NRC Canadian Codes Centre

2011 National Energy Code for Buildings (NECB) — Heating, Ventilating and Air-conditioning Systems

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Canada

Introduction

- Presentation is part of a series of seven
- Model code developed by Canadian Commission on Building and Fire Codes
- National Energy Code of Canada for Buildings 2011 (NECB) must be adopted by provincial/ territorial authorities to become law

Outline

- Scope and compliance
- Prescriptive path
  - Equipment
  - Ventilation, including heat recovery
  - Piping and pumping systems
  - Temperature control
  - Shut-off and setback controls
- Trade-off path
- Performance path

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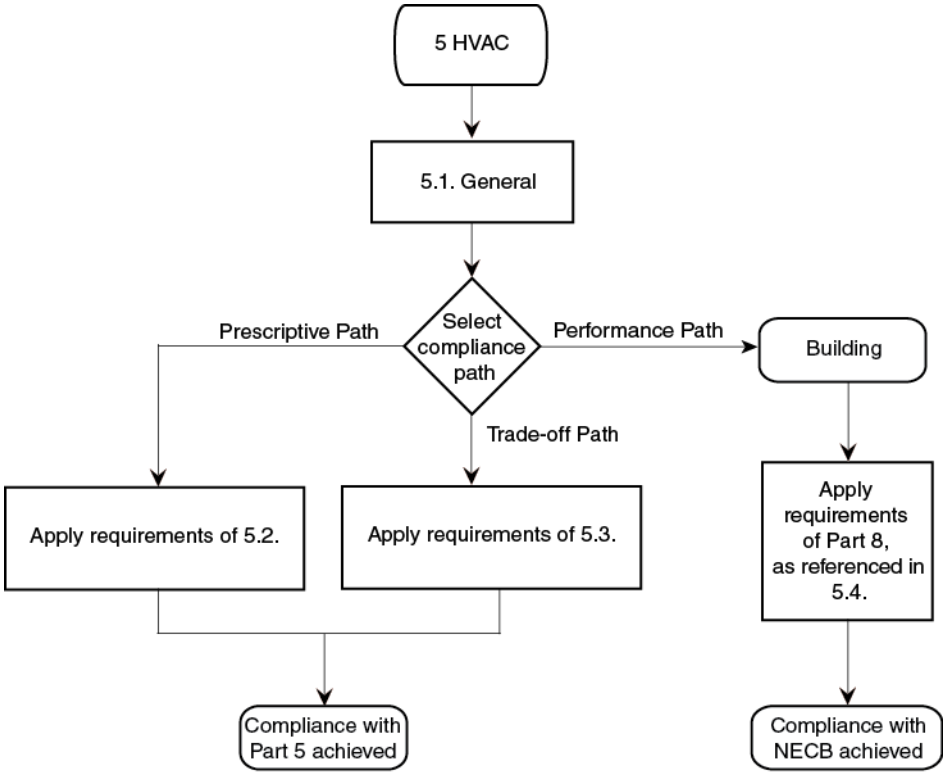
Scope

- Addresses HVAC - Part 5
  - Heating equipment
  - Ventilating equipment
  - Air-conditioning equipment
  - HVAC control systems
  - Piping and ducts forming part of the system

Compliance options

- Simple prescriptive
- Trade-off
- Performance – whole building



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Equipment – minimum performance efficiency

- Efficiency with referenced standard provided for:
  - Boilers
  - Warm-air furnaces
  - Duct furnaces
  - Unit heaters
  - Packaged water chillers
  - Packaged terminal A/C
  - Computer room A/C
  - Air-cooled A/C and heat pumps
  - Water- and evaporatively cooled A/C and heat pumps
  - Condensing units
  - Ground water heat pumps

Equipment – minimum performance efficiency

- Requirement set to median of current practice
- Trade-off path introduced

Equipment performance – other

- Refer to NBC for proper sizing
- Performance requirements for
  - Field-assembled equipment
  - Combination space and service water heating
  - Equipment installed outdoors

