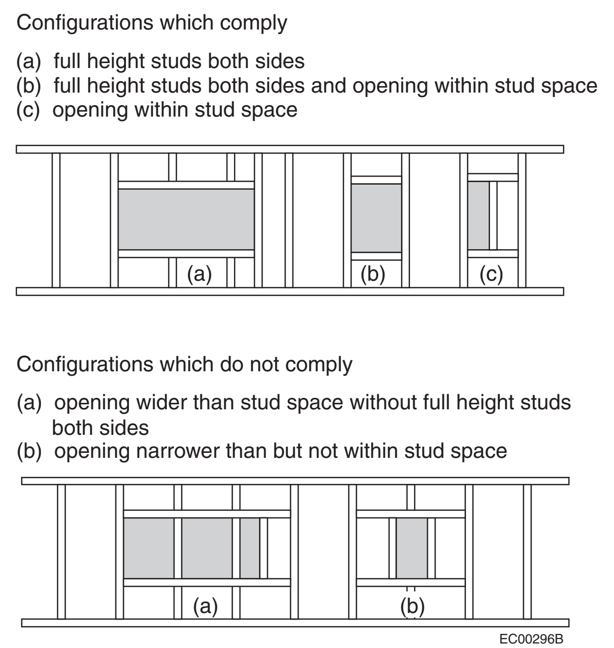


Figure A-9.23.10.6.A.
Single studs at openings in non-loadbearing interior walls

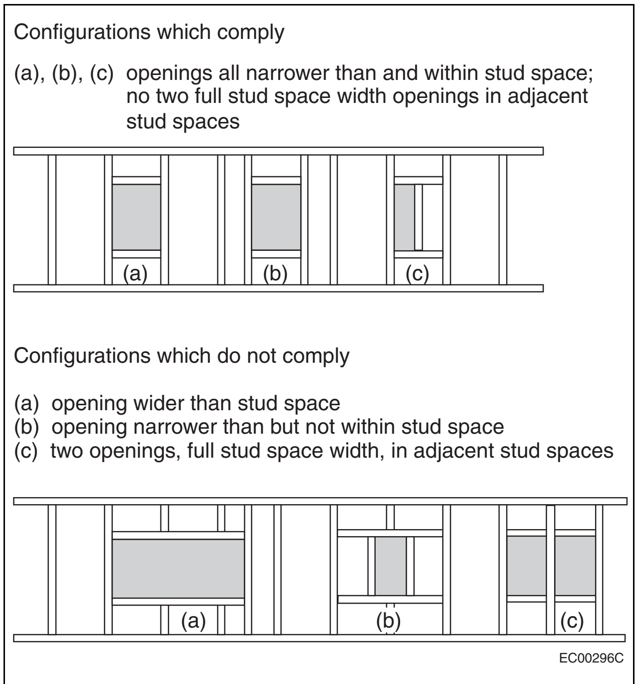


Figure A-9.23.10.6.B.
Single studs at openings in all other walls

A-9.23.13.11.(2) Wood Roof Truss Connections. Sentence 9.23.13.11.(2) requires that the connections used in wood roof trusses be designed in conformance with Subsection 4.3.1. Sentence 4.1.1.2.(2), which applies to all of Part 4, requires that the designer be a professional engineer or architect skilled in the work concerned. This has the effect of requiring that the trusses themselves be designed by professional engineers or architects. Although this is a departure from the usual practice in Part 9, it is appropriate, since wood roof trusses are complex structures which depend on a number of components (chord members, web members, cross-bracing, connectors) working together to function safely. This complexity precludes the standardization of truss design into tables comprehensive enough to satisfy the variety of roof designs required by the housing industry.

A-9.23.14.2.(4) Water Absorption Test. A method for determining water absorption is described in ASTM D 1037, “Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials.” The treatment to reduce water absorption may be considered to be acceptable if a 300 mm x 300 mm sample when treated on all sides and edges does not increase in weight by more than 6% when tested in the horizontal position.

A-9.23.14.4.(2) OSB. The CSA standard requires that Type O (aligned or oriented) panels be marked to show the grade and the direction of face alignment.

A-9.23.17.2.(1) Sheathing Membrane beneath Stucco. This article is intended to preclude the use, under stucco, of sheathing paper saturated with coal tar since there is a tendency for the tar to bleed through the stucco and cause stains. This is not a problem with the more commonly used asphalt-impregnated sheathing paper.

A-9.23.17.4.(2) Detailing of Joints in Exterior Insulating Sheathing. The shape of a joint is critical to its ability to shed water. Tongue and groove, and lapped joints can shed water if oriented correctly. Butt joints can drain to either side and so should not be used unless they are sealed. However, detailing of joints requires attention not just to the shape of the joint but also to the materials that form the joint. For example, even if properly shaped, the joints in insulating sheathing with an integral sheathing membrane could not be expected to shed water if the insulating material absorbs water, unless the membrane extends through the joints.

A-9.23.17.5.(1) Sheathing Membranes in Lieu of Sheathing. Article 9.23.16.1., Required Sheathing, indicates that sheathing must be installed only where the cladding requires intermediate fastening between supports (studs) or where the cladding requires a solid backing. Cladding such as brick or panels would be exempt from this requirement and in these cases a double layer of sheathing membrane would generally be needed. The exception (Article 9.23.17.6.) applies only to those types of cladding that provide a face seal to the weather.

A-9.23.17.6. Sheathing Membrane under Face Sealed Cladding. The purpose of sheathing membrane on walls is to reduce air infiltration and to prevent the entry of wind-driven rain. Certain types of cladding consisting of very large sheets or panels with well-sealed joints will perform this function, eliminating the need for sheathing membrane. This is true of the metal cladding with lock-seamed joints sometimes used on mobile homes. However, it does not apply to metal or plastic siding applied in narrow strips which is intended to simulate the appearance of lapped wood siding. Such material does not act as a substitute for sheathing membrane since it incorporates provision for venting the wall cavity and has many loosely-fitted joints which cannot be counted on to prevent the entry of wind and rain.

Furthermore, certain types of sheathing systems can perform the function of the sheathing membrane. Where it can be demonstrated that a sheathing material is at least as impervious to air and water penetration as sheathing membrane and that its jointing system results in joints that are at least as impervious to air and water penetration as the material itself, sheathing membrane may be omitted.

A-9.24.3.2.(3) Framing Above Doors in Steel Stud Fire Separations.

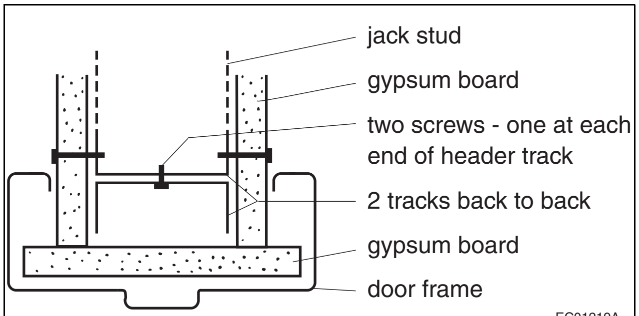


Figure A-9.24.3.2.
Steel stud header detail

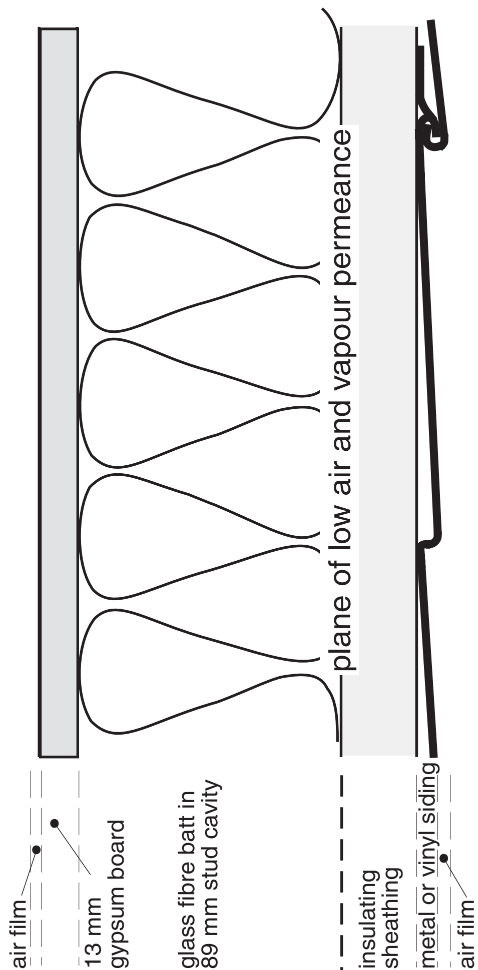
A-9.25.1.2. Location of Low Permeance Materials. Generally the location in a building assembly of a material with low air permeance is not critical; it can restrict outward movement of indoor air whether it is located near the outer surface of the assembly, near the inner surface, or at some intermediate location, and such restriction of air movement is generally beneficial, whether or not the particular material is designated as part of the air barrier system. However, if such a material also has the characteristics of a vapour barrier (i.e., low permeability to water vapour) and low thermal resistance, its location must be chosen more carefully in order to avoid moisture accumulation.

Any moisture from the indoor air which diffuses through the inner layers of the assembly or is carried by air leakage through those layers may be prevented from passing right through the assembly by such a material. This will usually not cause a problem if the material is located where the temperature is above the dew point of the indoor air; the water vapour will remain as vapour, the humidity level in the assembly will come to equilibrium with that of the indoor air, further accumulation of moisture will cease or stabilize at a low rate, and no harm will be done.

But if the material is located where the temperature is below the dew point of the indoor air, the water vapour will condense and accumulate as water or ice. This reduces the humidity level and encourages the movement of more water vapour into the assembly. If this temperature remains below the dew point for any length of time, significant moisture could accumulate. When warmer weather returns, the presence of a material with low water vapour permeance can retard drying of the accumulated moisture. Moisture which remains into warmer weather can support the growth of decay organisms.

Therefore Article 9.25.1.2. specifies that such a material be located on the warm face of the assembly or, if located within the assembly, either outboard of a vented air space or at a point where its inner surface is likely to be warm enough for most of the heating season that no significant accumulation of moisture will occur. This latter point is defined by the ratio of the thermal resistance values outboard and inboard of the innermost impermeable surface of the material in question. The method of calculating this ratio is illustrated in the following example.

A-9.25.1.2.



	Inboard			Outboard		
RSI value	0.12	0.08	2.11	0.87	0.12	0.03
Total RSI value	2.31			1.02		
Ratio	$\frac{1.02}{2.31} = 0.44$					

EC00382C

Figure A-9.25.1.2.
Example wall section showing thermal resistance inboard and outboard of a plane of low air and vapour permeance

Comparing the RSI ratio from the example wall section with those in Table 9.25.1.2. indicates that this wall would be acceptable in areas with Celsius degree-day values up to 7999, which includes, for example, Whitehorse, Fort McMurray, Yorkton, Flin Flon, Geraldton, Val-d'Or and Wabush. (Degree-day values for various locations in Canada are provided in Appendix C, Climatic Information for Building Design in Canada.)

A similar calculation would indicate that, for a similar assembly but with a 140 mm stud cavity filled with an RSI 3.52 batt, the ratio would be 0.28. Thus such a wall could be used in areas with Celsius degree-day values up to 4999, which includes, for example, Cranbrook, Lethbridge, Ottawa, Montreal, Fredericton, Sydney, Charlottetown and St. John's.

Similarly, if half the thickness of the same low permeance sheathing were used, the ratio with an 89 mm cavity would be 0.25, permitting its use in areas with Celsius degree-day values up to 4999. The ratio with a 140 mm cavity would be 0.16; thus this assembly could not be used anywhere, since this ratio is below the minimum permitted in Table 9.25.1.2.

Table A-9.25.1.2.A. shows the minimum thicknesses of low permeance insulating sheathing necessary to satisfy Article 9.25.1.2. in various degree-day zones for a range of resistivity values of insulating sheathing. These thicknesses are based on the detail shown in Figure A-9.25.1.2. but could also be used with cladding details, such as brick veneer or wood siding, which provide equal or greater outboard thermal resistance.

The air leakage characteristics and water vapour permeance values for a number of common materials are given in Table A-9.25.1.2.B. These values are provided on a generic basis; specific materials may have values differing somewhat from those in the table.

Table A-9.25.1.2.A.
Minimum Thicknesses of Low Permeance Insulating Sheathing

Celsius Heating Degree-days	Min. RSI Ratio	38 x 89 Framing					38 x 140 Framing				
		Min. Outboard Thermal Resistance, RSI	Min. Sheathing Thickness, mm				Min. Outboard Thermal Resistance, RSI	Min. Sheathing Thickness, mm			
			Sheathing Thermal Resistance, RSI/mm					Sheathing Thermal Resistance, RSI/mm			
			0.0300	0.0325	0.0350	0.0400		0.0300	0.0325	0.0350	0.0400
≤ 4999	0.20	0.46	10	10	9	8	0.72	19	17	16	14
5000 to 5999	0.30	0.69	18	17	16	14	1.07	31	28	26	23
6000 to 6999	0.35	0.81	22	20	19	16	1.25	37	34	32	28
7000 to 7999	0.40	0.92	26	24	22	19	1.43	43	39	37	32
8000 to 8999	0.50	1.16	34	31	29	25	1.79	55	50	47	41
9000 to 9999	0.55	1.27	37	34	32	28	1.97	61	56	52	45
10000 to 10999	0.60	1.39	41	38	35	31	2.15	67	61	57	50
11000 to 11999	0.65	1.50	45	42	39	34	2.33	73	67	62	54
≥ 12000	0.75	1.73	53	49	45	40	2.69	85	78	72	63

Table A-9.25.1.2.B.
Air and Vapour Permeance Values(1)

Material	Air Leakage Characteristic, L/(s • m²) at 75 Pa	Water Vapour Permeance, ng/(Pa • s • m²)
Sheathing (low insulation value)		
12.7-mm foil-backed gypsum board e2	negligible	negligible
6.4-mm plywood	0.0084	23 – 74
12.7-mm gypsum board sheathing	0.0091	1373
11-mm oriented strandboard	0.0108	44
11-mm fibreboard sheathing	0.8285	772 – 2465
17-mm wood sheathing	high – depends on no. of joints	982
Insulation		
25-mm foil-faced urethane	negligible	negligible
25-mm extruded polystyrene	negligible	23 – 92
25-mm urethane foam	negligible	69
25-mm phenolic foam	negligible	133
25-mm expanded polystyrene (Type 2)	0.0214	86 – 160
fibrous insulations	very high	very high
Membrane materials		
metal	negligible	negligible
0.15-mm polyethylene	negligible	1.6 – 5.8
breather type sheathing membrane	0.2706	170 – 1400
spun bonded polyolefin film	0.9593	3646

Notes to Table A-9.25.1.2.B.:

(1) Air leakage and vapour permeance values derived from:

- Bombaru, D., Jutras, R. and Patenaude, A. Air Permeance of Building Materials. Summary Report prepared by AIR-INS Inc. for Canada Mortgage and Housing Corporation, Ottawa, 1988. Values indicate properties of tested materials only. Values for specific products may vary significantly. e2
- The Details of Air Barrier Systems for Houses. Ontario New Home Warranty Program, Toronto, 1993.

A-9.25.2.2.(2) Flame-Spread Ratings of Insulating Materials. Part 9 has no requirements for flame-spread ratings of insulation materials since these are seldom exposed in parts of buildings where fires are likely to start. Certain of the insulating material standards referenced in Sentence 9.25.2.2.(1) do include flame-spread rating criteria. These are included either because the industry producing the product wishes to demonstrate that their product does not constitute a fire hazard or because the product is regulated by authorities other than building authorities (e.g., Hazardous Products Act). However, the Code cannot apply such requirements to some materials and not to others. Hence, these flame-spread rating requirements are excepted in referencing these standards.

A-9.25.2.3.(3) Position of Insulation. For thermal insulation to be effective, it must not be short-circuited by convective air flow through or around the material. If low density fibrous insulation is installed with an air space on both sides of the insulation, the temperature differential between the warm and cold sides will drive convective air flow around the insulation. If foam plastic insulation is spot adhered to a back-up wall or adhered in a grid pattern to an air permeable substrate, and is not sealed at the joints and around the perimeter, air spaces between the insulation and the substrate will interconnect with spaces behind the cladding. Any temperature or air pressure differential across the insulation will again lead to short circuiting of the insulation by air flow. Thermal insulation must therefore be installed in full and continuous contact with the air barrier or another continuous component with low air permeance. (See Appendix Note A-9.25.3.2. for examples of low-air-permeance materials.)

A-9.25.2.4.(3) Loose-Fill Insulation in Existing Wood Frame Walls. The addition of insulation into exterior walls of existing wood frame buildings increases the likelihood of damage to framing and cladding components as a result of moisture accumulation. Many older homes were constructed with little or no regard for protection from vapour transmission or air leakage from the interior. Adding thermal insulation will substantially reduce the temperature of the siding or sheathing in winter months, possibly leading to condensation of moisture at this location.

Defects in exterior cladding, flashing and caulking could result in rain entering the wall cavity. This moisture, if retained by the added insulation, could initiate the process of decay.

Steps should be taken therefore, to minimize these effects prior to the retrofit of any insulation. Any openings in walls that could permit leakage of interior heated air into the wall cavity should be sealed. The inside surface should be coated with a low-permeability paint to reduce moisture transfer by diffusion. Finally, the exterior siding, flashing and caulking should be checked and repaired if necessary to prevent rain penetration.

A-9.25.2.4.(5) Loose-Fill Insulation in Masonry Walls. Typical masonry cavity wall construction techniques do not lend themselves to the prevention of entry of rainwater into the wall space. For this reason, loose-fill insulation used in such space must be of the water repellent type. A test for water-repellency of loose-fill insulation suitable for installation in masonry cavity walls can be found in ASTM C 516, “Vermiculite Loose Fill Thermal Insulation.”

A-9.25.3.1.(1) Air Barrier Systems for Control of Condensation. The majority of moisture problems resulting from condensation of water vapour in walls and ceiling/attic spaces are caused by the leakage of moist interior heated air into these spaces rather than by the diffusion of water vapour through the building envelope.

Protection against such air leakage must be provided by a system of air-impermeable materials joined with leak-free joints. Generally, air leakage protection can be provided by the use of air-impermeable sheet materials, such as gypsum board or polyethylene of sufficient thickness, when installed with appropriate structural support. However, the integrity of the airtight elements in the air barrier system can be compromised at the joints and here special care must be taken in design and construction to achieve an effective air barrier system.

Although Section 9.25. refers separately to vapour barriers and airtight elements in the air barrier system, these functions in a wall or ceiling assembly of conventional wood frame construction are often combined as a single membrane that acts as a barrier against moisture diffusion and the movement of interior air into insulated wall or roof cavities. Openings cut through this membrane, such as for electrical boxes, provide opportunities for air leakage into concealed spaces, and special measures must be taken to make such openings as airtight as possible. Attention must also be paid to less obvious leakage paths, such as holes for electric wiring, plumbing installations, wall-ceiling and wall-floor intersections, and gaps created by shrinkage of framing members.

In any case, air leakage must be controlled to a level where the occurrence of condensation will be sufficiently rare, or the quantities accumulated sufficiently small, and drying sufficiently rapid, to avoid material deterioration and the growth of mould and fungi.

Generally the location in a building assembly of the airtight element of the air barrier system is not critical; it can restrict air leakage whether it is located near the outer surface of the assembly, near the inner surface or at some intermediate location. However, if a material chosen to act as an airtight element in the air barrier system also has the characteristics of a vapour barrier (i.e., low permeability to water vapour), its location must be chosen more carefully in order to avoid moisture problems. [See Appendix Notes A-9.25.1.2. and A-9.25.4.2.(2).]

In some constructions, an airtight element in the air barrier system is the interior finish, such as gypsum board, which is sealed to framing members and adjacent components by gaskets, caulking, tape or other methods to complete the air barrier system. In such cases, special care in sealing joints in a separate vapour barrier is not critical. This approach often uses no separate vapour barrier but relies on appropriate paint coatings to give the interior finish sufficient resistance to water vapour diffusion that it can provide the required vapour diffusion protection.

The wording in Section 9.25. allows for such innovative techniques, as well as the more traditional approach of using a continuous sheet, such as polyethylene, to act as an “air/vapour barrier.”

Further information is available in “Moisture Problems in Houses,” by A.T. Hansen, Canadian Building Digest 231, available from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

A-9.25.3.2. Air Barrier System Properties. Materials that have been tested and are considered to have low air permeance include:

- 2 mm smooth surface roofing membrane
- 2.7 mm modified bituminous torch-on membranes
- 1.3 mm modified bituminous self-adhesive membranes

- 12.7 mm gypsum board
- 12.7 mm cement board
- 8 mm plywood
- 12.7 mm particle board
- 11 mm waferboard
- 3.2 mm tempered hardboard
- 38 mm extruded polystyrene
- 25.4 mm foil back urethane insulation
- 24 mm phenolic insulation board
- aluminum foil
- polyethylene sheet
- reinforced non-perforated polyolefin.

Characteristics of specific products may vary significantly. e2

A-9.25.4.2.(2) Increased Vapour Diffusion Resistance. Sentence 9.25.4.2.(2) indicates that where other elements in the building assembly have low vapour permeance, the vapour permeance of the element identified as the vapour barrier must be further reduced. As discussed in Appendix Note A-9.25.1.2., the location or installation of elements with low air permeance and low vapour permeance requires special consideration to avoid moisture related deterioration. The following provides additional information on a variety of elements in the building assembly that may have low vapour permeance and thereby either perform as the vapour barrier or whose presence may demand more stringent requirements for the element identified as the vapour barrier.

Cladding

Different cladding materials have different vapour permeances and different susceptibilities to moisture deterioration. They are also installed in different manners which are more or less able to release moisture that may accumulate on the inner surface. Where low permeance cladding materials such as metal or vinyl siding, materials with a permeance less than 60 ng/(Pa • s • m^2), are installed with tight joints and without a vented air space, as may be the case with lock-seam metal siding the vapour barrier must provide greater control of vapour diffusion. Sentence 9.25.4.2.(2) specifies a maximum permeance of 15 ng/(Pa • s • m^2). Assemblies clad with standard residential vinyl or metal siding would not require additional protection as the joints are not so tight as to prevent the dissipation of moisture.

Low permeance cladding cannot itself serve as the vapour barrier as it will often fall to a temperature below that where saturation would occur.

Sheathing

Like cladding, sheathing materials have different vapour permeances and different susceptibilities to moisture deterioration. Again, where sheathing with a permeance less than 60 ng/(Pa • s • m^2), such as plywood, is installed, the permeance of the vapour barrier should not exceed 15 ng/(Pa • s • m^2).

Low permeance sheathing may serve as the vapour barrier if it can be shown that the interior surface of the sheathing will not fall below the temperature where saturation will occur. This may be the case where insulating sheathing is used. (See A-9.25.1.2.)

Thermal Insulation

Where low permeance foamed plastic is the sole thermal insulation in the building assembly, the inner surface of this element will be close to the interior temperature. In this case, no additional vapour barrier is needed to control condensation within the assembly. Where low permeance thermal insulation is installed on the outside of an insulated frame wall, however, the inner surface of the plastic insulation may fall below the temperature at which saturation will occur. In this case, a separate element must be installed to provide the necessary vapour diffusion protection. (See A-9.25.1.2.)

Air Barrier Systems

In residential construction, the airtight element in the air barrier system often provides the required resistance to vapour diffusion and thereby also serves as the vapour barrier. In this case, the combined air/vapour barrier must be positioned sufficiently close to the warm side of the assembly to remain above the dew point temperature of the indoor air.

Any moisture from the indoor air that diffuses through the inner layers of the assembly or is carried by air leakage through those layers is likely to be trapped at such an air barrier. This will not cause a problem if the air/vapour barrier is located where the temperature is above the dew point of the indoor air; the trapped water vapour will remain as vapour and no harm will be done. But if the air/vapour barrier is located where the temperature is below the dew point of the indoor air, the trapped water vapour will condense or freeze. If this temperature remains below the dew point for any length of time, significant moisture could accumulate. Moisture that remains in a building assembly into warmer weather can allow the growth of decay organisms. (See A-9.25.1.2.)

A-9.25.4.3.(2) Location of Vapour Barriers. Assemblies in which the vapour barrier is located partway through the insulation meet the intent of this Article provided it can be shown that the temperature of the vapour barrier will not fall below the dew point of the heated interior air.

A-9.26.2.2.(4) Fasteners for Treated Shingles. Where shingles or shakes have been chemically treated with a preservative or a fire retardant, the fastener should be of a material known to be compatible with the chemicals used in the treatment.

A-9.26.17.1.(1) Installation of Concrete Roof Tiles. Where concrete roof tiles are to be installed, the dead load imposed by this material should be considered in determining the minimum sizes and maximum spans of the supporting roof members.

A-9.27.10.2.(3) Grooves in Hardboard Cladding. Grooves deeper than that specified may be used in thicker cladding providing they do not reduce the thickness to less than the required thickness minus 1.5 mm. Thus for type 1 or 2 cladding, grooves must not reduce the thickness to less than 4.5 mm or 6 mm depending on method of support, or to less than 7.5 mm for type 5 material.

A-9.27.11.2.(2) Thickness of Grade O-2 OSB. In using Table 9.27.9.2. to determine the thickness of Grade O-2 OSB cladding, substitute "face orientation" for "face grain" in the column headings.

A-Table 9.28.4.3. Stucco Lath. Paper-backed welded wire lath may also be used on horizontal surfaces provided its characteristics are suitable for such application.

A-9.30.1.2.(1) Water Resistance. In some areas of buildings, water and other substances may frequently be splashed or spilled onto the floor. It is preferable, in such areas, that the finish flooring be a type that will not absorb moisture or permit it to pass through; otherwise, both the flooring itself and the subfloor beneath it may deteriorate. Also, particularly in food preparation areas and bathrooms, unsanitary conditions may be created by the absorbed moisture. Where absorbent or permeable flooring materials are used in these areas, they should be installed in such a way that they can be conveniently removed periodically for cleaning or replacement, i.e., they should not be glued or nailed down. Also, if the subfloor is a type that is susceptible to moisture damage (this includes virtually all of the wood-based subfloor materials used in wood frame construction), it should be protected by an impermeable membrane placed between the finish flooring and the subfloor. The minimum degree of impermeability required by Sentence 9.30.1.2.(1) would be provided by such materials as polyethylene, aluminum foil, and most single-ply roofing membranes (EPDM, PVC).

A-9.31.6.3.(3) Securement of Service Water Heaters.

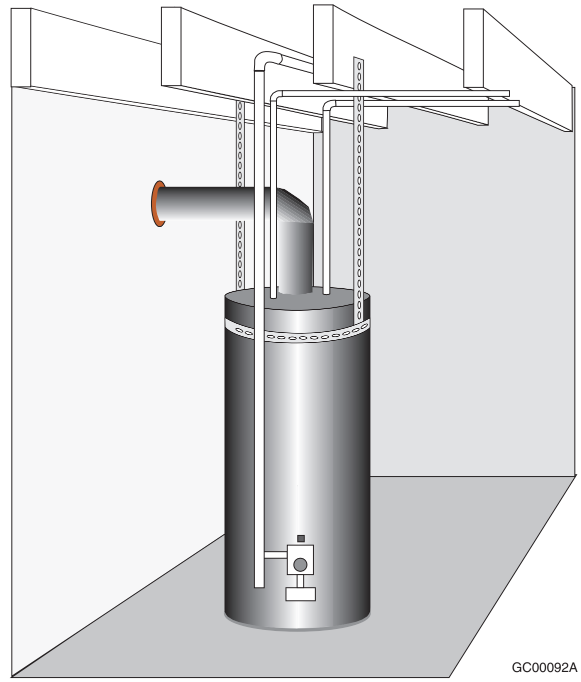


Figure A-9.31.6.3.
Securement of service water heater using strapping fastened to floor joists overhead

A-9.32.3. Heating Season (Mechanical) Ventilation. For many years, houses were constructed without mechanical ventilation systems and relied on natural air leakage through the building envelope for winter ventilation. However, houses have become progressively more airtight through the introduction of new products and practices, e.g., the substitution of panel sheathings such as plywood and waferboard for board sheathing, the replacement of paper-backed insulation batts with friction-fit batts and polyethylene film, improved caulking materials, tighter windows and doors, and more efficient heating systems. Following the energy crisis in the early 1970's, considerable emphasis was placed on reducing air leakage in order to conserve energy. Electric heating systems were encouraged and higher efficiency furnaces were developed, which further reduced air change rates in buildings. This led to concern that the natural air change in dwelling units might be insufficient in some instances to provide adequate indoor air quality. Condensation problems resulting from higher humidity levels were also a concern.

Mechanical ventilation requirements in the NBC have evolved from a simple requirement in the 1980 edition that exhaust fans be incorporated in electrically heated houses, through requirements in the 1985 and 1990 editions that all houses have mechanical ventilation systems capable of exchanging the indoor air for outdoor air at a specified rate: 0.5 air changes per hour in the 1985 edition and 0.3 air changes per hour in the 1990 edition. The current requirements address not only the overall air change rate created by the mechanical ventilation system but also the need to ensure that the outdoor air brought into the house by the system is distributed throughout the house.

Standard CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems" [9.32.3.1.(1)(a)]

CAN/CSA-F326-M is a very comprehensive standard. Its requirements are generally stated in performance terms and it therefore provides a great deal of flexibility for someone experienced in ventilation system design to devise a variety of residential ventilation systems that will satisfy those requirements.

Prescriptively-Described Alternatives to CAN/CSA-F326-M [9.32.3.1.(1)(b) and (c)]

Because CAN/CSA-F326-M is so comprehensive and stated in such performance terms, alternative, prescriptively-described systems are included in the Code for use by those less experienced in ventilation system design. These prescriptively-described systems, therefore, should be seen as particular alternatives to the wide variety of systems permitted in F326-M. Code users who do not find these prescriptively-described systems satisfactory for their purposes, or who find them too restrictive, are free to use any other type of ventilation system which satisfies the requirements of F326-M. The prescriptively-described alternatives are intended to provide a level of performance approaching that provided by F326-complying systems.

The requirements in Subsection 9.32.3. essentially describe two basic systems:

- one to be used in houses which have forced air heating systems, and
- one to be used in houses which do not have forced air heating systems.

Figures A-9.32.3.A. to A-9.32.3.D. show possible configurations of such systems. However, even within these prescriptive descriptions, a significant degree of flexibility is available. The configurations illustrated should therefore not be regarded as the only configurations acceptable under Clauses 9.32.3.1.(1)(b) and (c).

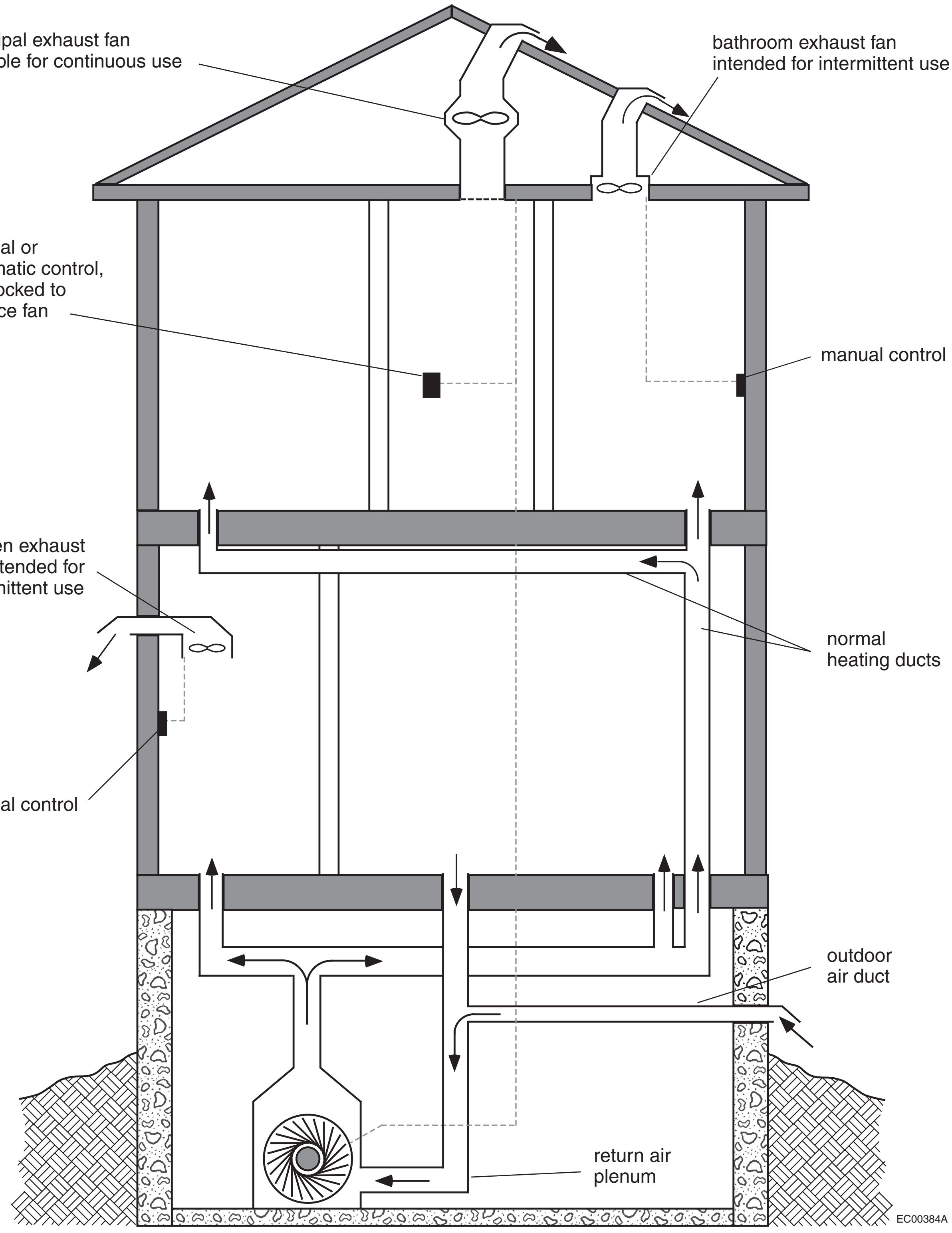


Figure A-9.32.3.A.
Possible configuration of ventilation system coupled with a forced air heating system

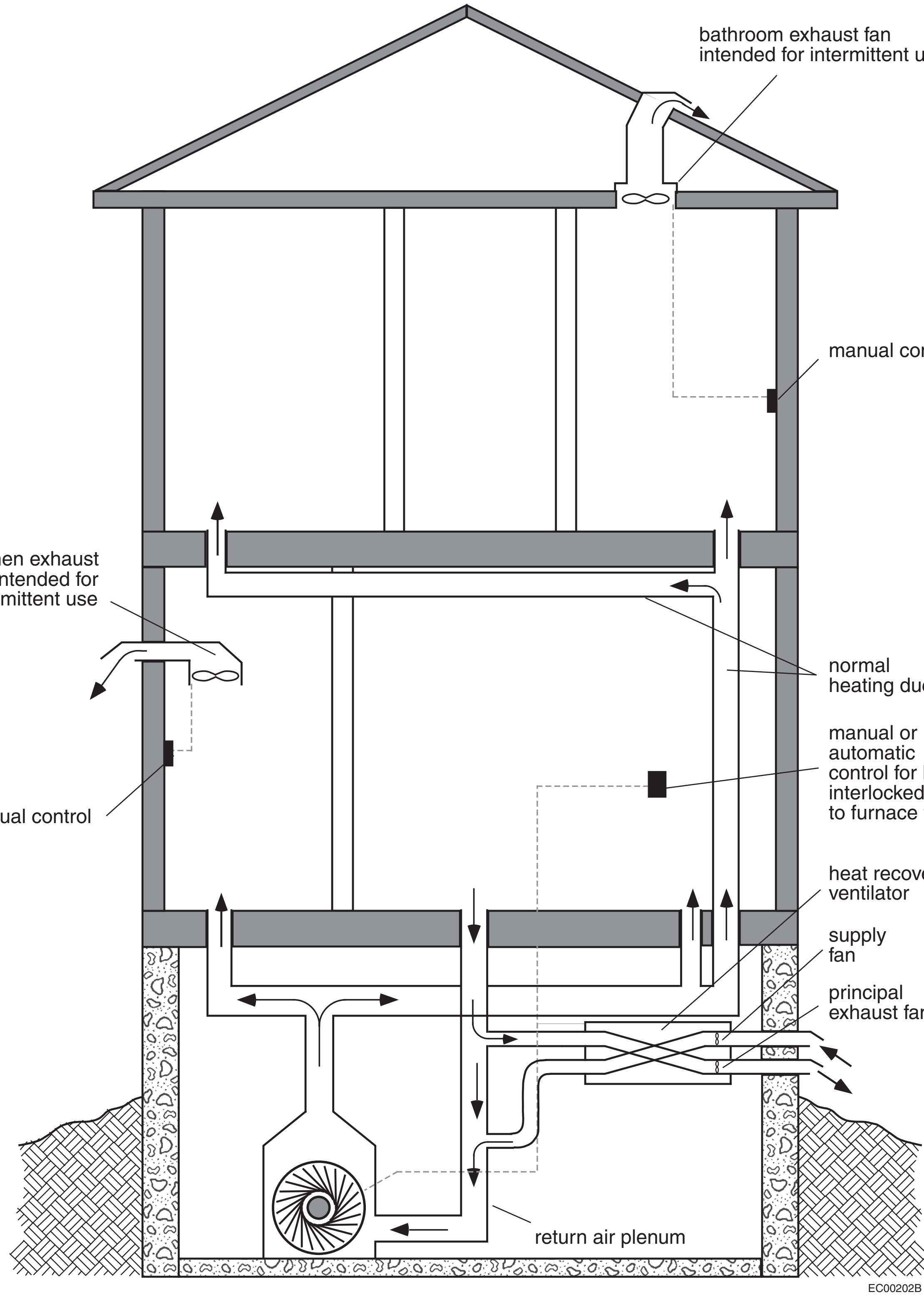


Figure A-9.32.3.B.
Possible configuration of ventilation system using a heat recovery ventilator coupled with a forced air heating system

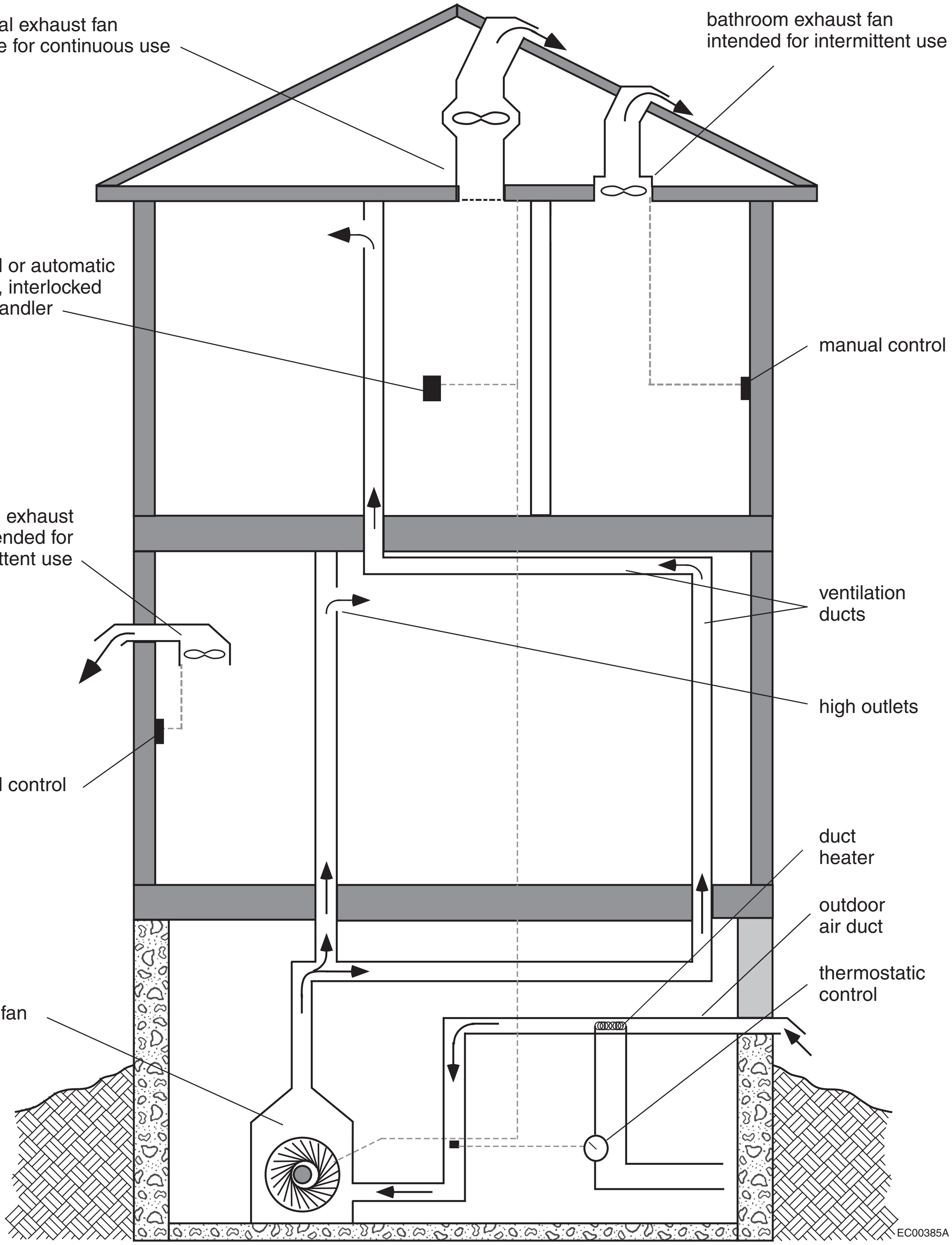


Figure A-9.32.3.C.
Possible configuration of ventilation system not coupled with a forced air heating system

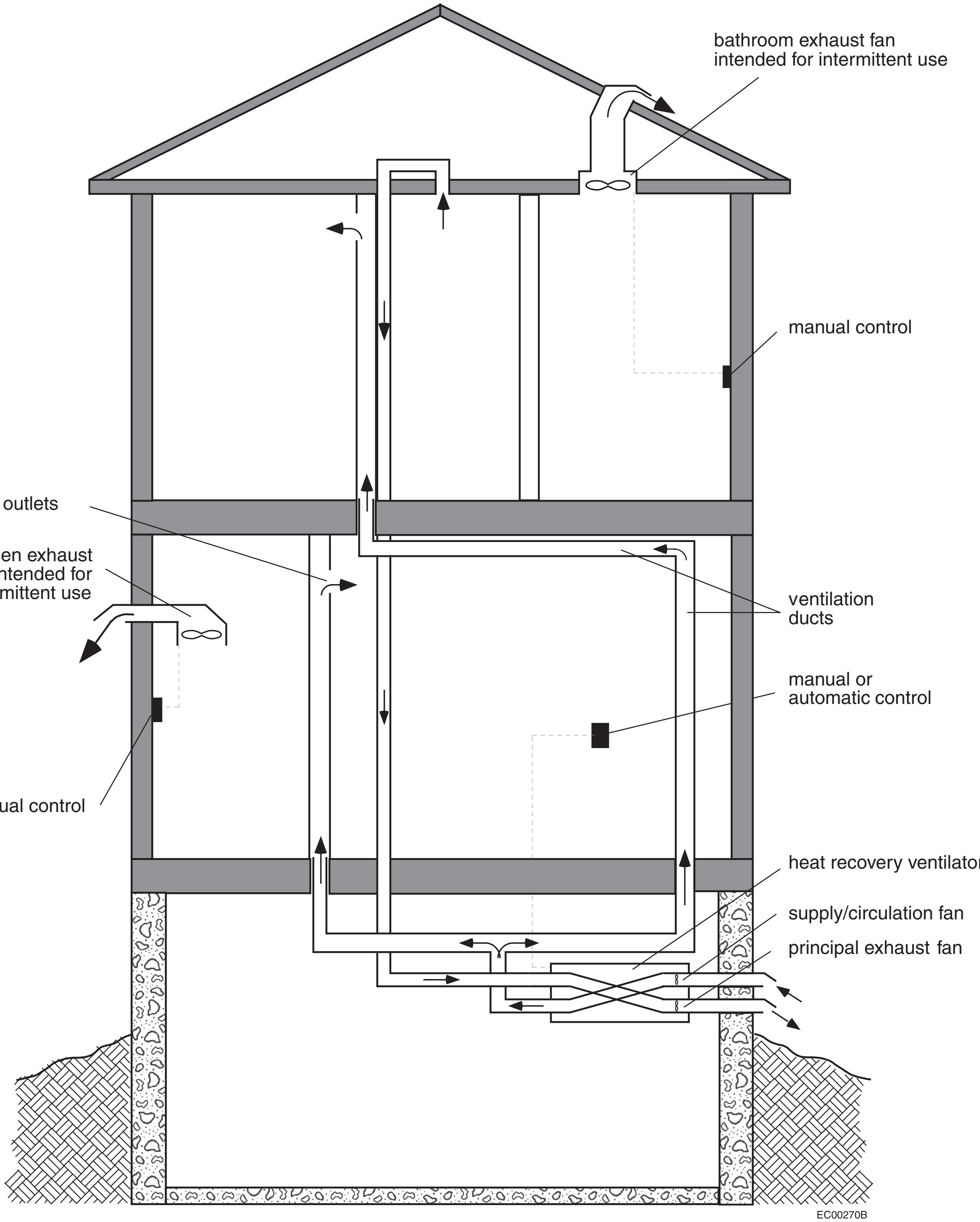


Figure A-9.32.3.D.
Possible configuration of ventilation system using a heat recovery ventilator not coupled with a forced air heating system

Ventilation Rates

Both systems provide two rates of ventilation:

Background or continuous ventilation

The lower rate is provided by the principal exhaust fan working in conjunction with either the furnace circulation fan or the supply fan (in houses without forced air heating). This rate is intended to be such that this portion of the system is suitable for use on a continuous basis at any time that an ongoing, background level of ventilation is needed, e.g., during those portions of the year, such as the late fall or early spring, when air leakage driven by wind and inside/outside temperature difference is lowest but it is too cold to rely on open windows. Because operation of the principal exhaust fan automatically activates either the furnace circulation fan or the supply fan, this portion of the system is essentially balanced and is not expected to have a significant influence on the inside/outside pressure difference of the house.

