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Publisher's version / Version de l'éditeur:

https://doi.org/10.4224/23002279 Research Report (National Research Council of Canada. Construction), 2017-09

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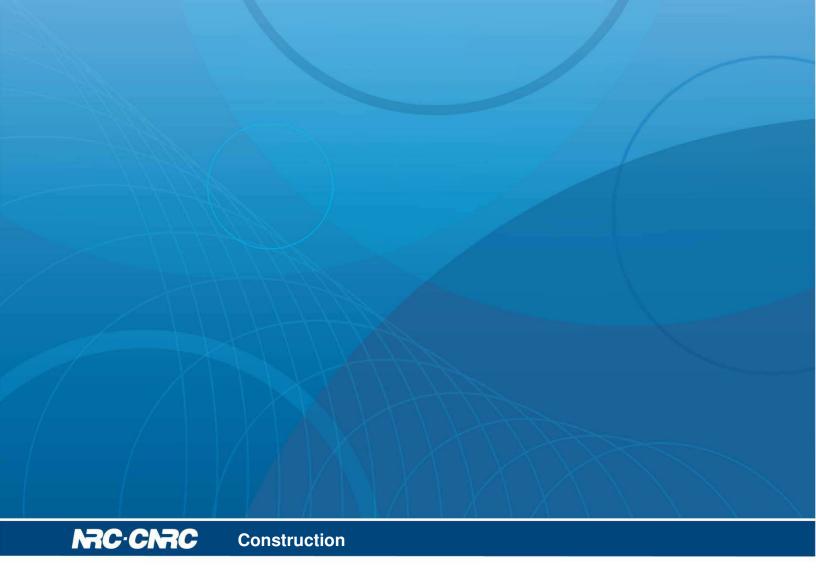
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RR-331 Guide to Calculating Airborne Sound Transmission in Buildings

Christoph Hoeller, David Quirt, Jeffrey Mahn

Third Edition September 2017



National Research Conseil national de recherches Canada



Guide to Calculating Airborne Sound Transmission in Buildings

Applying ISO Measurement and Prediction Standards in a North American Context

Abstract: In recent years, the science and engineering for controlling sound transmission in buildings have shifted from a focus on individual assemblies such as walls or floors, to a focus on performance of the complete system. Standardized procedures for calculating the overall transmission, combined with standardized measurements to characterize sub-assemblies, provide much better prediction of sound transmission between adjacent indoor spaces. The International Standards Organization (ISO) has published a calculation method, ISO 15712-1 that uses laboratory test data for sub-assemblies such as walls and floors as inputs for a detailed procedure to calculate the expected sound transmission between adjacent rooms in a building. This standard works very well for some types of construction, but to use it in a North American context one must overcome two obstacles – incompatibility with the ASTM standards used by our construction industry, and low accuracy of its predictions for lightweight wood or steel frame construction. To bypass limitations of ISO 15712-1, this Guide explains how to merge ASTM and ISO test data in the ISO calculation procedure, and provides recommendations for applying extended measurement and calculation procedures for specific common types of construction. This Guide was developed in a project established by the National Research Council Canada to support the transition of construction industry practice to using apparent sound transmission class (ASTC) for sound control objectives in the National Building Code of Canada (NBCC). However, the potential range of application goes beyond the minimum requirements of the NBCC - the Guide also facilitates design to provide enhanced sound insulation, and should be generally applicable to construction in both Canada and the USA.

This publication contains a limited set of examples for several types of construction, to provide an introduction and overview of the ASTC calculation procedure. Additional examples and measurement data can be found in the companion documents to this Guide, namely NRC Research Reports RR-333 to RR-337. Furthermore, the calculation procedure outlined and illustrated in this Guide is also used by the software web application *soundPATHS*, which is available for free on the website of the National Research Council Canada (see the references in Section 7 of this Guide for access details).

Although it is not repeated at every step of this Guide, it should be understood that some variation in sound insulation is to be expected in practice due to changes in the specific design details, quality of workmanship, substitution of "generic equivalents", or simply rebuilding the construction. It would be prudent to allow a margin of error of 2-3 ASTC points to ensure that a design will satisfy a specific requirement.

Despite this caveat, the authors believe that methods and results shown here do provide a good estimate of the apparent sound insulation for the types of constructions presented.

Changes in the Third Edition

This third edition supersedes the first and second editions of the NRC Research Report RR-331, which were published in October 2013 and April 2016, respectively.

Changes in the third edition include:

- New worked examples for constructions consisting of concrete masonry walls with hollowcore precast concrete floors in Chapter 2 ("Buildings with Concrete or Concrete Masonry Walls and Concrete Floors")
- Complete revision of Chapter 3 ("Buildings with CLT Wall and Floor Assemblies"), based on the recently published NRC Research Report RR-335, "Apparent Sound Insulation in Cross-Laminated Timber Buildings"
- Update of the worked examples for double wood-stud constructions in Section 4.2 ("Wood-Framed Wall and Floor Assemblies")
- Complete revision of Section 4.3 ("Cold-Formed Steel-Framed Wall and Floor Assemblies"), based on the recently published NRC Research Report RR-337, "Apparent Sound Insulation in Cold-Formed Steel-Framed Buildings"
- Minor reorganizations of Chapters 2, 4, and 5
- Move to a consistent layout for the worked examples throughout the entire Guide
- Changes in the normalization to the input data in the worked examples in Sections 4.2 and 5.3

<u>Acknowledgements</u>

The authors gratefully acknowledge that the development of this Guide was supported by a Special Interest Group of industry partners who co-funded the project, and participated in the planning and review process. The Steering Committee for the project included the following members:

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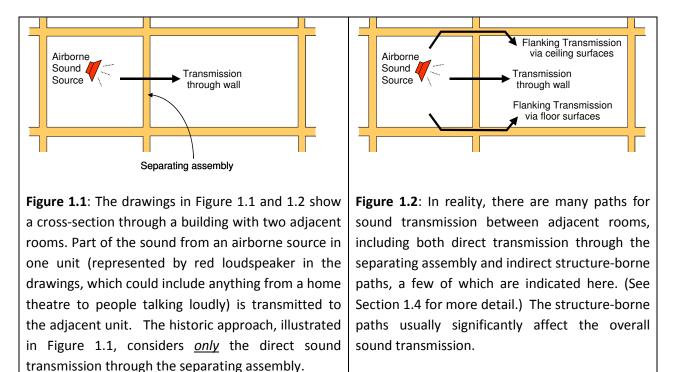
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1. Sound Transmission via Many Paths

The simplest approach to sound transmission between adjacent rooms in buildings considers only the sound transmission through the separating wall or floor. This perspective has been entrenched in North American building codes, which for many decades have considered only the ratings for the separating assembly: sound transmission class (STC) or field sound transmission class (FSTC) for airborne sources and impact insulation class (IIC) for footstep noise.

Implicit in this approach (illustrated in Figure 1.1) is the simplistic assumption that sound is transmitted only through the obvious separating assembly – the separating wall assembly when the rooms are sideby-side, or the floor/ceiling assembly when rooms are one-above-the-other. If the sound insulation is inadequate, this is attributed to errors in either the design of the separating assembly or the workmanship of those who built it, and remediation focusses on that assembly. Unfortunately, this paradigm is still common among designers and builders in North America.



In reality, the technical issue is more complex, as illustrated in Figure 1.2. There is direct transmission of sound through the separating assembly, but that is only part of the story of how sound is transmitted between adjacent rooms. As shown in the figure, the airborne sound source excites all the surfaces in the source space and all of these surfaces vibrate in response. Some of this vibrational energy is transmitted as structure-borne sound across the surfaces abutting the separating assembly, through the junctions where these surfaces join the separating assembly, and into surfaces of the adjoining space.

These surfaces in the receiving room then radiate part of the vibrational energy as airborne sound. The sound transmission by these paths is called flanking sound transmission.

It follows that the sound insulation between adjacent rooms is always worse than the sound insulation provided by the obvious separating assembly. Occupants of the adjacent room actually hear the combination of sound due to direct transmission through the separating assembly plus sound due to structure-borne flanking transmission involving all the other elements coupled to the separating assembly. Furthermore, there is also transmission of sound through leaks (openings) in the walls. The importance of including all of the transmission paths has long been recognized in principle (and the fundamental science was largely explained decades ago, by Cremer et al [8]). The challenge has been to reduce the complicated calculation process to manageable engineering that yields trustworthy quantitative estimates, and to standardize that process to facilitate its inclusion in a regulatory framework.

For design or regulation, there is well-established terminology to describe the overall sound transmission including all paths between adjacent rooms. ISO ratings such as the Weighted Apparent Sound Reduction Index (R'_w) have been used in many countries for decades, and ASTM E336 defines the corresponding apparent sound transmission class (ASTC), which is used in the examples in this Guide.

Although measuring the ASTC in a finished building (following ASTM Standard E336) is quite straightforward, predicting the ASTC due to the set of transmission paths in a building design is more complex. However, standardized frameworks for calculating the overall sound transmission have been developed. These start from standardized measurements to characterize sub-assemblies, and have been used for more than a decade to support performance-based European code systems.

In 2005, ISO published a calculation method, ISO 15712-1, "Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 1: Airborne sound insulation between rooms". This is one part of a series of standards: Part 2 deals with "impact sound insulation between rooms", Part 3 deals with "airborne sound insulation against outdoor sound", and Part 4 deals with "transmission of indoor sound to the outside".

There are two significant impediments to applying the methods of ISO 15712-1 in a North American context:

- ISO 15712-1 provides very reliable estimates for some types of construction, but not for the lightweight framed construction widely used for buildings in North America.
- ISO standards for building acoustics have many differences from the ASTM standards used by the construction industry in North America both in their terminology and in specific technical requirements for measurement procedures and ratings.

The following sections of this chapter outline a strategy for dealing with these limitations, both explaining how to merge ASTM and ISO test data and procedures, and providing recommendations for adapting the calculation procedures for common types of construction.

This Guide was developed in a project established by the National Research Council Canada and a Special Interest Group of industry partners (see page iii of this Guide) to support the transition of construction industry practice to using ASTC rather than STC for sound control objectives in the National Building Code of Canada (NBCC). However, the potential range of application goes beyond the minimum requirements of the NBCC. The Guide also facilitates design to provide enhanced levels of sound insulation, and should be generally applicable to construction in both Canada and the USA.

1.1. Predicting Sound Transmission for Common Types of Construction

As noted above, ISO 15712-1 provides very reliable estimates for buildings with concrete floors and walls of concrete or masonry, but it is less accurate for other common types of construction, especially for constructions whose stiffness is directional, such as wood-frame and steel-frame constructions.

ISO 15712-1 has other limitations, too. For example, in several places (especially for light frame construction) the Standard identifies situations where the detailed calculation is not appropriate, but does not provide specific guidance on how to deal with such cases. Many of these limitations can be overcome by using data from laboratory testing according to the ISO 10848 series of standards; the four parts of ISO 10848 were developed to deal with measuring flanking transmission for various combinations of construction types and junctions.

To work around these limitations, and to provide more guidance to users on how to use this calculation procedure for specific situations, this Guide presents an approach suited to each type of construction:

- For types of construction where the calculation procedure of ISO 15712-1 *is accurate*, the Guide outlines the steps of the standardized calculation process. In order to respect copyright, the Guide does not reproduce the equations of ISO 15712-1, but it does indicate which equations apply in each context;
- For types of construction where the calculation procedure of ISO 15712-1 *is not so accurate*, the Guide presents an alternative approach. This is based on experimental data obtained using the ISO 10848 series of standards for laboratory measurement of flanking transmission. It combines the sound power due to direct and flanking transmission in the same way as ISO 15712-1, as described in Section 1.4 of this Guide.

Each type of construction is presented in a separate chapter of this Guide, as follows:

- Concrete and masonry structures in Chapter 2
- Cross-laminated timber (CLT) structures in Chapter 3
- Lightweight wood-framed and steel-framed structures in Chapter 4
- Hybrid structures integrating different types of construction in Chapter 5

1.2. Standard Scenario for Examples in this Guide

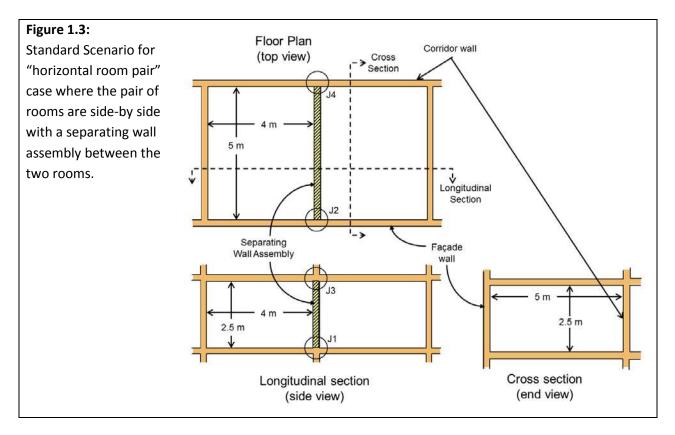
The prediction of the sound transmitted in buildings depends not only on the construction details of the transmission paths, but also on the size and shape of each of the room surfaces and on the sound absorption in the receiving room. The ability to adjust the calculation to fit the dimensions in a specific building or to normalize to different receiving room conditions enables a skilled designer to obtain more accurate predictions.

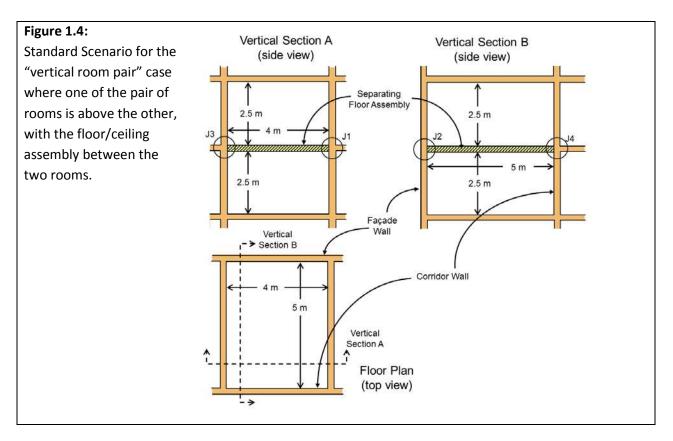
For purposes of this Guide, where results will be presented for a variety of constructions, easy and meaningful comparison of results is facilitated by calculating all the examples for a common set of room geometry and dimensions. This is particularly useful where only small changes are made between the construction details in the examples, since any change in the ASTC rating can then be attributed to the changes that were made in the construction details.

Therefore, a Standard Scenario has been adopted for all the examples, with the following constraints:

- Sound is transmitted between adjacent rooms, either side-by-side or one-above-the-other.
- The adjacent rooms are mirror images of each other, (with one side of the separating assembly facing each room, and constituting one complete face of each rectangular room).

The Standard Scenario is illustrated in Figures 1.3 and 1.4, for the cases where one room is beside the other, or one is above the other, respectively.





The pertinent dimensions and junction details are shown in Figures 1.3 and 1.4.

- Note the labelling of junctions at the four edges of the separating assembly (J1 to J4) in Figures 1.3 and 1.4. These junction designations are used in the design examples throughout this Guide.
- For horizontal room pairs (i.e. rooms are side-by-side) the separating wall is 2.5 m high by 5 m wide, flanking floor/ceilings are 4 m by 5 m and flanking walls are 2.5 m high by 4 m wide.
- For vertical room pairs (i.e. one room is above the other) the separating floor/ceiling is 4 m by 5 m wide and flanking walls in both rooms are 2.5 m high.
- In general, it is assumed that junctions at one side of the room (at the separating wall if rooms are side-by-side) are cross-junctions, while one or both of the other two junctions are T-junctions. This enables the examples to illustrate typical differences between the two common junction cases.
- For a horizontal pair, the separating wall has T-junctions with the flanking walls at both the façade and corridor sides, and cross-junctions at floor and ceiling.
- For a vertical pair, the façade wall has a T-junction with the separating floor, but the opposing corridor wall has a cross-junction, as do the other two walls.

Deviations from the Standard Scenario, such as for rooms with different dimensions or for room pairs where one room is an end unit with T-junctions instead of cross-junctions, can be calculated by substituting the appropriate room dimensions and junction details in the calculation procedures and in the worked examples in this Guide.

1.3. Applying the Concepts of ISO Standards in an ASTM Environment

Although the building acoustics standards developed by ASTM are very similar in concept to the corresponding ISO standards, there are differences in the terminology and technical requirements between the two which present numerous barriers to using a mix of standards from the two domains.

Although ASTM standard E336 recognizes the contribution of flanking to apparent sound transmission, there is neither an ASTM standard for measuring the structure-borne flanking sound transmission that often dominates sound transmission between rooms, nor an ASTM counterpart of ISO 15712-1 for predicting the combination of direct and flanking sound transmission. In the absence of suitable ASTM standards, this Guide uses the procedures of ISO 15712-1 and data from the complementary ISO 10848 series for some constructions, but connects this ISO calculation framework to the ASTM terms and test data widely used by the North American construction industry. This methodology combines identifying where data from ASTM laboratory tests can reasonably be used in place of their ISO counterparts, and presenting the results using ASTM terms) to facilitate their use and understanding by a North American audience. Some obvious counterparts in the terminology are presented in Table 1.1.

ISO Designation	Description	ASTM Counterpart
ISO 10140 Parts 1 and 2 (formerly ISO 140-3)	Laboratory measurement of airborne sound transmission through a wall or floor	ASTM E90
sound reduction index, R (ISO 10140-2)	Fraction of sound power transmitted (in dB) at each frequency, in laboratory test	sound transmission loss, TL (ASTM E90)
weighted sound reduction index, R _w (ISO 717-1)	Single-number rating determined from R or TL values in standard frequency bands	sound transmission class, STC (ASTM E413)
apparent sound reduction index, R' (ISO 16283-1)	Fraction of sound power transmitted (in dB) at each frequency, including all paths in a building	apparent sound transmission loss, ATL (ASTM E336)
weighted apparent sound reduction index, R' _w (ISO 717-1)	Single-number rating determined from R' or ATL values in standard frequency bands	apparent sound transmission class, ASTC (ASTM E413)

Table 1.1: Standards and terms used in ISO 15712-1 for which ASTM has close counterparts

Note that the description "counterpart" does not imply that the ASTM and ISO standards or terms are exactly equivalent. R_w and STC are not interchangeable. Neither are R'_w and ASTC because of systematic differences in the calculation procedures. However, the laboratory test used to measure airborne sound transmission through wall or floor assemblies – ASTM E90 and its counterpart ISO 10140-2 – are based on essentially the same procedure, with minor variants in facility requirements. Therefore, the measured quantities "sound transmission loss" from the ASTM E90 test and "sound reduction index" from the ISO standard are sufficiently similar so that data from ASTM E90 tests can be used in place of

data from ISO 10140-2 tests in the calculations of ISO 15712-1 to obtain a sensible answer. Similarly, the simplified calculation of ISO 15712-1 may be performed using STC ratings to predict the ASTC rating. The close parallel between "sound reduction index" and "sound transmission loss" also means that results from ISO 15712-1 calculations (normally expressed as R' values) can confidently be treated as calculated apparent sound transmission loss (ATL) values and then used in the procedure of ASTM E413 to calculate the ASTC rating, which is the objective for designers or regulators in the North American context.

For purposes of this Guide, a glossary of new terms with counterparts in ISO 15712-1 (using terminology consistent with measures used in ASTM standards) and of other key terms from pertinent ISO standards such as ISO 15712-1 and ISO 10848 is presented in Table 1.2.

In addition, several scientific terms used in ISO 15712-1 at various stages of the calculation have been used without change. These include: radiation efficiency, velocity level difference, internal loss factor, total loss factor, equivalent absorption length, and transmission factor. They are described in the glossary in Annex A of ISO 15712-1.

Terms used in this Guide	Description
Structural reverberation time (T _s)	Structural reverberation time is a measure indicating the rate of decay of vibration energy in an element and can apply either to a laboratory wall or floor assembly, or to a wall or floor assembly in-situ in a building.
Sound transmission loss in-situ (TL _{situ})	Sound transmission loss in-situ is the counterpart of sound reduction index in-situ (R_{situ}) described in ISO 15712-1 as "the sound reduction index of an element in the actual field situation".
Change in sound transmission loss (ΔTL)	Change in sound transmission loss is the difference in sound transmission loss due to a lining applied on one side of a wall or floor assembly when measured according to ASTM E90, compared with the sound transmission loss of the same assembly without a lining.
Change in sound transmission class (ΔSTC)	Change in sound transmission class is the difference in single-number rating due to a lining applied on one side of a wall or floor assembly. The calculation procedure for Δ STC is described in Appendix A1 of this Guide.
Vibration reduction index (K _{ij})	Vibration reduction index (K_{ij}) is described in ISO 15712-1 as "direction- averaged vibration level difference over a junction, normalised to the junction length and the equivalent sound absorption length to make it an invariant quantity". Depending on the type of building element, K_{ij} values may be determined using equations in Annex E of ISO 15712-1 or the measurement procedures of ISO 10848.
Velocity level difference (VLD)	Velocity level difference (VLD) is described in ISO 15712-1 as "junction velocity level difference in-situ between an excited element (wall or floor) and the receiving element (wall or floor)." It is calculated by correcting the K _{ij} value to allow for edge loss conditions (identified through structural reverberation times) of the assemblies in-situ.
Flanking sound transmission loss (Flanking TL _{ij})	Flanking sound transmission loss is the counterpart of flanking sound reduction index (R_{ij}) in ISO 15712-1. It is a measure of sound transmission via the flanking path from element i in the source room to element j in the receiving room, normalised like apparent sound transmission loss, as described in Section 1.4 of this Guide.
Flanking sound transmission class (Flanking STC _{ij})	Flanking STC is the single-number rating calculated from the flanking sound transmission loss following the STC calculation procedure of ASTM E413.

Table 1.2: Key terms used in this Guide to deal with concepts from ISO 15712-1 and ISO 10848 forwhich current ASTM acoustics standards have no counterparts.

1.4. Combining Sound Transmitted via Many Paths

The calculations of ISO 15712-1 must deal with combining the sound power transmitted via the direct path and via a set of flanking paths. To keep track of the sound transmission paths, it is useful to introduce the labeling convention for the paths that is used in ISO 15712-1 and is shown in Figure 1.5.

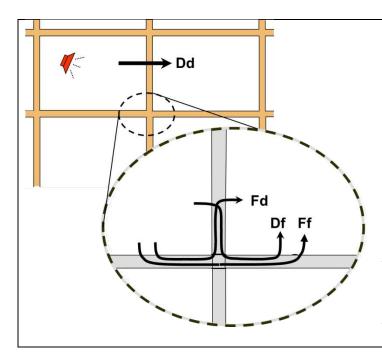


Figure 1.5: This figure shows the labelling convention for transmission paths used in ISO 15712-1. Consider the transmission of airborne sound from a source room (left) to a receiving room (right). Each transmission path involves one surface in the source room (denoted by a capital letter) and one in the receiving room (denoted by a lower case letter). <u>D</u>irect transmission through the separating assembly is path **Dd**. For each edge of the separating assembly there are three flanking paths: **Ff** from <u>f</u>lanking surface F to <u>f</u>lanking surface f, and **Fd** from <u>f</u>lanking surface F to <u>d</u>irect surface d.

Note that the letter "F" or "f" denotes <u>f</u>lanking surface, and "D" or "d" denotes the surface for <u>d</u>irect transmission, i.e. the surface of the separating assembly. These surfaces may be either wall or floor/ceiling assemblies.

The labels for the flanking surfaces of the Standard Scenarios are detailed in the following Table 1.3.

Room Pair	Surfaces D and d	Flanking Surfaces F and f	Junction
		Junction 1: floor F and f	Cross-junction
Horizontal	Soparating wall	Junction 2: façade wall F and f	T-junction
(Fig. 1.3)	Separating wall	Junction 3: ceiling F and f	Cross-junction
		Junction 4: corridor wall F and f	T-junction
		Junction 1: wall F and f	Cross-junction
Vertical	Separating floor/ceiling	Junction 2: façade wall F and f	T-junction
(Fig. 1.4)	Separating hoor/cening	Junction 3: wall F and f	Cross-junction
		Junction 4: corridor wall F and f	Cross-junction

Table 1.3: Surfaces (D, d, F and f) for flanking paths at each junction, as in the Standard Scenario.

In Canada, building elements are normally tested according to the ASTM E90 standard, and building code requirements are given in terms of apparent sound transmission class (ASTC) determined from the apparent sound transmission loss (ATL) for the set of frequency bands from 125 Hz to 4000 Hz, following the procedure in ASTM E413. Merging this context with using the ISO 15712-1 procedures in this Guide, the terms "direct sound transmission loss" and "flanking sound transmission loss" have been introduced to provide consistency with ASTM terminology while matching the function of the direct and flanking sound reduction indices defined in ISO 15712-1.

Section 4.1 of ISO 15712-1 defines a process to calculate the apparent sound transmission by combining the sound power transmitted via the direct path and the twelve first-order flanking paths (three paths at each of the four edges of the separating assembly, as illustrated in Figure 1.5). Equation 14 in ISO 15712-1 is recast here with slightly different grouping of the paths (treating the set of paths at each edge of the separating assembly in turn) to match the presentation approach chosen for the examples in this Guide.

The apparent sound transmission loss is the logarithmic expression of the total transmission factor (τ'):

$$ATL = -10 \log \tau' \, dB \qquad \qquad \text{Eq. 1.1}$$

The total transmission factor (τ') is calculated from a sum of transmission factors for individual paths:

$$\tau' = \tau_{Dd} + \sum_{Edge=1}^{4} (\tau_{Ff} + \tau_{Fd} + \tau_{Df})$$
 Eq. 1.2

The transmission factors are defined as follows:

- τ' is the ratio of the total sound power radiated into the receiving room relative to the sound power incident on the separating element;
- τ_{Dd} is the ratio of the sound power radiated by the separating element relative to the sound power incident on the separating element;
- τ_{Df} is the ratio of the sound power radiated by a flanking element f in the receiving room due to structure-borne transmission from element D in the source room, relative to the sound power incident on the separating element;
- τ_{Ff} is the ratio of the sound power radiated by a flanking element f in the receiving room due to structure-borne transmission from element F in the source room, relative to the sound power incident on the separating element;
- τ_{Fd} is the ratio of the sound power radiated by element d in the receiving room due to structureborne transmission from flanking element F in the source room, relative to the sound power incident on the separating element.

Each of the transmission factors τ_{ij} can be related to a corresponding path transmission loss associated with a specific pair of surfaces by the following expressions:

Direct transmission loss (for the separating assembly) =
$$-10 \log \tau_{Dd} \, dB$$

Flanking transmission loss (for flanking path ij) = $-10 \log \tau_{ij} \, dB$ Eq. 1.3
or conversely, $\tau_{ij} = 10^{-TL_{ij}/10}$

To connect this more obviously to standard laboratory test results, the expressions of Equations 1.1 to 1.3 can readily be recast in terms of sound transmission loss values, as shown in Eq. 1.4.

The apparent sound transmission loss (ATL) between two rooms (assuming the room geometry of Section 1.2 and neglecting the sound that by-passes the building structure, e.g. leaks, ducts,...) is the resultant of the direct sound transmission loss (TL_{Dd}) through the separating wall or floor element and the set of flanking sound transmission loss contributions (TL_{Ff} , TL_{Fd} , and TL_{Df}) of the three flanking paths for every junction at the edges of the separating element (as shown in Fig. 1.5) such that:

$$ATL = -10 \cdot \log_{10} \left(10^{-0.1 \cdot TL_{Dd}} + \sum_{edge=1}^{4} \left(10^{-0.1 \cdot TL_{Ff}} + 10^{-0.1 \cdot TL_{Fd}} + 10^{-0.1 \cdot TL_{Df}} \right) \right)$$
 Eq. 1.4

Note that this equation differs slightly from the calculation of the apparent sound transmission defined in Equation 14 of ISO 15712-1. Eq. 1.4 of this Guide treats the set of paths at each edge of the separating assembly in turn to match the presentation for the examples in this Guide. Eq. 1.4 is universally valid for all building systems, and the remaining challenge is to find the right expressions to calculate the sound transmission for the different paths for the chosen building system and situation.

The standard ISO 15712-1 describes two methods of calculating the apparent sound insulation in a building: the Detailed Method and the Simplified Method. This Guide describes both methods to calculate the apparent sound insulation in a building. The Simplified Method uses the single-number ratings (STC or Flanking STC for each transmission path, as appropriate) instead of the frequency-dependent sound transmission loss values, and yields the ASTC directly:

$$ASTC = -10 \cdot \log_{10} \left[10^{-0.1 \cdot STC_{Dd}} + \sum_{edge=1}^{4} \left(10^{-0.1 \cdot STC_{Ff}} + 10^{-0.1 \cdot STC_{Fd}} + 10^{-0.1 \cdot STC_{Df}} \right) \right] \quad \text{Eq. 1.5}$$

The Simplified Method has been widely used by designers in Europe for many years for calculations based on R_w data. Its primary advantage is the simplicity of the procedure, which makes it usable by non-specialists. Although it is less rigorous than the Detailed Method, the differences between the results using the two methods are small, and the calculations for the Simplified Method use approximations that should ensure the results are slightly conservative.

The calculation process for each type of construction is presented in a separate chapter of this Guide, as follows:

- Concrete and masonry structures in Chapter 2
- Cross-laminated timber (CLT) structures in Chapter 3
- Lightweight wood-framed and steel-framed structures in Chapter 4
- Hybrid structures integrating different types of construction in Chapter 5

For each of these types of construction, an appropriate type of laboratory data should be used, as detailed in that chapter.

The set of transmission factors used in this Guide is less general than the corresponding list of transmission factors in ISO 15712-1 to reflect the simplifications due to the Standard Scenario (see Section 1.2 above) and some further simplifications noted in the following cautions.

Cautions and limitations to examples presented in this Guide:

This Guide was developed to support the transition to ASTC ratings for sound control objectives in the National Building Code of Canada. Simplifications were made to meet the specific needs of that application, where sound insulation is addressed only in the context of multi-unit residential buildings. The simplifications include that:

- Transmission around or through the separating assembly due to leaks at its perimeter or penetrations such as ventilation systems are assumed negligible.
- Indirect airborne sound transmission (for example airborne flanking via an unblocked attic or crawl space) is assumed to be suppressed by normal fire blocking requirements.

For adjacent units in a multi-family residential building, these two issues should be dealt with by using normal good practice for fire and sound control between adjoining dwellings.

If this Guide is applied to situations other than separation between adjacent units in multi-family residential buildings, some of these issues may have to be explicitly addressed in the calculation process. For example, for adjoining rooms within a single office or home, flanking paths such as ventilation ducts or open shared plenum spaces may be an issue. The flanking sound transmission associated with these additional paths should be determined and included in the calculated ASTC. ISO 15712-1 includes specific guidance for such issues, and the examples in this Guide allow for such a correction.

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2. Buildings with Concrete or Concrete Masonry Walls and Concrete Floors

This chapter begins with an introduction outlining the concepts of the detailed calculation method of ISO 15712-1. The following sections provide more focussed procedural guidance and worked examples for specific sets of wall, floor, and junction details for concrete and masonry buildings.

Airborne sound in a source room excites vibration of the wall and floor assemblies that form the bounding surfaces of the room. As discussed in Chapter 1, the apparent transmission between adjacent rooms includes the combination of direct airborne sound transmission through the separating assembly and structure-borne flanking sound transmission via the three pairs of wall and floor surfaces (one in the source room and the other in the receiving room) that are connected at each of the four edges of the separating assembly. The detailed calculation method of ISO 15712-1 is focused on the balance between the input sound power and power losses (due to internal losses, sound radiation, and power flow into adjoining assemblies). This balance alters the direct transmission through each floor or wall assembly, and also the structure-borne transmission via the flanking surfaces.

More information on the direct and flanking sound insulation of concrete block wall assemblies connected to concrete floor assemblies can be found in NRC Research Report RR-334, "Apparent Sound Insulation in Concrete Block Buildings." The report provides the data for direct and flanking sound insulation for a variety of concrete block building configurations.

Direct Transmission through the Separating Assembly

For the direct transmission through the separating assembly, the calculation process is shown in Figure 2.1, and the steps are described in more detail below. To transform the laboratory sound transmission data into the direct in-situ transmission loss requires a correction to adjust for the difference between losses in a laboratory test specimen and the losses when the assembly is connected to adjoining structures in-situ in the building.

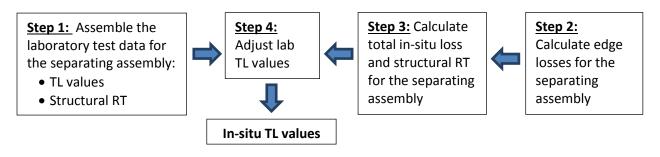


Figure 2.1: Steps to calculate the in-situ transmission loss for the separating assembly.

Step 1: Assemble the required laboratory test data:

- Laboratory sound transmission loss (TL) values measured according to ASTM E90 for the structural floor or wall assembly of bare concrete or masonry without added linings. For the treatment of linings in the calculation, please see Section 2.3.
- \circ Structural reverberation time (T_s) in the laboratory if available. ISO standards require measurement according to ISO 10848-1. Alternatively, a conservative estimate of the total loss factor for a laboratory specimen from Eq. C.5 of Annex C of ISO 15712-1 may be used.
- Step 2: Calculate edge losses for the separating assembly in-situ:
 - For each edge, calculate the vibration reduction index (K_{ij}) between the separating assembly and each attached assembly using the appropriate case from Annex E of ISO 15712-1. These values depend on the junction geometry and on the ratio of mass per area for the assemblies.
 - For each edge, calculate the resulting absorption coefficient using the values of K_{ij} and the coincidence frequency (frequency at which the wavelength on the element and in surrounding air coincide) for the attached assemblies in Eq. C.2 of ISO 15712-1.
- Step 3: Calculate total loss for the separating assembly and its in-situ structural reverberation time:
 - Use 2nd equation of Eq. C.1 of ISO 15712-1 to calculate the combination of internal losses, radiation losses and edge losses. (Comparison between the values calculated for a common surface for a vertical pair of rooms and a horizontal pair of rooms gives a check on the loss calculations. The total loss is frequency-dependent for most junction types; the worked examples give only the value for 500 Hz band, to provide a benchmark value.)
 - Use 1st equation of Eq. C.1 of ISO 15712-1 to calculate the resulting structural reverberation time of the assembly, for each frequency band.
- Step 4: Calculate in-situ TL values for the separating assembly using the ratio of structural reverberation times in Eq. 19 in Section 4.2.2 of ISO 15712-1.

Transmission via Flanking Elements

For each flanking path, a similar procedure is required to deal with in-situ losses associated with the connecting junction and the two wall or floor surfaces that comprise the flanking path. The calculation process is presented in Figure 2.2, and each step is subsequently explained.

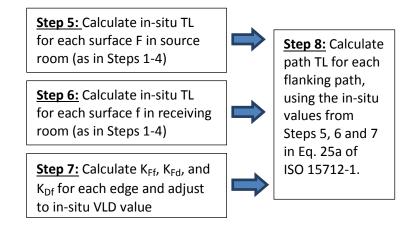
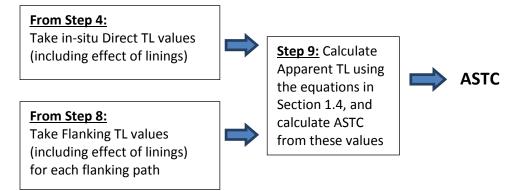


Figure 2.2: Steps to calculate the flanking transmission loss for each flanking path.

- Step 5: Calculate in-situ TL values for each flanking assembly F in the source room, repeating the procedure of Steps 1 4 for these assemblies. Note that for an assembly of concrete (cast-in-place concrete or precast concrete panels or concrete block) the coincidence frequency is below 125 Hz. Hence the radiation efficiency is equal to unity and the resonant sound transmission loss (required for these calculations) is equal to the sound transmission loss measured in the standard ASTM E90 laboratory test.
- Step 6: Calculate in-situ TL values for each flanking assembly f in the receiving room, by repeating the procedure of Steps 1 4 for these assemblies. (Note that because of the symmetry in the Standard Scenario used in this Guide, and because the preceding calculation for direct transmission provides in-situ values for surfaces D and d, Steps 5 and 6 in calculations for examples in this Guide require calculations for only 4 room surfaces: a floor/ceiling assembly, a separating wall, a corridor wall, and a façade wall. The standard is more general.)
- Step 7: Calculate in-situ velocity level difference (VLD) values for the junction attenuation:
 - Calculate vibration reduction index (K_{ij}) between the pair of assemblies using the appropriate case from Annex E of ISO 15712-1.
 - Calculate VLD for junction using Eq. 21 and 22 of ISO 15712-1.
- Step 8: Calculate flanking TL values for each flanking path:
 - $\circ~$ Use VLD and in-situ TL values for the surfaces in the calculation of Eq. 25a of ISO 15712-1.

<u>Combining Direct and Flanking Sound Transmission</u>



- Step 9: Combine the sound power transmitted via the direct path through the separating assembly and the 12 flanking paths (3 at each edge of the separating assembly).
 - Use Equations 1.4 in Section 1.4 of this Guide (equivalent to Section 4.1 of ISO 15712-1) to calculate the apparent transmission loss (ATL).
 - Use the resulting values of the apparent transmission loss in the procedure of ASTM E413 to calculate the apparent sound transmission class (ASTC) rating.

Worked Examples

The following sections present a number of worked examples that demonstrate the calculation of the ASTC rating for concrete and concrete block constructions according to the Detailed Method described above. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide.

The worked examples in this Guide pertain to masonry walls constructed of normal weight hollow concrete block masonry units. The NRC Research Report RR-334, "Apparent Sound Insulation in Concrete Block Buildings" contains worked examples and detailed information pertaining to masonry walls constructed of both normal weight hollow concrete block units and lightweight hollow concrete block units.

Each worked example presents all the pertinent physical characteristics of the assemblies and junctions, together with a summary of key steps in the calculation process for these constructions. The calculations are based on a more detailed spreadsheet that includes values for all the one-third octave bands between 100 Hz and 5 kHz and that has intermediate steps in some calculations. In order to condense the examples to a two-page format, only a subset of the calculated values are presented for some of the frequency bands.

To permit readers to better assess the worked examples, they also show the single-number ratings (such as STC for each assembly and Flanking STC for specific paths), but these summary values are not used in later stages of the calculation process. The full calculation is performed for the one-third octave frequency bands until the very end, and the ASTC rating is then calculated from the values for apparent sound transmission loss in the sixteen one-third octave frequency bands between 125 Hz and 4000 Hz.

Within the table for each worked example, the "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.

Under the heading "STC or ASTC" the examples present single-number ratings (each calculated from a set of one-third octave band data according to ASTM E413) to provide a consistent set of summary single-number measures at each stage of the calculation:

- STC values for the laboratory sound transmission loss of wall or floor assemblies
- In-situ STC values for the calculated in-situ sound transmission loss of wall and floor assemblies
- Direct STC values for the in-situ sound transmission loss through the separating assembly including the effect of linings
- Flanking STC values calculated for each flanking sound transmission path at each junction including the effect of linings
- Apparent STC (ASTC) values for the combination of direct and flanking transmission via all paths

When the calculated Flanking STC value for a given path exceeds 90 dB, the value is limited to 90, to allow for the inevitable effect of higher order flanking paths which make the higher calculated value not representative of the true situation. Further enhancements to elements in these paths will give negligible benefit. The consequence of this limit is that the Junction STC value for the set of 3 paths at each edge of the separating assembly cannot exceed 85, and the Total Flanking STC value for all 4 edges cannot exceed 79.

Colour is used to highlight input and output values in the worked examples:

- Light red is used to indicate input values
- Blue is used for the direct sound transmission loss, including the effect of in-situ loss corrections and any added lining(s) on the separating assembly
- Pale yellow highlights calculated values of the combined flanking sound transmission due to a set of flanking paths
- Green highlights the final result for the ASTC rating

Validation studies in Europe for concrete and concrete masonry constructions have confirmed that these detailed predictions should be expected to exhibit a standard deviation of about 1.5 dB, with negligible bias, relative to values measured in actual buildings with these characteristics.

Rounding and Precision in the Worked Examples

The final ASTC result obtained in each worked example depends slightly on the precision of the input data and on rounding of results at each stage of the calculation. There is no rounding approach explicitly specified in ISO 15712-1, but the worked examples in the ISO standard show input and calculated sound reduction index values rounded to 0.1 dB which is consistent with the requirements for presentation of results in the ISO standards for measuring laboratory sound transmission.

The ASTM standards for the measurement of sound transmission in the laboratory and in the field (ASTM E90 and ASTM E336, respectively) specify that sound transmission loss values should be rounded to the nearest integer, which is arguably more representative of meaningful precision of the result.

The examples in this document follow the ASTM convention of rounding to the nearest integer for input sound transmission loss data from laboratory tests of wall or floor assemblies, for measured or calculated values of flanking transmission loss for individual paths, and for the apparent sound transmission loss calculated from the combination of direct and flanking paths. For input values measured according to ISO standards for which there is no ASTM counterpart, specific rounding rules were used as noted below:

- Sound transmission loss values from measurements according to ASTM E90, and values of ∆TL calculated from such measurements (as explained in Appendix A1), were rounded to the nearest integer.
- Structural reverberation times measured for laboratory wall or floor specimens or calculated for laboratory results according to Annex C of ISO 15712-1 were rounded to 3 decimal places.
- Values of the vibration reduction index (K_{ij}) at junctions between a separating assembly and each attached assembly were rounded to the nearest 0.1 dB both for results measured according to ISO 10848 and for those calculated using the equations from Annex E of ISO 15712-1.

Between the input values and the flanking transmission loss results for each path (which were rounded to the nearest integer), the worked examples are calculated to the full precision of the spreadsheet and interim values are presented to slightly higher precision to permit detailed comparisons for users treating these examples as benchmarks for their own worksheets.

A jurisdiction could specify other rounding approaches. However, these choices provide a reasonable representation of data precision, and should permit unambiguous interpretation of the worked examples presented here. Other rounding approaches could occasionally change the calculated ASTC values by ± 1 point.

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2.1. Rigid Junctions in Concrete and Concrete Masonry Buildings

This section presents worked examples for the most basic sort of concrete and masonry building which has structural floor slabs of bare concrete and walls of bare concrete or masonry connecting at rigid cross-junctions or T-junctions.

- Here, "bare" is taken to mean the assembly of concrete or masonry without a lining such as an added gypsum board finish on the walls or ceiling, or flooring over the concrete slab. For an assembly of concrete or normal weight concrete blocks, the "bare" surface could be painted or sealed, or have a thin coat of plaster without appreciably changing the sound transmission. However, these simple linings significantly improve the sound transmission properties of masonry walls constructed of lightweight units. Obviously, most buildings would have wall finishes (and usually also ceiling finishes) of gypsum board mounted on some sort of lightweight framing, and some sort of flooring over the concrete. The calculation extensions to deal with such "linings" are presented in Section 2.3. The examples in Section 2.1 and 2.2 have placeholders for including the effect of such linings, but those corrections have been set to zero.
- "Rigid" implies that the assemblies meeting at the junction are firmly bonded so that bending vibration is effectively transmitted between the elements. Loadbearing junctions are always rigid; non-loadbearing junctions may or may not be rigid.

The calculations follow the steps of the detailed calculation procedure of ISO 15712-1, as described at the beginning of Chapter 2. The approximations of the calculation make it most suitable for "homogeneous, lightly damped" structural elements whose coincidence frequency is below the frequency range of interest (taken here as below about 125 Hz), and for which an average value of K_{ij} suitable for a rigid junction of homogeneous assemblies is appropriate. Homogeneous concrete walls and floors and masonry walls of several types fall in this category.

Hollowcore precast concrete floors are not homogeneous and isotropic. However, in laboratory testing of mock-up junctions of masonry walls with hollowcore concrete floors it was shown that the methods of ISO 15712-1 and the vibration reduction index values of Annex E of ISO 15712-1 are still appropriate to use for these types of constructions. The measurements on the junction were conducted with the cores of the hollowcore panels oriented perpendicular to the junction. It is expected that hollowcore panels with the cores oriented parallel to the junction would yield similar or higher vibration reduction index values, and hence the vibration reduction index values from Annex E of ISO 15712-1 are appropriate to use independent of core orientation.

Based on the findings described above, homogeneous concrete walls and floors, masonry walls, and hollowcore precast concrete floors are all treated in the same way in this chapter.

EXAMPLE 2.1.1:			DI	ETAIL	ED ME	THOD	Illus	strati	on fo	or thi	s cas	<u>e</u>	
 Rooms side-by-side Cast-in-place concreblock walls with rigid 			d nor	mal w	veight	concrete					No. of Concession, Name	100 A	
 Separating wall assembly (loss) One wythe of 190 mm h using normal weight uni per area of 238 kg/m², w 	ollow co ts not le	ncrete ss tha	e block					-3	•		100 100 100 100 100 100 100 100 100 100	1	<u>∕_f3</u>
 Junction 1: Bottom Junction (Cast-in-place concrete f normal weight concrete Rigid mortared cross-jun 	loor with 150 mm t	mass hick)	s per a with no	irea of toppii	345 k ng or fl	ooring		F1~] D-			d	. f1
 Junction 2 or 4: Each Side (s Abutting side wall and masonry¹ with mass per Rigid mortared T-junction 	separati area of 2	ng w	all_of	hollow	conc								
 Junction 3: Top Junction (sep Cast-in-place concrete c normal weight concrete Rigid mortared cross-jun Acoustical Parameters: 	eiling wit 150 mm t	h mas hick)	ss per with n	area o o adde	d ceilii	ng lining	sepa in-pl	aratin lace d	g wa conc	all wit rete f	n con h 150 loor a	mm t nd cei	hick cast- iling.
							(-)
<u>For separating assembly:</u> internal loss, n_i = 0.015			c -	3500						1	7	8	
mass $(kg/m^2) = 238$			f_c =			(Eq. C.2)				200	Contraction of		
Refere	200	V Ff			K Df	<u>(Eq. C.2)</u> Σ I_k . α_k	r						
X-Junction 1 or 3 ISO 15712-		K_Ff 6.1	11.6	к_ги 8.8	8.8	0.571			D	→	SIE	←d	
T-Junction 2 or 4 ISO 15712-		5.7	11.0	8.8 5.7	o.o 5.7	0.371					\cap		
Total loss, n tot ISO 15712-	-	5.7			(at 500		E	2. F4	1_		ment		-f2 f4
					(at 500	112)		2,1.	+	• E		4	,
Similarly, for flanking element	ents F and f	at June	1				Contraction of the local division of the loc		The second	10	V.	YA	
internal loss, η_i = <mark>0.006</mark>				3500									
mass (kg/m ²) = <mark>345</mark>			f_c =				DEFENSION	A. S. S. S.	A. A.	al source	(Aller		Saur Com
Total loss, η_tot ISO 15712-2	L, Eq. C.1			0.028	(at 500	Hz)							
Similarly, for flanking eleme	ents F and f	at June	ction 2 8	ζ4,			lune	otion	ofor	nore	ting	انبير الم	h cido
internal loss, η_i = 0.015			c_L =	3500						•	-		h side
mass (kg/m ²) = 238				98				<i>,</i>					block.
Total loss, η_tot,2 ISO 15712-2	L, Eq. C.1			0.047	(at 500	Hz)	(Pla	n viev	w of	Junct	ion 2	or 4)	
Total loss, η_tot,4 ISO 15712-2	L, Eq. C.1			0.043	(at 500	Hz)							
	r												
	ISO Symb	ol		Refer	ence		125 2	250	500	1000	2000	4000	STC or ASTC
Separating Partition (190 mm concre Sound Transmission Loss (TL)		00 1	334, NRC	Moon	U K100/M	1) //)	25	38	44	50	58	62	49
Structural Reverberation Time	R_D,lab T_s,lab		15712-1		•	,					58 0.042		43
Change by Lining on source side	ΔR_D		_ining ,	, 29. 0.3			0.255 0.	0	0	0.072	0.042	0.024	
Change by Lining on receive side	ΔR_d		ining ,				0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ		15712-1	, Eq. C.1	-C.3		0.256 0	.169 0	.108	0.067	0.040	0.023	
Leakage or Airborne Flanking			ed & Blo						0.0	0.0	0.0	0.0	
Direct TL in-situ	R_D,situ	ISO	15712-1	. Fa. 19	24		36	39	44	50	58	62	49

(For the notes in this table please see the corresponding endnotes on page 195.)

	ISO Symbol		Reference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (Rigid cross-junction, 190	mm block sep	arating wall / 1	L50 mm concrete floor)							
Sound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON1	50, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T s,lab	Measured T s		0.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR_F1	No Lining ,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR f1	No Lining,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, E	Eq. C.1-C.3	0.347	0.238	0.159	0.104	0.066	0.041	
TL in-situ for F1		ISO 15712-1, E	•	41.0	43.9	52.0	60.9	69.4	77.8	55
TL in-situ for f1		ISO 15712-1, E		41.0	43.9	52.0	60.9	69.4	77.8	55
Junction J1 - Coupling	_ ,	,								
Velocity Level Difference for Ff	D v.Ff 1.siti	ISO 15712-1, E	a. 21, 22	9.3	9.4	9.7	10.0	10.5	11.1	
/elocity Level Difference for Fd		ISO 15712-1, E		11.6	11.8	12.2	12.6	13.2	14.0	
Velocity Level Difference for Df		ISO 15712-1, E		11.6	11.8	12.2	12.6	13.2	14.0	
Flanking Transmission Loss - Path data		150 157 12 1, 1	-9. 21, 22	11.0	11.0	12.2	12.0	15.2	14.0	
Flanking TL for Path Ff_1	RFf	ISO 15712-1, E	a 25a	48	51	60	69	78	87	62
Flanking TL for Path Fd_1	R Fd	ISO 15712-1, E		48	52	59	67	76	83	63
Flanking TL for Path Df 1	R_Df		•	49	52	59	67	76	83	63
Junction 1: Flanking STC for all paths	K_DI	ISO 15712-1, E		49 10*LOG						
function 1: Flanking STC for all paths			-	10.100	10(10/	-0.2 + 1	0^- 0.3	+ 10^-	0.3)=	
unstion 2 (Disid T lunstion, 100 mm			na al al flanking wall)							
Junction 2 (Rigid T-Junction, 190 mm			Mean BLK190(NW)	25	20	4.4	50	58	62	49
Sound Transmission Loss, F2 or f2 Structural Reverberation Time	- '	,	· · ·	35	38	44				49
	T_s,lab	ISO 15712-1, E	-q. C.5			0.119				
Change by Lining on source side	ΔR_F2	No Lining ,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f2	No Lining ,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, E				0.094				
TL in-situ for F2	_	ISO 15712-1, E	•	36.4	39.2	45.0	50.8	58.7	62.5	50
TL in-situ for f2	R_f2,situ	ISO 15712-1, E	q. 19	36.4	39.2	45.0	50.8	58.7	62.5	50
Junction J2 - Coupling										
Velocity Level Difference for Ff		ISO 15712-1, E		10.9	11.1	11.5	12.0	12.7	13.5	
Velocity Level Difference for Fd		ISO 15712-1, E		11.0	11.3	11.7	12.3	13.0	13.8	
Velocity Level Difference for Df		ISO 15712-1, E	Eq. 21, 22	11.0	11.3	11.7	12.3	13.0	13.8	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, E		48	51	58	64	72	77	62
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, E	Eq. 25a	48	51	57	63	72	77	62
Flanking TL for Path Df_2	R_Df	ISO 15712-1, E	Eq. 25a	48	51	57	63	72	77	62
Junction 2: Flanking STC for all paths		-	-	10*LOG	10(10^	-6.2 + 1	0^- 6.2	+ 10^-	6.2)=	5
Junction 3 (Rigid cross-junction, 190		arating wall / 1	L50 mm concrete ceiling)							
All input values the same as for Juncti	on 1									
Junction 3: Flanking STC for all paths										Į,
Junction 4 (Rigid T-junction, 190 mm										
All input data the same as for Junctior	n 2, but differe	nt junctions at	ceiling and floor change ir	n-situ loss	s factor	s from	Junctio	n 2		
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, E	Eq. C.1-C.3	0.238	0.158	0.102	0.063	0.038	0.021	
TL in-situ for F4	R_F4,situ	ISO 15712-1, E	Eq. 19	36.0	38.8	44.7	50.6	58.4	62.3	50
TL in-situ for f4	R_f4,situ	ISO 15712-1, E	Eq. 19	36.0	38.8	44.7	50.6	58.4	62.3	50
Junction J4 - Coupling										
Velocity Level Difference for Ff	D_v,Ff_4,situ	ISO 15712-1, E	Eq. 21, 22	10.5	10.8	11.2	11.8	12.5	13.3	
Velocity Level Difference for Fd		ISO 15712-1, E		10.8	11.1	11.6	12.1		13.7	
Velocity Level Difference for Df		ISO 15712-1, E		10.8	11.1	11.6	12.1	12.9	13.7	
Flanking Transmission Loss - Path data	/ _ /		·, ,							
Flanking TL for Path Ff 4	R_Ff	ISO 15712-1, E	a. 25a	47	51	57	63	72	77	62
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, E	•	47	51	56	63	72	76	61
Flanking TL for Path Df 4	R_Df	ISO 15712-1, E		47	51	56	63	72	76	61
Junction 4: Flanking STC for all paths	к_D1	.50 157 12-1, I		10*LOG						
Anterior 4. Hanking Ste for an paths	1		-	10 200.	10(10	J.2 1	0.1	1 10	0.1 / -	
Total Flanking (for all 4 junctions)										
iotal manking (for all 4 junctions)										:
ASTC due to Direct plus Flanking Path	NC	RR-331, Eq. 1.	Λ	34	37	42	49	57	61	47

EXAMPLE 2.1.2:			D	ETAIL	ED M	ETHOD	Illustration for this case
 Rooms one-above-th Cast-in-place concre walls with rigid junct 	te floor	and n	ormal	weigh	t cond	crete block	F1, F3, F4
 <u>Separating floor/ceiling asse</u> Cast-in-place concrete normal weight concrete top, or ceiling lining belo <u>Junction 1, 3, 4: Cross-juncti</u> Rigid mortared cross-jur Wall above and below fl block masonry¹ constru- 53% solid, and with mass <u>Junction 2: T-Junction of sep</u> Rigid mortared T-junctio Wall above and below fl block masonry¹ constru- 53% solid, and with mass <u>Junction 2: T-Junction of sep</u> Rigid mortared T-junctio Wall above and below fl block masonry¹ constru- 53% solid, and with mass 	floor wit 150 mm w on of se action wi oor of o cted usin s per ar <u>arating</u> n with co oor of o cted usin	h mas n thick paratii th con ne wy ng nor ea of 2 floor / oncret ne wy ng nor	() with ng floor crete b the of mal we 238 kg/ flankin e block the of rmal we	no top r / flank block w 190 mr eight u (m ² , wit g wall w wall a 190 mr eight u	ping / all ass n hollo nits no th no li with: ssemt n hollo nits no	flooring on all with: semblies by concrete bt less than ining blies by concrete bt less than	d f1, f3, f4 Cross-junction of separating floor of 150 mm thick cast-in-place concrete with 190 mm concrete block wall. (Side view of Junctions 1, 3, 4)
For separating assembly: internal loss, η_i = 0.006			c -	3500			
mass (kg/m ²) = 345			f_c =			(Eq. C.2)	F2
Reference		K Ff	K Dd'	K_Fd	КDf	$\Sigma I_k \cdot \alpha_k$	
X-Junction 1, 3, 4 ISO 15712-1,	Fa. F.3	11.6	6.1	8.8	8.8	0.843	
T-Junction 2 ISO 15712-1,		8.1	0.1	5.8	5.8	0.657	
Total loss, η_tot ISO 15712-1,		0.1			(at 500		Res States Street Street
					(,,	and the second
Similarly, for flanking eleme	nts F and	f at Jun					1 3 3
internal loss, $\eta_i = 0.015$				3500			
				00			
mass $(kg/m^2) = \frac{238}{150}$	5- 64		f_c =		1-1 500	<u> </u>	h h
mass (kg/m ²) = 238 Total loss, η_tot ISO 15712-1,	Eq. C.1		t_c =		(at 500) Hz)	d d
		f at Jun		0.041	(at 500) Hz)	d
Total loss, η_tot ISO 15712-1,		<u>f at Jun</u>	ction 2 8	0.041	(at 500) Hz)	d d
Total loss, η_tot ISO 15712-1, Similarly, for flanking eleme		<u>f at Jun</u>	ction 2 8	0.041 <u>& 4,</u> 3500	(at 500) Hz)	f2
Total loss, η_tot ISO 15712-1, Similarly, for flanking eleme internal loss, η_i = 0.015	nts F and	<u>f at Jun</u>	<u>ction 2 8</u> c_L =	0.041 <u>& 4,</u> <u>3500</u> <u>98</u> 0.047	(at 500) Hz)	d f2
Total loss, η_tot ISO 15712-1, Similarly, for flanking eleme internal loss, η_i = 0.015 mass (kg/m ²) = 238	nts F and T	<u>f at Jun</u>	<u>ction 2 8</u> c_L =	0.041 <u>& 4,</u> <u>3500</u> <u>98</u> 0.047) Hz)	f2
Total loss, n_tot ISO 15712-1, <u>Similarly, for flanking eleme</u> internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1,	nts F and T	<u>f at Jun</u>	<u>ction 2 8</u> c_L =	0.041 <u>& 4,</u> <u>3500</u> <u>98</u> 0.047	(at 500) Hz)	T-Junction of separating floor of 150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2)
Total loss, n_tot ISO 15712-1, Similarly, for flanking eleme internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1,	Eq. C.1 Eq. C.1		<u>ction 2 8</u> c_L =	0.041 <u>3</u> 4, <u>3</u> 500 <u>98</u> 0.047 0.043	(at 500) Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2)
Total loss, n_tot ISO 15712-1, Similarly, for flanking eleme internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1, Separating Partition (150 mm concret	Eq. C.1 Eq. C.1 Eq. C.1	1bol	ction 2 8 c_L = f_c =	0.041 3500 98 0.047 0.043 Refe	(at 500 (at 500	0 Hz) 0 Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2)125250500100020004000STC or ASTC
Total loss, n_tot ISO 15712-1, <u>Similarly, for flanking eleme</u> internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1, <u>Separating Partition (150 mm concre</u> Sound Transmission Loss (TL)	Eq. C.1 Eq. C.1 Eq. C.1 ISO Sym te floor) R_D,la	1bol ab RR	ction 2 & c_L = f_c =	0.041 3500 98 0.047 0.043 Refe DN150, T	(at 500 (at 500	0 Hz) 0 Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2) 125 250 500 1000 2000 4000 STC or ASTC 40 42 50 58 66 75 53
Total loss, η_tot ISO 15712-1, Similarly, for flanking eleme internal loss, η_i = 0.015 mass (kg/m²) = 238 Total loss, η_tot,2 ISO 15712-1, Total loss, η_tot,4 ISO 15712-1, Total loss, η_tot,4 ISO 15712-1, Separating Partition (150 mm concressound Transmission Loss (TL) Structural Reverberation Time	Eq. C.1 Eq. C.1 Eq. C.1 ISO Sym te floor) R_D,la T_S,la	ıbol RRab RR	ction 2 & c_L = f_c =	0.041 3500 98 0.047 0.043 Refe DN150, T	(at 500 (at 500	0 Hz) 0 Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2) 125 250 500 1000 2000 4000 STC or ASTC 40 42 50 58 66 75 53 0.44 0.37 0.25 0.21 0.15 0.08
Total loss, n_tot ISO 15712-1, <u>Similarly, for flanking eleme</u> internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1, Separating Partition (150 mm concre Sound Transmission Loss (TL) Structural Reverberation Time Change by Lining on source side	Eq. C.1 Eq. C.1 Eq. C.1 Eq. C.1 Eq. C.1 T_S,la ΔR_t	1bol RR ab RR ab Mu D Nc	ction 2 & c_L = f_c = 	0.041 3500 98 0.047 0.043 Refe DN150, T	(at 500 (at 500	0 Hz) 0 Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2) 125 250 500 1000 2000 4000 STC or ASTC 40 42 50 58 66 75 53 0.44 0.37 0.25 0.21 0.15 0.08 0 0 0 0 0 0
Total loss, n_tot ISO 15712-1, Similarly, for flanking eleme internal loss, n_i = 0.015 mass (kg/m²) = 238 Total loss, n_tot,2 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1, Total loss, n_tot,4 ISO 15712-1, Separating Partition (150 mm concression) Sound Transmission Loss (TL) Structural Reverberation Time Change by Lining on source side Change by Lining on receive side Side Structure Side	Eq. C.1 Eq. C.1 Eq. C.1 ISO Sym te floor) R_D,la T_S,la	nbol ab RR ab Mi O Nc	ction 2 & c_L = f_c = -333, CC easured b lining , b lining ,	0.041 3500 98 0.047 0.043 Refe N150, T _s	(at 500 (at 500 rence) Hz)) Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2) 125 250 500 1000 2000 4000 STC or ASTC 40 42 50 58 66 75 53 0.44 0.37 0.25 0.21 0.15 0.08
Total loss, n_tot ISO 15712-1, <u>Similarly, for flanking eleme</u> internal loss, n_i = 0.015 mass (kg/m ²) = 238 Total loss, n_tot,2 ISO 15712-1,	Eq. C.1 Eq. C.1 Eq. C.1 Eq. C.1 Magnetic Eq. C.1	nbol Jab RR ab Mu D No d No tu ISC	ction 2 & c_L = f_c = 	0.041 3500 98 0.047 0.043 Refe N150, T T_s 1, Eq. C. locked	(at 500 (at 500 rence LF-15-04) Hz)) Hz)	150 mm cast-in-place concrete with 190 mm concrete block wall. (Side view of Junction 2) 125 250 500 1000 2000 4000 STC or ASTO 40 42 50 58 66 75 53 0.44 0.37 0.25 0.21 0.15 0.08 0 0 0 0 0 0

(For the notes in this table please see the corresponding endnotes on page 195.)

	ISO Symbol	R	eference	125	250	500	1000	2000	4000	STC or A
lunction 1 (Rigid cross-junction, 150 r	nm concrete :	separating floor	/ 190 mm block wall)							
Sound Transmission Loss, F1 or f1	R F1,lab	RR-334, NRC Me	an BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T s,lab	Estimate Eq. C.5	· · ·	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	$\Delta R F1$	No lining ,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR f1	No lining ,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	-	ISO 15712-1, Eq	. C.1-C.3	0.256	0.169	0.108	0.067	0.040	0.023	
TL in-situ for F1		ISO 15712-1, Eq		35.7	38.5	44.4	50.3	58.2	62.2	49
TL in-situ for f1		ISO 15712-1, Eq		35.7	38.5	44.4	50.3	58.2	62.2	49
Junction J1 - Coupling										
Velocity Level Difference for Ff	D v.Ff 1.situ	ISO 15712-1, Eq	21.22	14.1	14.4	14.8	15.4	16.1	17.0	
Velocity Level Difference for Fd		ISO 15712-1, Eq	,	11.6	11.9	12.2	12.7	13.2	14.0	
Velocity Level Difference for Df		ISO 15712-1, Eq		11.6	11.9	12.2	12.7	13.2	14.0	
Flanking Transmission Loss - Path data		150 157 12 1, Eq	. 21, 22	11.0	11.5	12.2	12.7	13.2	14.0	
Flanking TL for Path Ff_1	R Ff	ISO 15712-1, Eq	250	52	55	61	68	76	81	66
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq		51	54	61	69	78	85	65
Flanking TL for Path Df 1	R_PU R_Df	ISO 15712-1, Eq		51	54	61	69	78	85	65
Junction 1: Flanking STC for all paths	K_DI	150 157 12-1, Eq		10*LOG1						05
unction 1. Flanking STC for all paths	1			10 1001	10(10	0.0 + 1	0.2	+ 10***	0.3] =	
unation 2 (Disid T lunation 150 mm		wating flags / 10								
Junction 2 (Rigid T-Junction, 150 mm				25	20		50	50	()	40
Sound Transmission Loss, F2 or f2		RR-334, NRC Me	• •	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5					0.072			
Change by Lining on source side	ΔR_F2	No lining ,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f2	No lining ,	64.63	0	0	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq					0.059			
TL in-situ for F2		ISO 15712-1, Eq		36.4	39.2	45.0	50.9	58.7	62.5	50
۲L in-situ for f2	R_f2,situ	ISO 15712-1, Eq	. 19	36.4	39.2	45.0	50.9	58.7	62.5	50
Iunction J2 - Coupling										
Velocity Level Difference for Ff		ISO 15712-1, Eq		11.3	11.5	11.9	12.4	13.1	13.9	
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, Eq	. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, Eq	. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, Eq	. 25a	51	54	60	66	75	79	65
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq		50	53	60	68	76	83	64
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq	. 25a	50	53	60	68	76	83	64
Junction 2: Flanking STC for all paths			-	10*LOG1	0(10^-	6.5 + 1	0^- 6.4	+ 10^-	6.4)=	
lunction 3 (Rigid cross-junction, 150 r	nm concrete :	separating floor	/ 190 mm block wall)							
All input values the same as for Junction	on 1									
Junction 3: Flanking STC for all paths										
Junction 4 (Rigid cross-junction, 150 r	nm concrete :	separating floor	/ 190 mm block wall)							
All input data the same as for Junction				oss facto	rs and j	unctior	n attenu	uation f	rom Ju	nction 2
Structural Reverb. Time in-situ		ISO 15712-1, Eq					0.063			
TL in-situ for F4	- '	ISO 15712-1, Eq		36.0				58.4		50
TL in-situ for f4		ISO 15712-1, Eq			38.8			58.4		50
Junction J4 - Coupling				30.0	33.0		33.0	55.7	02.0	50
Velocity Level Difference for Ff	D v Ff 4 situ	ISO 15712-1, Eq	21 22	14.4	147	15 1	15.6	16 3	17 2	
Velocity Level Difference for Fd		ISO 15712-1, Eq		12.3			13.3			
/elocity Level Difference for Df		ISO 15712-1, Eq		12.3	12.5	12.8	13.3	13.8	14.5	
Flanking Transmission Loss - Path data	_ · _ ·	150 157 12-1, Eq	,	12.3	12.3	12.0	13.3	10.0	14.3	
Flanking TL for Path Ff_4	R_Ff	ISO 15712-1, Eq	25a	53	57	63	69	78	83	68
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, Eq		52	55	63	71	79	86	67
Flaulting TI fay Dath Df 4	R_Df	ISO 15712-1, Eq		52 10*LOG1	55	63	71	79	86	67
Flanking TL for Path Df_4					11111/-	n x + 1	11/2- h /	+ 10/-	n / 1 =	
Flanking TL for Path Df_4 Iunction 4: Flanking STC for all paths	1		-	10-1001	0(10	0.0 • 1	0 0.7	1 10	0.7)	
unction 4: Flanking STC for all paths			-	10 1001	10(10	0.0 1 1	0 0.7	10		
			-	10 1001	0(10	0.0 1	0 0.7	10	,	

EXAMPLE 2.1.3	:			[DETAIL	.ED M	ETHOD	IIIu	Istrat	ion f	or thi	s cas	e	
	ide-by-side lace concret	e floo	ors a	nd cor	ocrete	walls	with rigi	e						
	<u>assembly (loa</u> ce concrete w ght concrete w	/all wi	th ma	iss per				-	F3	3.				<u>^f3</u>
normal weig	om Junction (s ce concrete flo ght concrete 2 -junction with o	oor wi 00 mr	th ma n thick	iss per <) with r	area o no topp	f 460							∫ ⊷d	
	de wall and se area of 345 kg no lining	parati	ng wa	all of ca	st-in-pl	ace co	oncrete wit		F	1				, _ f1
Junction 3: Top		aratin	n wall	/ ceiling	n) with:								1944	
Rigid cross <u>Acoustical Para</u>	ght concrete 2 -junction with a ameters: ing assembly:							co thi	ncrete ck ca	e sep ast-in-	aratir place	ng wa e con	II witl crete	st-in-plac n 150 mi floor an s 1 and 3
internal loss, η_i =				c L=	3500			-	Ũ		1	1000000	a	
mass (kg/m ²) =				f_c =			(Eq. C.2)							
	Reference		K_Ff		K_Fd	K_Df	Σl_k.α_k	1						
X-Junction 1 or 3	ISO 15712-1, E	q. E.3	6.7	10.9	8.8	8.8	0.544	-				7		
T-Junction 2 or 4			5.7		5.7	5.7	0.473			- 1		R. Profil	l← d	
Total loss, η_tot					0.0293	(at 500) Hz)					100		
			مالامدا						2, F	1		1312		_f2, f4
internal loss, η_i =	r flanking eleme	IILS F di	lu i al j		3500			· ·	Z, I			1.19	L ¢	
mass (kg/m ²) =				f c=					10-16			T.F.	1	
Total loss, η_tot		a C 1		I_C -	0.0302	(at 500) H ²)						1.5	
						100 300	, , , , , , , , , , , , , , , , , , , ,							
Cimilarly fo	r flanking eleme	nts F ar	id f at J					- I.u	notion	of	conar	atina	wall	with sid
	0.000				3500									st-in-plac
internal loss, η_i =				f c =	124									on 2 or 4
internal loss, η_i = mass (kg/m²) =	345													
internal loss, η_i = mass (kg/m²) = Total loss, η_tot,2	345 ISO 15712-1, Ed				0.0356		-	-		`				
internal loss, η_i = mass (kg/m ²) =	345 ISO 15712-1, Ed				0.0356 0.0319		-			,				
internal loss, η_i = mass (kg/m²) = Total loss, η_tot,2	345 ISO 15712-1, Ed	q. C.1	mbol		0.0319	(at 500	-							
internal loss, η_i = mass (kg/m²) = Total loss, η_tot,2 Total loss, η_tot,4	345 ISO 15712-1, Ει ISO 15712-1, Ει	q. C.1 ISO Sy	mbol		0.0319		-	125	250	500				STC or AST
internal loss, η_i = mass (kg/m ²) = Total loss, η_tot,2 Total loss, η_tot,4 Separating Partition	345 ISO 15712-1, Ed ISO 15712-1, Ed (150 mm concret	q. C.1 ISO Sy		R-333, C	0.0319 Refe	(at 500) Hz)							
internal loss, η_i = mass (kg/m ²) = Total loss, η_tot,2 Total loss, η_tot,4 Separating Partition Sound Transmission	345 ISO 15712-1, Ed ISO 15712-1, Ed (150 mm concret Loss (TL)	q. C.1 ISO Sy e)	lab R		0.0319 Refe	(at 500) Hz)	125 40	250	500	1000 58	2000	4000 75	STC or AST
internal loss, η_i = mass (kg/m ²) = Total loss, η_tot,2 Total loss, η_tot,4 Separating Partition Sound Transmission Structural Reverberat Change by Lining on	345 ISO 15712-1, Ed ISO 15712-1, Ed (150 mm concret Loss (TL) tion Time source side	q. C.1 ISO Sy e) R_D, T_s, ΔR_	lab R lab N D N	R-333, Co Aeasured No Lining ,	0.0319 Refe ON150, T T_s	(at 500) Hz)	125 40 0.439 0	250 42 0.369 0	500 50 0.250 0	1000 58 0.205 0	2000 66 0.146 0	4000 75 0.077 0	STC or AST
internal loss, η_i = mass (kg/m ²) = Total loss, η_tot,2	345 ISO 15712-1, Ed ISO 15712-1, Ed (150 mm concret Loss (TL) tion Time source side receive side	q. C.1 ISO Sy e) R_D, T_s,	lab R lab N D N _d N	R-333, Co Measured	0.0319 Refe ON150, T T_s	(at 500 rence) Hz)	125 40 0.439 0 0 0	250 42 0.369 0 0	500 500 0.250 0 0	1000 58 0.205 0 0	2000 66 0.146	4000 75 0.077 0 0	STC or AS