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Air distribution

- Ability to balance
- Sealed and air leakage tested based on operating static pressure
  - Exemptions:
    - Return ducts in conditioned spaces
    - Supply ducts after control element

Duct and plenum insulation

- Requirements based on temperature difference

Temperature Difference, °C	Min. Thermal Resistance for Ducts and Plenums, m^2•C/W	Min. Thermal Resistance for Run-outs, m^2•C/W
< 5	0	0
5 to 22	0.58	0.58
> 22	0.88	0.58

Cooling with outdoor air

- Ability to cool with outdoor air when
  - Mechanical capacity > 20 kW and
  - Air handler > 1500 L/s
  - Exception for dwelling units and hotel/motel rooms

Cooling with outdoor air

- Air economizer
  - Capable of mixing return air with 100% outside air
  - Staging of mechanical cooling
- Water economizer
  - Capable of providing 100% of cooling load

Fan systems

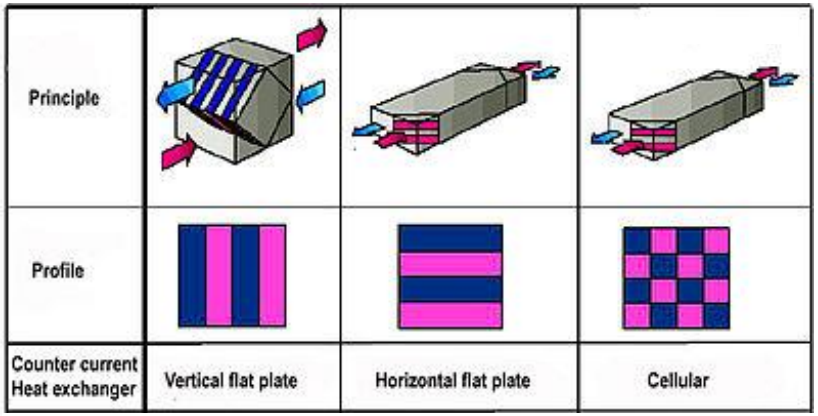
- Power demand restriction based on supply air delivered to conditioned space:
  - Constant air volume → 1.6 W per L/s
  - Variable air volume → 2.65 W per L/s
    - If demand > 7.5 kW and < 25 kW → 50% reduction in air volume with no more than 55% of design wattage
    - If demand ≥ 25 kW → 30% of wattage at 50% of design air volume

Dampers

- Motorized dampers required except where
  - Not permitted
  - Continuous HVAC operation required, or
  - Opening ≤ 0.08 m^2
- In closed position → not more than 15 L/s airflow

Heat recovery system

- Exhaust systems → sensible heat > 150 kW (~5000 cfm)
  - 50% efficiency requirement for heat-recovery apparatus
  - Exemption for specialized exhaust systems
- Humidity not included in heat content calculation
  - Energy-recovery ventilators can be used

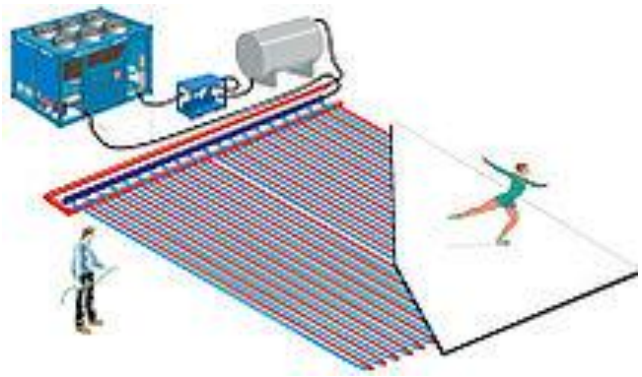


Heat recovery – dwelling units

- Dwellings with self-contained mechanical ventilation (except in climatic zones 4, 5 and 6)
  - Principal exhaust only
  - 50% sensible heat recovery
- Humidity not included in heat content calculation