High rate or episodic ventilation

When a higher rate of ventilation is needed, the rate provided by the principal exhaust fan is supplemented by operation of supplemental exhaust fans, likely in most instances to be kitchen and bathroom exhaust fans. When operating in this mode, the system is unbalanced and will depressurize the house; however, as the required amount of the unbalance is only 50 L/s, the level of depressurization will be below 5 Pa in most houses. Since this mode is intended to be used only periodically and for short periods, this level of depressurization is felt to be tolerable, even in houses with spillage-susceptible combustion appliances.

Outdoor Air Distribution

Both systems also include provision for circulation of the outdoor air throughout the house. In the case of the system coupled to a forced air heating system, the normal heating distribution ducts are used to circulate the outdoor air. In the case of the system not coupled to a forced air heating system, a rudimentary system of special ventilation distribution ducts must be installed. The performance of the latter system, in terms of distributing outdoor air evenly throughout the house, is not likely to be as good as that of a system coupled to a forced air heating system but is judged to be adequate.

Total Ventilation Capacity (9.32.3.3.)

The ventilation capacity prescribed by this Article is the “high rate or episodic ventilation” described above, i.e., the amount of outdoor air that must be introduced to the house when the principal and supplemental exhaust fans are all running. It is determined on the basis of the number and types of rooms in the house rather than on the basis of some fraction of the house volume, as in previous editions of the Code. This is because the amount of ventilation required is essentially related to the activities of people and the number of people in the house is usually related to the number of rooms rather than to the size of the house.

It should be emphasized that this air change rate refers to the installed capacity of the system, not the rate of ventilation that is actually used in the house. In many households, ventilating even at the background rate would provide more ventilation than required, resulting in unnecessarily high heating bills and perhaps excessively low indoor relative humidity. Thus, although a system with the minimum capacity must be installed, it can incorporate controls that allow the system to be used at less than its full capacity most of the time. It must incorporate controls that allow it to be turned off.

- The simplest form of control is a manual on/off switch. While acceptable, this is not the best solution, since the occupants might turn the system off and forget to turn it back on or might turn it off to save on heating bills or to reduce noise, not realizing the importance of proper ventilation.
- A better form of control is a dehumidistat-activated on/off switch, which turns the ventilation system on in response to rising humidity. Humidity is often the main reason that ventilation is required, but not always. Depending on the activities of the occupants and the relative strengths of other sources of pollutants and humidity, the amount of ventilation required to control humidity may not be enough to control other pollutants.
- Ventilation systems in large buildings are sometimes controlled by carbon dioxide (CO_2) sensors and this technology is just beginning to be available at a residential scale. Increasing CO_2 concentration is usually a good indication of decreasing air quality. But even this form of control may not be satisfactory in cases where there are unusual pollutants, such as those generated by certain hobbies.

Principal Exhaust (9.32.3.4.)

This is the principal exhaust fan installed for the purpose of maintaining acceptable indoor air quality. As such, it must be capable of drawing air from throughout the dwelling. Though actual operation will be determined by the occupants, the fan should be capable of continuous operation. Unfortunately, there is no standard method of testing and designating fans for continuous use. Therefore, such a designation is not yet a mandatory requirement.

Living areas or halls would be considered central locations [Sentence 9.32.3.4.(4)] for the installation of the principal exhaust fan control.

The principal exhaust fan is intended to provide a relatively low level of ventilation such that it can be run continuously without too much noise and without serious energy penalty. If the installed capacity exceeds the minimum by a large margin and the fan flow cannot be reduced, there is increased probability that it will not be used at all, thus defeating the purpose of having it in the first place. Thus Sentence 9.32.3.4.(2) places limits on oversizing.

Where the kitchen is chosen as the location for the principal exhaust fan air intake, certain restrictions as to where in the kitchen that intake may be located apply [Sentence 9.32.3.4.(7)]. These restrictions are related to capturing contaminants from cooking, which tend to rise as a plume from the cooking appliance and stratify near the ceiling. These restrictions preclude the use of a stove-top exhaust or range hood fan as the principal exhaust fan.

Supplemental Exhaust (9.32.3.5.)

As noted above, the kitchen is one possible location for the principal exhaust fan air intake. Where this option is not chosen, a separate kitchen exhaust fan must be installed [Sentence 9.32.3.5.(1)]. F326-M requires a certain amount of exhaust from kitchens to capture pollutants at source. If the principal exhaust fan has multiple inlets with only one in the kitchen, there will not be enough exhaust from the kitchen. Therefore, a separate kitchen exhaust fan is required in this circumstance as well.

The bathroom is also a possible location for a principal exhaust fan air intake. As with the kitchen, if this option is not chosen, a separate bathroom exhaust fan must be installed [Sentence 9.32.3.5.(2)].

Exhaust fans installed in other rooms (e.g., hobby rooms) can also contribute to the supplemental exhaust. Sentence 9.32.3.5.(3) requires that, together, the kitchen, bathroom and other supplemental exhaust fans have enough capacity to bring the total ventilation rate up from the "background or continuous" level provided by the principal exhaust fan to the "high rate or episodic" level, i.e., the required total ventilation capacity as determined from Table 9.32.3.3.

Ventilation Systems Coupled with Forced Air Heating Systems (9.32.3.6.)

Coupling a ventilation system with a forced air heating system to provide the necessary distribution of outdoor air is relatively simple. A duct brings air from outdoors to the heating system's return air plenum. Whenever the principal exhaust fan is activated, the furnace fan is automatically activated to distribute the outdoor air [Sentence 9.32.3.6.(7)]. Where no auxiliary supply fan is installed as per Clause 9.32.3.6.(4)(b), the furnace fan also drives the flow of outdoor air through the outdoor air duct. Use of an auxiliary supply fan permits the size of the outdoor air supply duct to be reduced.

This system tempers the outdoor air before it reaches occupied areas of the house by mixing it with return air in the furnace's return air plenum. It is important that thorough mixing occurs before the cold air reaches the furnace's heat exchanger, otherwise condensation of combustion products could occur, resulting in reduced heat exchanger life. The 3-m minimum distance between the furnace and the outdoor air duct connection is one means of addressing this concern. However, a well designed mixing device is likely to be more effective, as are certain arrangements of the outdoor air duct's connection to the return air plenum. Figures A-9.32.3.E., A-9.32.3.F. and A-9.32.3.G. illustrate one such device and arrangements that have been shown to be effective in research carried out by Canada Mortgage and Housing Corporation ("Testing of Fresh Air Mixing Devices," IRTA Research for Research Division of CMHC, March 1993).

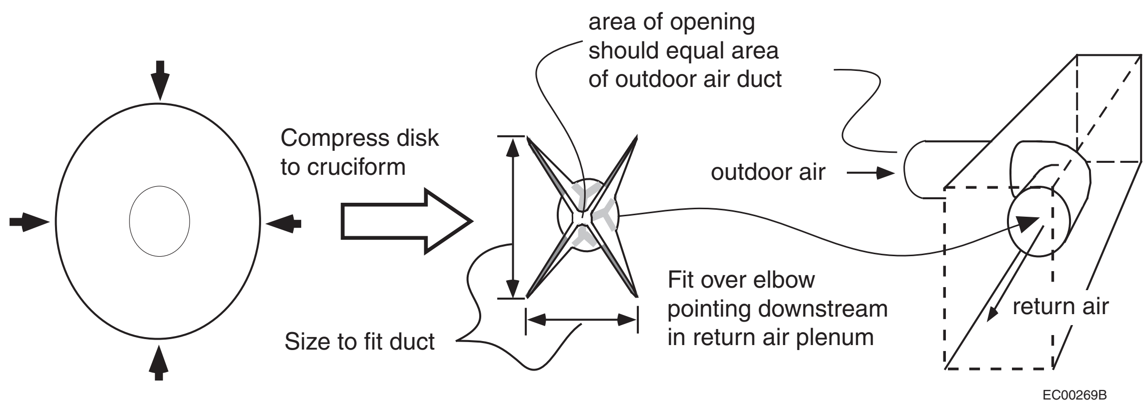


Figure A-9.32.3.E.
Simple air mixing device

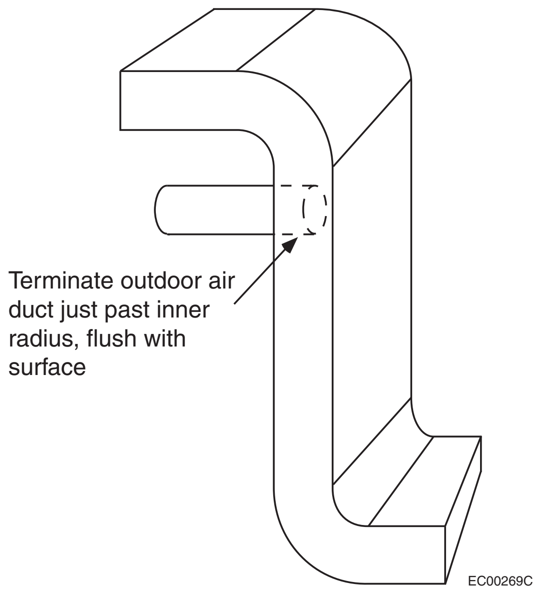


Figure A-9.32.3.F.
Outdoor air duct directly connected to drop plenum – inner side of corner

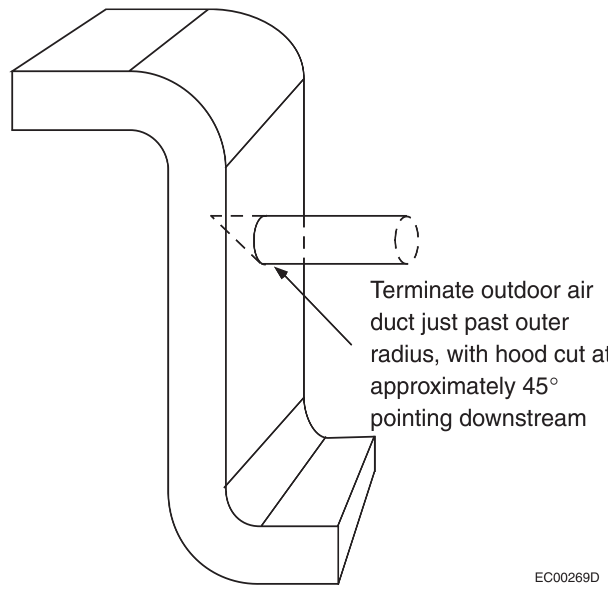


Figure A-9.32.3.G.
Outdoor air duct directly connected to drop plenum – outer side of corner

Ventilation Systems not Coupled with Forced Air Heating Systems (9.32.3.7.)

If there is no forced air heating system available or, for some reason it is elected not to use the heating system to distribute the outdoor air, then a special air distribution system must be installed. Because such a system only handles ventilation air and not heating distribution air, generally smaller ducts can be used and the supply fan is quite a bit smaller than a normal furnace circulation fan.

Sentences 9.32.3.7.(2) to (4) require that the supply fan operate at the same time and at the same rate as the principal exhaust fan in order to avoid either pressurizing or depressurizing the house. Pressurizing the house can lead to interstitial condensation within the building envelope; depressurization can lead to spillage of combustion products from heating equipment and increased entry of soil gas (see below).

The system described in Article 9.32.3.7. requires that the outdoor air be tempered before being circulated to the occupied areas of the house [Sentence 9.32.3.7.(5)]. Tempering can be accomplished by passing the outdoor air over some type of heating element or by mixing it with indoor air. However, the latter approach is more complex, since it requires that the ratio between the outdoor air and indoor air ducts or openings be neither too large nor too small. It was judged to be too complex to include within the context of these prescriptively-described requirements. Therefore, where tempering by mixing with indoor air is chosen, the system must be designed in accordance with CAN/CSA-F326-M.

Whereas a normal duct system associated with a forced air heating system would have ducts leading to almost all rooms, the requirements for this system are more limited [Sentences 9.32.3.7.(8) and (9)]. The most important point is that the outdoor air must be provided to each bedroom; people often spend long periods of time in the bedroom with the door closed. It is also required that at least one duct lead to every storey (including the basement). In houses where there is no storey without a bedroom (e.g., a basement-less bungalow), a duct must lead to the principal living area. Where there is more than one area that could be considered "living area," at least one such area must be designated as the "principal living area." There is also the alternative of locating one of the exhaust air intakes for the principal exhaust fan in the principal living area, rather than supplying outdoor air directly to it; in this arrangement, the outdoor air will pass through the principal living area on its way to the exhaust fan. However, this arrangement will be less effective if only a small portion of the exhaust is withdrawn from the principal living area; thus, there is a limitation on the number of other exhaust air intakes for the principal exhaust fan.

Protection against Depressurization (9.32.3.8.)

Depressurization of the house by the ventilation system or other exhaust devices can cause spillage of combustion products from certain types of combustion appliances. The types of appliances that are susceptible to pressure-induced spillage can generally be identified by the fact that they are vented through a natural draft chimney rather than through an arrangement which uses a fan to draw the products of combustion out of the house. Naturally-aspirated gas furnaces with draft hoods and oil furnaces with barometric dampers are examples of spillage-susceptible appliances. On the other hand, some gas furnaces with induced draft venting systems and the "sealed combustion" oil furnaces commonly used in mobile homes, are more resistant to spillage.

Terms used in gas appliance standards to describe categories of spillage-resistant appliances include "direct vented" and "side-wall-vented." Almost all fireplaces are spillage-susceptible, even those with so-called "airtight" glass doors and outside combustion air intakes, since most "airtight" doors are not really airtight. Certain types of gas combustion appliances, such as cooking appliances and "decorative appliances," are not required to be vented. Their operation will not be significantly affected by depressurization of the house.

As discussed above, the "background or continuous" portion of the system can be considered to be balanced and the "high rate or episodic" portion of the system is relatively small and only intended to be used for infrequent, short periods. Therefore, depressurization of the house by the ventilation system itself is generally not an issue unless the "high rate or episodic" portion of the system happens to be used at the same time as other exhaust devices, such as a clothes dryer; even this is likely to be of short duration. However, if the house incorporates other large exhaust devices (e.g., stove-top barbecues), they could cause high levels of depressurization when operated on their own. Therefore, in a house with spillage-susceptible appliances, any such large exhaust devices (i.e., greater than 75 L/s exhaust capacity) must be provided with make-up air [Sentence 9.32.3.8.(1)]. In the past, the NBC and other codes and standards have tended to rely on the passive supply of make-up air through make-up air openings. This is no longer felt to be a reliable approach in the context of a simple, prescriptively-described system without sophisticated controls on depressurization. Therefore, the make-up air must be provided by a supply fan that is automatically activated whenever the exhaust device that requires make-up air is activated [Sentences 9.32.3.8.(2) and (3)].

This need to provide make-up air can be avoided by avoiding the use of spillage-susceptable combustion equipment.

Even at the relatively low level of depressurization envisaged when the ventilation system is operated at its "high rate or episodic" level, an open fireplace which is operating in its "die-down" or smoldering stage can spill products of combustion into the house. In the absence of more sophisticated design and installation controls to prevent such levels of depressurization (such as those provided in CAN/CSA-F326-M), the only available safeguard is to require the installation of a carbon monoxide detector in any house incorporating an open solid-fuel burning device [Sentence 9.32.3.8.(6)]. Where this is not acceptable, the prescriptively-described alternatives must be abandoned and a system fully complying with CAN/CSA-F326-M must be designed.

Closed or closable solid-fuel burning devices, such as fireplaces with doors, are more resistant to depressurization-induced spillage than open fireplaces. They also have the "advantage" that their spillage is readily detected by a carbon monoxide detector (which is not true of gas- or oil-burning devices). Therefore, where this type of device is the only type of spillage-susceptable combustion device present, one has the choice of providing make-up air to avoid depressurization or providing a carbon monoxide detector [Sentence 9.32.3.8.(9)].

Fan Ratings (9.32.3.9.)

The principal exhaust fan is intended to be run for long periods. Even the supplemental exhaust fans may be used for significant periods. Therefore, all fans which contribute to the total ventilation capacity are required to have reasonably low sound ratings so that building occupants will not turn off these fans prematurely before the need for ventilation has passed.

Many kitchen exhaust fans have sone ratings greater than 3.5 and will not meet the requirements for fans required to achieve the total ventilation capacity. This does not preclude their use as kitchen fans intended to meet the requirements of Article 9.32.3.5.; however, their capacity may not be considered to contribute to the total ventilation capacity required by Article 9.32.3.2. It should also be noted that, where the principal exhaust fan draws all of its air from the kitchen, a supplemental kitchen exhaust fan is not required (but is not precluded).

A-9.33.1.1.(2) Combustion Air and Tight Houses. The operation of an air exhaust system or of a fuel-burning appliance removes the air from a house, creating a slight negative pressure inside. In certain cases the natural flow of air up a chimney can be reversed, leading to a possible danger of carbon monoxide poisoning for the inhabitants.

Newer houses are generally more tightly constructed than older ones because of improved construction practices, including tighter windows, weather stripping and caulking. This fact increases the probability that infiltration may not be able to supply enough air to compensate for simultaneous operation of exhaust fans, fireplaces, clothes dryers, furnaces and space heaters. It is necessary, therefore, to introduce outside air to the space containing the fuel-burning appliance. Information regarding combustion air requirements for various types of appliances can be found in the installation standards referenced in Sentences 6.2.1.4.(1) and 9.33.5.2.(1). In the case of solid-fuel burning stoves, ranges and space heaters, CSA B365 suggests that the minimum size of openings be determined by trial and error to accommodate the flue characteristics, the firing rate, the building characteristics, etc., and that, as a guide, the combustion air opening should be 0.5 times the flue collar area. r4

Further information is available in Canadian Building Digest 222, "Airtight Houses and Carbon Monoxide Poisoning," from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

A-9.33.6.14. Return Air System. It is a common practice to introduce outdoor air to the house by means of an outdoor air duct connected to the return air plenum of a forced air furnace. This is an effective method and is a component of one method of satisfying the mechanical ventilation requirements of Subsection 9.32.3. However, some caution is required. If the proportion of cold outside to warm return air is too high, the resulting mixed air temperature could lead to excessive condensation in the furnace heat exchanger and possible premature failure of the heat exchanger. Standard CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems," requires that this mixed air temperature not be below 15.5°C when the outdoor temperature is at the January 2.5% value. It is also important that the outdoor air and the return air mix thoroughly before reaching the heat exchanger. Appendix Note A-9.32.3. provides some guidance on this.

Appendix B
Fire Safety in High Buildings

B-3.2.6. Smoke Control for High Buildings. Experience with high buildings has shown that the time required for complete evacuation can exceed that which is considered necessary for the safe egress of all occupants. Studies of the "chimney effect" and observations of smoke movement in actual fires have shown that fire compartmentation to contain a fire on any one storey will not usually prevent the movement of smoke through elevator, stair and other vertical shafts to the upper floors of a high building. Occupants of a high building in which an automatic sprinkler system is not installed, and particularly those on upper storeys, could be faced with severe smoke conditions from fires occurring in storeys below them before their own evacuation is possible. The requirements of Subsection 3.2.6. are intended to maintain safe conditions for occupants of a high building who may have to remain in the building during a fire, and to assist the fire fighters by providing efficient access to the fire floor. The material in this Appendix is intended to assist a designer in complying with the requirements of Subsection 3.2.6. The knowledge requirements are well within the capabilities of a competent designer. The designer should appreciate, however, that successful application requires a clear understanding of the principles that govern smoke movement. Subsection 3.2.6. contains only those items that relate to the design and construction of a building; operation of the facilities and recommended actions to be taken by the building owner, occupant and fire department are covered by the National Fire Code of Canada 1995.

The designer is cautioned that the tabular and graphical information in this Appendix has been developed for buildings having conventional configurations. The designer has to judge the extent to which the building under consideration has characteristics that will allow the application of this information; this is particularly true of designs employing air-handling systems for which a realistic assessment of the leakage characteristics of the enclosures of spaces may be critical.

This Appendix is included for explanatory purposes only and does not form part of the requirements. The bold face reference numbers that introduce each item relate to specific requirements in the Code.

It is assumed that buildings regulated by Subsection 3.2.6. will be in an area served by a fire department capable of an early response and that all fire fighting and rescue situations will be under the direct control of the officer-in-charge of the fire department responding to the emergency. It is important that fire fighters be provided with a smoke-free access to fire floors below grade. Provisions are included to separate exit stairways serving storeys above grade from those serving storeys below grade, and to limit entry of smoke into these shafts. Similarly, elevator hoistways and service shafts are required to be provided with a separation near grade, or be designed to limit their functioning as paths of smoke movement into upper floor areas from storeys below grade.

It is assumed that in the event of fire, occupants of the floor on which the fire occurs will leave by exit stairs immediately following the sounding of a fire alarm, and that occupants of the floor immediately above the floor on which the fire occurs will be advised to leave by the first fire department officer on the scene or other person assigned this responsibility. Occupants of all other floors may remain on their floors unless otherwise directed. It is also assumed that the owner of the building has complied with the Emergency Planning Section of the National Fire Code of Canada 1995 by preparing a comprehensive fire safety plan to safeguard the building occupants and that the building supervisory staff are familiar with the requirements of Subsection 3.2.6. and with their responsibilities under the fire safety plan.

This Code requires that a check be made of the smoke control and mechanical venting systems. Testing will indicate deficiencies caused by inexact estimates of the leakage characteristics or of air supply requirements and, in all but the most extreme cases, will provide an opportunity for appropriate adjustments before the system is put into service.

B-3.2.6.2.(2) Stairway Protection Below Lowest Exit Level. A stairway serving floors below the lowest exit level is considered to comply with the intent of Sentence 3.2.6.2.(2) if the following conditions are satisfied.

1) The stairway has a vent or door to the outdoors at or near the top of the stairshaft that has an openable area of not less than 0.1 m^2 for each storey served by the stairway, less 0.01 m^2 for each weatherstripped door and 0.02 m^2 for each door that is not weatherstripped opening into the stairway.

2) The stairway is enclosed in a shaft that
a) does not pass through the floor above the lowest exit level and is separate from a shaft that contains a stairway serving upper storeys, or
b) contains a stairway serving upper storeys, but is separated from that stairway at the lowest exit level by a fire separation having a fire-resistance rating not less than that required for the shaft enclosure.

3) The stairway is provided with equipment capable of maintaining a flow of air introduced at or near the bottom of the stair shaft, at a rate equal to 0.47 m^3/s for each storey served by the stairway.

B-3.2.6.2.(3) Pressurization of Stair Shafts. The purpose of providing open doors and vents at the bottom of a stair shaft is to create a positive pressure in the shaft relative to adjacent floor areas and thus keep it free of smoke. The pressure depends on the temperature differential between the interior and the exterior of the building which is most pronounced during winter months when stack effect is greatest. If a shaft does not have a direct opening to the exterior, alternative means must be provided to achieve smoke control. If a corridor or vestibule is used as a link between the exit level of an interior stair shaft and the outdoors to provide a venting system, it will be necessary to assess the reliability of the overall system. The probability of all doors or closures being opened at the same time has to be addressed, as well as the size of the vestibule and its impact on the overall smoke control system.

If mechanical methods are used to develop a positive pressure in a stair shaft, a minimum pressure differential of 12 Pa is recommended to prevent smoke migration from floor areas in a sprinklered building where fire temperatures are controlled and smoke movement may be dominated by stack effect in a stair shaft. During a fire emergency, persons will be entering and exiting a stair shaft as they move to a place of safety and under these conditions the number of doors open to the stair shaft cannot be predetermined. The number will vary depending on the occupancy of the building, population density and the evacuation plan for the building. It should be assumed that two doors are open. This is based in part as a practical level for most buildings and considers the positive fire experience in sprinklered buildings.

The maximum pressure differential created by a mechanical system should not prevent doors to the stair shafts from being opened. A specific maximum value cannot be given, as this value will depend on the door opening force and size of the door. These values should be calculated for each specific case. Although a maximum value of 130 N is suggested by research as the force that can be opened by the majority of people in most occupancies, this value is above the maximum value of 90 N generally specified in this Code. The use of values below 130 N can create a practical problem in achieving effective smoke control as it is difficult to design for the acceptable minimum and maximum pressure differential range. Special consideration may need to be given for doors located in a barrier-free path of travel.

Care should be taken by designers and by building and fire officials in implementation of these requirements. Assumptions involved in the design of a smoke control system may be different from final construction conditions. For this reason each system should be tested after installation to ensure that the design intent is met. The minimum pressure differential is not intended to apply to locations in stair shafts when doors in their proximity are open to adjacent floor areas.

B-3.2.6.2.(4) Limiting Smoke Movement. Measures to prevent the migration of smoke from floor areas below the lowest exit storey into upper storeys include the following.

1) An elevator hoistway that passes through the floor above the lowest exit storey should not penetrate the floor of the storey immediately below the lowest exit storey, unless there is a vestibule between the shaft and each floor area below the lowest exit storey that
a) has a fire separation, with a fire-resistance rating not less than 45 min, between the vestibule and any public corridor,
b) has a fire separation, with a fire-resistance rating not less than that required for an exit by Article 3.4.4.1., between the vestibule and any stair or elevator enclosure or any part of a floor area, other than a public corridor, and
c) except for elevator hoistway entrances, has a self-closing device on any door through the fire separation required by Clauses (a) and (b), with the door opening in the direction of travel from the floor area to the exit stairway.

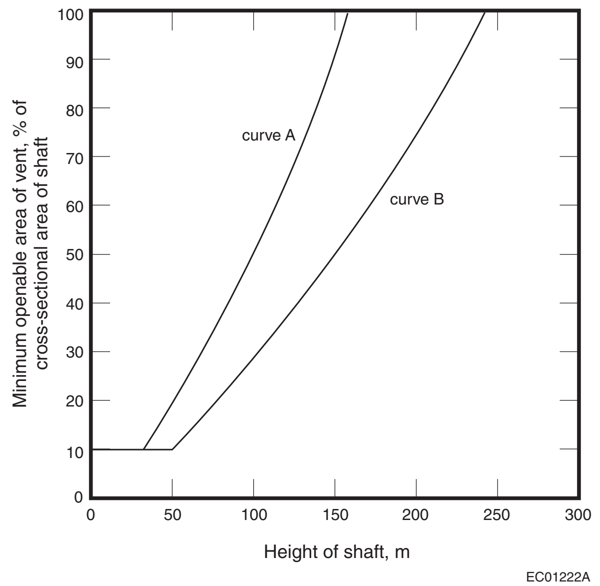


Figure B-3.2.6.2.(4).A.
Vent to a vertical service space with no other pressurized shaft in the building

Notes to Figure B-3.2.6.2.(4).A.:

(1) Curve A applies to a vertical service space that is enclosed by unplastered unit masonry or by plaster and steel stud construction with all openings in the shaft sealed to the degree required by Articles 3.1.9.1. to 3.1.9.4.
(2) Curve B applies to a vertical service space that is enclosed by monolithic concrete or by plastered unit masonry with all openings in the shaft sealed tightly to minimize air leakage.
(3) A shaft having a vent that is 100% of the cross-sectional area of the shaft is acceptable for buildings up to 1.5 times the height shown by the appropriate curve in Figures B-3.2.6.2.(4).A. and B-3.2.6.2.(4).B.
(4) The total leakage area, based on measurements in typical high buildings, is assumed to be 0.025 m^2 for every 10 m^2 of shaft wall area in the case of Curve A and 0.015 m^2 for every 10 m^2 of shaft wall area in the case of Curve B.

2) A vertical service space, other than an elevator hoistway, that passes through the floor assembly above the lowest exit storey, should be provided with a tight-fitting noncombustible seal or fire stop at the floor assembly of the storey immediately below the lowest exit storey, unless

a) the vertical service space is vented to the outdoors at the top and the vent has an openable area that is not less than
   i) that obtained from Figure B-3.2.6.2.(4).A. if the vertical service space is in a building in which other shafts are not mechanically pressurized, or
   ii) that obtained from Figure B-3.2.6.2.(4).B. if the vertical service space is in a building in which other shafts are mechanically pressurized,
b) for a shaft that serves floor areas above the lowest exit storey, a vent is located
   i) at or near the top of the shaft if the shaft is above the mid-height of the building, or
   ii) at or near the foot of the shaft at or near the exit level if the top of the shaft is below the mid-height of the building, or
c) for a shaft that serves floor areas below the lowest exit storey, a vent is located at or near the top of the shaft.

3) Any closure provided for a vent opening referred to in Sentence (2) must be openable:

a) manually,
b) on a signal from a smoke detector located at or near the top of the shaft, and
c) by a control device located at the central alarm and control facility.

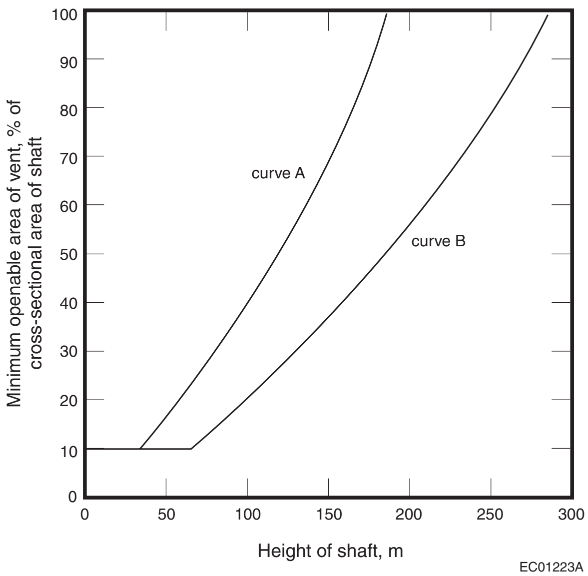


Figure B-3.2.6.2.(4).B.
Vent to a vertical service space with other pressurized shafts in the building

Notes to Figure B-3.2.6.2.(4).B.:

(1) Curve A applies to a vertical service space that is enclosed by unplastered unit masonry or by plaster and steel stud construction with all openings in the shaft sealed to the degree required by Articles 3.1.9.1. to 3.1.9.4.
(2) Curve B applies to a vertical service space that is enclosed by monolithic concrete or by plastered unit masonry with all openings in the shaft sealed tightly to minimize air leakage.
(3) A shaft having a vent that is 100% of the cross-sectional area of the shaft is acceptable for buildings up to 1.5 times the height shown by the appropriate curve in Figures B-3.2.6.2.(4).A. and B-3.2.6.2.(4).B.
(4) The total leakage area, based on measurements in typical high buildings, is assumed to be 0.025 m^2 for every 10 m^2 of shaft wall area in the case of Curve A and 0.015 m^2 for every 10 m^2 of shaft wall area in the case of Curve B.

B-3.2.6.3.(1) Connected Buildings. The measures described here are intended to prevent movement of smoke from one building to another. They are of particular significance for two buildings of unequal height that are joined together. The techniques suggested are the provision of a large opening to the outdoors in a connecting vestibule so that smoke entering through leakage areas around doors will be vented to the outdoors, or pressurization to maintain a higher pressure in the vestibule than in adjacent spaces, as illustrated in Figures B-3.2.6.3.(1).A., B-3.2.6.3.(1).B. and B-3.2.6.3.(1).C.

The provisions for protection of openings are described in terms appropriate to a doorway. Openings other than doorways should be avoided if possible. Openings should be protected by an airlock that gives the same standard of protection as the vestibule referred to below.

The requirement of Article 3.2.6.3. that limits movement of smoke from one building to another may be met by incorporating in the link between the buildings the provisions of Sentences (1) and (2).

1) A firewall conforming to Subsection 3.1.10. is constructed between one building and the other with any opening in the firewall protected against the passage of smoke by a vestibule that has

a) a fire separation between the vestibule and a public corridor with a fire-resistance rating not less than 45 min,
b) a fire separation between the vestibule and the remainder of the floor area, other than a public corridor, with a fire-resistance rating not less than that required by Article 3.4.4.1. for an exit,
c) a fire separation between the vestibule and a stair enclosure or elevator hoistway with a fire-resistance rating not less than that required by Article 3.4.4.1. for an exit, and
d) any door in the fire separation required by Clauses (a), (b) or (c), except for an elevator entrance, provided with a self-closing device as required by Article 3.1.8.11. and opening in the direction of travel from the floor area to the exit stairway.

2) The vestibule referred to in Sentence (1) should have

a) a vent to the outdoors that has a net area of 10(0.023 d + 0.00045 a) m^2, where ‘d’ is the number of doors having a perimeter not more than 6 m that open into the vestibule, or if the perimeter of doors exceeds 6 m, the value ‘d’ is increased in direct proportion to the increase in the perimeter, and ‘a’ is the area in square metres of enclosing walls, floors and ceilings whose outer face is in contact with the outside air, except that where the outer face of a wall is in contact with the ground or fill, it is assumed that there is no leakage through that portion, and the value of ‘a’ is assumed to be zero, or
b) equipment capable of maintaining a supply of air into the vestibule sufficient to ensure that the air pressure in the vestibule when the doors are closed is higher by at least 12 Pa than that in adjacent floor areas when the outdoor temperature is equal to the January design temperature on a 2.5% basis.

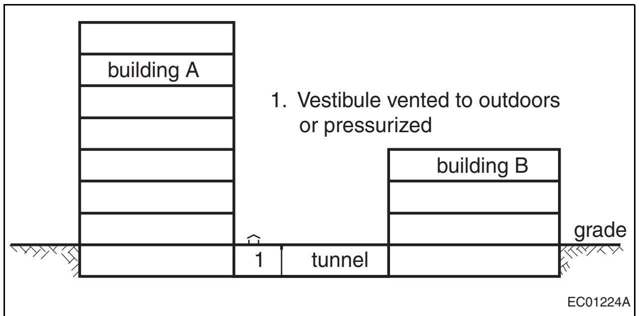


Figure B-3.2.6.3.(1).A.
Buildings connected by a tunnel

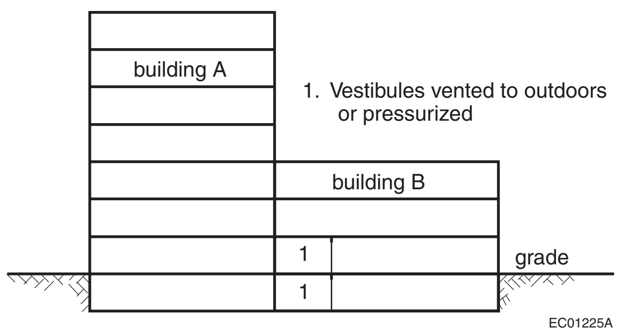


Figure B-3.2.6.3.(1).B.
Buildings connected at a firewall

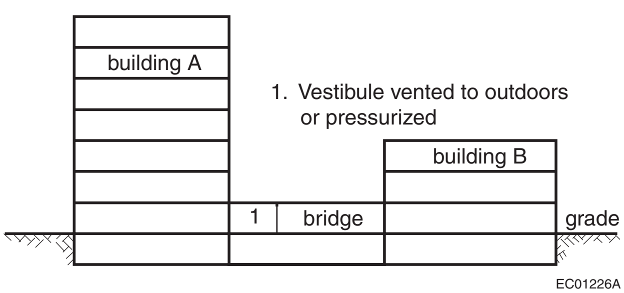


Figure B-3.2.6.3.(1).C.
Buildings connected by a bridge

B-3.2.6.5.(6)(b) Electrical Cable Protection. Electrical cables that provide continuous operation for 1 h when subjected to the fire exposure of the time/temperature curve of CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials," do not need additional protection against exposure to fire.

B-3.2.6.6.(1) Venting to Aid Fire Fighting. The requirements of Sentence 3.2.6.6.(1) are met by incorporating in a floor area windows or wall panels, as described in Sentence (1), by smoke shafts as described in Sentences (2) to (8), or by the use of building exhaust systems as described in Sentence (9).