R_D,situ ISO 15712-1, Eq. 24

Sealed & Blocked

Leakage or Airborne Flanking

Direct TL in-situ

41

44

0.0 0.0 0.0 0.0 0.0 0.0

52

61

70

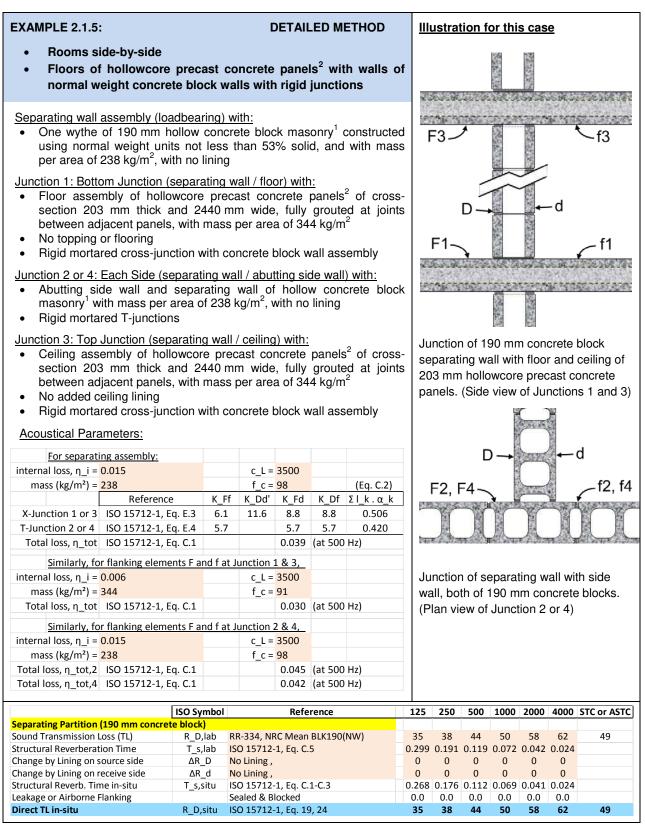
78

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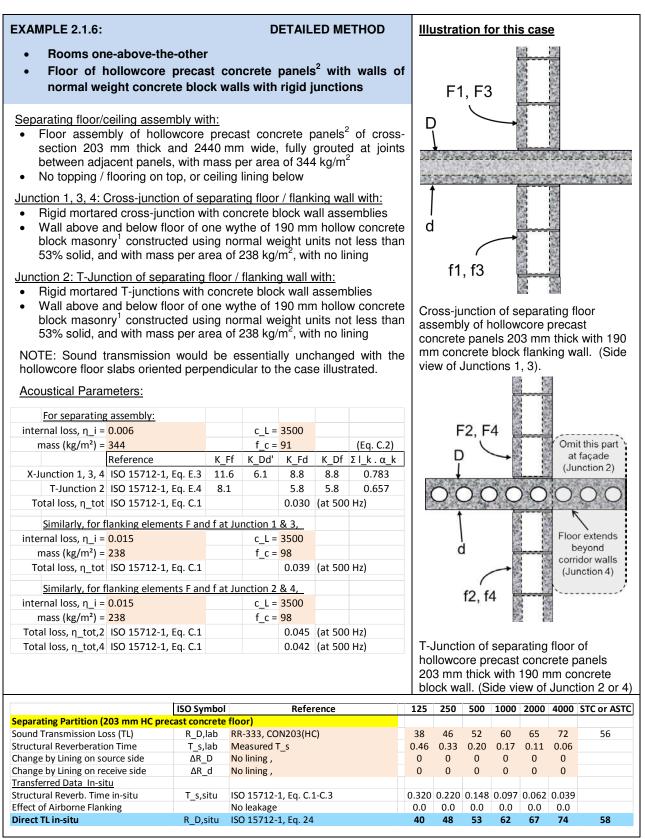
	ISO Symbol	Reference		125	250	500	1000	2000	4000	STC or AS
Junction 1 (Rigid cross-junction, 150										
Sound Transmission Loss, F1 or f1		RR-333, CON200, TLF-12-011		41	49	55	62	69	75	59
Structural Reverberation Time	T s,lab	Measured T s	0				0.170			
Change by Lining on source side	$\Delta R F1$	No Lining ,		0.0	0.0	0.0	0.0	0.0	0.0	
Change by Lining on receive side	ΔR f1	No Lining ,		0.0	0.0	0.0	0.0	0.0	0.0	
Structural Reverb. Time in-situ	_	ISO 15712-1, Eq. C.1-C.3					0.096			
TL in-situ for F1		ISO 15712-1, Eq. 19		41.1	49.6	57.2	64.5	70.8	77.0	60
TL in-situ for f1		ISO 15712-1, Eq. 19		41.1 41.1	49.6	57.2	64.5	70.8	77.0	60
	K_II,Situ	130 137 12-1, Eq. 19		+1.1	49.0	57.2	04.5	70.8	77.0	00
Junction J1 - Coupling		150 15712 1 5~ 21 22		10.2	10.4	10.0	11.0	11.4	11.0	
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22		10.3	10.4	10.6	11.0	11.4	11.9	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22		11.3	11.4	11.7	12.0	12.4	13.0	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22		11.3	11.4	11.7	12.0	12.4	13.0	
Flanking Transmission Loss - Path data	-									
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a		49	58	66	73	80	87	68
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a		51	57	65	74	82	89	68
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq. 25a		51	57	65	74	82	89	68
Junction 1: Flanking STC for all paths			- 10*	LOG1	0(10^-	6.8 + 1	0^- 6.8	+ 10^-	6.8)=	
lunction 2 (Rigid T-Junction, 150 mm	concrete wall	/ 150 mm concrete wall)								
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-333, CON150, TLF-15-045		40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T s	C	.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR F2	No Lining ,		0.0	0.0	0.0	0.0	0.0	0.0	
Change by Lining on receive side	ΔR f2	No Lining ,		0.0	0.0	0.0	0.0	0.0	0.0	
Structural Reverb. Time in-situ	_	ISO 15712-1, Eq. C.1-C.3					0.082			
TL in-situ for F2		ISO 15712-1, Eq. 19		42.2	45.1		62.0	70.4	78.6	56
TL in-situ for f2		ISO 15712-1, Eq. 19		42.2	45.1			70.4	78.6	56
Junction J2 - Coupling	N_12,510	150 157 12 1, Eq. 15		72.2	43.1	55.1	02.0	70.4	70.0	50
Velocity Level Difference for Ff	D y Ef 2 citu	ISO 15712-1, Eq. 21, 22		10.1	10.2	10.4	10.6	11.0	11.5	
· · · · · · · · · · · · · · · · · · ·					10.2	10.4	10.0	11.0	11.5	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22		10.1						
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22		10.1	10.2	10.4	10.7	11.1	11.6	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, Eq. 25a		53	56	64	74	82	90	67
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq. 25a		52	55	63	73	82	90	66
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq. 25a		52	55	63	73	82	90	66
Junction 2: Flanking STC for all paths			- 10*	LOG1	0(10^-	6.7 + 1	0^- 6.6	+ 10^-	6.6)=	
Junction 3 (Rigid cross-junction, 150	mm concrete	wall / 200 mm concrete ceiling)							
All values the same as for Junction 1										
Junction 3: Flanking STC for all paths										
Junction 4 (Rigid T-junction, 150 mm										
All input data the same as for Junction	n 2, but differe	nt junctions at ceiling and floor	change loss f	actor	s from	Junctio	on 2			
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3					0.091	0.059	0.034	
TL in-situ for F4		ISO 15712-1, Eq. 19		41.7		52.6	61.5		78.2	56
TL in-situ for f4		ISO 15712-1, Eq. 19		41.7			61.5	70.0	78.2	56
Junction J4 - Coupling							- 1.0			
Velocity Level Difference for Ff	D v Ff 4 situ	ISO 15712-1, Eq. 21, 22		9.6	9.7	99	10.2	10.6	11 1	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22		9.0 9.9	10.0	10.2			11.1	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22		9.9 9.9	10.0	10.2	10.5	10.9	11.5	
,		130 137 12-1, LY. 21, 22		J.J	10.0	10.2	10.5	10.9	11.5	
Flanking Transmission Loss - Path data				F 2		~	70	07	00	~~
Flanking TL for Path Ff_4	R_Ff	ISO 15712-1, Eq. 25a		52	55	63	73	82	90	66
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, Eq. 25a		52	55	63	72	81	90	66
Flanking TL for Path Df_4	R_Df	ISO 15712-1, Eq. 25a		52	55	63	72	81	90	66
Junction 4: Flanking STC for all paths			- 10*	LUG1	U(10^-	6.6 + 1	<u>0^- 6.6</u>	+ 10^-	6.6)=	
Total Flanking (for all 4 junctions)										!
ASTC due to Direct plus Flanking Path		RR-331, Eq. 1.4		38	42	50	59	67	75	

EXAMPLE 2.1.4:			D	ETAIL	ED ME	THOD	Illustration for this case
 Rooms one-above-the Cast-in-place concret 		ind w	alls wi	ith rigi	d junc	tions	
 <u>Separating floor/ceiling asser</u> Cast-in-place concrete f normal weight concrete top, or ceiling lining below <u>Junction 1, 3, 4: Cross-junction</u> Rigid cross-junction with Wall above and below fl area of 345 kg/m² (e.g. no lining 	loor with 200 mm w on of sep concrete oor of ca normal w	mass thick) earatin e wall ast-in- weight) with <u>g floor</u> assem place t conci	no topp <u>/ flank</u> iblies concre rete 15	bing / t ing wa te with 0 mm	flooring or Il with: mass pe	
 Junction 2: T-Junction of sep Rigid T-junction with con Wall above and below fl area of 345 kg/m² (e.g. 150 mm) with no lining Acoustical Parameters: 	crete wa oor of ca	ll asse ast-in-	emblie place	s concre	te with		f Cross-junction of separating floor 200 mm thick cast-in-place concr with 150 mm thick cast-in-pla
For separating assembly:							concrete wall. (Side view of Junctions 3 or 4)
internal loss, η_i = 0.006			c_L =	3500			
mass (kg/m ²) = 460			f_c =	93		(Eq. C.2)	
Reference		K_Ff	K_Dd'	K_Fd	K_Df	Σl_k.α_k	F2
X-Junction 1, 3, 4 ISO 15712-1	, Eq. E.3	10.9	6.7	8.8	8.8	0.789	
T-Junction 2 ISO 15712-1	, Eq. E.4	7.6		5.8	5.8	0.740	
Total loss, η_tot ISO 15712-1	, Eq. C.1			0.0302	(at 500	Hz)	
Similarly, for flanking elen	onte E ane	l f at lu	nction '	1 9. 2			
		i i al ji					BAR AN AN ALL MAR BAR AND AN
internal loss, $\eta_i = \frac{0.006}{0.006}$				3500			the state of the state of
mass (kg/m ²) = 345			f_c =				
Total loss, η_tot ISO 15712-1	, Eq. C.1			0.0293	(at 500	Hz)	
Similarly, for flanking elen	nents F and	l f at Ju	inction 2	2 & 4,			A. C.
internal loss, η_i = 0.006			cL=	3500			d
mass $(kg/m^2) = 345$			f c =				ų 🗸
Total loss, n tot,2 ISO 15712-1	. Ea. C.1		_	0.0355	(at 500	Hz)	
Total loss, n_tot,4 ISO 15712-1				0.0319			f2
							T-Junction of separating floor of 2 mm thick cast-in-place concrete fl with 150 mm thick cast-in-pla concrete wall. (Side view of Junction
	ISO Symb	ool		Refer	ence		125 250 500 1000 2000 4000 STC or A
Separating Partition (200 mm concre	,			-			
Sound Transmission Loss (TL)	R_D,lat			N200, TI	F-12-01	1	41 49 55 62 69 75 59
Structural Reverberation Time	T_s,lab		asured 1	_s			0.32 0.25 0.24 0.17 0.09 0.06
Change by Lining on source side	∆R_D		lining ,				0 0 0 0 0
Change by Lining on receive side	ΔR_d		lining,				0 0 0 0 0 0
Structural Reverb. Time in-situ	T_s,situ			1, Eq. C.1	-C.3		0.317 0.217 0.146 0.096 0.061 0.038
Leakage or Airborne Flanking Direct TL in-situ	R D,sit		led & Bl				0.0 0.0 0.0 0.0 0.0 0.0 0.0 41 50 57 64 71 77 60
COLECT TO DESIGN	D D SIT	u 150	13/12-	1, Eq. 24			

	ISO Symbol	R	eference		L25	250	500	1000	2000	4000	STC or AS
Junction 1 (Rigid cross-junction, 200 r											
Sound Transmission Loss, F1 or f1		RR-333, CON150			40	42	50	58	66	75	53
Structural Reverberation Time	T s,lab	Measured T s	,			0.369		0.205			
Change by Lining on source side		No lining ,			0.0	0.0	0.0	0.0	0.0	0.0	
Change by Lining on receive side	ΔR f1	No lining ,			0.0	0.0	0.0	0.0	0.0	0.0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq	C 1-C 3					0.099			
TL in-situ for F1		ISO 15712-1, Eq			1.3	44.2	52.2	61.2	69.7	77.9	55
TL in-situ for f1		ISO 15712-1, Eq			1.3		52.2			77.9	55
	K_II,Situ	150 157 12-1, Eq	. 19	4	1.5	44.2	52.2	01.2	09.7	11.9	55
Junction J1 - Coupling		10 15712 1 5~	21 22	1	1 11	12.45	12 (7	13.00	12.42	14.00	
Velocity Level Difference for Ff		ISO 15712-1, Eq									
Velocity Level Difference for Fd		ISO 15712-1, Eq	,					11.98			
Velocity Level Difference for Df		ISO 15712-1, Eq	. 21, 22	1	1.30	11.43	11.66	11.98	12.41	12.97	
Flanking Transmission Loss - Path data											
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq			56	59	67	76	85	90	70
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq	. 25a		53	60	67	76	84	90	70
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq	. 25a		53	60	67	76	84	90	70
Junction 1: Flanking STC for all paths	-				- 10*	LOG10	(10^-7	+ 10^-	7 + 10	^-7)=	
Junction 2 (Rigid T-Junction, 200 mm	concrete floo	<mark>r / 150 mm conc</mark>	rete wall)								
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-333, CON150), TLF-15-045		40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s		0	.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side		No lining,			0.0	0.0	0.0	0.0	0.0	0.0	
Change by Lining on receive side	ΔR f2	No lining,			0.0	0.0	0.0	0.0	0.0	0.0	
Structural Reverb. Time in-situ	_	ISO 15712-1, Eq	. C.1-C.3	0	265	0.183	0.124	0.082	0.053	0.034	
TL in-situ for F2		ISO 15712-1, Eq			2.2			62.0	70.4	78.6	56
TL in-situ for f2		ISO 15712-1, Eq			2.2		53.0	62.0	70.4	78.6	56
Junction J2 - Coupling	n_12,5itu	150 157 12 1, 29	. 15			13.1	55.0	02.0	70.1	70.0	50
Velocity Level Difference for Ff	D v Ef 2 situ	ISO 15712-1, Eq	21 22	c	02	10.03	10.21	10.48	10.85	11 22	
Velocity Level Difference for Fd		ISO 15712-1, Eq).23		9.56			10.77	
).23	9.35	9.56		10.25		
Velocity Level Difference for Df		ISO 15712-1, Eq	. 21, 22	3	9.23	9.35	9.50	9.85	10.25	10.77	
Flanking Transmission Loss - Path data		100 45740 4 5	25				~ ~				~~~
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, Eq			55	58	66	75	84	90	69
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq			52	58	66	74	82	90	69
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq	. 25a		52	58	66	74	82	90	69
Junction 2: Flanking STC for all paths				- 10*l	.0G1	0(10^-	6.9 + 1	0^- 6.9	+ 10^-	6.9)=	
		-									
Junction 3 (Rigid cross-junction, 200 r	nm concrete	floor / 150 mm o	oncrete wall)								
All values the same as for Junction 1											
Junction 3: Flanking STC for all paths											
lunction 4 (Rigid T-Junction, 200 mm											
All input data the same as for Junction	2, but differe	nt junctions at ce	iling and floor char	nge loss f	actor	s and j	unctior	n attenu	uation v	/s. Juno	tion 2
Structural Reverb. Time in-situ		ISO 15712-1, Eq						0.091			
TL in-situ for F4		ISO 15712-1, Eq		4	1.7	44.6	52.6	61.5	70.0	78.2	56
TL in-situ for f4		ISO 15712-1, Eq			1.7		52.6	61.5	70.0	78.2	56
Junction J4 - Coupling	,				-						
Velocity Level Difference for Ff	D v.Ff 4 situ	ISO 15712-1, Eq	21.22	1	2.73	12.84	13 04	13.34	13 75	14 28	
Velocity Level Difference for Fd		ISO 15712-1, Eq						12.64			
Velocity Level Difference for Df		ISO 15712-1, Eq						12.64			
Flanking Transmission Loss - Path data		130 137 12-1, Eq	1,	1	1.30	12.11	12.33	12.04	13.03	13.00	
Flanking TL for Path Ff 4		150 15712 1 5~	25-2		57	60	69	70	07	90	71
	R_Ff	ISO 15712-1, Eq			57	60		78	87 9F		
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, Eq			55	61	69	77	85	90	72
Flanking TL for Path Df_4	R_Df	ISO 15712-1, Eq	. 258		55	61	69	77	85	90	72
Junction 4: Flanking STC for all paths	1			- 10*1	061	0(10/-	/.1+1	0^- 7.2	+ 10^-	1.2)=	
Total Flanking (for all 4 junctions)											
ASTC due to Direct plus Flanking Path		RR-331, Eq. 1.4			39	46	54	61	69	75	56



	ISO Symbol	Reference		125	250	500	1000	2000	4000	STC or AS
unction 1 (Rigid cross-junction, 190 r	nm block wal	I / 203 mm HC precast concrete floor)							
Sound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON203(HC)		38	46	52	60	65	72	56
Structural Reverberation Time	T s,lab	Measured T s		0.458	0.328	0.200	0.168	0.109	0.061	
Change by Lining on source side	ΔR_F1	No Lining ,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR f1	No Lining ,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3		0.321	0.221	0.148	0.097	0.062	0.039	
TL in-situ for F1	_	ISO 15712-1, Eq. 19		39.5	47.7	53.3	62.4	67.4	74.0	58
TL in-situ for f1		ISO 15712-1, Eq. 19		39.5	47.7	53.3	62.4	67.4	74.0	58
Junction J1 - Coupling										
Velocity Level Difference for Ff	D v,Ff 1,situ	ISO 15712-1, Eq. 21, 22		9.6	9.7	10.0	10.3	10.7	11.3	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22		11.7	11.9	12.3	12.7	13.3	14.0	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22		11.7	11.9	12.3	12.7	13.3	14.0	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff 1	R Ff	ISO 15712-1, Eq. 25a		47	55	61	71	76	83	65
Flanking TL for Path Fd 1	R Fd	ISO 15712-1, Eq. 25a		48	54	60	68	75	81	65
Flanking TL for Path Df 1	R Df	ISO 15712-1, Eq. 25a		48	54	60	68	75	81	65
Junction 1: Flanking STC for all paths			- 10				0^- 6.5			
unction 2 (Rigid T-Junction, 190 mm	block separat	ing wall / 190 mm block flanking wal	n –							
Sound Transmission Loss. F2 or f2		RR-334, NRC Mean BLK190(NW)	-	35	38	44	50	58	62	49
Structural Reverberation Time		ISO 15712-1, Eq. C.5					0.072			-15
Change by Lining on source side		No Lining ,		0.255	0.151	0.115	0.072	0.042	0.024	
Change by Lining on receive side	_	No Lining ,		0	0	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3					0.061			
TL in-situ for F2		ISO 15712-1, Eq. 19		36.2	39.0	44.9	50.7	58.5	62.4	50
TL in-situ for f2	_	ISO 15712-1, Eq. 19		36.2	39.0	44.9	50.7	58.5	62.4	50
Junction J2 - Coupling	N_12,510	150 157 12 1, Eq. 15		50.2	55.0	44.5	50.7	50.5	02.4	50
Velocity Level Difference for Ff	D v Ef 2 situ	ISO 15712-1, Eq. 21, 22		10.7	11.0	11.4	11.9	12.6	13.4	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22		10.7	11.0	11.4	12.1	12.0	13.4	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22		10.8	11.1	11.6	12.1	12.8	13.7	
Flanking Transmission Loss - Path data		130 137 12-1, Eq. 21, 22		10.0	11.1	11.0	12.1	12.0	13.7	
Flanking TL for Path Ff 2	R Ff	ISO 15712-1, Eq. 25a		48	51	57	64	72	77	62
Flanking TL for Path Fd 2	R Fd	ISO 15712-1, Eq. 25a		47	50	56	63	72	76	61
Flanking TL for Path Df 2	R_FU	ISO 15712-1, Eq. 25a		47	50	56	63	72	76	61
Junction 2: Flanking STC for all paths	K_DI	150 157 12-1, Eq. 25a	- 10				0^- 6.1			01
function 2. Hanking STC for an paths			- 10	1001	- 01)0	0.2 1 1	0 - 0.1	110 -	0.1 / -	
lunction 2 (Rigid cross-junction, 190 r	nm block wal	l / 203 mm HC precast concrete ceilir	ים)							
All input values the same as for Junction		7 205 min ne precast concrete cenir	' 5 /							
Junction 3. Flanking STC for all naths								-		
Junction 3: Flanking STC for all paths										
	block separat	ing wall / 190 mm block flanking wall	N							
unction 4 (Rigid T-junction, 190 mm		ing wall / 190 mm block flanking wall		factor	s from	lunctio	n 2			
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction	2, but differe	nt junctions at ceiling and floor change	e loss					0 030	0.022	
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ	2, but differe T_s,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3	e loss	0.249	0.165	0.105	0.065			40
Iunction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ FL in-situ for F4	2, but differe T_s,situ R_F4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19	e loss	0.249 35.8	0.165 38.6	0.105 44.5	0.065 50.4	58.3	62.2	49
Iunction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ FL in-situ for F4 FL in-situ for f4	2, but differe T_s,situ R_F4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3	e loss	0.249	0.165 38.6	0.105	0.065	58.3	62.2	49 49
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling	2, but differe T_s,situ R_F4,situ R_f4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19	e loss	0.249 35.8 35.8	0.165 38.6 38.6	0.105 44.5 44.5	0.065 50.4 50.4	58.3 58.3	62.2 62.2	
All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22	e loss	0.249 35.8 35.8 10.3	0.165 38.6 38.6 10.6	0.105 44.5 44.5 11.0	0.065 50.4 50.4 11.6	58.3 58.3 12.3	62.2 62.2 13.2	
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,situ D_v,Fd_4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22	e loss	0.249 35.8 35.8 10.3 10.6	0.165 38.6 38.6 10.6 11.0	0.105 44.5 44.5 11.0 11.4	0.065 50.4 50.4 11.6 12.0	58.3 58.3 12.3 12.7	62.2 62.2 13.2 13.6	
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df	2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,situ D_v,Fd_4,situ D_v,Df_4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22	e loss	0.249 35.8 35.8 10.3	0.165 38.6 38.6 10.6	0.105 44.5 44.5 11.0	0.065 50.4 50.4 11.6	58.3 58.3 12.3	62.2 62.2 13.2	
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,situ D_v,Fd_4,situ D_v,Df_4,situ	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22	e loss	0.249 35.8 35.8 10.3 10.6 10.6	0.165 38.6 38.6 10.6 11.0 11.0	0.105 44.5 44.5 11.0 11.4 11.4	0.065 50.4 50.4 11.6 12.0 12.0	58.3 58.3 12.3 12.7 12.7	62.2 62.2 13.2 13.6 13.6	49
All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,situ D_v,Fd_4,situ D_v,Df_4,situ R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47	0.165 38.6 38.6 10.6 11.0 11.0 50	0.105 44.5 44.5 11.0 11.4 11.4 57	0.065 50.4 50.4 11.6 12.0 12.0 63	58.3 58.3 12.3 12.7 12.7 72	62.2 62.2 13.2 13.6 13.6 76	49 61
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Ff_4	2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,situ D_v,Df_4,situ R_Ff R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47 47	0.165 38.6 38.6 10.6 11.0 11.0 50 50	0.105 44.5 44.5 11.0 11.4 11.4 57 56	0.065 50.4 50.4 11.6 12.0 12.0 63 63	58.3 58.3 12.3 12.7 12.7 72 71	62.2 62.2 13.2 13.6 13.6 76 76 76	49 61 61
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,situ D_v,Fd_4,situ D_v,Df_4,situ R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47 47 47	0.165 38.6 38.6 10.6 11.0 11.0 50 50 50	0.105 44.5 11.0 11.4 11.4 57 56 56	0.065 50.4 50.4 11.6 12.0 12.0 63 63 63	58.3 58.3 12.3 12.7 12.7 72 71 71 71	62.2 62.2 13.2 13.6 13.6 76 76 76	49 61 61 61
Junction 4 (Rigid T-junction, 190 mm All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Ff_4	2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,situ D_v,Df_4,situ R_Ff R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47 47 47	0.165 38.6 38.6 10.6 11.0 11.0 50 50 50	0.105 44.5 11.0 11.4 11.4 57 56 56	0.065 50.4 50.4 11.6 12.0 12.0 63 63	58.3 58.3 12.3 12.7 12.7 72 71 71 71	62.2 62.2 13.2 13.6 13.6 76 76 76	49 61 61
All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for F4 Iunction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Fd Velocity Level Difference for Df Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Iunction 4: Flanking STC for all paths	2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,situ D_v,Df_4,situ R_Ff R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47 47 47	0.165 38.6 38.6 10.6 11.0 11.0 50 50 50	0.105 44.5 11.0 11.4 11.4 57 56 56	0.065 50.4 50.4 11.6 12.0 12.0 63 63 63	58.3 58.3 12.3 12.7 12.7 72 71 71 71	62.2 62.2 13.2 13.6 13.6 76 76 76 76	49 61 61 61
All input data the same as for Junction Structural Reverb. Time in-situ TL in-situ for F4 FL in FL in	2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,situ D_v,Df_4,situ R_Ff R_Ff	nt junctions at ceiling and floor change ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	e loss	0.249 35.8 35.8 10.3 10.6 10.6 47 47 47	0.165 38.6 38.6 10.6 11.0 11.0 50 50 50	0.105 44.5 11.0 11.4 11.4 57 56 56	0.065 50.4 50.4 11.6 12.0 12.0 63 63 63	58.3 58.3 12.3 12.7 12.7 72 71 71 71	62.2 62.2 13.2 13.6 13.6 76 76 76 76	49 61 61 61



	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or AS
lunction 1 (Rigid cross-junction, 203 I	nm HC precas	t concrete floor / 190 mm block wall							
Sound Transmission Loss, F1 or f1		RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time		Estimate Eq. C.5				0.072			
Change by Lining on source side		No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	$\Delta R f1$	No lining ,	0	Ő	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.069			
TL in-situ for F1		ISO 15712-1, Eq. 19	35.5	38.3	44.3	50.2		62.1	49
TL in-situ for f1		ISO 15712-1, Eq. 19	35.5	38.3	44.3	50.2	58.1	62.1	49
Junction J1 - Coupling	N_11,510	150 137 12 1, Eq. 15	55.5	50.5	44.5	50.2	50.1	02.1	73
Velocity Level Difference for Ff	D v Ef 1 citu	ISO 15712-1, Eq. 21, 22	13.9	14.2	14.6	15.2	16.0	16.9	
	/ _ /	, , ,	11.7	14.2	14.0	12.7	13.3	14.0	
Velocity Level Difference for Fd Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22							
•		ISO 15712-1, Eq. 21, 22	11.7	11.9	12.3	12.7	13.3	14.0	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	51	55	61	67	76	81	66
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a	50	56	62	70	77	83	67
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq. 25a	50	56	62	70	77	83	67
Junction 1: Flanking STC for all paths		·	- 10*LOG	LO(10^-	6.6 + 1	0^- 6.7	+ 10^-	6.7)=	
Junction 2 (Rigid T-junction, 203 mm	HC precast co	ncrete floor / 190 mm block wall)							
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	∆R_F2	No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f2	No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.227	0.151	0.097	0.061	0.037	0.022	
TL in-situ for F2		ISO 15712-1, Eq. 19	36.2	39.0	44.9	50.7	58.6	62.4	50
TL in-situ for f2		ISO 15712-1, Eq. 19	36.2	39.0	44.9	50.7	58.6	62.4	50
Junction J2 - Coupling	_ /* **								
Velocity Level Difference for Ff	D v.Ff 2.siti	ISO 15712-1, Eq. 21, 22	11.1	11.4	11.7	12.3	13.0	13.8	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	9.5	9.7	10.0	10.5	11.0	11.7	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	9.5	9.7	10.0	10.5	11.0	11.7	
Flanking Transmission Loss - Path data		150 157 12-1, Lq. 21, 22	5.5	5.7	10.0	10.5	11.0	11.7	
Flanking TL for Path Ff_2	R Ff	ISO 15712-1, Eq. 25a	50	53	60	66	75	79	64
Flanking TL for Path Fd_2	R Fd	· ·	49	55	60	68	75	81	65
		ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	49	55	60	68	75	81	65
Flanking TL for Path Df_2	R_Df	130 137 12-1, Eq. 23a							
Junction 2: Flanking STC for all paths	1		- 10*LOG	10(10^-	0.4 + 1	0^- 0.5	+ 10^-	= (כ.ס	(
		t concrete floor / 190 mm block wall							
All input values the same as for Junction	on 1								
Junction 3: Flanking STC for all paths	<u> </u>								
Junction 4 (Rigid T-junction, 203 mm									
•	2, but differe	nt junctions at ceiling and floor change	loss facto	rs and j	unctior	n atteni	uation f	from Ju	nction 2
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.248	0.164	0.105	0.065	0.039	0.022	
TL in-situ for F4	R_F4,situ	ISO 15712-1, Eq. 19	35.8	38.7	44.5	50.4	58.3	62.2	50
TL in-situ for f4	R_f4,situ	ISO 15712-1, Eq. 19	35.8	38.7	44.5	50.4	58.3	62.2	50
Junction J4 - Coupling									
Velocity Level Difference for Ff	D_v,Ff_4,situ	ISO 15712-1, Eq. 21, 22	14.2	14.5	14.9	15.5	16.2	17.1	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22				13.3		14.6	
•		ISO 15712-1, Eq. 21, 22	12.3	12.6	12.9	13.3		14.6	
velocity Level Difference for Di	· _ ·				-			_	
•		100 15712 1 5- 25-	53	56	62	69	78	82	67
Flanking Transmission Loss - Path data		ISU 15/12-1, EQ. 258							68
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4	R_Ff	ISO 15712-1, Eq. 25a	52	57	63	71	78	84	
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4	R_Ff R_Fd	ISO 15712-1, Eq. 25a	52	57	63 63	71	78	84 84	
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	R_Ff		52	57	63	71	78	84	68
Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	R_Ff R_Fd	ISO 15712-1, Eq. 25a		57	63	71	78	84	
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	R_Ff R_Fd	ISO 15712-1, Eq. 25a	52	57	63	71	78	84	68
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	R_Ff R_Fd	ISO 15712-1, Eq. 25a	52	57	63	71	78	84	68

<u>Summary for Section 2.1: Calculation Examples for Constructions of Concrete and</u> <u>Concrete Masonry with Rigid Junctions</u>

The worked examples 2.1.1 to 2.1.6 illustrate the basic process for calculating sound transmission between rooms in a building with bare concrete or concrete masonry walls and cast-in-place concrete floor assemblies with rigid junctions.

Here, "bare" means the assembly of concrete or masonry without a lining such as an added gypsum board finish on the walls or ceiling, or flooring over the concrete slab. Note that for a concrete block wall constructed using normal weight units, tests have shown that its surface could be painted or sealed, or have a thin coat of plaster with no effect on the sound transmission. "Rigid Junctions" implies that the assemblies meeting at the junction are firmly bonded so bending vibration is effectively transmitted between the elements. Loadbearing junctions are always rigid; non-loadbearing junctions may or may not be rigid.

The absence of finishing surface linings is not typical for occupied residential buildings in North America, but considering the "bare" case gives a clear presentation of the basic structure-borne transmission for a building with these structural subsystems. The effect of adding linings (such as gypsum board wall, ceiling finishes, or flooring) is presented in Section 2.3.

Overview of the Calculation Details:

There are recurrent patterns in the presented examples. The calculation process is in sections, dealing first with the separating wall or floor assembly, then with each of the junctions at the four edges of the separating assembly, In each section:

- In each section the first few lines present input data (shaded beige), followed by the insitu structural reverberation time for the pertinent separating or flanking surface, which is calculated using the procedures of Annex C in ISO 15712-1.
- For all the floor and wall assemblies in these examples, the structural reverberation time in-situ is shorter than that for the laboratory specimen, due to the higher edge losses when an assembly is attached to all adjacent assemblies in the building scenario.
- The in-situ sound transmission loss (TL) for the wall and floor assemblies (calculated from the laboratory TL and the ratio of structural reverberation times) is consistently higher than the laboratory TL, due to the greater losses in-situ.
- The coupling for each path (Ff, Fd, and Df) across the junctions (velocity level difference) is calculated from the K_{ij} values for each path, with corrections for losses and dimensions of the coupled assemblies, and is consistently higher than the corresponding K_{ij}.
- Finally, the flanking sound transmission loss for each path is calculated from the preceding values, followed by a summary value for the Flanking STC for the junction.

At the end of each example, the apparent sound transmission loss is calculated from the combined transmission via the direct and 12 flanking paths, and then used to determine ASTC.

General Trends in the STC and ASTC Results:

For both the cases with side-by-side rooms (Examples 2.1.1, 2.1.3, and 2.1.5) and the rooms oneabove-the-other (Example 2.1.2, 2.1.4, and 2.1.6) the ASTC tends to be slightly lower than the STC measured for the separating assembly. For the wall and floor assemblies in the examples, the differences between STC and ASTC values for the horizontal room pairs are 2, 0, and 2 points, and for the vertical room pairs, the differences are 1, 3, and 3 points. Different mass ratios of the building elements and different laboratory structural decay times could alter the specific differences, but the trend is clear.

What matters is that the ASTC values tend to be lower than the corresponding STC values and that the total Flanking Transmission Loss (due to the combination of 12 flanking paths) is quite similar to the Direct Transmission Loss through the separating wall. However, as shown in Section 2.3, the balance among the various paths can be significantly altered by lining the floor, ceiling, or wall surfaces.

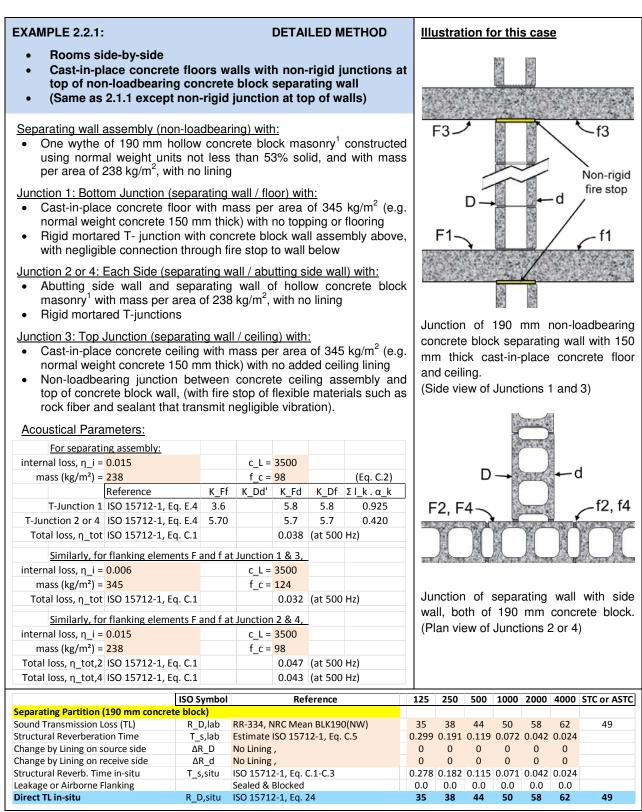
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2.2. Non-Rigid Junctions in Concrete and Concrete Masonry Buildings

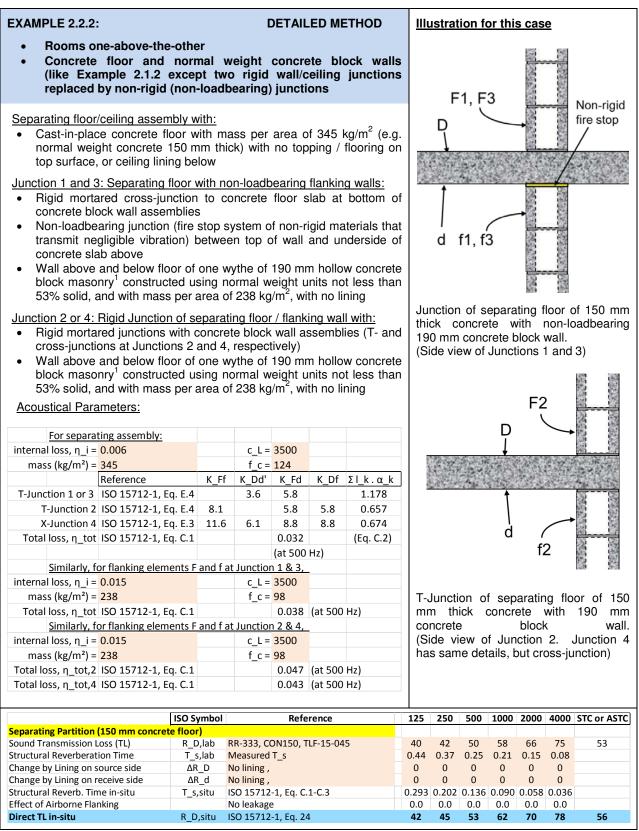
This section presents worked examples for adjacent rooms in a building which has structural floor slabs of bare cast-in-place concrete and walls of bare concrete or masonry, but includes some non-rigid junctions. Here, as before, "bare" is taken to mean the assembly of concrete or masonry without a lining such as an added gypsum board finish on the walls or ceiling, or flooring over the cast-in-place concrete floor assembly. The effect of adding a lining is discussed in detail in Section 2.3.

The calculations follow the steps of the ISO 15712-1 detailed calculation procedure, as described at the beginning of Chapter 2, with adaptations to deal with non-rigid joints. Two cases are relevant:

- 1. Non-loadbearing normal weight concrete block walls can be evaluated by a minor adaptation of the procedure presented in the examples of Section 2.1. Such walls would normally have sealant or a fire stop installed between the top of the masonry wall assembly and the bottom of the cast-in-place concrete floor above, as shown in the detail drawings in Examples 2.2.1 and 2.2.2. A common type of fire stop would comprise compressible rock fiber faced with pliable sealant. Such fire stops would transmit negligible vibration between the top of the wall and the floor above so they do not fit the context for Eq. E.5, but such junctions can readily be treated in the calculation by altering the calculated vibration reduction index for the affected junctions (assuming no connections through the fire stop) and making corresponding changes to the insitu losses for the adjacent surfaces. As discussed in the summary at the end of this Section, switching from rigid junctions to non-loadbearing junctions only slightly alters the overall calculated ASTC.
- 2. Wall/wall junctions with flexible interlayers are considered in ISO 15712-1. The vibration reduction index for these can be calculated using Equation E.5. The calculation is like that for rigid junctions except that different expressions are used for junction attenuation which depends on the characteristics of the interlayer. No example was included here for such cases, for which one needs specific data on the material properties of the flexible interlayer.



	ISO Symbol		Reference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (NON-rigid cross-junction,			· · · · · · · · · · · · · · · · · · ·							
Sound Transmission Loss, F1 or f1		RR-333, CON:	150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s	S	0.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR_F1	No Lining,		0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f1	No Lining,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1,	•				0.090			
TL in-situ for F1		ISO 15712-1,		41.8	44.6	52.6	61.6	70.0	78.3	56
TL in-situ for f1	R_f1,situ	ISO 15712-1,	Eq. 19	41.8	44.6	52.6	61.6	70.0	78.3	56
Junction J1 - Coupling										
Velocity Level Difference for Ff		ISO 15712-1,		7.5	7.6	7.8	8.1	8.5	9.1	
Velocity Level Difference for Fd	D_v,Fd_1,situ	ISO 15712-1,	Eq. 21, 22	8.8	9.0	9.4	9.8	10.4	11.1	
Velocity Level Difference for Df	D_v,Df_1,situ	ISO 15712-1,	Eq. 21, 22	8.8	9.0	9.4	9.8	10.4	11.1	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1,	Eq. 25a	47	50	58	68	76	85	61
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1,	Eq. 25a	46	49	57	65	73	80	61
Flanking TL for Path Df_1	R_Df	ISO 15712-1,	Eq. 25a	46	49	57	65	73	80	61
Junction 1: Flanking STC for all paths				- 10*LOG1	10(10^-	6.1 + 1	0^- 6.1	+ 10^-	6.1)=	5
Junction 2 (Rigid T-Junction, 190 mm	block separat	ing wall / 190	mm block flanking wal	I)						
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-334, NRC	Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate ISO	15712-1, Eq. C.5	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	ΔR_F2	No Lining ,		0	0	0	0	0	0	
Change by Lining on receive side	∆R_f2	No Lining ,		0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1,	Eq. C.1-C.3	0.219	0.146	0.094	0.059	0.036	0.021	
TL in-situ for F2	R_F2,situ	ISO 15712-1,	Eq. 19	36.4	39.2	45.0	50.8	58.7	62.5	50
TL in-situ for f2	R_f2,situ	ISO 15712-1,	Eq. 19	36.4	39.2	45.0	50.8	58.7	62.5	50
Junction J2 - Coupling										
Velocity Level Difference for Ff	D v,Ff 2,situ	ISO 15712-1,	Eg. 21, 22	10.9	11.1	11.5	12.0	12.7	13.5	
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1,	Eq. 21, 22	10.9	11.1	11.6	12.1	12.9	13.7	
Velocity Level Difference for Df	D v,Df 2,situ	ISO 15712-1,	Eq. 21, 22	10.9	11.1	11.6	12.1	12.9	13.7	
Flanking Transmission Loss - Path data			•							
Flanking TL for Path Ff_2	R Ff	ISO 15712-1,	Eg. 25a	48	51	58	64	72	77	62
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1,	Eq. 25a	47	50	57	63	72	76	61
Flanking TL for Path Df 2	R Df	ISO 15712-1,		47	50	57	63	72	76	61
Junction 2: Flanking STC for all paths	_			- 10*LOG1	0(10^-	6.2 + 1	0^- 6.1	+ 10^-	6.1)=	5
<pre>Junction 3 (NON-rigid cross-junction, Input data like Junction 1 except wall/i</pre>			im concrete floor)							
Flanking TL for Path Ff 3			Fa 2Fa	50	53	61	71	79	88	64
	R_Ff R Fd	ISO 15712-1, Negligible cor		90	90	90	90	90	90	90
Flanking TL for Path Fd_3	_			90 90	90	90 90	90	90	90	90
Flanking TL for Path Df_3	R_Df	Negligible cor	inection				90 + 10^-			
Junction 3: Flanking STC for all paths	1	1		- 10 - L	0010(.	10^-0.4	+ 10/	9 + 10	- 9] -	6
Junction 4 (Rigid T-junction, 190 mm	hlock constat	ing wall / 100	mm block flanking wal	n -						
All input data the same as for Junction					c factor	c vc b	Inction	2 0200		
Structural Reverb. Time in-situ		ISO 15712-1,							0.021	
TL in-situ for F4		ISO 15712-1, ISO 15712-1.					0.063			50
TL in-situ for F4	_ ,	,					50.6			
	κ_14,SILU	ISO 15712-1,	LY. 13	36.0	38.8	44.7	50.6	58.4	62.3	50
Junction J4 - Coupling		160 15712 4	Fa 21 22	10 5	10.0	11 7	11.0	12 5	12.2	
Velocity Level Difference for Ff		ISO 15712-1,		10.5		11.2	11.8		13.3	
Velocity Level Difference for Fd		ISO 15712-1,		10.7		11.4	12.0	12.7	13.6	
Velocity Level Difference for Df		ISO 15712-1,	cy. 21, 22	10.7	11.0	11.4	12.0	12.7	13.6	
Flanking Transmission Loss - Path data		160 15742 4	Fa 2Fa	47	F 4	F 7	62	72	77	~~~
Flanking TL for Path Ff_4	R_Ff	ISO 15712-1,	•	47	51	57	63	72	77	62
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1,	•	47	50	56	63	71	76	61
Flanking TL for Path Df_4	R_Df	ISO 15712-1,	Eq. 25a	47	50	56	63	71	76	61
Junction 4: Flanking STC for all paths				- 10*LOG1	10(10^-	o.2 + 1	U ^{^-} 6.1	+ 10^-	6.1)=	5
Total Flanking (for all 4 junctions)										5
ASTC due to Direct alua Flanking Dath	-	DD 221 Fa 4	1	33	36	42	40	57	61	47
ASTC due to Direct plus Flanking Path	`	RR-331, Eq. 1	.4	33	30	42	49	57	61	47



	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (NON-rigid cross-junction,									
Sound Transmission Loss, F1 or f1		RR-334, Mean TL-BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5				0.072			
Change by Lining on source side		No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f1	No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.071			
TL in-situ for F1		ISO 15712-1, Eq. 19	35.3	38.2	44.1	50.1	58.0	62.0	49
TL in-situ for f1	R_f1,situ	ISO 15712-1, Eq. 19	35.3	38.2	44.1	50.1	58.0	62.0	49
Junction J1 - Coupling									
Velocity Level Difference for Ff		Negligible connection							
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	8.8	9.0	9.4	9.8	10.4	11.1	
Velocity Level Difference for Df		Negligible connection							
Flanking Transmission Loss - Path data		AT 11 11 11		~~		~~			
Flanking TL for Path Ff_1	R_Ff	Negligible connection	90	90	90	90	90	90	90
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a	49	52	59	67	75	82	63
Flanking TL for Path Df_1	R_Df	Negligible connection	90	90	90	90	90	90	90
Junction 1: Flanking STC for all paths			- 10*L	OG10(1	10^-9 +	10^-6	.3 + 10	^-9)=	6
Junction 2 (Rigid T-Junction, 150 mm (concrete con	visiting floor (100 mm block wall)							
Sound Transmission Loss. F2 or f2			25	38	44	50	58	62	49
Sound Transmission Loss, F2 or f2		RR-334, Mean TL-BLK190(NW) Estimate Eg. C.5	35			50 0.072			49
	- '		0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side Change by Lining on receive side	ΔR_F2 ΔR_f2	No lining , No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	-	ISO 15712-1, Eq. C.1-C.3				0.059			
TL in-situ for F2		ISO 15712-1, Eq. 19	36.4	39.2	45.0	50.9	58.7	62.5	50
TL in-situ for f2		ISO 15712-1, Eq. 19	36.4	39.2		50.9	58.7	62.5	50
unction J2 - Coupling	K_12,Situ	130 137 12-1, Lq. 19	30.4	39.2	45.0	30.9	50.7	02.5	50
Velocity Level Difference for Ff	D v Ef 2 situ	ISO 15712-1, Eq. 21, 22	11.3	11.5	11.9	12.4	13.1	13.9	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	9.8	10.0	10.3	10.7	11.2	11.9	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	9.8	10.0	10.3	10.7	11.2	11.9	
Flanking Transmission Loss - Path data		130 137 12 1, 24. 21, 22	5.0	10.0	10.5	10.7	11.2	11.5	
Flanking TL for Path Ff_2	R Ff	ISO 15712-1, Eq. 25a	51	54	60	66	75	79	65
Flanking TL for Path Fd 2	R Fd	ISO 15712-1, Eq. 25a	51	54	61	69	77	84	65
Flanking TL for Path Df 2	R_Df	ISO 15712-1, Eq. 25a	51	54	61	69	77	84	65
Junction 2: Flanking STC for all paths	_	-	- 10*LOG1			0^- 6.5	+ 10^-	6.5)=	6
	450								
Junction 3 (NON-rigid cross-junction, All values the same as for Junction 1	150 mm conc	rete floor / 190 mm block wall)							
Flanking TL for Path Ff_3	R Ff	Negligible connection	90	90	90	90	90	90	90
Flanking TL for Path Fd_3	R Fd	ISO 15712-1, Eq. 25a	49	52	59	67	75	82	63
Flanking TL for Path Df 3		Negligible connection	90	90	90	90	90	90	90
Junction 3: Flanking STC for all paths	K_DI	Negligible connection				10^-6			6
8				0010(1		10 0			
Junction 4 (Rigid cross-junction, 150 r	nm concrete	separating floor / 190 mm block wall)							
All input data the same as for Junction	2, but differe	nt junctions at ceiling and floor change	loss factor	rs from	Junctio	on 2			
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.063			
TL in-situ for F4		ISO 15712-1, Eq. 19	36.0	38.8	44.7	50.6	58.4	62.3	50
TL in-situ for f4		ISO 15712-1, Eq. 19	36.0			50.6		62.3	50
Junction J4 - Coupling									
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	14.4	14.7	15.1	15.6	16.3	17.2	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	12.6	12.8	13.1	13.6	14.1	14.8	
Velocity Level Difference for Df	D_v,Df_4,situ	ISO 15712-1, Eq. 21, 22	12.6	12.8	13.1	13.6	14.1	14.8	
	1								
Flanking Transmission Loss - Path data	R Ff	ISO 15712-1, Eq. 25a	53	57	63	69	78	83	68
Flanking TL for Path Ff_4				56	64	71	80	86	67
Flanking TL for Path Ff_4	R_Fd	ISO 15712-1, Eq. 25a	53	50	•.				
Flanking TL for Path Ff_4 Flanking TL for Path Fd_4	_	ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	53	56	64	71	80	86	67
Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	R_Fd	ISO 15712-1, Eq. 25a		56	64	71	80	86	67
Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	R_Fd	ISO 15712-1, Eq. 25a	53	56	64	71	80	86	67 6
Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths Total Flanking (for all 4 junctions)	R_Fd	ISO 15712-1, Eq. 25a	53	56	64	71	80	86	

<u>Summary for Section 2.2: Calculation Examples for Concrete and Concrete Masonry</u> <u>Constructions with Non-Rigid Junctions</u>

The worked examples 2.2.1 and 2.2.2 illustrate the process for calculating sound transmission between rooms in a building with bare cast-in-place concrete floor/ceilings and concrete masonry wall assemblies where there is a non-rigid (non-loadbearing) junction between the top of the masonry wall and the cast-in-place concrete floor above (due to the presence of a soft firestop material).

For both the side-by-side room pair (Example 2.2.1) and the rooms one-above-the-other (Example 2.2.2) the ASTC is equal or lower than the STC of the separating assembly. For the specific wall and floor assemblies in the examples, the difference is 2 points for the horizontal pair and 0 points for the vertical pair. Different mass ratios of the building elements would alter the specific differences. The basic issue is that ASTC values tend to be lower than the corresponding STC value, and that the total Flanking Transmission Loss (due to the combination of 12 flanking paths) is of similar importance to the Direct Transmission Loss through the separating wall.

Examination of the individual flanking paths in the examples of Section 2.1 and 2.2 shows that some junctions transmit less vibration energy when a non-rigid junction is used, because the soft junction blocks some transmission paths. But this has only a small effect on the ASTC of the complete system because the paths via the remaining rigid connections transmit more vibration energy. Overall, the ASTC for these examples remains the same compared with the rigid case for side-by-side rooms, and increases by 1 point where one room is above the other.

Overall, the key conclusion is that introducing non-loadbearing masonry walls has only a small effect on the overall ASTC between adjacent rooms, and can readily be offset by the choice of suitable linings as shown in the following Section.

2.3. Adding "Linings" to Walls, Floors, and Ceilings in Concrete/Masonry Buildings

The practicality of the calculation framework of ISO 15712-1 comes from the straightforward extension to deal with the incremental effect of "linings" added to the bare structural elements. Here, as before, "bare" is taken to mean the assembly of concrete or masonry without a lining such as an added gypsum board finish on the walls or ceiling, or flooring over the cast-in-place concrete slab. The "bare" surface could be painted or sealed, or have a thin coat of plaster.

It is common practice, especially in residential buildings, to add finish surfaces to the basic structural wall and floor assemblies – for example, various flooring products, and gypsum board wall or ceiling surfaces that conceal both the bare concrete surfaces and building services such as electrical wiring, water pipes and ventilation ducts. These are described in ISO 15712-1 as "linings" or "liners" or "layers". The first term, "linings" is used in this Guide.

<u>Wall or ceiling linings</u> typically include lightweight framing supporting the gypsum board surface layer and often include sound absorptive material³ in the cavities between the bare assembly and the gypsum board.

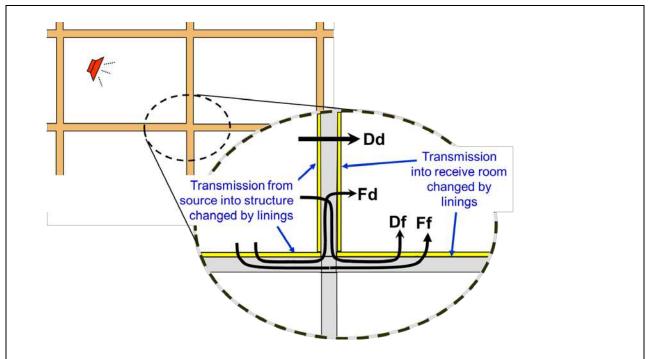


Figure 2.3: Transmission combines direct path through separating wall (Dd) and structure-borne flanking via paths Df, Fd, and Ff at each of the four edges of the separating assembly. Transmission via these paths is altered by addition of linings in the source room and/or receiving room.

Adding a lining can significantly improve the sound attenuation by changing the flow of sound power from the reverberant sound field in the source room to the resonant vibration in the structural assembly. It is assumed that adding the linings does not alter power flow between the heavy structural assemblies. As shown conceptually in Figure 2.3, the practical calculation combines the basic flow of structure-borne power via the coupled structural elements, with simple additive changes due to the linings. This approach works very well for common monolithic supporting structures of cast-in-place concrete or masonry that are much heavier than the linings.

Input Data for the Improvement due to Linings

A standard process for evaluating linings is given in ISO 10140-1; its ASTM counterpart uses ASTM E90 to measure the change between the TL for a bare concrete or masonry assembly and the TL for the same assembly with the lining added. The improvement depends slightly on mass and porosity of the bare assembly. Theoretically, this change in TL should be corrected to remove the non-resonant part of the transmission for flanking paths, but as noted in ISO 15712-1, the laboratory result gives a good (slightly conservative) estimate. Uncorrected ASTM E90 test data for linings are used in this Guide.

Note that the lining may be installed on either the source or the receiving side of the base assembly for the ASTM E90 test, and the result may be used for a lining added on either side of a matching assembly.

Including Linings in the Calculation Process

Adding the changes in sound transmission due to linings requires only minor extensions from the eight steps described at the beginning of Chapter 2:

- At Step 4: to calculate direct sound transmission loss in-situ through the separating assembly, add the laboratory data for TL change due to an added lining on the source side and the laboratory data for TL change due to an added lining on the receiving side using Eq. 24 of ISO 15712-1. The changes are identified in Eq. 24 as $\Delta R_{D,situ}$ and $\Delta R_{d,situ}$ respectively.
- At Step 8: to calculate flanking sound transmission via each flanking path, add the laboratory data for TL change due to an added lining on the assembly in the source room and the laboratory data for TL change due to an added lining on the assembly in the receiving room, using Eq. 24 of ISO 15712-1. The changes are identified in the equation as $\Delta R_{i,situ}$ and $\Delta R_{i,situ}$ respectively.

Other than these two additions, the process remains unchanged from that described in Section 2.1.

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EXAMPLE 2.3.1:

DETAILED METHOD

- Rooms side-by-side
- Cast-in-place concrete floors and normal weight concrete block walls with rigid junctions
- Same structure as Example 2.1.1, plus lining of walls

Separating wall assembly (loadbearing) with:

- One wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m²
- Both sides lined with 13 mm gypsum board⁴ supported on 65 mm non-loadbearing steel studs⁵ spaced 600 mm o.c., with no absorptive material³ filling stud cavities

Junction 1: Bottom Junction (separating wall / floor) with:

- Cast-in-place concrete floor with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no topping or flooring
- Rigid mortared cross-junction with concrete block wall assembly

Junction 2 or 4: Each Side (separating wall /abutting side wall) with:

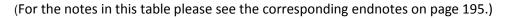
- Abutting side wall and separating wall of hollow concrete block masonry¹ with mass per area of 238 kg/m², with rigid mortared Tjunctions
- Flanking walls lined with 13 mm gypsum board⁴ supported on 65 mm non-loadbearing steel studs⁵ spaced 600 mm o.c. with no absorptive material³ filling stud cavities

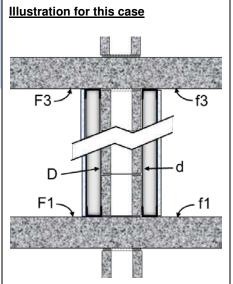
Junction 3: Top Junction (separating wall / ceiling) with:

- Cast-in-place concrete ceiling with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no added ceiling lining
- Rigid mortared cross-junction with concrete block wall assembly

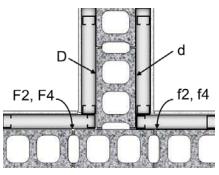
Acoustical Parameters:

<u>//coustical l'alan</u>											ļ
For separat	ing assembly:								F2, F	4	
internal loss, η_i =	0.015		C	:_L =	3500			-			z
mass (kg/m ²) =	238		1	f_c =	98		(Eq. C.2)	100	N. 10. 191.2	COLUMN T	
	Reference	К_	Ff K_	Dd'	K_Fd	K_Df	Σl_k.α_k	1	E	T	1
X-Junction 1 or 3	ISO 15712-1, Ed	q. E.3 6.	1 1	1.6	8.8	8.8	0.571		A	A	
T-Junction 2 or	ISO 15712-1, Ed	q. E.4 5.	7		5.7	5.7	0.420	369	18.41.212	14.8780.4	84
Total loss, η_tot	ISO 15712-1, Ed	q. C.1			0.041	(at 500	Hz)				
Similarly fo	or flanking eleme	ents F and f	at lun	ction	1& 3				nction		
internal loss, n i =					3500				le wal		
mass $(kg/m^2) =$				∟ = f с =					ock wi Ian vie		
Total loss, n tot		n C 1		_ L -		(at 500	L-)	(Г			J
	1 3 0 13712-1, EC	4. C. I			0.028	(at 500	Π2)				
Similarly, fo	or flanking eleme	ents F and f	at Jun	ction	2&4,						
internal loss, η_i =	0.015		C	:_L =	3500						
mass (kg/m ²) =	238		f	f_c =	98						
Total loss, η_tot,2	ISO 15712-1, Ed	q. C.1			0.047	(at 500	Hz)				
Total loss, η_tot,4	ISO 15712-1, Ed	q. C.1			0.043	(at 500	Hz)				
		ISO Symbo			Refe	rence		125	250	500	:
Separating Partition	(190 mm concret	e block)									
Sound Transmission	· · /	R_D,lab			RC Mean	•	NW)	35	38	44	
Structural Reverberat		T_s,lab			1, Eq. C.				0.191		(
Change by Lining on s		∆R_D					1, SS65_G13		8	14	
Change by Lining on r		_∆R_d				• •	1, SS65_G13		8	14	
Structural Reverb. Tir		T_s,situ			1, Eq. C.:	1-0.3			0.169		(
Leakage or Airborne I Direct TL in-situ	напкіпg	R D,situ			ocked 1, Eq. 24	l		0.0 28	0.0 55	0.0 72	
Direct TE III-Situ		n_D,situ		7712-	т, с ч . 24			20	- 35	12	





Junction of 190 mm concrete block separating wall (with gypsum board lining) with 150 mm thick cast-in-place concrete floor and ceiling. (Side view of Junctions 1 and 3)



eparating wall with flanking h of 190 mm concrete psum board linings. Junction 2 or 4)

50

15

15

0.0

80

58 0.072 0.042 0.024

13

13

0.067 0.040 0.023

0.0

84

1000 2000 4000 STC or ASTC

62

16

16

0.0

90

49

52

	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (Rigid cross-junction, 190		parating wall / 150 mm concrete floor)							
Sound Transmission Loss, F1 or f1		RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T s,lab	Measured T s				0.205			
Change by Lining on source side	ΔR_F1	No Lining ,	0	0	0	0	0	0	
Change by Lining on receive side	$\Delta R f1$	No Lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.104			
TL in-situ for F1	_	ISO 15712-1, Eq. 19	41.0	43.9	52.0	60.9	69.4	77.8	55
TL in-situ for f1		ISO 15712-1, Eq. 19	41.0	43.9	52.0	60.9	69.4	77.8	55
Junction J1 - Coupling	n_11,5itu	100 107 12 1, Eq. 15	11.0	13.5	52.0	00.5	05.1	77.0	55
Velocity Level Difference for Ff	D v Ff 1 sit	ISO 15712-1, Eg. 21, 22	9.3	9.4	9.7	10.0	10.5	11.1	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	11.6	11.8	12.2	12.6	13.2	14.0	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	11.6	11.8	12.2	12.6	13.2	14.0	
Flanking Transmission Loss - Path dat		130 137 12 1, Eq. 21, 22	11.0	11.0	12.2	12.0	15.2	14.0	
Flanking TL for Path Ff_1	R Ff	ISO 15712-1, Eq. 25a	48	51	60	69	78	87	62
Flanking TL for Path Fd 1	R_Fd	ISO 15712-1, Eq. 25a	45	60	73	82	89	90	69
Flanking TL for Path Df 1	R_Df	ISO 15712-1, Eq. 25a	45	60	73	82	89	90	69
Junction 1: Flanking STC for all paths	K_DI		0*LOG1						05
function 1. Hanking STC for an paths		- 10	0 1001	- 01)0 -	0.2 1 1	0 - 0.9	110 -	0.57-	
Junction 2 (Rigid T. Junction, 100 mm	block conorce	ting wall / 190 mm block flanking wall)							
			25	20	4.4	EO	EO	62	49
Sound Transmission Loss, F2 or f2		RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	ISO 15712-1, Eq. C.5				0.072			
Change by Lining on source side Change by Lining on receive side	ΔR_F2 ΔR_f2	RR-334, ΔTL-BLK190(NW)-61, SS65_G13	-4	8 8	14 14	15 15	13 13	16	
		RR-334 , ΔTL-BLK190(NW)-61, SS65_G13	-4					16	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.059			50
TL in-situ for F2		ISO 15712-1, Eq. 19	36.4	39.2	45.0	50.8	58.7	62.5	50
TL in-situ for f2	R_T2,situ	ISO 15712-1, Eq. 19	36.4	39.2	45.0	50.8	58.7	62.5	50
Junction J2 - Coupling									
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	10.9	11.1	11.5	12.0	12.7	13.5	
Velocity Level Difference for Fd		ulso 15712-1, Eq. 21, 22	11.0	11.3	11.7	12.3	13.0	13.8	
Velocity Level Difference for Df		u ISO 15712-1, Eq. 21, 22	11.0	11.3	11.7	12.3	13.0	13.8	
Flanking Transmission Loss - Path dat									
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, Eq. 25a	40	67	86	90	90	90	64
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq. 25a	40	67	85	90	90	90	64
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq. 25a	40	67	85	90	90	90	64
Junction 2: Flanking STC for all paths		- 10	0*LOG1	.0(10^-	6.4 + 1	0^- 6.4	+ 10^-	6.4)=	
	mm block sep	arating wall / 150 mm concrete ceiling)							
All values the same as for Junction 1									
Junction 3: Flanking STC for all paths			1	1	1	1		1	
	block constat	ting wall / 190 mm block flanking wall)							
Junction 4 (Rigid T-junction, 190 mm				s from	lunctic	on 2			
All input data the same as for Junctio	n 2, but differe	ent junctions at ceiling and floor change los						0 021	
All input data the same as for Junctio Structural Reverb. Time in-situ	n 2, but differe T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.238	0.158	0.102	0.063			
All input data the same as for Junctio Structural Reverb. Time in-situ IL in-situ for F4	n 2, but differe T_s,situ R_F4,situ	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19	0.238 36.0	0.158 38.8	0.102 44.7	50.6	58.4	62.3	50
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4	n 2, but differe T_s,situ R_F4,situ	ISO 15712-1, Eq. C.1-C.3	0.238 36.0	0.158	0.102 44.7	50.6		62.3	50 50
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling	n 2, but differe T_s,situ R_F4,situ R_f4,situ	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19	0.238 36.0 36.0	0.158 38.8 38.8	0.102 44.7 44.7	50.6 50.6	58.4 58.4	62.3 62.3	
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff	n 2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19	0.238 36.0 36.0	0.158 38.8 38.8	0.102 44.7 44.7	50.6	58.4 58.4	62.3 62.3 13.3	
All input data the same as for Junctio Structural Reverb. Time in-situ I'L in-situ for F4 I'L in-situ for f4 <u>Iunction J4 - Coupling</u> Velocity Level Difference for Ff Velocity Level Difference for Fd	n 2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Fd_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22	0.238 36.0 36.0 10.5 10.8	0.158 38.8 38.8 10.8 11.1	0.102 44.7 44.7 11.2 11.6	50.6 50.6 11.8 12.1	58.4 58.4 12.5 12.9	62.3 62.3 13.3 13.7	
All input data the same as for Junctio Structural Reverb. Time in-situ IT in-situ for F4 IT in-situ for f4 <u>Junction J4 - Coupling</u> Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19	0.238 36.0 36.0 10.5	0.158 38.8 38.8 10.8	0.102 44.7 44.7 11.2 11.6	50.6 50.6 11.8	58.4 58.4 12.5	62.3 62.3 13.3	
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path dat	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22	0.238 36.0 36.0 10.5 10.8	0.158 38.8 38.8 10.8 11.1	0.102 44.7 44.7 11.2 11.6	50.6 50.6 11.8 12.1	58.4 58.4 12.5 12.9	62.3 62.3 13.3 13.7	
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path dat	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22	0.238 36.0 36.0 10.5 10.8	0.158 38.8 38.8 10.8 11.1	0.102 44.7 44.7 11.2 11.6	50.6 50.6 11.8 12.1	58.4 58.4 12.5 12.9	62.3 62.3 13.3 13.7	
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path dat Flanking TL for Path Ff_4	2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Ff_4,sit D_v,Fd_4,sit	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 USO 15712-1, Eq. 21, 22 USO 15712-1, Eq. 21, 22	0.238 36.0 36.0 10.5 10.8 10.8	0.158 38.8 38.8 10.8 11.1 11.1	0.102 44.7 44.7 11.2 11.6 11.6	50.6 50.6 11.8 12.1 12.1	58.4 58.4 12.5 12.9 12.9	62.3 62.3 13.3 13.7 13.7	50
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Df Flanking Transmission Loss - Path dat Flanking TL for Path Ff_4 Flanking TL for Path Ff_4	n 2, but differe T_s,situ R_F4,situ R_f4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit a R_Ff	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22	0.238 36.0 36.0 10.5 10.8 10.8 39	0.158 38.8 38.8 10.8 11.1 11.1 67	0.102 44.7 44.7 11.2 11.6 11.6 85	50.6 50.6 11.8 12.1 12.1 90	58.4 58.4 12.5 12.9 12.9 90	62.3 62.3 13.3 13.7 13.7 90	50 63
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Df Elanking Transmission Loss - Path dat Flanking TL for Path Ff_4 Flanking TL for Path Df_4	n 2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit a R_Ff R_Fd	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	0.238 36.0 36.0 10.5 10.8 10.8 10.8 39 39	0.158 38.8 38.8 10.8 11.1 11.1 67 67 67	0.102 44.7 44.7 11.2 11.6 11.6 85 84 84	50.6 50.6 11.8 12.1 12.1 90 90 90 90	58.4 58.4 12.5 12.9 12.9 90 90 90 90	62.3 62.3 13.3 13.7 13.7 90 90 90	50 63 63 63
	n 2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit a R_Ff R_Fd	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	0.238 36.0 36.0 10.5 10.8 10.8 10.8 39 39 39	0.158 38.8 38.8 10.8 11.1 11.1 67 67 67	0.102 44.7 44.7 11.2 11.6 11.6 85 84 84	50.6 50.6 11.8 12.1 12.1 90 90 90 90	58.4 58.4 12.5 12.9 12.9 90 90 90 90	62.3 62.3 13.3 13.7 13.7 90 90 90	50 63 63 63
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Df Elanking Transmission Loss - Path dat Flanking TL for Path Ff_4 Flanking TL for Path Df_4	n 2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit a R_Ff R_Fd	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	0.238 36.0 36.0 10.5 10.8 10.8 10.8 39 39 39	0.158 38.8 38.8 10.8 11.1 11.1 67 67 67	0.102 44.7 44.7 11.2 11.6 11.6 85 84 84	50.6 50.6 11.8 12.1 12.1 90 90 90 90	58.4 58.4 12.5 12.9 12.9 90 90 90 90	62.3 62.3 13.3 13.7 13.7 90 90 90	50 63 63
All input data the same as for Junctio Structural Reverb. Time in-situ TL in-situ for F4 TL in-situ for f4 Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Df Flanking Transmission Loss - Path dat Flanking TL for Path Ff_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	n 2, but differe T_s,situ R_F4,situ D_v,Ff_4,situ D_v,Ff_4,sit D_v,Fd_4,sit D_v,Df_4,sit a R_Ff R_Fd	ISO 15712-1, Eq. C.1-C.3 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 19 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 21, 22 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	0.238 36.0 36.0 10.5 10.8 10.8 10.8 39 39 39	0.158 38.8 38.8 10.8 11.1 11.1 67 67 67	0.102 44.7 44.7 11.2 11.6 11.6 85 84 84	50.6 50.6 11.8 12.1 12.1 90 90 90 90	58.4 58.4 12.5 12.9 12.9 90 90 90 90	62.3 62.3 13.3 13.7 13.7 90 90 90	50 63 63 63

EXAMPLE 2.3.2:

DETAILED METHOD

- Rooms side-by-side
- Cast-in-place concrete floors and normal weight concrete block walls with rigid junctions
- Same structure as Example 2.1.1, enhanced lining of walls

Separating wall assembly (loadbearing) with:

- One wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m²
- Separating wall lined both sides with 13 mm gypsum board⁴ on 65 mm non-loadbearing steel studs⁵ spaced 600 mm o.c., with absorptive material³ filling stud cavities

Junction 1: Bottom Junction (separating wall / floor) with:

- Cast-in-place concrete floor with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no topping or flooring
- Rigid mortared cross-junction with concrete block wall assembly

Junction 2 or 4: Each Side (separating wall /abutting side wall) with:

- Rigid mortared T-junctions of abutting side wall and separating wall of hollow concrete block masonry¹ with mass per area of 238 kg/m²
- Flanking walls lined with 13 mm gypsum board⁴ on 65 mm nonloadbearing steel studs⁵ spaced 600 mm o.c., with absorptive material³ filling stud cavities

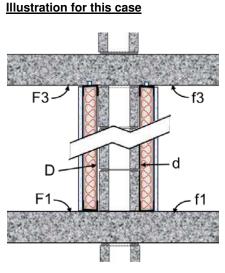
Junction 3: Top Junction (separating wall / ceiling) with:

- Cast-in-place concrete ceiling with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no added ceiling lining
- Rigid mortared cross-junction with concrete block wall assembly.

Acoustical Parameters:

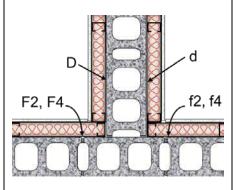
- loodollou - u.u.						
For separat	ing assembly:					
internal loss, η_i =	0.015		c_L =	3500		
mass (kg/m ²) =	238		f_c =	98		(Eq. C.2)
	Reference	K_Ff	K_Dd'	K_Fd	K_Df	Σl_k.α_k
X-Junction 1 or 3	ISO 15712-1, Eq. E.3	6.1	11.6	8.8	8.8	0.571
T-Junction 2 or	ISO 15712-1, Eq. E.4	5.7		5.7	5.7	0.420
Total loss, η_tot	ISO 15712-1, Eq. C.1			0.041	(at 500	Hz)
Similarly, fo	or flanking elements F a	nd f at J	lunction	1&3,		
internal loss, η_i =	0.006		c_L =	3500		
mass (kg/m ²) =	345		f_c =	124		
Total loss, η_tot	ISO 15712-1, Eq. C.1			0.028	(at 500	Hz)

Similarly, for flanking elements F and f at Junction 2 & 4, internal loss, $\eta i = 0.015$ c L = 3500 mass $(kg/m^2) = 238$ f_c = 98 Total loss, η_tot,2 ISO 15712-1, Eq. C.1 0.047 (at 500 Hz) Total loss, η_tot,4 ISO 15712-1, Eq. C.1



Junction of 190 mm concrete block separating wall (with enhanced gypsum board lining) with 150 mm thick cast-inplace concrete floor and ceiling.

(Side view of Junctions 1 and 3)



Junction of separating wall with flanking side wall, both of 190 mm concrete block with enhanced gypsum board linings.