Heat recovery – pools and ice surfaces

- Swimming pools
  - 40% recovery of sensible heat from exhaust air
  - Exemption if dehumidification system provides 80% of dehumidification that would be accomplished by exhaust system
- Ice arenas
  - Required if heating load elsewhere
  - Expanded to allow use for either space or service water heating



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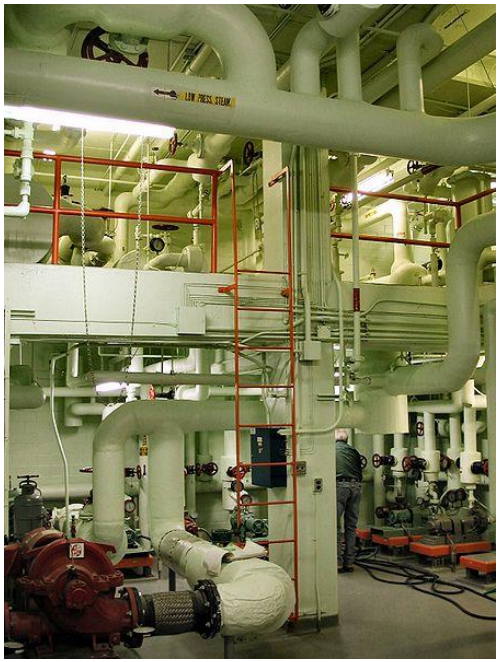
Piping

- Ability to balance
- Minimum insulation requirement based on
  - Operating temperature of fluid
  - Insulation conductivity
  - Nominal pipe diameter
- Piping outdoors insulated to > 177°C operating temperature



Pumping system

- Variable-flow pumps > 7.5 kW
  - Nameplate power rather than break power
  - Capable of reducing flow to 50% of design flow or less

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Temperature controls

- Parameters for proper thermostat installation
  - Height between 1400-1500 mm
  - 0.286 W/(m^2•K) insulation to outdoors
  - Away from drafts, sunlight and heat sources
  - Exemption provided for barrier-free and stratified ventilation
- One automatic space temperature control per system accurate to within 1°C

Space temperature controls

- Independent perimeter systems per building exposure
  - One thermostat
- Dwelling units
  - At least one thermostat
  - Manual or automatic control to reduce heating and, if present, cooling

Electric heating systems

- Update of referenced standard C828 clarifies controls based on technology used
  - No requirement for universal remotely mounted

Space temperature controls

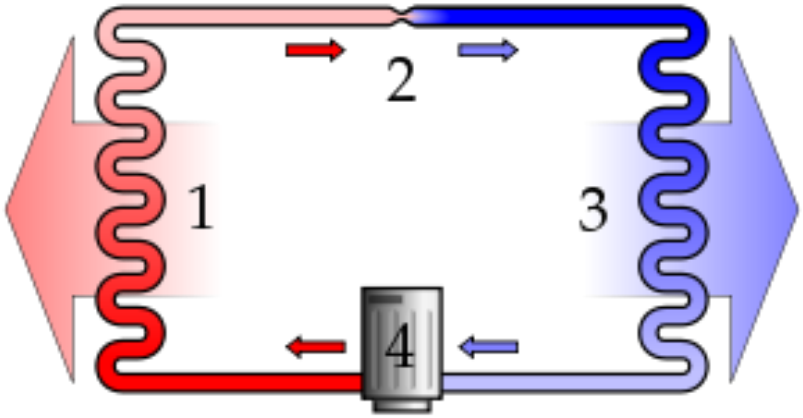
- Ice and snow melt heater
  - Controls to allow shut-down
  - Light indicator requirement removed
- Vestibules
  - Control device to limit heating to a maximum of 15°C

Reheating and recooling controls

- Air leaving supply air handler
  - Prevent heating previously cooled
  - Prevent cooling previously heated
- Space temperature control by reheating and recooling
  - Automatic adjustment to limit of temperature that will satisfy control zone