1) If windows or wall panels are used for venting, they must
- a) be uniformly distributed along the exterior wall of each storey,
- b) have a total area not less than 1% of the exterior wall area of each storey,
- c) be readily openable from the interior without the use of wrenches or keys,
- d) be readily identified from the interior, and from the exterior where they are accessible to fire fighters, and
- e) be designed so that when opened they will not endanger persons outside the building during a fire.

2) If one or more smoke shafts or vertical service spaces are used for venting, they must
- a) have an opening or openings into each storey with an aggregate area not less than that obtained from Table B-3.2.6.6.A. for the height of the building and the area of the largest floor area served by the smoke shaft, and the leakage characteristics of the shaft wall and closures obtained from Table B-3.2.6.6.B., and Table B-3.2.6.6.C.,
- b) have an aggregate unobstructed cross-sectional area equal to that required by Clause (a), and
- c) be designed to comply with the requirements of Sentence (3).

3) Each smoke shaft or vertical service space described in Sentence (2) must
- a) be separated from the remainder of the building by a fire separation that has a fire-resistance rating not less than that required for the floor assembly through which it passes, or be designed as a chimney conforming to Part 6, except that flue liners need not be provided,
- b) have an opening to the outdoors at the top that has an area not less than the cross-sectional area of the shaft, with the opening protected from the weather,
- c) terminate not less than 900 mm above the roof surface where it penetrates the roof, and
- d) contain no combustible material, fuel lines or services that are required for use in an emergency.

4) Each opening required by Clause (2)(a) must be located so that the top of the opening is not more than 250 mm below the ceiling, except that the opening may be above the ceiling if the ceiling freely allows passage of air.

5) The opening into the smoke shaft must be provided with a closure that
- a) has a fire-protection rating conforming to Sentence 3.1.8.4.(2), except that the temperature on the unexposed face of the closure shall be not more than 250 °C after 30 min during the fire test used to determine its rating,

b) is no closer to combustible material, except for paint or tightly-adhering paper covering not more than 1 mm thick applied to a noncombustible backing, than the distances described in Table B-3.2.6.6.D.,
c) can be opened from a remote location such as a stair shaft, the storey immediately below, or the central alarm and control facility, and
d) does not open automatically on any floor, other than the fire floor, when smoke and hot gases pass through the shaft.

6) Closures for openings described in Clause (3)(b) must
a) be openable from outside the shaft, and
b) open automatically
i) on a signal from a smoke detector in the shaft,
ii) by operation of the fire alarm system, and
iii) when the closure required by Sentence (5) opens.

7) A smoke shaft opening referred to in Sentence (2) that is less than 1 070 mm above the floor must conform to Article 3.3.1.17.

8) If a closure is required to comply with Sentence (5), the leakage area between closure components and between closure and frame must not be more than 3% of the openable area of the closure.

9) The building air handling system may be used for smoke venting, provided
a) the system can maintain an exhaust to the outdoors at the rate of 6 air changes per hour from any floor area, and
b) emergency power to the fans providing the exhaust required by Clause (a) is provided as described in Article 3.2.7.9.

Table B-3.2.6.6.A.
Minimum Size of Vent Openings into Smoke Shafts from Each Floor Area, m^2(1)(2)

Floor Area, m^2	Leakage Area, %(3)	Building Height, m								
		18	37	73	110	146	183	220	256	293
200	0	0.10	0.11	0.13	0.15	0.16	0.18	0.19	0.20	0.22
500		0.22	0.25	0.29	0.32	0.36	0.37	0.39	0.41	0.43
1 000		0.43	0.48	0.53	0.59	0.63	0.67	0.71	0.75	0.77
2 000		0.83	0.91	1.01	1.08	1.16	1.22	1.29	1.34	1.39
3 000		1.21	1.33	1.46	1.55	1.67	1.75	1.82	1.90	1.97
4 000		1.62	1.75	1.90	2.02	2.15	2.25	2.35	2.44	2.53
5 000		2.01	2.17	2.34	2.46	2.63	2.74	2.86	2.88	3.07
6 000		2.39	2.57	2.76	2.91	3.10	3.23	3.37	3.47	3.58
200	1	0.10	0.12	0.15	0.19	0.22	0.27	0.35	0.43	0.55
500		0.23	0.27	0.35	0.40	0.49	0.57	0.69	0.83	1.04
1 000		0.44	0.50	0.71	0.72	0.86	1.01	1.19	1.43	1.73
2 000		0.85	0.97	1.15	1.33	1.56	1.81	2.10	2.48	2.95
3 000		1.26	1.42	1.67	1.91	2.23	2.56	2.97	3.47	4.08
4 000		1.66	1.88	2.18	2.49	2.37	3.28	3.79	4.40	5.16
5 000		2.07	2.32	2.69	3.05	3.51	3.99	4.60	5.32	6.21
6 000		2.47	2.76	3.18	3.59	4.14	4.68	5.37	6.20	7.23
200	2	0.10	0.13	0.18	0.24	0.37	0.61	1.28	4.60	89.57
500		0.24	0.29	0.39	0.52	0.75	1.13	2.10	6.11	94.50
1 000		0.46	0.55	0.72	0.94	1.30	1.90	3.27	8.29	102.11
2 000		0.88	1.05	1.34	1.73	2.32	3.28	5.36	12.14	116.80
3 000		1.31	1.53	1.95	2.47	3.29	4.58	7.28	15.63	130.83
4 000		1.73	2.01	2.55	3.20	4.23	5.83	9.12	19.97	144.03
5 000		2.15	2.49	3.13	3.92	5.15	7.05	10.90	22.15	157.05
6 000		2.57	2.96	3.73	4.63	6.07	8.26	12.65	25.39	169.29

Table B-3.2.6.6.A. (Continued)

Floor Area, m^2	Leakage Area, %[3]	Building Height, m								
		18	37	73	110	146	183	220	256	293
200	3	0.11	0.14	0.21	0.37	0.88	2.06			
500		0.25	0.31	0.47	0.76	1.58	9.00			
1 000		0.47	0.59	0.86	1.33	2.60	11.99			
2 000		0.91	1.12	1.60	2.41	4.47	17.46			
3 000		1.35	1.64	2.31	3.43	5.21	22.48			
4 000		1.79	2.17	3.02	4.43	7.91	27.29			
5 000		2.22	2.68	3.71	5.42	9.55	31.95			
6 000		2.65	3.20	4.40	6.39	11.18	36.47			
200	4	0.11	0.15	0.28	0.70	24.83				
500		0.25	0.34	0.58	1.33	29.18				
1 000		0.49	0.63	1.06	2.27	36.07				
2 000		0.95	1.21	1.97	3.99	48.56				
3 000		1.41	1.78	2.84	6.63	60.15				
4 000		1.86	2.34	3.70	7.22	71.15				
5 000		2.21	2.90	4.55	8.79	81.81				
6 000		2.75	3.46	5.40	10.33	90.05				
200	5	0.11	0.16	0.36	3.33					
500		0.28	0.36	0.76	5.09					
1 000		0.50	0.69	1.37	7.67					
2 000		0.99	1.31	2.54	12.35					
3 000		1.46	1.94	3.65	16.75					
4 000		1.92	2.55	4.75	20.99					
5 000		2.40	3.16	5.84	25.11					
6 000		2.87	3.74	6.92	29.11					

Notes to Table B-3.2.6.6.A.:

(1) The minimum size of a vent opening into a smoke shaft is obtained from Table B-3.2.6.6.A. and is dependant on the floor area and total leakage area of the smoke shaft walls and closures. This total leakage area may be estimated by adding the leakage areas for the shaft wall obtained from Table B-3.2.6.6.B. and for the dampered openings obtained from Table B-3.2.6.6.C., provided the cross-sectional area of the smoke shaft, the opening into the shaft and the opening to the outdoors at the top of the shaft are equal.

(2) The size of the vent opening refers to the free or unobstructed area of the opening.

(3) Leakage area is the total of the leakage area of smoke shaft wall obtained from Table B-3.2.6.6.B. and the leakage area of openings in smoke shafts obtained from Table B-3.2.6.6.C.

Table B-3.2.6.6.B.
Leakage Area of Smoke Shaft Wall

Wall Construction	Leakage Area as % of Wall Area
Monolithic concrete	0.5
Masonry wall unplastered	1.5
Masonry wall plastered	0.5
Gypsum board on steel studs	1.0

Table B-3.2.6.6.C.
Leakage Area of Closures in Openings into Smoke Shaft

Type of Closure	Leakage Area as % of Closure Area(1)(2)
Curtain fire damper	2.5
Single-blade fire damper	3.5
Multi-blade fire damper	4.5

Notes to Table B-3.2.6.6.C.:

(1) Values include allowance for 0.5% leakage between frame and wall construction.

(2) These leakage data are based on clearances applicable to closures that have been tested in accordance with CAN/ULC-S112-M, "Fire Test of Fire Damper Assemblies."

Table B-3.2.6.6.D.
Minimum Distance from Closure to Combustible Material

Area of Closure(1), m^2	Minimum Distance in Front of or Above Closure, m	Minimum Distance to the Sides or Below Closure, m
0.5	0.35	0.20
1.0	0.50	0.25
1.5	0.60	0.30
2.0	0.70	0.35
2.5(2)	0.80	0.40

Notes to Table B-3.2.6.6.D.:

(1) For closure areas between those given in Table B-3.2.6.6.D., interpolation may be used to determine the appropriate distances.

(2) For closure areas greater than 2.5 m^2, the minimum distance in front of or above the closure shall be one half of the square root of the closure area, and the minimum distance to the sides or below the closure shall be one quarter of the square root of the closure area.

B-3.2.6.7.(1) Protection of Central Control Room. The design of a room provided for a central alarm and control facility should take into account the nature and sensitivity of the electronic components of the equipment and the room should be adequately protected from fire and smoke. The room should be ventilated with a supply of fresh air so that it has a clean environment and should be provided with adequate lighting.

B-3.2.6.7.(2) Central Control Room Air Control. Depending on the method of mechanical venting and air control that is selected for the building, additional controls may be required at the central alarm and control facility. These additional controls include those with a capability of opening closures to vents in shafts, stopping air-handling systems, and initiating mechanical air supply to stair shafts.

B-3.2.6.10.(1) Testing for Smoke Control. The efficiency of a smoke control system may be checked by measuring pressure differences and the directions of air flow around doors and through separating walls of compartments. A pressure meter can be used to measure pressure differences on either side of a door or partition. Where this is impracticable, a punk stick held near a crack will indicate the direction of air flow. Measurements of air flow may be taken on the intake side of supply fans or in supply ducts to determine whether the specified air flow is being provided. In general, air flow should be from the spaces which may be occupied for various lengths of time during a fire emergency (e.g., vestibules, stair shafts, and elevator hoistways) toward the space in which the fire is assumed to have occurred. Measurements may be taken at certain critical locations to check the overall efficiency of the smoke control system.

In buildings where protection is obtained by venting corridors or vestibules to the outdoors, inspection of the building to determine whether the requirements have been met should be sufficient. Where service shafts are vented to the outdoors at the top, a check may be made of the wall between the shaft and the uppermost occupied floor areas, to ensure that the direction of flow is from each floor area into the shaft, when the vent to the outside is open and the outdoor air temperature is significantly less than that indoors. Where mechanically pressurized vestibules are used, a check may be made to ensure that the pressure in each vestibule or area of refuge is greater than that in the adjacent floor areas at each floor level.

Doors to stair shafts, elevator hoistways and vestibules in locations subject to pressure differences that may interfere with normal opening should be checked when the outdoor temperature is near the January design temperature, with the air injection system operating and a number of windows open to the outdoors on each floor in turn.

Appendix C
Climatic Information for Building Design in Canada

Introduction

The great diversity of climate in Canada has a considerable effect on the performance of buildings; consequently, building design must reflect this diversity. This Appendix briefly describes how climatic design values are computed and provides recommended design data for a number of cities, towns, and smaller populated locations. Through the use of such data, appropriate allowances can be made for climate variations in different localities of Canada and the National Building Code can be applied nationally.

The climatic design data provided in this Appendix (previously published as Chapter 1 of the Supplement to the NBC) are based on weather observations collected by the Atmospheric Environment Service, Environment Canada. The climatic design data have been researched and analyzed for the Canadian Commission on Building and Fire Codes by Environment Canada, and appear at the end of this Appendix under the heading Design Data for Selected Locations in Canada.

As it is not practical to list values for all municipalities in Canada, recommended climatic design values for locations not listed can be obtained by writing to the Atmospheric Environment Service, Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4 or by contacting (416) 739-4365. It should be noted, however, that these recommended values may differ from the legal requirements set by provincial, territorial or municipal building authorities.

The information on seismic zones has been provided by the Geological Survey of Canada of Natural Resources Canada. Information for municipalities not listed may be obtained by writing to the Geophysics Division, Geological Survey of Canada, Natural Resources Canada, Ottawa, Ontario K1A 0Y3, or the Pacific Geoscience Centre, Geological Survey of Canada, P.O. Box 6000, Sidney, B.C. V8L 4B2.

This Appendix is included for explanatory purposes only and does not form part of the requirements.

General

The choice of climatic elements tabulated in this Appendix and the form in which they are expressed have been dictated largely by the requirements for specific values in several sections of the National Building Code of Canada 1995. These elements include the Ground Snow Loads, Wind Pressures, Design Temperatures, Heating Degree-Days, One-Day and 15-Minute Rainfalls, the Annual Total Precipitation values and Seismic Data. The following notes explain briefly the significance of these particular elements in building design, and indicate which weather observations were used and how they were analyzed to yield the required design values.

In the Design Data for Selected Locations in Canada (referred to in the Appendix as the Table), design weather recommendations and elevations are listed for over 600 locations. These locations have been chosen for a variety of reasons. Many incorporated cities and towns with significant populations have been included unless located close to larger cities. For sparsely populated areas, many smaller towns and villages have been listed. Other locations have been added to the list when the demand for climatic design recommendations at these sites has been significant. The named locations refer to the specific latitude and longitude defined by the Gazetteer of Canada (Natural Resources Canada), available from Mail Order Services, Canadian Government Publishing Centre, Ottawa, Ontario K1A 0S9. The elevations are given in metres and refer to heights above sea level.

Almost all of the weather observations used in preparing the Table were, of necessity, observed at inhabited locations. To estimate design values for arbitrary locations, the observed or computed values for the weather stations were mapped and interpolated appropriately. Where possible, adjustments have been applied for the influence of elevation and known topographical effects. Such influences include the tendency of cold air to collect in depressions, for precipitation to increase with elevation, and for generally stronger winds near large bodies of water. Elevations have been added to the Table because of their potential to significantly influence climatic design values.

Since interpolation from the values in the Table to other locations may not be valid due to local and other effects, Environment Canada will provide climatic design element recommendations for locations not listed in the Table. Local effects are particularly significant in mountainous areas, where the values apply only to populated valleys and not to the mountain slopes and high passes, where very different conditions are known to exist.

Changing and Variable Climates

Climate is not static. At any location, weather and climatic conditions vary from season to season, year to year, and over longer time periods (climate cycles). This has always been the case. When estimating climatic design loads, this variability can be considered using appropriate statistical analysis, sufficient length of data records, and meteorological judgement. The analysis generally assumes that the past climate will be representative of the future climate.

Past and ongoing modifications to atmospheric chemistry (from greenhouse gas emissions and land use changes) are expected to alter most climatic regimes in future. As a result, it can no longer be safely assumed that the climate of the past few decades will be a sufficient guide to the climate of the next few decades. While average climatic conditions may be changing, the frequency and magnitude of extreme climatic events may also be changing in unknown ways. Although consensus is emerging on the long-term trends for some climatic elements, there is no agreement as yet on the changes expected in climatic variability.

January Design Temperatures

A building and its heating system should be designed to maintain the inside temperature at some pre-determined level. To achieve this, it is necessary to know the most severe weather conditions under which the system will be expected to function satisfactorily. Failure to maintain the inside temperature at the pre-determined level will not usually be serious if the temperature drop is not great and if the duration is not long. The outside conditions should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The January design temperatures are based on an analysis of January air temperatures only. Wind and solar radiation also affect the inside temperature of most buildings and may need to be considered for energy-efficient design.

The January design temperature is defined as the lowest temperature at or below which only a certain small percentage of the hourly outside air temperatures in January occur. In the past, a total of 158 stations with records from all or part of the period 1951-66 formed the basis for calculation of the 2.5 and 1% January temperatures. Where necessary, the data were adjusted for consistency. Since most of the temperatures were observed at airports, design values for the core areas of large cities could be 1 or 2°C milder, although the values for the fringe areas are probably about the same as for the airports. No adjustments were made for this urban heat island effect. The design values for the next 20 to 30 years probably will differ from these tabulated values due to year-to-year climate variability and global climate change resulting from human modifications to atmospheric chemistry.

A review of the design temperatures was undertaken for the 1995 issue of this Appendix using hourly temperature observations from 265 stations for the length of record up to 1993. Where needed, hourly temperatures were supplemented with correlated record minimum temperatures from 1449 long-term stations. The results from the recent analysis indicated reasonable consistency with the previous recommendations. Consequently, the January design temperatures remain unchanged from previous issues of the Supplement to the National Building Code of Canada.

The 2.5% January design temperature is the value ordinarily used in the design of heating systems. In special cases, when the control of inside temperature is more critical, the 1% value may be used. Other temperature-dependent climatic design parameters may be considered for future issues of this document.

July Design Temperatures

A building and its cooling and dehumidifying system should be designed to maintain the inside temperature and humidity at certain pre-determined levels. To achieve this, it is necessary to know the most severe weather conditions under which the system is expected to function satisfactorily. Failure to maintain the inside temperature and humidity at the pre-determined levels will usually not be serious if the increases in temperature and humidity are not great and the duration is not long. The outside conditions used for design should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The summer design temperatures in this Appendix are based on an analysis of July air temperatures and humidities. Wind and solar radiation also affect the inside temperature of most buildings and may, in some cases, be more important than the outside air temperature. More complete summer and winter design information can be obtained from Environment Canada.

In the past, two datasets formed the basis for calculation of the July 2.5% dry-bulb temperatures. The first dataset was based on temperature frequency distributions for 33 stations and an empirical relationship between design temperatures and the mean annual maximum temperature. The second dataset consisted of hourly data summaries for 109 stations based on records from 1957 to 1966. Results from the two datasets were averaged and adjusted for consistency. The July 2.5% wet-bulb temperatures were obtained in a similar way, using the two datasets, but without the use of an empirical relationship for the first dataset.

A review of the July design temperatures was undertaken for the 1995 issue of this Appendix. Design dry-bulb temperatures were analyzed using hourly temperature observations from 264 stations for the length of record up to 1993. Where needed, hourly dry-bulb temperatures were supplemented with correlated record maximum temperatures from 1450 long-term stations. The July 2.5% coincident wet-bulb temperatures were obtained by averaging wet-bulb temperatures for all hours when the dry-bulb temperature was within 0.2°C of the July design dry-bulb temperature. A comparison of the results indicated reasonable consistency for design dry-bulb temperatures but some differences for design wet-bulb temperatures that will be investigated for future issues. The July design temperatures remain unchanged for this issue.

Heating Degree-Days

The rate of consumption of fuel or energy required to keep the interior of a small building at 21°C when the outside air temperature is below 18°C is roughly proportional to the difference between 18°C and the outside temperature. Wind speed, solar radiation, the extent to which the building is exposed to these elements and the internal heat sources also affect the heat required and may have to be considered for energy-efficient design. For average conditions of wind, radiation, exposure, and internal sources, however, the proportionality with the temperature difference generally still holds.

Since the fuel required is also proportional to the duration of the cold weather, a convenient method of combining these elements of temperature and time is to add the differences between 18°C and the mean temperature for every day in the year when the mean temperature is below 18°C. It is assumed that no heat is required when the mean outside air temperature for the day is 18°C or higher.

Although more sophisticated computer simulations using other forms of weather data have now almost completely replaced degree-day-based calculation methods for estimating annual heating energy consumption, degree-days remain a useful indicator of relative severity of climate and can form the basis for certain climate-related code requirements.

The degree-days below 18°C have been computed day by day for 1030 stations for the length of record available from the period 1961 to 1990. The average annual degree-day values were then interpolated from analyzed maps. When observations with 20 years or more of record were available, recommendations for those locations were weighted towards the observed value.

A difference of only one Celsius degree in the mean annual temperature will cause a difference of 250 to 350 in the Celsius degree-days. Since differences of 0.5 of a Celsius degree in the mean annual temperature are quite likely to occur between two stations in the same town, heating degree-days cannot be relied on to an accuracy of less than about 100 degree-days.

Heating degree-day values for the core areas of larger cities can be 200 to 400 degree-days less (warmer) than for the surrounding fringe areas. The observed degree-days, which are based on daily temperature observations, are often most representative of rural settings or the fringe areas of cities.

Rainfall Intensity

Roof drainage systems are designed to carry off the rainwater from the most intense rainfall that is likely to occur. A certain amount of time is required for the rainwater to flow across and down the roof before it enters the gutter or drainage system. This results in the smoothing out of the most rapid changes in rainfall intensity. The drainage system, therefore, need only cope with the flow of rainwater produced by the average rainfall intensity over a period of a few minutes, which can be called the concentration time.

In Canada, it has been customary to use the 15-minute rainfall that will probably be exceeded on an average of once in 10 years. The concentration time for small roofs is much less than 15 minutes and hence the design intensity will be exceeded more frequently than once in 10 years. The safety factors in the National Plumbing Code of Canada will probably reduce the frequency to a reasonable value and, in addition, the occasional failure of a roof drainage system will not be particularly serious in most cases.

The rainfall intensity values tabulated in previous editions of this document were based on measurements of the annual maximum 15-minute rainfalls at 139 stations with 7 or more years of record. They were the 15-minute rainfalls that would be exceeded once in 10 years on the average, or the values that had one chance in 10 of being exceeded in any one year. The values were analyzed using a Gumbel extreme value distribution.[1]

It is very difficult to estimate the pattern of rainfall intensity in mountainous areas, where precipitation is extremely variable. Many of the observations for these areas were taken at locations in valley bottoms or in extensive, fairly level areas. Much greater intensities can occur on mountainsides.

One-Day Rainfall

If for any reason a roof drainage system becomes ineffective, the accumulation of rainwater may be great enough in some cases to cause a significant increase in the load on the roof. It has been common practice in previous editions of this document to use the maximum one-day rainfall ever observed for estimating the additional load. Since the length of record for weather stations in Canada is quite variable, the maximum one-day rainfall amounts in previous editions often reflected the variable length of record at nearby stations as much as the climatology. As a result, the maximum values often differed greatly within relatively small areas where little difference should be expected. The current values have been standardized to represent the one-day rainfall amounts that have one chance in 30 of being exceeded in any one year or the one-in-30-year return value one-day rainfalls.

The 24-hour rainfall values in the Table were based on measurements of the annual maximum one-day rainfalls for 2051 stations with 10 years or more of record. These one-in-30–year values were obtained using a Gumbel extreme value distribution fitted using the method of moments.[1]

Rainfall frequency observations can vary considerably over time and space. This is especially true for mountainous areas, where elevation effects can be significant. In other areas, small scale intense storms or local influences can produce significant spatial variability in the data. As a result, the analysis has incorporated some spatial smoothing.

Annual Total Precipitation

The total amount of precipitation that normally falls in one year is frequently used as a general indication of the wetness of a climate, and is therefore included in this Appendix. Total precipitation is the sum in millimetres of the measured depth of rainwater and the estimated or measured water equivalent of the snow (typically estimated as 0.1 of the measured depth of snow, since the average density of fresh snow is about 0.1 that of water).

The average annual total precipitation amounts in the Table have been interpolated from an analysis of precipitation observations from 1379 stations for the 30-year period from 1961 to 1990.

Snow Loads

The roof of a building should be able to support the greatest weight of snow that is likely to accumulate on it in many years. Some observations of snow on roofs have been made in Canada, but not enough to form the basis for estimating roof snow loads throughout the country. Similarly, observations of the weight, or water equivalent, of the snow on the ground have not been available in digital form in the past. The observations of roof loads and water equivalents are very useful, as noted below, but the measured depth of snow on the ground is used to provide the basic information for a consistent set of snow loads.

The estimation of the design snow load on a roof from snow depth observations involves the following steps:

1. The depth of snow on the ground which has an annual probability of exceedence of 1-in-30 is computed.
2. The appropriate unit weight is selected and used to convert snow depth to loads, S_s.
3. The load, S_r, due to rain falling on the snow is computed.
4. Because the accumulation of snow on roofs is often different from that on the ground, adjustments are applied to the ground snow load to provide a design snow load on a roof.

The annual maximum depth of snow on the ground has been assembled for 1618 stations for which data has been recorded by the Atmospheric Environment Service (AES). The period of record used varied from station to station, ranging from 7 to 38 years. These data were analyzed using a Gumbel extreme value distribution fitted using the method of moments[1] as reported by Newark et al.[2] The resulting values are the snow depths which have a probability of 1-in-30 of being exceeded in any one year.

The unit weight of old snow generally ranges from 2 to 5 kN/m^3, and it is usually assumed in Canada that 1 kN/m^3 is the average for new snow. Average unit weights of the seasonal snow pack have been derived for different regions across the country[3] and an appropriate value has been assigned to each weather station. Typically, the values average 2.01 kN/m^3 east of the continental divide (except for 2.94 kN/m^3 north of the treeline), and range from 2.55 to 4.21 kN/m^3 west of the divide. The product of the 1-in-30 snow depth and the average unit weight of the seasonal snow pack at a station is converted to the snow load (SL) in units of kilopascals (kPa).

Except for the mountainous areas of western Canada, the values of the ground snow load at AES stations were normalized assuming a linear variation of the load above sea level in order to account for the effects of topography. They were then smoothed using an uncertainty-weighted moving-area average in order to minimize the uncertainty due to snow depth sampling errors and site-specific variations. Interpolation from analyzed maps of the smooth normalized values yielded a value for each location in the Table, which could then be converted to the listed code values (S_s) by means of an equation in the form:

S_s = smooth normalized SL + bZ

where b is the assumed rate of change of SL with elevation at the location and Z is the location's elevation above mean sea level (MSL). Although they are listed in the Table of Design Data to the nearest tenth of a kilopascal, values of S_s typically have an uncertainty of about 20%. Areas of sparse data in northern Canada were an exception to this procedure. In these regions, an analysis was made of the basic SL values. The effects of topography, variations due to local climates, and smoothing were all subjectively assessed. The values derived in this fashion were used to modify those derived objectively.

For the mountainous areas of British Columbia, Yukon, and the foothills area of Alberta, a more complex procedure was required to account for the variation of loads with terrain and elevation. Since the AES observational network often does not have sufficient coverage to detail this variability in mountainous areas, additional snow course observations were obtained from the provincial and territorial governments of British Columbia, Yukon, and Alberta. The additional data allowed detailed local analysis of ground snow loads on a valley-by-valley basis. Similar to other studies, the data indicated that snow loads above a critical or reference level increased according to either a linear or quadratic relation with elevation. The determination of whether the increase with elevation was linear or quadratic, the rate of the increase and the critical or reference elevation were found to be specific to the valley and mountain ranges considered. At valley levels below the critical elevation, the loads generally varied less significantly with elevation. Calculated valley and range specific regression relations then were used to describe the increase of load with elevation and to normalize the AES snow observations to a critical or reference level. These normalized values were smoothed using a weighted moving-average.

Tabulated values cannot be expected to indicate all the local differences in S_s. For this reason, especially in complex terrain areas, values should not be interpolated from the Table for unlisted locations. The values of S_s in the Table apply for the elevation and the latitude and longitude of the location, as defined by the Gazetteer of Canada. Values at other locations can be obtained from Environment Canada.

The heaviest loads frequently occur when the snow is wetted by rain, thus the rain load (S_r) was estimated to the nearest 0.1 kPa and is provided in the Table. Values of S_r, when added to S_s, provide a 1-in-30-year estimate of the combined ground snow and rain load. The values of S_r are based on an analysis of about 2100 weather station values of the 1-in-30-year one-day maximum rain amount. This return period is appropriate because the rain amounts correspond approximately to the joint frequency of occurrence of the one-day rain on maximum snow packs. For the purpose of estimating rain on snow, the individual observed one-day rain amounts were constrained to be less than or equal to the snow pack water equivalent, which was estimated by a snow pack accumulation model reported by Bruce and Clark.(4)

The results from surveys of snow loads on roofs indicate that average roof loads are generally less than loads on the ground. The conditions under which the design snow load on the roof may be taken as a percentage of the ground snow load are given in Subsection 4.1.7. of the National Building Code of Canada 1995. The Code also permits further decreases in design snow loads for steeply sloping roofs, but requires substantial increases for roofs where snow accumulation may be more rapid due to such factors as drifting. Recommended adjustments are given in the Structural Commentaries on the National Building Code of Canada 1995.

Wind Effects

All structures need to be designed to ensure that the main structural system and all secondary components, such as cladding and appurtenances, will withstand the pressures and suctions caused by the strongest wind likely to blow at that location in many years. Some flexible structures, such as tall buildings, slender towers and bridges, also need to be designed to minimize excessive wind-induced oscillations or vibrations.

At any time, the wind acting upon a structure can be treated as a mean or time-averaged component and as a gust or unsteady component. For a small structure, which is completely enveloped by wind gusts, it is only the peak gust velocity that needs to be considered. For a large structure, the wind gusts are not well correlated over its different parts and the effects of individual gusts become less significant. The Structural Commentaries on the National Building Code of Canada 1995 evaluate the mean pressure acting on a structure, provide appropriate adjustments for building height and exposure, and for the influence of the surrounding terrain and topography (including wind speedup for hills), and then incorporate the effects of wind gusts by means of the gust factor. The gust factor varies according to the type of structure and the size of the area over which the pressure acts.

The wind speeds and corresponding velocity pressures used in the Code are regionally representative or reference values. The reference wind speeds are nominally one-hour averages of wind speeds representative of the 10 m height in flat open terrain corresponding to Exposure A in the terminology of the Structural Commentaries on the National Building Code of Canada 1995. The reference wind speeds and wind velocity pressures are based on long-term wind records observed at a large number of weather stations across Canada.

In the past, reference wind velocity pressures in the Code have been calculated from hourly averaged wind speed observations measuring the number of miles of wind passing a wind anemometer cup in one hour. The pressures derived from these measurements were representative of true hourly wind pressures. When wind pressures were last calculated in the early 1960's, the hourly averaged wind speeds were the records most commonly available for statistical analysis. Since that time, the majority of the principal observation stations, including the major airports, have converted their observation programs to aviation type wind speed measurements or spot readings of wind speed.[5] These one-minute averaged wind speeds (later converted to two-minute averages) were observed just before the hour.

True one-hour averaged wind speed records from over 100 stations for periods from 10 to 22 years formed the basis for most of the wind pressures provided in the Table. The wind velocity pressures, q, were calculated in Pascals using the following equation:

$$q = \frac{1}{2}\rho V^2$$

where ρ is an average air density for the windy months of the year and V is wind speed in metres per second. While air density depends on both air temperature and atmospheric pressure, the density of dry air at 0°C and standard atmospheric pressure of 1.2929 kg/m^3 was used as an average value for the wind pressure calculations. As explained by Boyd[6], this value is within 10% of the monthly average air densities for most of Canada in the windy part of the year.

Hourly wind speeds that have one chance in 10, 30 and 100* of being exceeded in any one year were analyzed using the Gumbel extreme value distribution fitted using the method of moments with correction for sample size. Values of the one-in-30-year wind speeds for locations in the Table were estimated from a mapping analysis of wind speeds. The one-in-10- and one-in-100-year speeds were then computed from the one-in-30-year speeds using a map of the dispersion parameter that occurs in the Gumbel analysis.[1]

The following table has been arranged to give pressures to the nearest one-hundredth of a kPa and their corresponding wind speeds. The value of "q" in kPa is assumed to be equal to 0.00064645 V^2, where V is given in m/s.

* Wind speeds that have a one-in-"n"-year chance of being exceeded in any year can be computed from the one-in-10 and one-in-30 return values in the table using the following equation:

$$V_{1/n} = V_{1/30} + \frac{V_{1/10} - V_{1/30}}{-1.1339} \times \ln \frac{-0.0339}{\ln(1 - 1/n)}$$

Table C-1
Wind Speeds

q kPa	V m/s	q kPa	V m/s	q kPa	V m/s	q kPa	V m/s
0.15	15.2	0.53	28.6	0.91	37.5	1.29	44.7
0.16	15.7	0.54	28.9	0.92	37.7	1.30	44.8
0.17	16.2	0.55	29.2	0.93	37.9	1.31	45.0
0.18	16.7	0.56	29.4	0.94	38.1	1.32	45.2
0.19	17.1	0.57	29.7	0.95	38.3	1.33	45.4
0.20	17.6	0.58	30.0	0.96	38.5	1.34	45.5
0.21	18.0	0.59	30.2	0.97	38.7	1.35	45.7
0.22	18.4	0.60	30.5	0.98	38.9	1.36	45.9
0.23	18.9	0.61	30.7	0.99	39.1	1.37	46.0
0.24	19.3	0.62	31.0	1.00	39.3	1.38	46.2
0.25	19.7	0.63	31.2	1.01	39.5	1.39	46.4
0.26	20.1	0.64	31.5	1.02	39.7	1.40	46.5
0.27	20.4	0.65	31.7	1.03	39.9	1.41	46.7
0.28	20.8	0.66	32.0	1.04	40.1	1.42	46.9
0.29	21.2	0.67	32.2	1.05	40.3	1.43	47.0
0.30	21.5	0.68	32.4	1.06	40.5	1.44	47.2
0.31	21.9	0.69	32.7	1.07	40.7	1.45	47.4
0.32	22.2	0.70	32.9	1.08	40.9	1.46	47.5
0.33	22.6	0.71	33.1	1.09	41.1	1.47	47.7
0.34	22.9	0.72	33.4	1.10	41.3	1.48	47.8
0.35	23.3	0.73	33.6	1.11	41.4	1.49	48.0
0.36	23.6	0.74	33.8	1.12	41.6	1.50	48.2
0.37	23.9	0.75	34.1	1.13	41.8	1.51	48.3
0.38	24.2	0.76	34.3	1.14	42.0	1.52	48.5
0.39	24.6	0.77	34.5	1.15	42.2	1.53	48.6
0.40	24.9	0.78	34.7	1.16	42.4	1.54	48.8
0.41	25.2	0.79	35.0	1.17	42.5	1.55	49.0
0.42	25.5	0.80	35.2	1.18	42.7	1.56	49.1
0.43	25.8	0.81	35.4	1.19	42.9	1.57	49.3
0.44	26.1	0.82	35.6	1.20	43.1	1.58	49.4
0.45	26.4	0.83	35.8	1.21	43.3	1.59	49.6
0.46	26.7	0.84	36.0	1.22	43.4	1.60	49.7
0.47	27.0	0.85	36.3	1.23	43.6	1.61	49.9
0.48	27.2	0.86	36.5	1.24	43.8	1.62	50.1
0.49	27.5	0.87	36.7	1.25	44.0	1.63	50.2
0.50	27.8	0.88	36.9	1.26	44.1	1.64	50.4
0.51	28.1	0.89	37.1	1.27	44.3	1.65	50.5
0.52	28.4	0.90	37.3	1.28	44.5	1.66	50.7

A complete re-analysis of wind velocity pressures was undertaken for the 1995 issue of this document using aviation-type wind records and wind gust records. When necessary, the aviation-type wind speeds were adjusted to represent winds at 10 m above ground. Also, wind gust records were evaluated and, using an appropriate gust ratio, equivalent one-hour average speeds were estimated or "back calculated" to check the consistency of the hourly records, as discussed by Yip, Auld, and Dnes.[7] A total of 233 aviation-type wind records and 216 wind gusts were analyzed to obtain the speeds that have one chance in 30 of being exceeded in any year.

The results of the recent analysis were compared with the previous analysis. In most areas, the original values were found to be reasonably consistent with the recent values and the wind velocity pressures were left unchanged. Changes were made for areas when all of the recent information was inconsistent with the analysis from the early 1960's. Areas where the pressures have been changed include:

(a) decreased pressures for the Lower Mainland area of British Columbia, including Vancouver;
(b) decreased pressures for northern Manitoba;
(c) increased pressures for the Northern shore of Lake Superior in Ontario;
(d) increased pressures for the Haliburton Highlands of Ontario;
(e) changed pressures for parts of Quebec south of the St. Lawrence River (increased in the western portions and decreased eastern portions);
(f) decreased pressures for the Gulf of St. Lawrence.

Seismic Zones

The parameters used in establishing the seismic zones are the ground acceleration and ground velocity that have a 10% probability of being exceeded in 50 years. The zones are based on a statistical analysis of the earthquakes that have been experienced in Canada and adjacent regions using a method that provides for inclusion of geological and tectonic information in support of the seismic data.[8][9] The assigned zones reflect the opinions of experts in the fields of seismicity, geology and engineering, from industry, government and universities, who are members of the Canadian National Committee on Earthquake Engineering and various relevant committees responsible to the Canadian Commission on Building and Fire Codes.

The velocity and acceleration zones and assigned zonal velocity ratio, v, for each zone, as a fraction of a velocity of 1 m/s, are shown in the Table. The zone boundaries in terms of peak horizontal velocity and peak horizontal acceleration, are shown in Table J-1 of the Commentary on Effects of Earthquakes in Structural Commentaries on the National Building Code of Canada 1995.