(Plan view of Junction 2 or 4)

	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (190 mm concr	ete block)								
Sound Transmission Loss (TL)	R_D,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	ISO 15712-1, Eq. C.5	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	∆R_D	RR-334, ATL-BLK190(NW)-62, SS65_GFB	6 11	19	21	18	17	21	
Change by Lining on receive side	ΔR_d	RR-334, ATL-BLK190(NW)-62, SS65_GFB	6 11	19	21	18	17	21	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.256	0.169	0.108	0.067	0.040	0.023	
Leakage or Airborne Flanking		Sealed & Blocked	0.0	0.0	0.0	0.0	0.0	0.0	
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	58	77	86	86	90	90	82

0.043 (at 500 Hz)

	ISO Symbol		Reference		125	250	500	1000	2000	4000	STC or AST
lunction 1 (Rigid cross-junction, 190	mm block sep	arating wall /	150 mm concrete flo	oor)							
ound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON	150, TLF-15-045		40	42	50	58	66	75	53
Structural Reverberation Time	T s,lab	Measured T	s	C).439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR_F1	No Lining,			0	0	0	0	0	0	
Change by Lining on receive side	ΔR f1	No Lining ,			0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1,	Ea. C.1-C.3	0).347	0.238	0.159		0.066		
ΓL in-situ for F1		ISO 15712-1,			41.0	43.9	52.0	60.9	69.4	77.8	55
TL in-situ for f1		ISO 15712-1,			41.0	43.9	52.0	60.9	69.4	77.8	55
Iunction J1 - Coupling	11,510	150 157 12 1,	Lq. 15		11.0	13.5	52.0	00.5	05.1	77.0	55
Velocity Level Difference for Ff	D v Ef 1 situ	ISO 15712-1,	Fg 21 22		9.3	9.4	9.7	10.0	10.5	11.1	
Velocity Level Difference for Fd		ISO 15712-1,			11.6	11.8	12.2	12.6	13.2	14.0	
Velocity Level Difference for Df		ISO 15712-1,			11.6	11.8	12.2	12.6	13.2	14.0	
Flanking Transmission Loss - Path data		.130 13712-1,	Eq. 21, 22		11.0	11.0	12.2	12.0	15.2	14.0	
	-	100 15712 1	F-, 2F-		40	- 4		<u> </u>	70	07	~ ~ ~
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1,	1		48	51	60	69	78	87	62
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1,			60	71	80	85	90	90	82
Flanking TL for Path Df_1	R_Df	ISO 15712-1,	Eq. 25a	1.0	60	71	80	85	90	90	82
unction 1: Flanking STC for all paths		1		- 10*	*LOG1	.0(10^-	6.2+1	0^- 8.2	+ 10^-	8.2)=	f
unction 2 (Pigid T Junction 100 mm	block constat	ing wall / 10) mm block flanking u								
lunction 2 (Rigid T-Junction, 190 mm			Mean BLK190(NW)	valij	35	38	44	50	58	62	49
Sound Transmission Loss, F2 or f2	R_F2,lab	,	• • •	- ,							49
Structural Reverberation Time	T_s,lab	ISO 15712-1,							0.042		
Change by Lining on source side	ΔR_F2	-	-BLK190(NW)-62, SS6	_		19	21	18	17	21	
Change by Lining on receive side	∆R_f2		-BLK190(NW)-62, SS6	_		19	21	18	17	21	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1,							0.036		
TL in-situ for F2	_	ISO 15712-1,			36.4	39.2	45.0	50.8	58.7	62.5	50
TL in-situ for f2	R_f2,situ	ISO 15712-1,	Eq. 19		36.4	39.2	45.0	50.8	58.7	62.5	50
Junction J2 - Coupling											
Velocity Level Difference for Ff	D_v,Ff_2,situ	ISO 15712-1,	Eq. 21, 22		10.9	11.1	11.5	12.0	12.7	13.5	
Velocity Level Difference for Fd	D_v,Fd_2,site	ISO 15712-1,	Eq. 21, 22		11.0	11.3	11.7	12.3	13.0	13.8	
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1,	Eq. 21, 22		11.0	11.3	11.7	12.3	13.0	13.8	
Flanking Transmission Loss - Path data	a										
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1,	Eq. 25a		70	89	90	90	90	90	89
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1,	Eq. 25a		70	89	90	90	90	90	89
Flanking TL for Path Df_2	R_Df	ISO 15712-1,			70	89	90	90	90	90	89
Junction 2: Flanking STC for all paths	_			- 10'	*LOG1	0(10^-	8.9 + 1	0^- 8.9	+ 10^-	8.9) =	8
Junction 3 (Rigid cross-junction, 190	<mark>mm block sep</mark>	arating wall /	150 mm concrete ce	<mark>iling)</mark>							
All values the same as for Junction 1											
Junction 3: Flanking STC for all paths											e
Junction 4 (Rigid T-junction, 190 mm	block separat	ing wall / 190) mm block flanking v	vall)							
All input data the same as for Junction	n 2, but differe	nt junctions a	t ceiling and floor cha	nge loss i	factor	s from	Junctio	n 2			
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1,	Eq. C.1-C.3	0).238	0.158	0.102	0.063	0.038	0.021	
TL in-situ for F4	R_F4,situ	ISO 15712-1,	Eq. 19		36.0	38.8	44.7	50.6	58.4	62.3	50
TL in-situ for f4	R_f4,situ	ISO 15712-1,	Eq. 19		36.0	38.8	44.7	50.6	58.4	62.3	50
Junction J4 - Coupling											
Velocity Level Difference for Ff	D v,Ff 4,situ	ISO 15712-1,	Eq. 21, 22		10.5	10.8	11.2	11.8	12.5	13.3	
Velocity Level Difference for Fd		ISO 15712-1,			10.8	11.1	11.6	12.1		13.7	
Velocity Level Difference for Df		ISO 15712-1,			10.8	11.1	11.6	12.1	12.9	13.7	
Flanking Transmission Loss - Path data					_0.0						
Flanking TL for Path Ff 4	R Ff	ISO 15712-1,	Fg 25a		69	89	90	90	90	90	89
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1,			69	89	90	90	90	90	89
Flanking TL for Path Df_4	-	ISO 15712-1,			69	89	90	90	90	90	89
rianking il iui ralli UI_4	R_Df	130 13712-1,	Ly. 23d	10					+ 10^-		
Junction A: Flanking STC for all nothe				- 10	1001	O(TO	0.5 ± 1	00.9	- TO	0.91=	8
Junction 4: Flanking STC for all paths	Ť.	i i		1							
- · ·											r
Junction 4: Flanking STC for all paths Total Flanking (for all 4 junctions)											

EXAMPLE 2.3.3: DETAILED METHOD Illustration for this case Rooms one-above-the-other Cast-in-place concrete floors and normal weight concrete block walls with rigid junctions Same structure as Example 2.1.2, plus lining of walls F1, F3 Separating floor/ceiling assembly with: Cast-in-place concrete floor with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no topping or flooring on top, or ceiling lining below Junction 1, 3 or 4: Cross-junction of separating floor / flanking wall with: Rigid mortared cross-junction with concrete block wall assemblies Wall above and below floor of one wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than d 53% solid, and with mass per area of 238 kg/m² f1. f3 Flanking walls lined with 13 mm gypsum board⁴ on 65 mm non-• loadbearing steel studs⁵ spaced 600 mm o.c. with no absorptive material³ filling stud cavities Cross-junction of separating floor of 150 mm thick cast-in-place concrete Junction 2: T-Junction of separating floor / flanking wall with: with 190 mm concrete block wall. (Side • Rigid mortared T-junction with concrete block wall assemblies view of Junctions 1 or 3) Wall above and below floor of one wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m² Flanking walls lined with 13 mm gypsum board⁴ on 65 mm nonloadbearing steel studs⁵ spaced 600 mm o.c. with no absorptive F2 material³ filling stud cavities П Acoustical Parameters: For separating assembly: internal loss, $\eta_i = 0.006$ c_L = 3500 mass $(kg/m^2) = 345$ f c = 124 (Eq. C.2) K Df Reference K Ff K Dd' K Fd Σl k.α k X-Junction 1, 3, 4 ISO 15712-1, Eq. E.3 11.6 8.8 0.843 6.1 8.8 T-Junction 2 ISO 15712-1, Eq. E.4 8.1 5.8 0.657 5.8 Total loss, η_tot ISO 15712-1, Eq. C.1 0.028 (at 500 Hz) Similarly, for flanking elements F and f at Junction 1 & 3, f2 internal loss, η_i = 0.015 c_L = 3500 mass $(kg/m^2) = 238$ f c = 98 Total loss, n tot ISO 15712-1, Eq. C.1 0.041 (at 500 Hz) T-Junction of separating floor of 150 mm thick concrete with 190 mm Similarly, for flanking elements F and f at Junction 2 & 4, concrete block wall. (Side view of internal loss, $\eta_i = 0.015$ c_L = 3500 Junction 2. Junction 4 has same lining mass (kg/m²) = 238 f_c = 98 details, but cross-junction) Total loss, η_tot,2 ISO 15712-1, Eq. C.1 0.047 (at 500 Hz) Total loss, η_tot,4 ISO 15712-1, Eq. C.1 0.043 (at 500 Hz) 500 1000 2000 4000 STC or ASTC ISO Symbol 125 250 Reference Separating Partition (150 mm concrete floor) RR-333, CON150, TLF-15-045 R_D,lab 40 42 75 53 Sound Transmission Loss (TL) 50 58 66 Structural Reverberation Time T s,lab Measured T s 0.44 0.37 0.25 0.21 0.15 0.08 Change by Lining on source side ∆R D No lining. 0 0 0 0 0 0 Change by Lining on receive side ΔR_d No lining, 0 0 0 0 0 0 Structural Reverb. Time in-situ ISO 15712-1, Eq. C.1-C.3 0.346 0.237 0.159 0.104 0.066 0.041 T_s,situ Leakage or Airborne Flanking Sealed & Blocked 0.0 0.0 0.0 0.0 0.0 0.0 Direct TL in-situ R_D,situ ISO 15712-1, Eq. 24 41 55 44 52 61 69 78

	ISO Symbol	R	eference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (Rigid cross-junction, 150 r							<u> </u>			_
Sound Transmission Loss, F1 or f1			ean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time		ISO 15712-1, Eq					0.072			
Change by Lining on source side	ΔR F1		. 0.5 K190(NW)-61, SS65 G13		8	14	15	13	16	
Change by Lining on receive side	ΔR_{1}	· · · · · · · · · · · · · · · · · · ·	· · · -		8	14	15	13	16	
	_		K190(NW)-61, SS65_G13							
Structural Reverb. Time in-situ		ISO 15712-1, Eq					0.067			10
TL in-situ for F1		ISO 15712-1, Eq		35.7	38.5	44.4	50.3	58.2	62.2	49
TL in-situ for f1	R_f1,situ	ISO 15712-1, Eq	. 19	35.7	38.5	44.4	50.3	58.2	62.2	49
lunction J1 - Coupling										
Velocity Level Difference for Ff	D_v,Ff_1,situ	ISO 15712-1, Eq	. 21, 22	14.1	14.4	14.8	15.4	16.1	17.0	
/elocity Level Difference for Fd	D_v,Fd_1,situ	ISO 15712-1, Eq	. 21, 22	11.6	11.9	12.2	12.7	13.2	14.0	
Velocity Level Difference for Df	D v,Df 1,situ	ISO 15712-1, Eq	. 21, 22	11.6	11.9	12.2	12.7	13.2	14.0	
-lanking Transmission Loss - Path data		, ,		-						
Flanking TL for Path Ff_1	R Ff	ISO 15712-1, Eq	25a	44	71	89	90	90	90	68
Flanking TL for Path Fd 1		ISO 15712-1, Eq		47	62	75	84	90	90	71
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq		47	62	75	84	90	90	71
Junction 1: Flanking STC for all paths			- 10	0*LOG1	10(10^-	6.8 + 1	0^- 7.1	+ 10^-	7.1)=	6
Junction 2 (Rigid T-Junction, 150 mm	concrete sepa	rating floor / 19	0 mm block wall)							
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-334, NRC Me	ean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	ISO 15712-1, Eq	. C.5	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	ΔR F2	RR-334 . ΔTL-BL	K190(NW)-61, SS65 G13	-4	8	14	15	13	16	
Change by Lining on receive side	ΔR f2		K190(NW)-61, SS65 G13		8	14	15	13	16	
Structural Reverb. Time in-situ	_	ISO 15712-1, Eq					0.059			
TL in-situ for F2	_ /	ISO 15712-1, Eq		36.4	39.2	45.0	50.9	58.7	62.5	50
		, ,								
TL in-situ for f2	R_f2,situ	ISO 15712-1, Eq	. 19	36.4	39.2	45.0	50.9	58.7	62.5	50
Junction J2 - Coupling										
Velocity Level Difference for Ff		ISO 15712-1, Eq		11.3	11.5	11.9	12.4	13.1	13.9	
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, Eq	. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, Eq	. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Flanking Transmission Loss - Path data										
Flanking TL for Path Ff_2	R Ff	ISO 15712-1, Eq	. 25a	43	70	88	90	90	90	67
Flanking TL for Path Fd 2	R_Fd	ISO 15712-1, Eq		46	61	74	83	89	90	70
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq		46	61	74	83	89	90	70
Junction 2: Flanking STC for all paths	K_DI	150 157 12-1, Lq	. 238				+ 10^-			
function 2. Flanking STC for all paths				- 10 L	0010(.	10.1-0.7	+ 10/	7 + 10	~- /) -	
			(
Junction 3 (Rigid cross-junction, 150 r	nm concrete s	separating floor	/ 190 mm block wall)							
All values the same as for Junction 1										
Junction 3: Flanking STC for all paths										
lunction 4 (Rigid cross-junction, 150 r	nm concrete s	separating floor	/ 190 mm block wall)							
All input data the same as for Junction	2, but differe	nt junctions at ce	iling and floor change los	s facto	rs and j	unctior	n atteni	uation	rom Ju	inction 2
Structural Reverb. Time in-situ	T s,situ	, ISO 15712-1, Eq	C 1-C 3	0.237	0.157	0.101	0.063	0.038	0.021	
TL in-situ for F4	- '	ISO 15712-1, Eq		36.0		44.7			62.3	50
TL in-situ for f4		ISO 15712-1, Eq			38.8			58.4	62.3	50
	K_14,SILU	130 137 12-1, EQ	. 1.9	30.0	30.0	44.7	50.0	50.4	02.5	50
	· · ·	100 4F710 4 -	24. 22		4.5 -	45.4	45.6	16.2	4= 0	
		150 15712-1. Fa	. 21, 22				15.6			
Velocity Level Difference for Ff	D_v,Ff_4,situ			42.2	12.5	12.8	13.3	13.8	14.5	
Velocity Level Difference for Ff Velocity Level Difference for Fd	D_v,Fd_4,situ	ISO 15712-1, Eq		12.3						
Velocity Level Difference for Ff Velocity Level Difference for Fd	D_v,Fd_4,situ			12.3	12.5	12.8	13.3	13.8	14.5	
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df	D_v,Fd_4,situ D_v,Df_4,situ	ISO 15712-1, Eq					13.3	13.8	14.5	
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data	D_v,Fd_4,situ D_v,Df_4,situ	ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22	12.3	12.5			13.8 90	14.5 90	69
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4	D_v,Fd_4,situ D_v,Df_4,situ R_Ff	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a	12.3 45	12.5 73	12.8 90	90	90	90	
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4	D_v,Fd_4,situ D_v,Df_4,situ R_Ff R_Fd	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a	12.3 45 48	12.5 73 63	12.8 90 77	90 86	90 90	90 90	72
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	D_v,Fd_4,situ D_v,Df_4,situ R_Ff	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a . 25a	12.3 45 48 48	12.5 73 63 63	12.8 90 77 77	90 86 86	90 90 90	90 90 90	72 72
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	D_v,Fd_4,situ D_v,Df_4,situ R_Ff R_Fd	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a . 25a	12.3 45 48	12.5 73 63 63	12.8 90 77 77	90 86 86	90 90 90	90 90 90	72 72
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	D_v,Fd_4,situ D_v,Df_4,situ R_Ff R_Fd	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a . 25a	12.3 45 48 48	12.5 73 63 63	12.8 90 77 77	90 86 86	90 90 90	90 90 90	72 72
Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	D_v,Fd_4,situ D_v,Df_4,situ R_Ff R_Fd	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a . 25a	12.3 45 48 48	12.5 73 63 63	12.8 90 77 77	90 86 86	90 90 90	90 90 90	72 72
Junction J4 - Coupling Velocity Level Difference for Ff Velocity Level Difference for Fd Velocity Level Difference for Df Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths Total Flanking (for all 4 junctions) ASTC due to Direct plus Flanking Path	D_v,Fd_4,situ D_v,Df_4,situ R_Ff R_Fd R_Df	ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq ISO 15712-1, Eq	. 21, 22 . 25a . 25a . 25a	12.3 45 48 48	12.5 73 63 63	12.8 90 77 77	90 86 86	90 90 90	90 90 90	72 72

EXAMPLE 2.3.4: **DETAILED METHOD** Illustration for this case Rooms one-above-the-other Cast-in-place concrete floors and normal weight concrete block walls with rigid junctions F1, F3 Same structure as Example 2.1.2, enhanced lining of walls D Separating floor/ceiling assembly with: Cast-in-place concrete floor with mass per area of 345 kg/m² (e.g. normal weight concrete 150 mm thick) with no topping or flooring on top, or ceiling lining below Junction 1, 3, 4: Cross-junction of separating floor / flanking wall with: Rigid mortared cross-junction with concrete block wall assemblies Wall above and below floor of one wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than d 53% solid, and with mass per area of 238 kg/m² f1, f3 Flanking walls lined with 13 mm gypsum board⁴ on 65 mm non-loadbearing steel studs⁵ spaced 600 mm o.c. with absorptive • material³ filling stud cavities Cross-junction of separating floor of 150 mm thick cast-in-place concrete Junction 2: T-Junction of separating floor / flanking wall with: with 190 mm concrete block wall. (Side · Rigid mortared T-junction with concrete block wall assemblies view of Junctions 1 or 3) Wall above and below floor of one wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m² Flanking walls lined with 13 mm gypsum board⁴ on 65 mm non-loadbearing steel studs⁵ spaced 600 mm o.c. with absorptive F2 material³ filling stud cavities \Box Acoustical Parameters: For separating assembly: internal loss, $\eta_i = 0.006$ c_L = 3500 mass $(kg/m^2) = 345$ f_c = 124 (Eq. C.2) K Dd' K Fd Reference K Ff K Df Σl k.α k X-Junction 1, 3, 4 ISO 15712-1, Eq. E.3 8.8 0.843 11.6 6.1 8.8 0.657 T-Junction 2 ISO 15712-1, Eq. E.4 8.1 5.8 5.8 Total loss, n_tot ISO 15712-1, Eq. C.1 0.028 (at 500 Hz) Similarly, for flanking elements F and f at Junction 1 & 3, f2 internal loss, $\eta_i = 0.015$ c_L = 3500 mass $(kg/m^2) = 238$ f c = 98 T-Junction of separating floor of Total loss, n_tot ISO 15712-1, Eq. C.1 0.041 (at 500 Hz) 150 mm thick cast-in-place concrete Similarly, for flanking elements F and f at Junction 2 & 4, with 190 mm concrete block wall. (Side internal loss, $\eta_i = 0.015$ c_L = 3500 view of Junction 2. Junction 4 has mass $(kg/m^2) = 238$ f_c = 98 same lining details, but cross-junction) Total loss, η_tot,2 ISO 15712-1, Eq. C.1 0.047 (at 500 Hz) Total loss, η_tot,4 ISO 15712-1, Eq. C.1 0.043 (at 500 Hz) ISO Symbol 125 250 500 1000 2000 4000 STC or ASTC Reference Separating Partition (150 mm concrete floor) Sound Transmission Loss (TL) R_D,lab RR-333, CON150, TLF-15-045 40 42 50 58 66 75 53 T_s,lab 0.08 Structural Reverberation Time Measured T_s 0.44 0.37 0.25 0.21 0.15 Change by Lining on source side ΔR D No lining, 0 0 0 0 0 0 Change by Lining on receive side No lining, 0 0 0 ∆R d 0 0 0

(For the notes in this table please see the corresponding endnotes on page 195.)

ISO 15712-1, Eq. C.1-C.3

Sealed & Blocked

ISO 15712-1, Eq. 24

T_s,situ

R_D,situ

Direct TL in-situ

Structural Reverb. Time in-situ

Leakage or Airborne Flanking

44

0.0

41

0.346 0.237 0.159 0.104 0.066 0.041

61

0.0 0.0

69

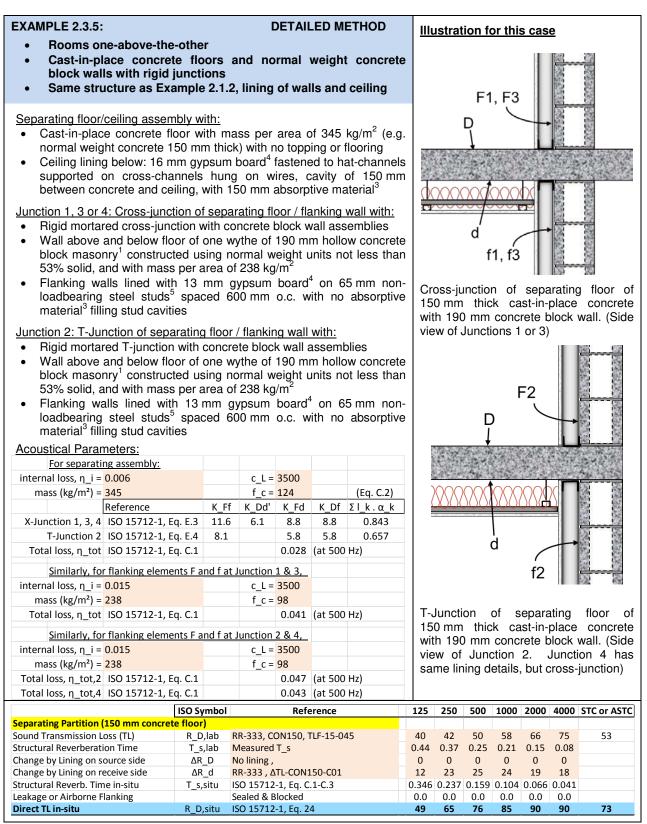
78

55

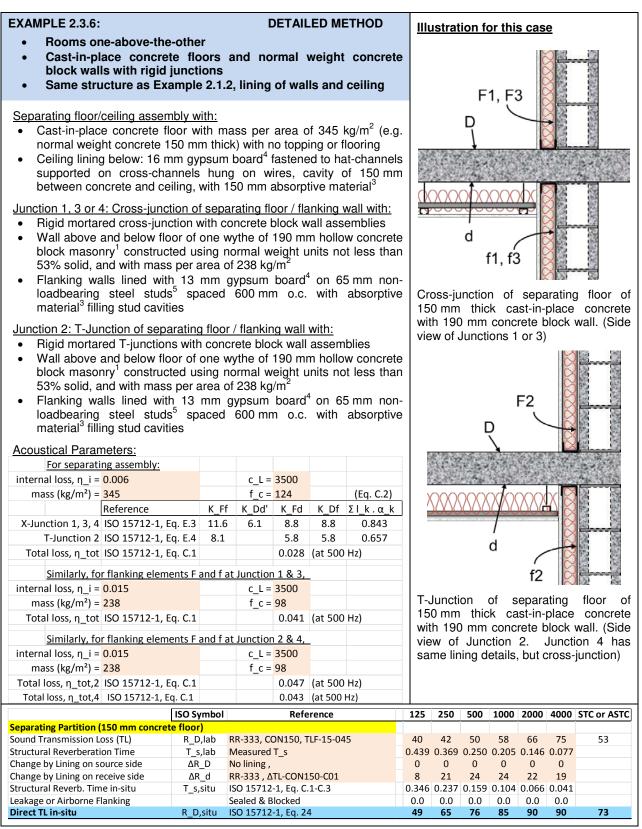
0.0 0.0 0.0

52

	ISO Symbol		Reference	125	250	500	1000	2000	4000	STC or A	٩ST
lunction 1 (Rigid cross-junction, 150 r	nm concrete s	separating floo	r / 190 mm block wall)								
Sound Transmission Loss, F1 or f1	R F1,lab	RR-334, NRC N	lean BLK190(NW)	35	38	44	50	58	62	49	
Structural Reverberation Time		ISO 15712-1, E	• •	0.299	0.191	0.119	0.072	0.042	0.024		
Change by Lining on source side			LK190(NW)-62, SS65 GFE	36 11	19	21	18	17	21		
Change by Lining on receive side		RR-334 , ΔTL-B	LK190(NW)-62, SS65 GFE	36 11	19	21	18	17	21		
Structural Reverb. Time in-situ	_	ISO 15712-1, E			6 0.169	0.108	0.067	0.040	0.023		
TL in-situ for F1		ISO 15712-1, E		35.7		44.4	50.3	58.2	62.2	49	
TL in-situ for f1		ISO 15712-1, E		35.7		44.4	50.3	58.2	62.2	49	
Junction J1 - Coupling											
Velocity Level Difference for Ff	D v.Ff 1.situ	ISO 15712-1, E	a. 21. 22	14.1	14.4	14.8	15.4	16.1	17.0		
Velocity Level Difference for Fd		ISO 15712-1, E	• •	11.6		12.2	12.7	13.2	14.0		
Velocity Level Difference for Df		ISO 15712-1, E		11.6		12.2	12.7	13.2	14.0		
Flanking Transmission Loss - Path data		130 137 12 1, 2	·q. ==, ==	11.0	11.5	12.2	12.7	13.2	11.0		
Flanking TL for Path Ff_1	R Ff	ISO 15712-1, E	a 25a	74	90	90	90	90	90	90	
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, E		62	73	82	87	90	90	84	
Flanking TL for Path Df 1	R_Df	ISO 15712-1, E		62	73	82	87	90	90	84	
Junction 1: Flanking STC for all paths	K_DI	150 157 12-1, 6		- 10*LC						04	8
unction 1. Flanking STC for all paths	1			- 10 10	010(10	··-9 + 1	0''- 8.4	+ 10/	0.4)-		
Junction 2 (Rigid T-Junction, 150 mm				25	20		50	50	62	40	
Sound Transmission Loss, F2 or f2	- '		lean BLK190(NW)	35	38	44	50	58	62	49	
Structural Reverberation Time		ISO 15712-1, E			0.191						
Change by Lining on source side	ΔR_F2	· · · · ·	LK190(NW)-62, SS65_GFE		19	21	18	17	21		
Change by Lining on receive side	∆R_f2	,	LK190(NW)-62, SS65_GFE		19	21	18	17	21		
Structural Reverb. Time in-situ		ISO 15712-1, E			8 0.145						
۲L in-situ for F2		ISO 15712-1, E		36.4		45.0	50.9	58.7	62.5	50	
۲L in-situ for f2	R_f2,situ	ISO 15712-1, E	q. 19	36.4	39.2	45.0	50.9	58.7	62.5	50	
Iunction J2 - Coupling											
Velocity Level Difference for Ff	D_v,Ff_2,situ	ISO 15712-1, E	q. 21, 22	11.3	11.5	11.9	12.4	13.1	13.9		
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, E	q. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6		
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, E	q. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6		
Flanking Transmission Loss - Path data											
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, E	q. 25a	73	90	90	90	90	90	90	
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, E	q. 25a	61	72	81	86	90	90	83	
Flanking TL for Path Df 2	R Df	ISO 15712-1, E	g. 25a	61	72	81	86	90	90	83	
Junction 2: Flanking STC for all paths	_			- 10*LC	G10(10	^-9 + 1	0^- 8.3	+ 10^-	8.3) =		8
Junction 3 (Rigid cross-junction, 150 r	nm concrete s	separating floo	r / 190 mm block wall)								
All values the same as for Junction 1											
Junction 3: Flanking STC for all paths											8
											_
lunction 4 (Rigid cross-junction, 150 r	nm concrete s	separating floo	r / 190 mm block wall)								
All input data the same as for Junction				ss facto	rs and i	unction	atteni	uation f	rom lu	nction 2	
Structural Reverb. Time in-situ		ISO 15712-1, E			0.157						
TL in-situ for F4		ISO 15712-1, E		36.0		44.7		58.4		50	
TL in-situ for f4		ISO 15712-1, E		36.0		44.7		58.4	62.3	50	
Junction J4 - Coupling	1i+,situ	130 137 12-1, L	·····································	50.0	50.0		55.0	50.4	02.5	50	
	D v Ef 4 cite	ISO 15712-1, E	a 21 22	14 4	14.7	15 1	15 6	16.2	17 2		
Velocity Level Difference for Fd											
•		ISO 15712-1, E		12.3			13.3				
Velocity Level Difference for Df		ISO 15712-1, E	y. 21, 22	12.3	12.5	12.8	13.3	13.8	14.5		
Flanking Transmission Loss - Path data		100 15740 4 5	a)Fa	75	00	00	00	00	00		
Flanking TL for Path Ff_4	R_Ff	ISO 15712-1, E		75	90	90	90	90	90	90	
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, E		63	74	84	89	90	90	85	
Flanking TL for Path Df_4	R_Df	ISO 15712-1, E		63	74	84	89	90	90	85	
Junction 4: Flanking STC for all paths				- 10*LC	G10(10	<u>~-9 + 1</u>	<u>U^- 8.5</u>	+ 10^-	8.5)=		8
Total Flanking (for all 4 junctions)											7
ASTC due to Direct plus Flanking Path		RR-331, Eq. 1.4		41	44	52	61	69	76	55	_



	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or AST
Junction 1 (Rigid cross-junction, 150 r	nm concrete :	separating floor / 190 mm block wall)							
Sound Transmission Loss, F1 or f1	R F1,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time		ISO 15712-1, Eq. C.5	0.299	0.191	0.119	0.072	0.042	0.024	
Change by Lining on source side	$\Delta R F1$	RR-334, ΔTL-BLK190(NW)-61, SS65 G1		8	14	15	13	16	
Change by Lining on receive side	$\Delta R f1$	RR-334 , ΔTL-BLK190(NW)-61, SS65_G1		8	14	15	13	16	
Structural Reverb. Time in-situ	T s,situ	ISO 15712-1, Eq. C.1-C.3				0.067			
TL in-situ for F1		ISO 15712-1, Eq. 19	35.7	38.5	44.4	50.3	58.2	62.2	49
				38.5			58.2		
TL in-situ for f1	R_f1,situ	ISO 15712-1, Eq. 19	35.7	38.5	44.4	50.3	58.2	62.2	49
Junction J1 - Coupling	D = = (+ + +								
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	14.1	14.4	14.8	15.4	16.1	17.0	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	11.6	11.9	12.2	12.7	13.2	14.0	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	11.6	11.9	12.2	12.7	13.2	14.0	
Flanking Transmission Loss - Path data	<u> </u>								
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	44	71	89	90	90	90	68
Flanking TL for Path Fd 1	R Fd	ISO 15712-1, Eq. 25a	55	83	90	90	90	90	79
Flanking TL for Path Df 1	R Df	ISO 15712-1, Eq. 25a	47	62	75	84	90	90	71
unction 1: Flanking STC for all paths			LO*LOG						6
						[
unction 2 (Rigid T-Junction, 150 mm	concrete sepa	rating floor / 190 mm block wall)							
Sound Transmission Loss, F2 or f2		RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	ISO 15712-1, Eq. C.5				0.072			-13
Change by Lining on source side	$\Delta R F2$	RR-334 , ΔTL-BLK190(NW)-61, SS65 G13		8	14	15	13	16	
Change by Lining on receive side	ΔR_{f2}	RR-334 , ΔTL-BLK190(NW)-61, SS65_G13		8	14	15	13	16	
Structural Reverb. Time in-situ	T s,situ					0.059			
	- '	ISO 15712-1, Eq. C.1-C.3							
FL in-situ for F2		ISO 15712-1, Eq. 19	36.4	39.2	45.0	50.9	58.7	62.5	50
TL in-situ for f2	R_f2,situ	ISO 15712-1, Eq. 19	36.4	39.2	45.0	50.9	58.7	62.5	50
Iunction J2 - Coupling									
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	11.3	11.5	11.9	12.4	13.1	13.9	
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, Eq. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, Eq. 21, 22	9.5	9.7	10.0	10.4	11.0	11.6	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff_2	R Ff	ISO 15712-1, Eq. 25a	43	70	88	90	90	90	67
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq. 25a	54	82	90	90	90	90	78
Flanking TL for Path Df 2	R Df	ISO 15712-1, Eq. 25a	46	61	74	83	89	90	70
Junction 2: Flanking STC for all paths	_		- 10*LO		^-6.7 +	10^-7	.8 + 10	^-7)=	6
								, í	
Junction 3 (Rigid cross-junction, 150 r	nm concrete s	separating floor / 190 mm block wall)							
All values the same as for Junction 1									
Junction 3: Flanking STC for all paths									e
function 5. Hanking Steror an paths	1		1	1	1	1	1	1	
lunction 4 (Pigid cross junction, 150)	nm concrete i	enerating floor / 100 mm block wall)							
		separating floor / 190 mm block wall) nt junctions at ceiling and floor change lo	aa faata		unation	otton	untion f		notion 2
									nction 2
Structural Reverb. Time in-situ	- '	ISO 15712-1, Eq. C.1-C.3				0.063			
TL in-situ for F4		ISO 15712-1, Eq. 19	36.0		44.7		58.4		50
TL in-situ for f4	R_f4,situ	ISO 15712-1, Eq. 19	36.0	38.8	44.7	50.6	58.4	62.3	50
Iunction J4 - Coupling									
Velocity Level Difference for Ff	D_v,Ff_4,situ	ISO 15712-1, Eq. 21, 22	14.4	14.7	15.1	15.6	16.3	17.2	
Velocity Level Difference for Fd	D_v,Fd_4,situ	ISO 15712-1, Eq. 21, 22	12.3	12.5	12.8	13.3	13.8	14.5	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	12.3	12.5	12.8	13.3		14.5	
- lanking Transmission Loss - Path data	·								
Flanking TL for Path Ff_4	R_Ff	ISO 15712-1, Eq. 25a	45	73	90	90	90	90	69
Flanking TL for Path Fd_4	R_Fd	ISO 15712-1, Eq. 25a	56	84	90	90	90	90	80
Flanking TL for Path Df 4	R_Df	ISO 15712-1, Eq. 25a	48	63	77	86	90	90	72
Junction 4: Flanking STC for all paths	<u>к_</u> DI	130 137 12°1, LY. 230	- 10*LO						12
Valietion 4. Hanking STC for an paths			10 10	01)010	-0.5 +	100	10.1-	1.2]-	
Total Elapking (for all 4 junctions)									
Total Flanking (for all 4 junctions)									e
ASTC due to Direct plus Flanking Path			36						
	C	RR-331, Eq. 1.4	36	55	68	76	79	79	60



	ISO Symbol		Reference		125	250	500	1000	2000	4000	STC or A	AST
Junction 1 (Rigid cross-junction, 150 r												
Sound Transmission Loss, F1 or f1			Aean BLK190(NW)		35	38	44	50	58	62	49	
Structural Reverberation Time	- '	ISO 15712-1, I	· · /	-				0.072				
Change by Lining on source side			3LK190(NW)-62, SS65 GF			19	21	18	17	21		
Change by Lining on receive side	$\Delta R f1$		3LK190(NW)-62, SS65 GF			19	21	18	17	21		
Structural Reverb. Time in-situ	_	ISO 15712-1, I						0.067				
TL in-situ for F1		ISO 15712-1, I			35.7	38.5	44.4	50.3	58.2	62.2	49	
TL in-situ for f1		ISO 15712-1, I			35.7	38.5	44.4	50.3	58.2	62.2	49	
Junction J1 - Coupling	n_n_joicu		-9. 25			50.5		00.0	50.2	02.2		
Velocity Level Difference for Ff	D v Ff 1 situ	ISO 15712-1, I	α 21 22		14.1	14.4	14.8	15.4	16.1	17.0		
Velocity Level Difference for Fd		ISO 15712-1, I			11.6	11.9	12.2	12.7	13.2	14.0		
Velocity Level Difference for Df		ISO 15712-1, I			11.6	11.9	12.2	12.7	13.2	14.0		
Flanking Transmission Loss - Path data		150 157 12-1, 1	-9. 21, 22		11.0	11.5	12.2	12.7	13.2	14.0		
Flanking TL for Path Ff 1	R_Ff	ISO 15712-1, I	a 25a		74	90	90	90	90	90	90	
		ISO 15712-1, I			70	90	90	90	90	90	89	
Flanking TL for Path Fd_1											89	
Flanking TL for Path Df_1	R_Df	ISO 15712-1, I	-q. 25a	1	62	73	82	87	90	90	84	
Junction 1: Flanking STC for all paths	1			- 1	0.100	10(10	~-9 + I	<u>0^- 8.9</u>	+ 10^-	8.4)=		8
Junction 2 (Rigid T-Junction, 150 mm					25	22				6.2	• ~	
Sound Transmission Loss, F2 or f2			Aean BLK190(NW)	Н.	35	38	44	50	58	62	49	
Structural Reverberation Time		ISO 15712-1, I						0.072				
Change by Lining on source side	-	· · ·	3LK190(NW)-62, SS65_GF			19	21	18	17	21		
Change by Lining on receive side	∆R_f2		3LK190(NW)-62, SS65_GF			19	21	18	17	21		
Structural Reverb. Time in-situ		ISO 15712-1, I	•					0.059				
TL in-situ for F2		ISO 15712-1, I			36.4	39.2	45.0	50.9	58.7	62.5	50	
TL in-situ for f2	R_f2,situ	ISO 15712-1, I	Eq. 19		36.4	39.2	45.0	50.9	58.7	62.5	50	
Junction J2 - Coupling												
Velocity Level Difference for Ff	D_v,Ff_2,situ	ISO 15712-1, I	Eq. 21, 22		11.3	11.5	11.9	12.4	13.1	13.9		
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, I	Eq. 21, 22		9.5	9.7	10.0	10.4	11.0	11.6		
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, I	Eq. 21, 22		9.5	9.7	10.0	10.4	11.0	11.6		
Flanking Transmission Loss - Path data												
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, I	Eq. 25a		73	90	90	90	90	90	90	
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, I	Eq. 25a		69	90	90	90	90	90	89	
Flanking TL for Path Df_2	R_Df	ISO 15712-1, I	Eq. 25a		61	72	81	86	90	90	83	
Junction 2: Flanking STC for all paths				- 1	0*LOC	610(10	^-9 + 1	0^- 8.9	+ 10^-	8.3)=		8
lunction 3 (Rigid cross-junction, 150 r	nm concrete s	separating floo	or / 190 mm block wall)									
All values the same as for Junction 1												
Junction 3: Flanking STC for all paths												8
	[
unction 4 (Rigid cross-junction, 150 r	nm concrete s	separating floo	or / 190 mm block wall)									
All input data the same as for Junction				oss	factor	s and j	unctior	n atteni	uation f	rom Ju	nction 2	
Structural Reverb. Time in-situ		ISO 15712-1, I						0.063				
FL in-situ for F4		ISO 15712-1, I			36.0		44.7	50.6			50	
TL in-situ for f4		ISO 15712-1, I	•			38.8			58.4	62.3	50	
Junction J4 - Coupling			-10	+	20.0	55.0		33.0	55.7	02.0	50	
	D. v. Ff 4 situ	ISO 15712-1, I	a. 21. 22		14 4	14 7	15 1	15.6	163	17 2		
Velocity Level Difference for Fd	$D_{\rm V} Ed_{\rm A} city$	ISO 15712-1, I	-4, a 21 22			14.7		13.3		14.5		
Velocity Level Difference for Df		ISO 15712-1, I			12.3	12.5	12.8	13.3	13.8	14.5		
Flanking Transmission Loss - Path data		130 137 12-1, 1	-4. 21, 22		12.3	12.3	12.0	13.3	10.0	14.0		
Flanking TL for Path Ff_4		ISO 15712-1, I	a 25a	+	75	90	90	90	90	90	90	
				++								
Flanking TL for Path Fd_4		ISO 15712-1, I	•		71	90	90	90	90	90	89	
Flanking TL for Path Df_4	R_Df	ISO 15712-1, I	:q. 25a		63	74	84	89	90	90	85	
Junction 4: Flanking STC for all paths	1			- 1	0*100	10(10	···9 + 1	0^- 8.9	+ 10^-	8.5)=		8
												-
Total Flanking (for all 4 junctions)												7
ASTC due to Direct plus Flanking Path		RR-331, Eq. 1.			48	63	72	77	79	79	72	_

<u>Summary for Section 2.3: Calculation Examples for Adding Linings to Constructions of</u> <u>Concrete and Concrete Masonry</u>

The worked examples 2.3.1 to 2.3.6 demonstrate the calculation of sound transmission between rooms in a building of concrete/masonry when linings are added to some or all of the bare floor and wall assemblies. The examples show improvements in direct and/or flanking transmission loss via specific paths due to the addition of some common types of linings using gypsum board, light steel framing, and sound absorbing material. Many other lining options are possible, and may be easily substituted if the necessary laboratory test data is available. Note that for a concrete block wall constructed using normal weight units, tests have shown that its surface could be painted or sealed, or have a thin coat of plaster without effect on the sound transmission.

Examples 2.3.1 and 2.3.2 for the horizontal room pair show the improvements relative to Example 2.1.1, which has the same concrete and masonry elements but no linings. For both of these examples, linings of gypsum board mounted on 65 mm lightweight steel studs are installed on all the wall surfaces; for Example 2.3.2, the cavities between the studs are filled with absorptive material. In both cases the ASTC is increased – from 47 with bare walls, to 50 with the basic lining, and to 59 with addition of absorptive material. In Example 2.3.1 with the basic lining (SS65_G13), the combined Flanking STC of 55 is slightly better than the Direct STC of 52, but the contributions of the flanking paths still decrease the ASTC to 50. The better wall linings in Example 2.3.2 raise the Direct STC for the separating partition to over 80, and provide a similar improvement for the wall/wall junctions. The apparent sound insulation of the complete system is limited by the significant transmission via junctions 1 and 3, particularly the floorfloor and ceiling-ceiling paths which are still bare concrete. Adding a lining to the ceiling could make flanking transmission via the ceiling insignificant, but would increase the ASTC by only 3 points to 62. To raise the ASTC to over 62, a substantial improvement to the floor surfaces would be required.

Examples 2.3.3 and 2.3.4 for the vertical room pair show the improvements relative to Example 2.1.2 when the flanking wall surfaces are lined. The ASTC is increased from 52 with bare concrete masonry walls to 54 (for 2.3.3, with the basic lining SS65_G13) and to 55 (for 2.3.4, with absorptive material filling the wall cavities). In both cases, the higher flanking TL due to the wall linings is short-circuited by direct transmission through the floor.

Examples 2.3.5 and 2.3.6 have the same structural assemblies and wall linings as 2.3.3 and 2.3.4 respectively, but show the effect of adding a ceiling lining. The ASTC rises to 60 with the ceiling plus the basic wall lining, and to 72 with ceiling and better wall lining with absorptive material filling the interstud cavities. In Example 2.3.5, with the basic SS65_G13 lining on the walls, the ASTC is limited by the flanking paths. With the addition of absorptive material to the wall linings in 2.3.6, the ASTC is mainly limited by direct transmission but an excellent ASTC is achieved.

Overall, these examples show the clear benefit of wall and ceiling linings in achieving high ASTC values, and emphasize the need to focus improvements on the weakest path(s).

2.4. Simplified Calculation Method for Concrete/Masonry Buildings

ISO 15712-1 presents a "Simplified model for structure-borne transmission" in Section 4.4 of the standard. This method has some clearly stated limitations, and some implicit cautions including that:

- The simplified method uses a set of ad hoc approximations that are appropriate for buildings with cast-in-place concrete and concrete masonry construction, with or without linings.
- The application of the simplified method "is restricted to primarily homogeneous constructions", further restricted here to homogeneous lightly-damped structural assemblies. Here "lightly-damped" implies a reverberant vibration field that can be characterized by a mean vibration level, and "homogeneous" implies similar bending stiffness in all directions across the surface. This limitation excludes wood-framed and steel-framed assemblies, but includes typical concrete or concrete masonry walls and cast-in-place concrete floors.
- Within that restricted context, the calculation has been structured to predict an ASTC slightly lower than that from the "detailed method" used in the examples presented in this Guide.

The calculation method of Section 4.4 of ISO 15712-1 is based on two main simplifications:

- The most significant simplification is to deal with losses to connected assemblies "in an average way", which requires ignoring the variation of in-situ transmission loss due to edge losses to adjoining wall and floor constructions, thereby eliminating much of the calculation process of the detailed method.
- The procedure uses only single-number measures. For purposes of this Guide, the singlenumber measures are laboratory measured STC ratings for the structural wall and floor assemblies and the ΔSTC values for any linings as the input data. The final output is the overall ASTC rating.

The Simplified Method predicts the overall ASTC rating by following the steps indicated in Figure 2.4.1 and explained in more detail below.

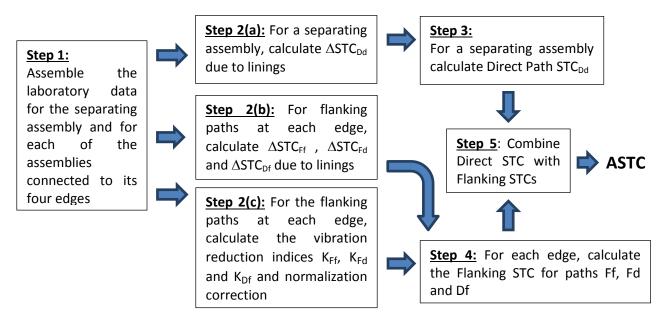


Figure 2.4.1 Steps to calculate the Direct STC and the Flanking STC for each flanking path.

- Step 1: Assemble the required laboratory test data for the constructions including the:
 - Laboratory sound transmission class (STC) values based on the TL measured according to ASTM E90 for the structural floor or wall assemblies (of bare concrete or masonry),
 - Mass per unit area for these bare assemblies,
 - Measured change in sound transmission class (Δ STC) determined according to Appendix A1 of this Guide for each lining that will be added to the bare structural floor or wall assemblies.
- Step 2: Determine correction terms as follows:
 - a) For linings on the source and/or receiving side of the separating assembly, the correction ΔSTC_{Dd} is the sum of the larger of the ΔSTC values for these two linings plus half of the smaller value.
 - b) For each flanking path *ij*, the correction ΔSTC_{ij} for linings on the source surface *i* and/or the receiving surface *j*, is the sum of the larger of the ΔSTC values for these two linings plus half of the smaller value.
 - c) For each edge of the separating assembly, calculate the vibration reduction indices K_{Ff}, K_{Fd}, and K_{Df} for the flanking paths between the assembly in the source room (D or F) and the attached assembly in the receiving room (f or d) using the appropriate case from Annex E of ISO 15712-1. These values depend on the junction geometry and the ratio of the mass per unit area for the connected assemblies. Also calculate the normalization correction, which depends on the length of the flanking junction and the area of the separating assembly.
- Step 3: Calculate the Direct STC rating for the direct transmission through the separating assembly (STC_{Dd}) using Eq. 27 of ISO 15712-1 with the inputs:
 - o Laboratory STC value for the bare structural assembly,
 - Correction for linings Δ STC_{Dd} from Step 2(a).

- Step 4: Calculate the Flanking STC for transmission via each pair of connected assemblies at each edge of the separating assembly, using Eq. 28a of ISO 15712-1 with inputs:
 - Laboratory STC value for each bare structural assembly,
 - Correction for linings Δ STC_{ij} from Step 2(b),
 - \circ Value of K_{ii} and normalization correction for this path from Step 2(c).
- Step 5: Combine the transmission via the direct and flanking paths to determine the ASTC. In the worked examples, the Direct STC and Flanking STC values are rounded to the nearest integer before they are combined, and the ASTC is also rounded to the nearest integer, to match the nominal precision of the ASTM ratings.

Expressing the Process using Equations

The ASTC rating between two rooms (neglecting sound that is by-passing the building structure, e.g. through leaks or ducts) is estimated using the Simplified Method from the logarithmic expression of the combination of the Direct STC rating (STC_{Dd}) of the separating wall or floor assembly and the combined Flanking STC ratings of the three flanking paths for every junction at the four edges of the separating assembly. This may be expressed as:

$$ASTC = -10\log_{10}\left[10^{-0.1 \cdot STC_{Dd}} + \sum_{edge=1}^{4} (10^{-0.1 \cdot STC_{Ff}} + 10^{-0.1 \cdot STC_{Fd}} + 10^{-0.1 \cdot STC_{Df}})\right]$$
Eq. 2.4.1

Eq. 2.4.1 is appropriate for all types of building systems similar to the Standard Scenario. The following expressions are used to calculate the transmission for each individual path:

For the direct path, STC_{Dd} is obtained according to Eq. 2.4.2 from the laboratory STC of the bare separating assembly and the ∆STC changes due to linings on source "D" and/or receiving side "d" of the assembly. This is the counterpart in ASTM metrics for Eq. 30 of ISO 15712-1.

$$STC_{Dd} = STC_{lab} + \max(\Delta STC_D, \Delta STC_d) + \frac{\min(\Delta STC_D, \Delta STC_d)}{2}$$
 Eq. 2.4.2

For each flanking path, STC_{ij} is calculated using Eq. 2.4.3 where index i and j refer to the coupled flanking assemblies; thus, "i" can either be "D" or "F" and "j" can be "f" or "d". The geometric correction factor at the end depends on the surface area of the separating assembly (S_s) and the length of the junction between flanking and separating assemblies (l_{ij}), with l₀ = 1 m. Eq. 2.4.3 is the counterpart in ASTM metrics for Equations 28a and 31 of ISO 15712-1.

$$STC_{ij} = \frac{STC_i}{2} + \frac{STC_j}{2} + K_{ij} + \max(\Delta STC_i, \Delta STC_j) + \frac{\min(\Delta STC_i, \Delta STC_j)}{2} + 10 \cdot \log_{10} \frac{S_S}{l_0 \cdot l_{ij}}$$
Eq. 2.4.3

Worked Examples

This section presents a number of worked examples that demonstrate the calculation of the ASTC rating for concrete and concrete block constructions according to the Simplified Method. Each worked example presents all the pertinent physical characteristics of the assemblies and junctions, together with a summary of key steps in the calculation process for these constructions. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide.

Within the table for each worked example, the "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.

Under the heading "STC or ΔSTC", the examples present input data determined in laboratory tests:

- STC values for the laboratory sound transmission loss of wall or floor assemblies;
- ΔSTC values measured in the laboratory for the change in STC due to adding that lining to the specified wall or floor assembly, as explained in Appendix A1 of this Guide.

Under the heading "STC or ASTC", the examples present the calculated values for sound transmission via specific paths:

- Direct STC values for the in-situ transmission loss of the separating wall or floor assembly;
- Flanking STC values for each flanking sound transmission path at each junction;
- Apparent STC (ASTC) values for the combination of direct and flanking transmission via all paths.

The numeric calculations are presented step-by-step in each worked example, using compact notation consistent with the spreadsheet expressions such that:

- For calculation of the Direct STC and the Flanking STC, these expressions are easily recognized as equivalent to Equations 2.4.2 and 2.4.3, respectively. These values are rounded to the nearest integer, for consistency with the corresponding measured values.
- For combining the sound power transmitted via specific paths, the calculation of Eq. 2.4.1 is presented in several stages. Note that in the compact notation, a term for transmitted sound power fraction such as $10^{-0.1 \cdot STC_{ij}}$ becomes $10^{-7.4}$, if $STC_{ij} = 74$.
- At each stage (such as the Flanking STC for the 3 paths at a given junction) the result is converted into decibel form by calculating -10*log₁₀ (transmitted sound power fraction) to facilitate comparison of each path or junction with the Direct STC and the final ASTC result.

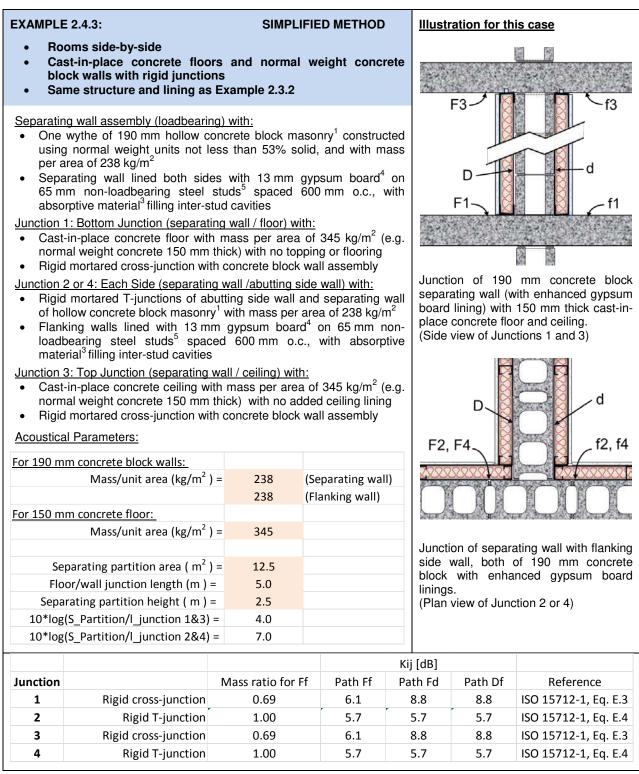
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EXAMPLE 2	2.4.1:	SIMPLIF	IED METHOD	Illust	ration for th	nis case
 Cast block 	ms side-by-side -in-place concrete floors k walls with rigid junctions e structure as Example 2.1	5	weight conc	rete		
 One w using in per are <u>Junction 1:</u> Cast-ir normal Rigid n <u>Junction 2 of</u> Abuttin mason Rigid n 	wall assembly (loadbearing) rythe of 190 mm hollow con normal weight units not les ea of 238 kg/m ² , with no linin <u>Bottom Junction (separating</u> n-place concrete floor with r I weight concrete150 mm thi nortared cross-junction with or 4: Each Side (separating r ng side wall and separatin ry ¹ with mass per area of 23 nortared T-junctions	crete block mase s than 53% solid g <u>wall / floor) with</u> mass per area o ck) with no toppir concrete block w <u>wall /abutting sid</u> g wall of hollow 8 kg/m ² , with no	d, and with m <u>:</u> f 345 kg/m ² (ng or flooring rall assembly <u>e wall) with:</u> v concrete b	lock Junct	ating wall w	f3 f3 f3 f1 f1 f1 f1 f1 f1 f1 f1 f1 f1
Cast-in	Top Junction (separating wa place concrete ceiling with	mass per area o		e.g. (Side		ctions 1 and 3)
 Cast-ir normal 	n-place concrete ceiling with I weight concrete150 mm thi nortared cross-junction with	mass per area o ck) with no adde	ed ceiling lining	e.g. (Side		
 Cast-ir normal Rigid n Acoustical P 	n-place concrete ceiling with I weight concrete150 mm thi nortared cross-junction with Parameters:	mass per area o ck) with no adde	ed ceiling lining	e.g. (Side	view of Jun D→	
 Cast-ir normal Rigid n Acoustical P 	n-place concrete ceiling with I weight concrete150 mm thi nortared cross-junction with	mass per area of ck) with no adde concrete block w 238 (S	ed ceiling lining vall assembly Separating wal	e.g. (Side		
 Cast-ir normal Rigid n Acoustical P For 190 mm 	n-place concrete ceiling with I weight concrete150 mm thi mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) =	mass per area of ck) with no adde concrete block w 238 (S	ed ceiling lining all assembly	e.g. (Side	view of Jun D→	
 Cast-ir normal Rigid n Acoustical P For 190 mm 	n-place concrete ceiling with I weight concrete150 mm thi mortared cross-junction with Parameters:	mass per area of ck) with no adde concrete block w 238 (9 238 (1	ed ceiling lining vall assembly Separating wal	e.g. (Side	view of Jun D→	
Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Sepa Floor Separa 10*log(S)	n-place concrete ceiling with I weight concrete150 mm thi mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u>	mass per area of ck) with no adde concrete block w 238 (f 238 (f 345	ed ceiling lining vall assembly Separating wal	e.g. (Side	view of Jun $D \rightarrow$ $F4 \rightarrow$ OOOC ion of separation of se	
Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Sepa Floor Separa 10*log(S)	n-place concrete ceiling with I weight concrete150 mm this mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u> Mass/unit area (kg/m ²) = arating partition area (m ²) = r/wall junction length (m) = ating partition height (m) = _Partition/l_junction 1&3) =	mass per area of ck) with no adde concrete block w 238 (9 238 (9 345 12.5 5.0 2.5 4.0	ed ceiling lining vall assembly Separating wal	e.g. (Side	view of Jun $D \rightarrow$ $F4 \rightarrow$ OOOC ion of separation of se	ctions 1 and 3)
Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Sepa Floor Separa 10*log(S)	n-place concrete ceiling with I weight concrete150 mm this mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u> Mass/unit area (kg/m ²) = arating partition area (m ²) = r/wall junction length (m) = ating partition height (m) = _Partition/l_junction 1&3) =	mass per area of ck) with no adde concrete block w 238 (9 238 (9 345 12.5 5.0 2.5 4.0	ed ceiling lining vall assembly Separating wal	e.g. (Side	view of Jun $D \rightarrow$ $F4 \rightarrow$ OOOC ion of separation of se	ctions 1 and 3)
Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Sepa Floor Separa 10*log(S)	n-place concrete ceiling with I weight concrete150 mm thi mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u> Mass/unit area (kg/m ²) = marating partition area (m ²) = r/wall junction length (m) = mating partition height (m) = partition/l_junction 1&3) = partition/l_junction 2&4) =	mass per area of ck) with no adde concrete block w 238 (9 238 (9 345 12.5 5.0 2.5 4.0	ed ceiling lining vall assembly Separating wal	e.g. (Side	view of Jun $D \rightarrow$ $F4 \rightarrow$ OOOC ion of separation of se	ctions 1 and 3)
 Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Separa Floor Separa 10*log(S) 	n-place concrete ceiling with I weight concrete150 mm thi mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u> Mass/unit area (kg/m ²) = marating partition area (m ²) = r/wall junction length (m) = mating partition height (m) = partition/l_junction 1&3) = partition/l_junction 2&4) =	mass per area of ck) with no adde concrete block w 238 (5 238 (1 345 12.5 5.0 2.5 4.0 7.0	ed ceiling lining rall assembly Separating wal Flanking wall)	(Side (Side F2 Junct wall, (Plan Kij [dB]	view of Jun D- , F4 OOOC ion of sep both of 19 view of Jun	ctions 1 and 3)
 Cast-ir normal Rigid n Acoustical P For 190 mm For 150 mm Separa 10*log(S) 10*log(S) Junction 	n-place concrete ceiling with I weight concrete150 mm this mortared cross-junction with Parameters: <u>concrete block walls:</u> Mass/unit area (kg/m ²) = <u>concrete floor:</u> Mass/unit area (kg/m ²) = mating partition area (m ²) = r/wall junction length (m) = mating partition height (m) = partition/l_junction 1&3) = partition/l_junction 2&4) =	mass per area of ck) with no adde concrete block w 238 (S 238 (F 345 12.5 5.0 2.5 4.0 7.0 Mass ratio for Ff	ed ceiling lining rall assembly Separating wal Flanking wall)	(Side (Side) (Side) (Si	view of Jun D- , F4 , F4 , OOO both of 19 view of Jun Path Df	ctions 1 and 3)
Cast-ir normal Rigid n Acoustical P For 190 mm For 190 mm Separa Floor Separa 10*log(S 10*log(n-place concrete ceiling with I weight concrete 150 mm thi mortared cross-junction with Parameters: Concrete block walls: Mass/unit area (kg/m ²) = Concrete floor: Mass/unit area (kg/m ²) = Mass/unit area (kg/m ²) = Mass/unit area (kg/m ²) = Mass/unit area (kg/m ²) = Partition length (m) = Partition height (m) = Partition/l_junction 1&3) = Partition/l_junction 2&4) = Rigid cross-junction	mass per area of ck) with no adde concrete block we 238 (S 238 (F 345 12.5 5.0 2.5 4.0 7.0 Mass ratio for Ff 0.69	ed ceiling lining rall assembly Separating wal Flanking wall) Path Ff 6.1	e.g. (Side	view of Jun D- F4 OOC ion of sept both of 19 view of Jun Path Df 8.8	ctions 1 and 3)

	ISO Symbol	Referenc	e	STC or Δ STC	STC or AS
Separating Partition (190 m					
Laboratory STC for Dd	R s,w	RR-334, NRC-Mean BLK190(N	W)	49	
Δ STC change by Lining on D	$\Delta R_D, w$	No Lining	,	0	
Δ STC change by Lining on d	$\Delta R_d, w$	No Lining		0	
Direct STC in-situ	R Dd,w	RR-331, Eq. 2.4.2	49 -	+ MAX(0,0) + MIN(0,0)/2 =	49
Junction 1 (Rigid cross-junct	ion. 190 mm	block separating wall / 150 m	m concrete floor)		
Flanking Element F1:			,,,		
Laboratory STC for F1	R_F1,w	RR-333, CON150, TLF-15-045		53	
ΔSTC change by Lining	ΔR F1,w	No Lining ,		0	
Flanking Element f1:					
Laboratory STC for f1	R_f1,w	RR-333, CON150, TLF-15-045		53	
ΔSTC change by Lining	ΔR_f1,w	No Lining ,		0	
Flanking STC for path Ff	R Ff,w	RR-331, Eq. 2.4.3	53/2 + 53/2 + MAX(0)	,0) + MIN(0,0)/2 + 6.1 + 4 =	63
Flanking STC for path Fd		RR-331, Eq. 2.4.3		(0) + MIN(0,0)/2 + 0.1 + 4 = (0) + MIN(0,0)/2 + 8.8 + 4 =	
Flanking STC for path Df	R Df,w	RR-331, Eq. 2.4.3		(0,0) + MIN(0,0)/2 + 8.8 + 4 = 0.000000000000000000000000000000000	
Junction 1: Flanking STC for		RR-331, subset of Eq. 2.4.1		$5.3 + 10^{-} 6.4 + 10^{-} 6.4 =$	
Junction 1: Flanking STC for		RR-331, Subset of Eq. 2.4.1	- 10 10010(100	0.5 + 10 0.4 + 10 0.4) =	1
Junction 2 (Rigid T-Junction	190 mm bloc	k separating wall / 190 mm b	lock flanking wall)		
Flanking Element F2:	200 1111 0100				
Laboratory STC for F2	R_F2,w	RR-334, NRC-Mean BLK190(N	W/)	49	
ΔSTC change by Lining	$\Delta R F2, w$	No Lining	•••		
Flanking Element f2:	Δη_Γ2,₩	NO LITTING		0	
	D £2	DD 224 NDC Maan DI K100/N	14/	49	
Laboratory STC for f2	R_f2,w	RR-334, NRC-Mean BLK190(N	vv)		
ΔSTC change by Lining	ΔR_f2,w	No Lining		0	
Flanking STC for path Ff	R_Ff,w	RR-331, Eq. 2.4.3	, , ,	(0) + MIN(0,0)/2 + 5.7 + 7 =	
Flanking STC for path Fd	R_Fd,w	RR-331, Eq. 2.4.3		.0) + MIN(0,0)/2 + 5.7 + 7 =	
Flanking STC for path Df	R_Df,w	RR-331, Eq. 2.4.3		.0) + MIN(0,0)/2 + 5.7 + 7 =	
Junction 2: Flanking STC for	all paths	RR-331, subset of Eq. 2.4.1	- 10*LOG10(10^-6	5 <mark>.2 + 10^- 6.2 + 10^- 6.2) =</mark>	1
lunction 2 (Digid gross junct	ion 100 mm	block concreting well (150 m	m concrete ceiling)		
	10n, 190 mm	block separating wall / 150 m	m concrete celling)		
Flanking Element F3:	D. 52	DD 222 CON450 THE 45 045		53	
Laboratory STC for F3	R_F3,w	RR-333, CON150, TLF-15-045		53	
ΔSTC change by Lining	ΔR_F3,w	No Lining		0	
Flanking Element f3:					
Laboratory STC for f3	R_f3,w	RR-333, CON150, TLF-15-045		53	
∆STC change by Lining	ΔR_f3,w	No Lining		0	
Flanking STC for path Ff	R_ Ff,w	RR-331, Eq. 2.4.3		,0) + MIN(0,0)/2 + 6.1 + 4 =	
Flanking STC for path Fd	R_ Fd,w	RR-331, Eq. 2.4.3		(0) + MIN(0,0)/2 + 8.8 + 4 =	
Flanking STC for path Df	R_ Df,w	RR-331, Eq. 2.4.3		.0) + MIN(0,0)/2 + 8.8 + 4 =	
Long at an O. Flambin - CTC fam					
Junction 3: Flanking SIC for	all paths	RR-331, subset of Eq. 2.4.1	- 10*LOG10(10^-6	5.3 + 10^- 6.4 + 10^- 6.4) =	;
~				5.3 + 10 [^] - 6.4 + 10 [^] - 6.4) =	
Junction 4 (Rigid T-junction,		k separating wall / 190 mm bl		5.3 + 10^- 6.4 + 10^- 6.4) =	
Junction 4 (Rigid T-junction, Flanking Element F4:	190 mm bloc	k separating wall / 190 mm bl	lock flanking wall)		
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4	190 mm bloc R_F4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N	lock flanking wall)	49	
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining	190 mm bloc	k separating wall / 190 mm bl	lock flanking wall)		
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4:	190 mm bloc R_F4,w ΔR_F4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining	lock flanking wall) W)	49 0	
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4	190 mm bloc R_F4,w ΔR_F4,w R_f4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N	lock flanking wall) W)	49 0 49	
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining	190 mm bloc R_F4,w ΔR_F4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining	lock flanking wall) W) W)	49 0 49 0	
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining	190 mm bloc R_F4,w ΔR_F4,w R_f4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N	lock flanking wall) W) W)	49 0 49	
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff	190 mm bloc R_F4,w ΔR_F4,w R_f4,w ΔR_f4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining	lock flanking wall) W) W) 49/2 + 49/2 + MAX(0,	49 0 49 0	62
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining Flanking Element f4: Laboratory STC for f4 ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd	190 mm bloc R_F4,w ΔR_F4,w R_f4,w ΔR_f4,w R_F4,w R_Ff,w R_Fd,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	lock flanking wall) W) W) 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0,	49 0 49 0 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	62
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining Flanking Element f4: Laboratory STC for f4 ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	190 mm bloc R_F4,w ΔR_F4,w R_f4,w ΔR_f4,w R_F4,w R_F4,w R_F4,w R_F4,w R_F4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	Nock flanking wall) W) 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0,	49 0 49 0 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	62 62 62
Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining Flanking Element f4: Laboratory STC for f4 ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 4: Flanking STC for	190 mm bloc R_F4,w ΔR_F4,w R_f4,w ΔR_f4,w R_F4,w R_F4,w R_F4,w R_F4,w R_F4,w	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	Nock flanking wall) W) 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0,	49 0 49 0 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	62 62 62
Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining Flanking Element f4: Laboratory STC for f4 ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	190 mm bloc R_F4,w $\Delta R_F4,w$ R_f4,w R_f4,w R_Ff,w R_Ff,w R_Fd,w R_Df,w all paths	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	Nock flanking wall) W) 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, - 10*LOG10(10^-6	49 0 49 0 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 5.2 + 10^- 6.2 + 10^- 6.2) =	62 62 62
Lunction 4 (Rigid T-junction, Elanking Element F4: Laboratory STC for F4 ASTC change by Lining Elanking Element f4: Laboratory STC for f4 ASTC change by Lining Elanking STC for path Ff Elanking STC for path Fd Elanking STC for path Df Flanking STC for path Df Flanking STC for path Df	190 mm bloc R_F4,w ΔR_F4,w ΔR_f4,w R_f4,w R_Ff,w R_Fd,w R_Fd,w R_Df,w all paths junctions)	k separating wall / 190 mm bl RR-334, NRC-Mean BLK190(N No Lining RR-334, NRC-Mean BLK190(N No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 RR-331, subset of Eq. 2.4.1	lock flanking wall) W) 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, 49/2 + 49/2 + MAX(0, - 10*LOG10(10^-6 Combin	49 0 49 0 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	62 62 62

EXAMPLE 2	.4.2:	SIMPLI	FIED METHOD	Illus	stration for th	<u>nis case</u>
Cast- block	ns one-above-the-other in-place concrete floo walls with rigid junctio structure as Example 2	ns	weight conci		F1, F3, F4	
Cast-in normal	floor/ceiling assembly with -place concrete floor with weight concrete 150 mm ceiling lining below	n mass per area	• •	6 153		
 Rigid m Wall ab block m 	3.or 4: Cross-junction of s nortared cross-junction wit nove and below floor of or nasonry ¹ constructed usir vlid, and with mass per are	h concrete block ne wythe of 190 r ng normal weight	wall assemblies nm hollow conc units not less t	s rete	d f1, f3, f4	
 Junction 2: 1 Rigid m Wall ab block m 53% so 	T-Junction of separating f nortared T-junction with co nove and below floor of or nasonry ¹ constructed usir lid, and with mass per are	loor / flanking wa oncrete block wall ne wythe of 190 r ng normal weight	<u>ll with:</u> assemblies nm hollow conc units not less t	rete with	mm thick cas 190 mm con	separating floor of st-in-place concrete crete block wall. ctions 1, 3 or 4)
ACOUSTICAL	Parameters:					
	Parameters:					F2
	concrete block walls:	- 729	(Junctions 19.2)		P	F2
			(Junctions 1&3)		D ↓	F2
For 190 mm	concrete block walls: Mass/unit area (kg/m ²)	= 238 238	(Junctions 1&3) (Junctions 2&4)		D ↓	F2
<u>For 190 mm</u>	concrete block walls:	238	· · ·		D ↓ ↑	F2
<u>For 190 mm</u> For 150 mm	concrete block walls: Mass/unit area (kg/m ²) concrete floor:	238 = 345	· · ·		D J d	F2
For 190 mm For 150 mm Sepa J	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m)	238 = 345 = 20 = 5.0	· · ·		D ↓ ↓ d	F2
<u>For 190 mm</u> For 150 mm Sepa J J	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) =	238 = 345 = 20 = 5.0 = 4.0	· · ·		D ↓ ↓ d	F2
For 190 mm For 150 mm Sepa J 10*log(S_	concrete block walls: Mass/unit area (kg/m ²) concrete floor: Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) = _Partition/I_junction 1&3)	238 = 345 = 20 = 5.0 = 4.0 = 6.0	· · ·		D J d	f2
For 190 mm For 150 mm Sepa J 10*log(S_	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) =	238 = 345 = 20 = 5.0 = 4.0 = 6.0	· · ·		D ↓ ↑ d	F2 f2
For 190 mm For 150 mm Sepa J 10*log(S_	concrete block walls: Mass/unit area (kg/m ²) concrete floor: Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) = _Partition/I_junction 1&3)	238 = 345 = 20 = 5.0 = 4.0 = 6.0	· · ·	T-Ju 150 floo	d unction of sep mm thick cas	f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f
For 190 mm For 150 mm Sepa J 10*log(S_	concrete block walls: Mass/unit area (kg/m ²) concrete floor: Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) = _Partition/I_junction 1&3)	238 = 345 = 20 = 5.0 = 4.0 = 6.0	· · ·	T-Ju 150 floo (Sid	d unction of sep mm thick cas with 190 mm	f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f
For 190 mm For 150 mm Sepa J 10*log(S_ 10*log(S_	concrete block walls: Mass/unit area (kg/m ²) concrete floor: Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) = unction 2 & 4 length (m) = _Partition/I_junction 1&3)	238 = 345 = 20 = 20 = 4.0 = 6.0 = 7.0	(Junctions 2&4)	T-Ju 150 floo	d unction of sep mm thick cas with 190 mm	arating floor of st-in-place concrete block wall. ction 2)
For 190 mm For 150 mm Sepa J 10*log(S_ 10*log(S_	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) : unction 2 & 4 length (m) : _Partition/I_junction 1&3) _Partition/I_junction 2&4)	238 = 345 = 20 = 5.0 = 4.0 = 6.0	f Path Ff	T-Ju 150 floo (Sid Kij [dB]	d unction of sep mm thick cas with 190 mm e view of Jun	arating floor of t-in-place concrete n concrete block wall. ction 2)
For 190 mm For 150 mm Sepa J 10*log(S_ 10*log(S_	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) : unction 2 & 4 length (m) : Partition/I_junction 1&3) Partition/I_junction 2&4) Rigid cross-junction	238 = 345 = 20 = 5.0 = 4.0 = 6.0 = 7.0	(Junctions 2&4)	T-Ju 150 floo (Sid Kij [dB] Path Fd	d unction of sep mm thick case with 190 mm e view of Jun Path Df	f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f2 f
For 190 mm For 150 mm Sepa J 10*log(S_ 10*log(S_ 10*log(S_	<u>concrete block walls:</u> Mass/unit area (kg/m ²) <u>concrete floor:</u> Mass/unit area (kg/m ²) rating partition area (m ²) unction 1 & 3 length (m) : unction 2 & 4 length (m) : _Partition/I_junction 1&3) _Partition/I_junction 2&4)	238 = 345 = 20 = 20 = 4.0 = 6.0 = 7.0 Mass ratio for F 1.45	(Junctions 2&4)	T-Ju 150 floo (Sid Kij [dB] Path Fd 8.8	d unction of sep mm thick cas with 190 mm e view of Jun Path Df 8.8	arating floor of t-in-place concrete n concrete block wall. ction 2)

Reference oor) RR-333, CON150, TLF-15-04 No Lining RR-331, Eq. 2.4.2 concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining	45 190 mm block wall) (NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	0,0) + N ((0,0) + ((0,0) +	STC or ASTC 53 0 0 AX(0,0) + MIN(0,0)/2 = 49 0 AIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 = 10^- 6.6 + 10^- 6.6) =	53 53 67 66 66	
RR-333, CON150, TLF-15-04 No Lining No Lining RR-331, Eq. 2.4.2 concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	190 mm block wall) 9(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 9(NW)	0,0) + N ((0,0) + ((0,0) +	0 0 0 AX(0,0) + MIN(0,0)/2 = 49 0 VIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	67 66	
No Lining No Lining RR-331, Eq. 2.4.2 concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	190 mm block wall) 9(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 9(NW)	0,0) + N ((0,0) + ((0,0) +	0 0 0 AX(0,0) + MIN(0,0)/2 = 49 0 VIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	67 66	
No Lining RR-331, Eq. 2.4.2 concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	190 mm block wall) (NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	0,0) + N ((0,0) + ((0,0) +	0 AX(0,0) + MIN(0,0)/2 = 49 0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	67 66	
RR-331, Eq. 2.4.2 concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	190 mm block wall) (NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	0,0) + N ((0,0) + ((0,0) +	AX(0,0) + MIN(0,0)/2 = 49 0 $MIN(0,0)/2 + 11.6 + 6 =$ $MIN(0,0)/2 + 8.8 + 6 =$ $MIN(0,0)/2 + 8.8 + 6 =$	67 66	
concrete separating floor / RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	190 mm block wall) (NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	0,0) + N ((0,0) + ((0,0) +	49 0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	67 66	
RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	0(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	0(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	0(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	<(0,0) + <(0,0) +	0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
No Lining RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	0(NW) 49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall) 0(NW)	<(0,0) + <(0,0) +	0 49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-334, NRC-Mean BLK190 No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	49 0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	49/2 + 49/2 + MAX(49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	0 MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	49/2 + 53/2 + MAX 53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	<(0,0) + <(0,0) +	MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	53/2 + 49/2 + MAX - 10*LOG10(10 0 mm block wall)	((0,0) +	MIN(0,0)/2 + 8.8 + 6 =		
RR-331, subset of Eq. 2.4.1 crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	- 10*LOG10(10 D mm block wall)		1		F
crete separating floor / 190 RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190	0 mm block wall))(NW)				
RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190)(NW)				
RR-334, NRC-Mean BLK190 No Lining RR-334, NRC-Mean BLK190)(NW)				
No Lining RR-334, NRC-Mean BLK190	、				
No Lining RR-334, NRC-Mean BLK190	、		49		
RR-334, NRC-Mean BLK190			0		
			0		
			49		
NO LITTING	(1400)		0		
DD 221 Eg 2 4 2	40/2 + 40/2 + 100	((0, 0)) .	MIN(0,0)/2 + 8.1 + 7 =	64	
RR-331, Eq. 2.4.3			1		
RR-331, Eq. 2.4.3			MIN(0,0)/2 + 5.8 + 7 =	64 64	
RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1			MIN(0,0)/2 + 5.8 + 7 = 10^- 6.4 + 10^- 6.4) =	64	5
111-331, 3003Et 01 Eq. 2.4.1	- 10 10010(10	<u>-0.4 +</u>	10 - 0.4 + 10 - 0.4 / -		
concrete separating floor /	190 mm block wall)				
concrete separating noor y	150 mm block wany				
RR-334, NRC-Mean BLK190	(NI\A/)		49		
No Lining	(1400)		0		
NO LITTING			0		
RR-334, NRC-Mean BLK190	(NI\A/)		49		
No Lining ,	(1400)		0		
RR-331, Eq. 2.4.3	$19/2 \pm 10/2 \pm 100/2$	0 0) + M	MIN(0,0)/2 + 11.6 + 6 =	67	
RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3			MIN(0,0)/2 + 11.6 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-331, Eq. 2.4.3			MIN(0,0)/2 + 8.8 + 6 = MIN(0,0)/2 + 8.8 + 6 =	66	
RR-331, subset of Eq. 2.4.1			$10^{-}6.6 + 10^{-}6.6$ =	00	6
RR-331, Subset Of Eq. 2.4.1	- 10 LOG10(10	/··-0.7 +	100.0+100.0/-		0
concrete separating floor /	100 mm block wall)				
concrete separating hoor /	190 mm block wall)				
RR-334, NRC-Mean BLK190			49		
,	(14 00)				
No Lining			0		
DD 224 NDC Martin DL/(400			40		
RR-334, NRC-Mean BLK190	(INVV)		49		
-			0		
No Lining	, , ,		MIN(0,0)/2 + 11.6 + 7 =	68	
No Lining RR-331, Eq. 2.4.3			1		
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	53/2 + 49/2 + MAX			67	
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3) <mark>^-6.8</mark> +	10^- 6.7 + 10^- 6.7) =		6
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3					
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, subset of Eq. 2.4.1	- 10*LOG10(10	bining	12 Flanking STC values		5
No Lining RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3 RR-331, Eq. 2.4.3	- 10*LOG10(10	0		_	
	RR-331, Eq. 2.4.3	RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX RR-331, subset of Eq. 2.4.1 - 10*LOG10(10)	RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(0,0) + RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,0) + RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^-6.8 + RR-331, subset of Eq. 2.4.1 Combining	RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(0,0) + MIN(0,0)/2 + 8.8 + 7 = RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,0) + MIN(0,0)/2 + 8.8 + 7 = RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^-6.8 + 10^- 6.7 + 10^- 6.7) =	RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(0,0) + MIN(0,0)/2 + 8.8 + 7 = 67 RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,0) + MIN(0,0)/2 + 8.8 + 7 = 67 RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^-6.8 + 10^- 6.7 + 10^- 6.7) = 67 RR-331, subset of Eq. 2.4.1 Combining 12 Flanking STC values 67