Heat pump controls

- Heating load to be met with heat pump first, prior to secondary heater
  - Clarification that supplementary heat applies to load above peak load



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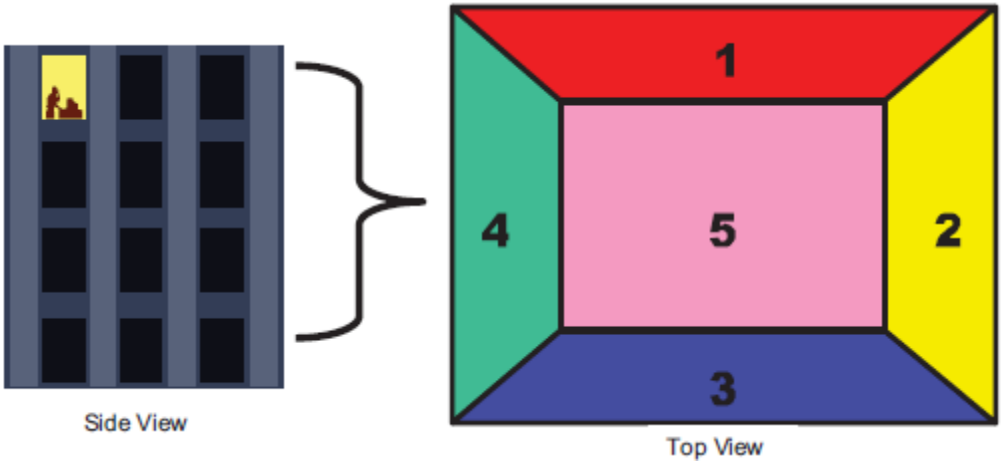
Shut-off and setback controls

- Systems serving dwelling units and non-continuously operating areas
  - Automatic controls
  - Set-back or shut-down controls during non-use periods
  - Application modified to larger than 5 kW capacity
- Seasonal shut-down controls for pumping systems

Airflow control areas

- Control areas to allow airflow reduction or stoppage
  - Limit area not more than 2500 m^2
  - Exhaust airflow controlled



Boiler controls

- Moderately sized boilers (176 kW) → staging required
- Large boilers (352 kW) → full modulation required