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Table C-2
Design Data for Selected Locations in Canada

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%													
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r	1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
British Columbia																	
100 Mile House	1040	-28	-31	30	18	5150	10	45	425	2.4	0.3	0.30	0.36	0.43	1	1	0.05
Abbotsford	10	-10	-11	29	20	3100	10	105	1600	1.8	0.3	0.42	0.55	0.71	4	4	0.20
Agassiz	15	-13	-15	31	20	2950	8	120	1700	2.2	0.6	0.57	0.69	0.84	3	3	0.15
Alberni	12	-5	-7	31	18	3400	10	135	2000	2.7	0.4	0.47	0.58	0.70	5	5	0.30
Ashcroft	305	-25	-28	34	20	3700	10	35	300	1.5	0.1	0.28	0.35	0.43	1	2	0.10
Beatton River	840	-37	-39	25	18	6700	13	60	450	3.0	0.1	0.22	0.27	0.34	0	1	0.05
Burns Lake	755	-30	-33	25	17	5500	10	50	450	2.7	0.2	0.30	0.36	0.43	1	3	0.15
Cache Creek	455	-25	-28	34	20	3700	10	35	300	1.5	0.2	0.29	0.35	0.43	1	2	0.10
Campbell River	20	-7	-9	26	18	3400	10	115	1600	3.0	0.4	0.46	0.58	0.72	6	6	0.40
Carmi	845	-24	-26	33	20	4900	10	60	550	3.5	0.2	0.24	0.33	0.44	1	1	0.05
Castlegar	430	-19	-22	32	20	3700	10	50	700	3.8	0.1	0.23	0.30	0.39	1	1	0.05
Chetwynd	605	-35	-38	27	18	5800	15	70	625	2.2	0.2	0.32	0.37	0.44	0	1	0.05
Chilliwack	10	-12	-13	30	20	2950	8	130	1700	2.0	0.3	0.48	0.63	0.83	4	4	0.20
Comox	15	-7	-9	27	18	3150	10	105	1200	2.4	0.4	0.45	0.58	0.74	6	6	0.40
Courtenay	10	-7	-9	28	18	3150	10	105	1450	2.4	0.4	0.45	0.58	0.74	6	6	0.40
Cranbrook	910	-27	-30	32	19	4650	10	55	400	2.7	0.2	0.22	0.29	0.37	1	1	0.05
Crescent Valley	585	-20	-23	31	19	3900	10	50	850	3.8	0.1	0.22	0.29	0.37	1	1	0.05
Crofton	5	-6	-8	28	18	3150	8	80	950	1.6	0.2	0.48	0.58	0.69	5	5	0.30
Dawson Creek	665	-36	-39	27	18	6050	18	75	475	2.3	0.2	0.31	0.37	0.44	0	1	0.05
Dog Creek	450	-28	-30	29	18	5200	10	45	375	1.6	0.2	0.31	0.37	0.44	1	2	0.10
Duncan	10	-6	-8	29	18	3150	8	100	1050	1.6	0.4	0.48	0.58	0.69	5	5	0.30
Elko	1065	-28	-31	29	19	4800	13	60	650	3.3	0.2	0.27	0.37	0.50	1	1	0.05
Fernie	1010	-29	-32	29	19	4800	13	110	1175	4.1	0.2	0.33	0.43	0.55	1	1	0.05
Fort Nelson	465	-40	-42	28	18	7000	13	65	450	2.2	0.1	0.21	0.26	0.31	0	1	0.05
Fort St. John	685	-36	-38	26	18	6000	15	75	475	2.5	0.1	0.31	0.36	0.42	0	1	0.05
Glacier	1145	-27	-30	27	17	6000	10	65	1500	8.5	0.2	0.24	0.29	0.35	1	1	0.05
Golden	790	-28	-31	29	17	4900	8	55	500	3.4	0.2	0.27	0.32	0.38	1	1	0.05
Grand Forks	565	-20	-22	35	20	3950	10	45	475	2.5	0.1	0.26	0.36	0.48	1	1	0.05
Greenwood	745	-20	-22	35	20	4500	10	60	550	3.6	0.1	0.29	0.39	0.52	1	1	0.05
Hope	40	-16	-18	32	20	3100	8	130	1900	2.5	0.6	0.41	0.55	0.73	3	3	0.15
Kamloops	355	-25	-28	34	20	3650	13	45	275	1.6	0.2	0.30	0.37	0.45	1	1	0.05
Kaslo	545	-23	-26	29	19	4000	10	55	850	2.5	0.1	0.22	0.28	0.36	1	1	0.05
Kelowna	350	-17	-20	33	20	3600	10	40	325	1.5	0.1	0.34	0.43	0.53	1	1	0.05
Kimberley	1090	-26	-29	31	19	4900	10	55	500	2.7	0.2	0.22	0.29	0.37	1	1	0.05
Kitimat Plant	15	-16	-18	23	16	4000	13	180	2500	5.0	0.7	0.36	0.44	0.53	2	4	0.20
Kitimat Townsite	130	-16	-18	23	16	4200	13	160	2300	5.9	0.7	0.36	0.44	0.53	2	4	0.20
Lillooet	245	-23	-25	33	20	3550	10	70	350	1.9	0.1	0.32	0.39	0.49	1	2	0.10
Lytton	325	-19	-22	35	20	3300	10	70	425	2.5	0.3	0.31	0.39	0.49	2	2	0.10
Mackenzie	765	-35	-38	26	17	5750	10	50	650	4.6	0.2	0.24	0.29	0.35	0	2	0.10
Masset	10	-7	-9	17	15	3800	13	75	1400	1.6	0.4	0.49	0.58	0.68	6	6	0.40
McBride	730	-34	-37	30	18	5050	13	50	650	3.9	0.2	0.27	0.32	0.38	0	1	0.05
McLeod Lake	695	-35	-37	27	17	5450	10	50	650	3.7	0.2	0.24	0.29	0.35	0	2	0.10
Merritt	570	-26	-29	34	20	4100	8	50	310	1.6	0.3	0.32	0.39	0.49	1	2	0.10
Mission City	45	-9	-11	30	20	3050	13	115	1700	2.2	0.3	0.47	0.60	0.77	4	4	0.20

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Montrose	615	-17	-20	32	20	3700	10	50	700	3.7	0.1	0.22	0.30	0.41	1	1	0.05
Nakusp	445	-24	-27	31	19	4000	10	60	850	4.0	0.1	0.24	0.30	0.37	1	1	0.05
Nanaimo	15	-7	-9	26	18	3150	8	85	1050	2.1	0.4	0.47	0.58	0.71	4	4	0.20
Nelson	600	-20	-24	31	19	3900	10	55	700	3.8	0.1	0.22	0.29	0.37	1	1	0.05
Ocean Falls	10	-12	-14	23	16	3600	13	260	4300	3.5	0.7	0.47	0.55	0.65	2	4	0.20
Osoyoos	285	-16	-18	33	20	3250	10	45	310	1.0	0.1	0.30	0.43	0.59	1	1	0.05
Penticton	350	-16	-18	33	20	3500	10	45	300	1.2	0.1	0.40	0.52	0.68	1	1	0.05
Port Alberni	15	-5	-7	31	18	3200	10	150	2000	2.7	0.4	0.47	0.58	0.70	5	5	0.30
Port Hardy	5	-5	-7	20	16	3600	13	140	1850	0.8	0.4	0.49	0.58	0.66	6	6	0.40
Port McNeill	5	-5	-7	22	17	3550	13	120	1850	1.0	0.4	0.49	0.58	0.68	6	6	0.40
Powell River	10	-9	-11	26	18	3200	8	75	1200	1.7	0.4	0.42	0.55	0.71	5	5	0.30
Prince George	580	-33	-36	28	18	5250	15	50	600	3.1	0.2	0.28	0.34	0.41	0	2	0.10
Prince Rupert	20	-14	-16	19	15	4050	13	140	2900	1.7	0.4	0.42	0.50	0.59	3	5	0.30
Princeton	655	-27	-30	32	20	4450	10	40	350	2.6	0.5	0.24	0.32	0.42	2	2	0.10
Qualicum Beach	10	-7	-9	27	18	3200	10	90	1250	2.0	0.4	0.46	0.58	0.72	4	4	0.20
Quesnel	475	-33	-35	30	17	4850	10	50	525	2.7	0.1	0.25	0.29	0.34	0	2	0.10
Revelstoke	440	-26	-29	32	19	4200	13	55	950	5.3	0.1	0.24	0.29	0.35	1	1	0.05
Salmon Arm	425	-23	-26	33	20	3900	13	45	525	3.2	0.1	0.29	0.35	0.43	1	1	0.05
Sandspit	5	-6	-7	15	15	3600	13	80	1350	1.6	0.4	0.54	0.63	0.74	6	6	0.40
Sidney	10	-6	-8	26	18	3100	8	90	850	1.0	0.2	0.46	0.55	0.66	6	5	0.30
Smith River	660	-46	-48	26	17	7400	8	60	500	2.5	0.1	0.21	0.26	0.31	1	2	0.10
Smithers	500	-29	-31	25	17	5200	13	60	500	2.7	0.2	0.31	0.37	0.44	1	3	0.15
Squamish	5	-11	-13	29	20	3200	10	140	2200	2.9	0.6	0.38	0.50	0.65	3	3	0.15
Stewart	10	-23	-25	23	16	4650	13	140	1900	7.2	0.7	0.32	0.39	0.48	2	4	0.20
Taylor	515	-36	-38	26	18	6000	15	60	450	2.1	0.1	0.32	0.37	0.44	0	1	0.05
Terrace	60	-20	-22	25	16	4400	13	120	1150	4.9	0.5	0.27	0.33	0.40	2	4	0.20
Tofino	10	-2	-4	19	16	3300	13	180	3300	1.0	0.4	0.54	0.63	0.74	5	5	0.30
Trail	440	-17	-20	33	20	3700	10	50	700	3.7	0.1	0.26	0.32	0.39	1	1	0.05
Ucluelet	5	-2	-4	19	16	3150	13	150	3200	0.9	0.4	0.54	0.63	0.74	5	5	0.30
Vancouver Region																	
Burnaby (Simon Fraser Univ.)	110	-7	-9	25	17	3000	10	140	1950	2.6	0.6	0.36	0.44	0.53	4	4	0.20
Cloverdale	10	-8	-10	29	20	3050	8	105	1400	2.3	0.2	0.36	0.43	0.52	4	4	0.20
Haney	10	-9	-11	30	20	3050	10	125	1950	2.2	0.2	0.36	0.43	0.52	4	4	0.20
Ladner	3	-6	-8	27	19	3000	10	75	1050	1.2	0.2	0.37	0.45	0.54	5	4	0.20
Langley	15	-8	-10	29	20	3100	8	105	1500	2.2	0.2	0.36	0.43	0.52	4	4	0.20
New Westminster	10	-8	-10	29	19	2950	10	125	1575	2.1	0.2	0.36	0.43	0.52	4	4	0.20
North Vancouver	135	-7	-9	26	19	3000	10	140	2100	2.7	0.3	0.36	0.44	0.53	4	4	0.20
Richmond	5	-7	-9	27	19	3000	8	80	1100	1.4	0.2	0.36	0.44	0.53	4	4	0.20
Surrey (88 Ave & 156 St.)	90	-8	-10	29	20	3050	10	120	1575	2.2	0.3	0.36	0.43	0.52	4	4	0.20
Vancouver	15	-7	-9	26	19	2925	10	105	1400	1.6	0.2	0.36	0.44	0.53	4	4	0.20
Vancouver (Granville & 41 Ave)	120	-6	-8	28	20	2950	10	100	1400	1.7	0.3	0.36	0.44	0.53	4	4	0.20
West Vancouver	45	-8	-10	28	19	3250	9	140	1700	2.2	0.2	0.36	0.44	0.53	4	4	0.20
Vernon	405	-20	-23	33	20	3900	13	40	400	2.0	0.1	0.32	0.39	0.49	1	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Victoria Region																	
Victoria (Gonzales Hts)	65	-5	-7	23	17	2900	9	85	625	1.4	0.3	0.49	0.58	0.69	6	5	0.30
Victoria (Mt Tolmie)	125	-6	-8	24	16	3050	9	85	800	1.9	0.3	0.49	0.58	0.69	6	5	0.30
Victoria	10	-5	-7	24	17	2950	8	85	825	1.0	0.2	0.48	0.58	0.70	6	5	0.30
Williams Lake	615	-31	-34	29	17	5100	10	45	425	2.2	0.2	0.30	0.35	0.41	1	2	0.10
Youbou	200	-5	-7	31	19	3200	10	150	2100	3.5	0.6	0.46	0.55	0.66	4	4	0.20
Alberta																	
Athabasca	515	-35	-38	28	19	6000	18	80	480	1.4	0.1	0.30	0.37	0.45	0	1	0.05
Banff	1400	-30	-32	27	17	5500	18	60	500	3.3	0.1	0.39	0.45	0.52	0	1	0.05
Barrhead	645	-34	-37	28	19	6000	20	80	475	1.6	0.1	0.32	0.39	0.49	0	1	0.05
Beaverlodge	730	-35	-38	28	18	5900	25	85	470	2.2	0.1	0.27	0.33	0.40	0	1	0.05
Brooks	760	-32	-34	32	19	5200	18	80	340	1.1	0.1	0.39	0.48	0.57	0	0	0.00
Calgary	1045	-31	-33	29	17	5200	23	95	425	1.0	0.1	0.40	0.46	0.54	0	1	0.05
Campsie	660	-34	-37	28	19	6000	20	80	475	1.6	0.1	0.32	0.39	0.49	0	1	0.05
Camrose	740	-33	-35	29	19	5700	20	85	470	1.8	0.1	0.30	0.37	0.45	0	0	0.00
Cardston	1130	-30	-33	29	18	4750	20	100	550	1.4	0.1	0.74	0.93	1.15	0	0	0.00
Claresholm	1030	-31	-34	29	18	4800	15	95	440	1.2	0.1	0.66	0.80	0.96	0	0	0.00
Cold Lake	540	-36	-38	28	20	6100	15	75	430	1.6	0.1	0.31	0.37	0.44	0	0	0.00
Coleman	1320	-31	-34	28	18	5300	15	70	550	2.5	0.3	0.54	0.69	0.87	1	1	0.05
Coronation	790	-31	-33	30	19	5800	20	85	400	2.0	0.1	0.23	0.32	0.43	0	0	0.00
Cowley	1175	-31	-34	29	18	5100	15	75	525	1.5	0.1	0.73	0.91	1.13	0	1	0.05
Drumheller	685	-31	-33	29	18	5300	20	80	375	1.1	0.1	0.32	0.39	0.49	0	0	0.00
Edmonton	645	-32	-34	28	19	5400	23	90	460	1.6	0.1	0.32	0.40	0.51	0	1	0.05
Edson	920	-34	-37	28	18	5900	18	75	570	1.9	0.1	0.36	0.43	0.50	0	1	0.05
Embarras Portage	220	-41	-44	27	19	7100	10	80	390	1.7	0.1	0.31	0.37	0.45	0	0	0.00
Fairview	670	-38	-40	27	18	6050	15	80	450	2.4	0.1	0.26	0.32	0.39	0	1	0.05
Fort MacLeod	945	-31	-33	31	18	4600	16	90	425	1.1	0.1	0.68	0.83	1.00	0	0	0.00
Fort McMurray	255	-39	-41	28	19	6550	13	85	460	1.3	0.1	0.27	0.32	0.38	0	0	0.00
Fort Saskatchewan	610	-32	-35	28	19	5700	20	80	425	1.5	0.1	0.31	0.39	0.49	0	1	0.05
Fort Vermilion	270	-41	-43	28	18	6900	13	60	380	1.9	0.1	0.22	0.26	0.32	0	1	0.05
Grande Prairie	650	-36	-39	27	18	6000	23	80	450	2.0	0.1	0.37	0.44	0.52	0	1	0.05
Habay	335	-41	-43	28	18	7150	13	65	425	2.2	0.1	0.21	0.26	0.31	0	1	0.05
Hardisty	615	-33	-35	30	19	5900	20	70	425	1.6	0.1	0.24	0.32	0.42	0	0	0.00
High River	1040	-31	-33	28	17	5300	18	95	425	1.2	0.1	0.51	0.60	0.72	0	1	0.05
Hinton	990	-34	-38	27	17	5700	13	75	500	2.7	0.1	0.36	0.43	0.50	0	1	0.05
Jasper	1060	-32	-35	28	18	5500	10	70	400	3.0	0.1	0.37	0.43	0.50	1	1	0.05
Keg River	420	-40	-42	28	18	6800	13	60	450	2.2	0.1	0.21	0.26	0.31	0	1	0.05
Lac la Biche	560	-35	-38	28	19	6150	15	80	475	1.5	0.1	0.31	0.37	0.44	0	0	0.00
Lacombe	855	-33	-35	29	18	5700	23	85	450	1.9	0.1	0.30	0.37	0.45	0	1	0.05
Lethbridge	910	-30	-33	31	18	4650	20	90	390	1.1	0.1	0.64	0.76	0.91	0	0	0.00
Manning	465	-39	-41	27	18	6700	13	75	390	2.1	0.1	0.21	0.26	0.32	0	1	0.05
Medicine Hat	705	-31	-34	33	19	4750	23	85	325	1.0	0.1	0.39	0.49	0.60	0	0	0.00
Peace River	330	-37	-40	27	18	6350	15	60	390	2.0	0.1	0.24	0.29	0.36	0	1	0.05
Pincher Creek	1130	-32	-34	29	18	5000	18	100	575	1.4	0.1	0.70	0.88	1.08	0	0	0.00
Ranfurly	670	-34	-37	29	19	5950	18	85	420	1.7	0.1	0.23	0.29	0.36	0	0	0.00

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature January 2.5% °C	January 1% °C	July 2.5% Dry °C	July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa S_s	S_r	Hourly Wind Pressures 1/10 kPa	1/30 kPa	1/100 kPa	Seismic Data Z_a	Z_v	Zonal Velocity Ratio, v
Red Deer	855	-32	-35	29	18	5750	23	90	475	1.8	0.1	0.31	0.37	0.44	0	1	0.05
Rocky Mountain House	985	-31	-33	28	18	5700	20	80	550	1.7	0.1	0.33	0.40	0.48	0	1	0.05
Slave Lake	590	-36	-39	27	19	6000	15	75	500	1.7	0.1	0.28	0.34	0.41	0	1	0.05
Stettler	820	-32	-34	30	19	5700	20	90	450	2.0	0.1	0.24	0.32	0.42	0	0	0.00
Stony Plain	710	-32	-35	28	19	5500	23	90	540	1.6	0.1	0.32	0.40	0.51	0	1	0.05
Suffield	755	-32	-34	33	19	4900	20	80	325	1.2	0.1	0.43	0.52	0.64	0	0	0.00
Taber	815	-31	-33	31	19	4800	20	85	370	1.1	0.1	0.57	0.69	0.82	0	0	0.00
Turner Valley	1215	-31	-33	28	17	5600	20	90	600	1.3	0.1	0.51	0.60	0.71	0	1	0.05
Valleyview	700	-37	-40	27	18	5900	18	80	490	2.1	0.1	0.35	0.43	0.51	0	1	0.05
Vegreville	635	-34	-36	29	19	6100	18	80	410	1.7	0.1	0.25	0.32	0.40	0	0	0.00
Vermilion	580	-35	-38	29	20	6150	18	80	410	1.6	0.1	0.23	0.28	0.34	0	0	0.00
Wagner	585	-36	-39	27	19	6000	15	70	500	1.7	0.1	0.28	0.34	0.41	0	1	0.05
Wainwright	675	-33	-36	29	19	6000	20	75	425	1.8	0.1	0.24	0.32	0.41	0	0	0.00
Wetaskiwin	760	-33	-35	29	19	5800	23	80	500	1.8	0.1	0.30	0.37	0.45	0	1	0.05
Whitecourt	690	-35	-38	27	18	6000	20	90	550	1.7	0.1	0.32	0.39	0.48	0	1	0.05
Wimborne	975	-31	-34	29	18	5650	23	85	450	1.5	0.1	0.30	0.37	0.45	0	0	0.00
Saskatchewan																	
Assiniboia	740	-32	-34	32	21	5300	33	75	375	1.5	0.1	0.44	0.52	0.63	0	0	0.00
Battrum	700	-32	-34	32	20	5400	28	70	350	1.1	0.1	0.49	0.60	0.74	0	0	0.00
Biggar	645	-34	-36	31	20	6000	23	70	350	1.9	0.1	0.48	0.60	0.76	0	0	0.00
Broadview	600	-34	-36	30	22	6000	25	100	420	1.6	0.1	0.32	0.39	0.47	0	0	0.00
Dafoe	530	-36	-39	29	21	6300	20	85	380	1.6	0.1	0.28	0.34	0.41	0	0	0.00
Dundurn	525	-35	-37	31	20	5900	10	90	380	1.4	0.1	0.39	0.48	0.57	0	0	0.00
Estevan	565	-32	-34	32	22	5400	36	85	420	1.5	0.1	0.42	0.51	0.62	0	0	0.00
Hudson Bay	370	-37	-39	29	21	6500	18	70	450	1.8	0.1	0.28	0.34	0.41	0	0	0.00
Humboldt	565	-36	-39	28	21	6300	20	80	375	1.9	0.1	0.29	0.36	0.44	0	0	0.00
Island Falls	305	-39	-41	26	20	7300	10	70	510	1.9	0.1	0.33	0.40	0.49	0	0	0.00
Kamsack	455	-35	-37	29	22	6300	20	90	450	1.9	0.2	0.32	0.37	0.44	0	0	0.00
Kindersley	685	-33	-35	32	20	5750	23	80	325	1.3	0.1	0.45	0.58	0.73	0	0	0.00
Lloydminster	645	-35	-38	29	20	6100	18	70	430	1.8	0.1	0.30	0.37	0.46	0	0	0.00
Maple Creek	765	-31	-34	31	20	4850	28	70	380	1.1	0.1	0.47	0.58	0.71	0	0	0.00
Meadow Lake	480	-36	-39	28	20	6200	15	70	450	1.6	0.1	0.36	0.45	0.55	0	0	0.00
Melfort	455	-37	-40	28	21	6350	18	75	410	1.9	0.1	0.26	0.32	0.40	0	0	0.00
Melville	550	-34	-36	29	21	6100	23	70	410	1.6	0.1	0.32	0.37	0.43	0	0	0.00
Moose Jaw	545	-32	-34	32	21	5350	28	80	360	1.3	0.1	0.36	0.43	0.51	0	0	0.00
Nipawin	365	-38	-41	28	21	6450	18	70	450	1.8	0.1	0.27	0.34	0.43	0	0	0.00
North Battleford	545	-34	-36	30	20	6000	20	75	370	1.6	0.1	0.45	0.62	0.83	0	0	0.00
Prince Albert	435	-37	-41	29	21	6450	20	80	410	1.7	0.1	0.26	0.34	0.44	0	0	0.00
Qu'Appelle	645	-34	-36	30	21	5800	25	95	430	1.6	0.1	0.34	0.39	0.46	0	0	0.00
Regina	575	-34	-36	31	21	5750	28	95	365	1.3	0.1	0.34	0.39	0.46	0	0	0.00
Rosetown	595	-33	-35	32	20	5900	25	70	330	1.6	0.1	0.47	0.58	0.71	0	0	0.00
Saskatoon	500	-35	-37	30	20	5950	23	80	350	1.6	0.1	0.36	0.44	0.54	0	0	0.00
Scott	645	-34	-36	31	20	6100	20	70	360	1.7	0.1	0.44	0.58	0.75	0	0	0.00
Strasbourg	545	-34	-36	30	21	5900	25	85	390	1.4	0.1	0.33	0.39	0.46	0	0	0.00
Swift Current	750	-32	-34	32	20	5400	33	75	350	1.3	0.1	0.46	0.56	0.69	0	0	0.00
Uranium City	265	-44	-46	26	19	7850	8	50	360	1.8	0.1	0.33	0.40	0.49	0	0	0.00

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature January 2.5% °C	January 1% °C	July 2.5% Dry °C	July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa S_s	S_r	Hourly Wind Pressures 1/10 kPa	1/30 kPa	1/100 kPa	Seismic Data Z_a	Z_v	Zonal Velocity Ratio, v
Weyburn	575	-33	-35	32	22	5500	33	100	400	1.3	0.1	0.38	0.45	0.53	0	0	0.00
Yorkton	510	-34	-37	29	21	6150	23	90	440	1.6	0.1	0.32	0.37	0.44	0	0	0.00
Manitoba																	
Beausejour	245	-33	-35	28	23	5900	28	90	530	1.7	0.2	0.31	0.37	0.45	0	0	0.00
Boissevain	510	-32	-34	32	23	5700	33	110	510	2.0	0.2	0.44	0.52	0.63	0	0	0.00
Brandon	395	-33	-35	31	22	6000	36	100	460	1.9	0.2	0.37	0.45	0.54	0	0	0.00
Churchill	10	-39	-41	24	18	9200	8	60	410	2.6	0.2	0.48	0.59	0.72	0	0	0.00
Dauphin	295	-33	-35	30	22	6050	25	100	490	1.7	0.2	0.31	0.37	0.44	0	0	0.00
Flin Flon	300	-38	-40	27	20	6700	13	75	475	2.0	0.2	0.33	0.40	0.49	0	0	0.00
Gimli	220	-34	-36	29	23	6100	28	100	530	1.7	0.2	0.30	0.37	0.45	0	0	0.00
Island Lake	240	-36	-38	26	20	7100	13	80	550	2.4	0.2	0.33	0.40	0.49	0	0	0.00
Lac du Bonnet	260	-34	-36	28	23	6000	28	90	560	1.7	0.2	0.28	0.34	0.41	0	0	0.00
Lynn Lake	350	-40	-42	27	19	7900	8	70	490	2.2	0.2	0.33	0.40	0.49	0	0	0.00
Morden	300	-31	-33	31	23	5550	28	110	520	2.0	0.2	0.40	0.48	0.56	0	0	0.00
Neepawa	365	-32	-34	30	22	5900	33	100	470	2.0	0.2	0.33	0.40	0.49	0	0	0.00
Pine Falls	220	-34	-36	28	23	6100	25	80	420	1.7	0.2	0.29	0.35	0.43	0	0	0.00
Portage la Prairie	260	-31	-33	30	23	5800	36	110	525	1.9	0.2	0.36	0.43	0.51	0	0	0.00
Rivers	465	-34	-36	30	22	6000	33	100	460	1.9	0.2	0.36	0.43	0.51	0	0	0.00
Sandilands	365	-32	-34	29	23	5850	28	90	550	2.0	0.2	0.31	0.37	0.44	0	0	0.00
Selkirk	225	-33	-35	29	23	5900	28	100	500	1.7	0.2	0.33	0.39	0.47	0	0	0.00
Split Lake	175	-38	-40	27	19	8100	10	60	500	2.3	0.2	0.37	0.45	0.54	0	0	0.00
Steinbach	270	-33	-35	30	23	5800	28	85	500	1.8	0.2	0.31	0.37	0.44	0	0	0.00
Swan River	335	-36	-38	29	22	6200	20	85	500	1.8	0.2	0.30	0.35	0.42	0	0	0.00
The Pas	270	-36	-38	28	21	6750	15	75	450	1.9	0.2	0.33	0.40	0.49	0	0	0.00
Thompson	205	-42	-45	26	19	7850	10	70	540	2.2	0.2	0.37	0.45	0.54	0	0	0.00
Virden	435	-33	-35	30	22	5800	33	100	460	1.8	0.2	0.36	0.43	0.51	0	0	0.00
Winnipeg	235	-33	-35	30	23	5900	28	90	500	1.7	0.2	0.35	0.42	0.49	0	0	0.00
Ontario																	
Ailsa Craig	230	-17	-19	30	23	4000	25	95	950	2.0	0.4	0.40	0.50	0.62	0	0	0.00
Ajax	95	-20	-22	30	23	4000	23	85	825	0.9	0.4	0.43	0.52	0.64	1	1	0.05
Alexandria	80	-24	-26	30	23	4600	28	95	975	2.2	0.4	0.30	0.37	0.45	4	2	0.10
Alliston	220	-23	-25	29	23	4400	28	105	875	1.8	0.4	0.22	0.29	0.38	1	0	0.05
Almonte	120	-26	-28	30	23	4850	25	80	800	2.3	0.4	0.30	0.37	0.46	4	2	0.10
Armstrong	340	-39	-42	28	21	7050	23	90	725	2.5	0.4	0.21	0.25	0.29	0	0	0.00
Arnprior	85	-27	-29	30	23	4800	23	80	775	2.3	0.4	0.27	0.34	0.42	4	2	0.10
Atikokan	400	-34	-37	29	22	6100	25	95	760	2.2	0.3	0.21	0.25	0.29	0	0	0.00
Aurora	270	-21	-23	30	23	4300	28	100	800	1.8	0.4	0.30	0.39	0.50	1	0	0.05
Bancroft	365	-27	-29	29	22	4900	25	85	900	2.8	0.4	0.23	0.29	0.36	2	1	0.05
Barrie	245	-24	-26	29	22	4600	28	90	900	2.3	0.4	0.21	0.29	0.39	1	1	0.05
Barriefield	100	-22	-24	27	23	4250	23	105	950	1.9	0.4	0.35	0.43	0.52	2	1	0.05
Beaverton	240	-24	-26	30	22	4550	28	100	950	2.0	0.4	0.24	0.32	0.42	1	1	0.05
Belleville	90	-22	-24	29	23	4100	23	95	850	1.6	0.4	0.32	0.39	0.48	1	1	0.05
Belmont	260	-17	-19	30	23	4050	25	90	950	1.6	0.4	0.35	0.45	0.58	0	0	0.00
Big Trout Lake	215	-38	-40	25	20	7650	13	85	600	2.9	0.2	0.33	0.39	0.46	0	0	0.00
CFB Borden	225	-23	-25	29	22	4550	28	105	875	2.0	0.4	0.21	0.29	0.39	1	0	0.05
Bracebridge	310	-26	-28	29	22	4850	25	95	1050	2.8	0.4	0.26	0.32	0.39	1	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%													
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r	1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
Bradford	240	-23	-25	30	23	4400	28	100	800	1.9	0.4	0.24	0.32	0.42	1	0	0.05
Brampton	215	-19	-21	30	23	4250	28	110	820	1.2	0.4	0.32	0.39	0.49	1	0	0.05
Brantford	205	-17	-19	30	23	3950	23	95	850	1.2	0.4	0.31	0.37	0.44	1	0	0.05
Brighton	95	-21	-23	29	23	4200	23	90	850	1.5	0.4	0.42	0.50	0.60	1	1	0.05
Brockville	85	-23	-25	29	23	4275	25	95	975	2.0	0.4	0.32	0.39	0.49	3	1	0.05
Burk's Falls	305	-26	-28	29	21	5100	25	95	1010	2.5	0.4	0.26	0.32	0.39	1	1	0.05
Burlington	80	-17	-19	31	23	3775	23	95	850	0.8	0.4	0.36	0.43	0.51	1	0	0.05
Cambridge	295	-18	-20	29	23	4150	25	105	890	1.5	0.4	0.26	0.32	0.39	1	0	0.05
Campbellford	150	-23	-26	30	23	4450	25	90	850	1.6	0.4	0.29	0.37	0.47	1	1	0.05
Cannington	255	-24	-26	30	23	4550	28	100	950	2.0	0.4	0.24	0.32	0.42	1	1	0.05
Carleton Place	135	-25	-27	30	23	4800	25	80	850	2.3	0.4	0.30	0.37	0.46	4	2	0.10
Cavan	200	-22	-25	30	23	4500	28	90	850	1.8	0.4	0.31	0.39	0.50	1	1	0.05
Centralia	260	-17	-19	30	23	4100	25	95	1000	2.1	0.4	0.37	0.48	0.60	0	0	0.00
Chapleau	425	-35	-38	27	21	6200	23	90	850	3.7	0.4	0.19	0.25	0.31	0	0	0.00
Chatham	180	-16	-18	31	24	3750	28	95	850	0.9	0.4	0.32	0.39	0.48	0	0	0.00
Chesley	275	-19	-21	29	22	4500	28	95	1125	2.6	0.4	0.33	0.43	0.55	1	0	0.05
Clinton	280	-17	-19	29	23	4150	23	95	1000	2.4	0.4	0.37	0.48	0.60	0	0	0.00
Coboconk	270	-25	-27	29	22	4750	25	100	950	2.3	0.4	0.26	0.32	0.39	1	1	0.05
Cobourg	90	-21	-23	30	23	4100	23	90	825	1.1	0.4	0.46	0.55	0.65	1	1	0.05
Cochrane	245	-34	-36	29	21	6400	20	80	875	2.6	0.3	0.26	0.32	0.39	1	0	0.05
Colborne	105	-21	-23	29	23	4100	23	80	850	1.5	0.4	0.44	0.52	0.62	1	1	0.05
Collingwood	190	-22	-24	29	22	4300	28	95	950	2.5	0.4	0.25	0.34	0.45	1	0	0.05
Cornwall	35	-23	-25	30	23	4350	28	95	960	2.0	0.4	0.30	0.37	0.46	4	2	0.10
Corunna	185	-16	-18	31	23	3800	23	90	800	0.9	0.4	0.35	0.43	0.52	0	0	0.00
Deep River	145	-29	-32	30	22	5050	23	85	850	2.3	0.4	0.26	0.32	0.39	4	2	0.10
Deseronto	85	-22	-24	28	23	4200	23	90	900	1.7	0.4	0.32	0.39	0.48	1	1	0.05
Dorchester	260	-18	-20	30	23	4100	28	95	950	1.7	0.4	0.33	0.43	0.55	0	0	0.00
Dorion	200	-33	-35	28	21	5950	20	95	725	2.6	0.4	0.30	0.36	0.43	0	0	0.00
Dresden	185	-16	-18	31	24	3750	28	90	820	0.9	0.4	0.32	0.39	0.48	0	0	0.00
Dryden	370	-34	-36	27	22	6000	25	90	700	2.2	0.3	0.21	0.25	0.29	0	0	0.00
Dunnville	175	-15	-17	30	24	3900	23	110	950	1.8	0.4	0.33	0.39	0.45	1	0	0.05
Durham	340	-20	-22	29	22	4700	28	95	1025	2.6	0.4	0.31	0.39	0.50	1	0	0.05
Dutton	225	-16	-18	31	24	3900	28	85	925	1.2	0.4	0.34	0.43	0.53	0	0	0.00
Earlton	245	-33	-36	30	21	5900	23	85	820	2.4	0.4	0.32	0.40	0.51	1	1	0.05
Edison	365	-34	-36	28	22	5950	25	100	680	2.2	0.3	0.23	0.28	0.34	0	0	0.00
Elmvale	220	-24	-26	29	22	4400	28	90	950	2.4	0.4	0.24	0.32	0.42	1	1	0.05
Embro	310	-18	-20	29	23	4200	28	110	950	1.8	0.4	0.33	0.43	0.54	0	0	0.00
Englehart	205	-33	-36	30	21	6000	23	85	880	2.3	0.4	0.29	0.37	0.47	1	1	0.05
Espanola	220	-25	-27	28	21	5200	23	100	840	2.1	0.4	0.28	0.37	0.48	1	0	0.05
Exeter	265	-17	-19	30	23	4150	25	105	975	2.2	0.4	0.37	0.48	0.60	0	0	0.00
Fenelon Falls	260	-25	-27	30	23	4650	25	100	950	2.1	0.4	0.25	0.32	0.41	1	1	0.05
Fergus	400	-20	-22	29	23	4600	33	100	925	2.0	0.4	0.26	0.32	0.40	1	0	0.05
Forest	215	-16	-18	31	23	3850	23	95	875	1.8	0.4	0.39	0.48	0.58	0	0	0.00
Fort Erie	180	-15	-17	30	24	3800	23	105	1020	2.4	0.4	0.36	0.43	0.50	2	0	0.05
Fort Erie (Ridgeway)	190	-15	-17	30	24	3750	28	105	1000	2.3	0.4	0.37	0.43	0.50	2	0	0.05
Fort Frances	340	-33	-35	29	22	5550	25	100	725	2.1	0.3	0.23	0.28	0.34	0	0	0.00