	ISO Symbol	Reference	STC or Δ STC	STC or AS
Separating Partition (190 m				
Laboratory STC for Dd	R_s,w	RR-334, NRC-Mean BLK190(NW)	49	
Δ STC change by Lining on D	ΔR D,w	RR-334, ΔTL-BLK(NW)-62, SS65 GFB65 G13	19	
Δ STC change by Lining on d	$\Delta R_d, w$	RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13	19	
Direct STC in-situ	R Dd,w		<pre><(19,19) + MIN(19,19)/2 =</pre>	78
Junction 1 (Rigid cross-junct	ion, 190 mm	block separating wall / 150 mm concrete floor)		
Flanking Element F1:				
Laboratory STC for F1	R F1,w	RR-333, CON150, TLF-15-045	53	
Δ STC change by Lining	ΔR F1,w	No Lining	0	
Flanking Element f1:			0	
Laboratory STC for f1	D f1 w	RR-333, CON150, TLF-15-045	53	
,	R_f1,w		0	
∆STC change by Lining	$\Delta R_{f1,w}$	No Lining	-	~~~
Flanking STC for path Ff	R_Ff,w		0) + MIN(0,0)/2 + 6.1 + 4 =	
Flanking STC for path Fd	R_Fd,w) + MIN(0,19)/2 + 8.8 + 4 =	
Flanking STC for path Df	R_Df,w) + MIN(19,0)/2 + 8.8 + 4 =	
Junction 1: Flanking STC for	all paths	RR-331, subset of Eq. 2.4.1	- 10*LOG10(10^-6.3 + 10/	/
	190 mm bloc	k separating wall / 190 mm block flanking wall)		
Flanking Element F2:				
Laboratory STC for F2	R_F2,w	RR-334, NRC-Mean BLK190(NW)	49	
ΔSTC change by Lining	ΔR_F2,w	RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13	19	
Flanking Element f2:				
Laboratory STC for f2	R_f2,w	RR-334, NRC-Mean BLK190(NW)	49	
ΔSTC change by Lining	∆R_f2,w	RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13	19	
Flanking STC for path Ff	R_ Ff,w	RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19)	+ MIN(19,19)/2 + 5.7 + 7 =	90
Flanking STC for path Fd	R_Fd,w	RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19)	+ MIN(19,19)/2 + 5.7 + 7 =	90
Flanking STC for path Df	R_ Df,w	RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19)	+ MIN(19,19)/2 + 5.7 + 7 =	90
Junction 2: Flanking STC for	all paths	RR-331, subset of Eq. 2.4.1	- 10*LOG10(10^-9 + 10^-	
	ion, 190 mm	block separating wall / 150 mm concrete ceiling)		
Flanking Element F3:				
Laboratory STC for F3	R_F3,w	RR-333, CON150, TLF-15-045	53	
ΔSTC change by Lining	ΔR_F3,w	No Lining	0	
Flanking Element f3:				
Laboratory STC for f3	R_f3,w	RR-333, CON150, TLF-15-045	53	
ACTO I IIII		No Lining		
∆STC change by Lining	ΔR_t3,w	NO LITING	0	
	ΔR_f3,w R Ff,w		°	63
Flanking STC for path Ff	R_ Ff,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0,	0 0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =	
Flanking STC for path Ff Flanking STC for path Fd	R_ Ff,w R_ Fd,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =	83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_ Ff,w R_ Fd,w R_ Df,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19) RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19,0)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 =	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_ Ff,w R_ Fd,w R_ Df,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for	R_Ff,w R_Fd,w R_Df,w all paths	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19,0 RR-331, subset of Eq. 2.4.1 49/2 + 53/2 + MAX(19,0)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 =	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction,	R_Ff,w R_Fd,w R_Df,w all paths	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19) RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19,0)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 =	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4:	R_Ff,w R_Fd,w R_Df,w all paths	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 S31, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10'	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4	R_Ff,w R_Fd,w R_Df,w all paths 190 mm bloc R_F4,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 S31, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19, RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0, RR-331, subset of Eq. 2.4.1	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10'	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining	R_Ff,w R_Fd,w R_Df,w all paths	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 S31, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10'	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4:	R_Ff,w R_Fd,w R_Df,w all paths 190 mm bloc R_F4,w ΔR_F4,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, 19, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4	R_Ff,w R_Fd,w R_Df,w all paths 190 mm bloc R_F4,w ΔR_F4,w R_f4,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0) RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13 RR-334, NRC-Mean BLK190(NW)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining	R_Ff,w R_Fd,w R_Df,w all paths 190 mm blocc R_F4,w ΔR_F4,w ΔR_F4,w ΔR_f4,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, 19 RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19	83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff	R_Ff,w R_Fd,w R_Df,w all paths 190 mm bloc R_F4,w ΔR_F4,w ΔR_F4,w ΔR_f4,w R_f4,w R_Ff,w	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13 RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13 RR-334, L-BLK(NW)-62, SS65_GFB65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 49 19 + MIN(19,19)/2 + 5.7 + 7 =	83 83
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd	R_Ff,w R_Fd,w R_Df,w all paths 190 mm bloc R_F4,w ΔR_F4,w ΔR_F4,w R_f4,w R_f4,w R_F4,w R_F4,w	RR-331, Eq. 2.4.3 $53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, 19)$ RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(19, 0)$ RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW)RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-334, NRC-Mean BLK190(NW)RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(19,19)$ RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(19,19)$	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 + MIN(19,19)/2 + 5.7 + 7 = + MIN(19,19)/2 + 5.7 + 7 =	83 83 90 90
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_Ff,w R_Fd,w R_Df,w all paths 190 mm blocc R_F4,w ΔR_F4,w ΔR_F4,w R_f4,w R_f4,w R_F4,w R_F4,w	RR-331, Eq. 2.4.3 $53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, 19)$ RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(19, 0)$ RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW)RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-331, Eq. 2.4.349/2 + 49/2 + MAX(19,19)RR-331, Eq. 2.4.349/2 + 49/2 + MAX(19,19)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 + MIN(19,19)/2 + 5.7 + 7 = + MIN(19,19)/2 + 5.7 + 7 =	83 83 90 90 90
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_Ff,w R_Fd,w R_Df,w all paths 190 mm blocc R_F4,w ΔR_F4,w ΔR_F4,w R_f4,w R_f4,w R_F4,w R_F4,w	RR-331, Eq. 2.4.3 $53/2 + 53/2 + MAX(0, RR-331, Eq. 2.4.3)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, 19)$ RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(19, 0)$ RR-331, subset of Eq. 2.4.1 k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW)RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-334, NRC-Mean BLK190(NW)RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-334, ATL-BLK(NW)-62, SS65_GFB65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(19,19)$ RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(19,19)$	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 + MIN(19,19)/2 + 5.7 + 7 = + MIN(19,19)/2 + 5.7 + 7 =	83 83 90 90
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Df Junction 4: Flanking STC for	$\begin{array}{c} R_{-} Ff, w \\ R_{-} Fd, w \\ R_{-} Df, w \\ \hline all paths \\ \hline 190 \text{ mm bloc} \\ R_{-} F4, w \\ \Delta R_{-} F4, w \\ \Delta R_{-} F4, w \\ R_{-} f4, w \\ R_{-} f4, w \\ R_{-} Ff, w \\ R_{-} Ff, w \\ R_{-} Df, w \\ \hline all paths \\ \hline \end{array}$	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, 19 RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1 K k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW) RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19) RR-331, subset of Eq. 2.4.1 49/2 + 49/2 + MAX(19,19)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 + MIN(19,19)/2 + 5.7 + 7 = + MIN(19,19)/2 + 5.7 + 7 = - 10*LOG10(10^-9 + 10^-	83 83 90 90 90
Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid T-junction, Flanking Element F4: Laboratory STC for F4 ASTC change by Lining Flanking Element f4: Laboratory STC for f4 ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	$\begin{array}{c} R_{-} Ff, w \\ R_{-} Fd, w \\ R_{-} Df, w \\ \hline all paths \\ \hline 190 \text{ mm bloc} \\ R_{-} F4, w \\ \Delta R_{-} F4, w \\ \Delta R_{-} F4, w \\ R_{-} f4, w \\ R_{-} f4, w \\ R_{-} Ff, w \\ R_{-} Ff, w \\ R_{-} Df, w \\ \hline all paths \\ \hline \end{array}$	RR-331, Eq. 2.4.3 53/2 + 53/2 + MAX(0, 19 RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, 19 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(19, 0 RR-331, subset of Eq. 2.4.1 K k separating wall / 190 mm block flanking wall) RR-334, NRC-Mean BLK190(NW) RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-62, SS65_GFB65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(19,19) RR-331, subset of Eq. 2.4.1 49/2 + 49/2 + MAX(19,19)	0) + MIN(0,0)/2 + 6.1 + 4 =) + MIN(0,19)/2 + 8.8 + 4 =) + MIN(19,0)/2 + 8.8 + 4 = - 10*LOG10(10^-6.3 + 10' 49 19 + MIN(19,19)/2 + 5.7 + 7 = + MIN(19,19)/2 + 5.7 + 7 =	83 83 90 90 90

EXAMPLE						
	E 2.4.4:	SIMPL	FIED METHOD	Illustr	ation for th	nis case
• Cas blo	oms one-above-the-other st-in-place concrete floo ock walls with rigid junctio me structure as Example 2	ns	weight concr	ete	F1, F	=3
 Cast norm Ceilin supp betw 	ng floor/ceiling assembly with -in-place concrete floor with nal weight concrete 150 mm ng lining below: 16 mm gyps ported on cross-channels h reen concrete and ceiling, wi	n mass per area thick) with no top sum board ⁴ fasten nung on wires, th 150 mm absor	pping or flooring ned to hat-chanr cavity of 150 ptive material ³	nels mm		
 Rigid Wall block 53% Flank loads 	1, 3 or 4: Cross-junction of s d mortared cross-junction wit above and below floor of or k masonry ¹ constructed usin solid, and with mass per are king walls lined with 13 m bearing steel studs ⁵ space erial ³ in inter-stud cavities	h concrete block le wythe of 190 r lg normal weight a of 238 kg/m ² m gypsum boar	wall assemblies nm hollow conci units not less tl d ⁴ on 65 mm n	rete nan on- tive Cross		f3 teparating floor of cast-in-place concrete
 Rigid Wall block 53% Flank loads 	2: T-Junction of separating f d mortared T-junctions with c above and below floor of or k masonry ¹ constructed usin solid, and with mass per are king walls lined with 13 m bearing steel studs ⁵ space erial ³ in inter-stud cavities	oncrete block wa le wythe of 190 r Ig normal weight a of 238 kg/m ² m gypsum boar	all assemblies nm hollow conci units not less th d ⁴ on 65 mm n	view o rete nan on-	90 mm con f Junction 1 D I	F2
Acoustica	al Parameters:				A 5 - 34 -	Carlo and an in the second
	m concrete block walls:			19.5		
	Mass/unit area (kg/m ²)		(Junctions 1&3)	200	00000000	
		238	(Junctions 2&4)		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
<u>For 150 m</u>	m concrete floor:	238	(Junctions 2&4)		2000000	
	Mass/unit area (kg/m ²)	= 345	(Junctions 2&4)		d	
		= 345	(Junctions 2&4)		d	f2
	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) :	= 345 = 20 = 5.0	(Junctions 2&4)	T-Jund	d	f2
Se	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) =	= 345 = 20 = 5.0 = 4.0	(Junctions 2&4)	150 m	m thick cas	arating floor of t-in-place concrete
Se 10*log	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3)	= 345 = 20 = 5.0 = 4.0 = 6.0	(Junctions 2&4)	150 m with 19	m thick cas 90 mm cond	t-in-place concrete crete block wall.
Se 10*log	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) =	= 345 = 20 = 5.0 = 4.0 = 6.0	(Junctions 2&4)	150 m with 19 (Side)	m thick cas 90 mm cond view of Jund ume lining d	t-in-place concrete
Se 10*log	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3)	= 345 = 20 = 5.0 = 4.0 = 6.0	(Junctions 2&4)	150 m with 19 (Side has sa junctio	m thick cas 90 mm cond view of Jund ume lining d	t-in-place concrete crete block wall. ction 2. Junction 4
Se 10*log 10*log	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3)	= 345 = 20 = 5.0 = 4.0 = 6.0 = 7.0		150 m with 19 (Side has sa junctic Kij [dB]	m thick cas 90 mm cond view of Jund ume lining d n)	t-in-place concrete crete block wall. ction 2. Junction 4 letails, but cross-
Se 10*log	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3) (S_Partition/I_junction 2&4)	 345 20 5.0 4.0 6.0 7.0 	-f Path Ff	Kij [dB]	m thick cas 90 mm cond view of Jund ime lining d n) Path Df	et-in-place concrete crete block wall. ction 2. Junction 4 letails, but cross-
Se 10*log 10*log Junction	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3) (S_Partition/I_junction 2&4) Rigid cross-junction	 345 20 5.0 4.0 6.0 7.0 Mass ratio for I 1.45	Ff Path Ff 11.6	Kij [dB] Path Fd	m thick cas 90 mm cond view of June me lining d n) Path Df 8.8	tt-in-place concrete crete block wall. ction 2. Junction 4 letails, but cross- Reference ISO 15712-1, Eq. E.3
Se 10*log 10*log Junction 1	Mass/unit area (kg/m ²) parating partition area (m ²) Junction 1 & 3 length (m) = Junction 2 & 4 length (m) = (S_Partition/I_junction 1&3) (S_Partition/I_junction 2&4)	 345 20 5.0 4.0 6.0 7.0 	-f Path Ff	Kij [dB]	m thick cas 90 mm cond view of Jund ime lining d n) Path Df	et-in-place concrete crete block wall. ction 2. Junction 4 letails, but cross-

	ISO Symbol	Reference	STC or Δ STC	STC or AST
Separating Partition (190 m		ock)		
Laboratory STC for Dd	R_s,w	RR-333, CON150, TLF-15-045	53	
ΔSTC change by Lining on D	ΔR D,w	No Lining ,	0	
Δ STC change by Lining on d		RR-333, ΔTLF-CON150-01, SUS150_GFB150_G16	19	
Direct STC in-situ	R Dd,w		IAX(0,19) + MIN(0,19)/2 =	72
Junction 1 (Rigid cross-junct	ion, 150 mm	concrete separating floor / 190 mm block wall)		
Flanking Element F1:				
Laboratory STC for F1	R F1,w	RR-334, NRC-Mean BLK190(NW)	49	
Δ STC change by Lining		RR-334, ΔTL-BLK(NW)-61, SS65_G13	2	
Flanking Element f1:	Διι 1,₩	III 334, ATE BER(IVW) 01, 3505_015	2	
Laboratory STC for f1	R f1,w	RR-334, NRC-Mean BLK190(NW)	49	
			2	
ΔSTC change by Lining		RR-334, ΔTL-BLK(NW)-61, SS65_G13		70
Flanking STC for path Ff) + MIN(2,2)/2 + 11.6 + 6 =	70
Flanking STC for path Fd) + MIN(2,19)/2 + 8.8 + 6 =	86
Flanking STC for path Df			2) + MIN(0,2)/2 + 8.8 + 6 =	68
Junction 1: Flanking STC for	all paths	RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^	-7 + 10^- 8.6 + 10^- 6.8) =	6
	150			
	150 mm con	crete separating floor / 190 mm block wall)		
Flanking Element F2:				
Laboratory STC for F2		RR-334, NRC-Mean BLK190(NW)	49	
ΔSTC change by Lining	ΔR_F2,w	RR-334, ΔTL-BLK(NW)-61, SS65_G13	2	
Flanking Element f2:				
Laboratory STC for f2	_ /	RR-334, NRC-Mean BLK190(NW)	49	
∆STC change by Lining		RR-334, ΔTL-BLK(NW)-61, SS65_G13	2	
Flanking STC for path Ff	R_ Ff,w	RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,	2) + MIN(2,2)/2 + 8.1 + 7 =	67
Flanking STC for path Fd	R_Fd,w	RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19) + MIN(2,19)/2 + 5.8 + 7 =	84
Flanking STC for path Df	R_ Df,w		2) + MIN(0,2)/2 + 5.8 + 7 =	66
Junction 2: Flanking STC for	all paths	RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^-6	6.7 + 10^- 8.4 + 10^- 6.6) =	6
	ion, 150 mm	concrete separating floor / 190 mm block wall)		
Flanking Element F3:				
Flanking Element F3: Laboratory STC for F3	R_F3,w	RR-334, NRC-Mean BLK190(NW)	49	
Flanking Element F3:	R_F3,w		49 2	
Flanking Element F3: Laboratory STC for F3	R_F3,w	RR-334, NRC-Mean BLK190(NW)		
<u>Flanking Element F3:</u> Laboratory STC for F3 ΔSTC change by Lining	R_F3,w	RR-334, NRC-Mean BLK190(NW)		
<u>Flanking Element F3:</u> Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3:	R_F3,w ΔR_F3,w R_f3,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13	2	
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3	R_F3,w ΔR_F3,w R_f3,w ΔR_f3,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13	2 49	70
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining	R_F3,w ΔR_F3,w R_f3,w ΔR_f3,w R_f3,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2	2 49 2	70 86
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd	R_F3,w ΔR_F3,w R_f3,w ΔR_f3,w R_F3,w R_Ff,w R_Fd,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2) RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =	
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_F3,w ΔR_F3,w R_f3,w ΔR_f3,w R_Ff,w R_Ff,w R_Fd,w R_Df,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 =	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining ASTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df	R_F3,w ΔR_F3,w R_f3,w ΔR_f3,w R_Ff,w R_Ff,w R_Fd,w R_Df,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 =	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for	R_F3,w $\Delta R_F3,w$ R_f3,w $\Delta R_f3,w$ R_Ff,w R_Fd,w R_Cfd,w all paths	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.349/2 + 49/2 + MAX(2,2) RR-331, Eq. 2.4.3RR-331, Eq. 2.4.349/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3RR-331, Eq. 2.4.353/2 + 49/2 + MAX(0, RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 =	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for	R_F3,w $\Delta R_F3,w$ R_f3,w $\Delta R_f3,w$ R_Ff,w R_Fd,w R_Cfd,w all paths	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0,19)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 =	86
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct	R_F3,w $\Delta R_F3,w$ R_f3,w $\Delta R_f3,w$ R_Ff,w R_Fd,w R_Cfd,w all paths	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.349/2 + 49/2 + MAX(2,2) RR-331, Eq. 2.4.3RR-331, Eq. 2.4.349/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3RR-331, Eq. 2.4.353/2 + 49/2 + MAX(0, RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 =	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4	R_F3,w Δ R_F3,w Δ R_f3,w Δ R_f3,w R_Ff,w R_Fd,w R_Df,w all paths cion, 150 mm R_F4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^A)concrete separating floor / 190 mm block wall)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) =	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4:	R_F3,w Δ R_F3,w R_f3,w Δ R_f3,w R_Ff3,w R_Ff,w R_Fd,w R_Df,w all paths cion, 150 mm	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, 10)$ RR-331, subset of Eq. 2.4.1Concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element F4:	R_F3,w Δ R_F3,w R_f3,w Δ R_f3,w R_Ff3,w R_Fd,w R_Df,w all paths cion, 150 mm of the second sec	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0, 10)$ RR-331, subset of Eq. 2.4.1Concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4	R_F3,w $\Delta R_F3,w$ R_f3,w R_F4,w R_F4,w R_F4,w R_F4,w R_F4,w R_F4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2 RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19 RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^A concrete separating floor / 190 mm block wall) RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, NRC-Mean BLK190(NW)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49	86 68
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining	R_F3,w $\Delta R_F3,w$ R_f3,w R_f3,w R_Ff,w R_Fd,w R_Df,w all paths ion, 150 mm of the second seco	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2	86 68 <u>6</u>
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff	R_F3,w $\Delta R_F3,w$ R_f3,w R_f3,w R_Ff,w R_Fd,w R_Df,w all paths R_F4,w $\Delta R_F4,w$ R_F4,w R_f4,w R_f4,w R_f4,w R_f4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-334, ΔTL-BLK(NW)-61, SS65_G13 RR-331, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2) RR-331, Eq. 2.4.3 49/2 + 53/2 + MAX(2,19) RR-331, Eq. 2.4.3 53/2 + 49/2 + MAX(0, RR-331, subset of Eq. 2.4.1 - 10*LOG10(10^A) concrete separating floor / 190 mm block wall) RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13 RR-334, NRC-Mean BLK190(NW) RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13 RR-334, ATL-BLK(NW)-61, SS65_G13 RR-334, Eq. 2.4.3 49/2 + 49/2 + MAX(2,2)	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =	86 68 6
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Fd Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff	R_F3,w Δ R_F3,w Δ R_f3,w R_f3,w R_Ff,w R_Fd,w R_Df,w all paths cion, 150 mm R_F4,w Δ R_F4,w Δ R_F4,w R_f4,w R_f4,w R_Ff,w R_Fd,w R_Fd,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,2)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,19)/2 + 8.8 + 7 =	86 68 6 71 87
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Fd Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Ff	R_F3,w $\Delta R_F3,w$ R_f3,w R_f3,w R_Ff,w R_Fd,w R_Df,w all paths ion, 150 mm R_F4,w $\Delta R_F4,w$ $\Delta R_F4,w$ R_f4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,19)/2 + 8.8 + 7 = 2) + MIN(0,2)/2 + 8.8 + 7 =	86 68 6 71 87 69
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Df Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining	R_F3,w $\Delta R_F3,w$ R_f3,w R_f3,w R_Ff,w R_Fd,w R_Df,w all paths ion, 150 mm R_F4,w $\Delta R_F4,w$ $\Delta R_F4,w$ R_f4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,19)/2 + 8.8 + 7 =	86 68 6 71 87 69
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Fd Flanking STC for path Fd Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff	R_F3,w ΔR_F3,w AR_F3,w AR_f3,w R_Ff,w R_Ff,w R_Df,w all paths cion, 150 mm R_F4,w AR_F4,w AR_F4,w R_F4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0,2)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,19)/2 + 8.8 + 7 = 2) + MIN(0,2)/2 + 8.8 + 7 = 1 + 10^- 8.7 + 10^- 6.9) =	86 68 6 71 87 69 6
Flanking Element F3: Laboratory STC for F3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking Element f3: Laboratory STC for f3 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Fd Flanking STC for path Fd Junction 3: Flanking STC for Junction 4 (Rigid cross-junct Flanking Element F4: Laboratory STC for F4 ΔSTC change by Lining Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining Flanking STC for path Ff Flanking STC for path Ff Flanking STC for path Ff	R_F3,w ΔR_F3,w AR_F3,w AR_f3,w R_Ff,w R_Ff,w R_Df,w all paths cion, 150 mm R_F4,w AR_F4,w AR_F4,w R_F4,w	RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,19)$ RR-331, subset of Eq. 2.4.1- 10*LOG10(10^A)concrete separating floor / 190 mm block wall)RR-334, NRC-Mean BLK190(NW) RR-334, ATL-BLK(NW)-61, SS65_G13RR-334, NRC-Mean BLK190(NW) RR-334, ΔTL-BLK(NW)-61, SS65_G13RR-331, Eq. 2.4.3 $49/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $49/2 + 53/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(2,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0,2)$ RR-331, Eq. 2.4.3 $53/2 + 49/2 + MAX(0,2)$	2 49 2) + MIN(2,2)/2 + 11.6 + 6 =) + MIN(2,19)/2 + 8.8 + 6 = 2) + MIN(0,2)/2 + 8.8 + 6 = -7 + 10^- 8.6 + 10^- 6.8) = -7 + 10^- 8.6 + 10^- 6.8) = 49 2 49 2 + MIN(2,2)/2 + 11.6 + 7 =) + MIN(2,19)/2 + 8.8 + 7 = 2) + MIN(0,2)/2 + 8.8 + 7 =	86 68 6 71 87

<u>Summary for Section 2.4: Calculation Examples for Simplified Calculation for Concrete</u> <u>and Masonry Constructions</u>

The worked examples 2.4.1 to 2.4.4 illustrate the use of the Simplified Method for calculating sound transmission between rooms in a building with concrete or concrete masonry walls and concrete floor assemblies, with or without linings added to some or all of the walls and floors.

The examples show the performance for two cases with "bare" concrete and masonry assemblies and two cases with improvements in direct and/or flanking transmission loss via specific paths due to the addition of some common types of linings using gypsum board, light steel framing, and sound absorbing material. Many other lining options are possible, but evaluating the benefit of linings is not the focus of this section – rather, it provides a basis for comparing the Simplified Method with the Detailed Method presented in Sections 2.1 to 2.3.

Each of the examples has a counterpart in the detailed calculations in Sections 2.1 and 2.3, and the differences between the results (Detailed Method vs. Simplified Method) are readily compared:

Detailed N	<u>lethod</u>	<u>Simplified</u>	<u>Metho</u> d	Compa	arison (Detailed vs Sii	mplified)
Example	ASTC	Example	ASTC	Direct STC	Total Flanking STC	ASTC
2.1.1	47	2.4.1	47	49 vs 49	51 vs 52	47 vs 47
2.1.2	52	2.4.2	51	55 vs 53	55 vs 55	52 vs 51
2.3.2	59	2.4.3	60	82 vs 78	59 vs 60	59 vs 60
2.3.5	60	2.4.4	59	73 vs 72	60 vs 59	60 vs 59

This limited set of comparisons is consistent with larger validation studies of the ISO procedure, which have shown that the Detailed Method tends to give slightly higher values of R'_w (the counterpart of ASTC) than the Simplified Method with a scatter of about ± 1.5 dB.

The basic conclusion that can be drawn from these examples is that the Simplified and Detailed Methods predict similar ASTC values for concrete and masonry buildings – for these cases, the deviations are typically about ± 1 ASTC points. But the differences tend to increase with better linings, with the Simplified Method tending to fall farther below the Detailed Method.

A more detailed look at predictions for specific paths suggests that the balance among the direct path and the twelve flanking paths is not always well-reflected by the ad hoc corrections of the Simplified Method, especially where there are matching good linings on both path surfaces. Hence, any detailed design considerations to optimize the choice of linings should use the Detailed Method.

3. Buildings with CLT Wall and Floor Assemblies

Cross-laminated timber (CLT) construction is based on structural floor and wall assemblies fabricated by laminating timber elements together into panels with layers of alternating perpendicular orientation of the timber elements. Typical panels have three or more layers or plies, with overall thickness ranging from about 75 mm to 250 mm.

Section 3.1 and Section 3.2 describe the calculation of the apparent sound insulation in CLT buildings using the Simplified Method and the Detailed Method of ISO 15712-1, respectively. More information on the direct and flanking sound insulation of CLT assemblies and building systems can be found in NRC Research Report RR-335, "Apparent Sound Insulation in CLT Buildings." The report provides the data for direct and flanking sound insulation for a variety of CLT building configurations.

3.1. Simplified Calculation Procedure for CLT Constructions

ISO 15712-1 states that the application of the Simplified Method "is restricted to primarily homogeneous constructions", further restricted here to homogeneous lightly-damped structural assemblies. Here, "lightly-damped" implies a reverberant vibration field that can be characterized by a mean vibration level, and "homogeneous" implies similar bending stiffness in all directions across the surface. These definitions exclude wood-framed and steel-framed assemblies, but typical CLT wall or floor/ceiling assemblies are considered appropriate for the Simplified Method.

Within this restricted context, the Simplified Method has been structured to predict an ASTC which is slightly lower than that from the Detailed Method described in Section 3.2 of this Guide.

The Simplified Method uses two main simplifications:

- The most significant simplification is that losses to connected assemblies are dealt with "in an average way", ignoring the variation of in-situ sound transmission loss due to edge losses to adjoining wall and floor constructions. This simplification eliminates much of the calculation process of the Detailed Method. Since the internal losses of CLT assemblies are high enough that the laboratory sound transmission loss can be used as in-situ sound transmission loss as described in Section 3.2, this simplification does not lead to a loss of accuracy for CLT constructions (unlike for less-damped constructions such as concrete or concrete block).
- The procedure uses only single-number quantities as input data, namely laboratory STC ratings for the wall and floor assemblies, Δ STC values for any linings, and mean K_{ij} values for the junction attenuation. The output of the calculations using the Simplified Method is the ASTC.

The Simplified Method predicts the overall ASTC, by following the steps in Figure 3.1.1, which are also explained in more detail below the figure.

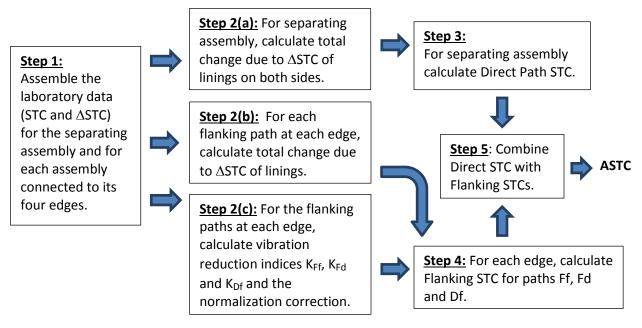


Figure 3.1.1: Steps to calculate the ASTC using the Simplified Method.

- **<u>Step 1</u>**: Assemble the required laboratory test data for the constructions:
 - Laboratory sound transmission class (STC) values based on direct sound transmission loss data measured according to ASTM E90 for the CLT floor or wall assemblies;
 - \circ Measured change in sound transmission class (Δ STC) determined according to Appendix A1 for each lining that will be added to the base floor or wall assemblies.
- **<u>Step 2:</u>** Determine the correction terms as follows:
 - d) For linings on the separating assembly, the correction ΔSTC_{Dd} is the sum of the larger of the ΔSTC values for these two linings plus half of the smaller ΔSTC value.
 - e) For each flanking path ij, the correction ΔSTC_{ij} for linings on the source surface i and/or the receiving surface j is the sum of the larger of the ΔSTC values for these two linings plus half of the smaller ΔSTC value.
 - f) For each edge of the separating assembly, determine the vibration reduction indices K_{Ff}, K_{Fd}, and K_{Df} for the flanking paths between the assembly in the source room (D or F) and the attached assembly in the receiving room (f or d). Also calculate the normalization correction, which depends on the length of the flanking junction and the area of the separating assembly.
- Step 3: Calculate the Direct STC for direct sound transmission through the separating assembly (STC_{Dd}) according to Eq. 27 of ISO 15712-1 (and Eq. 3.1.2 in this Guide) using the laboratory STC rating for the Base CLT assembly plus any correction for linings ∆STC_{Dd} from Step 2(a).

- **Step 4**: Calculate the Flanking STC for sound transmission via each pair of connected assemblies at each edge of the separating assembly according to Eq. 28a of ISO 15712-1 (and Eq. 3.1.3 in this Guide) with the following inputs:
 - o laboratory STC rating for each Base CLT assembly plus lining correction Δ STC_{ii} from Step 2(b);
 - \circ K_{ij} value and normalization correction for this path from Step 2(c).
- **Step 5**: Combine the sound transmission via the direct and flanking paths, using Equation 1.2 in Section 1.4 of this Guide (equivalent to Eq. 3.1.1 below and to Eq. 26 in Section 4.4 of ISO 15712-1).

Expressing the Process using Equations

The ASTC rating between two rooms (neglecting sound that is by-passing the building structure, e.g. through leaks or ducts) is estimated using the Simplified Method from the logarithmic expression of the combination of the Direct STC rating (STC_{Dd}) of the separating wall or floor assembly and the combined Flanking STC ratings of the three flanking paths for every junction at the four edges of the separating assembly. This may be expressed as:

$$ASTC = -10\log_{10}\left[10^{-0.1 \cdot STC_{Dd}} + \sum_{edge=1}^{4} (10^{-0.1 \cdot STC_{Ff}} + 10^{-0.1 \cdot STC_{Fd}} + 10^{-0.1 \cdot STC_{Df}})\right]$$
Eq. 3.1.1

Eq. 3.1.1 is appropriate for all types of building systems with the geometry of the Standard Scenario, and is applied here using the following expressions to calculate the transmission for each individual path:

 For the direct path, STC_{Dd} is obtained according to Eq. 4.1.2 from the laboratory STC of the Base CLT assembly and the ∆STC changes due to linings on source "D" and/or receiving side "d" of the separating assembly. Eq. 3.1.2 is the counterpart in ASTM metrics for Eq. 30 of ISO 15712-1.

$$STC_{Dd} = STC_{lab} + \max(\Delta STC_D, \Delta STC_d) + \frac{\min(\Delta STC_D, \Delta STC_d)}{2}$$
 Eq. 3.1.2

For each flanking path, STC_{ij} is calculated using Eq. 3.1.3 where indices i and j refer to the coupled flanking assemblies; thus, "i" can either be "D" or "F" and "j" can be "f" or "d". The geometric correction factor at the end depends on the surface area of the separating assembly (S_s) and the length of the junction between flanking and separating assemblies (I_{ij}), with I₀ = 1 m. Eq. 3.1.3 is the counterpart in ASTM metrics for Equations 28a and 31 of ISO 15712-1.

$$STC_{ij} = \frac{STC_i}{2} + \frac{STC_j}{2} + K_{ij} + \max(\Delta STC_i, \Delta STC_j) + \frac{\min(\Delta STC_i, \Delta STC_j)}{2} + 10 \cdot \log_{10} \frac{S_s}{l_0 \cdot l_{ij}}$$
Eq. 3.1.3

Worked Examples

This section presents a number of worked examples that demonstrate the calculation of the ASTC rating of CLT constructions according to the Simplified Method. Each worked example in this section presents all the pertinent physical characteristics of the assemblies and junctions, together with a summary of key steps in the calculation process for these constructions.

Within the table for each worked example, the "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation, or their counterparts using ASTM ratings as presented in Equations 3.1.1 to 3.1.3. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.

Under the single heading "STC or ΔSTC", the examples present input data determined in laboratory tests according to ASTM E90, including:

- STC ratings for laboratory sound transmission loss data for wall or floor assemblies; and
- ΔSTC values measured in the laboratory for the change in STC due to adding a lining to the base wall or floor assembly.

Under the heading "STC or ASTC", the examples present the calculated values for sound transmission via specific paths, including:

- Direct STC ratings for the in-situ transmission through the separating assembly including linings;
- Flanking STC ratings for each flanking transmission path including the change due to linings;
- ASTC ratings for the combination of direct and flanking sound transmission paths.

When the calculated Flanking STC for a given path exceeds 90 dB, the value is limited to 90, to allow for the inevitable effect of higher-order flanking paths that make the higher calculated value not representative of the true situation. Further enhancements to elements in these paths will give negligible benefit. The consequence of this limit is that the Junction STC for the set of 3 paths at each edge of the separating assembly cannot exceed 85 and the Total Flanking STC for all 4 edges cannot exceed 79.

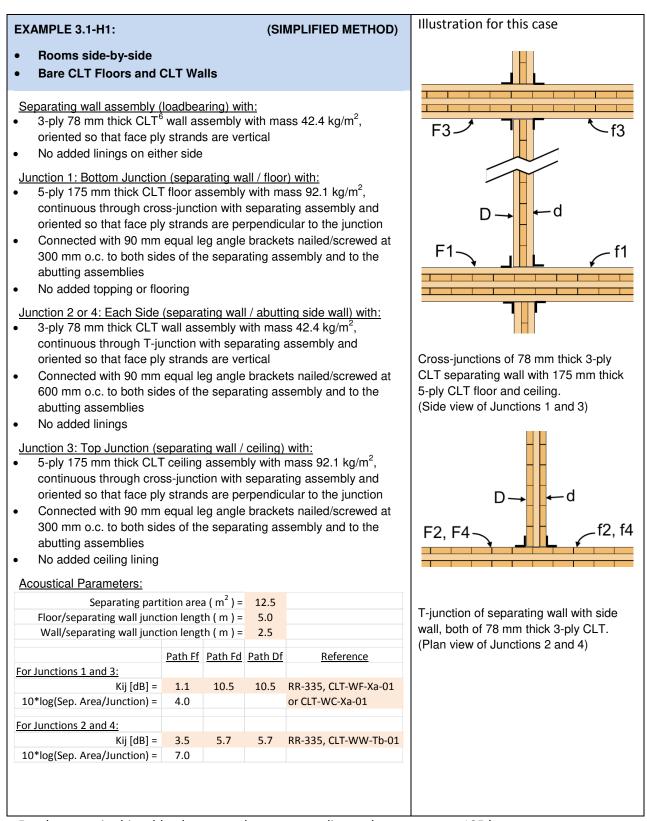
The numeric calculations present the arithmetic step-by-step in each worked example, using compact notation consistent with spreadsheet expressions:

- For the calculation of the Direct STC and the Flanking STC, these expressions are easily recognized as equivalent to Equations 3.1.2 and 3.1.3, respectively.
- For illustrating the combined sound power transmitted via specific paths, the calculation of Eq. 3.1.1 is broken down into several stages. Note that in the compact notation, a term for transmitted sound power fraction such as $10^{-0.1 \cdot TL_{ij}}$ becomes 10^-7.4, if TL_{ij} =74.

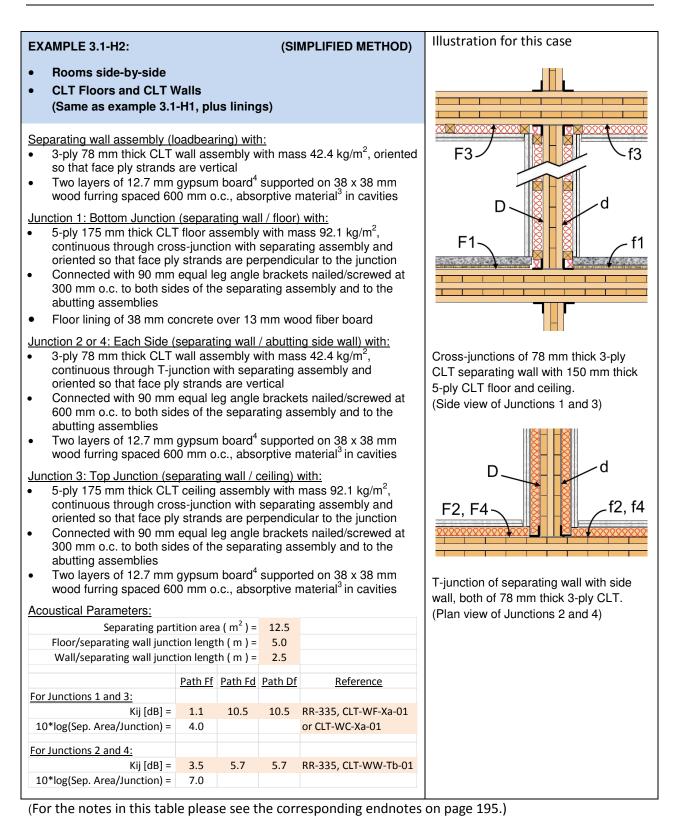
- At each stage (such as the Flanking STC for a given junction) the result is converted into decibel form by calculating -10*log₁₀(*transmitted sound power fraction*), to facilitate comparison of each path or junction with the Direct STC and the final ASTC result.
- The ASTC rating is calculated from the combined sound power transmitted via the direct path and the 12 individual flanking paths.

The numbering of the tables presenting the worked examples end in an alphanumeric such as "H1" or "V2" to indicate Horizontal Case 1 (with rooms side-by-side) or Vertical Case 2 (with rooms one-above-the-other), respectively.

All examples conform to the Standard Scenario presented in Section 1.2 of this Guide. The worked examples include both scenarios for CLT wall and floor assemblies without linings and scenarios where linings are included.



	ISO Symbol	Referen	nce	STC or ∆STC	STC or A	sтс
Separating Partition (78 mm					/ 4	
Laboratory STC for Dd	R_s,w	RR-335, Base CLT03		36		
Δ STC change by Lining on D	ΔR D,w	No Lining		0		
Δ STC change by Lining on d	$\Delta R d, w$	No Lining		0		
If airborne flanking or bare Cl		RR-335, STC(Bare CLT03) - ST		-3		
Direct STC in-situ	R Dd,w	RR-335, Eq. 4.1.2		X(0,0) + MIN(0,0)/2 + -3 =	33	
Direct STC III-situ	N_Du,w	NR-555, Eq. 4.1.2	30 + IVIA	$1 \times (0,0) + 1 \times 11 \times (0,0) / 2 + -3 -$	33	
lunction 1 (Cross Junction 7	9 mm 2 nly (LT Separating Wall / 175 mn				
	o min o-piy c	LI Separating Wait / 175 min				
Flanking Element F1: Laboratory STC for F1	R F1,w	RR-335, Base CLT05-Mean		42		
		No Lining		42		
Δ STC change by Lining on F1	ΔR_F1,w	NO LITINg		0		
Flanking Element f1:	D f1	DD 225 Date CLTOF Mean		42		
Laboratory STC for f1	R_f1,w	RR-335, Base CLT05-Mean				
Δ STC change by Lining on f1	ΔR_f1,w	No Lining		0	47	
Flanking STC for path Ff_1	R_Ff,w	RR-335, Eq. 4.1.3		(0,0)/2 + 1.1 + 4 =	47	
Flanking STC for path Fd_1	R_Fd,w	RR-335, Eq. 4.1.3		+ MIN(0,0)/2 + 10.5 + 4 =	54	
Flanking STC for path Df_1	R_Df,w	RR-335, Eq. 4.1.3		+ MIN(0,0)/2 + 10.5 + 4 =	54	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-4.	.7 + 10^- 5.4 + 10^- 5.4) =		46
	m 3-ply CLT S	eparating Wall / 78 mm 3-pl	y CLT Flanking Wall)			
Flanking Element F2:						
Laboratory STC for F2	R_F2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on F2	ΔR_F2,w	No Lining		0		
Flanking Element f2:						
Laboratory STC for f2	R_f2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on f2	ΔR_f2,w	No Lining		0		
Flanking STC for path Ff_2	R_ Ff,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0)) + MIN(0,0)/2 + 3.5 + 7 =	47	
Flanking STC for path Fd_2	R_Fd,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0	0) + MIN(0,0)/2 + 5.7 + 7 =	49	
Flanking STC for path Df_2	R_Df,w	RR-335, Eq. 4.1.3	36/2 + 36/2 +MAX(0,0	0) + MIN(0,0)/2 + 5.7 + 7 =	49	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-4.	.7 + 10^- 4.9 + 10^- 4.9) =		43
Junction 3 (Cross-Junction, 7	<mark>/8 mm 3-ply C</mark>	LT Separating Wall / 175 mn	n 5-ply CLT Ceiling)			
Flanking Element F3:						
Laboratory STC for F3	R_F3,w	RR-335, Base CLT05-Mean		42		
ΔSTC change by Lining on F3	ΔR F3,w	No Lining		0		
Flanking Element f3:						
Laboratory STC for f3	R f3,w	RR-335, Base CLT05-Mean		42		
ΔSTC change by Lining on f3	ΔR_f3,w	No Lining		0		
Flanking STC for path Ff 3	R_Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(0.0)	(0,0) + MIN(0,0)/2 + 1.1 + 4 =	47	
Flanking STC for path Fd_3	R_Fd,w	RR-335, Eq. 4.1.3		+ MIN(0,0)/2 + 10.5 + 4 =	54	
Flanking STC for path Df 3	R Df,w	RR-335, Eq. 4.1.3		+ MIN(0,0)/2 + 10.5 + 4 =		
Junction 3: Flanking STC for	_ /	Subset of Eq. 4.1.1		$.7 + 10^{-} 5.4 + 10^{-} 5.4$ =		4
	an patrio		10 20010(10 1			
lunction 4 (T-lunction, 78 m	m 3-nly CLT S	eparating Wall / 78 mm 3-pl	v CLT Flanking Wall)			
Flanking Flomont FA						
Flanking Element F4:	D E4 w	PP-225 Base CLT02		26		
Laboratory STC for F4	R_F4,w	RR-335, Base CLT03		36		
Laboratory STC for F4 ΔSTC change by Lining on F4	R_F4,w ΔR_F4,w	RR-335, Base CLT03 No Lining		36 0		
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4:	ΔR_F4,w	No Lining		0		
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4	ΔR_F4,w R_f4,w	No Lining RR-335, Base CLT03		0 36		
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4	ΔR_F4,w R_f4,w ΔR_f4,w	No Lining RR-335, Base CLT03 No Lining		0 36 0		
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4 Flanking STC for path Ff_4	ΔR_F4,w R_f4,w ΔR_f4,w R_Ff,w	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3		0 36 0) + MIN(0,0)/2 + 3.5 + 7 =	47	
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4 Flanking STC for path Ff_4 Flanking STC for path Fd_4	ΔR_F4,w R_f4,w ΔR_f4,w R_Ff,w R_Ff,w	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0	0 36 0 0) + MIN(0,0)/2 + 3.5 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	49	
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4 Flanking STC for path Ff_4 Flanking STC for path Fd_4 Flanking STC for path Df_4	ΔR_F4,w R_f4,w ΔR_f4,w R_Ff,w R_Fd,w R_Fd,w R_Df,w	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0 36/2 + 36/2 + MAX(0,0	0 36 0 0) + MIN(0,0)/2 + 3.5 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	49	
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4 Flanking STC for path Ff_4 Flanking STC for path Fd_4 Flanking STC for path Df_4	ΔR_F4,w R_f4,w ΔR_f4,w R_Ff,w R_Fd,w R_Fd,w R_Df,w	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0 36/2 + 36/2 + MAX(0,0	0 36 0 0) + MIN(0,0)/2 + 3.5 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	49	43
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4 ΔSTC change by Lining on f4 Flanking STC for path Ff_4 Flanking STC for path Fd_4 Flanking STC for path Df_4 Junction 4: Flanking STC for	$\Delta R_F4,w$ R_f4,w $\Delta R_f4,w$ R_Ff,w R_Fd,w R_Of,w all paths	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3 Subset of Eq. 4.1.1	36/2 + 36/2 + MAX(0,0 36/2 + 36/2 + MAX(0,0 - 10*LOG10(10^-4.	0 36 0 0) + MIN(0,0)/2 + 3.5 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 7 + 10^- 4.9 + 10^- 4.9) =	49	
Laboratory STC for F4 ΔSTC change by Lining on F4 Flanking Element f4: Laboratory STC for f4	$\Delta R_F4,w$ R_f4,w $\Delta R_f4,w$ R_Ff,w R_Fd,w R_Of,w all paths	No Lining RR-335, Base CLT03 No Lining RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3 RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(0,0 36/2 + 36/2 + MAX(0,0 - 10*LOG10(10^-4.	0 36 0 0) + MIN(0,0)/2 + 3.5 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 = 0) + MIN(0,0)/2 + 5.7 + 7 =	49	43



	ISO Symbol	Refer	ence	STC or Δ STC	STC or A	STC
Separating Partition (78 mm						
Laboratory STC for Dd	R_s,w	RR-335, Base CLT03		36		
Δ STC change by Lining on D	$\Delta R D, w$	RR-335, ΔTL-CLT03-W03		9		
Δ STC change by Lining on d	$\Delta R d, w$	RR-335, ΔTL-CLT03-W03		9		
If airborne flanking or bare Cl		RR-335, STC(Bare CLT03) -	STC/Base CLT02)	N/A		
Direct STC in-situ	R Dd,w	RR-335, Eq. 4.1.2		-MAX(9,9) + MIN(9,9)/2 =	50	
Directore in-situ	N_Du,w	NN-555, Eq. 4.1.2	50 1	-101AX(3,3) + 101110(3,3)/2 -	50	
Junction 1 (Cross-Junction, 7	0 mana 2 mly (TT Concreting Mall / 17E				
	o min o-piy c		IIII 5-ply CET FIOOL)			
Flanking Element F1:	R F1,w	RR-335, Base CLT05-Mean		42		
Laboratory STC for F1		RR-335, ΔTL-CLT-F03		42		
Δ STC change by Lining on F1	ΔR_F1,w	RR-335, Δ1L-CL1-F05		10		
Flanking Element f1:	D f1			42		
Laboratory STC for f1	R_f1,w	RR-335, Base CLT05-Mean		42		
Δ STC change by Lining on f1	∆R_f1,w	RR-335, ΔTL-CLT-F03		10	60	
Flanking STC for path Ff_1	R_Ff,w		42/2 + 42/2 + MAX(10,10)		62	
Flanking STC for path Fd_1	R_Fd,w	RR-335, Eq. 4.1.3		+ MIN(10,9)/2 + 10.5 + 4 =		
Flanking STC for path Df_1	R_Df,w	RR-335, Eq. 4.1.3		+ MIN(9,10)/2 + 10.5 + 4 =	68	
Junction 1: Flanking STC for a	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.2 + 10^- 6.8 + 10^- 6.8) =		60
Junction 2 (T-Junction, 78 m	m 3-ply CLT S	eparating Wall / 78 mm 3-	ply CLT Flanking Wall)			
Flanking Element F2:						
Laboratory STC for F2	R_F2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on F2	ΔR_F2,w	RR-335, ΔTL-CLT03-W03		9		
Flanking Element f2:						
Laboratory STC for f2	R_f2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on f2	ΔR_f2,w	RR-335, ΔTL-CLT03-W03		9		
Flanking STC for path Ff_2	R_ Ff,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,	9) + MIN(9,9)/2 + 3.5 + 7 =	60	
Flanking STC for path Fd_2	R_ Fd,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,	9) + MIN(9,9)/2 + 5.7 + 7 =	62	
Flanking STC for path Df_2	R_Df,w	RR-335, Eq. 4.1.3	36/2 + 36/2 +MAX(9,	9) + MIN(9,9)/2 + 5.7 + 7 =	62	
Junction 2: Flanking STC for a	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^	-6 + 10^- 6.2 + 10^- 6.2) =		56
Junction 3 (Cross-Junction, 7	8 mm 3-nly (IT Separating Wall / 175 n	nm 5-nly CIT Ceiling)			
Flanking Element F3:						
Laboratory STC for F3	R_F3,w	RR-335, Base CLT05-Mean		42		
Δ STC change by Lining on F3		RR-335, ΔTL-CLT-C01		7		
Flanking Element f3:	Διζ_15,₩			1		
Laboratory STC for f3	R f3,w	RR-335, Base CLT05-Mean		42		
Δ STC change by Lining on f3	ΔR_f3,w	RR-335, ΔTL-CLT-C01		42		
Flanking STC for path Ff_3	R Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + 840X/7	7) + MIN(7,7)/2 + 1.1 + 4 =	58	
Flanking STC for path Fd_3	R_Fd,w	RR-335, Eq. 4.1.3	, , , , , , , , , , , , , , , , , , , ,	(7,7)/2 + 1.1 + 4 =) + MIN(7,9)/2 + 10.5 + 4 =	66	
Flanking STC for path Df_3	R Df,w	RR-335, Eq. 4.1.3	· · · · · ·	(7,3)/2 + 10.5 + 4 =) + MIN(9,7)/2 + 10.5 + 4 =		
Junction 3: Flanking STC for a		Subset of Eq. 4.1.1	, , ,,	$5.8 + 10^{-} 6.6 + 10^{-} 6.6$	00	57
Junction 5: Flanking STC for	an patris	Subset of Eq. 4.1.1	- 10, 10010(10,-5	.0 + 10 0.0 + 10 0.0) =		5.
Junction 4 (T-Junction, 78 m	m 3-ply CLT S	eparating Wall / 78 mm 3-	ply CLT Flanking Wall)			
Flanking Element F4:						
Laboratory STC for F4	R_F4,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on F4	ΔR_F4,w	RR-335, ΔTL-CLT-W03		9		
Flanking Element f4:						
Laboratory STC for f4	R_f4,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on f4	ΔR_f4,w	RR-335, ΔTL-CLT-W03		9		
Flanking STC for path Ff_4	R_ Ff,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,	9) + MIN(9,9)/2 + 3.5 + 7 =	60	
Flanking STC for path Fd_4	R_Fd,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,	9) + MIN(9,9)/2 + 5.7 + 7 =	62	
Flanking STC for path Df_4	R_Df,w	RR-335, Eq. 4.1.3		9) + MIN(9,9)/2 + 5.7 + 7 =	62	
Junction 4: Flanking STC for		Subset of Eq. 4.1.1		-6 + 10^- 6.2 + 10^- 6.2) =		56
Total Elanking STC /for all 4	unctions	Subset of Eq. 4.1.1	Combini	ing 12 Elapking STC values		E /
Total Flanking STC (for all 4 j		Subset of Eq. 4.1.1		ing 12 Flanking STC values:		5:
ASTC due to Direct plus Flan	Death a	Eq. 4.1.1	Combining Direct CTC or	nd 12 Flanking STC values:	48	

EXAMPLE 3.1-H3:

(SIMPLIFIED METHOD)

- Rooms side-by-side
- CLT Floors and CLT Walls (Same as example 3.1-H2, except enhanced linings)

Separating wall assembly (loadbearing) with:

- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², oriented so that face ply strands are vertical
- Two layers of 12.7 mm gypsum board⁴ on resilient metal channels⁷ spaced 600 mm o.c., on 38 x 38 mm wood furring spaced 400 mm o.c. with absorptive material³ in cavities

Junction 1: Bottom Junction (separating wall / floor) with:

- 5-ply 175 mm thick CLT floor assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Floor lining of 38 mm concrete over 13 mm wood fiber board

Junction 2 or 4: Each Side (separating wall / abutting side wall) with:

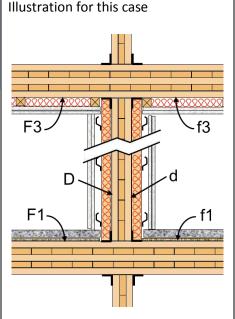
- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², continuous through T-junction with separating assembly and oriented so that face ply strands are vertical
- Connected with 90 mm equal leg angle brackets nailed/screwed at 600 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

Junction 3: Top Junction (separating wall / ceiling) with:

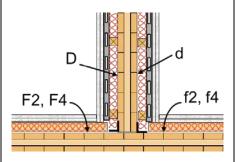
- 5-ply 175 mm thick CLT ceiling assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

Acoustical Parameters:

Separating parti	tion area	(m ²) =	12.5	
Floor/separating wall juncti	5.0			
Wall/separating wall juncti	2.5			
	Path Ff	Path Fd	Path Df	Reference
For Junctions 1 and 3:				
Kij [dB] =	1.1	10.5	10.5	RR-335, CLT-WF-Xa-01
10*log(Sep. Area/Junction) =	4.0			or CLT-WC-Xa-01
For Junctions 2 and 4:				
Kij [dB] =	3.5	5.7	5.7	RR-335, CLT-WW-Tb-01
10*log(Sep. Area/Junction) =	7.0			

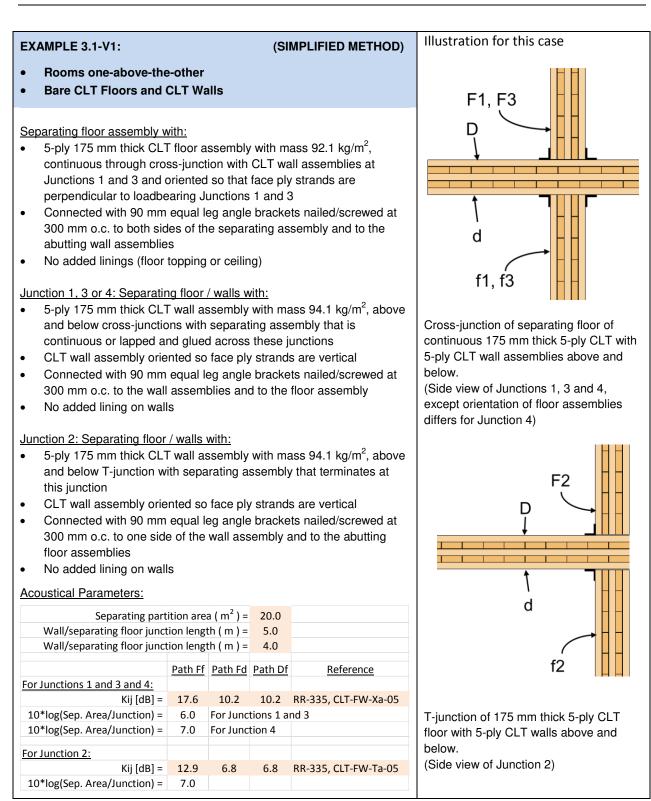


Cross-junctions of 78 mm thick 3-ply CLT separating wall with 150 mm thick 5-ply CLT floor and ceiling. (Side view of Junctions 1 and 3)

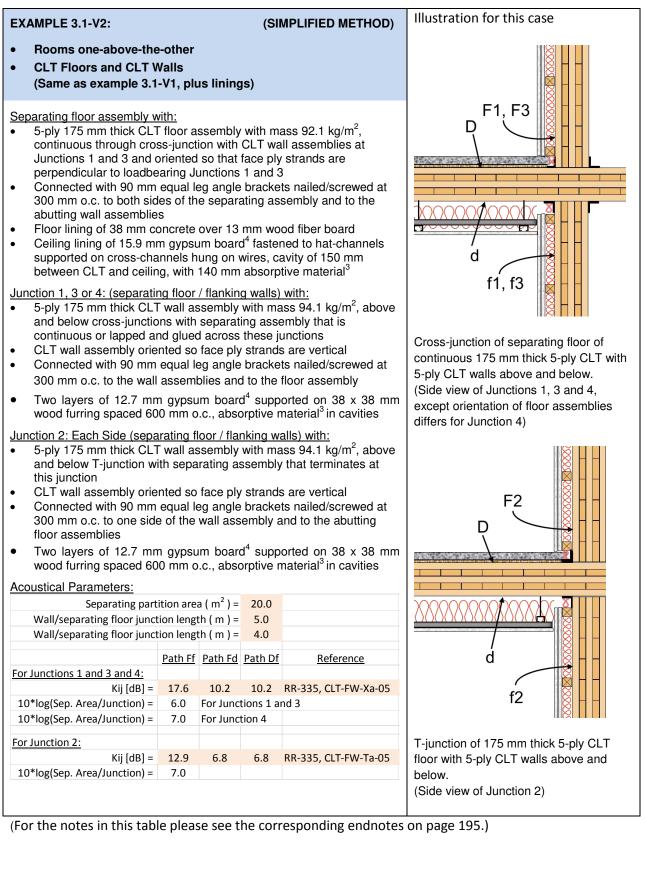


T-junction of separating wall with side wall, both of 78 mm thick 3-ply CLT. (Plan view of Junctions 2 and 4)

	ISO Symbol	Refer	ence	STC or Δ STC	STC or A	STO
Separating Partition (78 mm						
Laboratory STC for Dd	R s,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on D	$\Delta R D, w$	RR-335, ΔTL-CLT-W04		15		
∆STC change by Lining on d	$\Delta R d, w$	RR-335, ΔTL-CLT-W04		15		
If airborne flanking or bare Cl		RR-335, STC(Bare CLT03) -	STC/Rase CLT02)	N/A		
Direct STC in-situ	R Dd,w	RR-335, Eq. 4.1.2		((15,15) + MIN(15,15)/2 =	59	
Direct STC III-situ	K_DU,W	RR-333, Eq. 4.1.2	30 + IVIA7	(15,15) + 10110(15,15)/2 -	39	
Junction 1 (Cross-Junction, 7	9 mm 2 nly (T Soparating Wall / 175 m	am E ply CLT Elear)			
· · · · · · · · · · · · · · · · · · ·	o mm o-piy C	LT Separating wait / 175 h	IIII S-ply CLI Floor)			
Flanking Element F1:	D F1	RR-335, Base CLT05-Mean		42		
Laboratory STC for F1	R_F1,w	,				
∆STC change by Lining on F1	ΔR_F1,w	RR-335, ΔTL-CLT-F03		10		
Flanking Element f1:	5.64			10		
Laboratory STC for f1	R_f1,w	RR-335, Base CLT05-Mean		42		
∆STC change by Lining on f1	ΔR_f1,w	RR-335, ΔTL-CLT-F03		10		
Flanking STC for path Ff_1	R_Ff,w		42/2 + 42/2 + MAX(10,10)		62	
Flanking STC for path Fd_1	R_ Fd,w	, ,	2/2 + 36/2 + MAX(10,15) +		74	
Flanking STC for path Df_1	R_Df,w	•	36/2 + 42/2 +MAX(15,10) +		74	
Junction 1: Flanking STC for a	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.2 + 10^- 7.4 + 10^- 7.4) =		6
lunction 2 (T-Junction, 78 m	m 3-ply CLT S	eparating Wall / 78 mm 3-	ply CLT Flanking Wall)			
Flanking Element F2:						
Laboratory STC for F2	R_F2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on F2	ΔR_F2,w	RR-335, ΔTL-CLT03-W03		9		
Flanking Element f2:						
Laboratory STC for f2	R_f2,w	RR-335, Base CLT03		36		
ΔSTC change by Lining on f2	ΔR f2,w	RR-335, ΔTL-CLT03-W03		9		
Flanking STC for path Ff_2	R Ff,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9)	9) + MIN(9,9)/2 + 3.5 + 7 =	60	
Flanking STC for path Fd_2	R Fd,w	RR-335, Eq. 4.1.3) + MIN(9,15)/2 + 5.7 + 7 =	68	
Flanking STC for path Df_2	R Df,w	RR-335, Eq. 4.1.3) + MIN(15,9)/2 + 5.7 + 7 =		
Junction 2: Flanking STC for		Subset of Eq. 4.1.1		-6 + 10 [^] - 6.8 + 10 [^] - 6.8) =		59
	P • • • •		(-
Junction 3 (Cross-Junction, 7	8 mm 3-ply C	LT Separating Wall / 175 n	nm 5-ply CLT Ceiling)			
Flanking Element F3:		;;;;				
Laboratory STC for F3	R_F3,w	RR-335, Base CLT05-Mean		42		
ΔSTC change by Lining on F3		RR-335, ΔTL-CLT-C01		7		
Flanking Element f3:	∆n_13,₩			,		
Laboratory STC for f3	R f3,w	RR-335, Base CLT05-Mean		42		
Δ STC change by Lining on f3	ΔR_f3,w	RR-335, ΔTL-CLT-C01		42		
Flanking STC for path Ff 3	R Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX/7	7) + MIN(7,7)/2 + 1.1 + 4 =	58	
• • -				+ MIN(7,15)/2 + 10.5 + 4 =	72	
Flanking STC for path Fd_3	R_Fd,w	RR-335, Eq. 4.1.3		+ MIN(7,13)/2 + 10.3 + 4 = + MIN(15,7)/2 + 10.5 + 4 =		
Flanking STC for path Df_3	R_Df,w	RR-335, Eq. 4.1.3	, , , , , ,	(<i>i n</i>	72	-
Junction 3: Flanking STC for a	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-5	.8 + 10^- 7.2 + 10^- 7.2) =		5
Junction 4 (T-Junction, 78 m	m 3-ply CLT S	eparating Wall / 78 mm 3-	ply CLT Flanking Wall)			
Flanking Element F4:						
Laboratory STC for F4	R_F4,w	RR-335, Base CLT03		36		
∆STC change by Lining on F4	∆R_F4,w	RR-335, ΔTL-CLT03-W03		9		
Flanking Element f4:						
Laboratory STC for f4	R_f4,w	RR-335, Base CLT03		36		
∆STC change by Lining on f4	ΔR_f4,w	RR-335, ΔTL-CLT03-W03		9		
Flanking STC for path Ff_4	R_ Ff,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,	9) + MIN(9,9)/2 + 3.5 + 7 =	60	
Flanking STC for path Fd_4	R_Fd,w	RR-335, Eq. 4.1.3	36/2 + 36/2 + MAX(9,15) + MIN(9,15)/2 + 5.7 + 7 =	68	
Flanking STC for path Df_4	R_Df,w	RR-335, Eq. 4.1.3) + MIN(15,9)/2 + 5.7 + 7 =	68	
Junction 4: Flanking STC for		Subset of Eq. 4.1.1		-6 + 10 [^] - 6.8 + 10 [^] - 6.8) =		5
0						
Total Flanking STC (for all 4 j	unctions)	Subset of Eq. 4.1.1	Combining	all 12 Flanking STC values:		5
ASTC due to Direct plus Flan		Eq. 4.1.1	Combining Direct STC ar	1 4 6 6 1 1 6 6 6 1	52	



	ISO Symbol	Refere	nce	STC or Δ STC	STC or AST
Separating Partition (175 mi					
Laboratory STC for Dd	R_s,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on D	$\Delta R_D, w$	No Lining		0	
ΔSTC change by Lining on d	ΔR_d,w	No Lining		0	
If airborne flanking or bare Cl		RR-335, STC(Bare CLT05) - S		-1	
Direct STC in-situ	R_Dd,w	RR-335, Eq. 4.1.2	42 + MA	X(0,0) + MIN(0,0)/2 + -1 =	41
_					
Junction 1 (Cross-Junction, 1	75 mm 5-ply	CLT Separating Floor / 175 r	mm 5-ply CLT Wall)		
Flanking Element F1:					
Laboratory STC for F1	R_F1,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on F1	ΔR_F1,w	No Lining		0	
Flanking Element f1:					
Laboratory STC for f1	R_f1,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on f1	ΔR_f1,w	No Lining		0	
Flanking STC for path Ff_1	R_ Ff,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 17.6 + 6 =	
Flanking STC for path Fd_1	R_Fd,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(0,0) + MIN(0,0)/2 + 10.2 + 6 =	58
Flanking STC for path Df_1	R_Df,w	RR-335, Eq. 4.1.3	42/2 + 42/2 +MAX(0,0) + MIN(0,0)/2 + 10.2 + 6 =	58
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.6 + 10^- 5.8 + 10^- 5.8) =	5
Junction 2 (T-Junction, 175 n	nm 5-ply CLT	Separating Floor / 175 mm !	5-ply CLT Wall)		
Flanking Element F2:					
Laboratory STC for F2	R_F2,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on F2	ΔR_F2,w	No Lining		0	
Flanking Element f2:					
Laboratory STC for f2	R_f2,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on f2	ΔR_f2,w	No Lining		0	
Flanking STC for path Ff_2	R_ Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(0,0) + MIN(0,0)/2 + 12.9 + 7 =	62
Flanking STC for path Fd_2	R Fd,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(0,	0) + MIN(0,0)/2 + 6.8 + 7 =	56
Flanking STC for path Df_2	R Df,w	RR-335, Eq. 4.1.3	42/2 + 42/2 +MAX(0,	0) + MIN(0,0)/2 + 6.8 + 7 =	56
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.2 + 10^- 5.6 + 10^- 5.6) =	52
Junction 3 (Cross-Junction, 1	75 mm 5-ply	CLT Separating Floor / 175 i	mm 5-ply CLT Wall)		
Flanking Element F3:	D 53			42	
Laboratory STC for F3	R_F3,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on F3	ΔR_F3,w	No Lining		0	
Flanking Element f3:	5.62				
Laboratory STC for f3	R_f3,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on f3	∆R_f3,w	No Lining		0	
Flanking STC for path Ff_3	R_Ff,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 17.6 + 6 =	
Flanking STC for path Fd_3	R_Fd,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 10.2 + 6 =	
Flanking STC for path Df_3	R_Df,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 10.2 + 6 =	
Junction 3: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.6 + 10^- 5.8 + 10^- 5.8) =	5.
Junction 4 (Cross-Junction, 1	7E mana E miles	CIT Concepting Floor / 475			
Flanking Element F4:	75 mm 5-ply	CLI Separating Floor / 1/5 I	nin S-ply CL1 Wall)		
	D E4	DD 225 Daso CITOS Maan		12	
Laboratory STC for F4	R_F4,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on F4	ΔR_F4,w	No Lining		0	
Flanking Element f4:	D f4			10	
Laboratory STC for f4	R_f4,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on f4	∆R_f4,w	No Lining		0) + MIN(0,0) (2 + 17 (+ 7 -	C 7
Flanking STC for path Ff_4	R_Ff,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 17.6 + 7 =	
Flanking STC for path Fd_4	R_Fd,w	RR-335, Eq. 4.1.3	, , , ,,) + MIN(0,0)/2 + 10.2 + 7 =	
Flanking STC for path Df_4	R_Df,w	RR-335, Eq. 4.1.3) + MIN(0,0)/2 + 10.2 + 7 =	
Junction 4: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6	.7 + 10^- 5.9 + 10^- 5.9) =	50
Total Flanking STC (for all 4 j	unctions)	Subset of Eq. 4.1.1	Combining	all 12 Flanking STC values:	43
ASTC due to Direct plus Flan	king Paths	Eq. 4.1.1	Combining Direct STC ar	nd 12 Flanking STC values:	40



	ISO Symbol	Refere	ence	STC or Δ STC	STC or ASTC
Separating Partition (175 m					
Laboratory STC for Dd	R_s,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on D	ΔR_D,w	RR-335, ΔTL-CLT-F03		10	
ΔSTC change by Lining on d	ΔR_d,w	RR-335, ΔTL-CLT-C03		25	
If airborne flanking or bare C	LT	RR-335, STC(Bare CLT05) - 5	. ,	N/A	
Direct STC in-situ	R_Dd,w	RR-335, Eq. 4.1.2	42 + MAX	<pre><(10,25) + MIN(10,25)/2 =</pre>	72
Junction 1 (Cross-Junction, 1 Flanking Element F1:	75 mm 5-ply	CLI Separating Floor / 1/5	mm 5-ply CLT Wall)		
Laboratory STC for F1	D F1	RR-335, Base CLT05-Mean		42	
/	R_F1,w	,		42	
Δ STC change by Lining on F1	ΔR_F1,w	RR-335, ΔTL-CLT05-W03		8	
Flanking Element f1:	D f1			42	
Laboratory STC for f1	R_f1,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on f1	ΔR_f1,w	RR-335, ΔTL-CLT05-W03		8	
Flanking STC for path Ff_1	R_Ff,w	RR-335, Eq. 4.1.3) + MIN(8,8)/2 + 17.6 + 6 =	
Flanking STC for path Fd_1	R_Fd,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(8,25)		
Flanking STC for path Df_1	R_Df,w	RR-335, Eq. 4.1.3		+ MIN(10,8)/2 + 10.2 + 6 =	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-7	.8 + 10^- 8.7 + 10^- 7.2) =	71
Junction 2 (T-Junction, 175 n	nm 5-nly CLT	Separating Electr / 175 mm			
Flanking Element F2:	IIII 3-ply CET				
Laboratory STC for F2	R F2,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on F2	$\Delta R_F2, w$	RR-335, ΔTL-CLT05-W03		8	
Flanking Element f2:	ΔΝ_12,₩	КК-333, <u>ДТЕ-СЕТ03-</u> W03		8	
Laboratory STC for f2	D f2 w	RR-335, Base CLT05-Mean		42	
	R_f2,w	-		42	
Δ STC change by Lining on f2	ΔR_f2,w	RR-335, ΔTL-CLT05-W03	42 /2 · 42 /2 · MAX (8 8	-	74
Flanking STC for path Ff_2	R_Ff,w	RR-335, Eq. 4.1.3		+ MIN(8,8)/2 + 12.9 + 7 =	
Flanking STC for path Fd_2	R_Fd,w	RR-335, Eq. 4.1.3		+ MIN(8,25)/2 + 6.8 + 7 =	
Flanking STC for path Df_2	R_Df,w	RR-335, Eq. 4.1.3) + MIN(10,8)/2 + 6.8 + 7 =	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10*	-7.4 + 10^- 8.5 + 10^- 7) =	68
Junction 3 (Cross-Junction, 1	75 mm 5-ply	CLT Separating Floor / 175	mm 5-ply CLT Wall)		
Flanking Element F3:					
Laboratory STC for F3	R F3,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on F3	ΔR_F3,w	RR-335, ΔTL-CLT05-W03		8	
Flanking Element f3:				_	
Laboratory STC for f3	R f3,w	RR-335, Base CLT05-Mean		42	
Δ STC change by Lining on f3	ΔR f3,w	RR-335, ΔTL-CLT05-W03		8	
Flanking STC for path Ff_3	R Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(8.8) + MIN(8,8)/2 + 17.6 + 6 =	78
Flanking STC for path Fd_3	R Fd,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(8,25)		
Flanking STC for path Df_3	R Df,w	RR-335, Eq. 4.1.3		+ MIN(10,8)/2 + 10.2 + 6 =	
Junction 3: Flanking STC for	_ /	Subset of Eq. 4.1.1		.8 + 10^- 8.7 + 10^- 7.2) =	
Junction 4 (Cross-Junction, 1	75 mm 5-ply	CLT Separating Floor / 175	mm 5-ply CLT Wall)		
Flanking Element F4:					
Laboratory STC for F4	R_F4,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on F4	ΔR_F4,w	RR-335, ΔTL-CLT05-W03		8	
Flanking Element f4:					
Laboratory STC for f4	R_f4,w	RR-335, Base CLT05-Mean		42	
ΔSTC change by Lining on f4	ΔR_f4,w	RR-335, ΔTL-CLT05-W03		8	
Flanking STC for path Ff_4	R_ Ff,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(8,8)) + MIN(8,8)/2 + 17.6 + 7 =	79
Flanking STC for path Fd_4	R_Fd,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(8,25)	+ MIN(8,25)/2 + 10.2 + 7 =	88
Flanking STC for path Df_4	R_Df,w	RR-335, Eq. 4.1.3	42/2 + 42/2 + MAX(10,8)	+ MIN(10,8)/2 + 10.2 + 7 =	73
Junction 4: Flanking STC for		Subset of Eq. 4.1.1		.9 + 10^- 8.8 + 10^- 7.3) =	
Total Flanking STC (for all 4)	junctions)	Subset of Eq. 4.1.1	Combining	all 12 Flanking STC values:	64
ASTC due to Direct plus Flan	king Paths	Eq. 4.1.1	Combining Direct STC ar	nd 12 Flanking STC values:	64

Summary for Section 3.1: Calculation Examples using the Simplified Method

The worked examples (3.1-H1 to H3 and 3.1-V1 to V2) illustrate the use of the Simplified Method for calculating the sound transmission between rooms in a building with CLT floor and wall assemblies, with or without linings added to some or all of the walls and floors.

The examples show the performance for two cases with bare CLT assemblies without linings (Examples 3.1-H1 and 3.1-V1) and for three cases with improvements in direct and/or flanking sound transmission loss via specific paths due to the addition of some common types of linings using gypsum board, supporting framing, and sound absorbing material. Many other lining options are possible using the Δ STC values for linings in NRC Research Report RR-335, "Apparent Sound Insulation in CLT Buildings."

For a side-by-side pair of rooms, Examples 3.1-H2 and 3.1-H3 show typical improvements relative to Example 3.1-H1. Even with the rather light 3-ply CLT separating wall assembly, the addition of a gypsum board lining screwed directly to wood furring on all wall surfaces (Example 3.1-H2) brings the ASTC rating up to 48. Inspection of the path STC ratings in Example 3.1-H2 shows that direct sound transmission through the separating wall is dominant, and that flanking paths involving the surfaces of the separating wall are also significant. Improving these weak paths by adding resilient channels to the lining on the separating wall, raises the Direct STC to 59 and the overall ASTC rating to 52. Further improvement is possible but would require changes to all the flanking surfaces to raise the value above ASTC 60.

For a vertical room pair, Example 3.1-V2 shows the improvement relative to Example 3.1-V1 when some typical linings are added. Even with rather basic wall linings with Δ STC = 8, the ASTC rating is increased to 64, and higher values could be achieved by better wall linings and/or improvements to the floor surface.

Section 3.2 presents worked examples for the same set of constructions presented in Section 3.1, but uses the Detailed Method for calculating the sound transmission between rooms. Comparison of the corresponding examples in the two sections provides a clear indication of the difference in results with the two calculation methods.

3.2. Detailed Calculation Procedure for CLT Constructions

The calculation process of the Detailed Method of ISO 15712-1 is designed for constructions involving heavy, homogeneous building elements which support reverberant vibration fields. Although CLT assemblies have lower mass and higher internal losses than the heavy concrete and masonry walls and floor assemblies considered in Chapter 2, flanking sound transmission in buildings composed of CLT assemblies can also be predicted using the Detailed Method of ISO 15712-1. However, the differences between CLT assemblies and walls or floors of bare concrete or masonry require some changes to the calculation approach and the laboratory test data required as inputs.