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Trade-off concept

- Considers energy use throughout system

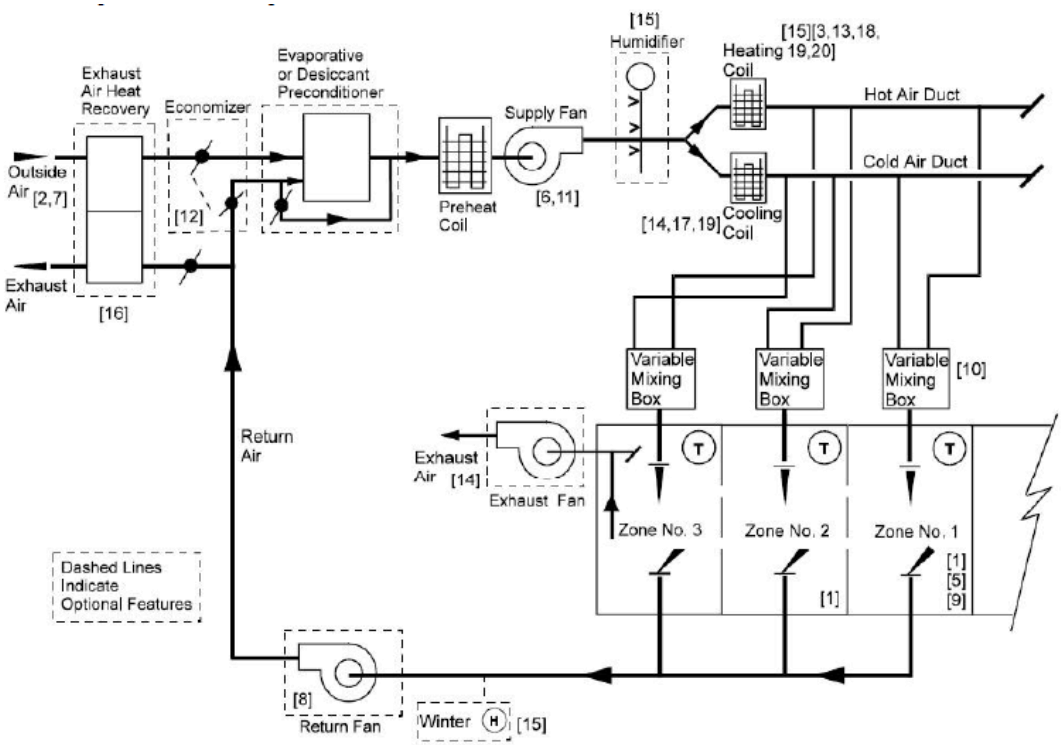
Trade-off concept

- System efficiency approach considers HVAC system as a whole
- Allows improvement in other system parts to compensate for one component not meeting a prescriptive requirement
- Intended to permit flexibility for typical design

Total **proposed** system efficiency $\geq$ Total **reference** system efficiency

Components and systems considered

- Comparison: system to same system
- 27 typical system types considered
- 32 components considered



From DOE 2.2 User manual

Method

- Calculation coefficients: performance of typical system

$$HVAC_{TOI} = \sum_{i=1}^{32}\left(\alpha_i \bullet ToV_i + \beta_i \bullet ToV_i^{\,2}\right) \bullet \gamma_i - \sum_{i=1}^{32}\left(\alpha_i \bullet BaV_i + \beta_i \bullet BaV_i^{\,2}\right) \bullet \gamma_i$$

BaVi – base prescriptive component efficiency

ToVi – component efficiency to be traded

Method

- Calculation coefficients: performance of typical system

$$HVAC_{TOI} = \sum_{i=1}^{32}\left(\alpha_i \bullet ToV_i + \beta_i \bullet ToV_i^{\,2}\right) \bullet \gamma_i - \sum_{i=1}^{32}\left(\alpha_i \bullet BaV_i + \beta_i \bullet BaV_i^{\,2}\right) \bullet \gamma_i$$

Proposed System

Prescriptive system

BaVi – base prescriptive component efficiency

ToVi – component efficiency to be traded

Coefficients

- Likely computer-program-assisted but can be completed with spreadsheet

Built-up Variable Volume

Component	XDD	α1	α2	α3	β1	β2	β3
ToV_1- Supply Fan Mechanical Efficiency	HDD	9.901E-01	-1.418E-04	5.710E-09	-5.191E-01	7.037E-05	-2.626E-09
ToV_2 -Supply Motor Efficiency	HDD	6.994E-01	-1.013E-04	4.055E-09	-2.670E-01	3.687E-05	-1.362E-09
ToV_3- Return Fan Mechanical Efficiency	HDD	6.087E-01	-5.513E-05	7.352E-10	-5.244E-01	4.324E-05	-2.153E-10
ToV_4 - Return Fan Motor Efficiency	HDD	2.916E-01	-2.712E-05	3.972E-10	-1.264E-01	1.095E-05	-8.620E-11
ToV_5 -Supply Temperature Control	HDD	-2.175E-01	1.610E-04	-1.976E-08	1.081E+00	-3.448E-04	2.887E-08
ToV_6 - Airflow Control Efficiency	TDD	1.034E-01	3.422E-05	-3.997E-09	8.110E-01	-2.076E-04	1.353E-08

Trade-off limitations

- Energy sources used must be natural gas, propane, oil or electricity
- Back-up equipment must meet prescriptive requirements
- One of the 27 “traditional” systems

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Limitation

- Equipment performance efficiency cannot be less than required by EEA
- Back-up equipment must comply with prescriptive path

Questions?

www.nationalcodes.nrc.gc.ca

Thank you