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature: January 2.5% °C	January 1% °C	July 2.5% Dry °C	July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa: S_s	S_r	Hourly Wind Pressures: 1/10 kPa	1/30 kPa	1/100 kPa	Seismic Data: Z_a	Z_v	Zonal Velocity Ratio, v
Gananoque	80	-22	-24	28	23	4200	23	95	900	1.9	0.4	0.35	0.43	0.52	2	1	0.05
Geraldton	345	-35	-38	28	21	6800	20	80	725	2.7	0.4	0.21	0.25	0.30	0	0	0.00
Glencoe	215	-16	-18	31	24	3900	28	95	925	1.4	0.4	0.31	0.39	0.49	0	0	0.00
Goderich	185	-16	-18	29	23	4000	23	85	950	2.2	0.4	0.40	0.50	0.62	0	0	0.00
Gore Bay	205	-23	-25	29	21	4900	23	85	860	2.4	0.4	0.30	0.36	0.43	0	0	0.00
Graham	495	-37	-40	29	22	6400	23	90	750	2.4	0.3	0.21	0.25	0.29	0	0	0.00
Gravenhurst (Muskoka Airport)	255	-26	-28	29	22	4750	25	95	1050	2.5	0.4	0.26	0.32	0.39	1	1	0.05
Grimsby	85	-16	-18	30	23	3650	23	100	875	0.8	0.4	0.36	0.43	0.50	1	0	0.05
Guelph	340	-19	-21	29	23	4350	28	105	875	1.7	0.4	0.25	0.30	0.36	1	0	0.05
Guthrie	280	-24	-26	29	22	4550	28	95	950	2.3	0.4	0.21	0.29	0.39	1	1	0.05
Haileybury	210	-32	-35	30	21	5600	23	85	820	2.2	0.4	0.32	0.39	0.49	2	1	0.05
Haldimand (Caledonia)	190	-17	-19	30	23	3900	23	100	875	1.1	0.4	0.31	0.37	0.44	1	0	0.05
Haldimand (Hagersville)	215	-16	-18	30	23	4000	25	90	875	1.2	0.4	0.33	0.39	0.46	1	0	0.05
Haliburton	335	-27	-29	29	22	4950	25	85	980	2.7	0.4	0.26	0.32	0.39	1	1	0.05
Halton Hills (Georgetown)	255	-19	-21	30	23	4300	28	110	850	1.3	0.4	0.27	0.34	0.42	1	0	0.05
Hamilton	90	-17	-19	31	23	3600	23	100	875	0.8	0.4	0.36	0.43	0.50	1	0	0.05
Hanover	270	-19	-21	30	22	4600	28	100	1050	2.4	0.4	0.34	0.43	0.54	1	0	0.05
Hastings	200	-23	-26	30	23	4450	28	85	840	1.8	0.4	0.29	0.37	0.47	1	1	0.05
Hawkesbury	50	-25	-27	30	23	4750	23	95	925	2.1	0.4	0.31	0.37	0.45	4	2	0.10
Hearst	245	-34	-36	28	21	6500	20	75	825	2.6	0.3	0.20	0.25	0.32	0	0	0.00
Honey Harbour	180	-24	-26	29	22	4300	23	90	1050	2.5	0.4	0.25	0.34	0.45	1	1	0.05
Hornepayne	360	-37	-40	28	21	6500	20	90	750	3.3	0.4	0.19	0.25	0.31	0	0	0.00
Huntsville	335	-26	-29	29	22	4900	25	95	1000	2.7	0.4	0.26	0.32	0.39	1	1	0.05
Ingersoll	280	-18	-20	30	23	4100	28	100	950	1.6	0.4	0.33	0.43	0.54	0	0	0.00
Iroquois Falls	275	-33	-36	29	21	6300	20	80	825	2.7	0.3	0.30	0.37	0.45	1	0	0.05
Jellicoe	330	-36	-39	28	21	6600	20	80	750	2.5	0.4	0.21	0.25	0.29	0	0	0.00
Kapuskasing	245	-33	-35	28	21	6450	20	80	825	2.6	0.3	0.23	0.28	0.34	0	0	0.00
Kemptville	90	-25	-27	30	23	4650	25	80	925	2.1	0.4	0.30	0.37	0.46	4	2	0.10
Kenora	370	-33	-36	28	22	5850	25	105	630	2.1	0.3	0.23	0.28	0.34	0	0	0.00
Killaloe	185	-28	-31	30	22	5100	23	80	825	2.5	0.4	0.26	0.32	0.39	3	1	0.05
Kincardine	190	-17	-19	28	22	4100	23	85	950	2.4	0.4	0.40	0.50	0.62	0	0	0.00
Kingston	80	-22	-24	27	23	4300	23	105	950	1.9	0.4	0.35	0.43	0.52	2	1	0.05
Kinmount	295	-26	-28	29	22	4800	25	100	950	2.5	0.4	0.26	0.32	0.39	1	1	0.05
Kirkland Lake	325	-33	-36	30	21	6100	20	95	875	2.7	0.3	0.29	0.37	0.46	1	1	0.05
Kitchener	335	-19	-21	29	23	4250	28	110	925	1.8	0.4	0.27	0.34	0.42	1	0	0.05
Lakefield	240	-24	-26	30	23	4550	28	85	850	2.0	0.4	0.27	0.34	0.43	1	1	0.05
Lansdowne House	240	-39	-41	28	21	7150	18	90	680	2.7	0.2	0.24	0.29	0.35	0	0	0.00
Leamington	190	-15	-17	31	24	3600	28	105	875	0.7	0.4	0.35	0.43	0.52	0	0	0.00
Lindsay	265	-24	-26	30	23	4550	25	95	850	2.1	0.4	0.26	0.34	0.43	1	1	0.05
Lion's Head	185	-19	-21	27	22	4300	25	100	950	2.5	0.4	0.33	0.43	0.54	1	0	0.05
Listowel	380	-19	-21	29	23	4500	30	110	1000	2.4	0.4	0.34	0.43	0.53	1	0	0.05
London	245	-18	-20	30	23	4150	28	95	975	1.7	0.4	0.36	0.48	0.61	0	0	0.00
Lucan	300	-17	-19	30	23	4150	25	105	1000	2.1	0.4	0.39	0.50	0.63	0	0	0.00
Maitland	85	-23	-25	29	23	4200	25	95	975	2.0	0.4	0.32	0.39	0.49	3	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature, January 2.5% °C	Design Temperature, January 1% °C	Design Temperature, July 2.5% Dry °C	Design Temperature, July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa S_s	Ground Snow Load, kPa S_r	Hourly Wind Pressures 1/10 kPa	Hourly Wind Pressures 1/30 kPa	Hourly Wind Pressures 1/100 kPa	Seismic Data Z_a	Seismic Data Z_v	Seismic Data Zonal Velocity Ratio, v
Markdale	425	-20	-22	29	22	4600	28	95	1050	3.1	0.4	0.29	0.37	0.47	1	0	0.05
Markham	175	-20	-22	31	24	4200	25	80	825	1.2	0.4	0.39	0.48	0.59	1	0	0.05
Martin	485	-36	-39	29	22	6200	25	95	750	2.4	0.3	0.21	0.25	0.29	0	0	0.00
Matheson	265	-33	-36	29	21	6250	20	80	825	2.6	0.3	0.30	0.37	0.46	1	1	0.05
Mattawa	165	-29	-31	30	22	5300	23	80	875	1.9	0.4	0.24	0.29	0.35	3	1	0.05
Midland	190	-23	-26	29	22	4300	25	90	1060	2.5	0.4	0.25	0.34	0.45	1	1	0.05
Milton	200	-18	-20	30	23	4100	25	110	850	1.2	0.4	0.32	0.39	0.48	1	0	0.05
Milverton	370	-19	-21	29	23	4450	30	100	1050	2.2	0.4	0.31	0.39	0.49	1	0	0.05
Minden	270	-26	-29	29	22	4900	25	90	1010	2.5	0.4	0.26	0.32	0.39	1	1	0.05
Mississauga	160	-18	-20	30	23	3950	25	105	800	1.0	0.4	0.37	0.45	0.55	1	0	0.05
Mississauga (Port Credit)	75	-18	-20	30	23	3800	25	100	800	0.8	0.4	0.37	0.45	0.55	1	0	0.05
Mitchell	335	-18	-20	29	23	4400	28	105	1050	2.2	0.4	0.35	0.45	0.57	0	0	0.00
Moosonee	10	-36	-38	28	21	7100	18	75	700	2.0	0.3	0.26	0.32	0.39	0	0	0.00
Morrisburg	75	-23	-25	30	23	4550	25	100	950	2.1	0.4	0.30	0.37	0.46	4	2	0.10
Mount Forest	420	-21	-23	29	22	4750	30	95	940	2.5	0.4	0.29	0.37	0.47	1	0	0.05
Nakina	325	-35	-37	28	21	6900	20	80	750	2.6	0.4	0.21	0.25	0.30	0	0	0.00
Nanticoke (Jarvis)	205	-16	-18	30	23	4000	28	100	900	1.3	0.4	0.33	0.39	0.47	1	0	0.05
Nanticoke (Port Dover)	180	-15	-17	30	24	3900	25	100	950	1.1	0.4	0.36	0.43	0.51	1	0	0.05
Napanee	90	-22	-24	28	23	4250	23	85	900	1.7	0.4	0.32	0.39	0.48	2	1	0.05
New Liskeard	180	-32	-35	30	21	5700	23	85	810	2.1	0.4	0.31	0.39	0.49	2	1	0.05
Newcastle	115	-20	-22	30	23	4200	23	80	830	1.4	0.4	0.46	0.55	0.65	1	1	0.05
Newcastle (Bowmanville)	245	-20	-22	30	23	4200	23	80	830	1.3	0.4	0.46	0.55	0.66	1	1	0.05
Newmarket	185	-22	-24	30	23	4400	28	100	800	1.8	0.4	0.26	0.34	0.44	1	1	0.05
Niagara Falls	210	-16	-18	30	23	3700	23	95	950	1.8	0.4	0.33	0.39	0.47	2	0	0.05
North Bay	210	-28	-30	28	21	5300	28	90	975	2.0	0.4	0.26	0.31	0.37	2	1	0.05
Norwood	225	-24	-26	30	23	4500	28	85	850	1.9	0.4	0.29	0.37	0.47	1	1	0.05
Oakville	90	-18	-20	30	23	3800	23	90	850	0.8	0.4	0.37	0.45	0.54	1	0	0.05
Orangeville	430	-21	-23	29	23	4600	30	100	875	2.1	0.4	0.25	0.32	0.41	1	0	0.05
Orillia	230	-25	-27	29	22	4600	25	95	1000	2.2	0.4	0.26	0.32	0.39	1	1	0.05
Oshawa	110	-19	-21	30	23	4000	23	80	875	1.3	0.4	0.43	0.52	0.64	1	1	0.05
Ottawa	60	-25	-27	30	23	4600	23	80	900	2.2	0.4	0.30	0.37	0.46	4	2	0.10
Owen Sound	215	-19	-21	29	22	4250	28	110	1075	2.6	0.4	0.33	0.43	0.55	1	0	0.05
Pagwa River	185	-34	-36	28	21	6600	20	90	825	2.2	0.4	0.19	0.25	0.31	0	0	0.00
Paris	245	-17	-19	30	23	4100	23	85	925	1.3	0.4	0.31	0.37	0.45	1	0	0.05
Parkhill	205	-16	-18	31	23	4000	23	95	925	1.9	0.4	0.40	0.50	0.61	0	0	0.00
Parry Sound	215	-24	-26	28	21	4700	23	95	1050	2.6	0.4	0.24	0.34	0.46	1	1	0.05
Pelham (Fonthill)	230	-15	-17	30	23	3800	23	95	950	2.1	0.4	0.33	0.39	0.46	1	0	0.05
Pembroke	125	-28	-31	30	22	5000	23	100	825	2.3	0.4	0.26	0.32	0.39	4	2	0.10
Penetanguishene	220	-23	-26	29	22	4300	25	90	1050	2.6	0.4	0.25	0.34	0.45	1	1	0.05
Perth	130	-25	-27	30	23	4650	25	85	900	2.1	0.4	0.29	0.37	0.46	3	1	0.05
Petawawa	135	-29	-31	30	22	5150	23	85	825	2.4	0.4	0.26	0.32	0.39	4	2	0.10
Peterborough	200	-23	-25	30	23	4400	28	85	840	1.8	0.4	0.29	0.37	0.47	1	1	0.05
Petrolia	195	-16	-18	31	24	3850	25	100	920	1.2	0.4	0.35	0.43	0.52	0	0	0.00
Pickering (Dunbarton)	85	-19	-21	30	23	4000	23	85	825	0.9	0.4	0.43	0.52	0.64	1	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Picton	95	-21	-23	29	23	4050	23	85	940	1.8	0.4	0.37	0.45	0.54	1	1	0.05
Plattsville	300	-18	-20	29	23	4200	28	95	950	1.7	0.4	0.30	0.37	0.46	1	0	0.05
Point Alexander	150	-29	-32	30	22	5050	23	85	850	2.3	0.4	0.26	0.32	0.39	4	2	0.10
Port Burwell	195	-15	-17	30	24	4000	25	85	1000	1.1	0.4	0.34	0.43	0.53	0	0	0.00
Port Colborne	180	-15	-17	30	24	3750	23	105	1000	2.1	0.4	0.37	0.43	0.50	1	0	0.05
Port Elgin	205	-17	-19	28	22	4250	23	85	850	2.6	0.4	0.40	0.50	0.62	1	0	0.05
Port Hope	100	-21	-23	30	23	4050	23	90	825	1.1	0.4	0.46	0.55	0.65	1	1	0.05
Port Perry	270	-22	-24	30	23	4350	25	90	850	2.2	0.4	0.31	0.39	0.50	1	1	0.05
Port Stanley	180	-15	-17	31	24	4000	25	85	975	1.1	0.4	0.34	0.43	0.53	0	0	0.00
Prescott	90	-23	-25	29	23	4250	25	95	975	2.0	0.4	0.32	0.39	0.49	3	2	0.10
Princeton	280	-17	-19	29	23	4100	25	90	925	1.4	0.4	0.30	0.37	0.46	1	0	0.05
Raith	475	-35	-37	28	22	6150	20	90	750	2.5	0.4	0.21	0.25	0.29	0	0	0.00
Rayside-Balfour (Chelmsford) e	270	-28	-30	29	21	5400	25	85	850	2.3	0.4	0.29	0.39	0.53	1	0	0.05
Red Lake	360	-34	-36	28	22	6350	18	80	630	2.2	0.3	0.22	0.26	0.31	0	0	0.00
Renfrew	115	-27	-30	30	23	4900	23	95	810	2.3	0.4	0.26	0.32	0.39	4	2	0.10
Richmond Hill	230	-20	-22	31	24	4200	25	90	850	1.4	0.4	0.39	0.48	0.59	1	0	0.05
Rockland	50	-26	-28	30	23	4800	23	85	950	2.2	0.4	0.30	0.37	0.45	4	2	0.10
Sarnia	190	-16	-18	31	23	3950	23	95	825	1.0	0.4	0.35	0.43	0.52	0	0	0.00
Sault Ste. Marie	190	-25	-28	29	21	5100	25	95	950	2.8	0.4	0.32	0.37	0.43	0	0	0.00
Schreiber	310	-35	-38	27	21	6200	20	100	850	3.0	0.4	0.30	0.36	0.43	0	0	0.00
Seaforth	310	-17	-19	30	23	4300	25	100	1025	2.3	0.4	0.37	0.48	0.60	0	0	0.00
Simcoe	210	-17	-19	30	23	4000	28	110	950	1.2	0.4	0.33	0.39	0.47	1	0	0.05
Sioux Lookout	375	-34	-36	28	22	6200	28	90	710	2.2	0.3	0.21	0.25	0.29	0	0	0.00
Smiths Falls	130	-25	-27	30	23	4600	28	85	850	2.1	0.4	0.29	0.37	0.46	3	2	0.10
Smithville	185	-16	-18	30	23	3800	23	110	900	1.4	0.4	0.33	0.39	0.46	1	0	0.05
Smooth Rock Falls	235	-34	-36	29	21	6400	20	85	850	2.5	0.3	0.24	0.29	0.36	1	0	0.05
South River	355	-27	-29	28	21	5200	28	90	975	2.6	0.4	0.23	0.29	0.36	1	1	0.05
Southampton	180	-17	-19	28	22	4250	23	85	830	2.5	0.4	0.38	0.48	0.59	1	0	0.05
St. Catharines	105	-16	-18	30	23	3675	23	85	850	0.9	0.4	0.36	0.43	0.50	1	0	0.05
St. Mary's	310	-18	-20	30	23	4250	28	100	1025	2.0	0.4	0.35	0.45	0.58	0	0	0.00
St. Thomas	225	-16	-18	31	23	4000	25	100	975	1.3	0.4	0.33	0.43	0.54	0	0	0.00
Stirling	120	-23	-25	30	23	4450	25	90	850	1.6	0.4	0.28	0.36	0.46	1	1	0.05
Stratford	360	-18	-20	29	23	4350	28	115	1050	2.1	0.4	0.33	0.43	0.54	0	0	0.00
Strathroy	225	-17	-19	31	23	3950	25	95	950	1.7	0.4	0.36	0.45	0.57	0	0	0.00
Sturgeon Falls	205	-27	-29	29	21	5250	28	90	910	2.0	0.4	0.25	0.32	0.40	1	1	0.05
Sudbury	275	-28	-30	29	21	5400	25	90	875	2.3	0.4	0.29	0.40	0.55	1	1	0.05
Sundridge	340	-27	-29	28	21	5200	28	90	975	2.6	0.4	0.23	0.29	0.37	2	1	0.05
Tavistock	340	-18	-20	29	23	4350	28	115	1010	1.9	0.4	0.34	0.43	0.53	1	0	0.05
Temagami	300	-30	-33	30	21	5400	25	85	875	2.4	0.4	0.27	0.34	0.42	2	1	0.05
Thamesford	280	-18	-20	30	23	4200	28	100	975	1.7	0.4	0.33	0.43	0.55	0	0	0.00
Thedford	205	-16	-18	31	23	3900	23	95	900	1.9	0.4	0.41	0.50	0.61	0	0	0.00
Thunder Bay	210	-31	-33	28	21	5650	20	100	710	2.7	0.4	0.30	0.36	0.43	0	0	0.00
Tillsonburg	215	-17	-19	30	23	4000	25	95	980	1.2	0.4	0.31	0.39	0.50	0	0	0.00
Timmins	300	-34	-36	30	21	6200	18	95	875	2.8	0.3	0.25	0.32	0.40	1	0	0.05
Timmins (Porcupine)	295	-34	-36	30	21	6200	18	90	875	2.7	0.3	0.27	0.34	0.42	1	0	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Toronto (Metropolitan)																	
Etobicoke	160	-20	-22	31	24	4050	26	95	800	1.0	0.4	0.39	0.48	0.59	1	0	0.05
North York	175	-20	-22	31	24	4000	25	95	850	1.1	0.4	0.39	0.48	0.59	1	0	0.05
Scarborough	180	-20	-22	31	24	4000	25	85	825	1.1	0.4	0.39	0.48	0.59	1	0	0.05
Toronto	105	-18	-20	31	23	3650	25	90	820	0.8	0.4	0.39	0.48	0.58	1	0	0.05
Trenton	80	-21	-23	29	23	4250	23	95	850	1.5	0.4	0.35	0.43	0.52	1	1	0.05
Trout Creek	330	-27	-29	28	21	5300	28	95	975	2.5	0.4	0.24	0.29	0.36	2	1	0.05
Uxbridge	275	-22	-24	30	23	4400	25	95	850	2.2	0.4	0.29	0.37	0.48	1	1	0.05
Vaughan (Woodbridge)	165	-20	-22	31	24	4250	26	105	800	1.0	0.4	0.39	0.48	0.59	1	0	0.05
Vittoria	215	-15	-17	30	24	3925	25	115	950	1.2	0.4	0.35	0.43	0.52	1	0	0.05
Walkerton	275	-18	-20	30	22	4500	28	105	1025	2.5	0.4	0.35	0.45	0.57	1	0	0.05
Wallaceburg	180	-16	-18	31	24	3700	28	90	825	0.8	0.4	0.32	0.39	0.48	0	0	0.00
Waterloo	330	-19	-21	29	23	4300	28	110	925	1.8	0.4	0.27	0.34	0.42	1	0	0.05
Watford	240	-16	-18	31	24	3900	25	100	950	1.7	0.4	0.34	0.43	0.53	0	0	0.00
Wawa	290	-35	-38	26	21	5800	20	95	950	3.8	0.4	0.30	0.36	0.43	0	0	0.00
Welland	180	-15	-17	30	23	3800	23	95	975	2.0	0.4	0.33	0.39	0.47	1	0	0.05
West Lorne	215	-16	-18	31	24	3850	28	95	900	1.2	0.4	0.34	0.43	0.53	0	0	0.00
Whitby	85	-20	-22	30	23	4000	23	80	850	1.1	0.4	0.43	0.52	0.64	1	1	0.05
Whitby (Brooklin)	160	-20	-22	30	23	4200	23	80	850	1.7	0.4	0.38	0.48	0.59	1	1	0.05
White River	375	-39	-42	28	21	6400	20	85	825	4.1	0.4	0.21	0.25	0.30	0	0	0.00
Wiarton	185	-18	-20	28	22	4500	25	105	1000	2.5	0.4	0.33	0.43	0.55	1	0	0.05
Windsor	185	-16	-18	31	24	3600	28	95	900	0.7	0.4	0.36	0.43	0.52	0	0	0.00
Wingham	310	-18	-20	30	23	4350	28	100	1050	2.4	0.4	0.35	0.45	0.57	0	0	0.00
Woodstock	300	-18	-20	29	23	4100	28	105	930	1.7	0.4	0.31	0.39	0.50	1	0	0.05
Wyoming	215	-16	-18	31	24	3850	25	95	900	1.5	0.4	0.35	0.43	0.52	0	0	0.00
Quebec																	
Acton-Vale	95	-24	-27	30	23	4800	20	100	1050	2.1	0.4	0.24	0.29	0.36	3	2	0.10
Alma	110	-30	-32	29	21	5800	20	85	950	3.0	0.4	0.23	0.29	0.36	3	3	0.15
Amos	295	-34	-36	28	21	6250	20	85	920	2.9	0.3	0.24	0.29	0.35	2	1	0.05
Asbestos	245	-26	-28	29	22	4850	23	90	1050	2.6	0.5	0.26	0.32	0.39	2	2	0.10
Aylmer	90	-25	-28	30	23	4700	23	90	900	2.3	0.4	0.30	0.37	0.46	4	2	0.10
Baie-Comeau	60	-27	-29	25	19	6050	18	85	1000	3.9	0.4	0.45	0.55	0.66	4	2	0.10
Beauport	45	-25	-28	28	22	5200	20	100	1200	3.1	0.5	0.38	0.48	0.58	4	3	0.15
Bedford	55	-23	-25	29	23	4600	23	80	1260	1.9	0.4	0.31	0.37	0.45	3	2	0.10
Beloeil	25	-24	-26	30	23	4550	23	85	1025	2.2	0.4	0.28	0.34	0.41	3	2	0.10
Brome	210	-24	-26	29	22	4800	23	90	1240	2.3	0.4	0.28	0.34	0.41	3	2	0.10
Brossard	15	-24	-26	30	23	4550	23	85	1025	2.2	0.4	0.31	0.37	0.44	4	2	0.10
Buckingham	130	-26	-28	30	23	4900	23	85	990	2.4	0.4	0.30	0.37	0.45	4	2	0.10
Campbell's Bay	115	-28	-30	30	23	5000	23	95	850	2.4	0.4	0.24	0.29	0.36	4	2	0.10
Chambly	20	-24	-26	30	23	4550	23	80	1000	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Chicoutimi	10	-30	-32	28	21	5700	18	80	975	2.3	0.4	0.25	0.32	0.41	4	3	0.15
Chicoutimi (Bagotville)	5	-31	-33	28	21	5800	18	80	925	2.2	0.4	0.27	0.34	0.43	5	4	0.20
Chicoutimi (Kenogami)	140	-29	-31	29	21	5650	18	80	925	2.8	0.4	0.25	0.32	0.40	4	3	0.15
Coaticook	295	-24	-26	28	22	4900	23	95	1060	2.1	0.5	0.27	0.34	0.43	2	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature January 2.5% °C	January 1% °C	July 2.5% Dry °C	July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa S_s	S_r	Hourly Wind Pressures 1/10 kPa	1/30 kPa	1/100 kPa	Seismic Data Z_a	Z_v	Zonal Velocity Ratio, v
Contrecoeur	10	-24	-27	30	23	4700	20	95	1000	2.6	0.4	0.33	0.40	0.48	3	2	0.10
Cowansville	120	-24	-26	29	22	4700	23	85	1150	2.1	0.4	0.31	0.37	0.45	3	2	0.10
Deux-Montagnes	25	-25	-27	29	23	4600	23	90	1025	2.2	0.4	0.28	0.34	0.41	4	2	0.10
Dolbeau	120	-31	-33	28	21	6050	28	85	900	3.2	0.3	0.26	0.32	0.39	3	2	0.10
Drummondville	85	-25	-28	30	23	4800	20	110	1075	2.3	0.4	0.24	0.29	0.35	3	2	0.10
Farnham	60	-24	-26	29	23	4600	23	90	1050	2.0	0.4	0.31	0.37	0.45	3	2	0.10
Fort-Coulonge	110	-28	-30	30	23	4950	23	100	900	2.3	0.4	0.24	0.29	0.35	4	2	0.10
Gagnon	545	-33	-35	24	19	7500	20	75	925	4.2	0.4	0.37	0.43	0.50	1	1	0.05
Gaspé	55	-23	-25	25	19	5600	15	110	1100	3.9	0.5	0.59	0.72	0.87	1	1	0.05
Gatineau	95	-25	-28	30	23	4650	23	90	950	2.3	0.4	0.30	0.37	0.46	4	2	0.10
Gracefield	175	-28	-31	30	22	5200	25	100	950	2.4	0.4	0.24	0.29	0.35	4	2	0.10
Granby	120	-25	-27	29	23	4650	23	95	1175	2.1	0.4	0.26	0.32	0.39	3	2	0.10
Harrington-Harbour	30	-25	-27	17	16	6000	15	95	1150	4.5	0.5	0.70	0.84	1.02	1	1	0.05
Havre-St-Pierre	5	-27	-29	22	18	6100	15	90	1125	3.8	0.5	0.59	0.72	0.87	1	1	0.05
Hemmingford	75	-23	-25	29	23	4550	25	80	1025	2.2	0.4	0.30	0.37	0.45	4	2	0.10
Hull	65	-25	-28	30	23	4600	23	90	900	2.2	0.4	0.30	0.37	0.46	4	2	0.10
Iberville	35	-24	-26	29	23	4450	23	80	1010	2.0	0.4	0.31	0.37	0.45	4	2	0.10
Inukjuak	5	-38	-40	17	16	9050	8	50	420	4.0	0.2	0.63	0.81	1.03	0	0	0.00
Joliette	45	-25	-28	29	23	4900	20	95	1000	2.8	0.4	0.27	0.33	0.40	3	2	0.10
Jonquière	135	-29	-31	29	21	5650	18	80	925	2.8	0.4	0.25	0.32	0.40	4	3	0.15
Kuujjuaq	25	-39	-41	24	17	8650	8	50	525	4.4	0.2	0.53	0.66	0.81	1	0	0.05
Kuujjuarapik	20	-36	-38	29	17	8250	10	75	610	4.1	0.3	0.64	0.76	0.92	0	0	0.00
La-Malbaie	25	-26	-28	28	21	5400	20	95	900	2.8	0.5	0.39	0.50	0.63	6	6	0.40
La-Tuque	165	-29	-31	29	22	5400	23	90	930	3.1	0.4	0.26	0.32	0.39	3	2	0.10
Lac-Mégantic	420	-27	-29	27	22	5250	23	85	1025	2.9	0.5	0.26	0.32	0.39	3	2	0.10
Lachute	65	-25	-27	29	23	4900	23	90	1075	2.2	0.4	0.31	0.37	0.44	4	2	0.10
Lennoxville	155	-28	-30	29	22	4800	23	95	1100	1.8	0.5	0.23	0.29	0.36	2	1	0.05
Léry	30	-23	-26	29	23	4550	23	85	950	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Loretteville	100	-25	-28	28	22	5250	20	95	1225	3.4	0.5	0.38	0.48	0.58	4	3	0.15
Louiseville	15	-25	-28	29	23	5000	20	95	1025	2.7	0.4	0.33	0.40	0.48	3	2	0.10
Magog	215	-26	-28	29	22	4800	23	90	1125	2.1	0.4	0.26	0.32	0.39	2	1	0.05
Malartic	325	-33	-36	29	21	6200	20	80	900	3.0	0.3	0.24	0.29	0.35	2	1	0.05
Maniwaki	180	-29	-32	29	22	5350	28	95	900	2.2	0.4	0.24	0.28	0.34	4	2	0.10
Masson	50	-26	-28	30	23	4700	23	85	975	2.2	0.4	0.30	0.37	0.45	4	2	0.10
Matane	5	-24	-26	24	20	5600	18	85	1050	3.4	0.4	0.45	0.55	0.66	3	2	0.10
Mont-Joli	90	-24	-26	25	20	5450	18	85	920	3.7	0.4	0.45	0.55	0.66	3	2	0.10
Mont-Laurier	225	-29	-32	29	22	5400	28	100	1000	2.4	0.4	0.24	0.28	0.33	4	2	0.10
Montmagny	10	-25	-28	28	22	5100	20	90	1090	2.7	0.5	0.39	0.50	0.63	5	4	0.20
Montréal Region																	
Beaconsfield	25	-23	-26	30	23	4550	23	85	950	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Dorval	25	-23	-26	30	23	4550	23	85	940	2.2	0.4	0.31	0.37	0.44	4	2	0.10
Laval	35	-24	-26	29	23	4600	23	90	1025	2.4	0.4	0.32	0.37	0.44	4	2	0.10
Montréal	35	-23	-26	30	23	4250	23	90	1025	2.4	0.4	0.31	0.37	0.44	4	2	0.10
Montréal-Est	25	-23	-26	30	23	4450	22	90	1025	2.5	0.4	0.31	0.37	0.44	4	2	0.10
Montréal-Nord	20	-23	-26	30	23	4550	23	90	1025	2.4	0.4	0.31	0.37	0.44	4	2	0.10
Outremont	105	-23	-26	30	23	4450	23	90	1025	2.6	0.4	0.31	0.37	0.44	4	2	0.10

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature January 2.5% °C	Design Temperature January 1% °C	Design Temperature July 2.5% Dry °C	Design Temperature July 2.5% Wet °C	Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa S_s	Ground Snow Load, kPa S_r	Hourly Wind Pressures 1/10 kPa	Hourly Wind Pressures 1/30 kPa	Hourly Wind Pressures 1/100 kPa	Seismic Data Z_a	Seismic Data Z_v	Seismic Data Zonal Velocity Ratio, v
Pierrefonds	25	-23	-26	30	23	4550	23	90	960	2.2	0.4	0.31	0.37	0.44	4	2	0.10
St-Lambert	15	-23	-26	30	23	4550	23	90	1050	2.3	0.4	0.31	0.37	0.44	4	2	0.10
St-Laurent	45	-23	-26	30	23	4500	23	90	950	2.3	0.4	0.31	0.37	0.44	4	2	0.10
Ste-Anne-de-Bellevue	35	-23	-26	29	22	4550	23	90	960	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Verdun	20	-23	-26	30	23	4500	23	85	1025	2.3	0.4	0.31	0.37	0.44	4	2	0.10
Nicolet (Gentilly)	15	-25	-28	30	23	5000	20	105	1025	2.6	0.4	0.32	0.39	0.47	3	2	0.10
Nitchequon	545	-38	-40	23	19	8100	15	65	825	3.2	0.3	0.29	0.34	0.40	0	1	0.05
Noranda	305	-33	-36	29	21	6150	20	85	875	2.9	0.3	0.26	0.32	0.39	2	1	0.05
Percé	5	-22	-25	25	19	5600	15	100	1300	3.5	0.5	0.64	0.78	0.94	1	1	0.05
Pincourt	25	-23	-26	29	23	4550	23	90	950	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Plessisville	145	-26	-28	29	23	5150	20	100	1150	2.6	0.5	0.26	0.32	0.39	3	2	0.10
Port-Cartier	20	-29	-32	25	19	6150	15	95	1125	3.8	0.4	0.52	0.63	0.76	4	1	0.05
Povungnituk	5	-36	-38	23	18	9200	5	50	375	4.1	0.2	0.62	0.81	1.03	1	0	0.05
Québec City Region																	
Ancienne-Lorette	35	-25	-28	28	22	5200	20	95	1200	3.1	0.5	0.38	0.48	0.58	4	3	0.15
Lévis	50	-25	-28	28	22	5200	20	100	1200	3.0	0.5	0.38	0.48	0.58	4	3	0.15
Québec	120	-25	-28	28	22	5200	20	100	1210	3.3	0.5	0.38	0.48	0.58	4	3	0.15
Sillery	10	-25	-28	28	22	5250	20	100	1200	2.8	0.5	0.38	0.48	0.58	4	3	0.15
Ste-Foy	115	-25	-28	28	22	5200	20	100	1200	3.4	0.5	0.38	0.48	0.58	4	3	0.15
Richmond	150	-25	-27	29	22	4850	23	90	1060	2.0	0.5	0.24	0.29	0.36	2	2	0.10
Rimouski	30	-25	-27	25	20	5300	20	85	890	3.5	0.4	0.45	0.55	0.66	3	2	0.10
Rivière-du-Loup	55	-25	-27	27	21	5500	23	85	900	3.0	0.5	0.41	0.52	0.66	6	5	0.30
Roberval	100	-30	-33	28	21	5850	25	85	910	3.2	0.3	0.26	0.32	0.39	3	2	0.10
Rock-Island	160	-24	-26	28	22	4900	23	85	1125	1.8	0.4	0.30	0.37	0.46	2	1	0.05
Rosemère	25	-24	-26	29	23	4650	23	90	1050	2.4	0.4	0.32	0.37	0.44	4	2	0.10
Rouyn	300	-33	-36	29	21	6150	20	85	900	2.8	0.3	0.26	0.32	0.39	2	1	0.05
Salaberry-de-Valleyfield	50	-23	-25	29	23	4450	25	90	900	2.1	0.4	0.31	0.37	0.44	4	2	0.10
Schefferville	550	-38	-40	24	17	8400	13	60	800	4.1	0.3	0.33	0.39	0.46	0	0	0.00
Senneterre	310	-34	-36	29	21	6350	23	85	925	3.0	0.3	0.24	0.29	0.35	2	1	0.05
Sept-Îles	5	-30	-32	24	18	6200	15	105	1125	3.8	0.4	0.52	0.63	0.76	3	1	0.05
Shawinigan	60	-26	-29	29	23	5050	20	95	1050	2.8	0.4	0.26	0.32	0.39	3	2	0.10
Shawville	170	-27	-30	30	23	5050	23	95	880	2.6	0.4	0.26	0.32	0.39	4	2	0.10
Sherbrooke	185	-28	-30	29	22	4800	23	95	1100	2.0	0.5	0.24	0.29	0.35	2	2	0.10
Sorel	10	-24	-27	30	23	4650	20	95	975	2.6	0.4	0.33	0.40	0.48	3	2	0.10
St-Félicien	105	-31	-33	28	21	6000	25	85	900	3.2	0.3	0.26	0.32	0.39	3	2	0.10
St-Georges-de-Cacouna	35	-25	-27	27	21	5500	23	85	925	2.9	0.5	0.41	0.52	0.66	6	5	0.30
St-Hubert	25	-24	-26	30	23	4600	23	85	1020	2.3	0.4	0.31	0.37	0.44	4	2	0.10
St-Hubert-de-Temiscouata	310	-26	-28	26	21	5500	25	85	1025	4.0	0.5	0.41	0.52	0.66	5	4	0.20
St-Hyacinthe	35	-24	-27	30	23	4550	20	85	1030	2.1	0.4	0.27	0.32	0.38	3	2	0.10
St-Jean	35	-24	-26	29	23	4450	23	80	1010	2.0	0.4	0.31	0.37	0.45	3	2	0.10
St-Jérôme	95	-25	-27	29	23	5000	23	90	1025	2.5	0.4	0.29	0.34	0.40	4	2	0.10
St-Jovite	230	-27	-30	27	22	5300	25	90	1025	2.6	0.4	0.25	0.30	0.36	4	2	0.10
St-Nicolas	65	-25	-28	28	22	5100	20	95	1200	3.2	0.5	0.37	0.45	0.55	4	3	0.15
Ste-Agathe-des-Monts	360	-27	-29	27	22	5500	23	90	1170	3.1	0.4	0.27	0.32	0.38	4	2	0.10

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Sutton	185	-24	-26	29	22	4725	23	90	1260	2.2	0.4	0.31	0.37	0.45	3	2	0.10
Tadoussac	65	-26	-28	27	21	5450	20	90	1000	3.1	0.4	0.40	0.51	0.64	6	5	0.30
Témiscaming	240	-30	-32	30	21	5100	23	95	940	2.3	0.4	0.24	0.29	0.35	3	1	0.05
Thetford Mines	330	-26	-28	28	22	5300	20	100	1230	3.0	0.5	0.28	0.34	0.41	3	2	0.10
Thurso	50	-26	-28	30	23	4850	23	85	950	2.2	0.4	0.30	0.37	0.45	4	2	0.10
Trois-Rivières	25	-25	-28	29	23	4950	20	100	1050	2.6	0.4	0.33	0.40	0.48	3	2	0.10
Val-d'Or	310	-33	-36	29	21	6200	20	80	925	3.1	0.3	0.24	0.29	0.35	3	1	0.05
Varennes	15	-24	-26	30	23	4600	23	90	1000	2.4	0.4	0.30	0.37	0.45	3	2	0.10
Verchères	15	-24	-26	30	23	4600	23	90	1000	2.5	0.4	0.33	0.40	0.48	3	2	0.10
Victoriaville	125	-26	-28	29	23	5000	20	95	1100	2.4	0.5	0.26	0.32	0.39	3	2	0.10
Ville-Marie	200	-31	-34	30	21	5550	23	90	825	2.1	0.4	0.30	0.37	0.45	2	1	0.05
Waterloo	205	-24	-27	29	22	4850	23	90	1250	2.3	0.4	0.26	0.32	0.39	3	2	0.10
Windsor	150	-25	-27	29	22	4850	23	90	1075	2.1	0.4	0.23	0.29	0.36	2	2	0.10
New Brunswick																	
Alma	5	-21	-23	26	20	4600	18	135	1450	2.1	0.5	0.38	0.50	0.65	2	1	0.05
Bathurst	10	-23	-26	30	21	5200	20	105	1020	3.2	0.5	0.34	0.43	0.54	1	1	0.05
Campbellton	30	-26	-28	29	22	5500	20	100	1025	3.3	0.4	0.37	0.48	0.60	2	1	0.05
Chatham	5	-24	-26	30	21	5000	20	90	1050	3.1	0.5	0.29	0.37	0.47	2	1	0.05
Edmundston	160	-27	-29	28	22	5400	23	85	1000	3.1	0.5	0.30	0.39	0.51	3	3	0.15
Fredericton	15	-24	-27	29	21	4650	23	105	1100	2.8	0.5	0.30	0.37	0.46	2	1	0.05
Gagetown	20	-23	-26	28	21	4500	20	110	1125	2.5	0.5	0.36	0.48	0.62	2	1	0.05
Grand Falls	115	-27	-30	28	22	5350	23	100	1100	3.3	0.5	0.29	0.37	0.48	3	2	0.10
Moncton	20	-22	-24	28	21	4750	20	105	1175	2.7	0.5	0.46	0.58	0.72	2	1	0.05
Oromocto	20	-23	-26	29	21	4700	23	105	1110	2.7	0.5	0.35	0.45	0.57	2	1	0.05
Sackville	15	-21	-23	27	21	4600	18	105	1175	2.3	0.5	0.41	0.52	0.66	1	1	0.05
Saint John	5	-22	-24	25	20	4800	18	130	1425	2.1	0.5	0.38	0.48	0.59	2	1	0.05
Shippagan	5	-22	-24	28	20	5100	18	90	1050	3.1	0.5	0.52	0.63	0.77	1	1	0.05
St. Stephen	20	-22	-25	27	21	4600	20	115	1160	2.3	0.5	0.45	0.55	0.67	2	1	0.05
Woodstock	60	-26	-29	30	22	5000	23	100	1100	2.8	0.5	0.27	0.34	0.42	2	1	0.05
Nova Scotia																	
Amherst	25	-21	-24	27	21	4600	18	115	1150	2.2	0.5	0.41	0.52	0.66	1	1	0.05
Antigonish	10	-20	-23	27	21	4600	15	115	1250	1.9	0.5	0.41	0.50	0.60	1	1	0.05
Bridgewater	10	-15	-17	27	20	4250	15	135	1475	1.7	0.5	0.41	0.52	0.67	1	1	0.05
Canso	5	-17	-19	25	20	4500	15	115	1400	1.5	0.5	0.49	0.58	0.68	1	1	0.05
Debert	45	-22	-25	27	21	4600	18	110	1200	1.9	0.5	0.39	0.50	0.63	1	1	0.05
Digby e4	35	-15	-17	25	20	4050	15	130	1275	2.0	0.5	0.40	0.50	0.62	1	1	0.05
Greenwood (CFB)	105	-17	-19	28	21	4300	15	115	1100	2.4	0.5	0.36	0.48	0.61	1	1	0.05
Halifax Region																	
Dartmouth e3	10	-16	-18	26	20	4200	18	135	1400	1.4	0.5	0.40	0.52	0.67	1	1	0.05
Halifax e3	55	-16	-18	26	20	4100	15	140	1500	1.7	0.5	0.40	0.52	0.67	1	1	0.05
Kentville	25	-18	-20	28	21	4200	18	120	1200	2.2	0.5	0.36	0.48	0.62	1	1	0.05
Liverpool	20	-14	-16	27	20	4050	15	140	1425	1.5	0.5	0.44	0.55	0.69	1	1	0.05
Lockeport	5	-14	-16	25	20	4100	15	130	1450	1.3	0.5	0.44	0.55	0.68	1	1	0.05
Louisburg	5	-15	-17	26	20	4500	15	110	1500	1.9	0.6	0.52	0.60	0.71	2	2	0.10
Lunenburg	25	-15	-17	26	20	4250	15	135	1450	1.7	0.5	0.43	0.55	0.70	1	1	0.05
New Glasgow	30	-21	-23	27	21	4450	15	100	1200	2.0	0.5	0.40	0.50	0.62	1	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%													
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r	1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
North Sydney	20	-16	-18	27	21	4600	13	115	1475	2.2	0.5	0.47	0.55	0.65	2	1	0.05
Pictou	25	-21	-24	27	21	4400	15	100	1175	2.0	0.5	0.40	0.50	0.62	1	1	0.05
Port Hawkesbury	40	-19	-22	27	21	4400	15	120	1450	1.9	0.5	0.59	0.69	0.80	1	1	0.05
Springhill	185	-20	-23	27	21	4600	18	115	1175	2.8	0.5	0.39	0.50	0.64	1	1	0.05
Stewiacke	25	-21	-23	27	21	4400	18	120	1250	1.6	0.5	0.39	0.50	0.63	1	1	0.05
Sydney	5	-16	-18	27	21	4650	13	115	1475	2.1	0.5	0.47	0.55	0.65	2	2	0.10
Tatamagouche	25	-21	-24	27	21	4500	18	110	1150	2.0	0.5	0.40	0.50	0.62	1	1	0.05
Truro	25	-21	-23	27	21	4650	18	115	1175	1.8	0.5	0.37	0.48	0.60	1	1	0.05
Wolfville	35	-19	-21	28	21	4200	18	115	1175	2.2	0.5	0.36	0.48	0.62	1	1	0.05
Yarmouth	10	-13	-15	22	19	4100	13	140	1260	1.6	0.5	0.41	0.51	0.63	1	1	0.05
Prince Edward Island																	
Charlottetown	5	-20	-22	26	21	4600	13	100	1150	2.4	0.5	0.46	0.55	0.66	1	1	0.05
Souris	5	-19	-21	27	21	4650	13	105	1130	2.4	0.5	0.41	0.50	0.60	1	1	0.05
Summerside	10	-20	-22	27	21	4650	13	105	1060	2.8	0.5	0.52	0.63	0.76	1	1	0.05
Tignish	10	-20	-22	27	20	4800	13	90	1100	2.9	0.5	0.61	0.72	0.85	1	1	0.05
Newfoundland																	
Argentia	15	-13	-15	21	18	4600	15	100	1400	2.2	0.6	0.57	0.69	0.83	1	1	0.05
Bonavista	15	-17	-19	24	19	4950	18	90	1010	2.5	0.5	0.52	0.63	0.77	1	1	0.05
Buchans	255	-21	-24	26	19	5400	13	100	1125	4.3	0.5	0.46	0.55	0.66	1	1	0.05
Cape Harrison	5	-29	-31	27	16	6900	15	105	950	5.7	0.4	0.46	0.55	0.66	1	0	0.05
Cape Race	5	-14	-16	19	18	4900	18	130	1550	2.1	0.6	0.79	0.96	1.17	1	1	0.05
Channel-Port aux Basques	5	-15	-17	19	18	5000	13	115	1520	2.7	0.6	0.55	0.63	0.73	1	1	0.05
Corner Brook	35	-19	-22	26	19	4750	13	85	1190	3.4	0.5	0.58	0.69	0.82	1	1	0.05
Gander	125	-18	-21	27	19	5200	18	85	1180	3.4	0.5	0.46	0.55	0.66	1	1	0.05
Grand Bank	5	-14	-16	20	18	4550	15	115	1525	2.2	0.6	0.59	0.69	0.81	2	2	0.10
Grand Falls	60	-21	-24	26	19	5000	15	80	1030	3.1	0.5	0.46	0.55	0.66	1	1	0.05
Happy Valley-Goose Bay	15	-31	-33	27	19	6700	20	75	960	4.8	0.4	0.29	0.34	0.40	0	0	0.00
Labrador City	550	-35	-37	23	18	7900	15	65	880	3.9	0.3	0.31	0.37	0.44	1	1	0.05
St. Anthony	10	-24	-27	22	18	6300	13	80	1280	4.6	0.5	0.57	0.76	1.01	0	1	0.05
St. John’s	65	-14	-16	24	20	4800	18	110	1575	2.6	0.6	0.60	0.73	0.89	1	1	0.05
Stephenville	25	-17	-20	24	19	4850	13	95	1275	3.2	0.5	0.62	0.72	0.84	1	1	0.05
Twin Falls	425	-35	-37	23	18	7850	15	65	950	4.2	0.4	0.31	0.37	0.44	0	0	0.00
Wabana	75	-15	-17	24	20	4800	18	105	1500	2.7	0.6	0.56	0.69	0.84	1	1	0.05
Wabush	550	-35	-37	23	18	7900	15	65	880	3.9	0.3	0.31	0.37	0.44	1	1	0.05
Yukon																	
Aishihik	920	-44	-46	23	16	8100	8	40	275	1.8	0.1	0.29	0.35	0.42	3	5	0.30
Dawson	330	-50	-51	26	16	8400	8	45	350	2.5	0.1	0.23	0.28	0.34	2	4	0.20
Destruction Bay	815	-43	-45	24	15	8100	8	45	300	1.5	0.1	0.45	0.55	0.66	4	6	0.40
Snag	595	-51	-53	23	16	8700	8	55	350	2.0	0.1	0.23	0.28	0.34	3	5	0.30
Teslin	690	-41	-43	25	16	7200	8	35	340	2.7	0.1	0.19	0.25	0.34	1	4	0.20
Watson Lake	685	-46	-48	26	16	7700	8	50	410	2.9	0.1	0.26	0.32	0.39	1	2	0.10
Whitehorse	655	-41	-43	25	15	6900	8	40	275	1.7	0.1	0.28	0.34	0.42	2	4	0.20
Northwest Territories																	
Fort Good Hope	100	-46	-48	27	17	9350	5	60	280	2.7	0.1	0.48	0.58	0.70	1	1	0.05
Fort Providence	150	-44	-46	24	18	7900	8	65	350	2.2	0.1	0.26	0.32	0.39	0	1	0.05

Table C-2 (Continued)

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, mm	Ann. Tot. Ppn., mm	Ground Snow Load, kPa		Hourly Wind Pressures			Seismic Data		
		January		July 2.5%								1/10 kPa	1/30 kPa	1/100 kPa	Z_a	Z_v	Zonal Velocity Ratio, v
		2.5% °C	1% °C	Dry °C	Wet °C					S_s	S_r						
Fort Simpson	120	-45	-47	27	18	8000	8	70	360	2.1	0.1	0.30	0.37	0.46	0	1	0.05
Fort Smith	205	-43	-45	28	19	7700	8	60	350	2.1	0.2	0.30	0.37	0.46	0	1	0.05
Hay River	45	-41	-43	26	18	11100	8	40	150	2.2	0.1	0.26	0.32	0.39	0	1	0.05
Holman	10	-43	-45	18	12	10050	3	40	250	1.9	0.1	0.63	0.78	0.95	0	1	0.05
Inuvik	45	-46	-48	25	16	10050	5	55	425	2.1	0.1	0.39	0.55	0.76	1	2	0.10
Mould Bay	5	-45	-47	10	8	13000	3	30	100	1.4	0.1	0.47	0.60	0.76	1	1	0.05
Norman Wells	65	-46	-47	27	17	8800	5	55	320	2.5	0.1	0.41	0.58	0.79	0	1	0.05
Rae-Edzo	160	-44	-46	24	17	8400	5	55	275	2.1	0.1	0.34	0.43	0.53	0	1	0.05
Tungsten	1340	-49	-51	26	16	7900	5	40	640	4.0	0.1	0.29	0.39	0.52	1	2	0.10
Yellowknife	160	-43	-45	25	17	8500	5	55	275	2.0	0.1	0.34	0.43	0.53	0	1	0.05
Nunavut																	
Aklavik	5	-44	-46	24	16	10000	5	45	250	2.1	0.1	0.37	0.52	0.72	1	2	0.10
Alert	5	-43	-45	13	9	13200	3	20	150	1.5	0.1	0.54	0.69	0.87	0	0	0.00
Arctic Bay	15	-43	-45	14	10	11900	3	35	150	1.9	0.1	0.40	0.50	0.62	1	1	0.05
Arviat / Eskimo Point	5	-40	-41	21	16	10000	5	60	300	2.7	0.2	0.49	0.59	0.71	0	0	0.00
Baker Lake	5	-45	-46	21	15	11000	3	50	260	2.7	0.2	0.42	0.50	0.59	0	0	0.00
Cambridge Bay	15	-45	-46	16	13	12000	3	35	140	1.5	0.1	0.41	0.50	0.60	0	0	0.00
Chesterfield Inlet	10	-40	-41	20	14	10500	5	55	270	2.8	0.2	0.44	0.52	0.62	0	0	0.00
Clyde River	5	-41	-43	15	9	11100	5	40	225	3.2	0.2	0.61	0.80	1.02	5	3	0.15
Coppermine	10	-44	-45	20	13	10700	5	50	150	2.4	0.1	0.33	0.42	0.52	0	1	0.05
Coral Harbour	15	-41	-43	18	13	10800	5	60	280	3.5	0.2	0.75	0.91	1.10	1	0	0.05
Echo Bay / Port Radium	195	-44	-46	22	16	9300	5	55	250	2.8	0.1	0.38	0.48	0.59	0	1	0.05
Eureka	5	-47	-48	12	9	13800	3	25	70	1.5	0.1	0.47	0.60	0.76	1	0	0.05
Fort Resolution	160	-42	-44	26	18	8050	8	55	300	2.1	0.1	0.29	0.36	0.44	0	1	0.05
Iqaluit	45	-40	-42	16	11	10050	5	55	425	2.7	0.2	0.39	0.55	0.76	1	0	0.05
Isachsen	10	-46	-48	12	9	13600	3	20	75	1.5	0.1	0.68	0.83	1.00	4	1	0.05
Nottingham Island	30	-38	-40	14	13	10000	5	55	325	4.2	0.2	0.75	0.91	1.10	1	0	0.05
Rankin Inlet	10	-40	-41	20	15	10600	5	60	250	2.8	0.2	0.46	0.55	0.66	0	0	0.00
Resolute	25	-44	-45	11	9	12600	3	25	140	1.6	0.1	0.52	0.63	0.77	2	1	0.05
Resolution Island	5	-35	-37	8	7	9000	5	65	550	4.8	0.2	0.85	1.10	1.41	2	0	0.05

Appendix D
Fire-Performance Ratings

Section D-1 General

The contents of this Appendix have been prepared on the recommendations of the Standing Committee on Fire Performance Ratings, which was established by the Canadian Commission on Building and Fire Codes (CCBFC) for this purpose.