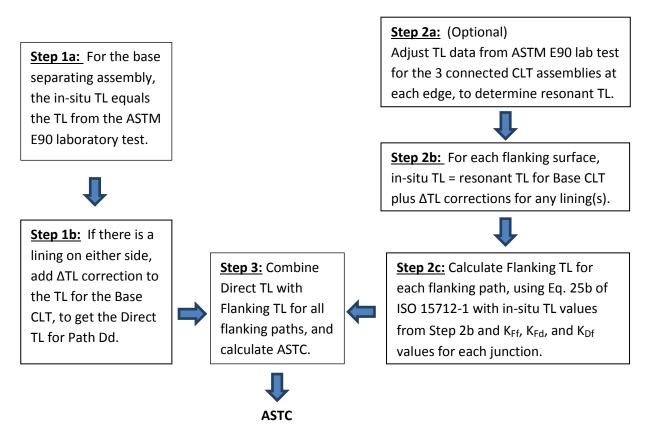
There are five key changes in the calculations due to properties of CLT assemblies and their junctions:

- 1. The internal loss factors for CLT assemblies are much higher than those typical of concrete and masonry (which range from 0.006 for solid concrete to 0.015 for typical concrete masonry). For CLT assemblies, measurements of the loss factors for laboratory wall and floor assemblies have established values of 0.03 or higher for most of the frequency range of interest (see Section 2.4 in NRC Research Report RR-335). This is above the threshold specified in ISO 15712-1 above which the effect of edge losses can be safely ignored, and hence there is no need to apply an absorption correction to obtain the in-situ sound transmission loss from the laboratory sound transmission loss in Equation 19 of ISO 15712-1. Thus, the direct sound transmission loss for each bare CLT flanking surface) is taken as equal to the laboratory sound transmission loss determined according to ASTM E90.
- 2. For flanking surfaces, Section 4.2.2 in ISO 15712-1 notes that only resonant sound transmission should be included. This requires a correction of the sound transmission loss measured in the laboratory below the critical frequency. For bare concrete and masonry assemblies, the critical frequency is below 125 Hz, so no correction to remove the non-resonant sound transmission is needed. For 3-ply CLT assemblies, the critical frequency is about 500 Hz, i.e. in the middle of the frequency range of interest when calculating the ASTC rating. Corrections to the laboratory sound transmission loss are therefore recommended at lower frequencies. Unfortunately, the current version of ISO 15712-1 does not specify a method to obtain the resonant sound transmission loss from the measured sound transmission loss. Hence, in the procedure below and in the worked examples, the uncorrected laboratory sound transmission loss is used as input data. This should lead to conservative results, especially for the flanking sound transmission loss of thin 3-ply CLT assemblies.
- 3. The effect of adding linings to the surfaces of CLT wall and floor assemblies can be treated with an additive correction, as for concrete and masonry assemblies (see discussion in Section 2.3 of this Guide). Because the mass of the CLT assemblies is much closer to that of typical linings than it is for the concrete and masonry assemblies in Section 2.3, the improvement due to linings is affected by the mass of the bare assembly. Data on the improvements due to linings for several common types of CLT assemblies are provided in NRC Research Report RR-335.

- 4. Because the connections provided by angle brackets at CLT junctions are not consistent with the symmetric rigid junction assumptions of Annex E of ISO 15712-1 (which are suitable for mortar-bonded junctions of concrete and masonry), the junction attenuation for a range of cases needs to be determined using measurements of junction transmission following the appropriate parts of ISO 10848. NRC Research Report RR-335 provides vibration reduction index data for a variety of floor/wall and wall/wall CLT junctions.
- Because of the high internal losses in CLT assemblies, the equivalent absorption length a_{situ} is set numerically equal to the surface area of the CLT assembly when calculating the velocity level difference from measured K_{ij} values using Equation 21 of ISO 15712-1, following Section 4.2.2 of ISO 15712-1.

The input data required for the calculations include both laboratory sound transmission loss data measured according to ASTM E90 (for the Base CLT assemblies and for the change in sound transmission loss due to linings applied to these assemblies) and junction attenuation data measured according to ISO 10848.

The calculation process follows the steps illustrated in Figure 3.2.1, and explained in detail below.





- **<u>Step 1:</u>** Determine the sound transmission loss of the separating assembly (Direct TL):
 - (a) For the base separating assembly, the in-situ sound transmission loss for each frequency is equal to the sound transmission loss measured in the laboratory according to ASTM E90.
 - (b) Add ΔTL corrections obtained following the procedures of ASTM E90 for changes due to added lining(s) on the source room and/or receiving room side of the separating assembly (surfaces D and d) to obtain the Direct TL.
- **<u>Step 2</u>**: Determine the sound transmission loss of the flanking assemblies (Flanking TL):
 - (a) For each flanking surface, use the laboratory sound transmission loss determined according to ASTM E90 as a conservative estimate of the resonant sound transmission loss. A correction to calculate the resonant sound transmission loss is recommended in ISO 15712-1, but not defined, and hence not used here. Set the equivalent absorption length for each surface numerically equal to the area of the CLT assembly, as required in Section 4.2.2 of ISO 15712-1.
 - (b) Add ΔTL corrections, obtained in accordance with ASTM E90 for changes due to adding a lining on a matching CLT assembly, to calculate the in-situ sound transmission loss values.
 - (c) For each flanking path, combine the values of the vibration reduction index (K_{Ff}, K_{Fd}, and K_{Df} measured following the procedures of ISO 10848) with in-situ sound transmission loss values (including the change due to linings from Step 2b) using Eq. 25b of ISO 15712-1 to obtain the Flanking TL values.
- **<u>Step 3:</u>** Calculate the Apparent TL by combining Direct TL and Flanking TL:

Combine the sound transmission via the direct path and the flanking paths, using Equation 1.1 in Chapter 1 of this Guide (equivalent to Eq. 26 in Section 4.4 of ISO 15712-1), and calculate the ASTC rating using the combined sound transmission loss values as apparent transmission loss in the procedure of ASTM E413.

<u>Worked Examples</u>

This section presents a number of worked examples that demonstrate the calculation of sound transmission in CLT constructions according to the Detailed Method. Each worked example presents all the pertinent physical characteristics of the assemblies and junctions, together with a summary of key steps in the calculation process for these constructions.

Within the table for each worked example, the "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.

Under the single heading "STC or ASTC" the examples present single-number ratings at each step (calculated from a set of one-third octave band data according to the rules for STC ratings defined in ASTM E413) to provide a consistent set of summary measures at each stage of the calculation:

- STC ratings for laboratory sound transmission loss data for wall or floor assemblies;
- Direct STC ratings for the in-situ sound transmission through the separating assembly including linings;
- Flanking STC ratings for each flanking sound transmission path including the change due to linings;
- ASTC ratings for the combination of direct and flanking sound transmission paths.

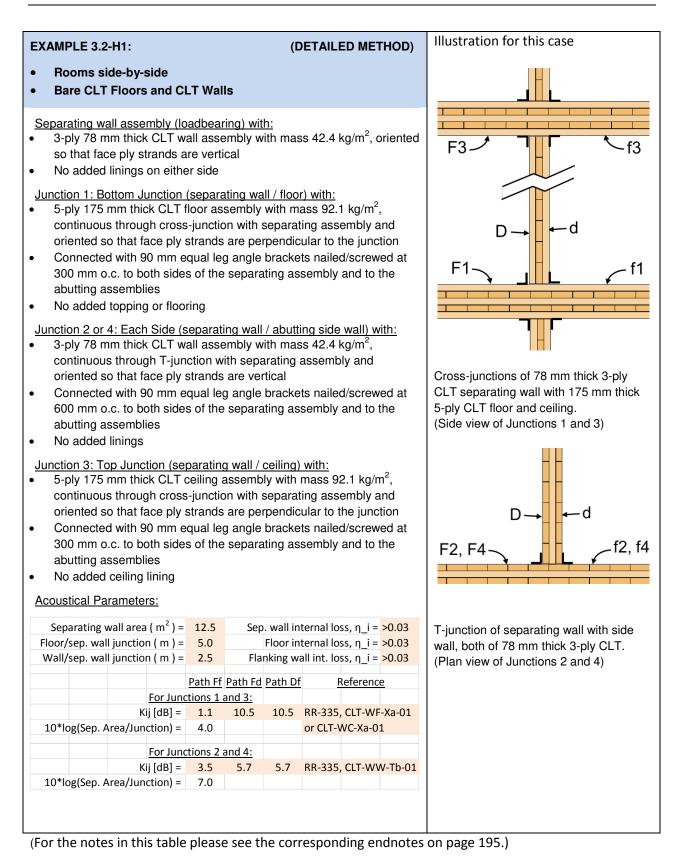
Note that these STC ratings shown at each stage of the calculation are presented only to provide readers with a convenient indication of the relative strength of the 13 sound transmission paths. The actual calculation at each step is performed in the individual one-third octave bands, and at the final steps, the sound transmission loss values for the 13 paths are combined to arrive at the overall apparent sound transmission loss (ATL) for each frequency band. These one-third octave values of ATL are used as inputs to the calculation of ASTM E413 to determine the ASTC rating.

When the calculated Flanking TL for a given path exceeds 90 dB, the value is limited to 90, to allow for the inevitable effect of higher-order flanking paths which make the higher calculated value not representative of the true situation. Further enhancements to elements in these paths will give negligible benefit. The consequence of this 90 dB limit is that the Junction TL for the set of 3 paths at each edge of the separating assembly cannot exceed 85 and the Total Flanking TL for all 4 edges cannot exceed 79.

The tables present extracts from calculations performed with a more detailed spreadsheet that includes values for all the one-third octave bands from 125 Hz to 4 kHz. To condense the examples to 2-page format, the extracts here present just the single-number ratings (such as ASTC and Path STC) and a subset of the calculated values for some one-third octave frequency bands.

The numbering of the tables presenting the worked examples end in an alphanumeric such as "H1" or "V2" to indicate Horizontal Case 1 (with rooms side-by-side) or Vertical Case 2 (with rooms one-above-the-other), respectively.

All examples conform to the Standard Scenario presented in Section 1.2 of this Guide. The worked examples include both scenarios for CLT wall and floor assemblies without linings and scenarios where linings are included, for the same set of cases presented in Section 4.2.



	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (78 mm 3-ply CLT									,
Laboratory Transmission Loss	R_D,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
Correction Resonant Transmission		N/A	0	0	0	0	0	0	
ΔTL change by Lining on D	∆R_D	No Lining	0	0	0	0	0	0	
ΔTL change by Lining on d	∆R_d	No Lining	0	0	0	0	0	0	
If airborne flanking or bare CLT		RR-335, TL(Bare CLT03) - TL(Base CLT03)	-1	-3	-3	-3	-4	-1	
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	25	25	28	34	42	49	33
Junction 1 (Cross-Junction, 78 mm 3-p		ating Wall / 175 mm 5-ply CLT Floor)							
Transmission Loss of Flanking Elemen									
TL of element F1, laboratory	R_F1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f1, laboratory	R_f1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission F1		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f1		N/A	0	0	0	0	0	0	
TL of element F1, in-situ	R F1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f1, in-situ		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
ΔTL change by Lining on F	ΔR F1	No Lining	0	0	0	0	0	0	
ΔTL change by Lining on f	ΔR f1	No Lining	Ő	0	0	Ő	0	0	
		No Lining	0	0	0	0	0	0	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,1	RR-335, CLT-WF-Xa-01	1.1	1.1	1.1	1.1	1.1	1.1	
Vibration Reduction Index for Fd	K_Fd,1	RR-335, CLT-WF-Xa-01	10.5	10.5	10.5	10.5	10.5	10.5	
Vibration Reduction Index for Df	K_10,1	RR-335, CLT-WF-Xa-01		10.5		10.5	10.5	10.5	
	ע_טו,ד	111 333, CEI-WI-AG-UI	10.5	10.5	10.5	10.5	10.5	10.5	
Flanking Transmission Loss									
Flanking TL for path Ff_1	R_ Ff	ISO 15712-1, Eq. 25b	37	35	44	48	57	54	47
Flanking TL for path Fd_1	R Fd	ISO 15712-1, Eq. 25b	44	44	50	55	64	64	54
Flanking TL for path Df 1	R_Df	ISO 15712-1, Eq. 255	44	44	50	55	64	64	54
Junction 1: Flanking TL for all paths	01		36	34	42	47	56	53	46
and an annung re for an pauls			30	34	74	77	50	33	-+0
Junction 2 (T-Junction, 78 mm 3-ply Cl	T Separating	Wall / 78 mm 3-ply CLT Flanking Wall)							
Transmission Loss of Flanking Elemen	ts								
TL of element F2, laboratory	R_F2,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
TL of element f2, laboratory	R_f2,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
Correction Resonant Transmission F2	,	N/A	0	0	0	0	0	0	
Correction Resonant Transmission 12		N/A	0	0	0	0	0	0	
TL of element F2, in-situ	R F2,situ		26	28	31	37	46	50	36
		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab		28		37			36
TL of element f2, in-situ	_	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	26		31		46	50	30
ΔTL change by Lining on F	ΔR_F2	No Lining	0	0	0	0	0	0	
ΔTL change by Lining on f	∆R_f2	No Lining	0	0	0	0	0	0	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,2	RR-335, CLT-WW-Tb-01	3.5	3.5	3.5	3.5	3.5	3.5	
Vibration Reduction Index for Fd	K Fd,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
Vibration Reduction Index for Df	K_10,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
			0.7	5.7	5.7	0.7	0.7		
Flanking Transmission Loss									
Flanking TL for path Ff_2	R_Ff	ISO 15712-1, Eq. 25b	37	39	42	48	57	61	47
Flanking TL for path Fd_2	R_ Fd	ISO 15712-1, Eq. 25b	39	41	44	50	59	63	49
Flanking TL for path Df_2	R_Df	ISO 15712-1, Eq. 25b	39	41	44	50	59	63	49
Junction 2: Flanking TL for all paths			33	35	38	44	53	57	43
	ly CLT Separa	ating Wall / 175 mm 5-ply CLT Ceiling)							
All values the same as for Junction 1									
Flanking TL for path Ff_3	R_ Ff	ISO 15712-1, Eq. 25b	37	35	44	48	57	54	47
Flanking TL for path Fd_3	R_Fd	ISO 15712-1, Eq. 25b	44	44	50	55	64	64	54
Flanking TL for path Df_3	R_Df	ISO 15712-1, Eq. 25b	44	44	50	55	64	64	54
Junction 3: Flanking TL for all paths			36	34	42	47	56	53	46
	T Separating	Wall / 78 mm 3-ply CLT Flanking Wall)							
All values the same as for Junction 2									
Flanking TL for path Ff_4	R_ Ff	ISO 15712-1, Eq. 25b	37	39	42	48	57	61	47
Flanking TL for path Fd_4	R_Fd	ISO 15712-1, Eq. 25b	39	41	44	50	59	63	49
Flanking TL for path Df 4	R Df	ISO 15712-1, Eq. 25b	39	41	44	50	59	63	49
Junction 4: Flanking TL for all paths	N_ 01		33	35	38	44	53	57	43
Another Planking IL for all patits			33	55	30	44	55	57	43
Total Flanking (for all 4 junctions)			28	29	34	39	48	49	38
ASTC due to Direct plus Flanking Paths		RR-335, Eq. 1.1	23	23	27	33	41	46	32

EXAMPLE 3.2-H2:

(DETAILED METHOD)

- Rooms side-by-side
- CLT Floors and CLT Walls (Same as example 3.2-H1, plus linings)

Separating wall assembly (loadbearing) with:

- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², oriented so that face ply strands are vertical
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

Junction 1: Bottom Junction (separating wall / floor) with:

- 5-ply 175 mm thick CLT floor assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Floor lining of 38 mm concrete over 13 mm wood fiber board

Junction 2 or 4: Each Side (separating wall / abutting side wall) with:

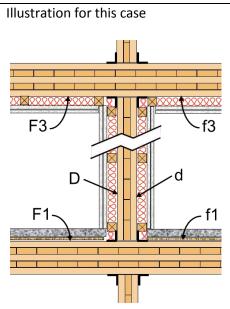
- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², continuous through T-junction with separating assembly and oriented so that face ply strands are vertical
- Connected with 90 mm equal leg angle brackets nailed/screwed at 600 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

Junction 3: Top Junction (separating wall / ceiling) with:

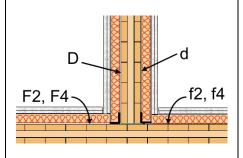
- 5-ply 175 mm thick CLT ceiling assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

Acoustical Parameters:

Acoustical I al	ameters	<u>.</u>									
Separating v	12.5	Sep. wall internal loss, η_i = <mark>></mark> 0									
Floor/sep. wall junction (m) =			5.0		Floor internal loss, η_i = <mark>></mark> (
Wall/sep. wall junction (m) =			2.5	Fla	Flanking wall int. loss, η_i = <mark>>0.0</mark>						
			Path Ff	Path Fd	Fd Path Df Refere			nce			
		For June	ctions 1	and 3:							
	Kij [dB] =			10.5	10.5	RR-335	, CLT-WF	-Xa-01			
10*log(Sep. A	10*log(Sep. Area/Junction) =					or CLT-\	NC-Xa-0	1			
		For June	tions 2	and 4:							
	K	ij [dB] =	3.5	5.7	5.7	RR-335	, CLT-WV	V-Tb-01			
10*log(Sep. Area/Junction) =			7.0								



Cross-junctions of 78 mm thick 3-ply CLT separating wall with 150 mm thick 5-ply CLT floor and ceiling. (Side view of Junctions 1 and 3)



T-junction of separating wall with side wall, both of 78 mm thick 3-ply CLT. (Plan view of Junctions 2 and 4)

	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (78 mm 3-ply CL1	-								
Laboratory Transmission Loss	R_D,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
Correction Resonant Transmission		N/A	0	0	0	0	0	0	
ΔTL change by Lining on D	∆R_D	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
ΔTL change by Lining on d	ΔR_d	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
If airborne flanking or bare CLT	_	N/A	0	0	0	0	0	0	
Direct TL in-situ	R D,situ	ISO 15712-1, Eq. 24	34	42	49	61	66	70	52
	_ /* **								
Junction 1 (Cross-Junction, 78 mm 3-p		ating Wall / 175 mm 5-ply CLT Floor)							
Transmission Loss of Flanking Elemen									
TL of element F1, laboratory	R_F1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f1, laboratory	R_f1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission F1		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f1		N/A	0	0	0	0	0	0	
TL of element F1, in-situ	R F1,situ	ISO 15712-1, Eq. 19, T s,situ = T s,lab	32	30	39	43	52	49	42
TL of element f1, in-situ	R f1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
ΔTL change by Lining on F			4	11	8	21	29	32	42
	ΔR_F1	RR-335, ΔTL-CLT-F03							
ΔTL change by Lining on f	ΔR_f1	RR-335, ΔTL-CLT-F03	4	11	8	21	29	32	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,1	RR-335, CLT-WF-Xa-01	1.1	1.1	1.1	1.1	1.1	1.1	
Vibration Reduction Index for Fd	K_H,1 K Fd,1	RR-335, CLT-WF-Xa-01	10.5	10.5	10.5	10.5	10.5	10.5	
Vibration Reduction Index for Df	K_Df,1	RR-335, CLT-WF-Xa-01	10.5	10.5	10.5	10.5	10.5	10.5	
Flanking Transmission Loss									
Flanking TL for path Ff_1	R Ff	ISO 15712-1, Eq. 25b	45	57	60	90	90	90	67
Flanking TL for path Fd 1	R Fd	ISO 15712-1, Eq. 25b	52	62	67	88	90	90	73
								90	73
Flanking TL for path Df_1	R_Df	ISO 15712-1, Eq. 25b	52	62	67	88	90		
Junction 1: Flanking TL for all paths			44	55	59	84	85	85	65
Junction 2 (T-Junction, 78 mm 3-nly Cl	T Sonarating	Wall / 78 mm 3-ply CLT Flanking Wall)							
Transmission Loss of Flanking Elemen									
TL of element F2, laboratory	R F2, lab	RR-335, Base CLT03	26	28	31	37	46	50	36
			26	28	31	37	40	50	36
TL of element f2, laboratory	R_f2,lab	RR-335, Base CLT03							30
Correction Resonant Transmission F2		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f2		N/A	0	0	0	0	0	0	
TL of element F2, in-situ		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	26	28	31	37	46	50	36
TL of element f2, in-situ	R_f2,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	26	28	31	37	46	50	36
ΔTL change by Lining on F	ΔR_F2	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
ΔTL change by Lining on f	∆R_f2	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
Junction Coupling									
	14 56 2		2.5	2.5	2.5	2.5	2.5	2.5	
Vibration Reduction Index for Ff	K_Ff,2	RR-335, CLT-WW-Tb-01	3.5	3.5	3.5	3.5	3.5	3.5	
Vibration Reduction Index for Fd	K_Fd,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
Vibration Reduction Index for Df	K_Df,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
Flanking Transmission Loss									
Flanking TL for path Ff_2	R Ff	ISO 15712-1, Eq. 25b	45	53	60	72	77	81	63
Flanking TL for path Fd_2	R Fd	ISO 15712-1, Eq. 25b	47	55	62	74	79	83	65
			47				79		
Flanking TL for path Df_2	R_Df	ISO 15712-1, Eq. 25b		55	62	74		83	65
Junction 2: Flanking TL for all paths			41	49	56	68	73	77	59
Junction 3 (Cross-Junction, 78 mm 3-p	ly CLT Separa	ating Wall / 175 mm 5-ply CLT Ceiling)							
All values the same as for Junction 1, e									
ΔTL change by Lining on F	ΔR_F3	RR-335, ΔTL-CLT-C01	2	11	5	12	11	11	
ΔTL change by Lining on f	ΔR_f3	RR-335, ΔTL-CLT-C01	2	11	5	12	11	11	
	_								
Flanking Transmission Loss									
Flanking TL for path Ff_3	R_Ff	ISO 15712-1, Eq. 25b	41	57	54	72	79	76	62
Flanking TL for path Fd_3	R_Fd	ISO 15712-1, Eq. 25b	50	62	64	79	85	85	70
Flanking TL for path Df_3	R_Df	ISO 15712-1, Eq. 25b	50	62	64	79	85	85	70
Junction 3: Flanking TL for all paths			40	55	53	71	77	75	60
lunction 4 (T. Institute 20 mm 2	TConnecti	Wall / 79 mm 2 mls CLT Floriday Mr. IV	-						
Junction 4 (T-Junction, 78 mm 3-ply Cl All values the same as for Junction 2	Li Separating	; Wall / 78 mm 3-ply CLT Flanking Wall)							
		150 15712 1 Eq. 25b	45	52	60	72	77	01	63
Flanking TL for path Ff_4	R_Ff	ISO 15712-1, Eq. 25b	45	53	60	72	77	81	63
Flanking TL for path Fd_4	R_Fd	ISO 15712-1, Eq. 25b	47	55	62	74	79	83	65
Flanking TL for path Df_4	R_Df	ISO 15712-1, Eq. 25b	47	55	62	74	79	83	65
Junction 4: Flanking TL for all paths			41	49	56	68	73	77	59
							_	_	
Total Flanking (for all 4 junctions)			35	45	50	64	70	72	55
		RR-335, Eq. 1.1		40	46	59	64	68	50

EXAMPLE 3.2-H3:

(DETAILED METHOD)

- Rooms side-by-side
- CLT Floors and CLT Walls (Same as example 3.2-H2, except enhanced linings)

Separating wall assembly (loadbearing) with:

- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², oriented so that face ply strands are vertical
- Two layers of 12.7 mm gypsum board⁴ on resilient metal channels⁷ spaced 600 mm o.c., on 38 x 38 mm wood furring spaced 400 mm o.c. with absorptive material³ in cavities

Junction 1: Bottom Junction (separating wall / floor) with:

- 5-ply 175 mm thick CLT floor assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Floor lining of 38 mm concrete over 13 mm wood fiber board

Junction 2 or 4: Each Side (separating wall / abutting side wall) with:

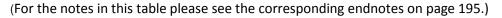
- 3-ply 78 mm thick CLT wall assembly with mass 42.4 kg/m², continuous through T-junction with separating assembly and oriented so that face ply strands are vertical
- Connected with 90 mm equal leg angle brackets nailed/screwed at 600 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

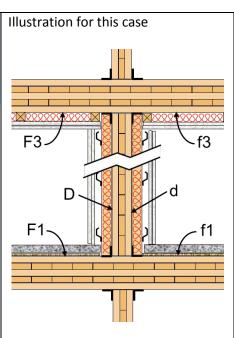
Junction 3: Top Junction (separating wall / ceiling) with:

- 5-ply 175 mm thick CLT ceiling assembly with mass 92.1 kg/m², continuous through cross-junction with separating assembly and oriented so that face ply strands are perpendicular to the junction
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting assemblies
- Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities

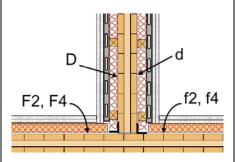
Acoustical Parameters:

/ toodottodi i al	amotoro.							
Separating	wall area (m^2) =	12.5	Sep	Sep. wall internal loss, η_i =				
Floor/sep. wa	ll junction (m) =	5.0		Floor in	>0.03			
Wall/sep. wa	ll junction (m) =	2.5	Fla	nking wa	>0.03			
		Path Ff	Path Fd	Path Df	<u>F</u>	Referenc	e	
	For June	ctions 1 a	and 3:					
	Kij [dB] =	1.1	10.5	10.5	RR-335,	, CLT-WF	-Xa-01	
10*log(Sep. A	Area/Junction) =	4.0			or CLT-V	NC-Xa-0	1	
	For June	ctions 2 a	and 4:					
	Kij [dB] =	3.5	5.7	5.7	RR-335,	, CLT-WV	W-Tb-01	
10*log(Sep. A	Area/Junction) =	7.0						





Cross-junctions of 78 mm thick 3-ply CLT separating wall with 150 mm thick 5-ply CLT floor and ceiling. (Side view of Junctions 1 and 3)



T-junction of separating wall with side wall, both of 78 mm thick 3-ply CLT. (Plan view of Junctions 2 and 4)

	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (78 mm 3-ply CL1 Laboratory Transmission Loss	r) R D,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
	R_D,Iab				31 0			0	30
Correction Resonant Transmission			0	0		0	0		
ΔTL change by Lining on D	ΔR_D	RR-335, ΔTL-CLT-W04	6	17	20	24	20	22	
ΔTL change by Lining on d	∆R_d	RR-335, ΔTL-CLT-W04	6	17	20	24	20	22	
If airborne flanking or bare CLT		N/A	0	0	0	0	0	0	
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	38	62	71	85	86	90	62
Junction 1 (Cross-Junction, 78 mm 3-p		ating Wall / 175 mm 5-ply CLT Floor)							
Transmission Loss of Flanking Elemen									
TL of element F1, laboratory	R_F1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f1, laboratory	R_f1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission F1		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f1		N/A	0	0	0	0	0	0	
TL of element F1, in-situ	R_F1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f1, in-situ	R_f1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
ΔTL change by Lining on F	ΔR_F1	RR-335, ΔTL-CLT-F03	4	11	8	21	29	32	
ΔTL change by Lining on f	ΔR_f1	RR-335, ΔTL-CLT-F03	4	11	8	21	29	32	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,1	RR-335, CLT-WF-Xa-01	1.1	1.1	1.1	1.1	1.1	1.1	
Vibration Reduction Index for Fd	K_Fd,1	RR-335, CLT-WF-Xa-01	10.5	10.5	10.5	10.5	10.5	10.5	
Vibration Reduction Index for Df	K_F0,1	RR-335, CLT-WF-Xa-01	10.5	10.5	10.5	10.5	10.5	10.5	
	·,_		10.5	10.5	10.5	10.5	10.5	10.5	
Flanking Transmission Loss									
Flanking TL for path Ff_1	R_ Ff	ISO 15712-1, Eq. 25b	45	57	60	90	90	90	67
Flanking TL for path Fd_1	R_ Fd	ISO 15712-1, Eq. 25b	54	72	78	90	90	90	78
Flanking TL for path Df_1	R_Df	ISO 15712-1, Eq. 25b	54	72	78	90	90	90	78
Junction 1: Flanking TL for all paths			44	57	60	85	85	85	67
Junction 2 (T-Junction, 78 mm 3-ply Cl	LT Separating	Wall / 78 mm 3-ply CLT Flanking Wall)							
Transmission Loss of Flanking Elemen									
TL of element F2, laboratory	R_F2,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
TL of element f2, laboratory	R_f2,lab	RR-335, Base CLT03	26	28	31	37	46	50	36
Correction Resonant Transmission F2		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f2		N/A	0	0	0	0	0	0	
TL of element F2, in-situ	R_F2,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	26	28	31	37	46	50	36
TL of element f2, in-situ	R_f2,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	26	28	31	37	46	50	36
ΔTL change by Lining on F	ΔR_F2	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
ΔTL change by Lining on f	∆R_f2	RR-335, ΔTL-CLT03-W03	4	7	9	12	10	10	
Junction Coupling									
Vibration Reduction Index for Ff	K_Ff,2	RR-335, CLT-WW-Tb-01	3.5	3.5	3.5	3.5	3.5	3.5	
Vibration Reduction Index for Fd	K Fd,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
Vibration Reduction Index for Df	K Df,2	RR-335, CLT-WW-Tb-01	5.7	5.7	5.7	5.7	5.7	5.7	
	- /								
Flanking Transmission Loss									
Flanking TL for path Ff_2	R_ Ff	ISO 15712-1, Eq. 25b	45	53	60	72	77	81	63
Flanking TL for path Fd_2	R_Fd	ISO 15712-1, Eq. 25b	49	65	73	86	89	90	73
Flanking TL for path Df_2	R_Df	ISO 15712-1, Eq. 25b	49	65	73	86	89	90	73
Junction 2: Flanking TL for all paths			42	52	60	72	76	80	63
Junction 3 (Cross-Junction, 78 mm 3-p	oly CLT Separa	ating Wall / 175 mm 5-ply CLT Ceiling)							
All values the same as for Junction 1, e									
ΔTL change by Lining on F	ΔR_F3	RR-335, ΔTL-CLT-C01	2	11	5	12	11	11	
ΔTL change by Lining on f	∆R_f3	RR-335, ΔTL-CLT-C01	2	11	5	12	11	11	
Flanking Transmission Loss									
Flanking TL for path Ff_3	R_Ff	ISO 15712-1, Eq. 25b	41	57	54	72	79	76	62
Flanking TL for path Fd_3	R_FI	ISO 15712-1, Eq. 25b	52	72	75	90	90	90	76
Flanking TL for path Df 3	R_Fu R_Df	ISO 15712-1, Eq. 25b	52	72	75	90	90	90	76
Junction 3: Flanking TL for all paths	N_ DI	130 137 12-1, Eq. 230	40	57	54	72	78	76	61
			40	57	54	12	70	70	
	LT Separating	Wall / 78 mm 3-ply CLT Flanking Wall)							
All values the same as for Junction 2									
Flanking TL for path Ff_4	R_Ff	ISO 15712-1, Eq. 25b	45	53	60	72	77	81	63
Flanking TL for path Fd_4	R_Fd	ISO 15712-1, Eq. 25b	49	65	73	86	89	90	73
Flanking TL for path Df_4	R_ Df	ISO 15712-1, Eq. 25b	49	65	73	86	89	90	73
Junction 4: Flanking TL for all paths			42	52	60	72	76	80	63
Total Flanking (for all 4 junctions)			36	48	51	67	72	73	57
0, 0, 0, 0, 0,		RR-335, Eq. 1.1			51	67	72	73	57
ASTC due to Direct plus Flanking Path			34	48					

EXAMPLE 3.2-V1:

(DETAILED METHOD)

- Rooms one-above-the-other
- Bare CLT Floors and CLT Walls

Separating floor assembly with:

- 5-ply 175 mm thick CLT floor assembly with mass 92.1 kg/m², continuous through cross-junction with CLT wall assemblies at Junctions 1 and 3 and oriented so that face ply strands are perpendicular to loadbearing Junctions 1 and 3
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting wall assemblies
- No added linings (floor topping or ceiling)

Junction 1, 3 or 4: Separating floor / walls with:

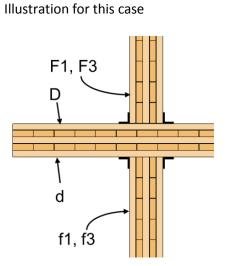
- 5-ply 175 mm thick CLT wall assembly with mass 94.1 kg/m², above and below cross-junctions with separating assembly that is continuous or lapped and glued across these junctions
- CLT wall assembly oriented so face ply strands are vertical
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to the wall assemblies and to the floor assembly
- No added lining on walls

Junction 2: Separating floor / walls with:

- 5-ply 175 mm thick CLT wall assembly with mass 94.1 kg/m², above and below T-junction with separating assembly that terminates at this junction
- CLT wall assembly oriented so face ply strands are vertical
- Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to one side of the wall assembly and to the abutting floor assemblies
- No added lining on walls

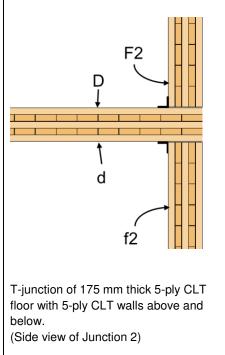
Acoustical Parameters:

Separating f	loor area (m²) =	20.0		Floor in	ternal los	ss, η_i =	>0.03
por/wall junction	ns 1 and 3 (m) =	5.0		Wall in	ss, η_i =	>0.03	
por/wall junction	por/wall junctions 2 and 4 (m) =			Wall in	>0.03		
		Path Ff	Path Fd	Path Df	<u>F</u>	Referenc	<u>e</u>
	For June	ctions 1	and 3 an	d 4:			
	Kij [dB] =	17.6	10.2	10.2	RR-335,	, CLT-FW	-Xa-05
10*log(Sep.	Area/Junction) =	6.0	For Junctions 1 and 3				
10*log(Sep. /	Area/Junction) =	7.0	For June	ction 4			
	For June	ction 2:					
	Kij [dB] =	12.9	6.8	6.8	RR-335,	CLT-FW	-Ta-05
10*log(Sep. /	Area/Junction) =	7.0	For June	ction 2			



Cross-junction of separating floor of continuous 175 mm thick 5-ply CLT with 5-ply CLT wall assemblies above and below.

(Side view of Junctions 1, 3 and 4, except orientation of floor assemblies differs for Junction 4)



	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (175 mm 5-ply C							_		
Laboratory Transmission Loss	R_D,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission		N/A	0	0	0	0	0	0	
ΔTL change by Lining on D	ΔR_D	No Lining	0	0	0	0	0	0	
ΔTL change by Lining on d	ΔR d	No Lining	0	0	0	0	0	0	
If airborne flanking or bare CLT	Lin_u	RR-335, TL(Bare CLT05) - TL(Base CLT05)	0	-1	-3	1	-1	-3	
									40
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	32	29	36	44	51	46	40
Junction 1 (Cross-Junction, 175 mm 5	-ply CLT Sepa	rating Floor / 175 mm 5-ply CLT Wall)							
Transmission Loss of Flanking Elemer									
TL of element F1, laboratory	R F1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f1, laboratory	R f1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
	11,100								72
Correction Resonant Transmission F1		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f1		N/A	0	0	0	0	0	0	
TL of element F1, in-situ	R_F1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f1, in-situ	R f1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
ΔTL change by Lining on F	ΔR_F1	No Lining	0	0	0	0	0	0	
ΔTL change by Lining on f	ΔR f1	No Lining	0	0	0	0	0	0	
		No Lining	0	0	0	0	0	0	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,1	RR-335, CLT-FW-Xa-05	17.6	17.6	17.6	17.6	17.6	17.6	
Vibration Reduction Index for Fd	K_Fd,1	RR-335, CLT-FW-Xa-05	10.2			10.2			
Vibration Reduction Index for Df	K_10,1 K Df,1	RR-335, CLT-FW-Xa-05				10.2			
	K_01,1	NN-555, CLI-FW-Ad-05	10.2	10.2	10.2	10.2	10.2	10.2	
Flanking Transmission Loss									
Flanking TL for path Ff_1	R_Ff	ISO 15712-1, Eq. 25b	56	54	63	67	76	73	66
Flanking TL for path Fd_1	R_Fd	ISO 15712-1, Eq. 25b	48	46	55	59	68	65	58
Flanking TL for path Df_1	R_ Df	ISO 15712-1, Eq. 25b	48	46	55	59	68	65	58
Junction 1: Flanking TL for all paths			45	43	52	56	65	62	55
Innetion 2 /T. Innetion, 175 mm F. alu									
Junction 2 (T-Junction, 175 mm 5-ply Transmission Loss of Flanking Elemer		g Floor / 175 mm 5-ply CLT wall)							
			22	20	20	42	5.2	40	, 12
TL of element F2, laboratory	R_F2,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f2, laboratory	R_f2,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission F2		N/A	0	0	0	0	0	0	
Correction Resonant Transmission f2		N/A	0	0	0	0	0	0	
TL of element F2, in-situ	R F2,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f2, in-situ	R f2,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
			0	0	0	0	0	0	72
ΔTL change by Lining on F	ΔR_F2	No Lining							
ΔTL change by Lining on f	∆R_f2	No Lining	0	0	0	0	0	0	
Junction Coupling									
Vibration Reduction Index for Ff	K_Ff,2	RR-335, CLT-FW-Ta-05	12.9	12.9	12.9	12.9	12.9	12.9	
Vibration Reduction Index for Fd	K_Fd,2	RR-335, CLT-FW-Ta-05	6.8	6.8	6.8	6.8	6.8	6.8	
Vibration Reduction Index for Df	K_Df,2	RR-335, CLT-FW-Ta-05	6.8	6.8	6.8	6.8	6.8	6.8	
Flanking Transmission Loss									
Flanking TL for path Ff_2	R_Ff	ISO 15712-1, Eq. 25b	52	50	59	63	72	69	62
Flanking TL for path Fd_2	R_Fd	ISO 15712-1, Eq. 25b	46	44	53	57	66	63	56
Flanking TL for path Df_2	R_Df	ISO 15712-1, Eq. 25b	46	44	53	57	66	63	56
Junction 2: Flanking TL for all paths	N_01	130 137 12-1, LQ. 230	40	44	49	53	62	59	50
renter of an paths			42	-0	45	33	02	55	52
Junction 3 (Cross-Junction, 175 mm 5	-ply CLT Sepa	rating Floor / 175 mm 5-ply CLT Wall)							
All values the same as for Junction 1									
Flanking TL for path Ff_3	R Ff	ISO 15712-1, Eq. 25b	56	54	63	67	76	73	66
Flanking TL for path Fd_3	R_Fd	ISO 15712-1, Eq. 25b	48	46	55	59	68	65	58
Flanking TL for path Df_3	R_Df	ISO 15712-1, Eq. 25b	48	46	55	59	68	65	58
Junction 3: Flanking TL for all paths			45	43	52	56	65	62	55
Junction 4 (Cross-Junction, 175 mm 5	-nly CLT Sena	rating Floor / 175 mm 5-ply CLT Wall)							
		e same as for Junction 2, but Kij values are	these	me ac f	or lun	tion 1	and 2 (cross-in	nction)
0									,
Flanking TL for path Ff_4	R_Ff	ISO 15712-1, Eq. 25b	57	55	64	68	77	74	67
Flanking TL for path Fd_4	R_Fd	ISO 15712-1, Eq. 25b	49	47	56	60	69	66	59
Flanking TL for path Df_4	R_ Df	ISO 15712-1, Eq. 25b	49	47	56	60	69	66	59
Junction 4: Flanking TL for all paths			46	44	53	57	66	63	56
			20	36	45	49	58	E E	48
Total Flanking (for all 4 junctions)			38	50	45	49	30	55	40

Illustration for this case EXAMPLE 3.2-V2: (DETAILED METHOD) Rooms one-above-the-other **CLT Floors and CLT Walls** (Same as example 3.2-V1, plus linings) F1. F3 Separating floor assembly with: D 5-ply 175 mm thick CLT floor assembly with mass 92.1 kg/m², continuous through cross-junction with CLT wall assemblies at Junctions 1 and 3 and oriented so that face ply strands are perpendicular to loadbearing Junctions 1 and 3 Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to both sides of the separating assembly and to the abutting wall assemblies Floor lining of 38 mm concrete over 13 mm wood fiber board Ceiling lining of 15.9 mm gypsum board⁴ fastened to hat-channels • supported on cross-channels hung on wires, cavity of 150 mm d between CLT and ceiling, with 140 mm absorptive material³ f1, f3 Junction 1, 3 or 4: (separating floor / flanking walls) with: 5-ply 175 mm thick CLT wall assembly with mass 94.1 kg/m², above and below cross-junctions with separating assembly that is continuous or lapped and glued across these junctions Cross-junction of separating floor of CLT wall assembly oriented so face ply strands are vertical continuous 175mm thick 5-ply CLT with Connected with 90 mm equal leg angle brackets nailed/screwed at • 5-ply CLT walls above and below. 300 mm o.c. to the wall assemblies and to the floor assembly (Side view of Junctions 1, 3 and 4, Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm . except orientation of floor assemblies wood furring spaced 600 mm o.c., absorptive material³ in cavities differs for Junction 4) Junction 2: Each Side (separating floor / flanking walls) with: 5-ply 175 mm thick CLT wall assembly with mass 94.1 kg/m², above and below T-junction with separating assembly that terminates at this junction CLT wall assembly oriented so face ply strands are vertical F2 Connected with 90 mm equal leg angle brackets nailed/screwed at 300 mm o.c. to one side of the wall assembly and to the abutting floor assemblies Two layers of 12.7 mm gypsum board⁴ supported on 38 x 38 mm wood furring spaced 600 mm o.c., absorptive material³ in cavities Acoustical Parameters: Separating floor area $(m^2) = 20.0$ Floor internal loss, $\eta = >0.03$ por/wall junctions 1 and 3 (m) = 5.0Wall internal loss, $\eta i = >0.03$ por/wall junctions 2 and 4 (m) = 4.0Wall internal loss, $\eta_i = >0.03$ d Path Ff Path Fd Path Df Reference For Junctions 1 and 3 and 4: Kij [dB] = 17.6 10.2 10.2 RR-335, CLT-FW-Xa-05 f2 10*log(Sep. Area/Junction) = 6.0 For Junctions 1 and 3 10*log(Sep. Area/Junction) = 7.0 For Junction 4 T-junction of 175mm thick 5-ply CLT For Junction 2: floor with 5-ply CLT walls above and Kij [dB] = 12.9 6.8 6.8 RR-335, CLT-FW-Ta-05 below. 10*log(Sep. Area/Junction) = 7.0 For Junction 2 (Side view of Junction 2)

	ISO Symbol	Reference	125	250	500	1000	2000	4000	STC or ASTC
Separating Partition (175 mm 5-ply Cl									-
Laboratory Transmission Loss	R_D,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission		N/A	0	0	0	0	0	0	
ΔTL change by Lining on D	∆R_D	RR-335, ΔTL-CLT-F03	4	11	8	21	29	32	
∆TL change by Lining on d	ΔR d	RR-335, ΔTL-CLT-C03	15	25	30	36	34	30	
If airborne flanking or bare CLT	_	N/A	0	0	0	0	0	0	
Direct TL in-situ	R D,situ	ISO 15712-1, Eq. 24	51	66	77	90	90	90	75
	,								
Junction 1 (Cross-Junction, 175 mm 5-	ply CLT Sepa	rating Floor / 175 mm 5-ply CLT Wall)							
Transmission Loss of Flanking Elemen	its								
TL of element F1, laboratory	R F1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f1, laboratory	R f1,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
Correction Resonant Transmission F1	_	N/A	0	0	0	0	0	0	
Correction Resonant Transmission f1		N/A	0	0	0	0	0	0	
TL of element F1, in-situ	R F1,situ	ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f1, in-situ		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
		RR-335, ΔTL-CLT05-W03	3	8	5	11	10	11	42
ΔTL change by Lining on F	ΔR_F1								
ΔTL change by Lining on f	ΔR_f1	RR-335, ΔTL-CLT05-W03	3	8	5	11	10	11	
Junction Coupling									
Vibration Reduction Index for Ff	K Ff,1	RR-335, CLT-FW-Xa-05	17.6	17.6	17.6	17.6	17.6	17.6	
Vibration Reduction Index for Fd	K_Fd,1	RR-335, CLT-FW-Xa-05	10.2			10.2			
Vibration Reduction Index for Df	K_F0,1 K Df,1	RR-335, CLT-FW-Xa-05				10.2			
	K_UI,1	NN 333, CLI-I W-Ad-03	10.2	10.2	10.2	10.2	10.2	10.2	
Flanking Transmission Loss									
Flanking TL for path Ff_1	R_Ff	ISO 15712-1, Eq. 25b	62	70	73	89	90	90	81
Flanking TL for path Fd 1	R Fd	ISO 15712-1, Eq. 25b	66	79	90	90	90	90	88
Flanking TL for path Df_1	R_Df	ISO 15712-1, Eq. 25b	55	65	68	90	90	90	76
Junction 1: Flanking TL for all paths	K_DI	150 137 12-1, Eq. 250	54	64	67	85	85	85	75
			54	04	07	05	05	85	/.
Junction 2 (T-Junction, 175 mm 5-ply	CIT Senaratin	g Floor / 175 mm 5-ply CLT Wall)							
Transmission Loss of Flanking Elemen									
TL of element F2, laboratory	R F2, lab	RR-335, Base CLT05	32	30	39	43	52	49	42
TL of element f2, laboratory	R f2,lab	RR-335, Base CLT05	32	30	39	43	52	49	42
	K_12,100			0			0		42
Correction Resonant Transmission F2		N/A	0		0	0		0	
Correction Resonant Transmission f2	D 50 11	N/A	0	0	0	0	0	0	
TL of element F2, in-situ		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
TL of element f2, in-situ		ISO 15712-1, Eq. 19, T_s,situ = T_s,lab	32	30	39	43	52	49	42
ΔTL change by Lining on F	ΔR_F2	RR-335, ΔTL-CLT05-W03	3	8	5	11	10	11	
ΔTL change by Lining on f	∆R_f2	RR-335, ΔTL-CLT05-W03	3	8	5	11	10	11	
Junction Coupling									
	V 54 2		12.0	12.0	12.0	12.0	12.0	12.0	
Vibration Reduction Index for Ff	K_Ff,2	RR-335, CLT-FW-Ta-05	12.9	12.9	12.9	12.9	12.9	12.9	
Vibration Reduction Index for Fd	K_Fd,2	RR-335, CLT-FW-Ta-05	6.8	6.8	6.8	6.8	6.8	6.8	
Vibration Reduction Index for Df	K_Df,2	RR-335, CLT-FW-Ta-05	6.8	6.8	6.8	6.8	6.8	6.8	
Flanking Transmission Loss									
Flanking TL for path Ff_2	R Ff	ISO 15712-1, Eq. 25b	58	66	69	85	90	90	77
Flanking TL for path Fd_2	R_Fd	ISO 15712-1, Eq. 25b	64	77	88	90	90	90	87
Flanking TL for path Df_2	R Df	ISO 15712-1, Eq. 25b	53	63	66	89	90	90	74
Junction 2: Flanking TL for all paths	<u>к_</u> UI	130 13/12-1, Eq. 230	53	61	64	89	85	85	74
ranking it for all paths			52	01	04	03	00	65	14
lunction 3 (Cross-Junction, 175 mm 5	nly CLT Sena	rating Floor / 175 mm 5-ply CLT Wall)	-						
All values the same as for Junction 1	рлу сет зера	acing river / 1/3 min 3-pry CET waity							
		ISO 15712-1, Eq. 25b	67	70	72	00	00	00	01
Flanking TL for path Ff_3	R_Ff	, ,	62	70	73	89	90	90	81
Flanking TL for path Fd_3	R_Fd	ISO 15712-1, Eq. 25b	66	79	90	90	90	90	88
Flanking TL for path Df_3	R_Df	ISO 15712-1, Eq. 25b	55	65	68	90	90	90	76
Junction 3: Flanking TL for all paths			54	64	67	85	85	85	75
	where our come								
		rating Floor / 175 mm 5-ply CLT Wall)						·	
		e same as for Junction 2, but Kij values ar							
Flanking TL for path Ff_4	R_Ff	ISO 15712-1, Eq. 25b	63	71	74	90	90	90	82
Flanking TL for path Fd_4	R_ Fd	ISO 15712-1, Eq. 25b	67	80	90	90	90	90	88
Flanking TL for path Df_4	R_ Df	ISO 15712-1, Eq. 25b	56	66	69	90	90	90	77
Junction 4: Flanking TL for all paths			55	65	68	85	85	85	76
Junction 4. Flanking TE for all paths									
Junction 4. Flanking TE for an paths									
Total Flanking (for all 4 junctions)			47	57	60	78	79	79	68

Summary for Section 3.2: Calculation Examples using the Detailed Method

The worked examples (3.2-H1 to H3 and 3.2-V1 to V2) illustrate the use of the Detailed Method for calculating sound transmission between rooms in a building with CLT floor and wall assemblies, with or without linings added to some or all of the walls and floors.

The examples present the calculations for the same set of scenarios used to illustrate the Simplified Method in Section 3.1.

- For the cases without linings (3.2-H1 and 3.2-V1), the detailed calculations give the same ASTC ratings as the simplified calculations. This agreement (aside from possible rounding errors of ±1) is to be expected since they simply combine the same data in slightly different order.
- For the cases with linings, the differences are larger, because the Simplified Method treats the Δ STC improvement due to linings using a deliberately conservative approximation. In the Detailed Method, the value of Δ TL for the two linings in each transmission path are simply added to the sound transmission loss values for the base assemblies, which tends to give higher predicted values of ASTC.
- In each of the cases with linings shown in these examples, the Detailed Method gives a result that is higher by 2 to 5 ASTC points than the Simplified Method. For linings with higher values of Δ STC, the difference between the two methods would increase further.

4. Buildings with Lightweight Framed Wall and Floor Assemblies

The focus of this chapter is to present the method for predicting the apparent sound insulation between adjacent rooms in a building constructed from lightweight framed wall and floor assemblies. The prediction method uses an empirical calculation approach described in ISO 15712-1 [7] that combines laboratory sound transmission data for individual lightweight framed wall or floor separating assemblies with flanking sound transmission data for each path at their junctions with adjoining assemblies.

The transmission of structure-borne vibration in a building with lightweight framed structures (made of wood or steel members) differs markedly from that in heavy homogeneous structures of concrete or masonry. There is both good news and bad news:

- The good news: For lightweight framed assemblies, the high internal loss factors result in minimal dependence on the connection to the adjoining structures, so that laboratory sound transmission values can be used without adjustment to estimate the direct transmission through the separating assembly in the finished building.
- The bad news: The standardized method of calculating flanking sound transmission from laboratory sound transmission data for individual wall and floor assemblies combined with junction attenuation data does not yield reliable results for lightweight framed building elements, and a different approach is required. The calculation process explained below is very simple (more good news), but it requires a new type of laboratory input data.

Before presenting the calculation process, some background justification seems appropriate. The characteristic transmission of structure-borne vibration can be illustrated by considering the vibration levels in a framed floor assembly excited by a localized impact source, as presented in Figure 4.1.

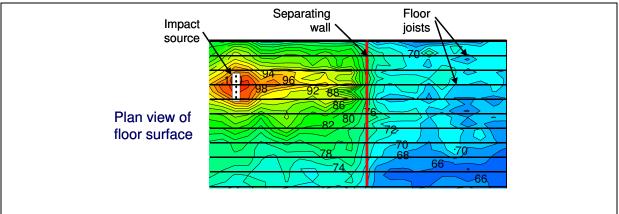


Figure 4.1: Variation across the floor surface of the vibration levels (2 kHz band) due to an impact source. The floor construction has a 19 mm plywood subfloor on wood joists that are perpendicular to the separating wall between the two side-by-side rooms.

Clearly, the lightweight framed floor system is both highly damped and anisotropic – the vibration field exhibits a strong gradient away from the source due to the high internal losses, and the gradient is different in the directions parallel and perpendicular to the joists, unlike the uniform flow of energy in all directions that would be expected in a homogeneous cast-in-place concrete assembly. As a result, the direction of transmission relative to the framing members becomes an additional parameter needed for accurate prediction, and the transmission of sound power to or from a flanking surface is not simply proportional to its area. In general, this vibration field is a poor approximation of a diffuse field, which limits applicability of the energy flow model of ISO 15712-1 (which assumes homogeneous and lightly-damped assemblies that can be sensibly represented by an average vibration level).

Because of the attenuation across a flanking assembly, especially at higher frequencies, the assumption that sound power due to flanking is proportional to the flanking area (implicit in Section 4.1 of ISO 15712-1) is not appropriate. The equations in Section 4.1 of this Guide provide more appropriate normalization for highly-damped assemblies such as lightweight wood- or steel-framed walls and floors.

Not only do vibration levels vary strongly across the surface of the structural assembly, but also typical changes to the surfaces (such as changing the gypsum board layers and/or their attachment to the walls and ceiling) *change* the attenuation across the structural assembly, with different changes in the three orthogonal directions pertinent to direct and flanking transmission. The change provided by a layer added to a surface depends on the weight and stiffness of the surface to which it is added, and if the added material is also anisotropic (for example, strip hardwood over a plywood subfloor) then its effect depends on its orientation relative to the supporting framing.

Hence, the concept of a simple correction to account for adding a given lining is not generally applicable for lightweight framed assemblies. However, the procedures presented in this Guide do allow using Δ TL and Δ STC corrections for floor finishes on a gypsum concrete subfloor, which is more reverberant.

4.1. Calculation Procedure for Lightweight Framed Walls and Floors

The calculation process requires specific laboratory test data, and can be performed using frequency band data or single-number ratings, following the steps illustrated in Figure 4.1.1.

The Detailed Method of ISO 15712-1 combines the set of one-third octave band transmission loss data for the direct path and all flanking paths using Eq. 1.4 to arrive at values of the apparent sound transmission loss (ATL). From the apparent sound transmission loss, the ASTC rating is calculated using the procedure of ASTM E413 [3].

For lightweight framed assemblies, using the Simplified Method presented below should provide essentially the same answer as the Detailed Method (within ±1 ASTC points, with no bias). Hence the Simplified Method is used for the following more complete description of the calculation procedure including equations, and for the examples in Sections 4.2 and 4.3.

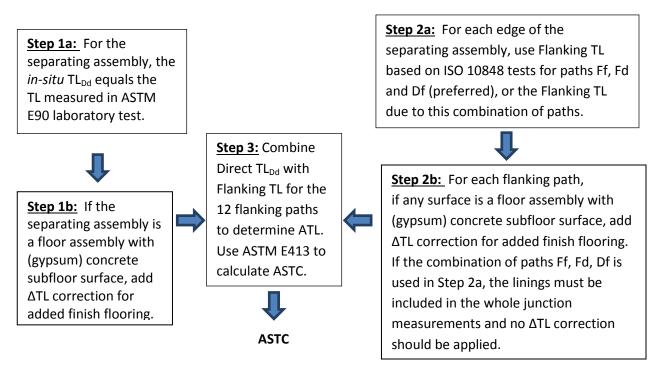


Figure 4.1.1: Steps to calculate the ASTC rating for wood- or steel-framed constructions using transmission loss data. For the simplified procedure with STC ratings, substitute "STC" for "TL".

Step 1: (a) For the separating assembly, the in-situ STC_{Dd} is equal to the STC rating determined in the laboratory according to ASTM E90.

(b) If the separating assembly is a floor assembly with (gypsum) concrete subfloor surface, add the Δ STC correction for added floor finishes to the STC rating for the bare floor to obtain STC_{Dd}.

- Step 2: (a) Determine the Flanking STC values (STC_{Ff} , STC_{Fd} , STC_{Df}) for the 3 flanking paths Ff, Fd and Df at each edge of the separating assembly with the following adjustments:
 - Values measured following the procedures of ISO 10848 must be re-normalized to the scenario dimensions using Equation 4.1.3.
 - If only the Flanking STC rating for the combined transmission by the set of 3 paths at a junction is available, that data may be used.

(b) If one (or both) surface(s) for a flanking path is a floor assembly with (gypsum) concrete subfloor surface, add the Δ STC correction for any added floor finish:

- \circ If one surface in a flanking path is a floor assembly with (gypsum) concrete subfloor surface, add the ΔSTC for the added finish flooring to the value for the bare floor to obtain the Flanking STC rating.
- If both surfaces are floor assemblies with (gypsum) concrete subfloor surface, the correction equals the larger of the two lining ΔSTC corrections plus half of the lesser one.
- Step 3: Combine the transmission via the direct path and the 12 flanking paths using Equation 4.1.1 (equivalent to Eq. 26 in Section 4.4 of ISO 15712-1), with the following adaptations:
 - If the Flanking STC rating calculated for any flanking path is over 90, set the value to 90 to allow for the inevitable effect of higher order flanking paths.
 - Round the final ASTC rating to the nearest integer.

Expressing the Calculation Process using Equations:

The ASTC rating between two rooms (neglecting sound transmitted by paths that bypass the building structure, e.g. through leaks or ducts) is estimated in the Simplified Method from the logarithmic expression of the combination of the Direct STC rating (STC_{Dd}) of the separating wall or floor element and the combined Flanking STC ratings of the three flanking paths for every junction at the four edges of the separating element. This may be expressed as:

ASTC =
$$-10 \log_{10} \left[10^{-0.1 \cdot \text{STC}_{Dd}} + \sum_{\text{edge}=1}^{4} (10^{-0.1 \cdot \text{STC}_{Ff}} + 10^{-0.1 \cdot \text{STC}_{Fd}} + 10^{-0.1 \cdot \text{STC}_{Df}}) \right]$$
 Eq. 4.1.1

Eq. 4.1.1 is appropriate for all types of building systems similar to the Standard Scenario. It is applied here using the following notes to calculate the sound transmission for each individual path:

For the Separating Assembly:

If the separating assembly is a framed wall assembly, then the direct path STC_{Dd} is equal to the laboratory STC rating for that assembly. Alternatively, if the separating assembly is a floor assembly with (gypsum) concrete subfloor surface, add the Δ STC correction for any added finish flooring to the STC rating for the bare floor to obtain STC_{Dd} for the direct path, as indicated in Eq. 4.1.2.

$$STC_{Dd} = STC_{bare} + \Delta STC_{flooring}$$
 Eq. 4.1.2

For Each Flanking Path:

The options for the calculation of the Flanking STC_{ij} for each flanking path ij include:

• The procedures described in ISO 10848-3 yield experimental values of the normalized flanking level difference D_{nf} . As per the standard, these D_{nf} values are normalized to an absorption area of 10 m^2 in the receiving room. In order to convert the D_{nf} values to Flanking TL_{ij} values, the correction term 10 log($S_{lab}/10$) is added, yielding values of Flanking TL normalized to the room dimensions (in metres) of the laboratory. When the laboratory values for Flanking TL or Flanking STC are to be applied for a calculation scenario where the room dimensions are different, they must be re-normalized to reflect room dimension differences between the laboratory test rooms and the prediction scenario (indicated in Eq. 4.1.3 by the subscript "situ"). The expression to use in the calculation is:

Flanking STC_{*ij*,*situ*} = Flanking STC_{*ij*,*lab*} +
$$10 \log(S_{situ}/S_{lab}) + 10 \log(l_{lab}/l_{situ})$$
 Eq. 4.1.3

Here, S_{situ} is the area (in m²) of the separating assembly and I_{situ} is the junction length (in m) for the prediction scenario, and S_{lab} and I_{lab} are the corresponding values for the specimen in the ISO 10848 laboratory test. The Flanking STC rating may be determined using the procedure of ASTM E413 with the one-third octave band values of Flanking TL as input data.

 If one of the flanking elements is a floor assembly with (gypsum) concrete subfloor surface, add the ΔSTC correction for added floor finishes to the Flanking STC_{ij} for the bare floor to obtain the Flanking STC_{ij} including the flooring.

Flanking
$$STC_{ij}$$
 = Flanking STC_{bare} + $\Delta STC_{flooring}$ Eq. 4.1.4

If flanking elements i and j are both floor assemblies with (gypsum) concrete subfloor surfaces, and both have added finish flooring, add the correction to the Flanking STC_{ij} for the bare floor as in Eq. 4.1.5. Note, however, that lining corrections are not appropriate for framed assemblies with surfaces other than (gypsum) concrete (such as OSB for floors or gypsum board for walls).

Flanking STC_{*ij*} = Flanking STC_{*bare*} +
$$\left\{ max(\Delta STC_i, \Delta STC_j) + \frac{min(\Delta STC_i, \Delta STC_j)}{2} \right\}$$
 Eq. 4.1.5

Worked Examples

The following sections present a number of worked examples that demonstrate the calculation of the ASTC rating for wood-framed and CFS-framed constructions according to the Simplified Method. Each worked example presents all the pertinent physical characteristics of the assemblies and junctions, together with a summary of key steps in the calculation process for these constructions. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide.

Within the table for each worked example, the "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation, or their counterparts using ASTM ratings as presented in Equations 4.1.1 to 4.1.5. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.

Under the heading "STC or ΔSTC", the examples present input data determined in laboratory tests:

- STC values for laboratory sound transmission loss data for wall and floor assemblies
- ΔSTC values measured in the laboratory for the change in STC due to adding a finish flooring to a base floor assembly with concrete or gypsum concrete topping
- Flanking STC values for each flanking path at each junction measured following ISO 10848 and re-normalized using Eq. 4.1.3

NOTE: In previous versions of this Guide, measured values of Flanking STC for each path were presented with normalization to the actual dimensions of the flanking facilities at NRC. Starting in 2017, data measured at NRC according to ISO 10848 has been normalized to a set of nominal dimensions that correspond more closely to the Standard Scenario used in this Guide. The pertinent dimensions for the laboratory data are identified clearly in the worked examples. This change only affects the laboratory values presented under the heading "STC or Δ STC". It had no effect on the resulting Flanking STC values for each path in the worked examples, since the values were always normalized to the dimensions of the Standard Scenario of the ASTC rating.

Under the heading "STC or ASTC", the examples present the calculated values for sound transmission via specific paths:

- Direct STC ratings for in-situ transmission through the separating assembly including linings
- Flanking STC ratings for each flanking transmission path including the change due to linings
- ASTC ratings for the combination of direct and flanking sound transmission paths

When the calculated Flanking STC for a given path exceeds 90 dB, the value is limited to 90, to allow for the inevitable effect of higher order flanking paths which make the higher calculated value not representative of the true situation. Further enhancements to elements in these paths will give negligible benefit. The consequence of this limit is that the Junction STC for the set of 3 paths at each

edge of the separating assembly cannot exceed 85 and the Total Flanking STC for all 4 edges cannot exceed 79.

The numeric calculations present the arithmetic step-by-step in each worked example, using compact notation consistent with spreadsheet expressions:

- For the calculation of the Direct STC, these expressions are easily recognized either as:
 - measured STC values without correction for a lining if the separating assembly is a wall
 - measured STC values that may include corrections for added floor finishes if the separating assembly is a floor assembly with (gypsum) concrete subfloor surface
- For the calculation of the Flanking STC rating, these expressions are easily recognized as measured Flanking STC values re-normalised according to Eq. 4.1.3, possibly with a ΔSTC correction for added flooring if one or both of the flanking surfaces is a floor assembly with (gypsum) concrete subfloor surface
- These STC or Flanking STC values are rounded to the nearest integer for consistency with the corresponding measured values

For combining the sound power transmitted via specific paths, the calculation of Eq. 4.1.1 is presented in several stages, first for the subset of paths at each junction, then for the combined effect of all four flanking junctions, and finally for the combination of the direct path and all flanking paths. Note that in the compact notation, a term for transmitted sound power fraction such as $10^{-0.1 \cdot \text{STC}_{ij}}$ becomes 10^-7.4, if STC_{ij} = 74.

For each path or junction, the overall transmission result is converted into decibel form by calculating $-10*\log_{10}$ (transmitted sound power fraction) to facilitate comparison of each path or junction with the Direct STC rating and the final ASTC rating.

The numbering of the tables presenting the worked examples end in an alphanumeric such as "H1" or "V2" to indicate Horizontal Case 1 (with rooms side-by-side) or Vertical Case 2 (with rooms one-above-the-other), respectively.

Repeatability studies in the NRC laboratories for such constructions suggest that these detailed predictions should be expected to agree with actual construction within a standard deviation of about 2 dB, in the absence of construction errors.

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4.2. Wood-Framed Wall and Floor Assemblies

For buildings with lightweight wood-framed walls and floors, the calculation procedure outlined in the preceding section can be used. The procedure requires specific laboratory test data (determined according to ASTM E90 and ISO 10848 with some extensions), and can be performed using frequency band data or single-number ratings, following the steps illustrated in Figure 4.1.1.

Previous NRC publications have presented predicted ASTC values and a procedure based on the same prediction approach, e. g. the NRC Research Report RR-219, "Guide for Sound Insulation in Wood Frame Construction", and Construction Technology Update 66 [10]. More information on the direct and flanking sound insulation of wood-framed assemblies and building systems can be found in NRC Research Report RR-336, "Apparent Sound Insulation in Wood-Framed Buildings" (in preparation at the time of publication of this Guide). The report provides the data for direct and flanking sound insulation for a variety of wood-framed building configurations.

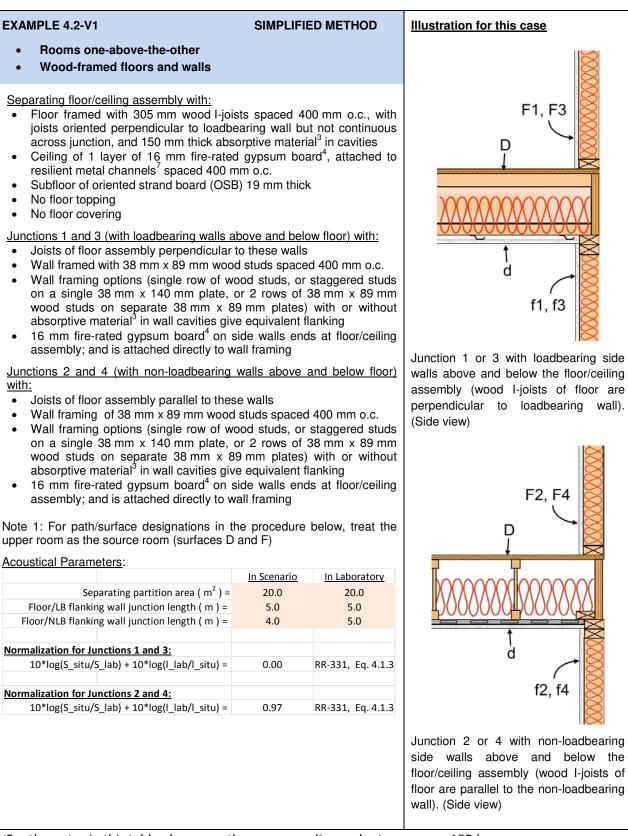
With lightweight framed assemblies, it is common practice to add layers of material such as gypsum board within hidden cavities at junctions between units, to block the spread of fire. This issue is beyond the scope of this Guide, but is discussed in considerable detail in the publication "Best Practice Guide on Fire Stops and Fire Blocks and their Impact on Sound Transmission" [16]. The specimens tested to provide the design information in NRC Research Report RR-219 and its supporting technical reports included such fire blocking. Fire blocking materials installed to protect the rimboard or header within floor cavities have minimal effect on the structure-borne flanking sound transmission. However, fire blocking within the cavity in a separating wall with a double row of studs can significantly alter the flanking sound transmission if they provide a rigid connection between the two rows of studs. Pertinent information on the resulting sound transmission with various fire blocking details is provided in the NRC Research Reports RR-219 and RR-336.