D-1.1. Introduction

D-1.1.1. Scope

1) This fire-performance information is presented in a form closely linked to the performance requirements and the minimum materials specifications of the National Building Code of Canada 1995.

2) The ratings have been assigned only after careful consideration of all available literature on assemblies of common building materials, where they are adequately identified by description. The assigned values based on this information will, in most instances, be conservative when compared to the ratings determined on the basis of actual tests on individual assemblies.

3) The fire-performance information set out in this Appendix applies to materials and assemblies of materials which comply in all essential details with the minimum structural design standards described in Part 4 of the National Building Code of Canada. Additional requirements, where appropriate, are described in other Sections of this Appendix.

This Appendix is included for explanatory purposes only and does not form part of the requirements. The bold face reference numbers that introduce each item do not relate to specific requirements in the Code.

4) Section D-2 of this Appendix assigns fire-resistance ratings for walls, floors, roofs, columns and beams related to CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials," and describes methods for determining these ratings.

5) Section D-3 assigns flame-spread ratings and smoke developed classifications for surface materials related to CAN/ULC-S102-M, "Test for Surface Burning Characteristics of Building Materials and Assemblies" and CAN/ULC-S102.2-M, "Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies."

6) Section D-4 describes noncombustibility in building materials when tested in accordance with CAN4-S114-M, "Test for Determination of Non-Combustibility in Building Materials."

7) Section D-5 contains requirements for the installation of fire doors and fire dampers in fire-rated stud wall assemblies and the installation of fire stop flaps in fire-rated membrane ceilings.

8) Section D-6 contains background information regarding fire test reports, obsolete materials and assemblies, assessment of archaic assemblies and the development of the component additive method.

D-1.1.2. Referenced Documents

1) Where documents are referenced in this Appendix, they shall be the editions designated in Table D-1.1.2.

Table D-1.1.2. r4
Documents Referenced in Appendix D Fire-Performance Ratings

Issuing Agency	Document Number	Title of Document	Reference
ANSI	A208.1-1993 r e2	Particleboard	Table D-3.1.1.A.
ASTM	C 36/C 36M-99e1 r r4	Gypsum Wallboard	D-1.5.1. Table D-3.1.1.A.
ASTM	C 37/C 37M-99 r r4	Gypsum Lath	D-1.5.1.

Table D-1.1.2. (Continued)

Issuing Agency	Document Number	Title of Document	Reference
ASTM	C 330-97 r	Lightweight Aggregates for Structural Concrete	D-1.4.3.(2)
ASTM	C 442/C 442M-99 r r4	Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board	D-1.5.1. Table D-3.1.1.A.
ASTM	C 588/C 588M-99 r r4	Gypsum Base for Veneer Plasters	D-1.5.1. Table D-3.1.1.A.
ASTM	C 630/C 630M-00 r r4	Water-Resistant Gypsum Backing Board	D-1.5.1. Table D-3.1.1.A.
ASTM	C 931/C 931M-98 r e2 r4	Exterior Gypsum Soffit Board	D-1.5.1. Table D-3.1.1.A.
ASTM	C 960-97 r	Predecorated Gypsum Board	D-1.5.1.
CCBFC	NRCC 30629	Supplement to the National Building Code of Canada 1990	D-6.2. D-6.3. D-6.4.
CGSB	4-GP-36M-1978	Carpet Underlay, Fibre Type	Table D-3.1.1.B.
CGSB	CAN/CGSB-4.129-93	Carpets for Commercial Use	Table D-3.1.1.B.
CGSB	CAN/CGSB-11.3-M87	Hardboard	Table D-3.1.1.A.
CGSB	CAN/CGSB-34.16-M89	Sheets, Asbestos-Cement, Flat, Fully Compressed	Table D-3.1.1.A.
CGSB	CAN/CGSB-92.2-M90	Trowel or Spray Applied Acoustical Material	D-2.3.4.(5)
CSA	A23.1-00 r r4	Concrete Materials and Methods of Concrete Construction	D-1.4.3.(1)
CSA	A23.3-94 r	Design of Concrete Structures	D-2.1.5. D-2.6.6. D-2.8.2. Table D-2.8.2. e2
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	Table D-2.6.1.A.
CSA	A82.22-M1977	Gypsum Plasters	Table D-3.1.1.A.
CSA	CAN/CSA-A82.27-M91	Gypsum Board	D-1.5.1. Table D-3.1.1.A.
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	D-1.7.2.(1) D-2.3.9.(1) Table D-2.5.1.
CSA	A82.31-M1980	Gypsum Board Application	D-2.3.9.
CSA	A126.1-M1984	Vinyl Asbestos and Vinyl Composition Floor Tile	Table D-3.1.1.B.
CSA	A165.1-94	Concrete Masonry Units	Table D-2.1.1.
CSA	CAN/CSA-A247-M86	Insulating Fibreboard	Table D-3.1.1.A.
CSA	CAN/CSA-G312.3-M92	Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections	D-2.6.6.
CSA	O86-01 e r4	Engineering Design in Wood	D-2.11.2.(1) D-2.11.2.(2)
CSA	O121-M1978	Douglas Fir Plywood	Table D-3.1.1.A.
CSA	CAN/CSA-O141-91	Softwood Lumber	D-2.3.6.(2) Table D-2.4.1.
CSA	O151-M1978	Canadian Softwood Plywood	Table D-3.1.1.A.
CSA	O153-M1980	Poplar Plywood	Table D-3.1.1.A.
CSA	O437.0-93 e	OSB and Waferboard	Table D-3.1.1.A.
CSA	CAN/CSA-S16.1-94	Limit States Design of Steel Structures	D-2.6.6.
NFPA	80-1999 r r4	Fire Doors and Fire Windows	D-5.2.1.

Table D-1.1.2. (Continued)

Issuing Agency	Document Number	Title of Document	Reference
ULC	CAN/ULC-S101-M89	Fire Endurance Tests of Building Construction and Materials	D-1.1.1.(4) D-1.12.1. D-2.3.2.
ULC	CAN/ULC-S102-M88	Test for Surface Burning Characteristics of Building Materials and Assemblies	D-1.1.1.(5)
ULC	CAN/ULC-S102.2-M88	Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies	D-1.1.1.(5) Table D-3.1.1.B.
ULC	CAN4-S114-M80	Test for Determination of Non-Combustibility in Building Materials	D-1.1.1.(6) D-4.1.1. D-4.2.1.
ULC	S505-1974	Fusible Links for Fire Protection Service	D-5.3.2.
ULC	CAN/ULC-S702-97 r	Mineral Fibre Thermal Insulation for Buildings e4	Table D-2.3.4.A. Table D-2.3.4.D. D-2.3.5. Table D-2.6.1.E. D-6.4.
ULC	CAN/ULC-S703-01 r4	Cellulose Fibre Insulation (CFI) for Buildings	D-2.3.4.(5)

D-1.1.3. Applicability of Ratings

The ratings shown in this document apply if more specific test values are not available. The construction of an assembly that is the subject of an individual test report must be followed in all essential details if the fire-resistance rating reported is to be applied for use with this Code.

D-1.1.4. Higher Ratings

The authority having jurisdiction may allow higher fire-resistance ratings than those derived from this Appendix, where supporting evidence justifies a higher rating. Additional information is provided in summaries of published test information and the reports of fire tests carried out by the Institute for Research in Construction, National Research Council of Canada, included in Section D-6, Background Information.

D-1.1.5. Additional Information on Fire Rated Assemblies

Assemblies containing materials for which there is no nationally recognized standard are not included in this Appendix. Many such assemblies have been rated by Underwriters Laboratories (UL), Underwriters' Laboratories of Canada (ULC), or Intertek Testing Services NA Ltd. (ITS). The UL "Fire Resistance Directory," Volume 1, can be obtained from UL, 333 Pfingsten Road, Northbrook, Illinois 60062 U.S.A. The ULC information is published in their "List of Equipment and Materials," Volume III, Fire Resistance Ratings. Copies of this document may be obtained from ULC, 7 Crouse Road, Scarborough, Ontario M1R 3A9. ITS' Directory of Listed Products can be obtained from ITS, 3210 American Drive, Mississauga, Ontario L4V 1B3. e2

D-1.2. Interpretation of Test Results

D-1.2.1. Limitations

1) The fire-performance ratings set out in this Appendix are based on those that would be obtained from the standard methods of test described in the Code. The test methods are essentially a means of comparing the performance of one building component or assembly with another in relation to its performance in fire.

2) Since it is not practicable to measure the fire resistance of constructions in situ, they must be evaluated under some agreed test conditions. A specified fire-resistance rating is not necessarily the actual time that the assembly would endure in situ in a building fire, but is that which the particular construction must meet under the specified methods of test.

3) Considerations arising from departures in use from the conditions established in the standard test methods may, in some circumstances, have to be taken into account by the designer and the authority having jurisdiction. Some of these conditions are covered at present by the provisions of the National Building Code.

4) For walls and partitions, the stud spacings previously specified as 16 or 24 inch have been converted to 400 and 600 mm, respectively, for consistency with other metric values; however, the use of equivalent imperial dimensions for stud spacing is permitted.

D-1.3. Concrete

D-1.3.1. Aggregates in Concrete

Low density aggregate concretes generally exhibit better fire performance than natural stone aggregate concretes. A series of tests on concrete masonry walls, combined with mathematical analysis of the test results, has allowed further distinctions between certain low density aggregates to be made.

D-1.4. Types of Concrete

D-1.4.1. Description

1) For purposes of this Appendix, concretes are described as Types S, N, L, L_1, L_2, L40S, $L_1$20S or $L_2$20S as described in (2) to (8).

2) Type S concrete is the type in which the coarse aggregate is granite, quartzite, siliceous gravel or other dense materials containing at least 30% quartz, chert or flint.

3) Type N concrete is the type in which the coarse aggregate is cinders, broken brick, blast furnace slag, limestone, calcareous gravel, trap rock, sandstone or similar dense material containing not more than 30% of quartz, chert or flint.

4) Type L concrete is the type in which all the aggregate is expanded slag, expanded clay, expanded shale or pumice.

5) Type L_1 concrete is the type in which all the aggregate is expanded shale.

6) Type L_2 concrete is the type in which all the aggregate is expanded slag, expanded clay or pumice.

7) Type L40S concrete is the type in which the fine portion of the aggregate is sand and low density aggregate in which the sand does not exceed 40% of the total volume of all aggregates in the concrete.

8) Type $L_1$20S and Type $L_2$20S concretes are the types in which the fine portion of the aggregate is sand and low density aggregate in which the sand does not exceed 20% of the total volume of all aggregates in the concrete.

D-1.4.2. Determination of Ratings

Where concretes are described as being of Type S, N, L, L_1 or L_2, the rating applies to the concrete containing the aggregate in the group that provides the least fire resistance. If the nature of an aggregate cannot be determined accurately enough to place it in one of the groups, the aggregate shall be considered as being in the group that requires a greater thickness of concrete for the required fire resistance.

D-1.4.3. Description of Aggregates

1) The descriptions of the aggregates in Type S and Type N concretes apply to the coarse aggregates only. Coarse aggregate for this purpose means that retained on a 5 mm sieve using the method of grading aggregates described in CSA A23.1, “Concrete Materials and Methods of Concrete Construction.” r

2) Increasing the proportion of sand as fine aggregate in low density concretes requires increased thicknesses of material to produce equivalent fire-resistance ratings. Low density aggregates for Type L and Types L-S concretes used in loadbearing components shall conform to ASTM C330, “Lightweight Aggregates for Structural Concrete.”

3) Non-loadbearing low density components of vermiculite and perlite concrete, in the absence of other test evidence, shall be rated on the basis of the values shown for Type L concrete.

D-1.5. Gypsum Wallboard

D-1.5.1. Types of Wallboard

1) Where the term gypsum wallboard is used in this Appendix, it is intended to include, in addition to gypsum wallboard, gypsum backing board and gypsum base for veneer plaster as described in

a) CAN/CSA-A82.27-M, “Gypsum Board,”
b) ASTM C 36/C 36M, “Gypsum Wallboard,” r4
c) ASTM C 37/C 37M, “Gypsum Lath,” r4
d) ASTM C 442/C 442M, “Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board,” r4
e) ASTM C 588/C 588M, “Gypsum Base for Veneer Plasters,” r4
f) ASTM C 630/C 630M, “Water-Resistant Gypsum Backing Board,” r
g) ASTM C 931/C 931M, “Exterior Gypsum Soffit Board,” or r
h) ASTM C 960, “Predecorated Gypsum Board.”

2) Where the term Type X gypsum wallboard is used in this Appendix, it applies to special fire-resistant board as described in

a) CAN/CSA-A82.27-M, “Gypsum Board,”
b) ASTM C 36/C 36M, “Gypsum Wallboard,” r4
c) ASTM C 442/C 442M, “Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board,” r4
d) ASTM C 588/C 588M, “Gypsum Base for Veneer Plasters,” r4

e) ASTM C 630/C 630M, “Water-Resistant Gypsum Backing Board,”
f) ASTM C 931/C 931M, “Exterior Gypsum Soffit Board,” or
g) ASTM C 960, “Predecorated Gypsum Board.”

D-1.6. Equivalent Thickness

D-1.6.1. Method of Calculating

1) The thickness of solid-unit masonry and concrete described in this Appendix shall be the thickness of solid material in the unit or component thickness. For units that contain cores or voids, the Tables refer to the equivalent thickness determined in conformance with (2) to (10).

2) Where a plaster finish is used, the equivalent thickness of a wall, floor, column or beam protection shall be equal to the sum of the equivalent thicknesses of the concrete or masonry units and the plaster finish measured at the point that will give the least value of equivalent thickness.

3) Except as provided in (5), the equivalent thickness of a hollow masonry unit shall be calculated as equal to the actual overall thickness of a unit in millimetres multiplied by a factor equal to the net volume of the unit and divided by its gross volume.

4) Net volume shall be determined using a volume displacement method that is not influenced by the porous nature of the units.

5) Gross volume of a masonry unit shall be equal to the actual length of the unit multiplied by the actual height of the unit multiplied by the actual thickness of the unit.

6) Where all the core spaces in a wall of hollow concrete masonry or hollow-core precast concrete units are filled with grout, mortar, or loose fill materials such as expanded slag, burned clay or shale (rotary kiln process), vermiculite or perlite, the equivalent thickness rating of the wall shall be considered to be the same as that of a wall of solid units, or a solid wall of the same concrete type and the same overall thickness.

7) The equivalent thickness of hollow-core concrete slabs and panels having a uniform thickness and cores of constant cross section throughout their length shall be obtained by dividing the net cross-sectional area of the slab or panel by its width.

8) The equivalent thickness of concrete panels with tapered cross sections shall be the cross section determined at a distance of 2 t or 150 mm, whichever is less, from the point of minimum thickness, where t is the minimum thickness.

9) Except as permitted in (10), the equivalent thickness of concrete panels with ribbed or undulating surfaces shall be

a) t_a for s less than or equal to 2 t,
b) $t + (4\,t/s - 1)(t_a - t)$ for s less than 4 t and greater than 2 t, and
c) t for s greater than or equal to 4 t

where

t = minimum thickness of panel,
t_a = average thickness of panel (unit cross-sectional area divided by unit width), and
s = centre to centre spacing of ribs or undulations.

10) Where the total thickness of a panel described in (9), exceeds 2 t, only that portion of the panel which is less than 2 t from the nonribbed surface shall be considered for the purpose of the calculations in (9).

D-1.7. Contribution of Plaster or Gypsum Wallboard Finish to Fire Resistance of Masonry or Concrete

D-1.7.1. Determination of Contribution

1) Except as provided in (2), (3), (4) and (5), the contribution of a plaster or gypsum wallboard finish to the fire resistance of a masonry or concrete wall, floor or roof assembly shall be determined by multiplying the actual thickness of the finish by the factor shown in Table D-1.7.1., depending on the type of masonry or concrete to which it is applied. This corrected thickness shall then be included in the equivalent thickness as described in D-1.6.

2) Where a plaster or gypsum wallboard finish is applied to a concrete or masonry wall, the calculated fire-resistance rating of the assembly shall not exceed twice the fire-resistance rating provided by the masonry or concrete because structural collapse may occur before the limiting temperature is reached on the surface of the non-fire-exposed side of the assembly.

3) Where a plaster or gypsum wallboard finish is applied only on the non-fire-exposed side of a hollow clay tile wall, no increase in fire resistance is permitted because structural collapse may occur before the limiting temperature is reached on the surface of the non-fire-exposed side of the assembly.

4) The contribution to fire resistance of a plaster or gypsum wallboard finish applied to the non-fire-exposed side of a monolithic concrete or unit masonry wall shall be determined in conformance with (1), but shall not exceed 0.5 times the contribution of the concrete or masonry wall.

5) When applied to the fire-exposed side, the contribution of a gypsum lath and plaster or gypsum wallboard finish to the fire resistance of masonry or concrete wall, floor or roof assemblies shall be determined from Table D-2.3.4.A. or D-2.3.4.B.

Table D-1.7.1.
Multiplying Factors for Masonry or Concrete Construction

Type of Surface Protection	Type of Masonry or Concrete			
	Solid Clay Brick, Unit Masonry and Monolithic Concrete, Type N or S	Cored Clay Brick, Clay Tile, Monolithic Concrete, Type L40S and Unit Masonry, Type $L_1$20S	Concrete Unit Masonry, Type L_1 or $L_2$20S and Monolithic Concrete, Type L	Concrete Unit Masonry, Type L_2
Portland cement-sand plaster or lime sand plaster	1	0.75	0.75	0.50
Gypsum-sand plaster, wood fibred gypsum plaster or gypsum wallboard	1.25	1	1	1
Vermiculite or perlite aggregate plaster	1.75	1.5	1.25	1.25

D-1.7.2. Plaster

1) Gypsum plastering shall conform to CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering."

2) Portland cement-sand plaster shall be applied in 2 coats: the first coat containing 1 part Portland cement to 2 parts sand by volume, and the second coat containing 1 part Portland cement to 3 parts sand by volume.

3) Plaster finish shall be securely bonded to the wall or ceiling.

4) The thickness of plaster finish applied directly to monolithic concrete without metal lath shall not exceed 10 mm on ceilings and 16 mm on walls.

5) Where the thickness of plaster finish on masonry or concrete exceeds 38 mm, wire mesh with 1.57 mm diam wire and openings not exceeding 50 mm by 50 mm shall be embedded midway in the plaster.

D-1.7.3. Attachment of Wallboard and Lath

Gypsum wallboard and gypsum lath finishes applied to masonry or concrete walls shall be secured to wood or steel furring members in conformance with D-2.3.9.

D-1.7.4. Sample Calculations

The following examples are included as a guide to the method of calculating the fire resistance of concrete or hollow masonry walls with plaster or gypsum wallboard protection:

Example (1)

A 3 h fire-resistance rating is required for a monolithic concrete wall of Type S aggregate with a 20 mm gypsum-sand plaster finish on metal lath on each face.

(a) The minimum equivalent thickness of Type S monolithic concrete needed to give a 3 h fire-resistance rating = 158 mm (Table D-2.1.1.).
(b) Since the gypsum-sand plaster finish is applied on metal lath, D-1.7.1.(5) does not apply. Therefore, the contribution to the equivalent thickness of the wall of 20 mm gypsum-sand plaster on each face of the concrete is 20 × 1.25 = 25 mm (see D-1.7.1.(1) to (4)).
(c) The total contribution of the plaster finishes is 2 × 25 = 50 mm.
(d) The minimum equivalent thickness of concrete required is 158 mm - 50 mm = 108 mm.
(e) From Table D-2.1.1., the 108 mm equivalent thickness of monolithic concrete gives a contribution of less than 1.5 h. This is less than half the rating of the assembly so that the conditions in D-1.7.1.(2) are not met. Thus the equivalent thickness of monolithic concrete must be increased to 112 mm to give 1.5 h contribution.
(f) The total equivalent thickness of the plaster finishes can then be reduced to 158 mm - 112 mm = 46 mm.
(g) The total actual thickness of the plaster finishes required is therefore 46 mm ÷ 1.25 = 37 mm (D-1.7.1.(1) to (4)) or 18.5 mm on each face.
(h) Since the thickness of the plaster finish on each face exceeds 16 mm, metal lath is still required (D-1.7.2.(4)).
(i) Since this wall is symmetrical with plaster on both faces, the contribution to fire resistance of the plaster finish on either face is limited to one-quarter of the wall rating by virtue of D-1.7.1.(2). Under these circumstances, the conditions in D-1.7.1.(4) are automatically met.

Example (2)

A 2 h fire-resistance rating is required for a hollow masonry wall of Type N concrete with a 12.7 mm Type X gypsum wallboard finish on each face.

(a) Since gypsum wallboard is used, D-1.7.1.(5) applies. The 12.7 mm gypsum wallboard finish on the fire-exposed side is, therefore, assigned 25 min by using Table D-2.3.4.A.
(b) The fire resistance required of the balance of the assembly is 120 min - 25 min = 95 min.
(c) Interpolating between 1.5 h and 2 h in Table D-2.1.1. for 95 min fire resistance, the equivalent thickness for hollow masonry units required is 95 mm + (18 mm × 5/30) = 95 mm + 3 mm = 98 mm.
(d) The contribution to the equivalent thickness of the wall of the 12.7 mm gypsum wallboard finish on the non-fire-exposed side using Table D-1.7.1. = 12.7 × 1.25 = 16 mm.
(e) Equivalent thickness required of concrete masonry unit = 98 - 16 = 82 mm.
(f) The fire-resistance rating of a concrete masonry wall having an equivalent thickness of 82 mm = 1 h for 73 mm + (9 mm × 30/22) = 1 h 12 min.

As this is more than 1 h, the conditions of D-1.7.1.(2) are met and the rating of 2 h is justified.

Example (3)

A 2 h fire-resistance rating is required for a hollow masonry exterior wall of Type L_220S concrete with a 15.9 mm Type X gypsum wallboard finish on the non-fire-exposed side only.
(a) According to Table D-2.1.1., the minimum equivalent thickness for Type L_220S concrete masonry units needed to achieve a 2 h rating is 94 mm.
(b) Since gypsum wallboard is not used on the fire-exposed side, D-1.7.1.(5) does not apply. The contribution to the equivalent thickness of the wall by the 15.9 mm Type X gypsum wallboard finish applied on the non-fire-exposed side is 15.9 × 1 ≈ 16 mm (see D-1.7.1.(1) and Table D-1.7.1.).
(c) Therefore, the equivalent thickness required of the concrete masonry unit is 94 - 16 = 78 mm.
(d) The contribution to fire resistance of a 78 mm L_220S concrete hollow masonry unit is 85 min. The contribution of the Type X gypsum wallboard finish is 120 - 85 = 35 min, which does not exceed half the 85 min contribution of the masonry unit or 42.5 min, so that the conditions in D-1.7.1.(4) are met.
(e) The rating of the wall (120 min) is less than twice the contribution of the masonry unit (170 min) so that the conditions in D-1.7.1.(2) are also met.

D-1.8. Tests on Floors and Roofs

D-1.8.1. Exposure to Fire

All tests relate to the performance of a floor assembly or floor-ceiling or roof-ceiling assembly above a fire. It has been assumed on the basis of experience that fire on top will take a longer time to penetrate the floor than one below, and that the fire resistance in such a situation will be at least equal to that obtained from below in the standard test.

D-1.9. Moisture Content

D-1.9.1. Effect of Moisture

1) The moisture content of building materials at the time of fire test may have a significant influence on the measured fire resistance. In general, an increase in the moisture content should result in an increase in the fire resistance, though in some materials the presence of moisture may produce disruptive effects and early collapse of the assembly.

2) Moisture content is now controlled in standard fire test methods and is generally recorded in the test reports. In earlier tests, moisture content was not always properly determined.

D-1.10. Permanence and Durability

D-1.10.1. Test Conditions

The ratings in this Appendix relate to tested assemblies and do not take into account possible changes or deterioration in use of the materials. The standard fire test measures the fire resistance of a sample building assembly erected for the test. No judgment as to the permanence or durability of the assembly is made in the test.

D-1.11. Steel Structural Members

D-1.11.1. Thermal Protection

Since the ability of a steel structural member to sustain the loading for which it was designed may be impaired because of elevated temperatures, measures shall be taken to provide thermal protection. The fire-resistance ratings, as established by the provisions of this Appendix, indicate the time periods during which the effects of heat on protected steel structural members are considered to be within acceptable limits.

D-1.12. Restraint Effects

D-1.12.1. Effect on Fire-Resistance Ratings

In fire tests of floors, roofs and beams, it is necessary to state whether the rating applies to a thermally restrained or thermally unrestrained assembly. Edge restraint of a floor or roof, structural continuity, or end restraint of a beam can significantly extend the time before collapse in a standard test. A restrained condition is one in which expansion or rotation at the supports of a load-carrying element resulting from the effects of fire is resisted by forces or moments external to the element. An unrestrained condition is one in which the load-carrying element is free to thermally expand and rotate at its supports.

Whether an assembly or structural member can be considered thermally restrained or thermally unrestrained depends on the type of construction and location in a building. Guidance on this subject can be found in Appendix A1 of CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials." Different acceptance criteria also apply to thermally unrestrained and thermally restrained assemblies. These are described in CAN/ULC-S101-M.

The ratings for floors, roofs, and beams in this Appendix meet the conditions of CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials," for thermally unrestrained specimens. In a thermally restrained condition, the structural element or assembly would probably have greater fire resistance, but the extent of this increase can be determined only by reference to behavior in a standard test.

Section D-2 Fire-Resistance Ratings

D-2.1. Masonry and Concrete Walls

D-2.1.1. Minimum Equivalent Thickness for Fire-Resistance Rating

The minimum thicknesses of unit masonry and monolithic concrete walls are shown in Table D-2.1.1. Hollow masonry units and hollow-core concrete panels shall be rated on the basis of equivalent thickness as described in D-1.6.

D-2.1.2. Applicability of Ratings

1) Ratings obtained as described in D-2.1.1. apply to either loadbearing or non-loadbearing walls, except for walls described in (2) to (6).

2) Ratings for walls with a thickness less than the minimum thickness prescribed for loadbearing walls in this Code apply to non-loadbearing walls only.

Table D-2.1.1.
Minimum Equivalent Thicknesses(1) of Unit Masonry and Monolithic Concrete Walls Loadbearing and Non-Loadbearing, mm

Type of Wall	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Solid brick units (80% solid and over), actual overall thickness	63	76	90	108	128	152	178
Cored brick units and hollow tile units (less than 80% solid), equivalent thickness	50	60	72	86	102	122	142
Solid and hollow concrete masonry units, equivalent thickness							
Type S or N concrete(2)	44	59	73	95	113	142	167
Type $L_1$20S concrete	42	54	66	87	102	129	152
Type L_1 concrete	42	54	64	82	97	122	143
Type $L_2$20S concrete	42	54	64	81	94	116	134
Type L_2 concrete	42	54	63	79	91	111	127
Monolithic concrete and concrete panels, equivalent thickness							
Type S concrete	60	77	90	112	130	158	180
Type N concrete	59	74	87	108	124	150	171
Type L40S or Type L concrete	49	62	72	89	103	124	140

Notes to Table D-2.1.1.:

(1) See definition of equivalent thickness in D-1.6.

(2) Hollow concrete masonry units made with Type S or N concrete shall have a minimum compressive strength of 15 MPa based on net area, as defined in CSA A165.1, "Concrete Masonry Units."

3) Masonry cavity walls (consisting of 2 wythes of masonry with an air space between) that are loaded to a maximum allowable compressive stress of 380 kPa have a fire resistance at least as great as that of a solid wall of a thickness equal to the sum of the equivalent thicknesses of the 2 wythes.

4) Masonry cavity walls that are loaded to a compressive stress exceeding 380 kPa are not considered to be within the scope of this Appendix.

5) A masonry wall consisting of 2 types of masonry units, either bonded together or in the form of a cavity wall, shall be considered to have a fire-resistance rating equal to that which would apply if the whole of the wall were of the material that gives the lesser rating.

6) A non-loadbearing cavity wall made up of 2 precast concrete panels with an air space or insulation in the cavity between them shall be considered to have a fire-resistance rating as great as that of a solid wall of a thickness equal to the sum of the thicknesses of the 2 panels.

D-2.1.3. Framed Beams and Joists

Beams and joists that are framed into a masonry or concrete fire separation shall not reduce the thickness of the fire separation to less than the equivalent thickness required for the fire separation.

D-2.1.4. Credit for Plaster Thickness

On monolithic walls and walls of unit masonry, the full plaster finish on one or both faces multiplied by the factor shown in Table D-1.7.1. shall be included in the wall thickness shown in Table D-2.1.1., under the conditions and using the methods described in D-1.7.

D-2.1.5. Walls Exposed to Fire on Both Sides

1) Except as permitted in (2), portions of loadbearing reinforced concrete walls, which do not form a complete fire separation and thus may be exposed to fire on both sides simultaneously, shall have minimum dimensions and minimum cover to steel reinforcement in conformance with D-2.8.2. to D-2.8.5.

2) A concrete wall exposed to fire from both sides as described in (1) has a fire-resistance rating of 2 h if the following conditions are met:

a) its equivalent thickness is not less than 200 mm,
b) its aspect ratio (width/thickness) is not less than 4.0,
c) the minimum thickness of concrete cover over the steel reinforcement specified in (d) is not less than 50 mm,
d) each face of the wall is reinforced with both vertical and horizontal steel reinforcement in conformance with either Clause 10 or Clause 14 of CSA A23.3, "Design of Concrete Structures,"
e) the structural design of the wall is governed by the minimum eccentricity requirements of Clause 10.11.6.3. of CSA A23.3, "Design of Concrete Structures," and
f) the effective length of the wall, kl_u, is not more than 3.7 m

where
k = effective length factor obtained from CSA A23.3, "Design of Concrete Structures,"
l_u = unsupported length of the wall in metres.

D-2.2. Reinforced and Prestressed Concrete Floor and Roof Slabs

D-2.2.1. Assignment of Rating

1) Floors and roofs in a fire test are assigned a fire-resistance rating which relates to the time that an average temperature rise of 140°C or a maximum temperature rise of 180 °C at any location is recorded on the unexposed side, or the time required for collapse to occur, whichever is the lesser. The thickness of concrete shown in Table D-2.2.1.A. shall be required to resist the transfer of heat during the fire resistance period shown.

Table D-2.2.1.A.
Minimum Thickness of Reinforced and Prestressed Concrete Floor or Roof Slabs, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S concrete	60	77	90	112	130	158	180
Type N concrete	59	74	87	108	124	150	171
Type L40S or Type L concrete	49	62	72	89	103	124	140

Table D-2.2.1.B.
Minimum Concrete Cover over Reinforcement in Concrete Slabs, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S, N, L40S or L concrete	20	20	20	20	25	32	39
Prestressed concrete slabs Type S, N, L40S or L concrete	20	25	25	32	39	50	64

2) The concrete cover over the reinforcement and steel tendons shown in Table D-2.2.1.B. shall be required to maintain the integrity of the structure and prevent collapse during the same period.

D-2.2.2. Floors with Hollow Units

The fire resistance of floors containing hollow units may be determined on the basis of equivalent thickness as described in D-1.6.

D-2.2.3. Composite Slabs

1) For composite concrete floor and roof slabs consisting of one layer of Type S or N concrete and another layer of Type L40S or L concrete in which the minimum thickness of both the top and bottom layers is not less than 25 mm, the combined fire-resistance rating may be determined using the following expressions:

a) when the base layer consists of Type S or N concrete,

$$\mathrm{R} = 0.00018\mathrm{t}^2 - 0.00009\mathrm{dt} + \frac{8.7}{\mathrm{t}}$$

b) when the base layer consists of Type L40S or L concrete,

$$\mathrm{R} = 0.0001\mathrm{t}^2 + 0.0002\mathrm{dt} - 0.0001\mathrm{d}^2 + \frac{6.4}{\mathrm{t}}$$

where

R = fire resistance of slab, h,
t = total thickness of slab, mm, and
d = thickness of base layer, mm.

2) If the base course described in (1) is covered by a top layer of material other than Type S, N, L40S or L concrete, the top course thickness may be converted to an equivalent concrete thickness by multiplying the actual thickness by the appropriate factor listed in Table D-2.2.3.A. This equivalent concrete thickness may be added to the thickness of the base course and the fire-resistance rating calculated using Table D-2.2.1.A.

3) The minimum concrete cover under the main reinforcement for composite concrete floor and roof slabs with base slabs less than 100 mm thick shall conform to Table D-2.2.3.B. For base slabs 100 mm or more thick, the minimum cover thickness requirements of Table D-2.2.1.B. shall apply.

4) Where the top layer of a 2-layer slab is less than 25 mm thick, the fire-resistance rating for the slab shall be calculated as though the entire slab were made up of the type of concrete with the lesser fire resistance.

Table D-2.2.3.A.
Multiplying Factors for Equivalent Thickness

Top Course Material	Base Slab Normal Density Concrete (Type S or N)	Base Slab Low Density Concrete (Type L40S or L)
Gypsum wallboard	3	2.25
Cellular concrete (mass density 400 – 560 kg/m^3)	2	1.50
Vermiculite and perlite concrete (mass density 560 kg/m^3 or less)	1.75	1.50
Portland cement with sand aggregate	1	0.75
Terrazzo	1	0.75

Table D-2.2.3.B.
Minimum Concrete Cover under Bottom Reinforcement in Composite Concrete Slabs, mm

Base Slab Concrete Type	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Reinforced concrete							
Type S, N, L40S or L	15	15	20	25	30	40	55
Prestressed concrete							
Type S	20	25	30	40	50	65	75
Type N	20	20	25	35	45	60	70
Type L40S or L	20	20	25	30	40	50	60

D-2.2.4. Contribution of Plaster Finish

1) The contribution of plaster finish securely fastened to the underside of concrete may be taken into account in floor or roof slabs under the conditions and using the methods described in D-1.7.

2) Plaster finish on the underside of concrete floors or roofs may be used in lieu of concrete cover referred to in D-2.2.1.(2) under the conditions and using the methods described in D-1.7.

D-2.2.5. Concrete Cover

1) In prestressed concrete slab construction, the concrete cover over an individual tendon shall be the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the slab, except that for ungrouted ducts the assumed cover thickness shall be the minimum thickness of concrete between the surface of the duct and the bottom of the slab. For slabs in which several tendons are used, the cover is assumed to be the average of those of individual tendons, except that the cover for any individual tendon shall be not less than half of the value given in Table D-2.2.1.B. nor less than 20 mm.

2) Except as provided in (3), in post-tensioned prestressed concrete slabs, the concrete cover to the tendon at the anchor shall be not less than 15 mm greater than the minimum cover required by (1). The minimum concrete cover to the anchorage bearing plate and to the end of the tendon, if it projects beyond the bearing plate, shall be 20 mm.

3) The requirements of (2) do not apply to those portions of slabs not likely to be exposed to fire, such as the ends and tops.

D-2.2.6. Minimum Dimensions for Cover

Minimum dimensions and cover to steel tendons of prestressed concrete beams shall conform to D-2.10.

D-2.3. Wood and Steel Framed Walls, Floors and Roofs

D-2.3.1. Maximum Fire-Resistance Rating

The fire-resistance rating of walls constructed of wood studs or light gauge steel studs, floors constructed of wood joists or open web steel joists, and roofs constructed of wood joists, pre-manufactured wood trusses or open web steel joists, can be determined for ratings up to 90 min from the information in D-2.3.

D-2.3.2. Loadbearing Conditions

1) The ratings derived from the information in D-2.3. apply to both loadbearing and non-loadbearing wood framed walls, to non-loadbearing steel framed walls and to loadbearing floors and roofs.

2) Loadbearing conditions shall be as defined in CAN/ULC-S101-M, "Fire Endurance Tests of Building Construction and Materials."

D-2.3.3. Limitations of Component Additive Method

(See D-6, Background Information.)

1) The fire-resistance rating of a framed assembly depends primarily on the time during which the membrane on the fire-exposed side remains in place.

2) The assigned times in D-2.3.4.(2), (3) and (4) are not intended to be construed as the fire-resistance ratings of the individual components of an assembly. These assigned times are the individual contributions to the overall fire-resistance rating of the complete assembly.

3) Wallboard membranes are permitted to be installed in multiple layers only as listed in Table D-2.3.4.A. (double 12.7 mm Type X gypsum wallboard).

D-2.3.4. Method of Calculation

1) The fire-resistance rating of a framed assembly may be calculated by adding the time assigned in (2) for the membrane on the fire-exposed side plus the time assigned in (3) for the framing members plus the time assigned in (4) for additional protective measures such as the inclusion of insulation or the reinforcement of a membrane.

2) The times which have been assigned to membranes on the fire-exposed side of the assembly, based on their ability to remain in place during fire tests, are listed in Tables D-2.3.4.A. and D-2.3.4.B. (This is not to be confused with the fire-resistance rating of the membrane, which also takes into account the rise in temperature on the unexposed side of the membrane. [See D-2.3.3.(2).])

Table D-2.3.4.A.
Time Assigned to Wallboard Membranes on Fire-Exposed Side

Description of Finish	Time, min
11.0 mm Douglas Fir plywood phenolic bonded	10(1)
14.0 mm Douglas Fir plywood phenolic bonded	15(1)
12.7 mm Type X gypsum wallboard	25
15.9 mm Type X gypsum wallboard	40
Double 12.7 mm Type X gypsum wallboard	80(2)

Notes to Table D-2.3.4.A.:

(1) Non-loadbearing walls only, stud cavities filled with mineral wool conforming to CAN/ULC-S702, “Mineral Fibre Thermal Insulation for Buildings,” and having a mass of not less than 2 kg/m^2, with no additional credit for insulation according to Table D-2.3.4.D. r e4

(2) Applies to non-loadbearing steel framed walls only.