EXAMPLE 4.2-H1 SIMPLIFIED METHOD Illustration for this case Rooms side-by-side Wood-framed floors and walls Separating wall assembly with: Single row of 38 mm x 89 mm wood studs spaced 400 mm o.c., with 89 mm thick absorptive material³ filling the inter-stud cavities Resilient metal channels⁷ on one side, spaced 600 mm o.c. 1 laver of 16 mm fire-rated gypsum board⁴ attached to the resilient channels⁷ and 2 layers screwed directly to framing on the other side Bottom Junction 1 (separating wall and floor) with: Floor framed with 305 mm wood I-joists spaced 400 mm o.c., with joists oriented perpendicular to separating wall but not continuous across junction, and 150 mm thick absorptive material³ in cavities Rimboard at junction may be covered with fire blocking material such D as gypsum board without changing sound transmission rating Subfloor on both sides of oriented strand board (OSB) 19 mm thick Floor topping of 19 mm OSB mechanically fastened over subfloor • Top Junction 3 (separating wall and ceiling) with: Ceiling framed with wood I-joists (details same as for bottom junction) with 150 mm thick absorptive material³ in cavities between ioists Rimboard at junction may be covered with fire blocking material such as gypsum board without changing sound transmission rating Ceiling (1 layer of 13 mm regular gypsum board⁴) screwed directly to bottom of ceiling framing Side Junctions 2 and 4 (separating wall and abutting side walls) with: 1 layer of 16 mm fire-rated gypsum board⁴ on side walls attached Junctions 1 and 3 of loadbearing directly to framing and terminating at the separating wall separating wall with floor and ceiling. Side wall framing with single row of wood studs spaced 400 mm o.c. (Side view) with absorptive material³ filling stud cavities Side wall framing structurally-connected to the separating wall, but continuous across junction (as illustrated) Note 1: For path/surface designations in the procedure below, treat the room at left as the source room (surfaces D and F) Acoustical Parameters: f2. f4 F2, F4 In Scenario In Laboratory Separating partition area $(m^2) =$ 12.5 12.5 Floor/separating wall junction length (m) = 5.0 5.0 Wall/separating wall junction length (m) = 2.5 2.5 Junction 2 or 4 of separating wall with abutting side walls with side walls' Normalization for Junctions 1 and 3: framing continuous across junction and 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = 0.00 RR-331, Eq. 4.1.3 gypsum board terminating at separating wall. (Plan view) Normalization for Junctions 2 and 4: 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = 0.00 RR-331, Eq. 4.1.3

	ISO Symbol	Reference	STC or ∆STC	STC or ASTC
Separating Partition (Loadbe	earing Wood-			
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-WS89-001	53	
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no Δ STC correction)		53
Junction 1 (Loadbearing Wa	II / Wood-Fra	med Floor)		
For Flanking Path Ff 1:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-002	53	
Δ STC change by Lining on F	ΔR F,w	No flooring	0	
Δ STC change by Lining on f	$\Delta R f, w$	No flooring	0	
Flanking STC for path Ff_1	R_Ff,w		AX(0,0)) + MIN(0,0)/2 + 0 =	53
For Flanking Path Fd_1:	_ /			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-002	56	
ΔSTC change by Lining on F	ΔR_F,w	No flooring	0	
Flanking STC for path Fd_1	R Fd,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	56+0+0 =	56
For Flanking Path Df_1:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-002	57	
Δ STC change by Lining on f	ΔR f,w	No flooring	0	
Flanking STC for path Df_1	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	57+0+0 =	57
Junction 1: Flanking STC for			5.3 + 10^- 5.6 + 10^- 5.7) =	50
Junction 2 (Loadbearing Wo	od-Framed Se	parating Wall / Wood-Framed Flanking Walls)		
For Flanking Path Ff 2:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-001	70	
Flanking STC for path Ff 2	R Ff,w	RR-331, Eq. 4.1.3	70 + 0 =	70
For Flanking Path Fd_2:	_ /			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-001	69	
Flanking STC for path Fd_2	R Fd,w	RR-331, Eq. 4.1.3	69 + 0 =	69
For Flanking Path Df 2:	_ ,			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-001	68	
Flanking STC for path Df_2	R_Df,w	RR-331, Eq. 4.1.3	68 + 0 =	68
Junction 2: Flanking STC for	all paths		<u>-7 + 10^- 6.9 + 10^- 6.8) =</u>	64
Junction 3 (Loadbearing Wo	od-Framed W	all / Wood-Framed Floor/Ceiling)		
For Flanking Path Ff 3:				
Laboratory Flanking STC		RR-336,FTL-13-WS89-WC-LB-001	65	
Flanking STC for path Ff_3	R_Ff,w	RR-331, Eq. 4.1.3	65 + 0 =	65
For Flanking Path Fd_3:				
Laboratory Flanking STC		RR-336,FTL-13-WS89-WC-LB-001	64	
Flanking STC for path Fd_3	R_ Fd,w	RR-331, Eq. 4.1.3	64 + 0 =	64
For Flanking Path Df 3:				
Laboratory Flanking STC		RR-336,FTL-13-WS89-WC-LB-001	79	
Flanking STC for path Df_3	R_Df,w	RR-331, Eq. 4.1.3	79 + 0 =	79
Junction 3: Flanking STC for	all paths	Subset of Eq. 4.1.1 - 10*LOG10(10^-e	5 <mark>.5 + 10^- 6.4 + 10^- 7.9) =</mark>	61
Junction 4 (Loadbearing Wo All values the same as for Jui		eparating Wall / Wood-Framed Flanking Walls)		
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff 2		70
Flanking STC for path Fd_4	R_FI,w	Same as for Fd 2		69
Flanking STC for path Df_4	R_Fd,w	Same as for Df 2		68
Junction 4: Flanking STC for			<mark>^-7 + 10^- 6.9 + 10^- 6.8) =</mark>	64
Junction 4. Fidliking STC 101		5003ct 01 Lq. 4.1.1 - 10 LOG10(10	/ 10 - 0.3 + 10 - 0.0] =	04
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1 Combin	ning 12 Flanking STC values	50
ASTC due to Direct plus Tota	al Flanking	Equation 4.1.1 Combining Direct STC	with 12 Flanking STC values	48

EXAMPLE 4.2-H2:	SIMPLIFI	ED METHOD	Illustration for this case
 Rooms side-by-side Wood-framed floors and walls Same structure as 4.2-H1 but improved 	oved wall and	d floor surfaces	
 <u>Separating wall assembly with:</u> Single row of 38 mm x 89 mm wood st 89 mm thick absorptive material³ filling Resilient metal channels⁷ on one side, 2 layers of 16 mm fire-rated gypsum b channels and 2 layers screwed directly <u>Bottom Junction 1 (separating wall and floo</u> Floor framed with 305 mm wood I-jois joists oriented perpendicular to separ across junction, and 150 mm thick abs. Subfloor on both sides of oriented strant Engineered floor topping of 16 mm ply on 9 mm thick resilient mat Strip hardwood flooring 19 mm thick, r long axis perpendicular to joists Top Junction 3 (separating wall and ceiling) Ceiling framed with wood I-joists (o junction) with 150 mm thick absorptive joists Ceiling (1 layer of 13 mm regular gypst bottom of ceiling framing Side Junctions 2 and 4 (separating wall and ceiling wall and ceiling wall and ceiling framing and terminating at the set of the set	spaced 600 m poard ⁴ attacher to framing or sts spaced 40 rating wall bu orptive materi nd board (OSI ywood bonder nailed to toppi <u>) with:</u> details same material ³ in um board ⁴) so	nm o.c. ad to the resilient the other side 00 mm o.c., with t not continuous al ³ in cavities 3) 19 mm thick d to 16 mm OSB ng, oriented with as for bottom cavities between rewed directly to <u>a walls) with:</u> e walls attached	F3 f3 D + d F1 f1 Junctions 1 and 3 of loadbearing
 Side wall framing with single row of work with absorptive material³ in cavities Side wall framing structurally-connected continuous across junction (as illustrated Note 1: For path/surface designations in the room at left as the source room (surfaces D) 	ood studs spa ed to the sep ed) ne procedure	ced 400 mm o.c. arating wall, but	separating wall with floor and ceiling (Side view) $D \rightarrow \bigcup_{i=1}^{n} d$
Acoustical Parameters:			F2, F4
	In Scenario	In Laboratory	
Separating partition area (m^2) =	12.5	12.5	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Floor/separating wall junction length (m) =	5.0	5.0	lunction 2 or 4 of concreting well with
Wall/separating wall junction length (m) =	2.5	2.5	Junction 2 or 4 of separating wall with
			abutting side walls with side walls
Normalization for Junctions 1 and 3:			framing continuous across junction and
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3	gypsum board terminating at separating
			wall. (Plan view)
Normalization for Junctions 2 and 4: 10*log(S_situ/S_lab) + 10*log(L_lab/L_situ) =		RR-331, Eq. 4.1.3	wall. (Plan view)

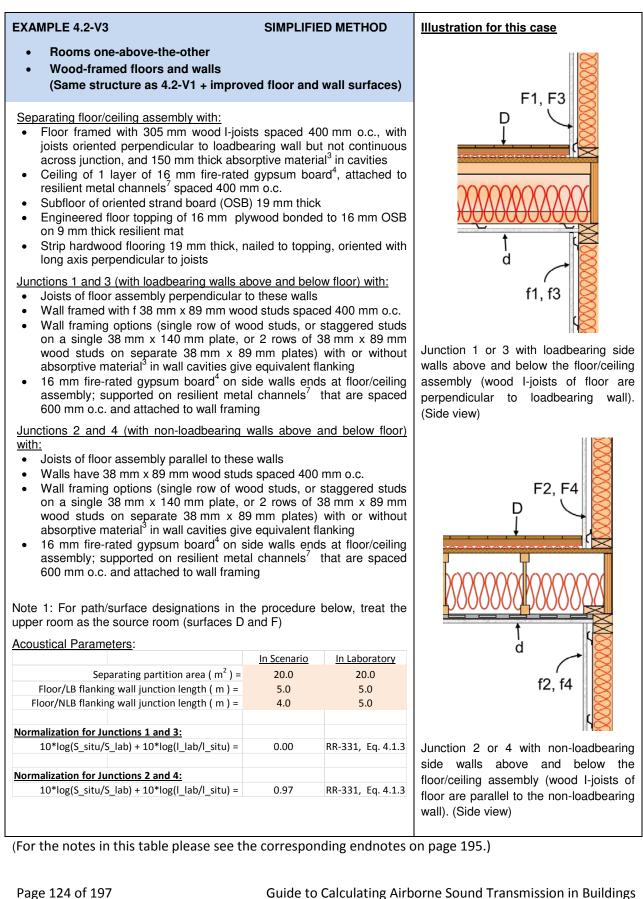
	ISO Symbol	Reference	STC or Δ STC	STC or ASTC
Separating Partition (Loadbe	earing Wood-	Framed Wall)		
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-WS89-010	57	
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no Δ STC correction)	57
Junction 1 (Loadbearing Wa	II / Wood-Fra	med Floor)		
For Flanking Path Ff 1:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-010	67	
Δ STC change by Lining on F	ΔR F,w	No flooring	0	
Δ STC change by Lining on f	$\Delta R f, w$	No flooring	0	
Flanking STC for path Ff_1	R Ff,w		AX(0,0)) + MIN(0,0)/2 + 0 =	67
For Flanking Path Fd_1:	,			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-010	69	
Δ STC change by Lining on F	ΔR_F,w	No flooring	0	
Flanking STC for path Fd_1	R Fd,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	69 + 0 + 0 =	69
For Flanking Path Df_1:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WF-LB-010	66	
Δ STC change by Lining on f	ΔR f,w	No flooring	0	
Flanking STC for path Df_1	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	66 + 0 + 0 =	66
Junction 1: Flanking STC for			$-6.7 + 10^{-} - 6.9 + 10^{-} - 6.6$) =	62
	an paulo			
Junction 2 (Loadbearing Wo	od-Framed Se	eparating Wall / Wood-Framed Flanking Walls)		
For Flanking Path Ff 2:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-010	70	
Flanking STC for path Ff_2	R Ff,w	RR-331, Eq. 4.1.3	70+0 =	70
For Flanking Path Fd_2:			,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-010	71	
Flanking STC for path Fd_2	R Fd,w	RR-331, Eq. 4.1.3	71+0 =	71
For Flanking Path Df 2:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WW-LB-010	68	
Flanking STC for path Df_2	R_Df,w	RR-331, Eq. 4.1.3	68+0 =	68
Junction 2: Flanking STC for			^-7 + 10^- 7.1 + 10^- 6.8) =	65
Junction 3 (Loadbearing Wo	od-Framed W	all / Wood-Framed Floor/Ceiling)		
For Flanking Path Ff 3:				
Laboratory Flanking STC		RR-336, FTL-13-WS89-WC-LB-010	65	
Flanking STC for path Ff_3	R Ff,w	RR-331, Eq. 4.1.3	65 + 0 =	65
For Flanking Path Fd 3:	_ /			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WC-LB-010	81	
Flanking STC for path Fd 3	R Fd,w	RR-331, Eq. 4.1.3	81+0 =	81
For Flanking Path Df 3:	,			
Laboratory Flanking STC		RR-336, FTL-13-WS89-WC-LB-010	65	
Flanking STC for path Df_3	R Df,w	RR-331, Eq. 4.1.3	65 + 0 =	65
Junction 3: Flanking STC for			6.5 + 10^- 8.1 + 10^- 6.5) =	62
Ŭ				
Junction 4 (Loadbearing Wo	od-Framed Se	parating Wall / Wood-Framed Flanking Walls)		
All values the same as for Ju				
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff_2		70
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2		71
Flanking STC for path Df_4	R_Df,w	Same as for Df_2		68
Junction 4: Flanking STC for			^-7 + 10^- 7.1 + 10^- 6.8) =	65
			, , , , , , , , , , , , , , , , , , , ,	
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1 Comb	ining 12 Flanking STC values	57
ASTC due to Direct plus Tota	I Flanking	Equation 4.1.1 Combining Direct STC	with 12 Flanking STC values	54



	ISO Symbol	Reference		STC or Δ STC	STC or A	STC
Separating Partition (Wood	-Framed Floo	r)				
Laboratory STC for Dd	R_s,w	RR-336, TLF-13-WIJ305-001		51		
∆STC change by Lining on D	ΔR_D,w	No finish flooring		0		
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2		51+0 =	51	
Junction 1 (Wood-Framed F	loor / Loadbe	aring Wood-Framed Wall)				
For Flanking Path Ff 1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-001		64		
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3		64 + 0 =	64	
For Flanking Path Fd_1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-001		57		
Flanking STC for path Fd 1	R Fd,w	RR-331, Eq. 4.1.3		57+0 =	57	
For Flanking Path Df 1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-001		90		
ΔSTC change by Lining on D	ΔR_D,w	No finish flooring		0		
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90+0+0 =	90	
Junction 1: Flanking STC for		Subset of Eq. 4.1.1	- 10*LOG10(10^	$-6.4 + 10^{-} 5.7 + 10^{-} 9) =$		56
5		•		,		
Junction 2 (Wood-Framed F	loor / Non-lo	adbearing Wood-Framed Wall)				
For Flanking Path Ff 2:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-001		64		
Flanking STC for path Ff 2	R Ff,w	RR-331, Eq. 4.1.3	-	64 + 1 =	65	
For Flanking Path Fd 2:		NN 551, Eq. 4.1.5		0111		
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-001		61		
Flanking STC for path Fd_2	R Fd,w	RR-331, Eq. 4.1.3	•	61+1 =	62	
For Flanking Path Df 2:		in 331, Eq. 4.1.3		01 · 1		
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-001		90		
Δ STC change by Lining on D	ΔR D,w	No finish flooring	-	0		
Flanking STC for path Df 2	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90 + 0 + 1 =	90	
Junction 2: Flanking STC for		Subset of Eq. 4.1.1	- 10*10610(104	$-6.5 + 10^{-} 6.2 + 10^{-} 9) =$		60
Junction 2. Hanking STC for		Subset of Eq. 4.1.1	10 10010(10	-0.5 + 10 - 0.2 + 10 - 5 / -	1	00
Junction 3 (Wood-Framed F	loor / Loadba	aring Wood-Framed Wall)				
Flanking STC for path Ff 3	R Ff,w	Same as for Ff 1			64	
Flanking STC for path Fd 3	R_Fd,w	Same as for Fd 1			57	
Flanking STC for path Df 3	R Df,w	Same as for Df 1			90	
Junction 3: Flanking STC for		Subset of Eq. 4.1.1	- 10*10610/104	-6.4 + 10^- 5.7 + 10^- 9) =	50	56
Surveyor St. Hanking STC 101		Subset of Eq. 4.1.1	10 10010(10	-0.4 + 10 - 5.7 + 10 - 5 / -	1	50
Junction 4 (Wood Framed F	loor / Non-lo	adbearing Wood-Framed Wall)				
All values the same as for Ju						
Flanking STC for path Ff 4	R Ff,w	Same as for Ff 2			65	
Flanking STC for path Fd_4	R Fd,w	Same as for Fd 2			62	
Flanking STC for path Df_4	R Df,w	Same as for Df 2			90	
		_	- 10*10610/104	$-65 \pm 100 + 62 \pm 100 + 0 =$	90	60
Junction 4: Flanking STC for		Subset of Eq. 4.1.1	- 10 10010(10/	<mark>-6.5 + 10^- 6.2 + 10^- 9) =</mark>		60
Total Flanking STC /famall 4	iunstig ===)	Subset of Eq. 4.1.1	Combin	ing 12 Flanking CTC values		F 2
Total Flanking STC (for all 4	junctions	Subset of Eq. 4.1.1	Combir	ing 12 Flanking STC values		52
ASTC due to Direct plus Tota	al Flanking	Equation 4.1.1 C	ombining Direct STC v	vith 12 Flanking STC values	48	

Rooms one-above-the-other	SIMPLIFI	ED METHOD	Illustration for this case
• Wood-framed floors and walls (Same structure as 4.2-V1 plus im	proved floor	surfaces)	F1, F3
 Separating floor/ceiling assembly with: Floor framed with 305 mm wood I-joi joists oriented perpendicular to loadb across junction, and 150 mm thick abs Ceiling of 1 layer of 16 mm fire-rate resilient metal channels⁷ spaced 400 r Subfloor of oriented strand board (OSI Engineered floor topping of 16 mm p on 9 mm thick resilient mat Strip hardwood flooring 19 mm thick, long axis perpendicular to joists Junctions 1 and 3 (with loadbearing walls a Joists of floor assembly perpendicular Wall framing options (single row of w on a single 38 mm x 140 mm plate, wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v Junctions 2 and 4 (with non-loadbearing with: Joists of floor assembly parallel to the Walls have 38 mm x 89 mm wood stude 	ists spaced 4 earing wall busorptive material d gypsum boson mm o.c. B) 19 mm thick lywood bonde nailed to toppin above and belat to these walls of studs space yood studs, or or 2 rows of 39 mm plates) ve equivalent f side walls encoval vall framing walls above se walls ds spaced 400 rood studs, or or 2 rows of	00 mm o.c., with ut not continuous ial ³ in cavities ard ⁴ , attached to k d to 16 mm OSB ing, oriented with <u>ow floor) with:</u> ad 400 mm o.c. staggered studs 38 mm x 89 mm with or without lanking ds at floor/ceiling <u>and below floor)</u> 0 mm o.c. staggered studs	F1, F3
on a single 38 mm x 140 mm plate, wood studs on separate 38 mm x 8			
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in t pper room as the source room (surfaces D 	ve equivalent f side walls end vall framing the procedure	lanking ds at floor/ceiling	
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v ote 1: For path/surface designations in topper room as the source room (surfaces D) 	ve equivalent f side walls end vall framing he procedure and F)	lanking ds at floor/ceiling below, treat the	
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in t pper room as the source room (surfaces D coustical Parameters: 	ve equivalent f side walls end vall framing the procedure and F) In Scenario	lanking ds at floor/ceiling below, treat the In Laboratory	t d f2, f4
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v ote 1: For path/surface designations in t pper room as the source room (surfaces D <u>coustical Parameters</u>: Separating partition area (m²) = 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0	lanking ds at floor/ceiling below, treat the In Laboratory 20.0	
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in the poer room as the source room (surfaces Desparating partition area (m²) = Floor/LB flanking wall junction length (m) = 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0 5.0	ilanking ds at floor/ceiling below, treat the <u>In Laboratory</u> 20.0 5.0	
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in t pper room as the source room (surfaces D coustical Parameters: Separating partition area (m²) = 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0	lanking ds at floor/ceiling below, treat the In Laboratory 20.0	f2, f4
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in t pper room as the source room (surfaces D coustical Parameters: Separating partition area (m²) = Floor/LB flanking wall junction length (m) = Floor/NLB flanking wall junction length (m) = 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0 5.0	ilanking ds at floor/ceiling below, treat the <u>In Laboratory</u> 20.0 5.0	
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v lote 1: For path/surface designations in t pper room as the source room (surfaces D acoustical Parameters: Separating partition area (m²) = Floor/LB flanking wall junction length (m) = Floor/NLB flanking wall junction length (m) = 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0 5.0	ilanking ds at floor/ceiling below, treat the <u>In Laboratory</u> 20.0 5.0	f2, f4
 wood studs on separate 38 mm x 8 absorptive material³ in wall cavities giv 16 mm fire-rated gypsum board⁴ on assembly; and is attached directly to v Note 1: For path/surface designations in t pper room as the source room (surfaces Description area (m²) = Separating partition area (m²) = Floor/LB flanking wall junction length (m) = Floor/NLB flanking wall junction length (m) = Mormalization for Junctions 1 and 3: 	ve equivalent f side walls end vall framing the procedure and F) <u>In Scenario</u> 20.0 5.0 4.0	lanking ds at floor/ceiling below, treat the <u>In Laboratory</u> 20.0 5.0 5.0	f2, f4 Junction 2 or 4 with non-loadbearing side walls above and below the

	ISO Symbol	Reference		STC or Δ STC	STC or A	STC
Separating Partition (Wood	-Framed Floo	r)				
Laboratory STC for Dd	R_s,w	RR-336, TLF-13-WIJ305-011		66		
ΔSTC change by Lining on D	ΔR_D,w	N/A		0		
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2		66 + 0 =	66	
Junction 1 (Wood-Framed F	loor / Loadbe	aring Wood-Framed Wall)				
For Flanking Path Ff 1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB010		64		
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3		64 + 0 =	64	
For Flanking Path Fd_1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB010		74		
Flanking STC for path Fd_1	R_Fd,w	RR-331, Eq. 4.1.3		74+0 =	74	
For Flanking Path Df 1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB010		90		
ΔSTC change by Lining on D	ΔR_D,w	N/A		0		
Flanking STC for path Df_1	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90+0+0 =	90	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-	6.4 + 10^- 7.4 + 10^- 9) =		64
			•	· · ·		
Junction 2 (Wood-Framed F	loor / Non-lo	adbearing Wood-Framed Wall)				
For Flanking Path Ff 2:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB010		64		
Flanking STC for path Ff 2	R Ff,w	RR-331, Eq. 4.1.3		64 + 1 =	65	
For Flanking Path Fd 2:	_ /					
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB010		73		
Flanking STC for path Fd_2	R_Fd,w	RR-331, Eq. 4.1.3		73+1 =	74	
For Flanking Path Df 2:	_ ,					
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB010		90		
ΔSTC change by Lining on D	ΔR_D,w	N/A		0		
Flanking STC for path Df_2	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90+0+1 =	90	
Junction 2: Flanking STC for		Subset of Eq. 4.1.1	- 10*LOG10(10^-	6.5 + 10^- 7.4 + 10^- 9) =		64
				·		
Junction 3 (Wood-Framed F	loor / Loadbe	aring Wood-Framed Wall)				
Flanking STC for path Ff 3	R_Ff,w	Same as for Ff 1			64	
Flanking STC for path Fd_3	R_Fd,w	Same as for Fd_1			74	
Flanking STC for path Df_3	R_Df,w	Same as for Df_1			90	
Junction 3: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-	6.4 + 10^- 7.4 + 10^- 9) =		64
Junction 4 (Wood-Framed F	loor / Non-lo	adbearing Wood-Framed Wall)				
All values the same as for Ju						
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff_2			65	
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2			74	
Flanking STC for path Df_4	R_Df,w	Same as for Df_2			90	
Junction 4: Flanking STC for		Subset of Eq. 4.1.1	- 10*LOG10(10^-	6.5 + 10^- 7.4 + 10^- 9) =		64
U		· · · · ·				
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1	Combini	ng 12 Flanking STC values		58
		·				_
ASTC due to Direct plus Tota	Elanking	Equation 4.1.1 Con	mhining Direct STC w	ith 12 Flanking STC values	57	



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	ISO Symbol	Reference		STC or Δ STC	STC or A	STC
Separating Partition (Wood	-Framed Floo	r)				
Laboratory STC for Dd	R_s,w	RR-336, TLF-13-WIJ305-011		66		
∆STC change by Lining on D	∆R_D,w	N/A		0		
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2		66+0 =	66	
Junction 1 (Wood-Framed F	<mark>loor / Loadbe</mark>	aring Wood-Framed Wall)				
For Flanking Path Ff_1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-011		80		
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3		80 + 0 =	80	
For Flanking Path Fd_1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-011		90		
Flanking STC for path Fd_1	R_ Fd,w	RR-331, Eq. 4.1.3		90 + 0 =	90	
For Flanking Path Df 1:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-LB-011		90		
∆STC change by Lining on D	ΔR_D,w	N/A		0		
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90 + 0 + 0 =	90	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10	(10^-8 + 10^- 9 + 10^- 9) =		79
Junction 2 (Wood-Framed F	<mark>loor / Non-lo</mark> a	adbearing Wood-Framed Wall)				
For Flanking Path Ff_2:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-00)1	80		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3		80 + 1 =	81	
For Flanking Path Fd 2:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-00)1	90		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq. 4.1.3		90+1 =	90	
For Flanking Path Df 2:						
Laboratory Flanking STC		RR-336, FTL-13-WIJ305-FW-NLB-00)1	90		
ΔSTC change by Lining on D	ΔR_D,w	N/A		0		
Flanking STC for path Df_2	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		90+0+1 =	90	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(1	0^-8.1 + 10^- 9 + 10^- 9) =		80
Junction 3 (Wood-Framed F	loor / Loadbe	aring Wood-Framed Wall)				
Flanking STC for path Ff_3	R_Ff,w	Same as for Ff_1			80	
Flanking STC for path Fd_3	R_Fd,w	Same as for Fd_1			90	
Flanking STC for path Df_3	R_Df,w	Same as for Df_1			90	
Junction 3: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10	(10^-8 + 10^- 9 + 10^- 9) =		79
Junction 4 (Wood-Framed F	loor / Non-lo	adbearing Wood-Framed Wall)				
All values the same as for Ju	nction_2					
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff_2			81	
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2			90	
Flanking STC for path Df_4	R_Df,w	Same as for Df_2			90	
Junction 4: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(1	0^-8.1 + 10^- 9 + 10^- 9) =		80
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1	Combir	ing 12 Flanking STC values		74
ASTC due to Direct plus Tota	al Flanking	Equation 4.1.1	Combining Direct STC v	vith 12 Flanking STC values	65	

EXAMPLE 4.2-H3

SIMPLIFIED METHOD III

- Rooms side-by-side
- Wood-framed floors and walls
- Double wood stud separating wall

Separating wall assembly with:

- Double row of 38 mm x 89 mm wood studs spaced 400 mm o.c., with 25 mm space between rows and 89 mm thick absorptive material³ filling the inter-stud cavities of one row of studs
- 1 layer of 16 mm fire-rated gypsum board⁴ on each side

Bottom Junction 1 (separating wall and floor) with:

- Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., framing not continuous across junction, with 150 mm thick absorptive material³ in cavities
- Subfloor on both sides of oriented strand board (OSB) 19 mm thick, continuous across junction, with no floor topping

Top Junction 3 (separating wall and ceiling) with:

- Ceiling framed with wood joists (details same as for bottom junction) with 150 mm thick absorptive material³ in cavities between joists
- Ceiling (2 layers of 16 mm fire-rated gypsum board⁴) supported on resilient metal channels⁷ attached to bottom of joists on each side

Two options are compared:

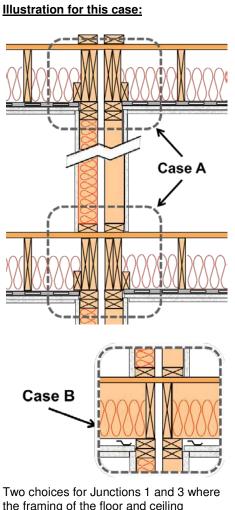
- ⇒ Case A with the joists of the floor and ceiling <u>parallel</u> to separating wall as illustrated above,
- ⇒ Case B with floor and ceiling joists <u>perpendicular</u> to the separating wall as illustrated in lower detail.

Side Junctions 2 and 4 (separating wall and abutting side walls) with:

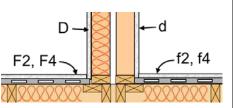
- 16 mm fire-rated gypsum board⁴ on side walls ends at separating wall assembly; supported on resilient metal channels⁷ attached to wall framing
- Side wall framing with single row of wood studs with absorptive material³ filling stud cavities
- Side wall framing structurally-connected to the separating wall, but continuous across junction (as illustrated)

Acoustical Parameters:

	In Scenario	In Laboratory
Separating partition area (m^2) =	12.5	12.5
Floor/separating wall junction length (m) =	5.0	5.0
Wall/separating wall junction length (m) =	2.5	2.5
Normalization for Junctions 1 and 3:		
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3
Normalization for Junctions 2 and 4:		
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3



Two choices for Junctions 1 and 3 where the framing of the floor and ceiling connects to the separating wall. (Side view)



Junction 2 or 4 of separating wall with abutting side walls with side walls' framing continuous across junction and gypsum board terminating at separating wall. (Plan view)

urenot		es, Flanking TL data for individual paths at ea so these examples use the available data for	•	
CASE A: Floor Joists Par	allel to Ser	parating Wall		
	ISO Symbo	_	STC or ΔSTC	STC or ASTC
Separating Partition (Wall F			510 01 2510	STC OF ASTC
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-DWS203-001	55	
Direct STC in situ	R Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no Δ STC correction)		55
				1
Junction 1 (Wall/Floor Junc	tion: Non-loa	dbearing Wall / Floor Joists Parallel to Wall)		
Measured Laboratory Flanki	ng STC	RR-336, FTL-13-DWS203-WF-NLB-001	47	
Junction 1: Flanking STC for	all paths	· · · · · · · · · · · · · · · · · · ·	47 + 0 =	47
		Wall / Wood-Framed Flanking Walls)		
Measured Laboratory Flanki	U	RR-336, FTL-13-DWS203-WW-NLB-001	65	C-
Junction 2: Flanking STC for	all paths		65 + 0 =	65
Junction 3 (Wall/Cailing Jun	ction: Non la	adbearing Wall / Ceiling Joists Parallel to Wall)		
Measured Laboratory Flanki		RR-336, FTL-13-DWS203-WC-NLB-001	65	
Junction 3: Flanking STC for		NN 330, TTE-13-DW3203-WC-NED-001	65 + 0 =	65
Janetion J. Hanking STC IOI			05+0 -	0.5
Junction 4 (Non-loadbearing Measured Laboratory Flanki	• • •	Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-001	65	
Junction 4: Flanking STC for	U		65 + 0 =	65
Total Flanking STC (for all 4 ASTC due to Direct plus Tota		RR-331, Subset of Eq. 4.1.1Combining 4 JunctionRR-331, Eq. 4.1.1Combining Direct STC with the sector of	on Flanking STC values	47 46
CASE B: Floor Joists Per	nendicular	to Senarating Wall		
CASE B: Floor Joists Per			STC or ASTC	STC or ASTC
	ISO Symbo	Reference	STC or ASTC	STC or ASTC
CASE B: Floor Joists Per Separating Partition (Wall F	ISO Symbo ramed with 2	Reference Reference		STC or ASTC
Separating Partition (Wall F Laboratory STC for Dd	ISO Symbo ramed with 2 R_s,w	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001	STC or ΔSTC 55	
Separating Partition (Wall F	ISO Symbo ramed with 2	Reference Reference		STC or ASTC
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ	ISO Symbo ramed with 2 R_s,w R_Dd,w	Reference2 Rows of Studs)RR-336, TLW-13-DWS203-001RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)		
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001		
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall)	55	55
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall)	55 49	55
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001	55 49	55
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001	55 49 49+0 = 65	<u>55</u>
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flankin Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flankin	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls)	55 49 49+0 =	<u>55</u>
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 2: Flanking STC for	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001	55 49 49+0 = 65	<u>55</u>
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths ction: Separat	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001 atting Wall / Ceiling Joists Perpendicular to Wall)	55 49 49+0 = 65 65+0 =	<u>55</u>
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3 (Wall/Ceiling Jun Measured Laboratory Flanki	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths ction: Separat ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001	55 49 49+0 = 65 65+0 = 65	49
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 2: Flanking STC for	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths ction: Separat ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001 atting Wall / Ceiling Joists Perpendicular to Wall)	55 49 49+0 = 65 65+0 =	<u>55</u> 49 65
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3: Flanking STC for Measured Laboratory Flanki Junction 3: Flanking STC for	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths function: Separat ng STC all paths function: Separat	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001 ating Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WW-LB-001	55 49 49+0 = 65 65+0 = 65	49
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flanki Junction 3: Flanking STC for Junction 4 (Separating Wall	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths for tion: Separat ng STC all paths for tion: Separat ng STC all paths / Wood-Frar	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001 ating Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WW-LB-001 ating Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-LB-001	55 49 $49 + 0 =$ 65 $65 + 0 =$ $65 + 0 =$	49
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3: Flanking STC for Junction 3: Flanking STC for Junction 3: Flanking STC for Junction 4 (Separating Wall Measured Laboratory Flanki	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths f C all paths / Wood-Frar ng STC all paths / Wood-Frar ng STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-001 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) ing Wall / Floor Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WF-LB-001 ned Flanking Walls) RR-336, FTL-13-DWS203-WW-LB-001 ating Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WW-LB-001	55 49 $49 + 0 =$ 65 $65 + 0 =$ 65 $65 + 0 =$ 65	<u>49</u> 65 65
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3 (Wall/Ceiling Jun Measured Laboratory Flanki Junction 3: Flanking STC for Junction 4 (Separating Wall Measured Laboratory Flanki Junction 4 (Separating Wall Measured Laboratory Flanki Junction 4: Flanking STC for	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths f Wood-Frar ng STC all paths / Wood-Frar ng STC all paths	Reference2 Rows of Studs)RR-336, TLW-13-DWS203-001RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)ing Wall / Floor Joists Perpendicular to Wall)RR-336, FTL-13-DWS203-WF-LB-001ned Flanking Walls)RR-336, FTL-13-DWS203-WW-LB-001ating Wall / Ceiling Joists Perpendicular to Wall)RR-336, FTL-13-DWS203-WW-LB-001ating WallsRR-336, FTL-13-DWS203-WC-LB-001RR-336, FTL-13-DWS203-WC-LB-001RR-336, FTL-13-DWS203-WC-LB-001	55 49 $49 + 0 =$ 65 $65 + 0 =$ 65 $65 + 0 =$ 65 $65 + 0 =$	55 49 65 65 65
Separating Partition (Wall F Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Junc Measured Laboratory Flanki Junction 1: Flanking STC for Junction 2 (Separating Wall Measured Laboratory Flanki Junction 3: Flanking STC for Junction 3: Flanking STC for Junction 3: Flanking STC for Junction 4 (Separating Wall Measured Laboratory Flanki	ISO Symbo ramed with 2 R_s,w R_Dd,w tion: Separat ng STC all paths / Wood-Frar ng STC all paths f Wood-Frar ng STC all paths / Wood-Frar ng STC all paths	Reference2 Rows of Studs)RR-336, TLW-13-DWS203-001RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)ing Wall / Floor Joists Perpendicular to Wall)RR-336, FTL-13-DWS203-WF-LB-001ned Flanking Walls)RR-336, FTL-13-DWS203-WW-LB-001ating Wall / Ceiling Joists Perpendicular to Wall)RR-336, FTL-13-DWS203-WW-LB-001ating WallsRR-336, FTL-13-DWS203-WC-LB-001RR-336, FTL-13-DWS203-WC-LB-001RR-336, FTL-13-DWS203-WC-LB-001	55 49 $49 + 0 =$ 65 $65 + 0 =$ 65 $65 + 0 =$ 65	<u>49</u> 65 65

EXAMPLE 4.2-H4 SIMPLIFIED METHOD Illustration for this case: Rooms side-by-side Wood-framed floors and walls Double wood stud separating wall Separating wall assembly with: Double row of 38 mm x 89 mm wood studs spaced 400 mm o.c., with 25 mm space between rows and 89 mm thick absorptive material³ filling the inter-stud cavities of both rows of studs 1 layer of 16 mm fire-rated gypsum board⁴ on each side Bottom Junction 1 (separating wall and floor) with: Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., framing not continuous across junction, with 150 mm thick absorptive material³ in cavities Subfloor on both sides of oriented strand board (OSB) 19 mm thick, with no floor topping Top Junction 3 (separating wall and ceiling) with: Ceiling framed with wood joists (details same as for bottom junction) with 150 mm thick absorptive material³ in cavities between joists Ceiling (2 layers of 16 mm fire-rated gypsum board⁴) supported on resilient channels⁷ attached to bottom of joists on each side Two options are compared: ⇒ Case A with the OSB subfloor continuous across the floor and Case B ceiling junctions, as illustrated above, ⇒ Case B with OSB subfloor not continuous across the junctions as illustrated in lower detail. Because both wall cavities are full of absorptive material, the solid fire block is not required. Two choices for Junctions 1 and 3 where Side Junctions 2 and 4 (separating wall and abutting side walls) with: the framing of the floor and ceiling 16 mm fire-rated gypsum board⁴ on side walls ends at separating connects to the separating wall. wall assembly; supported on resilient metal channels⁷ attached to (Side view) wall framing Side wall framing with single row of wood studs with absorptive material³ filling stud cavities Side wall framing structurally-connected to the separating wall, but continuous across junction (as illustrated) F2. F4 Acoustical Parameters: In Scenario In Laboratory Junction 2 or 4 of separating wall with 12.5 Separating partition area $(m^2) =$ 12.5 Floor/separating wall junction length (m) = 5.0 abutting side walls with side walls' framing 5.0 continuous across junction and gypsum Wall/separating wall junction length (m) = 2.5 2.5 board terminating at separating wall. (Plan view) Normalization for Junctions 1 and 3: 10*log(S situ/S lab) + 10*log(l lab/l situ) = 0.00 RR-331, Eq. 4.1.3

(For the notes in this table please see the corresponding endnotes on page 195.)

0.00

RR-331, Eq. 4.1.3

Normalization for Junctions 2 and 4:

10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =

Case A

f2, f4

		es, Flanking TL data for individual paths at a so these examples use the available data j	•	
CASE A: Floor Joists Pa	rallel to Ser	parating Wall		
	ISO Symbo	_	STC or ∆STC	STC or ASTC
Separating Partition (Wall				
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-DWS203-002	58	
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)		58
		dbearing Wall / Floor Joists Parallel to Wall)		
Measured Laboratory Flank	U	RR-336, FTL-13-DWS203-WF-NLB-001	47	
Junction 1: Flanking STC for	r all paths		47 + 0 =	47
Junction 2 (Non loadhoarin	a Constating	Wall / Wood-Framed Flanking Walls)		
Measured Laboratory Flank		RR-336, FTL-13-DWS203-WW-NLB-001	65	
Junction 2: Flanking STC for		111 333, TE 13 D 113203 WW NED 001	65+0 =	65
	3 portio		03.0 -	
Junction 3 (Wall/Ceiling Ju	nction: Non-lo	adbearing Wall / Ceiling Joists Parallel to Wall)		
Measured Laboratory Flank		RR-336, FTL-13-DWS203-WC-NLB-001	65	
Junction 3: Flanking STC for			65 + 0 =	65
Junction 4 (Non-loadbearin	g Separating	Wall / Wood-Framed Flanking Walls)		
Measured Laboratory Flank	ing STC	RR-336, FTL-13-DWS203-WW-NLB-001	65	
Junction 4: Flanking STC for	r all paths		65 + 0 =	65
Total Flanking STC (for all 4	junctions)	RR-331, Subset of Eq. 4.1.1 Combining 4 Jun	ction Flanking STC values	4
ASTC due to Direct plus Tot	tal Flanking	RR-331, Eq. 4.1.1 Combining Direct STC	with Flanking STC values	46
CASE B: Floor Joists Pe	rpendicular	to Separating Wall		
	ISO Symbo		STC or Δ STC	STC or AST
Separating Partition (Wall	Framed with 2	Rows of Studs)		
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-DWS203-002	58	
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)		58
		dbearing Wall / Floor Joists Perpendicular to Wall)	0-	
Measured Laboratory Flank	-	RR-336, FTL-13-DWS203-WF-NLB-002	85	05
Junction 1: Flanking STC for	r all paths		85 + 0 =	85
Junction 2 (Non-loadhearin	g Senarating	Wall / Wood-Framed Flanking Walls)		
			65	
Measured Lanoratory Flank	ing STC	RR-336 FTT-13-DVA/S203-VA/V/-NTR-007	65	
		RR-336, FTL-13-DWS203-WW-NLB-002	65 65 + 0 =	65
		RR-336, FTL-13-DWS203-WW-NLB-002	65 65 + 0 =	65
Junction 2: Flanking STC for	r all paths		65 + 0 =	65
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun	r all paths nction: Non-Ic	RR-336, FTL-13-DWS203-WW-NLB-002 padbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002	65 + 0 =	65
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank	nction: Non-Ic	adbearing Wall / Ceiling Joists Perpendicular to Wall)	65 + 0 =	
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank	nction: Non-Ic	adbearing Wall / Ceiling Joists Perpendicular to Wall)	<u>65</u> +0 = 85	
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank Junction 3: Flanking STC for Junction 4 (Non-loadbearir	r all paths nction: Non-lo ing STC r all paths g Separating	adbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002 Wall / Wood-Framed Flanking Walls)	65 + 0 = 85 85 + 0 =	
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank Junction 3: Flanking STC for Junction 4 (Non-loadbearin Measured Laboratory Flank	r all paths nction: Non-Id ing STC r all paths ng Separating ing STC	adbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002	<u>65</u> +0 = 85	
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank Junction 3: Flanking STC for Junction 4 (Non-loadbearin Measured Laboratory Flank	r all paths nction: Non-Id ing STC r all paths ng Separating ing STC	adbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002 Wall / Wood-Framed Flanking Walls)	65 + 0 = 85 85 + 0 =	85
Measured Laboratory Flank Junction 3: Flanking STC for	r all paths inction: Non-Id ing STC r all paths og Separating ing STC r all paths	adbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-002	65 + 0 = 85 85 + 0 = 65	85
Junction 2: Flanking STC for Junction 3 (Wall/Ceiling Jun Measured Laboratory Flank Junction 3: Flanking STC for Junction 4 (Non-loadbearin Measured Laboratory Flank Junction 4: Flanking STC for	r all paths nction: Non-lo ing STC r all paths ing Separating ing STC r all paths - Junctions)	adbearing Wall / Ceiling Joists Perpendicular to Wall) RR-336, FTL-13-DWS203-WC-NLB-002 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-002 RR-331, Subset of Eq. 4.1.1 Combining 4 Jun	65 + 0 = 85 85 + 0 = 65 65 + 0 =	85 65

EXAMPLE 4.2-H5 SIMPLIFIED METHOD Illustration for this case: Rooms side-by-side Double wood stud separating wall Wood-framed floors with concrete topping Separating wall assembly with: Double row of 38 mm x 89 mm wood studs spaced 400 mm o.c., with 25 mm space between rows and 89 mm thick absorptive material³ filling the inter-stud cavities of both rows of studs 1 layer of 16 mm fire-rated gypsum board⁴ on each side Bottom Junction 1 (separating wall and floor) with: Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., framing not continuous across junction, with 150 mm thick absorptive material³ in cavities Subfloor on both sides of oriented strand board (OSB) 19 mm thick, with floor topping of 38 mm thick concrete on each side Top Junction 3 (separating wall and ceiling) with: Ceiling framed with wood joists (details same as for bottom junction) with 150 mm thick absorptive material³ in cavities between joists Ceiling (2 layers of 16 mm fire-rated gypsum board⁴) supported on resilient channels⁷ attached to bottom of joists on each side Two options are compared: ⇒ Case A with the OSB subfloor continuous across the floor and Case B ceiling junctions, as illustrated above, ⇒ Case B with OSB subfloor not continuous across the junctions as illustrated in lower detail. Because both wall cavities are full of absorptive material, the solid fire block is not required. Side Junctions 2 and 4 (separating wall and abutting side walls) with: 16 mm fire-rated gypsum board⁴ on side walls ends at separating wall assembly; supported on resilient metal channels⁷ attached to (Side view) wall framing Side wall framing with single row of wood studs with absorptive material³ filling stud cavities Side wall framing structurally-connected to the separating wall, but continuous across junction (as illustrated) Acoustical Parameters: In Scenario In Laboratory Separating partition area $(m^2) =$ 12.5 12.5 Floor/separating wall junction length (m) = 5.0 5.0 Wall/separating wall junction length (m) = 2.5 2.5 (Plan view) Normalization for Junctions 1 and 3: 0.00 $10*\log(S \text{ situ/S lab}) + 10*\log(I \text{ lab/I situ}) =$ Guide, Eq. 4.1.3

Case A Two choices for Junctions 1 and 3 where the framing of the floor and ceiling connects to the separating wall. f2, f4 Junction 2 or 4 of separating wall with

abutting side walls with side walls' framing continuous across junction and gypsum board terminating at separating wall.

(For the notes in this table please see the corresponding endnotes on page 195.)

0.00

Guide, Eq. 4.1.3

Normalization for Junctions 2 and 4:

10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =

Note: For these examples, Flanking TL data for individual paths at each junction are not available, so these examples use the available data for junctions.

	arallal to Sam	arating Wall		
CASE A: Floor Joists P	ISO Symbo		STC or ASTC	STC or AST
Separating Partition (Wal			0.00. 20.0	0100171017
Laboratory STC for Dd	R_s,w	RR-336, TLW-13-DWS203-002	58	
Direct STC in situ	R Dd,w	RR-331, Eq. 4.1.2 (not a floor, so no Δ STC correction)	50	58
Directore in situ	N_Du,w			50
Junction 1 (Wall/Floor Ju	nction: Non-loa	dbearing Wall / Floor Joists Parallel to Wall)		
Measured Laboratory Flan		RR-336, FTL-13-DWS203-WF-NLB-003	61	
Junction 1: Flanking STC fo	U		61+0 =	61
Junction 1. Hanking STC I			0110	01
Junction 2 (Non-loadbear	ing Separating	Wall / Wood-Framed Flanking Walls)		
Measured Laboratory Flan		RR-336, FTL-13-DWS203-WW-NLB-003	65	
Junction 2: Flanking STC for	U		65 + 0 =	65
			00.0	
Junction 3 (Wall/Ceiling J	unction: Non-lo	badbearing Wall / Ceiling Joists Parallel to Wall)		
Measured Laboratory Flan		RR-336, FTL-13-DWS203-WC-NLB-003	65	
Junction 3: Flanking STC fo		,	65 + 0 =	65
Junction 4 (Non-loadbear	ing Separating	Wall / Wood-Framed Flanking Walls)		
Measured Laboratory Flan	king STC	RR-336, FTL-13-DWS203-WW-NLB-003	65	
Junction 4: Flanking STC f	or all paths		65 + 0 =	65
Total Flanking STC (for all	4 junctions)	RR-331, Subset of Eq. 4.1.1 Combining 4 Juncti	on Flanking STC values	5
ASTC due to Direct plus To	otal Elanking	RR-331, Eq. 4.1.1 Combining Direct STC w	ith Elanking STC values	55
ASTC due to Direct plus h	otal Flatiking	KR-551, Eq. 4.1.1 Combining Direct STC w	ILII FIAIIKIIIg SIC Values	
CASE B: Floor Joists P	arallel to Ser	parating Wall, Discontinuous Subfloor		
CASE B: Floor Joists P		parating Wall, Discontinuous Subfloor	STC or ASTC	STC or AST
	ISO Symbo	I Reference	STC or ∆STC	STC or AST
Separating Partition (Wal	ISO Symbo	I Reference 2 Rows of Studs)		STC or AST
Separating Partition (Wal Laboratory STC for Dd	ISO Symbo I Framed with 2 R_s,w	I Reference I 2 Rows of Studs) RR-336, TLW-13-DWS203-002 I	STC or ∆STC	
Separating Partition (Wal	ISO Symbo	I Reference 2 Rows of Studs)		STC or AST
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ	ISO Symbo I Framed with 2 R_s,w R_Dd,w	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)		
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun	ISO Symbo I Framed with 2 R_s,w R_Dd,w	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Idbearing Wall / Floor Joists Parallel to Wall)	58	
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan	ISO Symbo I Framed with 2 R_s,w R_Dd,w Inction: Non-loa Iking STC	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction)	58 85	58
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun	ISO Symbo I Framed with 2 R_s,w R_Dd,w Inction: Non-loa Iking STC	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Idbearing Wall / Floor Joists Parallel to Wall)	58	58
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa Iking STC or all paths	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004	58 85	58
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa king STC or all paths ing Separating	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls)	58 85 85 + 0 =	58
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa Iking STC or all paths ing Separating Iking STC	Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004	58 85 85 + 0 = 65	<u>58</u> 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa Iking STC or all paths ing Separating Iking STC	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls)	58 85 85 + 0 =	<u>58</u> 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-Ioadbear Measured Laboratory Flan Junction 2: Flanking STC for	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa king STC or all paths ing Separating king STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004	58 85 85 + 0 = 65	<u>58</u> 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 2: Flanking STC for Junction 3 (Wall/Ceiling J	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths ing Separating aking STC or all paths unction: Non-loa	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 Dadbearing Wall / Ceiling Joists Parallel to Wall)	58 85 85 + 0 = 65 65 + 0 =	<u>58</u> 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 2: Flanking STC for Junction 3 (Wall/Ceiling J Measured Laboratory Flan	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths ing Separating aking STC or all paths unction: Non-loa aking STC	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) Adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004	58 85 85 + 0 = 65 65 + 0 = 85	58 85 65
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 2: Flanking STC for Junction 3 (Wall/Ceiling J	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths ing Separating aking STC or all paths unction: Non-loa aking STC	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 Dadbearing Wall / Ceiling Joists Parallel to Wall)	58 85 85 + 0 = 65 65 + 0 =	58 85 65
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 2: Flanking STC for Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths or all paths unction: Non-loa king STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 badbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004	58 85 85 + 0 = 65 65 + 0 = 85	58 85 65
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for Junction 4 (Non-loadbear	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths or all paths unction: Non-loa aking STC or all paths unction: Non-loa aking STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 badbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls)	58 85 85 + 0 = 65 65 + 0 = 85 85 + 0 =	58 85 65
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for Junction 4 (Non-loadbear Measured Laboratory Flan	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths or all paths unction: Non-lo aking STC or all paths ing Separating aking STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 badbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004	58 85 85 + 0 = 65 65 + 0 = 85 85 + 0 = 65	58 58 85 65 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for Junction 4 (Non-loadbear	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths or all paths unction: Non-lo aking STC or all paths ing Separating aking STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 badbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls)	58 85 85 + 0 = 65 65 + 0 = 85 85 + 0 =	58 58 85 65 85
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for Junction 4 (Non-loadbear Measured Laboratory Flan Junction 4: Flanking STC for	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths or all paths unction: Non-loa aking STC or all paths ing Separating aking STC or all paths	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 Dadbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004	58 85 85 + 0 = 65 65 + 0 = 85 85 + 0 = 65 65 + 0 =	58 58 85 65 85 65
Separating Partition (Wal Laboratory STC for Dd Direct STC in situ Junction 1 (Wall/Floor Jun Measured Laboratory Flan Junction 1: Flanking STC for Junction 2 (Non-loadbear Measured Laboratory Flan Junction 3 (Wall/Ceiling J Measured Laboratory Flan Junction 3: Flanking STC for Junction 4 (Non-loadbear Measured Laboratory Flan	ISO Symbo I Framed with 2 R_s,w R_Dd,w nction: Non-loa aking STC or all paths or all paths 4 junctions)	I Reference 2 Rows of Studs) RR-336, TLW-13-DWS203-002 RR-331, Eq. 4.1.2 (not a floor, so no ΔSTC correction) adbearing Wall / Floor Joists Parallel to Wall) RR-336, FTL-13-DWS203-WF-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004 Dadbearing Wall / Ceiling Joists Parallel to Wall) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WC-NLB-004 Wall / Wood-Framed Flanking Walls) RR-336, FTL-13-DWS203-WW-NLB-004	58 85 85 + 0 = 65 65 + 0 = 85 85 + 0 = 65	58 58 85 65 85

Summary for Section 4.2: Calculation Examples for Wood-Framed Constructions

The worked examples (4.2-H1 to H4 and 4.2-V1 to V3) illustrate the use of the Simplified Method for calculating the apparent sound transmission class (ASTC) ratings between rooms in a building with wood-framed floor and wall assemblies.

The examples show the performance for cases with bare floor surfaces and for cases with improvements in direct and/or flanking transmission loss via specific paths due to selected changes in the surface layers of the walls and floors.

The first set of examples (4.2-H1 to 4.2-V3) concerns cases where the loadbearing walls are framed with a single row of wood studs. The second group of examples (4.2-H3 and 4.2-H4) have loadbearing walls framed with a double row of wood studs.

Separating Walls with Single Row of Wood Studs

Example 4.2-H2 for a horizontal pair of rooms separated by a single-stud wall shows improvements relative to the base case (4.2-H1) due to improving the weakest paths – the separating wall and the set of paths at the floor/wall junction.

- Improving the wall by adding a layer of gypsum board increases the Direct STC to 57 and also provides an improvement to path Fd at both sidewall junctions.
- The main improvement is adding hardwood flooring on an engineered wood topping, which increases the Flanking STC at the floor/wall junction from 50 to 62. This gives a good balance between flanking transmission at the four junctions, and between direct transmission and flanking transmission. The ASTC of 54 is near the maximum feasible with this wall construction.

Examples 4.2-V2 and 4.2-V3 for a vertical pair of rooms show the improvements relative to the base case (4.2-V1) as the floor and wall surfaces are upgraded.

- As shown in 4.2-V2, the obvious first step to increase ASTC is to improve the floor surface, in this case by adding hardwood flooring supported on an engineered wood topping, which increases the Direct STC from 51 to 66. The change to the floor surface also improves Flanking STC for paths Df at all four wall junctions by more than 10 dB, but flanking transmission still dominates the transmission in case 4.2-V2. For all these wall/floor junctions, the dominant flanking path is path Ff (wall above to wall below), with path Df a weaker secondary concern.
- Changing the surface f (walls in the room below) by mounting the gypsum board in the room below on resilient metal channels, as shown in 4.2-V3, improves the key flanking paths, so the total Flanking STC increases to 74, and the overall ASTC approaches the limit of 66 due to direct transmission through the floor.

Separating Walls with Double Row of Wood Studs

Examples 4.2-H3 to 4.2-H5 illustrate the effect of changing some details for a horizontal pair of rooms separated by a double-stud wall.

- In the base Case A in 4.2-H3, the separating wall has a Direct STC rating of 55, but the ASTC is limited to 46 by flanking transmission at the floor/wall junction due to the rigid connection provided by the continuous OSB subfloor. This junction detail has advantages for shear bracing and provides a fire block, but also causes low Flanking STC values. If the continuous subfloor is essential for structural reasons, the flanking transmission can be moderated by orienting the floor joists perpendicular to the separating wall as shown in Case B of 4.2-H3. This raises the ASTC over 47, with no changes in the details of the wall or floor assemblies.
- In Example 4.2-H4, sound absorbing material is added to the stud cavities on both sides of the separating wall, which raises the Direct STC from 55 to 58. However, adding the sound absorbing material has negligible effect on the structure-borne flanking transmission, so flanking transmission via the wall/floor junction limits the ASTC for Case A to only 46, as in the previous example. In this example, because there is absorptive material filling the stud cavities on both sides of the wall, a solid fire block at the junctions is not required, and eliminating continuity of the OSB subfloor across the junctions (as shown in Case B), if not required for structural reasons, eliminates the flanking transmission there, raising the ASTC to 57.

For larger buildings, the continuity of the subfloor (or some other solid fire block) may be necessary for structural stability. In such cases, two obvious options to improve the ASTC are to increase the Direct STC by adding more gypsum board on the separating walls, or to add a heavy topping (such as a concrete subfloor, or an extra layer of OSB, or even strip hardwood flooring) on the floor surfaces to control the dominant flanking path.

In Example 4.2-H5, the effect of adding a topping over the OSB subfloor on both sides of the separating wall is illustrated. The Direct STC is 58, as in Example 4.2-H4. However, adding the floor topping has a significant effect on the structure-borne flanking transmission, so the ASTC for Case A improves from 46 to 53 due to reduced flanking transmission via the wall/floor junction. In this example, because there is absorptive material filling the stud cavities on both sides of the wall, a solid fire block at the junctions is not required, and eliminating continuity of the OSB subfloor across the junctions (as shown in Case B) eliminates the flanking transmission there, raising the ASTC to 57, limited only by direct transmission and flanking via the side walls as in the previous example. Although the ASTC is not better than for Option B in 4.2-H4, addition of the floor topping would also benefit the sound insulation between units one-above-the-other.

Overall, these examples show the clear benefit of suitable wall and ceiling surface layers in achieving high ASTC values, and emphasize the cost/benefit of focussing improvements on the weakest path(s).

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4.3. Cold-Formed Steel-Framed Wall and Floor Assemblies

For buildings with cold-formed steel-framed⁸ (CFS-framed) walls and floor/ceiling assemblies, the calculation procedure outlined in Section 4.1 can be used in precisely the same manner as presented for wood-framed constructions in Section 4.2.

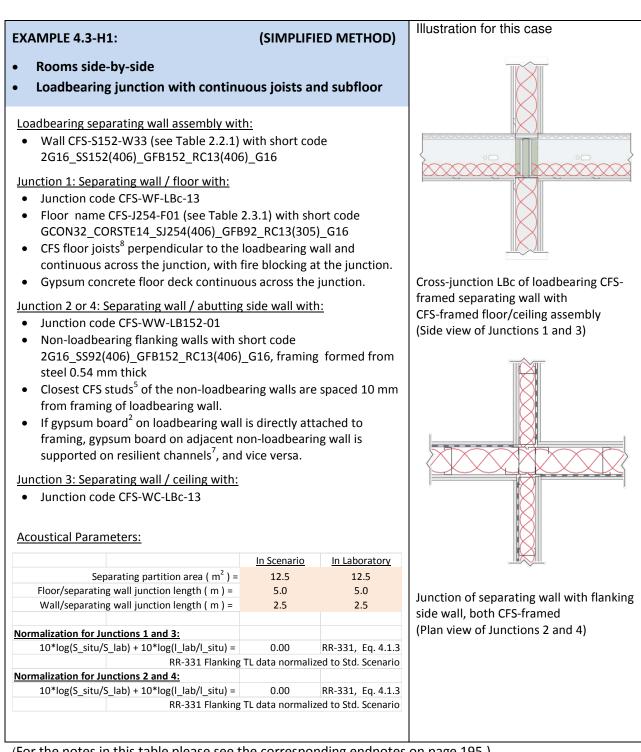
This section applies to buildings where the floors are framed with cold-formed steel joists⁸ and the walls are framed with cold-formed steel studs⁸. These joists and studs typically have a C-shaped cross-section, but other possibilities such as I-shaped floor joists are also possible. Common surfaces include gypsum board walls and ceilings, and floor decks of plywood or OSB.

As for wood-framed construction, the ASTC between the pair of adjacent rooms can be calculated using one-third octave band sound transmission data or single-number ratings derived from that data, following the steps illustrated in Figure 4.1.1 and the explanatory notes following that figure.

The calculation procedure requires two types of laboratory test data as inputs:

- 1) Sound transmission loss data determined according to ASTM E90 for direct sound transmission through the separating assembly, and
- 2) Flanking sound transmission data determined according to ISO 10848 for the pairs of flanking surfaces at each edge of the separating assembly.

More information on the direct and flanking sound insulation of cold-formed steel-framed assemblies and building systems can be found in NRC Research Report RR-337, "Apparent Sound Insulation in Cold-Formed Steel-Framed Buildings." The report provides the data for direct and flanking sound insulation for a variety of CFS-framed building configurations.



	ISO Symbo		ence	STC or ∆STC	STC or AS	STC
Separating Partition (Loadbo						
Laboratory STC for Dd	R_s,w	RR-337, Wall CFS-S152-W3		54		
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floo	or, so no ΔSTC correction)		54	
Junction 1 (Wall/Floor Junct	ion I Be with	CES_Eramed Elear)				
For Flanking Path Ff 1:		cr3-framed floor)				
		DD 227 CEC W/E LD 212		50		
Laboratory Flanking STC		RR-337, CFS-WF-LBc-13				
ΔSTC change by Lining on F	ΔR_F,w	No flooring		0		
Δ STC change by Lining on f	ΔR_f,w	No flooring	4 F F0 - M4	0	50	
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3 and Eq. 4	.1.5 50 + MA	X(0,0) + MIN(0,0)/2 + 0 =	50	
For Flanking Path Fd_1:				50		
Laboratory Flanking STC		RR-337, CFS-WF-LBc-13		53		
ΔSTC change by Lining on F	∆R_F,w	No flooring		0		
Flanking STC for path Fd_1	R_Fd,w	RR-331, Eq. 4.1.3 and Eq. 4	.1.4	53 + 0 + 0 =	53	
For Flanking Path Df_1:						
Laboratory Flanking STC		RR-337, CFS-WF-LBc-13		55		
Δ STC change by Lining on f	∆R_f,w	No flooring		0		
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4		55 + 0 + 0 =	55	_
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10/	<mark>-5 + 10^- 5.3 + 10^- 5.5) =</mark>		4
lunction 2 /I P CEC From od C	operating M	all / NLB CFS-Framed Flankin				
		all / NLB CF3-Frameu Flankin				
For Flanking Path Ff_2:		DD 337 CEC MUNULD4E3 04		02		
Laboratory Flanking STC		RR-337, CFS-WW-LB152-01	-	82		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3		82+0 =	82	
For Flanking Path Fd 2:						
Laboratory Flanking STC		RR-337, CFS-WW-LB152-01	-	76		
Flanking STC for path Fd_2	R_Fd,w	RR-331, Eq. 4.1.3		76 + 0 =	76	
For Flanking Path Df 2:						
Laboratory Flanking STC		RR-337, CFS-WW-LB152-01	-	82		
Flanking STC for path Df_2	R_Df,w	RR-331, Eq. 4.1.3		82 + 0 =	82	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-8	3.2 + 10^- 7.6 + 10^- 8.2) =		74
Junction 3 (Wall/Ceiling Jun	ction I Bc wit	h CFS-Framed Floor/Ceiling)				
For Flanking Path Ff 3:	CION LDC WI	in cro-rrained ribbly cering)				
Laboratory Flanking STC		RR-337, CFS-WC-LBc-13		65		
Flanking STC for path Ff_3	R Ff,w	RR-331, Eq. 4.1.3		65 + 0 =	65	
For Flanking Path Fd 3:	··_··,••	NN 331, LQ. 4.1.3		03+0 =	05	
Laboratory Flanking STC		RR-337, CFS-WC-LBc-13		73		
Flanking STC for path Fd_3	R Fd,w	RR-331, Eq. 4.1.3		73 + 0 =	73	
For Flanking Path Df 3:	N_FU,W	NN-331, EQ. 4.1.3		/3+0 =	/3	
Laboratory Flanking STC		RR-337, CFS-WC-LBc-13		69		
Flanking STC for path Df_3	R Df,w	RR-337, CFS-WC-LBC-13 RR-331, Eq. 4.1.3		69 + 0 =	69	
Junction 3: Flanking STC for		Subset of Eq. 4.1.3	- 10*10610/104-6	<u>5.5 + 10^- 7.3 + 10^- 6.9) =</u>	09	6
Junction 5. Fidliking STC 101		Juddet of Ly. 4.1.1	- 10 LOGIU(100			0.
Junction 4 (LB CFS-Framed S	eparating W	all / NLB CFS-Framed Flankin	ng Walls)			
All values the same as for Jui						
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff_2			82	
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2			76	
Flanking STC for path Df_4	R_Df,w	Same as for Df_2			82	
Junction 4: Flanking STC for		Subset of Eq. 4.1.1	- 10*LOG10(10^-8	3.2 + 10^- 7.6 + 10^- 8.2) =		74
						4
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1	Combir	ning 12 Flanking STC values		
Total Flanking STC (for all 4		Subset of Eq. 4.1.1 Eq. 4.1.1		rith 12 Flanking STC values	46	- - .

EXAMPLE 4.3-H2:	(SIMPLIFI	ED METHOD)	Illustration for this case
 Rooms side-by-side 			
Loadbearing junction with discont	inuous joists	and subfloor	
 Loadbearing separating wall assembly wit Wall CFS-S152-W33 (see Table 2.2.1) 2G16_SS152(406)_GFB152_RC13(406) Junction 1: Separating wall / floor with: Junction code CFS-WF-LBd-21 Floor name CFS-J254-F01 (see Table 2 GCON32_CORSTE14_SJ254(406)_GFB CFS floor joists⁸ perpendicular to the continuous across the junction. Gypsum concrete floor deck discontin Junction code CFS-WW-LB152-01 Non-loadbearing flanking walls with s 2G16_SS92(406)_GFB152_RC13(406) steel 0.54 mm thick Closest CFS studs¹ of the non-loadbear from framing of loadbearing wall. 	with short cod j_2G16 2.3.1) with sho 92_RC13(305 loadbearing w huous at the ju side wall with hort code _2G16, framinaring walls spa	ort code)_G16 vall but not unction. <u>n:</u> og formed from ced 10 mm	Cross-junction LBd of loadbearing CFS- framed separating wall with CFS-framed floor/ceiling assembly (Side view of Junctions 1 and 3)
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>Junction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u>	on-loadbearir vice versa.	ng wall is	
 framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>Junction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u> 	on-loadbearir vice versa. <u>In Scenario</u>	ng wall is <u>In Laboratory</u>	
 framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>Junction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBd-21 	on-loadbearir vice versa.	ng wall is	
 framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>Junction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u> Separating partition area (m²) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5	ng wall is In Laboratory 12.5	Junction of separating wall with flanking
 framing, gypsum board on adjacent n supported on resilient channels⁷, and Junction 3: Separating wall / ceiling with: Junction code CFS-WC-LBd-21 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0	ng wall is In Laboratory 12.5 5.0	Junction of separating wall with flanking side wall, both CFS-framed
 framing, gypsum board on adjacent n supported on resilient channels⁷, and Junction 3: Separating wall / ceiling with: Junction code CFS-WC-LBd-21 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0	ng wall is In Laboratory 12.5 5.0	Junction of separating wall with flanking
 framing, gypsum board on adjacent n supported on resilient channels⁷, and Junction 3: Separating wall / ceiling with: Junction code CFS-WC-LBd-21 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0	ng wall is In Laboratory 12.5 5.0	Junction of separating wall with flanking side wall, both CFS-framed
framing, gypsum board on adjacent n supported on resilient channels ⁷ , and <u>Junction 3: Separating wall / ceiling with:</u> • Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u> Separating partition area (m ²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = Normalization for Junctions 1 and 3: 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = RR-331 Flanking	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00	In Laboratory 12.5 5.0 2.5	Junction of separating wall with flanking side wall, both CFS-framed
framing, gypsum board on adjacent n supported on resilient channels ⁷ , and <u>Junction 3: Separating wall / ceiling with:</u> • Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u> Separating partition area (m ²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = <u>Normalization for Junctions 1 and 3:</u> 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = RR-331 Flanking <u>Normalization for Junctions 2 and 4:</u>	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00 TL data normaliz	In Laboratory 12.5 5.0 2.5 RR-331, Eq. 4.1.3 ed to Std. Scenario	Junction of separating wall with flanking side wall, both CFS-framed
framing, gypsum board on adjacent n supported on resilient channels ⁷ , and <u>Junction 3: Separating wall / ceiling with:</u> • Junction code CFS-WC-LBd-21 <u>Acoustical Parameters:</u> Separating partition area (m ²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = <u>Normalization for Junctions 1 and 3:</u> 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = RR-331 Flanking <u>Normalization for Junctions 2 and 4:</u> 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) =	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00 TL data normaliz 0.00	In Laboratory 12.5 5.0 2.5 RR-331, Eq. 4.1.3	Junction of separating wall with flanking side wall, both CFS-framed

	ISO Symbol		Reference		STC or ∆STC	STC or A	ASTO
Separating Partition (Loadbe							
Laboratory STC for Dd	R_s,w	RR-337, Wall CFS			58		
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2	2 (not a floor, so i	no ΔSTC correction)		58	
Junction 1 (Wall/Floor Junct	ion LBd with	CFS-Framed Floor	r)				
For Flanking Path Ff 1:			/				
Laboratory Flanking STC		RR-337, CFS-WF-	IBd-21		65		
Δ STC change by Lining on F	ΔR F,w	No flooring			0		
Δ STC change by Lining on f	$\Delta R_{f,w}$	No flooring			0		
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3	and Eq. 4.1 E	65 ± M/	X(0,0)) + MIN(0,0)/2 + 0 =	65	
For Flanking Path Fd_1:	K_11,W	NN-331, Eq. 4.1.3	5 anu Eq. 4.1.5	05 + 1012	((0,0)) + ((0,0)) + 0 =	05	
Laboratory Flanking STC		RR-337, CFS-WF-	104 21		62		
Δ STC change by Lining on F		No flooring	LDU-21		02		
Flanking STC for path Fd_1	ΔR_F,w R Fd,w	•	and Eq. 4.1.4		62 + 0 + 0 =	62	
	K_FU,W	RR-331, Eq. 4.1.3	5 anu Eq. 4.1.4		62 + 0 + 0 =	02	
For Flanking Path Df_1:			104 21		67		
Laboratory Flanking STC		RR-337, CFS-WF-	LDU-Z1		67		
ΔSTC change by Lining on f	$\Delta R_f, w$	No flooring) and Far 111		-	~ ¬	
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3		10*10010/104	67 + 0 + 0 = 6.5 + 10^- 6.2 + 10^- 6.7) =	67	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1	.1	- 10*LOG10(10^-t	$5.5 + 10^{-} - 6.2 + 10^{-} - 6.7) =$		5
Junction 2 (LB CFS-Framed S	eparating Wa	all / NLB CFS-Fram	ed Flanking Wal	ls)			
For Flanking Path Ff 2:			0				
Laboratory Flanking STC		RR-337, CFS-WW	/-IB152-01		82		
Flanking STC for path Ff_2	R Ff,w	RR-331, Eq. 4.1.3			82 + 0 =	82	
For Flanking Path Fd_2:	K_11,W	NN 331, Eq. 4.1.	,		8210 -	02	
Laboratory Flanking STC		RR-337, CFS-WW	/_I B152_01		76		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq. 4.1.3			76+0 =	76	
For Flanking Path Df 2:	N_10,W	NN-551, LQ. 4.1.)		7010 -	70	
Laboratory Flanking STC		RR-337, CFS-WW			82		
Flanking STC for path Df_2	R_Df,w	RR-331, Eq. 4.1.3			82 + 0 =	82	
Junction 2: Flanking STC for		Subset of Eq. 4.1		- 10*10610/10^-9	3.2 + 10^- 7.6 + 10^- 8.2) =	02	74
Junction 2. Hanking STC 101		Subset of Eq. 4.1	.1		5.2 + 10 - 7.0 + 10 - 0.2 / -		/.
Junction 3 (Wall/Ceiling June	ction LBd wit	h CFS-Framed Flo	or/Ceiling)				
For Flanking Path Ff 3:							
Laboratory Flanking STC		RR-337, CFS-WC-	LBd-21		75		
Flanking STC for path Ff_3	R_Ff,w	RR-331, Eq. 4.1.3	3		75 + 0 =	75	
For Flanking Path Fd 3:							
Laboratory Flanking STC		RR-337, CFS-WC-	LBd-21		64		
Flanking STC for path Fd_3	R_Fd,w	RR-331, Eq. 4.1.3	3			64	
For Flanking Path Df 3:							
Laboratory Flanking STC		RR-337, CFS-WC-	LBd-21		70		
Flanking STC for path Df_3	R_Df,w	RR-331, Eq. 4.1.3			70 + 0 =	70	
Junction 3: Flanking STC for		Subset of Eq. 4.1		- 10*LOG10(10/	-7.5 + 10^- 6.4 + 10^- 7) =		6
Junction 4 (LB CFS-Framed So All values the same as for Jur		all / NLB CFS-Fram	ied Flanking Wal	ls)			
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff 2				82	
Flanking STC for path Fd_4	R Fd,w	Same as for FI_2				76	
		_					
Flanking STC for path Df_4 Junction 4: Flanking STC for a	R_ Df,w all paths	Same as for Df_2 Subset of Eq. 4.1		- 10*LOG10(10^-8	8.2 + 10 [^] - 7.6 + 10 [^] - 8.2) =	82	74
Total Flanking STC (for all 4 j	junctions)	Subset of Eq. 4.1	.1	Combir	ning 12 Flanking STC values		58
ASTC due to Direct plus Flan	king Paths	Eq. 4.1.1	Com	bining Direct STC w	ith 12 Flanking STC values	55	
					U		

 Rooms side-by-side Non-loadbearing junction with continuous <u>Non-loadbearing separating wall assembly with:</u> Non-loadbearing separating walls with short conduct 2G16_SS92(406)_GFB92_RC13(406)_2G16, fract steel 0.54 mm thick Junction 1: Separating wall / floor with: Junction 1: Separating wall / floor with: Junction code CFS-WF-NLBc-31 Floor name CFS-J254-F01 (see Table 2.3.1) with GCON32_CORSTE14_SJ254(406)_GFB92_RC134 CFS floor joists⁸ parallel to the non-loadbearing Gypsum concrete floor deck continuous across Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice versiliant channels⁷, and vice versiliant channels⁷. 	ode iming formed from th short code s(305)_G16 g wall s the junction. l with: 3 (see Table 2.2.1) C13(406)_2G16 s spaced 10 mm ly attached to
 Non-loadbearing junction with continuous <u>Non-loadbearing separating wall assembly with:</u> Non-loadbearing separating walls with short co 2G16_SS92(406)_GFB92_RC13(406)_2G16, fract steel 0.54 mm thick <u>Junction 1: Separating wall / floor with:</u> Junction code CFS-WF-NLBc-31 Floor name CFS-J254-F01 (see Table 2.3.1) with GCON32_CORSTE14_SJ254(406)_GFB92_RC136 CFS floor joists⁸ parallel to the non-loadbearing Gypsum concrete floor deck continuous across <u>Junction 2 or 4: Separating wall / abutting side wall</u> Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice version 	ode iming formed from th short code s(305)_G16 g wall s the junction. l with: 3 (see Table 2.2.1) C13(406)_2G16 s spaced 10 mm ly attached to
 Non-loadbearing separating walls with short conditions and the second sec	Iming formed from th short code (305)_G16 g wall s the junction. I with: 3 (see Table 2.2.1) C13(406)_2G16 Is spaced 10 mm Iy attached to
 2G16_SS92(406)_GFB92_RC13(406)_2G16, fragsteel 0.54 mm thick Junction 1: Separating wall / floor with: Junction code CFS-WF-NLBc-31 Floor name CFS-J254-F01 (see Table 2.3.1) with GCON32_CORSTE14_SJ254(406)_GFB92_RC130 CFS floor joists⁸ parallel to the non-loadbearing Gypsum concrete floor deck continuous across Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC0 Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice versilient channels⁷ 	Iming formed from th short code (305)_G16 g wall s the junction. I with: 3 (see Table 2.2.1) C13(406)_2G16 Is spaced 10 mm Iy attached to
 Junction code CFS-WF-NLBc-31 Floor name CFS-J254-F01 (see Table 2.3.1) with GCON32_CORSTE14_SJ254(406)_GFB92_RC134 CFS floor joists⁸ parallel to the non-loadbearing Gypsum concrete floor deck continuous across Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice verse 	g(305)_G16 Implies the junction. g wall Cross-junction NLBc of non-loadbearing CFS-framed separating wall assembly with CFS-framed floor/ceiling assembly I with: with CFS-framed floor/ceiling assembly 3 (see Table 2.2.1) (Side view of Junctions 1 and 3) C13(406)_2G16 Implies the separation of Junctions 1 and 3) Iy attached to Implies the separation of Junctions 1 and 3)
 Floor name CFS-J254-F01 (see Table 2.3.1) with GCON32_CORSTE14_SJ254(406)_GFB92_RC134 CFS floor joists⁸ parallel to the non-loadbearing Gypsum concrete floor deck continuous across Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice verse 	g(305)_G16 Implies the junction. g wall Cross-junction NLBc of non-loadbearing CFS-framed separating wall assembly with CFS-framed floor/ceiling assembly I with: with CFS-framed floor/ceiling assembly 3 (see Table 2.2.1) (Side view of Junctions 1 and 3) C13(406)_2G16 Implies the separation of Junctions 1 and 3) Iy attached to Implies the separation of Junctions 1 and 3)
 Gypsum concrete floor deck continuous across Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbe supported on resilient channels⁷, and vice verse 	S the junction. CFS-framed separating wall assembly I with: with CFS-framed B (see Table 2.2.1) (Side view of Junctions 1 and 3) C13(406)_2G16 Spaced 10 mm Is spaced 10 mm Image: CFS spaced 10 mm
 Junction 2 or 4: Separating wall / abutting side wall Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice versilient channels⁷ 	I with: with CFS-framed I with: floor/ceiling assembly (Side view of Junctions 1 and 3) C13(406)_2G16 Is spaced 10 mm Iy attached to
 Junction code CFS-WW-NLB92-01 Loadbearing flanking walls Wall CFS-S152-W33 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbearing supported on resilient channels⁷, and vice versions and vice versions and vice versions. 	floor/ceiling assembly (Side view of Junctions 1 and 3) (Side view of Junctions 1 and 3) (Side view of Junctions 1 and 3) (Side view of Junctions 1 and 3)
 with short code 2G16_SS152(406)_GFB152_RC Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbe supported on resilient channels⁷, and vice verse 	y attached to
 Closest CFS studs⁵ of the non-loadbearing walls from framing of loadbearing wall. If gypsum board² on loadbearing wall is directly framing, gypsum board on adjacent non-loadbe supported on resilient channels⁷, and vice verse 	ls spaced 10 mm ly attached to
 Junction code CFS-WC-NLBc-31 	
Acoustical Parameters:	
In Scena	
Separating partition area $(m^2) = 12.5$	
Floor/separating wall junction length (m) = 5.0 Wall/separating wall junction length (m) = 2.5	5.0 2.5
	Junction of separating wall with flanking
Normalization for Junctions 1 and 3:	side wall, both CFS-framed
10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = 0.00	
RR-331 Flanking TL data nor	rmalized to Std. Scenario
Normalization for Junctions 2 and 4:	
10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = 0.00 RR-331 Flanking TL data nor	

Separating Partition (Non-Le Laboratory STC for Dd Direct STC in situ	R_s,w	F <mark>S-Framed Wall)</mark> RR-337, NLB wall 2G16_SS				
Direct STC in situ		RR-337 NI B wall 2G16 SS				
				57		
	R_Dd,w	RR-331, Eq. 4.1.2 (not a flo	or, so no Δ STC correction)		57	
unction 1 (Mall/Elear lund		h CFS-Framed Floor)				
For Flanking Path Ff 1:		CF3-Flamed Floor				
		RR-337, CFS-WF-NLBc-31		40		
Laboratory Flanking STC		-		40 0		
∆STC change by Lining on F	$\Delta R_F, w$	No flooring		0		
ΔSTC change by Lining on f	ΔR_f,w	No flooring		•	40	
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3 and Eq. 4	40 + MA	X(0,0)) + MIN(0,0)/2 + 0 =	40	
For Flanking Path Fd_1:				10		
Laboratory Flanking STC		RR-337, CFS-WF-NLBc-31		49		
ΔSTC change by Lining on F	ΔR_F,w	No flooring		0		
Flanking STC for path Fd_1	R_Fd,w	RR-331, Eq. 4.1.3 and Eq. 4	1.1.4	49 + 0 + 0 =	49	
For Flanking Path Df_1:						
Laboratory Flanking STC		RR-337, CFS-WF-NLBc-31		50		
Δ STC change by Lining on f	ΔR_f,w	No flooring		0		
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4		50 + 0 + 0 =		
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10	<u>^-4 + 10^- 4.9 + 10^- 5) =</u>		3
	Companyation of Mark		14/-11-1			
Junction 2 (NLB CFS-Framed For Flanking Path Ff 2:	Separating v	vall / LB CFS-Framed Flankir	ng vvalis)			
				24		
Laboratory Flanking STC	D 51	RR-337, CFS-WW-NLB92-03	1	84		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3		84 + 0 =	84	
For Flanking Path Fd 2:						
Laboratory Flanking STC		RR-337, CFS-WW-NLB92-02	1	82		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq. 4.1.3		82 + 0 =	82	
For Flanking Path Df_2:						
Laboratory Flanking STC		RR-337, CFS-WW-NLB92-02	1	81		
Flanking STC for path Df_2	R_Df,w	RR-331, Eq. 4.1.3		81+0 =	-	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-8.	.4 + 10^- 8.2 + 10^- 8.1) =		7
Junction 3 (Wall/Ceiling Jun		ith CEE Framed Floor/Cailin				
For Flanking Path Ff 3:		ith Cr3-rramed rioor/Cellin	81			
Laboratory Flanking STC		RR-337, CFS-WC-NLBc-31		67		
Flanking STC for path Ff_3	R Ff,w			67 + 0 =	67	
	К_ГI,W	RR-331, Eq. 4.1.3		07 + 0 =	07	
For Flanking Path Fd_3:		DD 227 CEC M/C MUD- 24		65		
Laboratory Flanking STC		RR-337, CFS-WC-NLBc-31		65		
Flanking STC for path Fd_3	R_ Fd,w	RR-331, Eq. 4.1.3		65 + 0 =	65	
For Flanking Path Df 3:				74		
Laboratory Flanking STC		RR-337, CFS-WC-NLBc-31		71		
Flanking STC for path Df_3	R_Df,w	RR-331, Eq. 4.1.3		71+0 =	71	-
Junction 3: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6.	.7 + 10^- 6.5 + 10^- 7.1) =		6
Junction 4 (NLB CFS-Framed	Separating M	Vall / LB CES-Framed Flankir	ng Walls)			
All values the same as for Ju			is waits			
Flanking STC for path Ff_4	R Ff,w	Same as for Ff 2			84	
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd 2			82	
Flanking STC for path Df_4	R Df,w	Same as for Df_2			81	
Junction 4: Flanking STC for		Subset of Eq. 4.1.1	- 10*LOG10(10^-8	.4 + 10^- 8.2 + 10^- 8.1) =	01	7
						-
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1	Combini	ing 12 Flanking STC values		3
ASTC due to Direct plus Flan	king Paths	Eq. 4.1.1	Combining Direct STC wi	th 12 Flanking STC values	39	

XAMPLE 4.3-H4:	(SIMPLIFI	ED METHOD)	Illustration for this case	
Rooms side-by-side				
Non-loadbearing junction with dis	continuous	subfloor		
Ion-loadbearing separating wall assembly	<u>with:</u>			
• Non-loadbearing separating wall with	Non-loadbearing separating wall with short code			
2G16_SS92(406)_GFB92_RC13(406)_2	2G16_SS92(406)_GFB92_RC13(406)_2G16, framing formed from			
steel 0.54 mm thick				
unction 1. Constating wall / floor with				
unction 1: Separating wall / floor with:				
Junction code CFS-WF-NLBd-41				
Floor name CFS-J254-F01 (see Table 2	-			
GCON32_CORSTE14_SJ254(406)_GFB				
• CFS floor joists ⁸ parallel to the non-loa	-		Cross-junction NLBd of the non-	
 Gypsum concrete floor deck discontin 	uous at the ju	unction.	loadbearing CFS-framed separating wa	
unction 2 or 4: Separating wall / abutting	side wall with	า:	with CFS-framed floor/ceiling assembl	
 Junction code CFS-WW-NLB92-01 			(Side view of Junctions 1 and 3)	
Loadbearing flanking walls Wall CFS-S	152-W33 (see	e Table 2.2.1)		
with short code 2G16_SS152(406)_GF				
 Closest CFS studs⁵ of the non-loadbea 				
from framing of loadbearing wall.	0			
• If gypsum board ² on loadbearing wall	is directly att	ached to		
framing, gypsum board on adjacent no				
supported on resilient channels ⁷ , and		0		
 unction 3: Separating wall / ceiling with: Junction code CFS-WC-NLBd-41 				
• Junction code CFS-WC-NLB0-41				
Acoustical Parameters:				
	In Scenario	In Laboratory		
Separating partition area (m^2) =	12.5	12.5		
Floor/separating wall junction length (m) =	5.0	5.0		
Wall/separating wall junction length (m) =	2.5	2.5	Junction of separating wall with flanking side wall, both CFS-framed	
ormalization for Junctions 1 and 3:			(Plan view of Junctions 2 and 4)	
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3		
	TL data normaliz	ed to Std. Scenario		
ormalization for Junctions 2 and 4:				
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3		
RR-331 Flanking	TL data normaliz	ed to Std. Scenario		

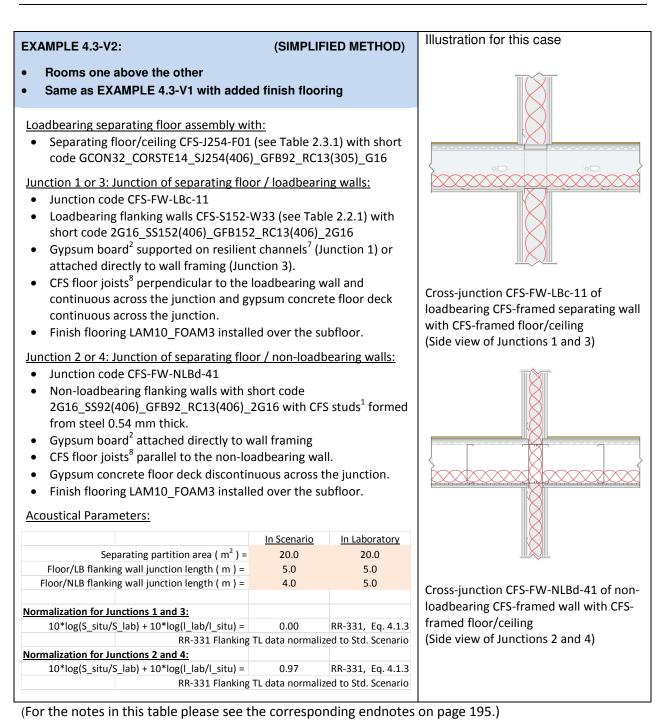
	ISO Symbo		STC or A	STC STC or A	ASTC
Separating Partition (Non-L					
Laboratory STC for Dd	R_s,w	RR-337, NLB wall 2G16_SS92(4			
Direct STC in situ	R_Dd,w	RR-331, Eq. 4.1.2 (not a floor,	so no Δ STC correction)	57	
Junction 1 (Wall/Floor Junc	tion NI Bd wi	th CES-Eramed Floor)			
For Flanking Path Ff 1:					
Laboratory Flanking STC		RR-337, CFS-WF-NLBd-41	60		
Δ STC change by Lining on F	ΔR F,w	No flooring	0		
		0	_ 0		
ΔSTC change by Lining on f	∆R_f,w	No flooring		.0)/2 + 0 = 60	
Flanking STC for path Ff_1	R_Ff,w	RR-331, Eq. 4.1.3 and Eq. 4.1.	60 + MAX(0,0)) + MIN(0	,0)/2+0= 00	
For Flanking Path Fd_1:		DD 227 CEC ME NUDI 44			
Laboratory Flanking STC		RR-337, CFS-WF-NLBd-41	_ 63		
ΔSTC change by Lining on F	ΔR_F,w	No flooring	0		
Flanking STC for path Fd_1	R_ Fd,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	6	3 + 0 + 0 = 63	
For Flanking Path Df_1:					
Laboratory Flanking STC		RR-337, CFS-WF-NLBd-41	67		
ΔSTC change by Lining on f	∆R_f,w	No flooring	0		
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4		7+0+0 = 67	
Junction 1: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-6 + 10^- 6.3 + 1	10^- 6.7) =	58
For Flanking Path Ff 2:	Separating	Vall / LB CFS-Framed Flanking V	valis)		
Laboratory Flanking STC	D 5(RR-337, CFS-WW-NLB92-01	84		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3		84 + 0 = 84	
For Flanking Path Fd 2:					
Laboratory Flanking STC		RR-337, CFS-WW-NLB92-01	82		
Flanking STC for path Fd_2	R_Fd,w	RR-331, Eq. 4.1.3		82 + 0 = 82	
For Flanking Path Df_2:					
Laboratory Flanking STC		RR-337, CFS-WW-NLB92-01	81		
Flanking STC for path Df_2	R_ Df,w	RR-331, Eq. 4.1.3		81 + 0 = 81	
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1	- 10*LOG10(10^-8.4 + 10^- 8.2 + 1	10^- 8.1) =	7
Junction 2 (Wall/Coiling Jun	ction NI Bd y	vith CFS-Framed Floor/Ceiling)			
For Flanking Path Ff 3:		in cr3-rialled riddi/ ceiling)			
Laboratory Flanking STC		RR-337, CFS-WC-NLBd-41	77		
Flanking STC for path Ff_3	R Ff,w	RR-331, Eq. 4.1.3	,,	77 + 0 = 77	,
For Flanking Path Fd 3:	N_11,W	MN-331, LY. 4.1.3		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Laboratory Flanking STC		RR-337, CFS-WC-NLBd-41	70		
Flanking STC for path Fd_3	R Fd,w		/0	70 + 0 = 70	
For Flanking Path Df 3:	n_ru,w	RR-331, Eq. 4.1.3		/U+U = /U	
		DD 227 CES MIC NUDA 44	69		
Laboratory Flanking STC Flanking STC for path Df 3		RR-337, CFS-WC-NLBd-41	69	60 + 0 - 60	
Junction 3: Flanking STC for	R_Df,w	RR-331, Eq. 4.1.3 Subset of Eq. 4.1.1	- 10*LOG10(10^-7.7 + 10^- 7 + 1	69 + 0 = 69	
Junction 5: Flanking STC for		Subset OI Eq. 4.1.1	- 10 10010(10^-/./ + 10^- / + .	10 - 0.9] =	6
Junction 4 (NLB CFS-Framed	Separating	Vall / LB CFS-Framed Flanking V	Valls)		
All values the same as for Ju					
Flanking STC for path Ff_4	R_Ff,w	Same as for Ff 2		84	Ļ
Flanking STC for path Fd_4	R Fd,w	Same as for Fd 2		82	
Flanking STC for path Df_4	R Df,w	Same as for Df_2		81	
		Subset of Eq. 4.1.1	- 10*LOG10(10^-8.4 + 10^- 8.2 + 1		7
Junction 4: Flanking STC for					
Junction 4: Flanking STC for	junctions)	Subset of Eq. 4.1.1	Combining 12 Flanking	STC values	57
Junction 4: Flanking STC for Total Flanking STC (for all 4 ASTC due to Direct plus Flar		Subset of Eq. 4.1.1	Combining 12 Flanking		57

XAMPLE 4.3-H5:	(SIMPLIFI	ED METHOD)	Illustration for this case
Rooms side-by-side Loadbearing junction with continu Same as EXAMPLE 4.3-H1 with add	-		
 oadbearing separating wall assembly wit Wall CFS-S152-W33 (see Table 2.2.1) 2G16_SS152(406)_GFB152_RC13(406) 			
 unction 1: Separating wall / floor with: Junction code CFS-WF-LBc-13 Floor name CFS-J254-F01 (see Table 3) GCON32_CORSTE14_SJ254(406)_GFB CFS floor joists⁸ perpendicular to the 	92_RC13(305)_G16	
 continuous across the junction with fi Gypsum concrete floor deck continuo Finish flooring LAM10_FOAM3 install unction 2 or 4: Separating wall / abutting 	Cross-junction LBc of loadbearing CFS- framed separating wall with CFS-frame floor/ceiling assembly (Side view of Junctions 1 and 3)		
 Junction code CFS-WW-LB152-01 Non-loadbearing flanking walls with s 2G16_SS92(406)_GFB152_RC13(406) steel 0.54 mm thick Closest CFS studs⁵ of the non-loadbear 	hort code _G16, framing	formed from	
 from framing of loadbearing wall. If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and 	on-loadbearir		
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 	on-loadbearir		
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 	on-loadbearir		Junction of separating wall with flankir
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 	on-loadbearir vice versa.	ig wall is	Junction of separating wall with flankir side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 	on-loadbearir vice versa. <u>In Scenario</u>	ıg wall is <u>In Laboratory</u>	
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5	ng wall is In Laboratory 12.5	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0	ng wall is In Laboratory 12.5 5.0	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = ormalization for Junctions 1 and 3: 	on-loadbearin vice versa. <u>In Scenario</u> 12.5 5.0 2.5	In Laboratory 12.5 5.0 2.5	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = 0 ormalization for Junctions 1 and 3: 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00	In Laboratory 12.5 5.0 2.5 RR-331, Eq. 4.1.3	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and <u>unction 3: Separating wall / ceiling with:</u> Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = 0 ormalization for Junctions 1 and 3: 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = RR-331 Flanking 	on-loadbearir vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00	In Laboratory 12.5 5.0 2.5	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and unction 3: Separating wall / ceiling with: Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = RR-331 Flanking lormalization for Junctions 2 and 4: 	on-loadbearin vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00 TL data normaliz	In Laboratory 12.5 5.0 2.5 RR-331, Eq. 4.1.3 ed to Std. Scenario	side wall, both CFS-framed
 If gypsum board² on loadbearing wall framing, gypsum board on adjacent n supported on resilient channels⁷, and lunction 3: Separating wall / ceiling with: Junction code CFS-WC-LBc-13 Acoustical Parameters: Separating partition area (m²) = Floor/separating wall junction length (m) = Wall/separating wall junction length (m) = Internalization for Junctions 1 and 3: 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = RR-331 Flanking Iormalization for Junctions 2 and 4: 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = Internalization for Junctions 2 and 4: 10*log(S_situ/S_lab) + 10*log(I_lab/I_situ) = Internalization for Junctions 2 and 4: Internalization for Junction	on-loadbearin vice versa. <u>In Scenario</u> 12.5 5.0 2.5 0.00 TL data normaliz 0.00	In Laboratory 12.5 5.0 2.5 RR-331, Eq. 4.1.3	side wall, both CFS-framed

	ISO Symbol		Reference		STC or Δ STC	STC or A	ASTC
Separating Partition (Loadb							
Laboratory STC for Dd	R_s,w		CFS-S152-W33		54		
Direct STC in situ	R_Dd,w	RR-331, Eq.	4.1.2 (not a floor, so	no ΔSIC correction)	i	54	
Junction 1 (Wall/Floor Junc	tion I Bc with	CES-Framed F	loor)				
For Flanking Path Ff 1:							
Laboratory Flanking STC		RR-337, CFS-	-W/F-I Bc-13		50		
Δ STC change by Lining on F	ΔR_F,w	-	, flooringLAM10 FO		2		
Δ STC change by Lining on f	$\Delta R_{F,W}$, flooringLAM10_FO		2		
Flanking STC for path Ff_1	R_Ff,w		4.1.3 and Eq. 4.1.5		X(2,2)) + MIN(2,2)/2 + 0 =	53	
For Flanking Path Fd_1:	N_11,W	лл-ээт, еq.	4.1.5 anu Eq. 4.1.5	50 + IVIA	(2,2) + With $(2,2)/2 + 0 =$	55	
Laboratory Flanking STC		RR-337, CFS-			53		
	ΔR F,w				2		
ΔSTC change by Lining on F	_ /		, flooringLAM10_FO	AIVIS ON GCONSZ			
Flanking STC for path Fd_1	R_ Fd,w	KR-331, Eq.	4.1.3 and Eq. 4.1.4		53 + 2 + 0 =	55	
For Flanking Path Df_1:		DD 227 CFC	ME ID - 40				
Laboratory Flanking STC	10.0	RR-337, CFS-			55		
Δ STC change by Lining on f	ΔR_f,w		, flooringLAM10_FO	AM3 on GCON32	2		
Flanking STC for path Df_1	R_Df,w		4.1.3 and Eq. 4.1.4	40*10040/404	55 + 2 + 0 =		
Junction 1: Flanking STC for	all paths	Subset of Eq	. 4.1.1	- 10*LOG10(10^-5	. <u>3 + 10^- 5.5 + 10^- 5.7) =</u>		50
Junction 2 (LB CFS-Framed S	oparating Wa		Framed Flanking Wa	lle)			
For Flanking Path Ff 2:		II / INLD CF3-I	rianieu rianking vva	1157			
Laboratory Flanking STC		DD 227 CES	-WW-LB152-01		82		
, .						07	
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq.	4.1.3		82 + 0 =	82	
For Flanking Path Fd_2:		DD 227 CFC			76		
Laboratory Flanking STC	5.51		-WW-LB152-01		76		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq.	4.1.3		76 + 0 =	76	
For Flanking Path Df_2:							
Laboratory Flanking STC			-WW-LB152-01		82		
Flanking STC for path Df_2	R_Df,w	RR-331, Eq.		40*10040/404	82 + 0 =	-	
Junction 2: Flanking STC for		Subset of Eq	. 4.1.1	- 10*LOG10(10^-8	<mark>.2 + 10^- 7.6 + 10^- 8.2) =</mark>		74
Junction 3 (Wall/Ceiling Jun	ction LBc with	CFS-Framed	Floor/Ceiling)				
For Flanking Path Ff 3:							
Laboratory Flanking STC		RR-337, CFS-	-WC-LBc-13		65		
Flanking STC for path Ff_3	R Ff,w	RR-331, Eq.			65 + 0 =	65	
For Flanking Path Fd 3:	,						
Laboratory Flanking STC		RR-337, CFS-	-WC-LBc-13		73		
Flanking STC for path Fd_3	R Fd,w	RR-331, Eq.			73 + 0 =	73	
For Flanking Path Df 3:					, , , , , , , , , , , , , , , , , , , ,	,,,,	
Laboratory Flanking STC		RR-337, CFS-	-WC-LBc-13		69		
Flanking STC for path Df_3	R_Df,w	RR-331, Eq.			69 + 0 =	69	
Junction 3: Flanking STC for		Subset of Eq		- 10*LOG10(10^-6	0.5 + 10^- 7.3 + 10^- 6.9) =		63
Junction 4 (LB CFS-Framed S		II / NLB CFS-I	Framed Flanking Wa	lls)			
All values the same as for Ju							
Flanking STC for path Ff_4	R_Ff,w	Same as for	Ff_2			82	
Flanking STC for path Fd_4	R_ Fd,w	Same as for	Fd_2			76	
Flanking STC for path Df_4	R_Df,w	Same as for	Df_2			82	
Junction 4: Flanking STC for	all paths	Subset of Eq	. 4.1.1	- 10*LOG10(10^-8	.2 + 10^- 7.6 + 10^- 8.2) =		74
Total Flanking STC (for all 4	junctions)	Subset of Eq	. 4.1.1	Combin	ing 12 Flanking STC values		50
ASTC due to Direct plus Flan	king Datha	Eq. 4.1.1		Interiment Diverse CTC	ith 12 Flanking STC values	48	

 Separating floor/ceiling CFS-J254-F01 (se code GCON32_CORSTE14_SJ254(406)_GI Junction 1 or 3: Separating floor / loadbearing Junction code CFS-FW-LBc-11 	FB92_RC13						
 Separating floor/ceiling CFS-J254-F01 (se code GCON32_CORSTE14_SJ254(406)_GI Junction 1 or 3: Separating floor / loadbearing Junction code CFS-FW-LBc-11 	FB92_RC13						
• Junction code CFS-FW-LBc-11	g walls wit	 Loadbearing separating floor assembly with: Separating floor/ceiling CFS-J254-F01 (see Table 2.3.1) with short code GCON32_CORSTE14_SJ254(406)_GFB92_RC13(305)_G16 					
 Loadbearing flanking walls CFS-S152-W33 short code 2G16_SS152(406)_GFB152_R4 Gypsum board² supported on resilient ch attached directly to wall framing (Junctio CFS floor joists⁸ perpendicular to the load continuous across the junction and gypsu continuous across the junction. Junction 2 or 4: Separating floor / non-loadbea Junction code CFS-FW-NLBd-41 Non-loadbearing flanking walls with shor 2G16_SS92(406)_GFB92_RC13(406)_2G1 from steel 0.54 mm thick. Gypsum board² attached directly to wall CFS floor joists⁸ parallel to the non-loadbe Gypsum concrete floor deck discontinuot 	3 (see Tabl C13(406)_ hannels ⁷ (Ju on 3). dbearing w um concre earing wall t code L6 with CFS framing bearing wa	le 2.2.1) with _2G16 unction 1) or wall and ete floor deck <u>ls with:</u> S studs ¹ formed	Cross-junction CFS-FW-LBc-11 of loadbearing CFS-framed separating wa with CFS-framed floor/ceiling (Side view of Junctions 1 and 3)				
Acoustical Parameters:							
1	n Scenario	In Laboratory					
Separating partition area (m^2) =	20.0	20.0					
Floor/LB flanking wall junction length (m) =	5.0	5.0					
Floor/NLB flanking wall junction length (m) =	4.0	5.0					
Normalization for Junctions 1 and 3:							
10*log(S_situ/S_lab) + 10*log(I_lab/l_situ) =	0.00	RR-331, Eq. 4.1.3					
RR-331 Flanking TL d			Cross-junction CFS-FW-NLBd-41 of non				
Normalization for Junctions 2 and 4:			loadbearing CFS-framed wall with CFS-				
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.97	RR-331, Eq. 4.1.3	framed floor/ceiling				

	ISO Symbol	Reference	STC or Δ STC	STC or ASTC
Separating Partition (CFS-Fr				
Laboratory STC for Dd	R_s,w	RR-337, floor CFS-J254-F01	57	
ΔSTC change by Lining on D	ΔR_D,w	No finish flooring	0	
Direct STC in situ	R Dd,w	RR-331, Eq. 4.1.2	57+0 =	57
			0,7,4	•••
Junction 1 (Floor/Wall Junct	tion LBc of CE	S-Framed Floor with Loadbearing Wall)		
For Flanking Path Ff 1:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11r, wall gypsum board on RC	67	
Flanking STC for path Ff 1	R Ff,w	RR-331, Eq. 4.1.3	67+0 =	67
For Flanking Path Fd 1:	N_11,W	III 331, Eq. 4.1.3	0710 -	07
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11r, wall gypsum board on RC	71	
Flanking STC for path Fd_1	R_ Fd,w	RR-331, Eq. 4.1.3	71+0 =	71
For Flanking Path Df 1:	N_10,W	NR-331, Eq. 4.1.3	/1+0 =	/1
		PR 227 CES EW LBs 11r wall gunsum beard on BC	70	
Laboratory Flanking STC	ΔR D,w	RR-337, CFS-FW-LBc-11r, wall gypsum board on RC No finish flooring	72 0	
ΔSTC change by Lining on D			-	70
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	72 + 0 + 0 = .7 + 10^- 7.1 + 10^- 7.2) =	72
Junction 1: Flanking STC for		Subset of Eq. 4.1.1 - 10*LOG10(10^-6	.7 + 10 ² - 7.1 + 10 ² - 7.2) =	0.
	cion NLBd of C	FS-Framed Floor with Non-loadbearing Wall)		
For Flanking Path Ff_2:			70	
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3	72 + 1 =	73
For Flanking Path Fd_2:				
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq. 4.1.3	76 + 1 =	77
For Flanking Path Df 2:				
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct		
ΔSTC change by Lining on D	ΔR_D,w	No finish flooring	0	
Flanking STC for path Df_2	R_ Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	74 + 0 + 1 =	75
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1 - 10*LOG10(10^-7	.3 + 10^- 7.7 + 10^- 7.5) =	70
	tion LBc of CF	6-Framed Floor with Loadbearing Wall)		
For Flanking Path Ff_3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	67	
Flanking STC for path Ff_3	R_Ff,w	RR-331, Eq. 4.1.3	67 + 0 =	67
For Flanking Path Fd_3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	69	
Flanking STC for path Fd_3	R_ Fd,w	RR-331, Eq. 4.1.3	69+0 =	69
For Flanking Path Df 3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	65	
ΔSTC change by Lining on D	ΔR_D,w	No finish flooring	0	
Flanking STC for path Df_3	R Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	65 + 0 + 0 =	65
Junction 3: Flanking STC for			.7 + 10^- 6.9 + 10^- 6.5) =	62
Junction 4 (Floor/Wall Junc	tion NLBd of C	FS-Framed Floor with Non-loadbearing Wall)		
All values the same as for Ju				
Flanking STC for path Ff_4	R Ff,w	Same as for Ff 2		73
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2		77
	R Df,w	Same as for Df_2		75
			2 404 77 404 75	70
Flanking STC for path Df_4		Subset of Eq. 4.1.1 - 10*LOG10/10^-7	$3 + 10^{-1} / 1 + 10^{-1} / 51 =$	
Flanking STC for path Df_4 Junction 4: Flanking STC for		Subset of Eq. 4.1.1 - 10*LOG10(10^-7	.3 + 10^- /./ + 10^- /.5) =	70
Flanking STC for path Df_4 Junction 4: Flanking STC for	all paths			
Flanking STC for path Df_4	all paths junctions)	Subset of Eq. 4.1.1 Combin	ing 12 Flanking STC values	59 55



	ISO Symbol	Reference	STC or Δ STC	STC or ASTC
Separating Partition (CFS-Fr				
Laboratory STC for Dd	R_s,w	RR-337, floor CFS-J254-F01	57	
ΔSTC change by Lining on D	ΔR_D,w	ΔTL-CFS-F02, flooringLAM10_FOAM3 on GCON32	2	
Direct STC in situ	R Dd,w	RR-331, Eq. 4.1.2	57 + 2 =	59
	,			
Junction 1 (Floor/Wall Junct	tion LBc of CE	-Framed Floor with Loadbearing Wall)		
For Flanking Path Ff 1:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11r, wall gypsum board on RC	67	
Flanking STC for path Ff 1	R Ff,w	RR-331, Eq. 4.1.3	67 + 0 =	67
For Flanking Path Fd 1:	<u> </u>	NN 331, Eq. 4.1.3	07 10 -	07
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11r, wall gypsum board on RC	71	
Flanking STC for path Fd_1	R_ Fd,w	RR-331, Eq. 4.1.3	71+0 =	71
For Flanking Path Df 1:	K_FU,W	KK-551, EQ. 4.1.5	71+0 -	/1
		PR 227 CES EW LBs 11r wall gunsum board on PC	72	
Laboratory Flanking STC	ΔR D,w	RR-337, CFS-FW-LBc-11r, wall gypsum board on RC	72 2	
ΔSTC change by Lining on D		ΔTL-CFS-F02, flooringLAM10_FOAM3 on GCON32		74
Flanking STC for path Df_1	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	72 + 2 + 0 = 5.7 + 10^- 7.1 + 10^- 7.4) =	74
Junction 1: Flanking STC for		Subset of Eq. 4.1.1 - 10*LOG10(10^-6	$5.7 + 10^{-5} - 7.1 + 10^{-5} - 7.4 =$	65
	ion NLBd of C	FS-Framed Floor with Non-loadbearing Wall)		
For Flanking Path Ff_2:			70	
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct		
Flanking STC for path Ff_2	R_Ff,w	RR-331, Eq. 4.1.3	72 + 1 =	73
For Flanking Path Fd_2:				
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct		
Flanking STC for path Fd_2	R_ Fd,w	RR-331, Eq. 4.1.3	76 + 1 =	77
For Flanking Path Df 2:				
Laboratory Flanking STC		RR-337, CFS-FW-NLBd-41d, wall gypsum board direct	74	
ΔSTC change by Lining on D	ΔR_D,w	ΔTL-CFS-F02, flooring LAM10_FOAM3 on GCON32	2	
Flanking STC for path Df_2	R_ Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	74 + 2 + 1 =	77
Junction 2: Flanking STC for	all paths	Subset of Eq. 4.1.1 - 10*LOG10(10^-7	7.3 + 10^- 7.7 + 10^- 7.7) =	70
	tion LBc of CFS	-Framed Floor with Loadbearing Wall)		
For Flanking Path Ff_3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	67	
Flanking STC for path Ff_3	R_Ff,w	RR-331, Eq. 4.1.3	67 + 0 =	67
For Flanking Path Fd_3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	69	
Flanking STC for path Fd_3	R_ Fd,w	RR-331, Eq. 4.1.3	69 + 0 =	69
For Flanking Path Df_3:				
Laboratory Flanking STC		RR-337, CFS-FW-LBc-11d, wall gypsum board direct	65	
ΔSTC change by Lining on D	ΔR_D,w	ΔTL-CFS-F02, flooringLAM10_FOAM3 on GCON32	2	
Flanking STC for path Df_3	R_Df,w	RR-331, Eq. 4.1.3 and Eq. 4.1.4	65 + 2 + 0 =	67
Junction 3: Flanking STC for			5.7 + 10^- 6.9 + 10^- 6.7) =	
			,	
Junction 4 (Floor/Wall Junc	ion NLBd of C	FS-Framed Floor with Non-loadbearing Wall)		
All values the same as for Ju				
Flanking STC for path Ff_4	R Ff,w	Same as for Ff 2		73
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd 2		77
Flanking STC for path Df_4	R Df,w	Same as for Df_2		77
Junction 4: Flanking STC for			7.3 + 10^- 7.7 + 10^- 7.7) =	7(
	an pario	10 L0010(10 /		
Total Flanking STC (for all 4	junctions)	Subset of Eq. 4.1.1 Combin	ning 12 Flanking STC values	60
ASTC due to Direct plus Flan	king Dathe	Eq. 4.1.1 Combining Direct STC w	ith 12 Flenking CTC	
ASTC due to Direct blus Flan	iking Paths	Combining Direct STC w	ith 12 Flanking STC values	56

Summary for Section 4.3: Calculation Examples for CFS-Framed Constructions

The worked examples (4.3-H1 to H5 and 4.3-V1 to V2) illustrate the use of the Simplified Method for calculating the apparent sound transmission class (ASTC) ratings between rooms in a building with CFS-framed floor and wall assemblies.

The examples show the performance for five cases with "bare" gypsum concrete floor surfaces (Examples 4.3-H1 to H4 and 4.3-V1) and for two cases with improvements in direct and/or flanking transmission loss via specific paths due to the addition of typical finish flooring.

For a horizontal room pair, comparing pairs of examples shows the effect of changing key details of the wall/floor junctions:

- Comparing Example H1 vs. Example H2 shows the change from ASTC 46 to ASTC 55 when a break is introduced in the gypsum concrete floor surface, for the case with joists perpendicular to a loadbearing separating wall.
- Comparing Example H3 vs. Example H4 shows the even larger change from ASTC 39 to ASTC 54 when a break is introduced in the gypsum concrete floor surface, for the case with floor joists parallel to a non-loadbearing separating wall.

From these examples, it is clear that a break in the continuous gypsum concrete surface significantly reduces flanking transmission, which raises the ASTC rating from the unacceptable range to a level which should satisfy a majority of occupants.

Adding laminate flooring to the bare floor surface (Example H5 vs. H1) only slightly increases the Flanking STC ratings for the floor paths, but as the floor paths limit the ASTC rating for the are configuration this small improvement is enough to raise the ASTC rating from 46 to 48, above the minimum requirement of ASTC 47 in the 2015 edition of the National Building Code of Canada.

For a vertical room pair, Example 4.3-V1 shows that the sound transmitted through all 12 flanking paths combined is slightly less than the sound transmitted via the separating floor assembly (Total Flanking STC rating of 59 vs. Direct STC rating of 57). Hence, the ASTC rating of 55 is dominated by the STC rating of the separating floor. Adding finished flooring in Example V2 increases the Direct STC by 2 points to STC 59, and the ASTC increases to 56.

5. Buildings with Hybrid Construction

This chapter presents extended procedures to deal with cases that combine two types of construction.

In each case, the calculation procedures of ISO 15712-1 can be applied to one or more of the constructions, and those values can be combined with test results of flanking sound transmission (measured according to ISO 10848) or direct sound transmission through a separating wall or floor assembly (measured according to ASTM E90) to predict the apparent sound transmission loss and ASTC rating between a pair of adjacent rooms.

5.1. Concrete Floors with Lightweight Framed Walls and Heavy Façades

Building constructions of concrete floors combined with lightweight framed interior wall assemblies are identified in ISO 15712-1 as a special concern for which the standard approach may not give accurate results. To ensure a reasonably conservative approach, this Guide recommends the approach of Annex C of ISO 15712-1 to the calculation procedure for these systems.

As noted in Annex C and Section 4.2.4 of ISO 15712-1, if a surface of one room is part of a larger heavy structural element, and some of the bounding junctions are formed by light elements such as steel-framed or wood-framed wall assemblies, the response of the heavy element is influenced not only by the elements in the room but by the response of the extended structure. This affects both concrete floors (cast-in-place or precast) and other adjoining heavy elements such as concrete or masonry supporting walls which are "divided" by lightweight partitions. In this situation, the excitation of the floor by airborne sound in one room can create nearly uniform vibration levels over the entire extended floor surface. Similarly, for a heavy concrete or masonry wall intersecting lightweight wall assemblies, the vibration attenuation at the intersection is small, so the heavy wall responds over an extended surface bounded by junctions with other heavy elements.

To obtain a conservative estimate of the in-situ losses, Annex C of ISO 15712-1 recommends a modified approach to calculating the in-situ loss of heavy extended floor or wall assemblies when evaluating the transmission at junctions with lightweight walls. The Standard recommends calculating the in-situ loss both for the section of floor in one room, and for the extended floor area bounded by rigid junctions with heavy elements. The larger of these two losses should then be used in the loss calculations which otherwise follow the same procedures shown in Chapter 2 of this Guide.

In addition, there are a number of changes for dealing with in-situ estimates of direct transmission through a lightweight wall assembly and flanking transmission at the intersection of lightweight wall assemblies. These affect the calculations at several stages.

To illustrate the resulting changes in the calculation process, this Guide uses an **Extended Scenario**, which is presented in Figure 5.1, and has the following features:

- The Extended Scenario comprises a floor area considerably larger than that of the Standard Scenario, with lightweight partitions dividing the area into two pairs of adjacent rooms with a corridor between. In Figure 5.1, the floor area would be the entire floor with an area of approximately 96 m².
- Each pair of adjacent rooms has the same dimensions as the Standard Scenario used elsewhere in the Guide.
- At the perimeter are T-junctions of the floor with the façade walls above and below. In the case of heavy concrete or masonry façade walls, the junctions will be rigid junctions which means firmly fastened so that vibration can readily be transmitted between assemblies.

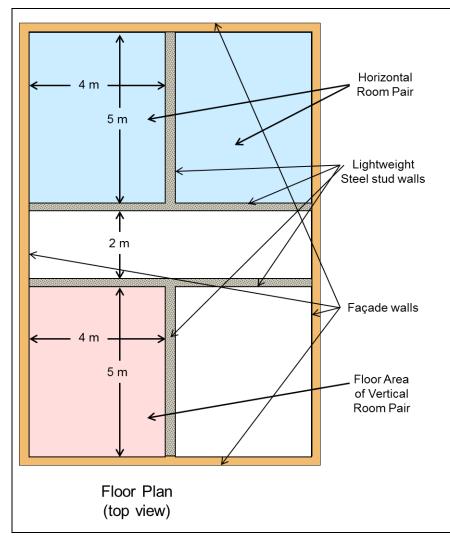


Figure 5.1: Extended Scenario for the case with concrete structural floors and rigid junctions with a facade wall at the perimeter of the floor. Lightweight framed interior walls divide the interior space into two pairs of adjacent rooms with a corridor between. The room pairs have the same dimensions as in the Standard Scenario used elsewhere in the Guide. The rooms above and below have the same floor plan. The floor area for the horizontal pair is shaded blue. The floor area for the vertical pair is shaded pink.

For Examples 5.1.1 to 5.1.3, the façade wall is of heavy concrete or masonry. For Examples 5.2.1 and 5.2.2, the façade wall is a much lighter glass curtain wall.

<u>Calculation Steps for Horizontal Pair of Rooms with a Heavy Façade Wall of Concrete or</u> <u>Concrete Masonry:</u>

- For the direct sound transmission through the separating assembly of non-loadbearing wood or steel studs⁵, the calculation process is simple, because the high internal losses of the wall mask any effect due to edge losses. The in-situ direct transmission loss is equal to the laboratory transmission loss, and the equivalent absorption length for subsequent junction calculations is taken as equal to the partition area (see Section 4.2.2 of ISO 15712-1).
- 2. The lightweight framed walls in these examples could use either loadbearing or non-loadbearing studs. Normally the walls would use non-loadbearing studs, but the same calculation can be used in either case. The top and bottom tracks of the wall framing are mechanically attached to the concrete floor/ceiling assemblies above and below. For non-loadbearing steel studs, it is common practice to use a nested pair of tracks at the top of the wall assembly, with the studs attached to the lower member of the pair. The attachment may also include a fire stop. These variations could reduce the floor/wall and ceiling/wall flanking sound transmission slightly (i.e. give a higher Flanking

STC values), but the calculations here ignore this effect because the rather weak coupling from the concrete floor/ceiling to the lightweight framed walls results in Flanking STC values of 80 or higher for these paths even for loadbearing studs, so they have negligible effect on the overall ASTC rating. However, the wall/wall flanking sound transmission paths may be affected by differences between loadbearing or non-loadbearing studs.

- 3. For flanking sound transmission at the cross-junctions of the concrete floor assembly with lightweight wood-framed or steel-framed separating walls (Junctions 1 and 3 in the examples in this chapter) the calculation steps are unchanged from those in Chapter 2, except that the vibration reduction index values are calculated according to Eq. E.7 of ISO 15712-1, and the losses for the concrete slab are calculated differently. In-situ edge losses for the concrete floor or wall assemblies are calculated for the junctions at the perimeter of the extended surface where it connects with the heavyweight façade, using Equations C.1 and C.2 of Annex C of ISO 15712-1 and the K_{ij} values from Annex E of ISO 15712-1. This controls the calculated total loss factors for the concrete floor surfaces in each room, and hence the in-situ sound transmission loss and junction attenuation values. (The calculated loss values are given in "Acoustical Parameters" below the specimen description in each of the worked examples.)
- 4. For flanking sound transmission at the T-junction with the concrete block perimeter wall (Junction 2 in the examples in this chapter), the calculation steps are unchanged from the discussion in Chapter 2 except that the in-situ edge loss is calculated for the junctions at the perimeter of the extended surface area for the concrete block surfaces. This change affects the calculated loss factors for the concrete block flanking surfaces in each room, and hence the in-situ transmission loss and junction attenuation values.
- 5. For flanking sound transmission at the T-junction of the steel stud separating wall with the nonloadbearing steel stud corridor wall, the calculation uses values of the flanking transmission loss determined by measurements according to ISO 10848, as explained in Chapter 4.
- 6. The Direct TL and Flanking TL values are combined as described in Section 1.4 of this Guide.

<u>Calculation Steps for Vertical Pair of Rooms with a Heavy Façade Wall of Concrete or</u> <u>Concrete Masonry:</u>

- For the separating concrete floor assembly, the calculation steps are unchanged from the discussion in Chapter 2 except that the in-situ edge loss is calculated for the junctions at the perimeter of the extended surface area where it connects with the heavyweight façade using Equations C.1 and C.2 of Annex C of ISO 15712-1 and the K_{ij} values from Annex E of ISO 15712-1. This change affects the calculated total loss, and hence the in-situ transmission loss and the in-situ attenuation at junctions with flanking walls at the four edges of the room.
- 2. For flanking sound transmission at the cross-junctions with the lightweight framed wall assemblies (Junctions 1 and 4 in the examples in this chapter), the calculation process is simpler. The in-situ transmission loss of the wall is equal to the laboratory transmission loss, and the equivalent

absorption length for subsequent junction calculations is taken as numerically equal to the partition area as required in Section 4.2.2 of ISO 15712-1. The K_{ij} values are calculated using the appropriate mass ratios in equation E.7 in Annex E of ISO 15712-1. The final stages of determining the flanking transmission loss follow the process presented in Chapter 2.

- 3. For flanking sound transmission at the T-junction with the concrete block perimeter wall (Junctions 2 and 3 in the examples in this chapter), the calculation steps are unchanged from those in Chapter 2 except that the in-situ edge loss of the concrete block perimeter wall is calculated for the junctions at the perimeter of the extended surface area (see Annex C of ISO 15712-1). This change affects the calculated total loss for the concrete block surfaces in each room, and hence the in-situ transmission loss for the masonry surfaces and the resulting junction attenuation. (The calculated loss values are given in "Acoustical Parameters" below the specimen description in each of the worked example.)
- 4. The Direct TL and Flanking TL values are combined as described in Section 1.4 of this Guide.

Worked Examples

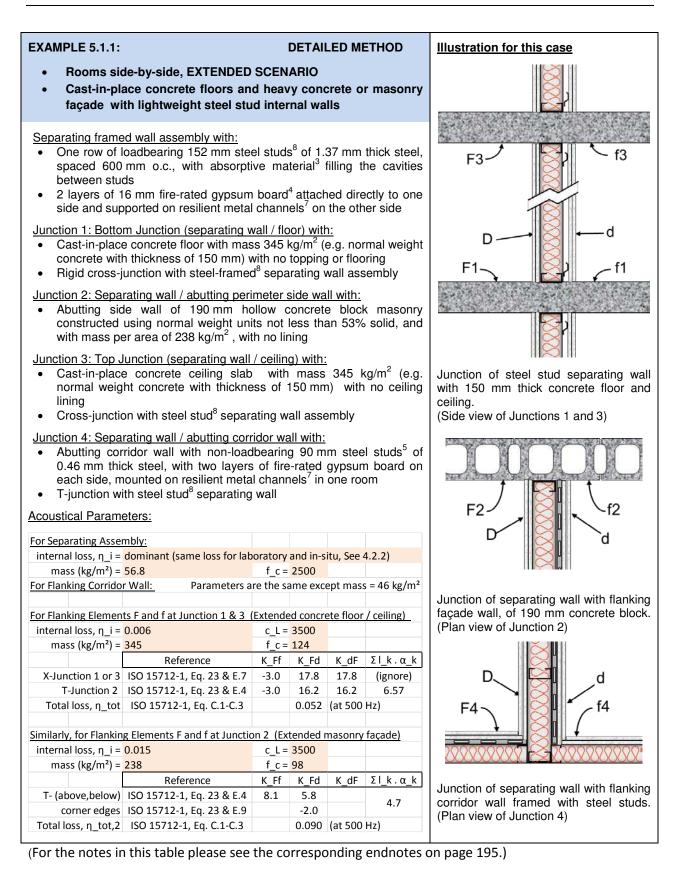
The worked examples present all the pertinent physical characteristics of the assemblies and junctions, including references for the source of the laboratory test data. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide but also use extensions conforming to the Extended Scenario shown in Figure 5.1 for the calculation of the loss factors of the heavyweight walls or floors.

The calculations in the examples use a combination of the steps presented near the beginning of Chapters 2 and 4, as discussed in this Section. The changes in the calculations and the results due to the use of the extended response of the concrete and masonry assemblies can be seen by comparing the worked examples 5.1.1 and 5.1.3 in this Section with their counterparts 2.1.1 and 2.1.2 in Section 2.1.

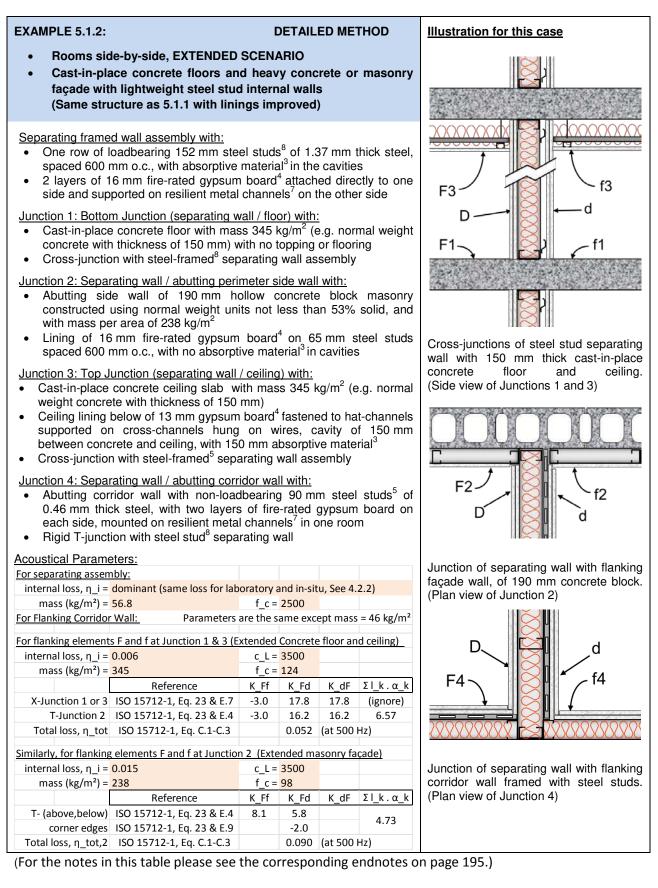
Under the single heading "STC, ASTC, etc.", the examples present single-number ratings (each calculated from a set of one-third octave band data according to the rules for STC ratings defined in ASTM E413) to provide a consistent set of summary measures at each stage of the calculation:

- STC values for laboratory sound transmission loss data for wall or floor assemblies,
- In-situ STC values for the calculated in-situ transmission loss of wall and floor assemblies,
- Direct STC for in-situ transmission through the separating assembly including linings,
- Flanking STC values calculated for each flanking transmission path at each junction,
- Apparent STC (ASTC) for the combination of direct and flanking transmission via all paths.

The "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.



	ISO Symbol	Reference	125	250	630	1250	2500	5000	STC or AS
Separating Partition (Steel stud wall)									
Sound Transmission Loss (TL)	R D,lab	RR-337, CFS-S152-W33	37	51	56	63	57	64	58
Leakage or Airborne Flanking	_ /	Sealed & Blocked	0	0	0	0	0	0	
Direct TL in-situ	R_D,situ	4.2.2: Equal to lab. TL	37	51	56	63	57	64	58
Junction 1 (Cross-junction, steel stud									
Sound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s	0.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR_F1	No Lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f1	No Lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.176	0.122	0.084	0.057	0.038	0.025	
TL in-situ for F1	R_F1,situ	ISO 15712-1, Eq. 19	44.0	46.8	54.7	63.6	71.8	79.9	58
TL in-situ for f1	R_f1,situ	ISO 15712-1, Eq. 19	44.0	46.8	54.7	63.6	71.8	79.9	58
Junction J1 - Coupling									
Velocity Level Difference for Ff	D_v,Ff_1,situ	ISO 15712-1, Eq. 21, 22	3.1	3.2	3.3	3.5	3.8	4.1	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
Velocity Level Difference for Df	D_v,Df_1,situ	ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	45	48	56	65	74	82	59
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a	60	70	77	86	89	90	80
Flanking TL for Path Df 1	R Df	ISO 15712-1, Eq. 25a	60	70	77	86	89	90	80
Junction 1: Flanking STC for all paths	_		- 10*L	OG10(1	10^-5.9	+ 10^-	8 + 10	^- 8) =	
e						1			
Junction 2 (T-Junction, steel stud sepa	arating wall /	190 mm concrete block flanking walls)							
Sound Transmission Loss, F2 or f2	R F2,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5		0.191	0.119		0.042	0.024	
Change by Lining on source side	ΔR_F2	No Lining ,	0	0	0	0	0	0	
Change by Lining on receive side	$\Delta R f2$	No Lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3					0.021		
TL in-situ for F2		ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5		64.5	53
TL in-situ for f2	R_f2,situ	ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5	61.0	64.5	53
Junction J2 - Coupling	,								
Velocity Level Difference for Ff	D v.Ff 2.situ	ISO 15712-1, Eq. 21, 22	5.4	5.5	5.7	6.0	6.3	6.8	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	21.9	22.9	24.0	25.2	26.3	27.6	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	21.9	22.9	24.0	25.2	26.3	27.6	
Flanking Transmission Loss - Path data						2012	20.0	27.0	
Flanking TL for Path Ff 2	R Ff	ISO 15712-1, Eq. 25a	46	49	55	60	68	72	59
Flanking TL for Path Fd 2	R_Fd	ISO 15712-1, Eq. 25a	61	70	76	84	86	90	80
Flanking TL for Path Df 2	R Df	ISO 15712-1, Eq. 25a	61	70	76	84	86	90	80
Junction 2: Flanking STC for all paths	к_Di	130 137 12-1, Eq. 23a					8 + 10		80
Junction 2. Flanking STC for all paths	1		- 10 L		101-5.5	+ 10	0 + 10		
Junction 3 (Cross-junction, steel stud	separating wa	all / 150 mm concrete ceilings)							
All input values the same as for Junction									
Flanking TL for Path Ff 3	R_Ff	ISO 15712-1, Eq. 25a	45	48	56	65	74	82	59
Flanking TL for Path Fd_3	R_Fd	ISO 15712-1, Eq. 25a	60	70	77	86	89	90	80
Flanking TL for Path Df 3	R_Df	ISO 15712-1, Eq. 25a	60	70	77	86	89	90	80
Junction 3: Flanking STC for all paths						50	33		00
Junction 4 (T-junction, steel stud sepa	rating wall /	steel stud flanking corridor walls)							
Flanking Transmission Loss - Measure									
Flanking TL for Path Ff_4		RR-337, CFS-WW-LB152-01	63	79	85	90	78	90	82
Flanking TL for Path Fd_4	R Fd	RR-337, CFS-WW-LB152-01	67	75	85	90	78	90	82
Flanking TL for Path Df 4	R_Df	RR-337, CFS-WW-LB152-01	65	68	77	81	72	83	76
Junction 4: Flanking STC for all paths	K_DI		10*LOG1						
ore for an paths			2001	5120		- 0.2		,=	
Total Flanking (for all 4 junctions)									
i i i i i i i i i i i i i i i i i i i									
ASTC due to Direct plus Flanking Path	c	RR-331, Eq. 1.4	35	43	50	57	56	63	53
Bill and a second se		=/ = -1. =				-			



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	ISO Symbol	Reference	125	250	630	1250	2500	5000	STC or AS
Separating Partition (Steel stud wall)					1				
Sound Transmission Loss (TL)	R D,lab	RR-337, CFS-S152-W33	37	51	56	63	57	64	58
Leakage or Airborne Flanking		Sealed & Blocked	0	0	0	0	0	0	
Direct TL in-situ	R_D,situ	4.2.2: Equal to lab. TL	37	51	56	63	57	64	58
Junction 1 (Cross-junction, steel stud									
Sound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s				0.205			
Change by Lining on source side	ΔR_F1	No Lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_f1	No Lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.057			- 0
TL in-situ for F1		ISO 15712-1, Eq. 19	44.0	46.8	54.7	63.6	71.8	79.9	58
TL in-situ for f1	R_f1,situ	ISO 15712-1, Eq. 19	44.0	46.8	54.7	63.6	71.8	79.9	58
Junction J1 - Coupling	D 50 4 11		2.4	~ ~	2.2	2.5	2.0		
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	3.1	3.2	3.3	3.5	3.8	4.1	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
Flanking Transmission Loss - Path data			45	40			74		50
Flanking TL for Path Ff_1 Flanking TL for Path Fd 1	R_Ff	ISO 15712-1, Eq. 25a	45	48 70	56	65	74 89	82 90	59 80
Flanking TL for Path Df_1	R_Fd	ISO 15712-1, Eq. 25a	60 60	70	77 77	86 86	89	90	80
Junction 1: Flanking STC for all paths	R_Df	ISO 15712-1, Eq. 25a				80 + 10^-			80
Junction 1. Flanking STC for all paths	1		- 10 L	0010(.	10 5.5	+ 10	0 + 10	-0)-	
lunction 2 (T-lunction steel stud sena	rating wall /	190 mm concrete block flanking walls)							
Flanking Element F2 and f2: Input Date									
Sound Transmission Loss. F2 or f2	R F2,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5				0.072			75
Change by Lining on source side	$\Delta R F2$	ΔTL-BLK190(NW)-61, SS65 G13	-4	8	14	15	13	16	
Change by Lining on receive side	$\Delta R f2$	ΔTL-BLK190(NW)-61, SS65_G13	-4	8	14	15	13	16	
Structural Reverb. Time in-situ		ISO 15712-1, Eq. C.1-C.3				0.032			
TL in-situ for F2		ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5	61.0	64.5	53
TL in-situ for f2		ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5	61.0	64.5	53
Junction J2 - Coupling									
Velocity Level Difference for Ff	D v,Ff 2,situ	ISO 15712-1, Eq. 21, 22	5.4	5.5	5.7	6.0	6.3	6.8	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	21.9	22.9	24.0	25.2	26.3	27.6	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	21.9	22.9	24.0	25.2	26.3	27.6	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff 2	R Ff	ISO 15712-1, Eq. 25a	38	65	83	90	90	90	62
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq. 25a	57	78	90	90	90	90	81
Flanking TL for Path Df_2	R_Df	ISO 15712-1, Eq. 25a	57	78	90	90	90	90	81
Junction 2: Flanking STC for all paths	_	-	10*LOG1	.0(10^-	6.2 + 1	0^- 8.1	+ 10^-	8.1)=	
Junction 3 (Cross-junction, steel stud :	separating wa	all / 150 mm concrete ceilings)							
All values the same as for Junction 1, e	xcept linings								
Change by Lining on source side	ΔR_F3	RR-333 , ΔTL-CON150-C01	8	21	24	24	22	19	
Change by Lining on receive side	∆R_f3	RR-333, ΔTL-CON150-C01	8	21	24	24	22	19	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff_3	R_Ff	ISO 15712-1, Eq. 25a	61	90	90	90	90	90	85
Flanking TL for Path Fd_3	R_Fd	ISO 15712-1, Eq. 25a	68	90	90	90	90	90	89
Flanking TL for Path Df_3	R_Df	ISO 15712-1, Eq. 25a	68	90	90	90	90	90	89
Junction 3: Flanking STC for all paths	1								
Junction 4 (T-junction, steel stud sepa	<u> </u>	steel stud flanking corridor walls)							
Flanking Transmission Loss - Measured									
Flanking TL for Path Ff_4	R_Ff	RR-337, CFS-WW-LB152-01	63	79	85	90	78	90	82
Flanking TL for Path Fd_4	R_Fd	RR-337, CFS-WW-LB152-01	67	75	85	90	78	90	82
Flanking TL for Path Df_4	R_Df	RR-337, CFS-WW-LB152-01	65	68	77	81	72	83	76
Junction 4: Flanking STC for all paths			10*LOG1	.0(10^-	8.2 + 1	<u>U^- 8.2</u>	+ 10^-	/.6)=	
Total Flanking (for all 4 junctions)									

EXAMPLE 5.1.3:

DETAILED METHOD

- Rooms one-above-the-other, EXTENDED SCENARIO
- Cast-in-place concrete separating floor and heavy concrete or masonry façade with lightweight steel stud internal flanking walls

Separating floor/ceiling assembly with:

 Cast-in-place concrete floor with mass 345 kg/m² (e.g. normal weight concrete with thickness of 150 mm) with no topping / flooring on top, or ceiling lining below

Junction 1: Cross-junction of separating floor / flanking walls with:

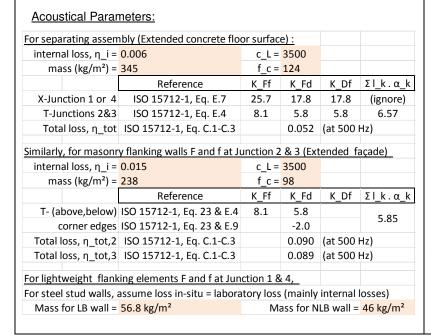
- Walls above and below the floor have one row of loadbearing 152 mm steel studs⁸ of 1.37 mm thick steel, spaced 600 mm o.c., with absorptive material³ filling the cavities between studs
- 2 layers of 16 mm fire-rated gypsum board⁴ attached directly to one side and supported on resilient metal channels⁷ on the other side (total weight per unit area of 56.8 kg/m²)

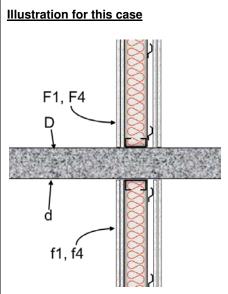
Junction 2 and 3: T-Junction of separating floor / flanking wall with:

- Rigid mortared T-junctions with perimeter concrete block façade wall assemblies
- Wall above and below floor of one wythe of 190 mm hollow concrete block masonry constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m², with no lining

Junction 4: Junction of separating floor / corridor wall with:

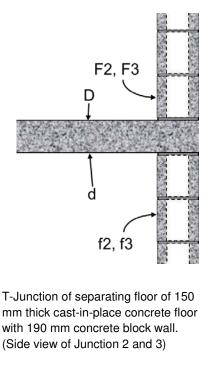
 Non-loadbearing 90 mm steel studs⁵ of 0.46 mm thick steel, with two layers of fire-rated gypsum board attached directly to one side and supported on resilient metal channels⁷ on the other side (total weight per unit area of 46 kg/m²)





Cross-junction of separating floor of 150 mm thick cast-in-place concrete with steel stud wall with 152 mm LB or 90 mm NLB studs.

(Side view of Junctions 1 or 4)



	ISO Symbol	Reference	125	250	630	1250	2500	5000	STC or AS
Separating Partition (150 mm concret									
Sound Transmission Loss (TL)	R_D,lab	RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s	0.44	0.37	0.25	0.21	0.15	0.08	
Change by Lining on source side	ΔR_D	No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_d	No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.176			0.057			
Leakage or Airborne Flanking		Sealed & Blocked	0	0	0	0	0	0	
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	44	47	55	64	72	80	58
lunction 1 (Cross-junction, 150 mm co	oncrete floor	/ steel stud flanking walls)							
Sound Transmission Loss, F1 or f1		RR-337, CFS-WW-LB152-01, Dd(LB)	38	50	58	61	55	63	58
FL in-situ for F1		4.2.2: Equal to lab. TL	38	50	58	61	55	63	58
TL in-situ for f1	_	4.2.2: Equal to lab. TL	38	50	58	61	55	63	58
Iunction J1 - Coupling	N_11,510	4.2.2. Equal to lab. TE	50	50	50	01	55	05	50
Velocity Level Difference for Ff	D v Ff 1 situ	ISO 15712-1, Eq. 21, 22	31.7	30.7	29.7	28.7	27.7	26.7	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
/elocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	20.9	21.9	23.0	24.0	25.2	26.3	
Flanking Transmission Loss - Path data		150 157 12-1, Eq. 21, 22	20.5	21.5	23.0	24.0	25.2	20.5	
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	72	83	90	90	85	90	88
Flanking TL for Path Fd 1	R Fd	ISO 15712-1, Eq. 25a	63	71	80	88	90	90	82
Flanking TL for Path Df 1	R_Pu R_Df	ISO 15712-1, Eq. 25a	63	71	80	88	90	90	82
lunction 1: Flanking STC for all paths	N_01		10*LOG1						02
		r / 190 mm concrete block flanking wall	ls)						
lanking Element F2 and f2: Input Dat	-								-
Sound Transmission Loss, F2 or f2	R_F2,lab	RR-334, NRC Mean BLK190(NW)	35	38	44	50	58	62	49
Structural Reverberation Time	T_s,lab	Estimate Eq. C.5	0.299		0.119	0.072		0.024	
Change by Lining on source side	ΔR_F2	No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	∆R_f2	No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T_s,situ	ISO 15712-1, Eq. C.1-C.3	0.105	0.072	0.049	0.032	0.021	0.013	
TL in-situ for F2	R_F2,situ	ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5	61.0	64.5	53
ΓL in-situ for f2	R_f2,situ	ISO 15712-1, Eq. 19	39.5	42.2	47.9	53.5	61.0	64.5	53
Junction J2 - Coupling									
Velocity Level Difference for Ff		ISO 15712-1, Eq. 21, 22	14.4	14.5	14.7	15.0	15.4	15.9	
Velocity Level Difference for Fd	D_v,Fd_2,situ	ISO 15712-1, Eq. 21, 22	12.5	12.6	12.8	13.0	13.3	13.7	
Velocity Level Difference for Df	D_v,Df_2,situ	ISO 15712-1, Eq. 21, 22	12.5	12.6	12.8	13.0	13.3	13.7	
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff_2	R_Ff	ISO 15712-1, Eq. 25a	57	60	66	71	79	83	71
Flanking TL for Path Fd_2	R_Fd	ISO 15712-1, Eq. 25a	56	59	66	73	81	87	70
Flanking TL for Path Df 2	R Df	ISO 15712-1, Eq. 25a	56	59	66	73	81	87	70
Junction 2: Flanking STC for all paths	_		- 10*L	OG10(1	10^-7.1	+ 10^-	7 + 10	^-7)=	
		ng / 190 mm concrete block flanking want nt junction length changes Flanking TL	alls)						
Flanking Transmission Loss - Path data									
Flanking TL for Path Ff 3	R_Ff	ISO 15712-1, Eq. 25a	56	59	65	70	78	82	70
Flanking TL for Path Fd_3		ISO 15712-1, Eq. 25a	55	58	65	72	80	86	69
Flanking TL for Path Df 3	R_Df	ISO 15712-1, Eq. 25a	55	58	65	72	80	86	69
unction 3: Flanking STC for all paths	R_DI		- 10*LO						
			10 10	510(10		0 0.5	- 10	0.0 /	
	ncrete floor	/ steel stud flanking walls)							
lunction 4 (Cross-junction, 150 mm co	Shcrete Hoor								
		th change Flanking TL							
ike Junction 1, but different studs and		th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB)	35.0	50.0	62.0	69.0	60.0	62.0	58
ike Junction 1, but different studs and Sound Transmission Loss, F4 or f4	l junction leng		35.0 35.0	50.0 50.0	<mark>62.0</mark> 62.0	69.0 69.0	60.0 60.0	62.0 62.0	58 58
ike Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4	l junction leng	RR-337, CFS-WW-NLB90-01, Dd(NLB)							
Iunction 4 (Cross-junction, 150mm co Like Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data	R_F4,situ R_f4,situ	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL	35.0	50.0	62.0	69.0	60.0	62.0	58
Like Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4	R_F4,situ R_f4,situ	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL	35.0	50.0	62.0	69.0	60.0	62.0	58
Like Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data	I junction leng R_F4,situ R_f4,situ	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL	35.0 35.0	50.0 50.0	62.0 62.0	69.0 69.0	60.0 60.0	62.0 62.0	58 58
ike Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4	R_F4,situ R_f4,situ R_f4,situ R_Ff	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a	35.0 35.0 71	50.0 50.0 85	62.0 62.0 90	69.0 69.0 90	60.0 60.0 90	62.0 62.0 90	58 58 89
ike Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data Flanking TL for Path Ff_4	I junction leng R_F4,situ R_f4,situ R_Ff R_Ff	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	35.0 35.0 71 63	50.0 50.0 85 73 73	62.0 62.0 90 84 84	69.0 69.0 90 90 90	60.0 60.0 90 90 90	62.0 62.0 90 90 90	58 58 89 84
Like Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4 Flanking TL Flanking STC for all paths	I junction leng R_F4,situ R_f4,situ R_Ff R_Ff	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	35.0 35.0 71 63 63	50.0 50.0 85 73 73	62.0 62.0 90 84 84	69.0 69.0 90 90 90	60.0 60.0 90 90 90	62.0 62.0 90 90 90	58 58 89 84 84
Like Junction 1, but different studs and Sound Transmission Loss, F4 or f4 FL in-situ for F4 FL in-situ for f4 Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Fd_4 Flanking TL for Path Df_4	I junction leng R_F4,situ R_f4,situ R_Ff R_Ff	RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	35.0 35.0 71 63 63	50.0 50.0 85 73 73	62.0 62.0 90 84 84	69.0 69.0 90 90 90	60.0 60.0 90 90 90	62.0 62.0 90 90 90	58 58 89 84 84

Summary for Section 5.1: Calculation Examples for Concrete Floors with Lightweight Framed Walls and Heavy Façades

Examples 5.1.1 to 5.1.3 show calculation examples for the Extended Scenario in a building with heavy concrete or concrete masonry façade walls, steel-framed wall assemblies dividing the interior area, and heavy concrete structural floor assemblies above and below.

Example 5.1.1 shows the calculation for a horizontal pair of rooms separated by a steel-framed wall with laboratory STC rating of 58. The ASTC rating of this configuration is 52. If the separating wall is replaced by a wall with laboratory STC rating of 50, the ASTC rating drops to 47. The overall Flanking STC of 53 is dominated by the flanking sound transmission paths Ff at Junctions 1, 2 and 3 (floor-floor, wall-wall and ceiling-ceiling paths via the extended heavy concrete and masonry assemblies). Even if a separating wall with a higher STC rating was used, the dominance of these flanking paths would limit the ASTC rating to a maximum value of 52.

Example 5.1.2 shows that it is not possible to substantially increase the ASTC rating by applying linings on the ceiling and the masonry façade wall. Despite the use of linings or a separating wall with a higher STC rating, the ASTC rating will not exceed a value of 55 unless the floor is improved with an effective lining and/or a thicker concrete floor is used.

Example 5.1.3 shows the calculation for a vertical pair of rooms separated by a bare cast-in-place concrete floor assembly of 150 mm thickness. Due to the extended response of the floor, the in-situ STC rating for the separating floor is 58, which is significantly higher than the corresponding laboratory STC rating of 53 or the in-situ STC rating of 55 in Example 2.1.2. The combined flanking sound transmission for the four junctions has a Flanking STC rating of 62, even with bare concrete block for two wall surfaces in each room. This means that the contribution from flanking sound transmission only marginally reduces the ASTC to 56. Adding a ceiling and linings to the concrete block walls could increase the ASTC to well over 60.

Overall, these examples emphasize the need to focus improvements on the weakest path(s). A high ASTC rating between rooms requires both a separating partitions with a high STC rating and suitable linings over the heavy concrete or masonry surfaces.

5.2. Concrete Floors with Lightweight Framed Walls and Lightweight Façades

<u>Calculation Steps for Horizontal or Vertical Pair of Rooms with Lightweight Glass</u> <u>Curtain Wall Facade:</u>

The following set of examples show the change in performance when a lightweight façade is substituted for the heavy concrete or masonry façade of Examples 5.1.1 to 5.1.3.

- 1. Most steps of the calculation (and the comments about details of the steel framing) are unchanged from those presented at the beginning of Section 5.1 using the Extended Scenario.
- 2. For the concrete floor assembly, the calculation of the loss factor differs from what is presented in Section 5.1 because the substitution of the lighter curtain wall façade for the heavy masonry façade of Examples 5.1.1 to 5.1.3 significantly reduces the losses to the coupled façade assemblies. In addition, losses due to the lightweight interior stud partitions become significant. These losses due to the lightweight walls were ignored in Examples 5.1.1 to 5.1.3 when performing the loss calculations for the floor coupled to the heavyweight façade since they were insignificant compared with the losses due to the rigid connection between the floor/ceiling assembly and the heavyweight façade. The inclusion of the lightweight interior stud partitions appears to be consistent with Annex C of ISO 15712-1 for the calculation of the loss factors. The total losses for the concrete floor/ceiling calculated for this section therefore differ from those calculated in Section 5.1 for the examples with heavyweight façades.
- 3. The calculation of the losses to connected assemblies depends on the critical frequency of the attached assemblies. For the gypsum board interior partitions used in the examples, the critical frequency is taken as 2500 Hz, as evident from the measured transmission loss curves. For the curtain walls used in the examples, the mean of the critical frequencies for the two types of glass in the tested curtain wall is used (1425 Hz).
- 4. For flanking sound transmission via the curtain wall façade surfaces, the calculation is greatly simplified relative to that for a heavy concrete or masonry façade. The flanking transmission loss can be taken directly from the values of D_{n,f} measured according to ISO 10848, with conversion to flanking transmission loss and re-normalization according to Equation 4.1.3 of this Guide.

The data used in the examples for glass curtain wall assemblies are from the *ACOUBAT* software developed at the Centre Scientifique et Technique du Bâtiment (CSTB) in France. The glass curtain wall has aluminum frame elements and double glazing with 8 mm glass on one face and laminated glass (two layers of 5 mm glass with elastomeric interlayer) on the other face. The air cavity depth between the panes is 18 ± 2 mm.

The data are presented in Table 5.2.1. The data were measured using the procedures of ISO 10140 and ISO 10848-3 and are used here, with permission, to illustrate the effect of such a lightweight façade on the calculations of ISO 15712-1.

	R _w etc.	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4 kHz
Sound Reduction Index, R	44	30.9	33.5	41.0	43.9	49.8	54.6
Horizontal Normalized Flanking Level Difference, D _{n,f} for junction length of 2.5 m	52	42.3	46.8	51.8	46.9	59.1	59.4
Vertical Normalized Flanking Level Difference, D _{n,f} for junction length of 4.8 m	47	36.1	35.5	42.4	50.0	50.4	53.4

Table 5.2.1: Experimental data for flanking sound transmission by a curtain wall assembly.

-THESE DATA SHOULD NOT BE TREATED AS GENERIC-

Significant variation is to be expected between proprietary products from different manufacturers, and data for the intended curtain wall system should always be used.

For proprietary constructions such as a curtain walls, the manufacturer's installation instructions normally include specification of an appropriate fire stop assembly to prevent the spread of smoke and fire via the junction where the lightweight façade assembly meets the walls and floor/ceiling of the building structure. For acoustical testing of flanking sound transmission by a curtain wall or other lightweight façade assembly, the installation should include the specified fire stop, to ensure that any sound transmission through this connecting element is included in the measured result.

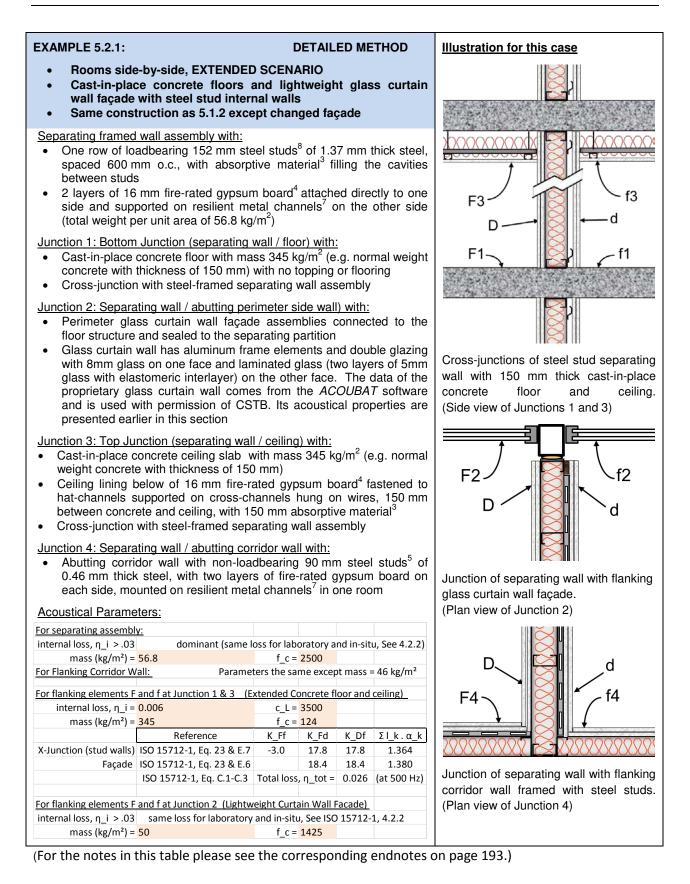
Worked Examples

The worked examples present all the pertinent physical characteristics of the assemblies and junctions, including references for the source of the laboratory test data. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide but also use extensions conforming to the Extended Scenario shown in Figure 5.1 for the calculation of the loss factor of the floor and ceiling. The calculations use a combination of the steps presented near the beginning of Chapters 2 and 4, as discussed in this Section.

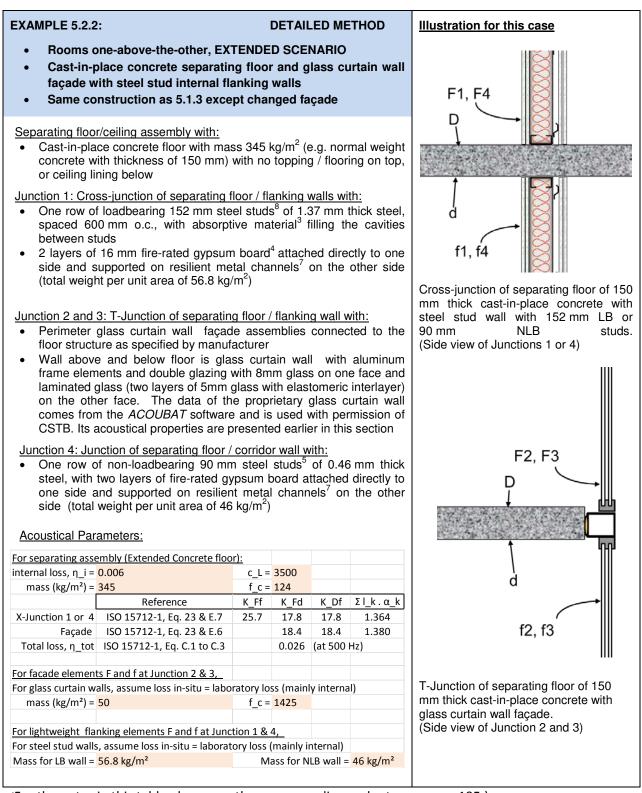
Under the single heading "STC, ASTC, etc.", the examples present single-number ratings (each calculated from a set of one-third octave band data according to the rules for STC ratings defined in ASTM E413) to provide a consistent set of summary measures at each stage of the calculation:

- STC values for laboratory sound transmission loss data for wall or floor assemblies,
- ΔSTC values for change in STC due to adding the lining to the specified wall or floor assembly,
- In-situ STC values for the calculated in-situ transmission loss of wall and floor assemblies,
- Direct STC for in-situ transmission through the separating assembly including linings,
- Flanking STC values calculated for each flanking transmission path at each junction,
- Apparent STC (ASTC) for the combination of direct and flanking transmission via all paths.

The "References" column presents the source of input data (combining the NRC report number and identifier for each laboratory test result or derived result), or identifies applicable equations and sections of ISO 15712-1 at each stage of the calculation. Symbols and subscripts identifying the corresponding variable in ISO 15712-1 are given in the adjacent column.