3) When the membrane on the fire-exposed side of a framed assembly falls off, there is a brief period before structural failure occurs during which the studs or joists are exposed directly to flame. Table D-2.3.4.C. lists the times which have been assigned to the framing members based on the time involved between failure of the membrane and collapse of the assembly.

4) Preformed insulation of glass, rock or slag fibre provides additional protection to wood studs by shielding the studs from exposure to the fire and thus delaying the time of collapse. The use of reinforcement in the membrane exposed to fire also adds to the fire resistance by extending the time to failure. Table D-2.3.4.D. shows the time increments that may be added to the fire resistance if these features are incorporated in the assembly.

5) Cellulose fibre insulation conforming to CAN/ULC-S703, “Cellulose Fibre Insulation (CFI) for Buildings,” applied in conformance with CAN/CGSB-92.2-M, “Trowel or Spray Applied Acoustical Material,” does not affect the fire-resistance rating of a steel stud wall assembly, provided that it is sprayed to either face of the wall cavity. r4

D-2.3.5. Considerations for Various Types of Assemblies

1) Interior vertical fire separations shall be rated for exposure to fire on each side, and a membrane shall be provided on both sides of the assembly. In the calculation of the fire-resistance rating of such an assembly, however, no contribution to fire resistance can be assigned for a membrane on the non-fire-exposed side, since this membrane may fail when the structural members fail.

Table D-2.3.4.B.
Time Assigned for Contribution of Lath and Plaster Protection on Fire-Exposed Side, min(1)

Type of Lath	Plaster Thickness, mm	Type of Plaster Finish		
		Portland Cement and Sand(2) or Lime and Sand	Gypsum and Sand or Gypsum Wood Fibred	Gypsum and Perlite or Gypsum and Vermiculite
9.5 mm gypsum	13	—	35	55
	16	—	40	65
	19	—	50	80(1)
Metal	19	20	50	80(1)
	23	25	65	80(1)
	26	30	80	80(1)

Notes to Table D-2.3.4.B.:

(1) Values shown for these membranes have been limited to 80 min because the fire-resistance ratings of framed assemblies derived from these Tables shall not exceed 1.5 h.

(2) For mixture of Portland cement-sand plaster, see D-1.7.2.(2).

Table D-2.3.4.C.
Time Assigned for Contribution of Wood or Light Steel Frame

Description of Frame	Time Assigned to Frame, min
Wood studs 400 mm o.c. maximum	20
Wood studs 600 mm o.c. maximum	15
Steel studs 400 mm o.c. maximum	10
Wood floor and wood roof joists 400 mm o.c. maximum	10
Open web steel joist floors and roofs with ceiling supports 400 mm o.c. maximum	10
Wood roof and wood floor truss assemblies 600 mm o.c. maximum	5

Table D-2.3.4.D.
Time Assigned for Additional Protection

Description of Additional Protection	Time Assigned, min
Add to the fire-resistance rating of wood stud walls, sheathed with gypsum wallboard or lath and plaster, if the spaces between the studs are filled with preformed insulation of rock or slag fibres conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," and with a mass of not less than 1.22 kg/m² of wall surface(1) r e4	15
Add to the fire-resistance rating of non-loadbearing wood stud walls, sheathed with gypsum wallboard or lath and plaster, if the spaces between the studs are filled with preformed insulation of glass fibres conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," and having a mass of not less than 0.6 kg/m² of wall surface r e4	5
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 0.76 mm diam wire mesh with 25 mm by 25 mm openings or 1.57 mm diam diagonal wire reinforcing at 250 mm o.c. is placed between lath and plaster	30
Add to the fire-resistance rating of plaster on gypsum lath ceilings if 76 mm wide metal lath strips are placed over joints between lath and plaster	10
Add to the fire-resistance rating of plaster on 9.5 mm thick gypsum lath ceilings (Table D-2.3.4.B.) if supports for lath are 300 mm o.c.	10

Notes to Table D-2.3.4.D.:

(1) There are no test data to justify the15 min additional protection for preformed glass fibre insulation.

2) When an exterior wall assembly is required to be rated from the interior side only, such wall assemblies shall have an outer membrane consisting of sheathing and exterior cladding with spaces between the studs filled with insulation conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," and having a mass of not less than 1.22 kg/m² of wall surface. r e4

3) In the case of a floor or roof, the standard test provides only for testing for fire exposure from below. Floor or roof assemblies of wood, light-gauge steel members or open-web steel joist framing shall have an upper membrane consisting of a subfloor and finish floor conforming to Table D-2.3.5. or any other membrane that has a contribution to fire resistance of not less than 15 min in Table D-2.3.4.A. For the purposes of this requirement, it is not necessary to comply with note (1) to Table D-2.3.4.A.

4) Insulation used in the cavities of a wood floor assembly will not reduce the assigned fire-resistance rating of the assembly provided:

a) the insulation is preformed of rock, slag or glass fibre conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," and having a mass of not more than 1.1 kg/m² and is installed adjacent to the bottom edge of the framing member, directly above steel furring channels, r e4
b) the gypsum wallboard ceiling membrane is attached to
   i) wood trusses in conformance with D-2.3.9.(2) by way of steel drywall furring channels spaced not more than 400 mm o.c., and the channels are secured to each bottom truss member with a double strand of 1.2 mm galvanized steel wire, or
   ii) wood joists by way of drywall or resilient steel furring channels spaced not more than 400 mm o.c. in conformance with D-2.3.9.(2) and (3), and

Table D-2.3.5.
Flooring or Roofing Membranes for Wood, Cold Formed Steel Members or Open-Web Steel Joists e3

Type of Assembly	Structural Members	Subfloor or Roof Deck	Finish Flooring or Roofing
Floor	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	Hardwood or softwood flooring on building paper Resilient flooring, parquet floor, felted synthetic fibre floor coverings, carpeting, or ceramic tile on 8 mm thick panel-type underlay Ceramic tile on 30 mm mortar bed
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet, or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish flooring
Roof	Wood or steel joists and wood trusses	12.5 mm plywood or 17 mm T & G softwood	Finish roofing material with or without insulation
	Steel joists	50 mm reinforced concrete or 50 mm concrete on metal lath or formed steel sheet, or 40 mm reinforced gypsum-fibre concrete on 12.7 mm gypsum wallboard	Finish roofing material with or without insulation

c) a steel furring channel is installed midway between each furring channel mentioned in (b) to provide additional support for the insulation.

D-2.3.6. Framing Members

1) The values shown in Tables D-2.3.4.A., D-2.3.4.B. and D-2.3.12. apply to membranes supported on framing members installed in their conventional orientation and spaced in conformance with Table D-2.3.4.C.

2) Wood studs and wood roof and floor framing members are assumed to be not less than 38 mm by 89 mm. Wood trusses are assumed to consist of wood chord and web framing members and connector plates fabricated from not less than 1 mm thick galvanized steel with projecting teeth not less than 8 mm long. Dimensions for dressed lumber are given in CAN/CSA-O141, "Softwood Lumber."

3) The allowable spans for wood joists listed in Part 9 of this Code are provided for floors supporting specific occupancies.

4) Except as otherwise required in this Appendix, metal studs shall be of galvanized steel not less than 0.5 mm thick, not less than 63 mm wide and with a flange width of not less than 31 mm.

5) Metal studs in walls required to have a fire-resistance rating shall be installed with not less than 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire. Where attachment of the studs is necessary for alignment purposes during erection, such attachment shall be made to the bottom runners only.

6) Except as required in D-2.3.5.(4), resilient or drywall furring channels may be used to attach a gypsum wallboard ceiling membrane to a floor or roof assembly. The channels must be of galvanized steel not less than 0.5 mm thick, placed at a spacing of not more than 600 mm o.c. perpendicular to the framing members, with an overlap of not less than 100 mm at splices and a minimum end clearance between the channels and walls of 15 mm.

D-2.3.7. Plaster Finish

The thickness of plaster finish shall be measured from the face of gypsum or metal lath.

D-2.3.8. Edge Support for Wallboard

Gypsum wallboard installed over framing or furring shall be installed so that all edges are supported, except that 15.9 mm Type X gypsum wallboard may be installed horizontally with the horizontal joints unsupported when framing members are at 400 mm o.c. maximum.

D-2.3.9. Membrane Fastening

1) Except as provided in (2) to (6), the application of lath and plaster finish shall conform to CSA A82.30-M, "Interior Furring, Lathing and Gypsum Plastering," and gypsum wallboard finish shall conform to CSA A82.31-M, "Gypsum Board Application."

2) Where a membrane referred to in Tables D-2.3.4.A., D-2.3.4.B. and D-2.3.12. is applied to steel framing or furring, fasteners shall penetrate not less than 10 mm through the metal.

3) Except as provided in (4) and (5) where a membrane referred to in Tables D-2.3.4.A., D-2.3.4.B. and D-2.3.12. is applied to wood framing or furring, minimum fastener penetrations into wood members shall conform to Table D-2.3.9. for the time assigned to the membrane.

4) Where a membrane is applied in 2 layers, the fastener penetrations described in Table D-2.3.9. shall apply to the base layer. Fasteners for the face layer shall penetrate not less than 20 mm into wood supports.

5) Where adhesives are used to attach the face layer of gypsum wallboard in a double layer application for walls, the top and bottom of the face layer shall be secured to the supports by mechanical fasteners having lengths as required in (2) and (4) and spaced not more than 150 mm o.c. for wood supports and not more than 200 mm o.c. for steel supports.

6) In a double layer application of gypsum wallboard on wood supports, fastener spacing shall conform to CSA A82.31-M, "Gypsum Board Application."

D-2.3.10. Ceiling Membrane Openings – Combustible Construction

1) Except as permitted in D-2.3.12., where a floor or roof assembly of combustible construction is assigned a fire-resistance rating on the basis of D-2.3. and incorporates a ceiling membrane described in Table D-2.3.4.A. or D-2.3.4.B., the ceiling membrane may be penetrated by openings leading to ducts within concealed spaces above the membrane provided:

a) the assembly is not required to have a fire-resistance rating in excess of 1 h,
b) the area of any openings does not exceed 930 cm^2 (see (2)),
c) the aggregate area of openings does not exceed 1% of the ceiling area of the fire compartment,
d) the depth of the concealed space above the ceiling is not less than 230 mm,
e) no dimension of any opening exceeds 310 mm,
f) supports are provided for openings with any dimension exceeding 150 mm where framing members are spaced greater than 400 mm o.c.,
g) individual openings are spaced not less than 2 m apart,
h) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
i) the clearance between the top surface of the membrane and the bottom surface of the ducts is not less than 100 mm.

2) Where an individual opening permitted in (1) exceeds 130 cm^2 in area, it shall be protected by
a) a fire stop flap conforming to D-5.3., or
b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure D-2.3.10.).

Table D-2.3.9.
Minimum Fastener Penetrations for Membrane Protection on Wood Frame, mm

Type of Membrane	Assigned Contribution of Membrane to Fire Resistance(1), min					
	5 – 25	30 – 35	40	50	55 – 70	80
Single layer	20	29	32	—	—	—
Double layer	20	20	20	29	35	44
Gypsum lath	20	20	23	23	29	29

Notes to Table D-2.3.9.:
(1) Assigned contributions of membranes to fire resistance are determined in Tables D-2.3.4.A., D-2.3.4.B. and D-2.3.12.

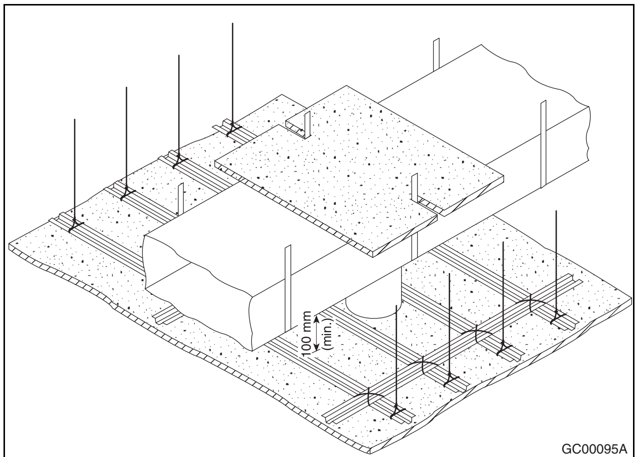

Figure D-2.3.10.
Thermal protection above a duct

D-2.3.11. Ceiling Membrane Openings – Noncombustible Construction

1) Except as permitted in D-2.3.12., where a floor or roof assembly of noncombustible construction is assigned a fire-resistance rating on the basis of D-2.3. and incorporates a ceiling membrane described in Table D-2.3.4.A. or D-2.3.4.B., the ceiling membrane may be penetrated by openings leading to ducts located within concealed spaces provided:

a) the area of any opening does not exceed 930 cm^2 (see (2)),
b) the aggregate area of openings does not exceed 2% of the ceiling area of the fire compartment,
c) no dimension of any opening exceeds 400 mm,
d) individual openings are spaced not less than 2 m apart,
e) openings are located not less than 200 mm from major structural members such as beams, columns or joists,
f) the ducts above the membrane are sheet steel and are supported by steel strapping firmly attached to the framing members, and
g) the clearance between the top surface of the membrane and the bottom surface of the duct is not less than 100 mm.

2) Where an individual opening permitted in (1) exceeds 130 cm^2 in area, it shall be protected by

a) a fire stop flap conforming to D-5.3., or
b) thermal protection above the duct consisting of the same materials as used for the ceiling membrane, mechanically fastened to the ductwork and extending 200 mm beyond the opening on all sides (see Figure D-2.3.10.).

D-2.3.12. Ceiling Membrane Rating

Where the fire-resistance rating of a ceiling assembly is to be determined on the basis of the membrane only and not of the complete assembly, the ratings may be determined from Table D-2.3.12., provided no openings are located within the ceiling membrane.

Table D-2.3.12.
Fire-Resistance Rating for Ceiling Membranes

Description of Membrane	Fire-Resistance Rating, min
15.9 mm Type X gypsum wallboard with ≥75 mm mineral wool batt insulation above wallboard	30
19 mm gypsum-sand plaster on metal lath	30
Double 14.0 mm Douglas Fir plywood phenolic bonded	30
Double 12.7 mm Type X gypsum wallboard	45
25 mm gypsum-sand plaster on metal lath	45
Double 15.9 mm Type X gypsum wallboard	60
32 mm gypsum-sand plaster on metal lath	60

D-2.3.13. Beams

1) Where a beam is included with an open-web steel joist or similar construction and is protected by the same continuous ceiling, the beam is assumed to have a fire-resistance rating equal to that assigned to the rest of the assembly.

2) The ratings in this Appendix assume that the construction to which the beam is related is a normal one and does not carry unusual loads from the floor or slab above.

D-2.3.14. Wired Glass Assembly Support

1) Openings in a vertical fire separation having a fire-resistance rating of not more than 1 h are allowed to be protected by wired glass assemblies, provided the wired glass is

a) not less than 6 mm thick;
b) reinforced by a steel wire mesh in the form of diamonds, squares or hexagons having dimensions of
   i) approximately 25 mm across the flats, using wire of not less than 0.45 mm diam, or
   ii) approximately 13 mm across the flats, using wire of not less than 0.40 mm diam, the wire to be centrally embedded during manufacture and welded or intertwined at each intersection;

c) set in fixed steel frames with metal not less than 1.35 mm thick and providing a glazing stop of not less than 20 mm on each side of the glass; and
d) limited in area so that
   i) individual panes are not more than 0.84 m², with neither height nor width more than 1.4 m, and
   ii) the area not structurally supported by mullions is not more than 7.5 m².

2) It is intended that the structural mullions referred to in Subclause (1)(d)(ii) will not distort or be displaced to the extent that there would be a failure of the wired glass closure during the period for which a closure in the fire separation would be expected to function. Hollow structural steel tubing not less than 100 mm square filled with a Portland cement-based grout will satisfy the intent of the Subclause. e

D-2.4. Solid Wood Walls, Floors and Roofs

D-2.4.1. Minimum Thickness

The minimum thickness of solid wood walls, floors and roofs for fire-resistance ratings from 30 min to 1.5 h is shown in Table D-2.4.1.

D-2.4.2. Increased Fire-Resistance Rating

1) The fire-resistance rating of the assemblies described in Table D-2.4.1. may be increased by 15 min if one of the following finishes is applied on the fire-exposed side:
a) 12.7 mm thick gypsum wallboard,
b) 20 mm thick gypsum-sand plaster on metal lath, or
c) 13 mm thick gypsum-sand plaster on 9.5 mm gypsum lath.

2) Fastening of the plaster to the wood structure shall conform to D-2.3.

D-2.4.3. Supplementary Ratings

Supplementary ratings based on tests are included in Table D-2.4.3. The ratings given shall apply to constructions that conform in all details with the descriptions given.

Table D-2.4.1.
Minimum Thickness of Solid Wood Walls, Roofs and Floors, mm(1)(2)

Type of Construction	Fire-Resistance Rating			
	30 min	45 min	1 h	1.5 h
Solid wood floor with building paper and finish flooring on top(3)	89	114	165	235
Solid wood, splined or tongued and grooved floor with building paper and finish flooring on top(4)	64	76	—	—
Solid wood walls of loadbearing vertical plank(3)	89	114	140	184
Solid wood walls of non-loadbearing horizontal plank(3)	89	89	89	140

Notes to Table D-2.4.1.:

(1) See CAN/CSA-O141, "Softwood Lumber," for sizes.

(2) The fire-resistance ratings and minimum dimensions for floors also apply to solid wood roof decks of comparable thickness with finish roofing material.

(3) The assembly shall consist of 38 mm thick members on edge fastened together with 101 mm common wire nails spaced not more than 400 mm o.c. and staggered in the direction of the grain.

(4) The floor shall consist of 64 mm by 184 mm wide planks either tongued and grooved or with 19 mm by 38 mm splines set in grooves and fastened together with 88 mm common nails spaced not more than 400 mm o.c.

Table D-2.4.3.
Fire-Resistance Rating of Non-Loadbearing Built-up Solid Wood Partitions(1)

Construction Details	Actual Overall Thickness, mm	Fire-Resistance Rating
Solid panels of wood boards 64 mm to 140 mm wide grooved and joined with wood splines, nailed together, boards placed vertically with staggered joints, 3 boards thick	58	30 min
Solid panels with 4 mm plywood facings(2) glued to 46 mm solid wood core of glued, tongued and grooved construction for both sides and ends of core pieces with tongued and grooved rails in the core about 760 mm apart	54	1 h

Notes to Table D-2.4.3.:

(1) The ratings and notes are taken from “Fire Resistance Classifications of Building Constructions,” Building Materials and Structures Report BMS 92, National Bureau of Standards, Washington, 1942.

(2) Ratings for plywood faced panel are based on phenolic resin glue being used for gluing facings to wood frames. If other types of glue are used for this purpose, the ratings apply if the facings are nailed to the frames in addition to being glued.

D-2.5. Solid Plaster Partitions

D-2.5.1. Minimum Thickness

The minimum thickness of solid plaster partitions for fire-resistance ratings from 30 min to 4 h is shown in Table D-2.5.1.

Table D-2.5.1.
Minimum Thickness of Non-Loadbearing Solid Plaster Partitions, mm

Type of Plaster on Metal Lath(1)	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Portland cement-sand(2) or Portland cement-lime-sand	50(3)	—	—	—	—	—	—
Gypsum-sand	50(3)	50(3)	64	—	—	—	—
Gypsum-vermiculite, gypsum-perlite, Portland cement-vermiculite or Portland cement-perlite	50(3)	50(3)	50(3)	58	64	83	102

Notes to Table D-2.5.1.:

(1) Metal lath shall be expanded metal lath or welded woven wire fabric supported on 19 mm vertical light steel studs spaced not more than 600 mm o.c. Plaster shall be applied to both sides of the lath.

(2) For mixture of Portland cement-sand plaster, see D-1.7.2.(2).

(3) CSA A82.30-M, “Interior Furring, Lathing and Gypsum Plastering,” does not permit solid plaster partitions less than 50 mm thick.

D-2.6. Protected Steel Columns

D-2.6.1. Minimum Thickness of Protective Covering

The minimum thickness of protective covering to steel columns is shown in Tables D-2.6.1.A. to D-2.6.1.F. for fire-resistance ratings from 30 min to 4 h.

Table D-2.6.1.A.
Minimum Thickness of Concrete or Masonry Protection to Steel Columns, mm

Description of Cover	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Monolithic concrete							
Type S concrete(1) (column spaces filled)(2)	25	25	25	25	39	64	89
Type N or L concrete(1) (column spaces filled)(2)	25	25	25	25	32	50	77
Concrete masonry units(3) or precast reinforced concrete units							
Type S concrete (column spaces not filled)	50	50	50	50	64	89	115
Type N or L concrete (column spaces not filled)	50	50	50	50	50	77	102
Clay or shale brick(4) (column spaces filled)(2)	50	50	50	50	50	64	77
Clay or shale brick(4) (column spaces not filled)	50	50	50	50	50	77	102
Hollow clay tile(5) (column spaces filled)(2)	50(6)	50(6)	50(6)	50(6)	(7)	(7)	(7)
Hollow clay tile(5) (column spaces not filled)	50(6)	50(6)	50(6)	—	—	—	—

Notes to Table D-2.6.1.A.:

(1) Applies to cast-in-place concrete reinforced with 5.21 mm diam wire wrapped around column spirally 200 mm o.c., or 1.57 mm diam wire mesh with 100 mm by 100 mm openings.

(2) The space between the protective covering and the web or flange of the column shall be filled with concrete, cement mortar or a mixture of cement mortar and broken bricks.

(3) Concrete masonry shall be reinforced with 5.21 mm diam wire or wire mesh with 1.19 mm diam wire and 10 mm by 10 mm openings, laid in every second course.

(4) Brick cover 77 mm thick or less shall be reinforced with 2.34 mm diam wire or 1.19 mm diam wire mesh with 10 mm by 10 mm openings, laid in every second course.

(5) Hollow clay tiles and masonry mortar shall be reinforced with 1.19 mm diam wire mesh with 10 mm by 10 mm openings, laid in every horizontal joint and lapped at corners.

(6) Hollow clay tiles shall conform to CSA A82.5-M, “Structural Clay Non-Load-Bearing Tile.”

(7) 50 mm nominal hollow clay tile, reinforced with 1.19 mm diam wire mesh with 10 mm by 10 mm openings laid in every horizontal joint and covered with 19 mm gypsum-sand plaster and with limestone concrete fill in column spaces, has a 4 h fire-resistance rating.

Table D-2.6.1.B.
Minimum Thickness of Plaster Protection to Steel Columns, mm

Description	Fire-Resistance Rating(1)(2)						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Gypsum-sand plaster on 9.5 mm gypsum lath(3)	13	13	13	20	—	—	—
Gypsum-perlite or vermiculite plaster on 9.5 mm gypsum lath(3)	13	13	13	20	25	—	—
Gypsum perlite or vermiculite plaster on 12.7 mm gypsum lath(3)	13	13	13	20	25	32	50
Gypsum perlite or vermiculite plaster on double 12.7 mm gypsum lath(3)	13	13	13	20	25	25	32
Portland cement-sand plaster on metal lath(4)(5)	25	25	25	—	—	—	—

Table D-2.6.1.B. (Continued)

Notes to Table D-2.6.1.B.:

(1) Fire-resistance ratings of 30 min and 45 min apply to columns whose M/D ratio is 30 or greater. Fire-resistance ratings greater than 45 min apply to columns whose M/D ratio is greater than 60. Where the M/D ratio is between 30 and 60 and the required fire-resistance rating is greater than 45 min, the total thickness of protection specified in the Table shall be increased by 50%. (To determine M/D, refer to D-2.6.4.)

(2) Where the thickness of plaster over gypsum lath is 25 mm or more, wire mesh with 1.57 mm diam wire and openings not exceeding 50 mm by 50 mm shall be placed midway in the plaster.

(3) Lath held in place by 1.19 mm diam wire wrapped around lath 450 mm o.c.

(4) Expanded metal lath 1.36 kg/m^2 fastened to 9.5 mm by 19 mm steel channels held in vertical position around column by 1.19 mm diam wire ties.

(5) For mixture of Portland cement-sand plaster, see D-1.7.2.(2).

Table D-2.6.1.C.
Minimum Thickness of Gypsum-Sand Plaster on Metal Lath Protection to Steel Columns, mm

M/D(1)	Fire-Resistance Rating					
	30 min	45 min	1 h	1.5 h	2 h	3 h
30 to 60	16	16	32	—	—	—
over 60 to 90	16	16	16	32	—	—
over 90 to 120	16	16	16	25	39	—
over 120 to 180	16	16	16	16	25	—
over 180	16	16	16	16	25	39

Notes to Table D-2.6.1.C.:

(1) To determine the M/D ratio, refer to D-2.6.4.

Table D-2.6.1.D.
Minimum Thickness of Gypsum-Perlite or Gypsum-Vermiculite Plaster on Metal Lath Protection to Steel Columns, mm

M/D(1)	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
30 to 60	16	16	20	32	35	—	—
over 60 to 90	16	16	16	20	26	35	45
over 90 to 120	16	16	16	16	26	35	45
over 120 to 180	16	16	16	16	20	32	35
over 180	16	16	16	16	16	26	35

Notes to Table D-2.6.1.D.:

(1) To determine the M/D ratio, refer to D-2.6.4.

Table D-2.6.1.E.
Steel Columns with Sheet-Steel Membrane and Insulation as Shown in Figures D-2.6.1.A. and D-2.6.1.B.

Type of Protection	Steel Thickness,(1) mm	Fastening(2)	Insulation	Fire-Resistance Rating
See Figure D-2.6.1.A.	0.51	No. 8 sheet-metal screws 9.5 mm long, 200 mm o.c.	50 mm mineral wool batts(3)	45 min
See Figure D-2.6.1.B.	0.64	Self-threading screws or No. 8 sheet-metal screws, 600 mm o.c.	2 layers 12.7 mm gypsum wallboard	1.5 h
See Figure D-2.6.1.A.	0.64	No. 8 sheet-metal screws, 9.5 mm long 200 mm o.c.	75 mm mineral wool batts,(3) 12.7 mm gypsum wallboard	2 h
See Figure D-2.6.1.B.	0.76	Crimped joint or No. 8 sheet-metal screws, 300 mm o.c.	2 layers 15.9 mm gypsum wallboard	2 h

Notes to Table D-2.6.1.E.:

(1) Minimum thickness, galvanized or wiped-zinc-coated sheet-steel.

(2) Sheet-steel shall be securely fastened to the floor and superstructure, or where sheet-steel cover does not extend floor to floor, fire stopping shall be provided at the level where sheet-steel protection ends. In the latter case, an alternate type of fire protection shall be applied between the fire stopping and the superstructure.

(3) Conforming to CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings," Type 1A, minimum density 30 kg/m^3: column section and batts wrapped with 25 mm mesh chicken wire. r e4

Table D-2.6.1.F.
Minimum M/D Ratio for Steel Columns Covered with Type X Gypsum Wallboard Protection(1)

Minimum Thickness of Type X Gypsum Wallboard Protection,(2) mm	Fire-Resistance Rating			
	1 h	1.5 h	2 h	3 h
12.7	75	—	—	—
15.9	55	—	—	—
25.4	35	60	—	—
28.6	35	50	—	—
31.8	35	40	75	—
38.1	35	35	55	—
41.3	35	35	45	—
44.5	35	35	35	—
47.6	35	35	35	—
50.8	35	35	35	75
63.5	35	35	35	45

Notes to Table D-2.6.1.F.:

(1) To determine the M/D ratio, refer to D-2.6.4.

(2) See D-2.6.5.

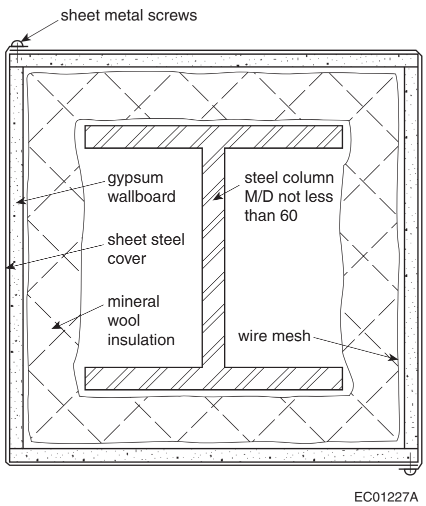

Figure D-2.6.1.A.
Column protected by sheet-steel membrane and mineral-wool insulation

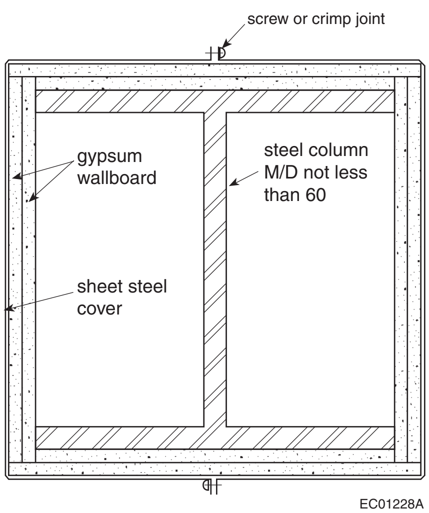

Figure D-2.6.1.B.
Column protected by sheet-steel membrane and gypsum wallboard

D-2.6.2. Hollow Unit Masonry Columns

For hollow-unit masonry column protection, the thickness shown in Tables D-2.6.1.A. to D-2.6.1.D. is the equivalent thickness as described in D-1.6.

D-2.6.3. Effect of Plaster

The effect on fire-resistance ratings of the addition of plaster to masonry and monolithic concrete column protection is described in D-1.7.

D-2.6.4. Determination of M/D Ratio

1) The ratio M/D to which reference is made in Tables D-2.6.1.B., D-2.6.1.C., D-2.6.1.D. and D-2.6.1.F. shall be found by dividing "M," the mass of the column in kilograms per metre by "D," the heated perimeter of the steel column section in metres.

2) The heated perimeter "D" of steel columns, shown as the dashed line in Figure D-2.6.4.A., shall be equal to 2 (B+H) in Examples (1) and (2), and 3.14B in Example (3). In Figure D-2.6.4.B., the heated perimeter "D" shall be equal to 2 (B+H).

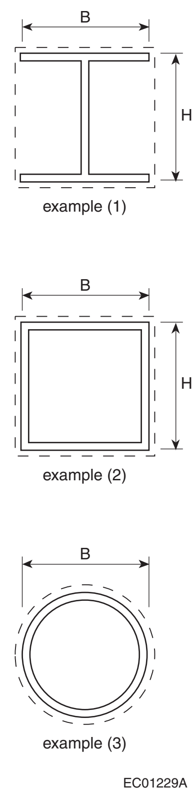

Figure D-2.6.4.A.
Example (1), standard or wide-flange beam; Example (2), hollow structural section (rectangular or square); Example (3), hollow structural section (round)

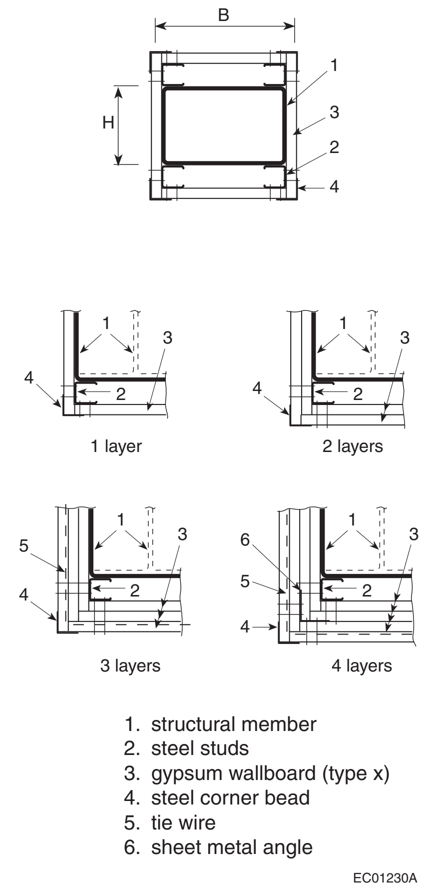

Figure D-2.6.4.B.
Columns protected by Type X gypsum wallboard without sheet-steel membrane

D-2.6.5. Attachment of Gypsum Wallboard

1) Where Type X gypsum wallboard is used to protect a steel column without an outside sheet-steel membrane, the method of wallboard attachment to the column shall be as shown in Figure D-2.6.4.B. and shall meet the construction details described in (2) to (7).

2) The Type X gypsum wallboard shall be applied vertically without horizontal joints.

3) The first layer of wallboard shall be attached to steel studs with screws spaced not more than 600 mm o.c. and other layers of wallboard shall be attached to steel studs and steel corner beads with screws spaced at a maximum of 300 mm o.c. Where a single layer of wallboard is used, attachment screws shall be spaced not more than 300 mm o.c.

4) Steel tie wires spaced at a maximum of 600 mm o.c. shall be used to secure the second last layer of wallboard in 3- and 4-layer systems.

5) Studs shall be fabricated of galvanized steel not less than 0.53 mm thick and not less than 41.3 mm wide, with legs not less than 33.3 mm long and shall be 12.7 mm less than the assembly height.

6) Corner beads shall
a) be fabricated of galvanized steel that is not less than 0.41 mm thick,
b) have legs not less than 31 mm long,
c) be attached to the wallboard or stud with 25.4 mm screws spaced not more than 300 mm o.c., and
d) have the attaching fasteners penetrate either another corner bead in multiple layer assemblies or the steel stud member.

7) In a 4-layer system, metal angles shall be fabricated of galvanized steel and shall be not less than 0.46 mm thick with legs not less than 51 mm long.

D-2.6.6. Concrete Filled Hollow Steel Columns

Concentrically loaded hollow steel columns that are filled with plain concrete and are fabricated and erected within the tolerances stipulated in CAN/CSA-S16.1, “Limit States Design of Steel Structures,” shall be assigned a fire-resistance rating, R, provided:

$$\mathrm{C} \leq \mathrm{C}_{\mathrm{max}}$$

where
C = axial compressive force due to dead and live loads without load factors, kN,
$\mathrm{C}_{\mathrm{max}} = \left(\frac{\mathrm{a}(\mathrm{f}'_{\mathrm{c}}+20)\,\mathrm{D}^{2.5}}{\mathrm{R}\,(\mathrm{KL}-1000)}\right)^2$ but shall not exceed the factored compressive resistance of the concrete core, C'_{r}, in accordance with CAN/CSA-S16.1,
a = 0.06 for square columns filled with Type S concrete, 0.07 for square columns filled with Type N concrete and for round columns filled with Type S concrete, 0.08 for round columns filled with Type N concrete,
f'_{c} = specified compressive strength of concrete in accordance with CSA A23.3, “Design of Concrete Structures,” MPa,
D = outside diameter of a round column or outside width of a square column, mm,
R = specified fire-resistance rating, min,
KL = effective length of column as defined in CAN/CSA-S16.1, mm,

subject to validity limits:
f'_{c} 20 MPa to 40 MPa,
D 140 mm to 410 mm for round columns but 140 mm to 305 mm for square columns,
R ≤ 120 min,
KL 2000 mm to 4000 mm, and

the hollow steel sections shall be Class 1, 2 or 3 in accordance with CAN/CSA-S16.1. For hollow structural sections commonly available in Canada, C_{max} for concrete strengths of 30 MPa and 40 MPa may be read from Figures D-2.6.6.A. to D-2.6.6.F..

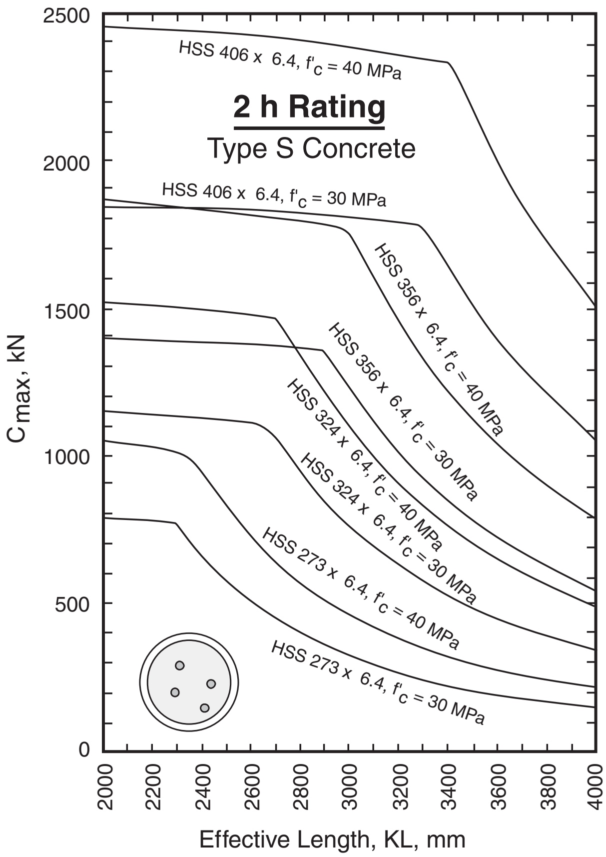

Figure D-2.6.6.A.
Round hollow steel columns, 2 h fire resistance, Type S concrete

Note to Figure D-2.6.6.A.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

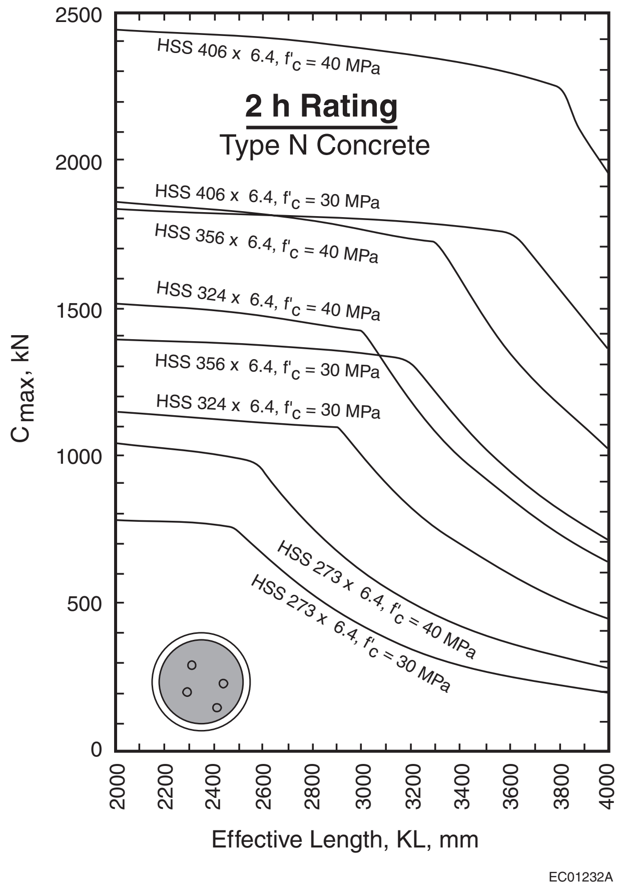

Figure D-2.6.6.B.
Round hollow steel columns, 2 h fire resistance, Type N concrete

Note to Figure D-2.6.6.B.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

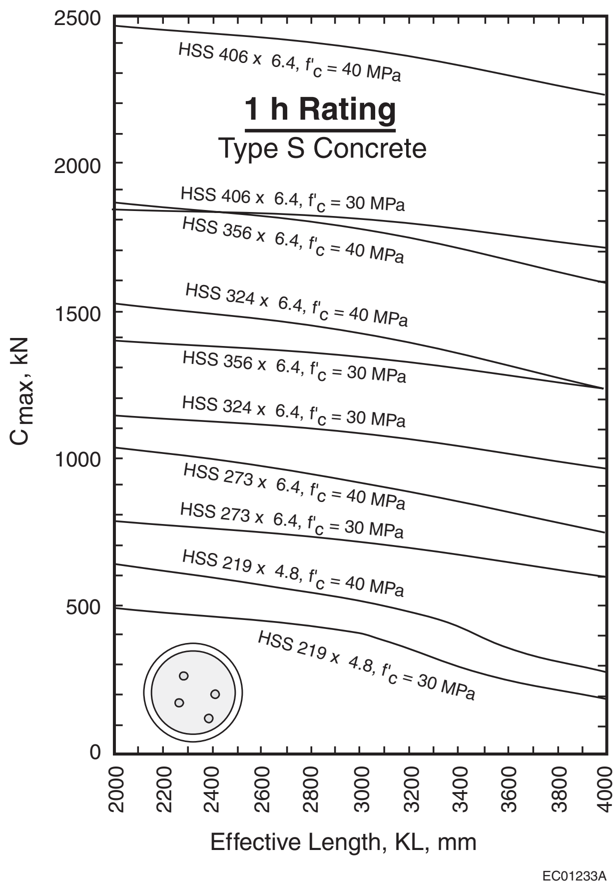

Figure D-2.6.6.C.
Round hollow steel columns, 1 h fire resistance, Type S concrete

Note to Figure D-2.6.6.C.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

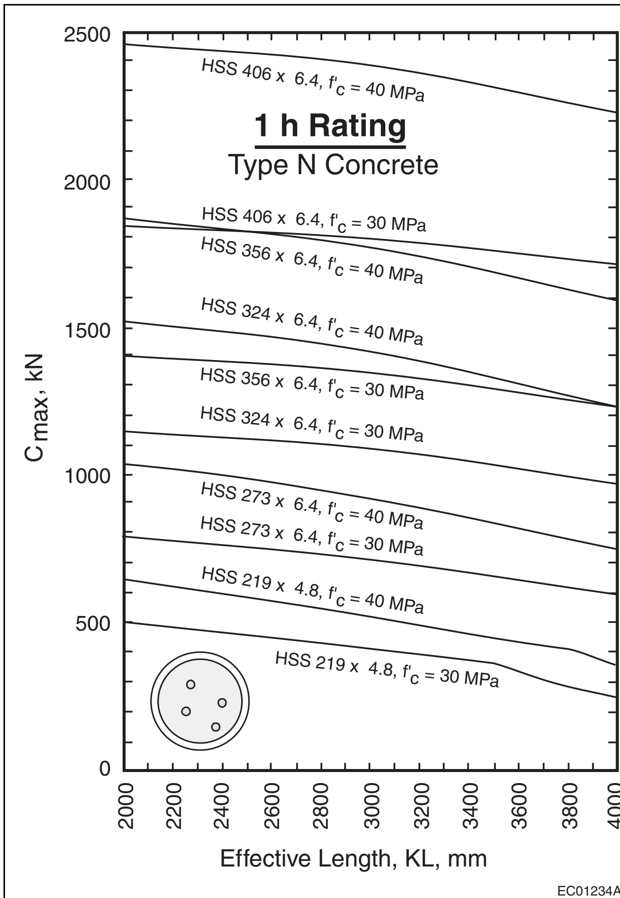

Figure D-2.6.6.D.
Round hollow steel columns, 1 h fire resistance, Type N concrete

Note to Figure D-2.6.6.D.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

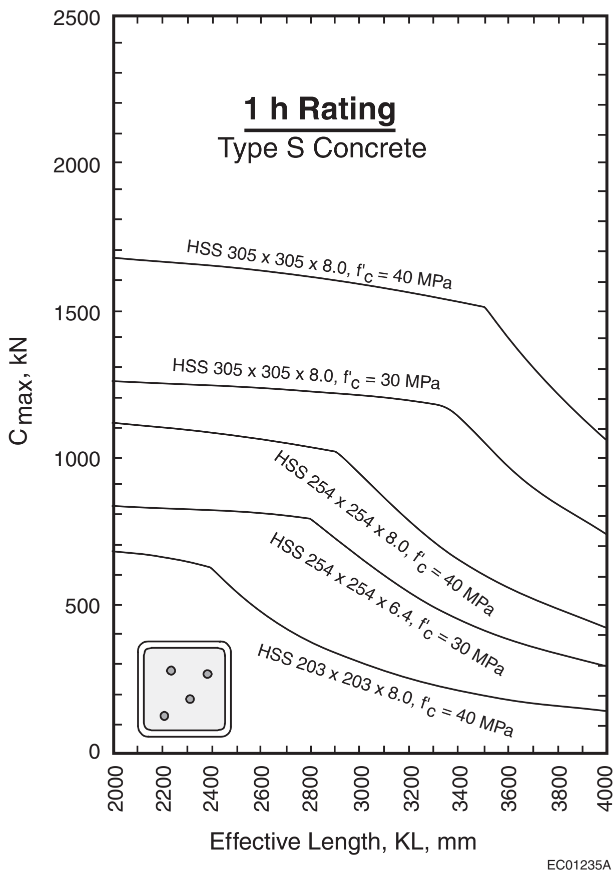

Figure D-2.6.6.E.
Square hollow steel columns, 1 h fire resistance, Type S concrete

Note to Figure D-2.6.6.E.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

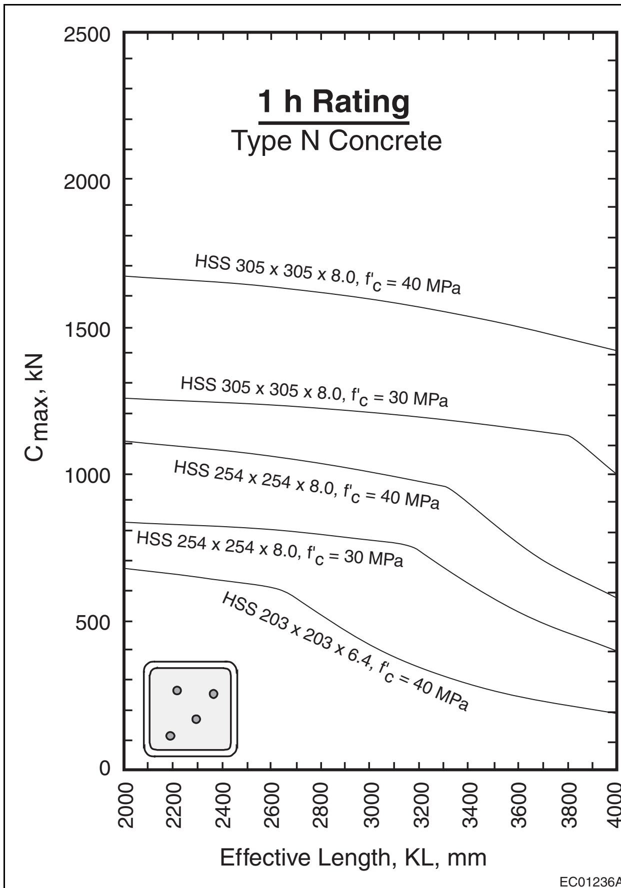

Figure D-2.6.6.F.
Square hollow steel columns, 1 h fire resistance, Type N concrete

Note to Figure D-2.6.6.F.:

(1) In accordance with CAN/CSA-G312.3-M, "Metric Dimensions for Structural Steel Shapes and Hollow Structural Sections," HSS 406 × 6.4 (for example) designates a round steel hollow structural section of 406 mm nominal outside diameter and 6.4 mm wall thickness, whereas HSS 305 × 305 × 8.0 designates a square steel hollow structure of 305 mm nominal outside width and 8.0 mm wall thickness.

D-2.7. Individually Protected Steel Beams

D-2.7.1. Minimum Thickness of Protective Covering

The minimum thickness of protective covering on steel beams exposed to fire on 3 sides for fire-resistance ratings from 30 min to 4 h is shown in Table D-2.7.1.

D-2.7.2. Types of Concrete

Concrete is referred to as Type S, N or L, depending on the nature of the aggregate used. This is described in D-1.4.1.

D-2.7.3. Effect of Plaster

The effect on fire-resistance ratings of the addition of plaster finish to concrete or masonry beam protection is described in D-1.7.1.

D-2.7.4. Exceptions

The fire resistance of protected steel beams depends on the means used to hold the protection in place. Because of the importance of this factor, no rating has been assigned in Table D-2.7.1. to masonry units used as protective cover to steel beams. These ratings, however, may be determined on the basis of comparison with column protection at the discretion of the authority having jurisdiction, if satisfactory means of fastening are provided.

D-2.7.5. Beam Protected by a Membrane

A steel beam or steel joist assembly that is entirely above a horizontal ceiling membrane will be protected from fire below the membrane and will resist structural collapse for a period equal to the fire-resistance rating determined in conformance with D-2.3. The support for this membrane shall be equivalent to that described in D-2.3. The rating on this basis shall not exceed 1.5 h.

Table D-2.7.1.
Minimum Thickness of Cover to Individual Protected Steel Beams, mm(1)

Description of Cover	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S concrete(2) (beam spaces filled solid)	25	25	25	25	32	50	64
Type N or L concrete(2) (beam spaces filled solid)	25	25	25	25	25	39	50
Gypsum-sand plaster on 9.5 mm gypsum lath(3)	13	13	13	20	—	—	—
Gypsum-perlite or vermiculite plaster on 9.5 mm gypsum lath(3)	13	13	13	13	25	—	—
Gypsum-perlite or gypsum-vermiculite on 12.7 mm gypsum lath(3)	13	13	13	20	25	39	50
Gypsum-perlite or vermiculite plaster on double 12.7 mm gypsum lath(3)	13	13	13	20	25	25	39
Portland cement-sand on metal lath(4)	23	23	23	—	—	—	—
Gypsum-sand on metal lath(4) (plaster in contact with lower flange)	16	20	25	39	—	—	—
Gypsum-sand on metal lath with air gap between plaster and lower flange(4)	16	16	16	25	25	—	—
Gypsum-perlite or gypsum-vermiculite on metal lath(4)	16	16	16	23	23	35	48(5)

Notes to Table D-2.7.1.:

(1) Where the thickness of plaster finish applied over gypsum lath is 26 mm or more, the plaster shall be reinforced with wire mesh with 1.57 mm diam wire and 50 mm by 50 mm openings placed midway in the plaster.

(2) Applies to cast-in-place concrete reinforced by 5.21 mm diam wire spaced 200 mm o.c. or 1.57 mm diam wire mesh with 100 mm by 100 mm openings.

(3) Lath held in place by 1.18 mm diam wire wrapped around the gypsum lath 450 mm o.c.

(4) Expanded metal lath 1.63 kg/m^2 fastened to 9.5 mm by 19 mm steel channels held in position by 1.19 mm diam wire.

(5) Plaster finish shall be reinforced with wire mesh with 1.57 mm diam wire and 50 mm by 50 mm openings placed midway in the plaster.

D-2.8. Reinforced Concrete Columns

D-2.8.1. Minimum Dimensions

Minimum dimensions for reinforced concrete columns and minimum concrete cover for vertical steel reinforcement are obtained from D-2.8.2. to D-2.8.5., taking into account the type of concrete, the effective length of the column and the area of the vertical reinforcement.

D-2.8.2. Method

1) The minimum dimension, t, in millimetres, of a rectangular reinforced concrete column shall be equal to

a) 75 f (R + 1) for all Types L and L40S concrete,

b) 80 f (R + 1) for Type S concrete when the design condition of the concrete column is defined in the second and fourth columns of Table D-2.8.2.,

c) 80 f (R + 0.75) for Type N concrete when the design condition of the concrete column is defined in the second and fourth columns of Table D-2.8.2., and

d) 100 f (R + 1) for Types S and N concrete when the design condition of the concrete column is defined in the third column of Table D-2.8.2.

where

f = the value shown in Table D-2.8.2.,
R = the required fire-resistance rating in hours,
k = the effective length factor obtained from CSA A23.3, "Design of Concrete Structures,"
h = the unsupported length of the column in metres, and
p = the area of vertical reinforcement in the column as a percentage of the column area.

2) The diameter of a round column shall be not less than 1.2 times the value t determined in (1) for a rectangular column.

Table D-2.8.2.
Values of Factor f[1]

Overdesign Factor[2]	Values of Factor f to be Used in Applying D-2.8.2.[3][4]		
	Where kh is not more than 3.7 m	Where kh is more than 3.7 m but not more than 7.3 m e3	
		t is not more than 300 mm, p is not more than 3%	All other cases
1.00	1.0	1.2	1.0
1.25	0.9	1.1	0.9
1.50	0.83	1.0	0.83

Notes to Table D-2.8.2.:

(1) For conditions that do not fall within the limits described in Table D-2.8.2., further information may be obtained from Reference (7) in D-6.1.

(2) Overdesign factor is the ratio of the calculated load carrying capacity of the column to the column strength required to carry the specified loads determined in conformance with CSA A23.3, "Design of Concrete Structures."

(3) Where the factor f results in a t greater than 300 mm, the appropriate factor f for all other cases shall be applicable.

(4) Where p is equal to or less than 3% and the factor f results in a t less than 300 mm, the minimum thickness shall be 300 mm.

D-2.8.3. Minimum Thickness of Concrete Cover

1) Where the required fire-resistance rating of a concrete column is 3 h or less, the minimum thickness in millimetres of concrete cover over vertical steel reinforcement shall be equal to 25 times the number of hours of fire resistance required or 50 mm, whichever is less.

2) Where the required fire-resistance rating of a concrete column is greater than 3 h, the minimum thickness in millimetres of concrete cover over vertical steel reinforcement shall be equal to 50 plus 12.5 times the required number of hours of fire resistance in excess of 3 h.

3) Where the concrete cover over vertical steel required in (2) exceeds 62.5 mm, wire mesh reinforcement with 1.57 mm diameter wire and 100 mm openings shall be incorporated midway in the concrete cover to retain the concrete in position.

D-2.8.4. Minimum Requirements

The structural design standards may require minimum column dimensions or concrete cover over vertical steel reinforcement differing from those obtained in D-2.8.2.(1) and (2). Where a difference occurs, the greater dimension shall govern.

Table D-2.9.1.
Minimum Cover to Principal Steel Reinforcement in Reinforced Concrete Beams, mm

Type of Concrete	Fire-Resistance Rating						
	30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S, N or L	20	20	20	25	25	39	50

D-2.8.5. Addition of Plaster

The addition of plaster finish to the concrete column may be taken into account in determining the cover over vertical steel reinforcement by applying the multiplying factors described in D-1.7. The addition of plaster shall not, however, justify any decrease in the minimum column sizes shown.

D-2.8.6. Built-in Columns

The fire-resistance rating of a reinforced concrete column that is built into a masonry or concrete wall so that not more than one face may be exposed to the possibility of fire at one time may be determined on the basis of cover to vertical reinforcing steel alone. In order to meet this condition, the wall shall conform to D-2.1. for the fire-resistance rating required.

D-2.9. Reinforced Concrete Beams

D-2.9.1. Minimum Cover Thickness

The minimum thickness of cover over principal steel reinforcement in reinforced concrete beams is shown in Table D-2.9.1. for fire-resistance ratings from 30 min to 4 h where the width of the beam or joist is at least 100 mm.

D-2.9.2. Maximum Rating

No rating over 2 h may be assigned on the basis of Table D-2.9.1. to a beam or joist where the average width of the part that projects below the slab is less than 140 mm, and no rating over 3 h may be assigned where the average width of the part that projects below the slab is less than 165 mm.

D-2.9.3. Beam Integrated in Floor or Roof Slab

For the purposes of these ratings, a beam may be either independent of or integral with a floor or roof slab assembly.

D-2.9.4. Minimum Thickness

Where the upper extension or top flange of a joist or T-beam in a floor assembly contributes wholly or partly to the thickness of the slab above, the total thickness at any point shall be not less than the minimum thickness described in Table D-2.2.1.A. for the fire-resistance rating required.

D-2.9.5. Effect of Plaster

The addition of plaster finish to a reinforced concrete beam may be taken into account in determining the cover over principal reinforcing steel by applying the multiplying factors described in D-1.7.

Table D-2.10.1.
Minimum Thickness of Concrete Cover over Steel Tendons in Prestressed Concrete Beams, mm(1)

Type of Concrete	Area of Beam, cm^2	Fire-Resistance Rating						
		30 min	45 min	1 h	1.5 h	2 h	3 h	4 h
Type S or N	260 to 970	25	39	50	64	—	—	—
	Over 970 to 1 940	25	26	39	45	64	—	—
	Over 1 940	25	26	39	39	50	77	102
Type L	Over 970	25	25	25	39	50	77	102

Notes to Table D-2.10.1.:

(1) Where the thickness of concrete cover over the tendons exceeds 64 mm, a wire mesh reinforcement with 1.57 mm diam wire and 100 mm by 100 mm openings shall be incorporated in the beams to retain the concrete in position around the tendons. The mesh reinforcement shall be located midway in the cover.

D-2.10. Prestressed Concrete Beams

D-2.10.1. Minimum Cross-Sectional Area and Thickness of Cover

The minimum cross-sectional area and thickness of concrete cover over steel tendons in prestressed concrete beams for fire-resistance ratings from 30 min to 4 h are shown in Table D-2.10.1.

D-2.10.2. Minimum Cover Thickness

The cover for an individual tendon shall be the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the beam, except that for ungrouted ducts the assumed cover thickness shall be the minimum thickness of concrete between the surface of the duct and the surface of the beam. For beams in which several tendons are used, the cover is assumed to be the average of the minimum cover of the individual tendons. The cover for any individual tendon shall be not less than half the value given in Table D-2.10.1. nor less than 25 mm.

D-2.10.3. Applicability of Ratings

The ratings in Table D-2.10.1. apply to a beam that is either independent of or integral with a floor or roof slab assembly. Minimum thickness of slab and minimum cover to steel tendons in prestressed concrete slabs are contained in D-2.2.

D-2.10.4. Effect of Plaster

The addition of plaster finish to a prestressed concrete beam may be taken into account in determining the cover over steel tendons by applying the multiplying factors described in D-1.7.

D-2.10.5. Minimum Cover

1) Except as provided in (2), in unbonded post-tensioned prestressed concrete beams, the concrete cover to the tendon at the anchor shall be not less than 15 mm greater than the minimum required away from the anchor. The concrete cover to the anchorage bearing plate and to the end of the tendon, if it projects beyond the bearing plate, shall be not less than 25 mm.

2) The requirements in (1) do not apply to those portions of beams not likely to be exposed to fire (such as the ends and the tops of flanges of beams immediately below slabs).

D-2.11. Glued-Laminated Timber Beams and Columns

D-2.11.1. Applicability of Information

The information in D-2.11. applies to glued-laminated timber beams and columns required to have fire-resistance ratings greater than those afforded under the provisions of Article 3.1.4.5. of this Code.

D-2.11.2. Method of Calculation

1) The fire-resistance rating of glued-laminated timber beams and columns in minutes shall be equal to

a) $0.1\,fB\,[4 - 2(B/D)]$ for beams that may be exposed to fire on 4 sides,
b) $0.1\,fB\,[4 - (B/D)]$ for beams that may be exposed to fire on 3 sides,
c) $0.1\,fB\,[3 - (B/D)]$ for columns that may be exposed to fire on 4 sides, and
d) $0.1\,fB\,[3 - (B/2D)]$ for columns that may be exposed to fire on 3 sides,

where

f = the load factor shown in Figure D-2.11.2.A.,

B = the full dimension of the smaller side of a beam or column in millimetres before exposure to fire [see Figure D-2.11.2.B.],
D = the full dimension of the larger side of a beam or column in millimetres before exposure to fire [see Figure D-2.11.2.B.],
k = the effective length factor obtained from CSA O86, "Engineering Design in Wood," r4
L = the unsupported length of a column in millimetres.

2) The factored resistance of a beam or column shall be determined by using the specified strengths in CSA O86, "Engineering Design in Wood." r4

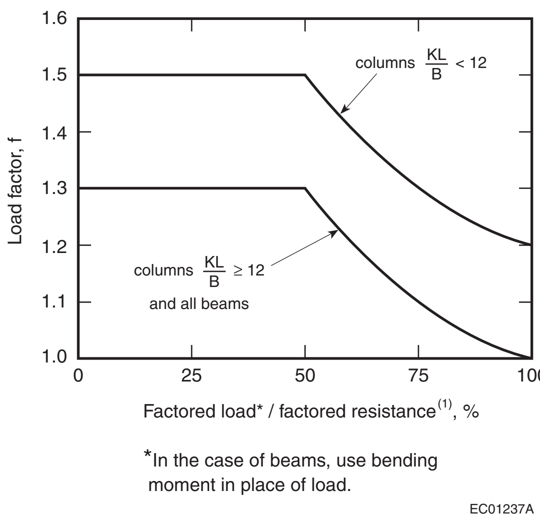

Figure D-2.11.2.A.
Factors to compensate for partially loaded columns and beams

Note to Figure D-2.11.2.A.:

(1) See D-2.11.2.(2).

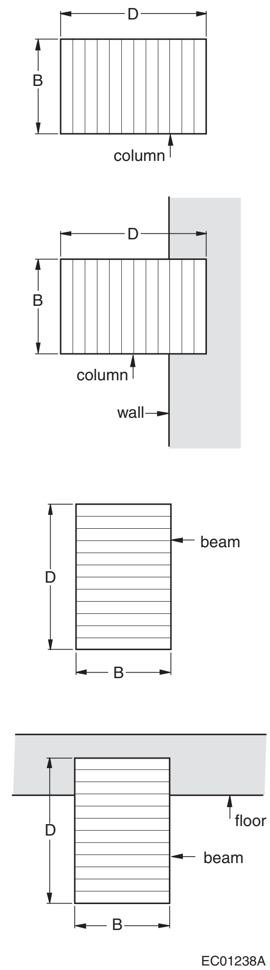

Figure D-2.11.2.B.
Full dimensions of glued-laminated beams and columns

Section D-3 Flame-Spread Ratings and Smoke Developed Classifications

D-3.1. Interior Finish Materials

D-3.1.1. Scope of Information

Tables D-3.1.1.A. and D-3.1.1.B. show flame-spread ratings and smoke developed classifications for combinations of some common interior finish materials. The values are based on all the evidence available at present. Many materials have not been included because of lack of test evidence or because of inability to classify or describe the material in generic terms for the purpose of assigning ratings.

Table D-3.1.1.A.
Assigned Flame-Spread Ratings and Smoke Developed Classifications for Combinations of Wall and Ceiling Finish Materials and Surface Coatings[1]

Materials	Applicable Material Standard	Minimum Thickness, mm	Surface Coating	
			Unfinished	Paint or Varnish not more than 1.3 mm Thick, Cellulosic Wallpaper not more than One Layer[2][3]
Asbestos cement board	CAN/CGSB-34.16-M	None	0/0	25/50
Brick, concrete, tile	None	None		
Steel, copper, aluminum	None	0.33		
Gypsum plaster	CSA A82.22-M	None		
Gypsum wallboard	CAN/CSA-A82.27-M ASTM C 36/C 36M r4 ASTM C 442/C 442M r4 ASTM C 588/C 588M r4 ASTM C 630/C 630M r ASTM C 931/C 931M r e2	9.5	25/50	25/50
Lumber	None	16	150/300	150/300
Douglas Fir plywood[4]	CSA O121-M	11	150/100	150/300
Poplar plywood[4]	CSA O153-M			
Plywood with Spruce face veneer[4]	CSA O151-M			
Douglas Fir plywood[4]	CSA O121-M	6	150/100	150/100
Fiberboard low density	CAN/CSA-A247-M	11	X/100	150/100
Hardboard	CAN/CGSB-11.3-M			
Type 1		9	150/X	[5]
Standard		6	150/300	150/300
Particleboard	ANSI A208.1 r	12.7	150/300	[5]
Waferboard	CSA O437.0 e	—	[5]	[5]

Notes to Table D-3.1.1.A.:

(1) See D-1.1.1.(5) for standards used to assign flame-spread ratings and smoke developed classifications.
(2) Flame-spread ratings and smoke developed classifications for paints and varnish are not applicable to shellac and lacquer.
(3) Flame-spread ratings and smoke developed classifications for paints apply only to alkyd and latex paints.
(4) The flame-spread ratings and smoke developed classifications shown are for those plywoods without a cellulose resin overlay.
(5) Insufficient test information available.

Table D-3.1.1.B.
Flame-Spread Ratings and Smoke-Developed Classifications for Combinations of Common Floor Finish Materials and Surface Coatings[(1)]

Materials	Applicable Standard	FSR/SDC[(2)]
Hardwood or softwood flooring either unfinished or finished with a spar or urethane varnish coating	None	300/300
Vinyl-asbestos flooring not more than 4.8 mm thick applied over plywood or lumber subfloor or direct to concrete	CSA A126.1–M	300/300
Wool carpet (woven), pile weight not less than 1120 g/m^2, applied with or without felt underlay[(3)]	CAN/CGSB-4.129-93	300/300
Nylon carpet, pile weight not less than 610 g/m^2 and not more than 800 g/m^2, applied with or without felt underlay[(3)]	CAN/CGSB-4.129-93	300/500
Nylon carpet, pile weight not less than 610 g/m^2 and not more than 1355 g/m^2, glued down to concrete	CAN/CGSB-4.129-93	300/500
Wool/nylon blend carpet (woven) with not more than 20% nylon and pile weight not less than 1120 g/m^2	CAN/CGSB-4.129-93	300/500
Nylon/wool blend carpet (woven) with not more than 50% wool, pile weight not less than 610 g/m^2 and not more than 800 g/m^2	CAN/CGSB-4.129-93	300/500
Polypropylene carpet, pile weight not less than 500 g/m^2 and not more than 1200 g/m^2, glued down to concrete	CAN/CGSB-4.129-93	300/500

Notes to Table D-3.1.1.B.:

(1) Tested on the floor of the tunnel in conformance with provisions of CAN/ULC-S102.2-M, “Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies.”

(2) Flame-Spread Rating/Smoke Developed Classification.

(3) Type 1 or 2 underlay as described in CGSB 4-GP-36M, “Carpet Underlay, Fibre Type.”

D-3.1.2. Ratings

The ratings shown in Tables D-3.1.1.A. and D-3.1.1.B. are arranged in groups corresponding to the provisions of this Code. The ratings apply to materials falling within the general categories indicated.

D-3.1.3. Table Entries

In Tables D-3.1.1.A. and D-3.1.1.B., the first number of each entry relates to flame spread and the second number to smoke developed limit. For example:

25/50 represents a flame-spread rating of 0 to 25 and a smoke developed classification of 0 to 50,

150/300 represents a flame-spread rating of 75 to 150 and a smoke developed classification of 100 to 300, and

X/X applied to walls and ceilings means a flame-spread rating over 150 and a smoke developed classification over 300. e

D-3.1.4. Effect of Surface Coatings

Thin surface coatings can modify flame-spread characteristics either upward or downward. Table D-3.1.1.A. includes a number of thin coatings that increase the flame-spread rating of the base material, so that these may be considered where more precise control over flame spread hazard is desired.

D-3.1.5. Proprietary Materials

1) Information on flame-spread rating of proprietary materials and fire-retardant treatments that cannot be described in sufficient detail to ensure reproducibility is available through the listing and labelling services of Underwriters’ Laboratories of Canada, Intertek Testing Services NA Ltd. (3210 American Drive, Mississauga, Ontario L4V 1B3), or other recognized testing laboratory. e2

2) A summary of flame spread test results published prior to 1965 has been prepared by the Institute for Research in Construction of the National Research Council of Canada (see Item (1) in D-6.1., Fire Test Reports).

D-3.1.6. Limitations and Conditions

1) The propagation of flame along a surface in the standard test involves some finite depth of the material or materials behind the surface, and this involvement extends to the depth to which temperature variations are to be found during the course of the test; for many commonly used lining materials, such as wood, the depth involved is about 25 mm.

2) For all the combustible materials described in Table D-3.1.1.A., a minimum dimension is shown, and this represents the thickness of the test samples on which the rating has been based; when used in greater thicknesses than that shown, these materials may have a slightly lower flame-spread rating, and thinner specimens may have higher flame-spread ratings.

3) No rating has been included for foamed plastic materials because it is not possible at this time to identify these products with sufficient accuracy on a generic basis. Materials of this type that melt when exposed to the test flame generally show an increase in flame-spread rating as the thickness of the test specimen increases.

D-3.1.7. Referenced Standards

In Tables D-3.1.1.A. and D-3.1.1.B., the standards applicable to the materials described are noted because the ratings depend on conformance with these specifications.

Section D-4 Noncombustibility

D-4.1. Test Method

D-4.1.1. Determination of Noncombustibility

1) Noncombustibility is required of certain components of buildings by the provisions of this Code, which specifies noncombustibility by reference to CAN4-S114-M, " Test for Determination of Non-Combustibility in Building Materials."

2) The test to which reference is made in (1) is severe, and it may be assumed that any building material containing even a small proportion of combustibles will itself be classified as combustible. The specimen, 38 mm by 51 mm, is exposed to a temperature of 750°C in a small furnace. The essential criteria for noncombustibility are that the specimen does not flame or contribute to temperature rise.

D-4.2. Materials Classified as Combustible

D-4.2.1. Combustible Materials

Most materials from animal or vegetable sources will be classed as combustible by CAN4-S114-M, "Test for Determination of Non-Combustibility in Building Materials," and wood, wood fibreboard, paper, felt made from animal or vegetable fibres, cork, plastics, asphalt and pitch would therefore be classed as combustible.

D-4.2.2. Composite Materials

Materials that consist of combustible and noncombustible elements in combination will in many cases also be classed as combustible, unless the proportion of combustibles is very small. Some mineral wool insulations with combustible binder, cinder concrete, cement and wood chips and wood-fibred gypsum plaster would also be classed as combustible.

D-4.2.3. Effect of Chemical Additives

The addition of a fire-retardant chemical is not sufficient to change a combustible product to a noncombustible product.

D-4.3. Materials Classified as Noncombustible

D-4.3.1. Typical Examples

Noncombustible materials include brick, ceramic tile, concrete made from Portland cement with noncombustible aggregate, asbestos cement, plaster made from gypsum with noncombustible aggregate, metals commonly used in buildings, glass, granite, sandstone, slate, limestone and marble.

Section D-5 Protection of Openings in Fire-Rated Assemblies

D-5.1. Scope

D-5.1.1. Installation Information

1) The information in D-5 specifies requirements for

a) the installation of fire doors and fire dampers in gypsum-wallboard-protected stud wall assemblies, and

b) fire stop flaps for installation in fire-rated membrane ceilings.

D-5.2. Installation of Fire Doors and Fire Dampers

D-5.2.1. References

1) Fire doors and fire dampers in gypsum-wallboard-protected steel stud non-loadbearing walls required to have a fire-resistance rating shall be installed in conformance with Section 9.24. of this Code and the applicable requirements of NFPA 80, "Fire Doors and Fire Windows."

2) Fire doors and fire dampers in gypsum-wallboard-protected wood stud walls required to have a fire-resistance rating shall be installed in conformance with Section 9.23. of this Code and the applicable requirements of NFPA 80, "Fire Doors and Fire Windows."

D-5.3. Fire Stop Flaps

D-5.3.1. Construction Requirements

Fire stop flaps shall be constructed of steel not less than 1.5 mm thick, covered on both sides with painted asbestos paper not less than 1.6 mm thick and equipped with pins and hinges of corrosion-resistant material (see Figure D-5.3.1.).

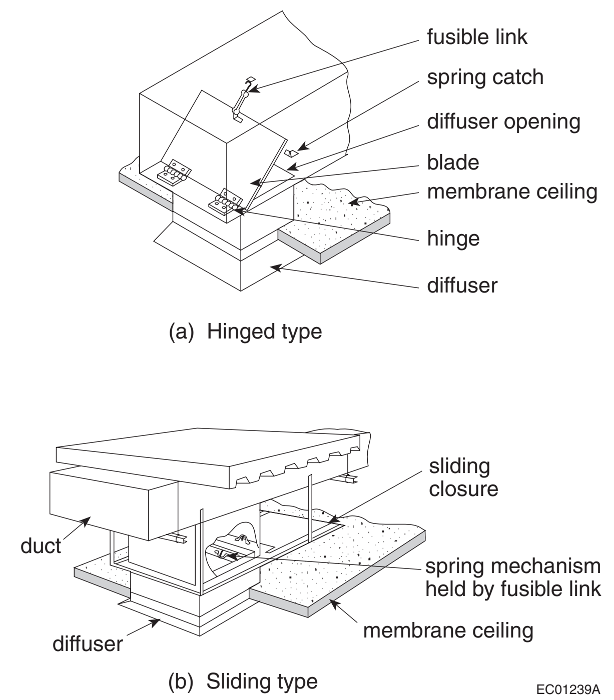

Figure D-5.3.1.
Typical fire stop flaps

D-5.3.2. Hold-open Devices

Fire stop flaps shall be held open with fusible links conforming to ULC-S505, "Fusible Links for Fire Protection Service," or other heat-activated devices having a temperature rating approximately 30°C above the maximum temperature that would exist in the system either with the system in operation or shut down.

Section D-6 Background Information

D-6.1. Fire Test Reports

Summaries of available fire test information have been published by the Institute for Research in Construction (formerly the Division of Building Research) as follows:

(1) M. Galbreath, Flame Spread Performance of Common Building Materials. Technical Paper No. 170, Division of Building Research, National Research Council Canada, Ottawa, April 1964. NRCC 7820.
(2) M. Galbreath and W.W. Stanzak, Fire Endurance of Protected Steel Columns and Beams. Technical Paper No. 194, Division of Building Research, National Research Council Canada, Ottawa, April 1965. NRCC 8379.
(3) T.Z. Harmathy and W.W. Stanzak, Elevated-Temperature Tensile and Creep Properties of Some Structural and Prestressing Steels. American Society for Testing and Materials, Special Technical Publication 464, 1970, p. 186 (DBR Research Paper No. 424) NRCC 11163.
(4) T.Z. Harmathy, Thermal Performance of Concrete Masonry Walls in Fire. American Society for Testing and Materials, Special Technical Publication 464, 1970, p. 209 (DBR Research Paper No. 423) NRCC 11161.
(5) L.W. Allen, Fire Endurance of Selected Non-Loadbearing Concrete Masonry Walls. DBR Fire Study No. 25, Division of Building Research, National Research Council Canada, Ottawa, March 1970. NRCC 11275.
(6) A. Rose, Comparison of Flame Spread Ratings by Radiant Panel, Tunnel Furnace, and Pittsburgh-Corning Apparatus. DBR Fire Study No. 22, Division of Building Research, National Research Council Canada, Ottawa, June 1969. NRCC 10788.
(7) T.T. Lie and D.E. Allen, Calculation of the Fire Resistance of Reinforced Concrete Columns. DBR Technical Paper No. 378, Division of Building Research, National Research Council Canada, Ottawa, August 1972. NRCC 12797.
(8) W.W. Stanzak, Column Covers: A Practical Application of Sheet Steel as a Protective Membrane. DBR Fire Study No. 27, Division of Building Research, National Research Council Canada, Ottawa, February 1972. NRCC 12483.
(9) W.W. Stanzak, Sheet Steel as a Protective Membrane for Steel Beams and Columns. DBR Fire Study No. 23, Division of Building Research, National Research Council Canada, Ottawa, November 1969. NRCC 10865.

(10) W.W. Stanzak and T.T. Lie, Fire Tests on Protected Steel Columns with Different Cross-Sections. DBR Fire Study No. 30, Division of Building Research, National Research Council Canada, Ottawa, February 1973. NRCC 13072.

(11) G. Williams-Leir and L.W. Allen, Prediction of Fire Endurance of Concrete Masonry Walls. DBR Technical Paper No. 399, Division of Building Research, National Research Council Canada, Ottawa, November 1973. NRCC 13560.

(12) G. Williams-Leir, Prediction of Fire Endurance of Concrete Slabs. DBR Technical Paper No. 398, Division of Building Research, National Research Council Canada, Ottawa, November 1973. NRCC 13559.

(13) A. Rose, Flammability of Fibreboard Interior Finish Materials. Building Research Note No. 68, Division of Building Research, National Research Council Canada, Ottawa, October 1969.

(14) L.W. Allen, Effect of Sand Replacement on the Fire Endurance of Lightweight Aggregate Masonry Units. DBR Fire Study No. 26, Division of Building Research, National Research Council Canada, Ottawa, September 1971. NRCC 12112.

(15) L.W. Allen, W.W. Stanzak and M. Galbreath, Fire Endurance Tests on Unit Masonry Walls with Gypsum Wallboard. DBR Fire Study No. 32, Division of Building Research, National Research Council Canada, Ottawa, February 1974, NRCC 13901.

(16) W.W. Stanzak and T.T. Lie, Fire Resistance of Unprotected Steel Columns. Journal of Structural Division, Proc., Am. Soc. Civ. Eng., Vol. 99, No. ST5 Proc. Paper 9719, May 1973 (DBR Research Paper No. 577) NRCC 13589.

(17) T.T. Lie and T.Z. Harmathy, Fire Endurance of Concrete-Protected Steel Columns. A.C.I. Journal, January 1974, Title No. 71-4 (DBR Technical Paper No. 597) NRCC 13876.

(18) T.T. Lie, A Method for Assessing the Fire Resistance of Laminated Timber Beams and Columns. Can. J. Civ. Eng., Vol. 4, No. 2, June 1977 (DBR Technical Paper No. 718) NRCC 15946.

(19) T.T. Lie, Calculation of the Fire Resistance of Composite Concrete Floor and Roof Slabs. Fire Technology, Vol. 14, No. 1, February 1978 (DBR Technical Paper No. 772) NRCC 16658.

D-6.2. Obsolete Materials and Assemblies

Building materials, components and structural members and assemblies in buildings constructed before 1995 may have been assigned ratings based on earlier editions of The Supplement to the National Building Code of Canada or older reports of fire tests. To assist users in determining the ratings of these obsolete assemblies and structural members, the following list of reference documents has been prepared. Although some of these publications are out of print, reference copies are available at the Institute for Research in Construction, National Research Council of Canada, Ottawa, Ont., K1A 0R6.

(1) M. Galbreath, Fire Endurance of Unit Masonry Walls. Technical Paper No. 207, Division of Building Research, National Research Council Canada, Ottawa, October 1965. NRCC 8740.

(2) M. Galbreath, Fire Endurance of Light Framed and Miscellaneous Assemblies. Technical Paper No. 222, Division of Building Research, National Research Council Canada, Ottawa, June 1966. NRCC 9085.

(3) M. Galbreath, Fire Endurance of Concrete Assemblies. Technical Paper No. 235, Division of Building Research, National Research Council Canada, Ottawa, November 1966. NRCC 9279

(4) Guideline on Fire Ratings of Archaic Materials and Assemblies. Rehabilitation Guideline #8, U.S. Department of Housing and Urban Development, Germantown, Maryland 20767, October 1980.

(5) T.Z. Harmathy, Fire Test of a Plank Wall Construction. Fire Study No. 2, Division of Building Research, National Research Council Canada, Ottawa, July 1960. NRCC 5760.

(6) T.Z. Harmathy, Fire Test of a Wood Partition. Fire Study No. 3, Division of Building Research, National Research Council Canada, Ottawa, October 1960. NRCC 5769.

D-6.3. Assessment of Archaic Assemblies

Information in this document applies to new construction. Please refer to early editions of the Supplement to the National Building Code of Canada for the assessment or evaluation of assemblies that do not conform to the information in this edition of the National Building Code. As with other documents, this Code is revised according to the information presented to the standing committee responsible for its content, and with each update new material may be added and material that is not relevant may be deleted.

D-6.4. Development of the Component Additive Method

The component additive method was developed based upon the following observations and conclusions drawn from published as well as unpublished test information.

Study of the test data showed that structural failure preceded failure by other criteria (transmission of heat or hot gases) in most of the tests of loadbearing wood-framed assemblies. The major contributor to fire resistance was the membrane on the fire-exposed side.

Fire tests of wood joist floors without protective ceilings resulted in structural failure between 8 and 10 min. Calculation of the time for wood joists to approach breaking stress, based upon the charring rate of natural woods, suggested a time of 10 min for structural failure. This time was subtracted from the fire-resistance test results of wood joist floors and the remainder considered to be the contribution of the membrane.

The figures obtained for the contribution of membranes were then applied to the test results for open web steel joist floors and wood and steel stud walls and values of 20 min for the contribution of wood stud framing and 10 min for steel framing were derived.

The fire-resistance rating has been limited to 1.5 h as this method of developing ratings for framed assemblies was new and untried. Although this is the subject of current review, no decision has been made to extend the ratings beyond 1.5 h.

(1) M. Galbreath, G. C. Gosselin, and R. B. Chauhan, Historical Guide to Chapter 2 of the Supplement to the National Building Code of Canada, Committee Paper FPR 1-3, Prepared for the Standing Committee on Fire Performance Ratings, May 1987.

Example showing fire-resistance rating of a typical membrane assembly, calculated using the component additive method.

1 hour Gypsum Board/Wood Stud Interior Partition

A 1 h fire-resistance rating is required for an interior wood framed partition, using 12.7 mm Type X gypsum wallboard.

(a) Since gypsum wallboard is used (D-2.3.4.(2) and Table D-2.3.4.A.) time assigned to 12.7 mm Type X gypsum wallboard membrane on the fire-exposed side of the partition = 25 min

(b) Time assigned to wood framing members at 400 mm o.c. (D-2.3.4.(3) and Table D-2.3.4.C.) = 20 min

(c) Time assigned to insulation, if the spaces between the studs are filled with preformed insulation of rock or slag fibres conforming to CAN/ULC-S702, “Mineral Fibre Thermal Insulation for Buildings,” (D-2.3.4.(4) and Table D-2.3.4.D.) = 15 min r e4

(d) Time assigned to the membrane on the non-fire-exposed side (D-2.3.5.(1)) = 0 min

Fire-resistance rating = 25 + 20 + 15 = 60 min

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Conversion Factors

To Convert	To	Multiply by
°C	°F	1.8 and add 32
kg	lb.	2.205
kPa	lbf./in.^{2}(psi)	0.1450
kPa	lbf./ft.^{2}	20.88
L	gal. (imp.)	0.2200
L/s	gal./min (gmp)	13.20
lx	ft.-candle	0.09290
m	ft.	3.281
m^2	ft.^{2}	10.76
m^3	ft.^{3}	35.31
mm	in.	0.03937
m^3/h	ft.^{3}/min (cfm)	0.5886
m/s	ft./min	196.8
MJ	Btu	947.8
N	lbf.	0.2248
ng/(Pa • s • m^2) e3	perms	0.0174
Pa e3	in. of water	0.004014
W e3	Btu/h	3.412