	ISO Symbol	Reference	125	250	630	1250	2500	5000	STC or AST
Separating Partition (Loadbearing ste	,								
Sound Transmission Loss (TL)		RR-337,CFS-S152-W33	37	51	56	63	57	64	58
Leakage or Airborne Flanking	N_D,185	Sealed & Blocked	0	0	0	0	0	04	50
Direct TL in-situ	R_D,situ	4.2.2: Equal to lab. TL	37	51	56	63	57	64	58
	N_D,Situ				50		57		50
unction 1 (Cross-junction, steel stud	separating wa	all / 150 mm concrete floors)							
Sound Transmission Loss, F1 or f1	R_F1,lab	RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T_s,lab	Measured T_s	0.439	0.369	0.250	0.205	0.146	0.077	
Change by Lining on source side	ΔR_F1	No Lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR f1	No Lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	T s,situ	ISO 15712-1, Eq. C.1-C.3	0.374	0.256	0.171	0.111	0.070	0.043	
TL in-situ for F1		ISO 15712-1, Eq. 19	41	44	52	61	69	78	55
TL in-situ for f1		ISO 15712-1, Eq. 19	41	44	52	61	69	78	55
Junction J1 - Coupling	n_n_)	100 107 12 1, 24, 10					0.5		
Velocity Level Difference for Ff	D v Ff 1 situ	ISO 15712-1, Eq. 21, 22	0.00	0.01	0.26	0.62	1.11	1.74	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	19.2	20.3	21.4	22.6	23.8	25.1	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	19.2	20.3	21.4	22.6		25.1	
		130 13/12-1, Eq. 21, 22	19.2	20.3	21.4	22.0	23.ð	23.1	
Flanking Transmission Loss - Path data		150 15712 1 Fa 25-		42	F^	F.0	60	77	50
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	39	42	50	59	68	77	52
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a	57	67	74	83	86	90	77
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq. 25a	57	67	74	83	86	90	77
Junction 1: Flanking STC for all paths			- 10*LOG1	0(10^-	5.2 + 1	0^- 7.7	' + 10^-	7.7)=	5
Junction 2 (T-Junction, steel stud sepa	rating wall /	glazed curtain facade walls)							
Flanking Element F2 and f2: Input Dat	a								
Horizontal flanking (measured)	Dn, f	CSTB, Acoubat example	42.3	46.8	51.8	46.9	59.1	59.4	52
	, .								
		UVIPASUIPED, ISU-10848-31							
	Note: These	(Measured, ISO-10848-3) data were furnished by CSTB in Fran	nce and are u	sed wi	th nerr	nission			
	Note: These	data were furnished by CSTB in Fran			th perr	nission	l.		
		data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA	TED AS GENI	RIC.				urors	
	Wide variati	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri	TED AS GEN etary produc	RIC. ts fron	n diffei			urers,	
	Wide variati	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA	TED AS GEN etary produc	RIC. ts fron	n diffei			urers,	
Correction D. n to Flanking TI in Scenar	Wide variati and data fo	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri r the intended curtain wall system s	TED AS GENI etary produc hould alway	ERIC. Its from Is be us	n diffei ied.	rent mo	anufact		0.97
	Wide variati and data fo	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri	TED AS GEN etary produc	RIC. ts fron	n diffei			o.97	0.97
Correction D_n to Flanking TL in Scenar Flanking Transmission Loss - Path data	Wide variati and data fo	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri r the intended curtain wall system s Guide, Eq. 4.1.3	TED AS GEN etary produc hould alway 0.97	ERIC. Its from Is be us 0.97	n differ ed. 0.97	r ent mo 0.97	anufact 0.97	0.97	
Flanking Transmission Loss - Path data	Wide variati and data fo	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri r the intended curtain wall system s	TED AS GENI etary produc hould alway	ERIC. Its from s be us 0.97	n diffei ied.	rent mo	anufact		0.97
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths	Wide variati and data fo rio	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri r the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4	TED AS GEN etary produc hould alway 0.97	ERIC. Its from Is be us 0.97	n differ ed. 0.97	r ent mo 0.97	anufact 0.97	0.97	
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud	Wide variati and data fo rio separating wa	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri r the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4	TED AS GEN etary produc hould alway 0.97	ERIC. Its from Is be us 0.97	n differ ed. 0.97	r ent mo 0.97	anufact 0.97	0.97	
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e	Wide variati and data fo rio separating wa	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri- r the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings)	TED AS GENI etary produc hould alway 0.97 43	ERIC. its from s be us 0.97 <u>48</u>	0.97	0.97	0.97 60	0.97 60	
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side	Wide variati and data fo rio separating wa xcept linings ΔR_F3	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01	TED AS GENI etary production in the second s	RIC. its from s be us 0.97 48 21	0.97 53	0.97 48	anufact 0.97 60 22	0.97 60 19	
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_f3	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between propri- r the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings)	TED AS GENI etary produc hould alway 0.97 43	ERIC. its from s be us 0.97 <u>48</u>	0.97	0.97	0.97 60	0.97 60	
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data	Wide variati and data fo io separating wa xcept linings ΔR_F3 ΔR_f3	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01	TED AS GENI etary production inhould alway 0.97 43 43 8 8 8	RIC. ts from s be us 0.97 48 21 21	n differed. 0.97 53 24 24 24	cent mo 0.97 48 24 24	anufact 0.97 60	0.97 60 19 19	5
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3	Wide variati and data fo tio separating wa except linings ΔR_F3 ΔR_f3 R_Ff	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a	TED AS GENI etary production ihould alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ets from s be us 0.97 48 21 21 21 84	n differed. 0.97 53 24 24 24 90	24 24 90	0.97 60 22 22 90	0.97 60 19 19 90	79
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Fd_3	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_F3 R_Ff R_Ff	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	TED AS GENI etary product ihould alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ts from s be us 0.97 48 21 21 21 84 88	n differ ed. 0.97 53 24 24 24 90 90	ent mo 0.97 48 24 24 90 90	0.97 60 22 22 90 90	0.97 60 19 19 90 90	79 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Flanking Tu for path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Flanking TL for Path Df_3	Wide variati and data fo tio separating wa except linings ΔR_F3 ΔR_f3 R_Ff	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a	TED AS GENI etary product should alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ts from s be us 0.97 48 21 21 21 84 88 88	n differ red. 0.97 53 24 24 24 90 90 90	24 24 24 90 90 90	0.97 60 22 22 90 90 90	0.97 60 19 19 90 90 90	79 88 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Flanking TL for Path Df_3	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_F3 R_Ff R_Ff	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	TED AS GENI etary product ihould alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ts from s be us 0.97 48 21 21 21 84 88 88	n differ red. 0.97 53 24 24 24 90 90 90	24 24 24 90 90 90	0.97 60 22 22 90 90 90	0.97 60 19 19 90 90 90	79 88 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Junction 3: Flanking STC for all paths	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	TED AS GENI etary product should alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ts from s be us 0.97 48 21 21 21 84 88 88	n differ red. 0.97 53 24 24 24 90 90 90	24 24 24 90 90 90	0.97 60 22 22 90 90 90	0.97 60 19 19 90 90 90	79 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	TED AS GENI etary product should alway 0.97 43 43 43 43 43 43 43 43 43 43 43 43 43	RIC. ts from s be us 0.97 48 21 21 21 84 88 88	n differ red. 0.97 53 24 24 24 90 90 90	24 24 24 90 90 90	0.97 60 22 22 90 90 90	0.97 60 19 19 90 90 90	79 88 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking Transmission Loss - measured	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	TED AS GENI etary product should alway 0.97 43 43 8 8 8 55 65 65 65 - 10*LOG1	ERIC. ets from s be us 0.97 48 21 21 21 84 88 0(10^-	n differ ed. 0.97 53 24 24 24 90 90 90 7.9 + 1	24 24 24 90 90 0^- 8.8	0.97 60 22 22 90 90 90 + 10^-	0.97 60 19 19 90 90 90 8.8) =	79 88 88 7
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking Transmission Loss - measured Flanking TL for Path Ff_4	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01	TED AS GENI etary product should alway 0.97 43 43 8 8 8 55 65 65 65 - 10*LOG1	ERIC. ts from s be us 0.97 48 21 21 21 84 88 88 88 0(10^-	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 90 90 90 90 90 90 90	24 24 24 90 90 90 90 90 90 90 90 90	anufact 0.97 60 22 22 90 90 90 90 90 78	0.97 60 19 19 90 90 90 8.8) =	79 88 88 7 88 88 88 88 88 88
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01 RR-337, CFS-WW-LB152-01	TED AS GENI etary product should alway 0.97 43 8 8 8 55 65 65 65 65 - 10*LOG1	ERIC. ts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76	n differ ed. 0.97 53 24 24 24 90 90 90 90 7.9 + 1 86 85	24 24 24 90 90 90 90 90 90 90 90 90 90 90 90 90	0.97 60 22 22 90 90 90 90 + 10^-	0.97 60 19 90 90 90 8.8) = 90 90 90	79 88 88 7 88 88 7
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Fd_4	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior in the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01	TED AS GENI etary product ihould alway 0.97 43 43 55 65 65 65 - 10*LOG1 64 68 65	ERIC. tts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76 68	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 7.9 + 1 86 85 78	0.97 48 24 24 24 90 90 90 90 90 90 81	0.97 60 22 22 90 90 90 90 90 90 90 78 78 78 78 78	0.97 60 19 90 90 90 8.8) =	79 88 88 88 88 82 82 82 76
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths Junction 3 (Cross-junction, steel stud All values the same as for Junction 1, e Change by Lining on source side Flanking Tunsmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Fd_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Pf_4	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01 RR-337, CFS-WW-LB152-01	TED AS GENI etary product should alway 0.97 43 8 8 8 55 65 65 65 65 - 10*LOG1	ERIC. tts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76 68	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 7.9 + 1 86 85 78	0.97 48 24 24 24 90 90 90 90 90 90 81	0.97 60 22 22 90 90 90 90 90 90 90 78 78 78 78 78	0.97 60 19 90 90 90 8.8) =	79 88 88 7 88 88 7
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Gf_4 Junction 4: Flanking STC for all paths	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01 RR-337, CFS-WW-LB152-01	TED AS GENI etary product ihould alway 0.97 43 43 55 65 65 65 - 10*LOG1 64 68 65	ERIC. tts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76 68	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 7.9 + 1 86 85 78	0.97 48 24 24 24 90 90 90 90 90 90 81	0.97 60 22 22 90 90 90 90 90 90 90 78 78 78 78 78	0.97 60 19 90 90 90 8.8) =	79 88 88 88 7 82 82 76 7
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Gf_4 Junction 4: Flanking STC for all paths	Wide variati and data fo rio separating wa except linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01 RR-337, CFS-WW-LB152-01	TED AS GENI etary product ihould alway 0.97 43 43 55 65 65 65 - 10*LOG1 64 68 65	ERIC. tts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76 68	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 7.9 + 1 86 85 78	0.97 48 24 24 24 90 90 90 90 90 90 81	0.97 60 22 22 90 90 90 90 90 90 90 78 78 78 78 78	0.97 60 19 90 90 90 8.8) =	79 88 88 7 88 7 82 82 82 76
Flanking Transmission Loss - Path data Junction 2: Flanking STC for all paths All values the same as for Junction 1, e Change by Lining on source side Change by Lining on receive side Flanking Transmission Loss - Path data Flanking TL for Path Ff_3 Flanking TL for Path Df_3 Junction 3: Flanking STC for all paths Junction 4 (T-junction, steel stud sepa Flanking Transmission Loss - measurec Flanking TL for Path Ff_4	Wide variati and data fo rio separating wa xcept linings ΔR_F3 ΔR_F3 ΔR_F3 R_Ff R_Fd R_Df	data were furnished by CSTB in Fran THESE DATA SHOULD NOT BE TREA on is to be expected between proprior ir the intended curtain wall system s Guide, Eq. 4.1.3 Guide, Section 1.4 all / 150 mm concrete ceilings) RR-333 , ΔTL-CON150-C01 RR-333 , ΔTL-CON150-C01 ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a Steel stud flanking corridor walls) RR-337, CFS-WW-LB152-01 RR-337, CFS-WW-LB152-01	TED AS GENI etary product ihould alway 0.97 43 43 55 65 65 65 - 10*LOG1 64 68 65	ERIC. tts from s be us 0.97 48 21 21 21 84 88 88 0(10^- 79 76 68	n differ ed. 0.97 53 24 24 24 90 90 90 90 90 90 7.9 + 1 86 85 78	0.97 48 24 24 24 90 90 90 90 90 90 81	0.97 60 22 22 90 90 90 90 90 90 90 78 78 78 78 78	0.97 60 19 90 90 90 8.8) =	79 88 88 88 7 82 82 76 7



	ISO Symbol	Reference	125	250	630	1250	2500	5000	STC or AST
Separating Partition (150 mm concret									
Sound Transmission Loss (TL)	R D,lab	RR-333, CON150, TLF-15-045	40	42	50	58	66	75	53
Structural Reverberation Time	T s,lab	Measured T s				0.205			
Change by Lining on source side	ΔR D	No lining ,	0	0	0	0	0	0	
Change by Lining on receive side	ΔR_d	No lining ,	0	0	0	0	0	0	
Structural Reverb. Time in-situ	_	ISO 15712-1, Eq. C.1-C.3						0.043	
Leakage or Airborne Flanking	1_3,510	Sealed & Blocked	0.574	0.250	0.171	0	0	0.015	
Direct TL in-situ	R_D,situ	ISO 15712-1, Eq. 24	41	44	52	61	69	78	55
Junction 1 (Cross-junction, 150 mm co	oncrete / stee	l stud flanking walls)							
Flanking Element F1 and f1: Input									
Sound Transmission Loss	R F1,lab	RR-337, SS(LB)150-WW-01, Dd(LB)	38	50	58	61	55	63	58
TL in-situ for F1		4.2.2: Equal to lab. TL	38	50	58	61	55	63	58
TL in-situ for f1	- '	4.2.2: Equal to lab. TL	38	50	58	61	55	63	58
Junction J1 - Coupling	n_11,5ttu	4.2.2. Equal to lab. TE	50	50	50	01	55	05	50
Velocity Level Difference for Ff	D v Ef 1 citu	ISO 15712-1, Eq. 21, 22	31.7	30.7	29.7	28.7	27.7	26.7	
Velocity Level Difference for Fd		ISO 15712-1, Eq. 21, 22	19.2	20.3	21.4	22.6	23.8	25.1	
Velocity Level Difference for Df		ISO 15712-1, Eq. 21, 22	19.2	20.3	21.4	22.6	23.8	25.1	
Flanking Transmission Loss - Path data				-			0-	0-	
Flanking TL for Path Ff_1	R_Ff	ISO 15712-1, Eq. 25a	72	83	90	90	85	90	88
Flanking TL for Path Fd_1	R_Fd	ISO 15712-1, Eq. 25a	60	68	77	85	87	90	79
Flanking TL for Path Df_1	R_Df	ISO 15712-1, Eq. 25a	60	68	77	85	87	90	79
Junction 1: Flanking STC for all paths	1	-	10*LOG1	0(10^-	<u>8.8 + 1</u>	0^- 7.9	+ 10^-	7.9)=	7
Junction 2 (T-Junction, 150 mm concr		rtain walls)							
Flanking Element F2 and f2: Input Dat									
Vertical flanking	Dn, f	CSTB, Acoubat example	36.1	35.5	42.4	50.0	50.4	53.4	47
		(Measured, ISO-10848-3)							
	Note: These	(Measured, ISO-10848-3) data were furnished by CSTB in France of	and are u	sed wi	th pern	nission			
	Note: These				th pern	nission			
		data were furnished by CSTB in France of	AS GENE	RIC.				turers,	
	Wide variati	data were furnished by CSTB in France (THESE DATA SHOULD NOT BE TREATED	AS GENE y produc	RIC. ts fron	n diffei			turers,	
	Wide variati	data were furnished by CSTB in France o THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietal	AS GENE y produc	RIC. ts fron	n diffei			turers,	
	Wide variati	data were furnished by CSTB in France o THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou	AS GENE y produc	RIC. ts fron	n diffei			turers, 3.8	
Correction (D_n,f to Flanking TL)	Wide variati and data fo	data were furnished by CSTB in France o THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietal	AS GENE y produc ld alway	RIC. ts from s be us	n diffei ied.	rent mo	anufaci		
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data	Wide variati and data fo	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3	AS GENE y produc ld alway 3.8	RIC. ts from s be us 3.8	n differ sed. 3.8	rent ma 3.8	anufact 3.8	3.8	
Correction (D_n,f to Flanking TL)	Wide variati and data fo	data were furnished by CSTB in France o THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou	AS GENE y produc ld alway	RIC. ts from s be us	n diffei ied.	rent mo	anufaci		5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data	Wide variati and data fo	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3	AS GENE y produc ld alway 3.8	RIC. ts from s be us 3.8	n differ sed. 3.8	rent ma 3.8	anufact 3.8	3.8	5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff	Wide variati and data fo	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprieta r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4	AS GENE y produc ld alway 3.8	RIC. ts from s be us 3.8	n differ sed. 3.8	rent ma 3.8	anufact 3.8	3.8	5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concre	Wide variati and data fo	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4	AS GENE y produc ld alway 3.8	RIC. ts from s be us 3.8	n differ sed. 3.8	rent ma 3.8	anufact 3.8	3.8	5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concre All input data the same as for Junction	Wide variati and data fo	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL	AS GENE ry produc ild alway 3.8 40	RIC. ts from s be us 3.8 39	n differ ed. 3.8 46	3.8 54	3.8 54	3.8 57	5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concre All input data the same as for Junction Correction (D_n,f to Flanking TL)	Wide variati and data fo ete / glass cur 2, but differe	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4	AS GENE y produc ld alway 3.8	RIC. ts from s be us 3.8	n differ sed. 3.8	rent ma 3.8	anufact 3.8	3.8	5
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concr All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data	Wide variati and data fo ete / glass cur 2, but differe	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3	AS GENE y produce ild alway 3.8 40 2.8	RIC. ts from s be us 3.8 39 2.8	n differed. 3.8 46 2.8	2.8	3.8 54 2.8	3.8 57 2.8	
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Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concre All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 3: Flanking STC for all paths Junction 4 (Cross-junction, 150 mm co Elanking Element F4 and f4: TL in-situ for F4 TL in-situ for F4 Flanking Transmission Loss - Path data Flanking TL for Path Ff_4	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 stud flanking walls) th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL SO 15712-1, Eq. 25a	AS GENE ty produce ld alway 3.8 40 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from 3.8 3.9 2.8 38 50 50 50 50 50 50 50 50	a difference a. 3.8 46 2.8 45 62 62 62 62	2.8 53 69 69 69	2.8 53 60 60 60	3.8 57 2.8 56 62 62 62	58 58 58 58
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data function 2: Flanking STC for Path Ff function 3 (T-junction, 150 mm concre All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data function 3: Flanking STC for all paths function 4 (Cross-junction, 150 mm co Like Junction 1, but different studs and Flanking Element F4 and f4: Flanking Element F4 and f4: Flanking Transmission Loss - Path data Flanking Transmission Loss - Path data Flanking Transmission Loss - Path data Flanking TL for Path Ff_4 Flanking TL for Path Ff_4	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietal r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 stud flanking walls) th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL SO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	AS GENE ty produc ld alway 3.8 40 2.8 39 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from 3.8 3.9 2.8 38 50 50 50 50 50 50 50 50 50 50 50 50 50 70	an differ ed. 3.8 46 2.8 45 62 62 62 62 62 90 81	2.8 53 69 69 69 90 90	3.8 54 2.8 53 60 60 60 90 90	3.8 57 2.8 56 62 62 62 90 90	58 58 58 89 81
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concreant All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 3: Flanking STC for all paths Junction 4 (Cross-junction, 150 mm concreant Like Junction 1, but different studs and Flanking Element F4 and f4: TL in-situ for F4 TL in-situ for F4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Df_4	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	AS GENE ty product ld alway 3.8 40 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from s be us 3.8 39 2.8 38 50 50 50 50 50 50 50 70 70	a difference ad. 3.8 46 2.8 45 62 62 62 62 62 62 90 81 81	2.8 53 69 69 69 69 90 90	3.8 3.8 54 2.8 53 60 60 60 60 90 90 90	3.8 57 2.8 56 62 62 62 62 62 90 90	58 58 58 89 81 81
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concreant All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 3: Flanking STC for all paths Junction 4 (Cross-junction, 150 mm concreant Like Junction 1, but different studs and Flanking Element F4 and f4: TL in-situ for F4 TL in-situ for F4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Df_4	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	AS GENE y produc ld alway 3.8 40 2.8 39 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from s be us 3.8 39 2.8 38 50 50 50 50 50 50 50 70 70	a difference ad. 3.8 46 2.8 45 62 62 62 62 62 62 90 81 81	2.8 53 69 69 69 69 90 90	3.8 3.8 54 2.8 53 60 60 60 60 90 90 90	3.8 57 2.8 56 62 62 62 62 62 90 90	58 58 58 58 89 81
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concreant All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 3: Flanking STC for all paths Junction 3: Flanking STC for all paths Junction 1, but different studs and Flanking Element F4 and f4: TL in-situ for F4 TL in-situ for F4 Flanking TL for Path Ff_4 Flanking TL for Path Ff_4 Flanking TL for Path Df_4 Junction 4: Flanking STC for all paths	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	AS GENE y produc ld alway 3.8 40 2.8 39 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from s be us 3.8 39 2.8 38 50 50 50 50 50 50 50 70 70	a difference ad. 3.8 46 2.8 45 62 62 62 62 62 62 90 81 81	2.8 53 69 69 69 69 90 90	3.8 3.8 54 2.8 53 60 60 60 60 90 90 90	3.8 57 2.8 56 62 62 62 62 62 90 90	58 58 58 89 81 81
Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 2: Flanking STC for Path Ff Junction 3 (T-junction, 150 mm concre All input data the same as for Junction Correction (D_n,f to Flanking TL) Flanking Transmission Loss - Path data Junction 3: Flanking STC for all paths Junction 4 (Cross-junction, 150 mm co Like Junction 1, but different studs and	Wide variati and data fo ete / glass cur 2, but differe R_Ff Junction leng R_F4,situ R_F4,situ R_Ff R_Ff	data were furnished by CSTB in France of THESE DATA SHOULD NOT BE TREATED on is to be expected between proprietau r the intended curtain wall system shou Guide, Eq. 4.1.3 Guide, Section 1.4 tain walls) nt junction length changes Flanking TL Guide, Eq. 4.1.3 Guide, Section 1.4 th change Flanking TL RR-337, CFS-WW-NLB90-01, Dd(NLB) 4.2.2: Equal to lab. TL 4.2.2: Equal to lab. TL ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a ISO 15712-1, Eq. 25a	AS GENE y produc ld alway 3.8 40 2.8 39 2.8 39 40 2.8 39 40 40 40 40 40 40 40 40 40 40	RIC. ts from s be us 3.8 39 2.8 38 50 50 50 50 50 50 50 70 70	a difference ad. 3.8 46 2.8 45 62 62 62 62 62 62 90 81 81	2.8 53 69 69 69 69 90 90	3.8 3.8 54 2.8 53 60 60 60 60 90 90 90	3.8 57 2.8 56 62 62 62 62 62 90 90	58 58 58 58 89 81 81 81 7

<u>Summary for Section 5.2: Calculation Examples for Concrete Floors with Lightweight</u> <u>Framed Walls and Lightweight Façade</u>

Examples 5.1.4 and 5.1.5 show the calculation procedures for the Extended Scenario in a building whose façade is a glass curtain wall assembly. Compared with the same buildings with concrete masonry façades presented in Section 5.1, the ASTC ratings of the lightweight façade that extends across junctions are significantly reduced.

Example 5.2.1 shows a horizontal case identical to Example 5.1.2 except that glass curtain walls are substituted for the heavy masonry façade. The ASTC rating is reduced by the combination of the rather low Flanking STC value for the curtain wall façade and the lower Flanking STC values via the floor paths, primarily due to low edge losses from the concrete floor to the façade.

Example 5.2.2 shows the corresponding vertical case which is identical to Example 5.1.3 except that glass curtain walls are substituted for the heavy masonry façade. The ASTC rating is reduced by both a lower Direct STC value via the separating floor (due to lower edge losses from the concrete floor to the façade) and the rather low Flanking STC value for the curtain wall façade.

Overall, these examples emphasize the need to focus improvements on the weakest paths. Even with a heavy façade, achieving high ASTC ratings between spaces requires both separating partitions with high STC ratings and suitable linings over the heavy concrete or masonry surfaces. Replacing a heavy façade with a lightweight façade can both provide more significant flanking sound transmission via the façade surfaces and can reduce the in-situ STC rating of the floor due to the lower losses of the extended concrete floor/ceiling.

The calculations for this Section have used an extension that goes beyond the explicit guidance in Annex C of ISO 15712-1 but is still quite conservative. For this situation, extended response of the concrete floor/ceiling occurs because the lightweight interior partitions provide almost no resistance to transmission of the vibration from the excited surface in the source room to the entire floor surface of the Extended Scenario. For the case in Section 5.1 where most of the energy is transferred to the heavy façade assemblies, the process in Annex C that considers only the transfer at the perimeter is appropriate. But with a lightweight façade, it is more appropriate to include the transfers from the concrete to all of the connected walls including the lightweight façade and the internal partitions. In a typical building, however, there would be other connections such as stairwells, elevators, interior concrete or masonry walls to provide fire separations or shear bracing, and columns or other framing to support the structural load. All of these elements would transfer vibration energy away from the concrete floor and thereby increase the in-situ STC rating of the floor. Ignoring the contribution of all of these other elements, especially the framing that supports the structural load, makes the estimated ASTC ratings in Section 5.2 conservative.

5.3. Concrete Masonry Walls with Lightweight Framed Floors and Walls

This section presents the calculation approach for buildings that combine lightweight framed assemblies (walls and floors) with walls of normal weight or lightweight concrete blocks. The transmission of structure-borne vibration in a building with lightweight framed assemblies differs markedly from that in heavy homogeneous structures of masonry and concrete.

- For direct transmission through the separating lightweight framed assembly, the high internal loss factors of the wood- or steel-framed assembly result in minimal dependence on the connections to the adjoining structures, so laboratory measured sound transmission values are used without adjustment.
- For flanking paths where one or both of the assemblies is a lightweight framed assembly, the calculation process is very simple, but it requires use of flanking sound transmission loss data measured according to ISO 10848 (like the calculations for framed assemblies in Chapter 4).
- Linings on the concrete block surfaces (either for direct or flanking transmission) may be treated using a simple additive correction (ΔSTC) as in Chapter 2.

An experimental study of such systems with concrete block walls and wood-framed floors was performed at the NRC, as described in the NRC Research Report RR-334, and results from that study were used for the examples in this section.

The calculation process requires specific laboratory test data, but can be performed using single-number ratings, following the steps illustrated in Figure 5.3.1, and explained in detail below.

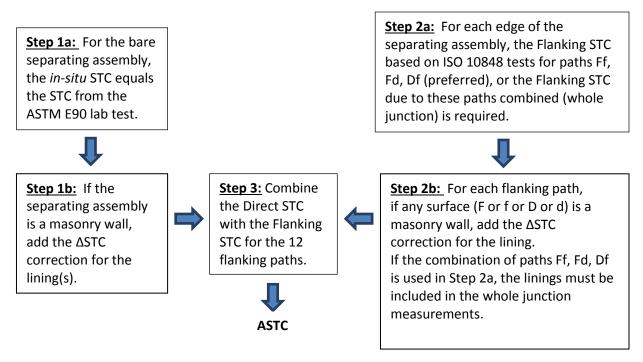


Figure 5.3.1: Steps to calculate the ASTC for masonry walls with lightweight framed assemblies.

Step 1: (a) For the bare separating assembly, the in-situ STC is equal to the STC measured in the laboratory according to ASTM E90.

(b) If the separating assembly is a masonry wall, add the Δ STC correction for lining(s) on the source room and/or receiving room surfaces (D and d) to obtain the Direct STC. This correction procedure matches that of Section 2.4. If there are two linings, the correction equals the larger of the two lining Δ STC corrections plus half of the lesser one (see Eq. 5.3.2).

- Step 2: (a) Determine the Flanking STC rating for the 3 flanking paths Ff, Fd and Df at each edge of the separating assembly with the following adaptations:
 - Values measured according to ISO 10848 should be normalized using Equation 4.1.3 as explained in Section 4.1.
 - If only the Flanking STC for combined transmission by the set of 3 paths at a junction is available, that data may be used.
 - If both flanking surfaces F and f are concrete masonry walls, the Flanking STC for path Ff may either be taken from measurement according to ISO 10848, or calculated using the assembly STC rating and vibration reduction index (measured or calculated) as in Section 2.4.

(b) If one surface for a flanking path (source room or receiving room) is a masonry wall, add the Δ STC correction for any lining added to the masonry surface to obtain the Flanking STC for that path. If both flanking surfaces are concrete block walls with linings, the correction equals the larger of the two lining Δ STC corrections plus half of the lesser one (see Eq. 5.3.3.)

- Step 3: Combine the transmission via the direct path and the 12 flanking paths using Equation 5.3.1 (equivalent to Eq. 26 in Section 4.4 of ISO 15712-1 or Eq. 1.4 of this Guide), with the following adaptations:
 - If the Flanking STC rating calculated for any flanking path is over 90, set the value to 90 to allow for the inevitable effect of higher order flanking paths.
 - Round the final ASTC result to the nearest integer.

Expressing the Calculation Process using Equations:

As in Sections 2.4 and 4.1 of this Guide and Section 4.4.1 of ISO 15712-1, the ASTC value between two rooms (neglecting sound that is by-passing the building structure, e.g. leaks, ducts,...) is estimated in the Simplified Method from the logarithmic expression of the combination of Direct STC rating (STC_{Dd}) of the separating wall or floor element and the combined Flanking STC ratings of the three flanking paths for every junction at the four edges of the separating element which may be expressed as:

$$ASTC = -10\log_{10}\left[10^{-0.1 \cdot STC_{Dd}} + \sum_{edge=1}^{4} (10^{-0.1 \cdot STC_{Ff}} + 10^{-0.1 \cdot STC_{Fd}} + 10^{-0.1 \cdot STC_{Df}})\right] \quad \text{Eq. 5.3.1}$$

Eq. 5.3.1 is appropriate for all types of building systems similar to the Standard Scenario. It is applied here using the following expressions to calculate the sound transmission for individual paths.

- Eq. 5.3.1 is a special case of Eq. 1.4 in this Guide:
 - (a) The single-number rating ASTC is substituted for the ATL in Eq. 1.4.
 - (b) If the separating assembly is a framed wall or floor assembly, then the direct path STC_{Dd} is equal to the laboratory STC for that assembly. Alternatively, if the separating assembly is a concrete masonry wall, the direct path STC_{Dd} is obtained from the laboratory measured STC rating of the unlined element and the Δ STC changes due to linings on source "D" and/or receiving side "d" of the separating assembly using the equivalent of Eq. 24 and 30 in ISO 15712-1:

$$STC_{Dd} = STC_{lab} + max(\Delta STC_D, \Delta STC_d) + \frac{min(\Delta STC_D, \Delta STC_d)}{2}$$
 Eq. 5.3.2

(c) The calculation of Flanking STC_{ij} for each flanking path depends on the constructions involved. Here, indices i and j refer to the coupled flanking elements, where "i" can either be "D" or "F" and "j" can be "f" or "d".

The options for the calculation of the Flanking STC_{ij} for each flanking path include:

• In all cases, values of D_{n,f} or Flanking STC_{ij} measured according to ISO 10848 may be used to determine the Flanking STC (after re-normalization as explained in Section 4.1).

NOTE: In previous versions of this Guide and in NRC Research Report RR-334, experimental Flanking STC data for each path were normalized to the actual dimensions of the flanking facilities at NRC. Starting in 2017, data measured at NRC according to ISO 10848 has been normalized to a set of nominal dimensions that correspond more closely to the Standard Scenario used in this Guide. The pertinent dimensions for laboratory data are identified clearly in the worked examples, and this change had no effect on the resulting Flanking STC values for each path in the worked examples.

- Note that lining corrections are not appropriate for framed assemblies.
- If one of the flanking elements is a concrete masonry wall, then the appropriate ΔSTC should be added to the Flanking STC_{ij} measured for this path without a lining, as the correction due to any lining added on that surface.
- If both flanking elements i and j are concrete masonry wall assemblies, and there are added linings then add $\left\{ max(\Delta STC_i, \Delta STC_j) + \frac{min(\Delta STC_i, \Delta STC_j)}{2} \right\}$ to the Flanking STC_{ij} measured for this path without the lining(s).
- Alternatively, if both flanking elements i and j are concrete masonry wall assemblies, then the following equation (Eq. 5.3.3, the equivalent of Eq. 28 and 31 in ISO 15712-1 and the same as Eq. 2.4.3 of Section 2.4) could be used to determine the Flanking STC_{ij}.

Flanking
$$\text{STC}_{ij} = \frac{\text{STC}_i}{2} + \frac{\text{STC}_j}{2} + K_{ij} + \max(\Delta \text{STC}_i, \Delta \text{STC}_j) + \frac{\min(\Delta \text{STC}_i, \Delta \text{STC}_j)}{2} + 10 \log_{10}\left(\frac{S_s}{l_o l_{ij}}\right)$$
 Eq. 5.3.3

Worked Examples

The worked examples present all the pertinent physical characteristics of the assemblies and junctions, including references for the source of the laboratory test data. All examples conform to the Standard Scenario presented in Section 1.2 of this Guide, and calculations were performed following the steps presented above in Section 5.3.

Under the heading "STC, Δ STC" the examples present input data determined by applying the calculation process of ASTM E413 to laboratory test data of several types:

- STC values for laboratory sound transmission loss of wall or floor assemblies, measured according to ASTM E90,
- ΔSTC values measured in the laboratory according to ASTM E90 for the change in STC due to adding a given lining to the specified wall or floor assembly (as discussed in Appendix A1),
- Flanking STC values for each flanking path at each junction measured according to ISO 10848 and renormalized using Eq. 4.1.3, as explained in Section 4.1.

Under the heading "ASTC", the examples present the calculated values including:

- Direct STC for the calculated in-situ transmission loss of the separating wall or floor assembly,
- Flanking STC calculated for each flanking transmission path at each junction, and for the combined set of paths at each junction,
- Apparent STC (ASTC) for the combination of direct and flanking transmission via all paths.

The numeric calculations are presented step-by-step in each worked example using compact notation consistent with spreadsheet expressions such that:

- For calculation of Direct STC, these expressions are easily recognized either as:
 - measured STC values without correction for a lining if the separating assembly is a lightweight wall, or
 - equivalent to Equations 5.3.2 with correction(s) for lining(s) if the separating assembly is a concrete block wall
- For calculation of Flanking STC, these expressions are easily recognized either as:
 - measured flanking STC values re-normalised using Eq. 4.1.3, possibly with a correction for a lining if the concrete block wall is one of the flanking surfaces, or
 - equivalent to Equations 5.3.3 if both flanking surfaces are concrete block walls.

These STC or Flanking STC values are rounded to the nearest integer for consistency with the corresponding measured values.

For combining the sound power transmitted via specific paths, the calculation of Eq. 5.3.1 (an adapted version of Eq. 1.4) is presented in several stages, first for the subset of paths at each junction, then for the combined effect of all four flanking junctions, and finally for the combination of direct and all flanking paths. Note that in the compact notation, a term for transmitted sound power fraction such as $10^{-0.1 \cdot \text{STC}_{ij}}$ becomes 10^-7.4, if STC_{ii} = 74.

For each path or junction, the overall transmission result is converted into decibel form by calculating – $10*\log_{10}$ (transmitted sound power fraction) to facilitate comparison of each path or junction with the Direct STC and the final ASTC.

EXAMPLE 5.3.1: SIMPLIFIED METHOD Illustration for this case Rooms side-by-side Separating loadbearing wall of normal weight concrete block with wood-framed flanking floors and walls Separating wall assembly with: One wythe of 190 mm hollow concrete block masonry¹ F3 constructed using normal weight units not less than 53% solid. and with mass per area of 238 kg/m², with no lining Bottom Junction 1 (separating wall and floor) with: 38 mm x 235 mm wood ledger plate on each side, fastened through with 16 mm diameter bolts spaced 400 mm o.c. Cells in concrete block¹ assembly between the ledger plates are • filled with grout, and floor joists are supported on joist hangers attached to these plates Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., with joists oriented perpendicular to separating wall and supported on joist hangers, with 150 mm thick absorptive material³ in the inter-joist cavities Floor deck of 16 mm oriented strand board (OSB) • Junctions 1 and 3 of loadbearing No floor finish or floor topping separating concrete block wall with wood-Top Junction 3 (separating wall and ceiling) with: framed flanking floor and ceiling. (Side view) • Ceiling framed with wood joists (same details as Junction 1) Ceiling with 1 layer of 13 mm gypsum board⁴ fastened directly to bottom of floor framing on each side Side Junction 2 or 4 (separating wall and abutting side walls) with: • Side wall framing with single row of wood studs · Side wall framing structurally-connected to the separating concrete block¹ wall, but not continuous across the junction 13 mm gypsum board⁴ on the side walls ends at separating wall assembly and is attached directly to wall framing of 38 mm x 89 mm wood studs spaced 400 mm o.c., with absorptive material³ in the stud cavities In Scenario In Laboratory Separating partition area $(m^2) =$ 12.5 12.5 f2. f4 F2. F4 Floor/separating wall junction length (m) = 5.0 5.0 Wall/separating wall junction length (m) = 2.5 2.5 Normalization for Junctions 1 and 3: Junction 2 or 4 of separating concrete 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = 0.00 RR-334, Eq. 4.2.1 block wall with abutting side walls, with side walls' framing and gypsum board Normalization for Junctions 2 and 4: terminating at separating 10*log(S situ/S lab) + 10*log(l lab/l situ) = 0.00 RR-334, Eq. 4.2.1 (Plan view)

(For the notes in this table please see the corresponding endnotes on page 195.)

wall.

	ISO Symbol		Reference	9	STC or Δ STC	STC or A	\STC
Separating Partition (190 m				A /)	10		
Laboratory STC for Dd	R_s,w		-Mean BLK190(N)	(V)	49		
ΔSTC change by Lining on D	∆R_D,w	No Lining			0		
ΔSTC change by Lining on d	∆R_d,w	No Lining	- ll		0		
Leakage or Airborne Flanking		Sealed & Blo		40 - 144	0	40	
Direct STC in-situ	R_Dd,w	150 15/12-1	, Eq. 24 and 30	49 + MA	X(0,0) + MIN(0,0) / 2 + 0 =	49	
Junction 1 (190 mm concret	e block separ	ating wall / w	ood-framed floo	r)			
For Flanking Path Ff 1:	e bioen separ			.,			
Laboratory Flanking STC		RR-334, BLK	190-WF-LB-01		59		
Flanking STC for path Ff_1	R_Ff,w	ISO 15712-1			59+0 =	59	
For Flanking Path Fd 1:	_ /						
Laboratory Flanking STC	R_Fd,w	RR-334, BLK	190-WF-LB-01		59		
Δ STC change by Lining on d	$\Delta R_d, w$	No Lining			0		
Flanking STC for path Fd_1	R_Fd,w	ISO 15712-1	. Ea. 28 - 31		59+0+0 =	59	
For Flanking Path Df_1:		100 107 11 1	1 29. 20 02				
Laboratory Flanking STC	R Df,w	RR-334, BLK	190-WF-LB-01		59		
Δ STC change by Lining on D	$\Delta R_D, w$	No Lining			0		
Flanking STC for path Fd_1	R Df,w	ISO 15712-1	. Fa. 28 - 31		59+0+0 =	59	
Junction 1: Flanking STC for		Subset of Eq.		- 10*LOG10(10^-5	.9 + 10^- 5.9 + 10^- 5.9) =		54
Junction 2 (190 mm concret	e block separ	ating wall / w	vood-framed flan	king wall)			
For Flanking Path Ff 2:					0.1		
Laboratory Flanking STC	5 56		190-WW-LB-01		81		
Flanking STC for path Ff_2	R_Ff,w	ISO 15712-1	, Eq. 28 - 31		81+0 =	81	
For Flanking Path Fd_2:							
Laboratory Flanking STC	R_Fd,w		190-WW-LB-01		71		
ΔSTC change by Lining on d	∆R_d,w	No Lining			0		
Flanking STC for path Fd_2	R_Fd,w	ISO 15712-1	, Eq. 28 - 31		71+0+0 =	71	
For Flanking Path Df 2:							
Laboratory Flanking STC	R_Df,w		190-WW-LB-01		71		
ΔSTC change by Lining on D	$\Delta R_D, w$	No Lining			0		
Flanking STC for path Fd_2	R_Df,w	ISO 15712-1			71+0+0 =	71	
Junction 2: Flanking STC for	all paths	Subset of Eq.	. 5.3.1	- 10*LOG10(10^-8	<mark>.1 + 10^- 7.1 + 10^- 7.1) =</mark>		68
Junction 3 (190 mm concret	e block separ	ating wall / w	ood-framed ceili	ng)			
For Flanking Path Ff 3:							
Laboratory Flanking STC		RR-334, BLK	190-WC-LB-01		65		
Flanking STC for path Ff_3	R_Ff,w	ISO 15712-1			65 + 0 =	65	
For Flanking Path Fd_3:		100 107 11 1	1 29. 20 02				
Laboratory Flanking STC	R Fd,w	RR-334, BLK	190-WC-LB-01		65		
Δ STC change by Lining on d	$\Delta R_d, w$	No Lining			0		
Flanking STC for path Fd 3	R_Fd,w	ISO 15712-1	. Fa. 28 - 31		65 + 0 + 0 =	65	
For Flanking Path Df 3:			,10 0 1				
Laboratory Flanking STC	R_Df,w	RR-334, BLK	190-WC-LB-01		65		
Δ STC change by Lining on D	$\Delta R_D, w$	No Lining			0		
Flanking STC for path Fd_3	R_Df,w	ISO 15712-1	. Fg. 28 - 31		65 + 0 + 0 =	65	
Junction 3: Flanking STC for		Subset of Eq.		- 10*10G10(10^-6	$.5 + 10^{-} 6.5 + 10^{-} 6.5$ =	00	60
		ousset of Eq.		10 10 010(10 0			
Junction 4 (190 mm concret	e block separ	ating wall / w	vood-framed flan	king wall)			
All values the same as for Ju	nction 2						
Flanking STC for path Ff_4	R_Ff,w	Same as for I	Ff_2		81+0 =	81	
Flanking STC for path Fd_4	R_Fd,w	Same as for			71+0+0 =	71	
Flanking STC for path Fd_4	R_Df,w	Same as for I			71+0+0 =	71	
Junction 4: Flanking STC for		Subset of Eq.		- 10*LOG10(10^-8	.1 + 10^- 7.1 + 10^- 7.1) =		68
Total Flanking STC (4 Junctic	ons)	Subset of Eq.	. 5.3.1	Combin	ing 12 Flanking STC values		53
ASTC due to Direct plus Tota	al Flanking	RR-331, Equa	ation 5 3 1	Combining Direct STC w	vith 12 Flanking STC values	48	

EXAMPLE 5.3.2

SIMPLIFIED METHOD

- Rooms side-by-side
- Separating loadbearing wall of normal weight concrete block with wood-framed flanking floors and walls (Same structure as Example 5.3.1, plus linings)

Separating wall assembly with:

- One wythe of 190 mm hollow concrete block masonry¹ constructed using normal weight units not less than 53% solid, and with mass per area of 238 kg/m²
- Concrete block assembly lined on each side by 1 layer of 13 mm gypsum board⁴ supported on 41 mm steel studs⁵ that are not in contact with the concrete blocks and are spaced 600 mm o.c., with absorptive material³ filling the stud cavities

Bottom Junction 1 (separating wall and floor) with:

- 38 mm x 235 mm wood ledger plate on each side, fastened through with 16 mm diameter bolts spaced 400 mm o.c.
- Cells in concrete block¹ assembly between the ledger plates are filled with grout
- Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., with joists oriented perpendicular to separating wall and supported on joist hangers, with 150 mm thick absorptive material³ in the inter-joist cavities
- Floor deck of 16 mm thick oriented strand board (OSB)
- No floor finish or floor topping

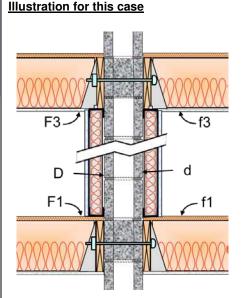
Top Junction 3 (separating wall and ceiling) with:

- Ceiling framed with wood joists (same details as Junction 1)
- Ceiling with one layer of 13 mm gypsum board⁴ fastened directly to bottom of floor framing on each side

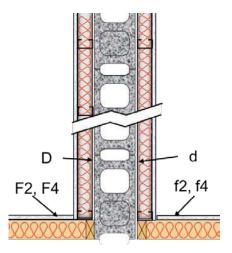
Side Junction 2 or 4 (separating wall and abutting side walls) with:

- Side wall framing with single row of wood studs
- Side wall framing structurally-connected to the separating concrete block wall, but not continuous across the junction
- 13 mm gypsum board⁴ on the side wall ends at separating wall assembly and is attached directly to wall framing of 38 mm x 89 mm wood studs spaced 400 mm o.c., with absorptive material³ filling the stud cavities

	In Scenario	In Laboratory
Separating partition area (m^2) =	12.5	12.5
Floor/separating wall junction length (m) =	5.0	5.0
Wall/separating wall junction length (m) =	2.5	2.5
Normalization for Junctions 1 and 3:		
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-334, Eq. 4.2.1
Normalization for Junctions 2 and 4:		
10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) =	0.00	RR-334, Eq. 4.2.1



Junctions 1 and 3 of loadbearing separating concrete block wall with woodframed flanking floor and ceiling. (Side view)



Junction 2 or 4 of separating concrete block wall with abutting side walls, with side walls' framing and gypsum board terminating at separating wall. (Plan view)

(For the notes in this table please see the corresponding endnotes on page 195.)

	ISO Symbol	Referen	ce	STC or Δ STC	STC or ASTC
Separating Partition (190 m				010012010	5100171010
Laboratory STC for Dd	R_s,w	RR-334, NRC-Mean BLK190(I	NIW)	49	
Δ STC change by Lining on D	$\Delta R D, w$	RR-334, ΔTL-BLK(NW)-42	NVV)	9	
Δ STC change by Lining on d	$\Delta R d, w$	RR-334, ΔTL-BLK(NW)-42		9	
Leakage or Airborne Flanking		Sealed & Blocked		9	
Direct STC in situ	R Dd,w	ISO 15712-1, Eq. 24 and 30	40 + MA	X(9,9) + MIN(9,9) / 2 + 0 =	63
Direct STC III situ	K_Du,w	130 13712-1, Eq. 24 and 30	49 + 1017	(9,9) + 10110(9,9) / 2 + 0 =	03
h					
	e block separ	ating wall / wood-framed flo	or)		
For Flanking Path Ff_1:					
Laboratory Flanking STC		RR-334, BLK190-WF-LB-01		59	
Flanking STC for path Ff_1	R_Ff,w	ISO 15712-1, Eq. 28 - 31		59 + 0 =	59
For Flanking Path Fd_1:					
Laboratory Flanking STC	R_Fd,w	RR-334, BLK190-WF-LB-01		59	
ΔSTC change by Lining on d	∆R_d,w	RR-334, ΔTL-BLK(NW)-42		9	
Flanking STC for path Fd_1	R_Fd,w	ISO 15712-1, Eq. 28 - 31		59 + 9 + 0 =	68
For Flanking Path Df 1:					
Laboratory Flanking STC	R Df,w	RR-334, BLK190-WF-LB-01		59	
Δ STC change by Lining on D	ΔR_D,w	RR-334, ΔTL-BLK(NW)-42		9	
Flanking STC for path Fd_1	R_Df,w	ISO 15712-1, Eq. 28 - 31		59 + 9 + 0 =	68
Junction 1: Flanking STC for		Subset of Eq. 5.3.1	- 10*LOG10(10^-5	5.9 + 10^- 6.8 + 10^- 6.8) =	58
Junction 2 (190 mm concret	e block separ	ating wall / wood-framed fla	nking wall)		
For Flanking Path Ff_2:					
Laboratory Flanking STC		RR-334, BLK190-WW-LB-01		81	
Flanking STC for path Ff 2	R_Ff,w			81+0 =	81
For Flanking Path Fd 2:	<u>к_гі,w</u>	ISO 15712-1, Eq. 28 - 31		81+0 -	01
Laboratory Flanking STC	R Fd,w	RR-334, BLK190-WW-LB-01		71	
				9	
ΔSTC change by Lining on d	∆R_d,w	RR-334, ΔTL-BLK(NW)-42		-	
Flanking STC for path Fd_2	R_Fd,w	ISO 15712-1, Eq. 28 - 31		71+9+0 =	80
For Flanking Path Df 2:					
Laboratory Flanking STC	R_Df,w	RR-334, BLK190-WW-LB-01		71	
ΔSTC change by Lining on D	$\Delta R_D, w$	RR-334, ΔTL-BLK(NW)-42		9	
Flanking STC for path Fd_2	R_ Df,w	ISO 15712-1, Eq. 28 - 31		71 + 9 + 0 =	
Junction 2: Flanking STC for	all paths	Subset of Eq. 5.3.1	- 10*LOG10(1	0^-8.1 + 10^- 8 + 10^- 8) =	76
	e block separ	ating wall / wood-framed ce	iling)		
Laboratory Flanking STC		RR-334, BLK190-WC-LB-01		65	
Flanking STC for path Ff_3	R_Ff,w	ISO 15712-1, Eq. 28 - 31		65 + 0 =	65
For Flanking Path Fd 3:					
Laboratory Flanking STC	R_Fd,w	RR-334, BLK190-WC-LB-01		65	
ΔSTC change by Lining on d	ΔR d,w	RR-334, ΔTL-BLK(NW)-42		9	
Flanking STC for path Fd_3	R Fd,w	ISO 15712-1, Eq. 28 - 31		65 + 9 + 0 =	74
For Flanking Path Df 3:		•			
Laboratory Flanking STC	R Df,w	RR-334, BLK190-WC-LB-01		65	
Δ STC change by Lining on D	$\Delta R_D, w$	RR-334, ΔTL-BLK(NW)-42		9	
Flanking STC for path Fd_3	R Df,w	ISO 15712-1, Eq. 28 - 31		65 + 9 + 0 =	74
Junction 3: Flanking STC for	_ /	Subset of Eq. 5.3.1	- 10*LOG10(10^-F	$5.5 + 10^{-} 7.4 + 10^{-} 7.4$) =	
Surfection 5. Hunking Sterior		505500 Eq. 5.5.1	10 10010(10 0		04
Junction 4 (190 mm concret	a block conor	ating wall / wood-framed fla	nking wall)		
All values the same as for Jur					
Flanking STC for path Ff_4		Same as for Ff 2		81+0 =	81
	R_Ff,w	_			
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2		71 + 9 + 0 =	80
Flanking STC for path Fd_4	R_Df,w	Same as for Df_2	104100101	71 + 9 + 0 =	
Junction 4: Flanking STC for	an paths	Subset of Eq. 5.3.1	- 10*LOG10(1	0 <mark>^-8.1 + 10^- 8 + 10^- 8) =</mark>	76
Total Flanking STC (4 Junctio	ons)	Subset of Eq. 5.3.1	Combir	ing 12 Flanking STC values	57
ASTC due to Direct plus Tota	al Flanking	RR-331, Equation 5.3.1	Combining Direct STC v	vith 12 Flanking STC values	56

	SIMPLIF	IED METHOD	Illustration for this case
 Rooms one-above-the-other Separating wood-framed flow perpendicular to flanking walls block and parallel to wood-framed 	of normal w	-	F1, F3
 Separating floor/ceiling assembly with: Floor framed with 38 mm x 235 mm o.c., with joists oriented perpendicula 150 mm thick absorptive material³ in th Ceiling of 2 layers of 16 mm fire-rated resilient metal channels⁷ spaced 400 r Subfloor of oriented strand board (OSI No floor topping and no floor finish 			
 Junction 1 or 3 (with loadbearing walls above and below floor of on concrete block masonry constructed to less than 53% solid, and with mass per cells in concrete block assembly be filled with grout 38 mm x 235 mm wood ledger plate oblocks¹, fastened through with 16 400 mm o.c., and floor joists are plated blocks. 	f1, f3 Junction 1 or 3 of separating wood-frame floor/ceiling assembly with loadbearin flanking concrete block wa (Side view)		
 attached to these plates No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls above and below floor) with: Joists of floor assembly parallel to these walls Walls have 38 mm x 89 mm wood studs spaced 400 mm o.c with several framing options (single row of wood studs, or staggered studs on a single 38 mm x 140 mm plate, or 2 rows of 38 mm x 89 mm wood studs on separate 38 mm x 89 mm plates) Walls with or without absorptive material³ in the stud cavities give equivalent flanking Single layer of 13 mm gypsum board⁴ that ends at floor/ceiling assembly and is attached directly to wall framing 			
 No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls Joists of floor assembly parallel to the Walls have 38 mm x 89 mm wood stuseveral framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa 	se walls uds spaced 4 of wood stuc plate, or 2 ro n x 89 mm pla rial ³ in the s rd ⁴ that ends	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give	F2, F4
 No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls Joists of floor assembly parallel to the Walls have 38 mm x 89 mm wood stuseveral framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa 	se walls uds spaced 4 of wood stuc plate, or 2 ro n x 89 mm pla rial ³ in the s rd ⁴ that ends	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give	
 No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rd ⁴ that ends all framing <u>In Scenario</u> 20.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0	
 No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rd ⁴ that ends all framing <u>In Scenario</u> 20.0 5.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0 5.0	
 No lining on concrete block walls <u>Junction 2 or 4 (with non-loadbearing walls</u> Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stusseveral framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rd ⁴ that ends all framing <u>In Scenario</u> 20.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0	
 No lining on concrete block walls <u>Junction 2 or 4 (with non-loadbearing walls</u> Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rrd ⁴ that ends all framing In Scenario 20.0 5.0 4.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0 5.0 5.0	D d f2, f4
 No lining on concrete block walls <u>Junction 2 or 4 (with non-loadbearing walls</u> Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rd ⁴ that ends all framing <u>In Scenario</u> 20.0 5.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0 5.0	Junction 2 or 4 of separating wood-frame
 No lining on concrete block walls Junction 2 or 4 (with non-loadbearing walls Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rrd ⁴ that ends all framing In Scenario 20.0 5.0 4.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0 5.0 5.0	Junction 2 or 4 of separating wood-frame floor/ceiling assembly with abutting sic
 No lining on concrete block walls <u>Junction 2 or 4 (with non-loadbearing walls</u> Joists of floor assembly parallel to thes Walls have 38 mm x 89 mm wood stus several framing options (single row studs on a single 38 mm x 140 mm 89 mm wood studs on separate 38 mr Walls with or without absorptive mate equivalent flanking Single layer of 13 mm gypsum boa assembly and is attached directly to w 	se walls uds spaced 4 of wood stud plate, or 2 rd n x 89 mm pla rial ³ in the s rrd ⁴ that ends all framing In Scenario 20.0 5.0 4.0	100 mm o.c with ds, or staggered ows of 38 mm x ates) stud cavities give s at floor/ceiling In Laboratory 20.0 5.0 5.0	Junction 2 or 4 of separating wood-frame

	ISO Symbol	Reference	STC or Δ STC	STC or ASTC
Separating partition (Wood	-framed floor			
Laboratory STC for Dd	R_s,w	RR-336, WJ235-02	53	
Leakage or Airborne Flanking	5	Sealed & Blocked	0	
Direct STC in-situ	R_Dd,w	No adjustment, ISO 15712-1, 4.2.2		53
Junction 1 (Wood-framed se	eparating floo	r / 190 mm concrete block flanking wall)		
For Flanking Path Ff_1:				
Laboratory Flanking STC	R_s,w	RR-334, WJ235-FW-LB-02	59	
∆STC change by Lining on F	ΔR_F,w	No Lining	0	
∆STC change by Lining on f	ΔR_f,w	No Lining	0	
Normalization correction		ISO 15712-1, Eq.28a	0	
Flanking STC for path Ff_1	R_Ff,w	ISO 15712-1, Eq. 28 - 31 59 -	+ MAX(0,0) + MIN(0,0)/2 + 0 =	59
For Flanking Path Fd 1:				
Laboratory Flanking STC	R_Fd,w	RR-334, WJ235-FW-LB-02	73	
ΔSTC change by Lining on F	∆R_d,w	No Lining	0	
Flanking STC for path Fd_1	R_Fd,w	ISO 15712-1, Eq. 28 - 31	73 + 0 + 0 =	73
For Flanking Path Df 1:				
Laboratory Flanking STC	R_Df,w	RR-334, WJ235-FW-LB-02	67	
ΔSTC change by Lining on f	$\Delta R_D, w$	No Lining	0	
Flanking STC for path Fd_1	R_Df,w	ISO 15712-1, Eq. 28 - 31	67+0+0 =	67
Junction 1: Flanking STC for			$0^{-5.9} + 10^{-7.3} + 10^{-6.7} =$	58
Junction 2 (Wood-framed se	parating floo	r / wood-framed flanking wall)		
For Flanking Path Ff_2:				
Laboratory Flanking STC		RR-336, WJ235-VF_NLB-02	63	
Flanking STC for path Ff_2	R Ff,w	ISO 15712-1, Eq. 28 - 31	63 + 0.97 =	64
For Flanking Path Fd 2:	/			
Laboratory Flanking STC	R Fd,w	RR-336, WJ235-VF_NLB-02	80	
Flanking STC for path Fd_2	R_Fd,w	ISO 15712-1, Eq. 28 - 31	80 + 0.97 =	81
For Flanking Path Df 2:	,			
Laboratory Flanking STC	R Df,w	RR-336, WJ235-VF NLB-02	60	
Flanking STC for path Fd_2	R_Df,w	ISO 15712-1, Eq. 28 - 31	60 + 0.97 =	61
Junction 2: Flanking STC for			$0^{-6.4} + 10^{-8.1} + 10^{-6.1} =$	59
	an patto			
Junction 3 (Wood-framed se	parating floo	r / 190 mm concrete block flanking wall)		
Flanking STC for path Ff_3	R_Ff,w		+ MAX(0,0) + MIN(0,0)/2 + 0 =	59
Flanking STC for path Fd_3	R_Fd,w	Same as for Fd 1	73 + 0 + 0 =	73
Flanking STC for path Fd_3	R_Df,w	Same as for Df_1	67 + 0 + 0 =	67
Junction 3: Flanking STC for			0^-5.9 + 10^- 7.3 + 10^- 6.7) =	58
	an patto			
Junction 4 (Wood-framed se	parating floo	r / wood-framed flanking wall)		
All values the same as for Ju				
Flanking STC for path Ff 4	R_Ff,w	Same as for Ff_2	63 + 0.97 =	64
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd 2	80 + 0.97 =	81
Flanking STC for path Fd_4	R Df,w	Same as for Df 2	60 + 0.97 =	61
Junction 4: Flanking STC for			00 + 0.97 = $0^{-6.4} + 10^{-8.1} + 10^{-6.1} =$	59
	un putito			55
Total Flanking STC (4 Junctio	ns)	Subset of Eq. 5.3.1 Cor	nbining 12 Flanking STC values	53
	,		In this is a second sec	33
ASTC due to Direct plus Tota	al Elanking	RR-331, Equation 5.3.1 Combining Direct S	TC with 12 Flanking STC values	50
ASTC due to Direct plus 10ta	ai rialikilig	NN-351, Equation 3.5.1 Combining Direct S	TC WITH IZ FIGHKING STC VALUES	50

EXAMPLE 5.3.4 SIMPLIFIED METHOD Illustration for this case Rooms one-above-the-other Separating wood-framed floor assembly with joists perpendicular to flanking walls of normal weight concrete F1. F3 block and parallel to wood-framed flanking walls D Same structure as Example 5.3.3, plus linings Separating floor/ceiling assembly with: Floor framed with 38 mm x 235 mm wood joists spaced 400 mm o.c., with joists oriented perpendicular to concrete block wall, with 150 mm thick absorptive material³ in the inter-joist cavities Ceiling of 2 layers of 16 mm fire-rated gypsum board⁴, attached to resilient metal channels⁷ spaced 400 mm o.c. Subfloor of oriented strand board (OSB) 16 mm thick f1, f3 No floor topping and no floor finish Junction 1 or 3 (with loadbearing walls above and below floor) with: Wall above and below floor of one wythe of 190 mm hollow Junction 1 or 3 of separating wood-framed concrete block masonry¹ constructed using normal weight units floor/ceiling assembly with loadbearing not less than 53% solid, and with mass per area of 238 kg/m² flanking concrete block wall. Cells in concrete block assembly between the ledger plates are (Side view) filled with grout 38 mm x 235 mm wood ledger plate on each side of concrete blocks, fastened through with 16 mm diameter bolts spaced 400 mm o.c. and floor joists are supported on joist hangers attached to these plates Lining on each side of the concrete block walls¹ of 1 layer of 13 mm gypsum board⁴ supported on 38 mm x 38 mm wood F2, F4 furring spaced 600 mm o.c. and fastened to the concrete blocks, D with absorptive material³ filling the cavities Junction 2 or 4 (with non-loadbearing walls above and below floor) with: Joists of floor assembly parallel to these walls • Walls have 38 mm x 89 mm wood studs spaced 400 mm o.c with several framing options (single row of wood studs, or staggered studs on a single 38 mm x 140 mm plate, or 2 rows of 38 mm x 89 mm wood studs on separate 38 mm x 89 mm plates) d Walls with or without absorptive material³ in the stud cavities give f2, f4 equivalent flanking Single layer of 13 mm gypsum board⁴ that ends at floor/ceiling assembly and is attached directly to wall framing In Scenario In Laboratory Junction 2 or 4 of separating wood-framed Separating partition area $(m^2) =$ 20.0 20.0 floor/ceiling assembly with abutting side Floor/LB flanking wall junction length (m) = 5.0 5.0 walls, with side walls' framing and gypsum Floor/NLB flanking wall junction length (m) = 4.0 5.0 board terminating at framing of floor. (Plan view) Normalization for Junctions 1 and 3: 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = 0.00 RR-334, Eq. 4.2.1 Normalization for Junctions 2 and 4: 10*log(S_situ/S_lab) + 10*log(l_lab/l_situ) = 0.97 RR-334, Eq. 4.2.1

(For the notes in this table please see the corresponding endnotes on page 195.)

	ISO Symbol	Referer	ice	STC or Δ STC	STC or A	ASTC
Separating partition (Wood	-framed floor)				
Laboratory STC for Dd	R_s,w	RR-336, WJ235-02		53		
Leakage or Airborne Flanking	5	Sealed & Blocked		0		
Direct STC in-situ	R_Dd,w	No adjustment, ISO 15712-1	, 4.2.2		53	
Junction 1 (Wood-framed se	eparating floo	or / 190 mm concrete block f	lanking wall)			
For Flanking Path Ff_1:						
Laboratory Flanking STC	R_s,w	RR-334, WJ235-FW-LB-02		59		
ΔSTC change by Lining on F	ΔR_F,w	RR-334, ΔTL-BLK(NW)-33		4		
ΔSTC change by Lining on f	ΔR_f,w	RR-334, ΔTL-BLK(NW)-33		4		
Normalization correction		ISO 15712-1, Eq.28a		0		
Flanking STC for path Ff_1	R_Ff,w	ISO 15712-1, Eq. 28 - 31	59 + M/	AX(4,4) + MIN(4,4)/2 + 0 =	65	
For Flanking Path Fd 1:						
Laboratory Flanking STC	R_Fd,w	RR-334, WJ235-FW-LB-02		73		
ΔSTC change by Lining on F	ΔR_d,w	RR-334, ΔTL-BLK(NW)-33		4		
Flanking STC for path Fd_1	R_Fd,w	ISO 15712-1, Eq. 28 - 31		73+4+0 =	77	
For Flanking Path Df 1:						
Laboratory Flanking STC	R_Df,w	RR-334, WJ235-FW-LB-02		67		
ΔSTC change by Lining on f	$\Delta R_D, w$	RR-334, ΔTL-BLK(NW)-33		4		
Flanking STC for path Fd_1	R_Df,w	ISO 15712-1, Eq. 28 - 31		67 + 4 + 0 =	71	
Junction 1: Flanking STC for		Subset of Eq. 5.3.1	- 10*LOG10(10^-6	.5 + 10^- 7.7 + 10^- 7.1) =		64
<u> </u>		·				
Junction 2 (Wood-framed se	parating floo	r / wood-framed flanking w	all)			
For Flanking Path Ff 2:						
Laboratory Flanking STC		RR-336, WJ235-VF NLB-02		63		
Flanking STC for path Ff_2	R_Ff,w	ISO 15712-1, Eq. 28 - 31		63 + 0.97 =	64	
For Flanking Path Fd 2:	_ /					
Laboratory Flanking STC	R Fd,w	RR-336, WJ235-VF_NLB-02		80		
Flanking STC for path Fd_2	R Fd,w	ISO 15712-1, Eq. 28 - 31		80 + 0.97 =	81	
For Flanking Path Df 2:	,					
Laboratory Flanking STC	R Df,w	RR-336, WJ235-VF_NLB-02		60		
Flanking STC for path Fd_2	R Df,w	ISO 15712-1, Eq. 28 - 31		60 + 0.97 =	61	
Junction 2: Flanking STC for		Subset of Eq. 5.3.1	- 10*LOG10(10^-6	$.4 + 10^{-} 8.1 + 10^{-} 6.1) =$		5
			10 10 010(10 0		1	
Junction 3 (Wood-framed se	parating floo	or / 190 mm concrete block f	lanking wall)			
Flanking STC for path Ff_3	R_Ff,w	Same as for Ff 1		AX(4,4) + MIN(4,4)/2 + 0 =	65	
Flanking STC for path Fd_3	R_Fd,w	Same as for Fd_1	00 111	73+4+0 =		
Flanking STC for path Fd_3	R_Df,w	Same as for Df_1		67 + 4 + 0 =		
Junction 3: Flanking STC for		Subset of Eq. 5.3.1	- 10*LOG10(10^-6	.5 + 10^- 7.7 + 10^- 7.1) =		6
			10 10 010(10 0		1	
Junction 4 (Wood-framed se	parating floo	or / wood-framed flanking wa	all)			
All values the same as for Ju						
Flanking STC for path Ff_4		Same as for Ef 2		63 + 0.97 =	64	
Flanking STC for path Fd_4	R_Fd,w	Same as for Fd_2		80 + 0.97 =		
Flanking STC for path Fd_4	R Df,w	Same as for Df 2		60 + 0.97 =		
Junction 4: Flanking STC for		Subset of Eq. 5.3.1	- 10*10G10(104-6	$.4 + 10^{-} 8.1 + 10^{-} 6.1$ =		5
	an paris		10 10010(10 0			<u> </u>
Total Flanking STC (4 Junctio	ns)	Subset of Eq. 5.3.1	Combin	ing 12 Flanking STC values		5
	,	Jubber 01 Eq. J.J.1	Combin	ing 12 Hanking STC values		J.
ASTC due to Direct plus Tota	l Elanking	PP 221 Equation E 2.1	Combining Direct CTC	vith 12 Flanking STC values	E1	
as redue to Direct plus 10ta		RR-331, Equation 5.3.1	Combining Direct STC W	And The Flatiking STC values	51	

<u>Summary for Section 5.3: Calculation for Concrete Masonry Walls with Lightweight</u> <u>Framed Wall and Floor Assemblies</u>

The Examples 5.3.1 to 5.3.4 use a combination of the simplified procedures from Chapter 4 for lightweight framed assemblies, and the simplified methods from Section 2.4 for calculating transmission between rooms in a building with concrete floors and concrete or masonry wall assemblies.

The examples show that flanking does play a significant role in determining the performance of these systems. For Example 5.3.1 with a bare concrete block wall between the side-by-side rooms, the ASTC rating is 48, which is 1 point lower than the STC of the separating assembly. For Example 5.3.3 with one room above the other, the ASTC rating is 50 which is 3 points lower than the STC of the separating floor. In neither case do the flanking paths via the bare concrete block surfaces dominate the flanking.

For the side-by-side pair of rooms

The effect of added linings is shown in Example 5.3.2. The following trends are observed:

- Adding a lining with ΔSTC = 9 to the concrete block surfaces (both sides of separating wall) raises the ASTC rating from 48 to 56. Even this moderate improvement of the STC rating of the separating wall makes flanking transmission the dominant transmission, especially for the floorfloor and ceiling-ceiling paths.
- If the ceiling in Example 5.3.3 is also improved by mounting the gypsum board ceiling on resilient channels, the Flanking STC value for the ceiling paths (Junction 3) would improve to 75. However, this would increase the ASTC rating by only 1 point because the benefit is limited by flanking at the floor junction combined with the appreciable direct transmission.
- Significant further improvement in the ASTC rating requires the treatment of <u>both</u> the floor and the ceiling surfaces as well as the use of better linings on the separating wall. With these changes, the ASTC rating could be raised to 65 or higher.

With one room above the other

The effect of added linings on the concrete block flanking walls is shown in Example 5.3.4.

Example 5.3.4 shows the effect of adding a minimal wall lining with Δ STC = 4 to all of the concrete block surfaces. Even this small improvement makes the flanking transmission via the concrete block walls nearly insignificant. The use of better wall linings could raise the Flanking STC for Junctions 1 and 3 (paths involving the concrete block walls) to the point where they are clearly insignificant, but would not improve the ASTC rating appreciably.

Achieving significantly higher ASTC ratings requires the improvement of the floor surface and the woodframed flanking walls, as well as the use of better linings on the concrete block flanking walls. With such changes, the ASTC rating could be raised to 65 or higher.

6. Appendices

6.1. Appendix A1: Calculation of Δ TL and Δ STC Values

To characterize the change in sound transmission loss due to adding a specific lining to a heavy base wall or floor a single-number rating called Δ STC is introduced.

Key issues concerning ΔSTC include:

- The ΔSTC is a required input for the calculation of ASTC using the Simplified Method of ISO 15712-1, as discussed in Sections 2.4, 3.1, 4.1, and 5.3 of this Guide.
- Values of ΔSTC calculated from the experimental data in this Guide were calculated from experimental data using the procedure here, and are presented in tables in the companion reports for specific types of base construction; see NRC Research Reports RR-333 to RR-337. Readers of this Guide can simply use the tabulated ΔSTC values from those reports without the need to perform the calculations explained here.
- The general procedure for calculating ΔSTC is presented in this Appendix, but its application for specific constructions is explained in more detail for each material in the appendices of the NRC Research Reports RR-333 to RR-337.

ASTM does not define a Δ STC rating, but it has a counterpart (Δ R_w) in the ISO standards. The procedure used here is modified from its ISO counterpart in two ways:

- 1. The STC calculation according to ASTM E413 is substituted for the ISO calculation of R_w , plus additional Steps 4 and 5 are included, as explained in Figure A1.1 and the adjacent text.
- 2. A reference curve to represent the base assembly is required for the calculation. The ISO standards provide a set of three reference curves, one for heavy concrete floors and two for base wall assemblies. For calculations of the Δ STC value for CLT assemblies, a fourth reference curve has been added for wall assemblies that fall between the two ISO wall cases. The new reference curve is denoted as Reference Wall 2, and is described as "wall with medium-low coincidence frequency." The four reference curves are presented at the end of this Appendix.

The reference curves for the ISO procedure to calculate ΔR_w are smoothed average sound transmission loss curves for some constructions common in Europe – a homogeneous concrete floor (140 mm thick with mass per unit area of 300 kg/m²), a heavy masonry wall with low coincidence frequency (mass per unit area of 350 kg/m²) and a lighter masonry wall of gypsum blocks (mass per unit area of 70 kg/m²) described as a "wall with medium-high coincidence frequency."

In selecting the appropriate reference curve for the calculation of Δ STC, the mass or thickness of the unlined base wall or floor assembly is irrelevant. What matters is the frequency dependence of its sound transmission loss curve, especially around the frequency where the curve transitions from a comparatively flat plateau at low frequencies to rising at about 2 dB per one-third octave band.

To establish the best reference curve for a given base wall or floor assembly, the reference curve should be shifted up or down to match the STC of the tested assembly. This permits clear identification of the fit below and above the frequency where the curve bends up. The reference curve can be shifted up or down (changing the sound transmission loss at all frequency bands by the same amount) without altering the calculation of Δ STC because, as detailed in the calculation procedure below, Δ STC is the *difference* between the STC for the reference curve and the STC calculated for the curve obtained by adding the Δ TL values at each frequency to the reference curve.

<u>Procedure for Calculating ΔSTC Ratings</u>

The procedure to establish the change in sound transmission loss ΔTL due to adding linings is presented in the reports on sound transmission for specific base assemblies such as concrete block walls or CLT assemblies (NRC Research Reports RR-333 to RR-337). The following procedure uses those values for ΔTL (in one-third octave bands) for each lining to calculate the corresponding single-number ΔSTC ratings.

Steps in the procedure are detailed here and shown schematically in Figure A1.1:

- Step 1. The change in sound transmission loss (ΔTL) due to adding the lining is calculated from the laboratory test results according to ASTM E90 (for the base assembly without any added lining and for that assembly with lining(s) added) for each frequency band, including at least 125 Hz to 4 kHz. This may involve averaging results from several pairs of assemblies as explained in the NRC Research Reports RR-333 to RR-337.
- Step 2. (a) Calculate the sum of the sound transmission loss for the chosen reference curve plus ΔTL for each frequency band. The STC rating for this case is STC_{1-Side}.
 (b) Calculate the sum of the sound transmission loss for the chosen reference curve plus 2 x ΔTL for each frequency band. The STC rating for this case is STC_{2-Sides}.
 (c) Calculate the STC rating for the chosen reference curve (STC_{REF}).
- **<u>Step 3.</u>** Subtract the STC rating of the reference curve (STC_{REF}) from STC_{1-side} to obtain Δ STC_{1-side}.
- **<u>Step 4.</u>** Subtract the STC rating of the reference curve (STC_{REF}) from STC_{2-sides} to obtain Δ STC_{2-sides}.
- **Step 5.** Calculate the Δ STC value: Δ STC is the smaller of Δ STC_{1-Side} and Δ STC_{2-Sides}/1.5, rounded to integers (e.g. 20/1.5 \Rightarrow 13).

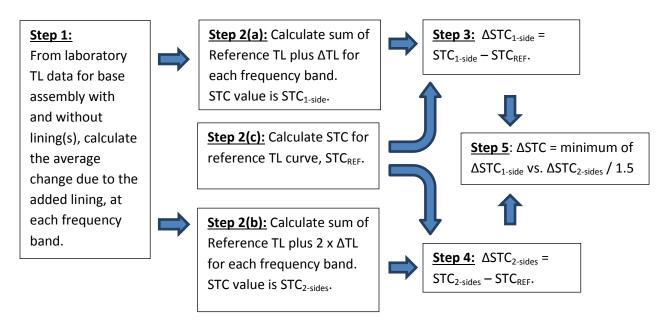


Figure A1.1: Steps to calculate the single-number rating Δ STC for added linings (as detailed above).

Consideration of the change in STC when there is a lining on both sides of the wall (Step 4) and dividing Δ STC_{2-sides} by 1.5 in Step 5 can be understood by considering the use of Δ STC values in Equations 2.4.2 and 2.4.3, in Equations 3.1.2 and 3.1.3, and in the worked examples in Sections 2.4 and 3.1.

Selection of the more conservative value (at Step 5) is required to avoid a misleading (over-optimistic) Δ STC rating in the calculation procedure of the Simplified Method.

<u>Reference Curves for Calculation of ASTC Ratings</u>

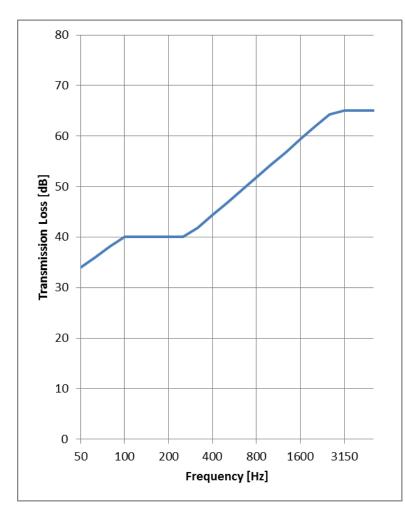
A set of four reference curves are presented here:

- One curve for concrete floors with low coincidence frequency
- Three curves for wall assemblies (or CLT floor assemblies) with different coincidence frequencies

Three of these curves match ISO Reference curves.

Figure A1.2:

Reference curve for the calculation of Δ STC values **for concrete floor assemblies with low coincidence frequency.**



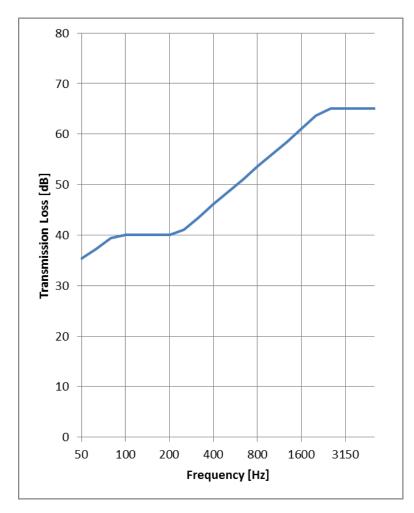
Reference Curve Floor 1

(aka Reference Curve B.2 from Annex B of ISO 140-16).

Frequency, Hz	TL, dB
50 Hz	34.0
63 Hz	36.0
80 Hz	38.1
100 Hz	40.0
125 Hz	40.0
160 Hz	40.0
200 Hz	40.0
250 Hz	40.0
315 Hz	41.8
400 Hz	44.4
500 Hz	46.8
630 Hz	49.3
800 Hz	51.9
1000 Hz	54.4
1250 Hz	56.8
1600 Hz	59.5
2000 Hz	61.9
2500 Hz	64.3
3150 Hz	65.0
4000 Hz	65.0
5000 Hz	65.0
STC	52

Figure A1.3:

Reference curve for the calculation of Δ STC values **for wall assemblies with low coincidence frequency.** This reference curve may also be used for CLT floor assemblies with low coincidence frequency (see NRC Research Report RR-335).



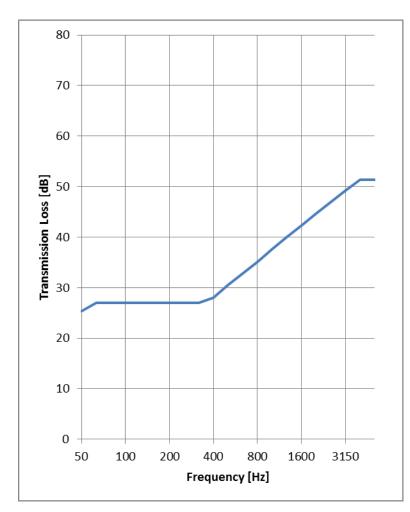
Reference Curve Wall 1

(aka Reference Curve B.1 from Annex B of ISO 140-16).

Frequency, Hz	TL, dB
50 Hz	35.3
63 Hz	37.3
80 Hz	39.4
100 Hz	40.0
125 Hz	40.0
160 Hz	40.0
200 Hz	40.0
250 Hz	41.0
315 Hz	43.5
400 Hz	46.1
500 Hz	48.5
630 Hz	51.0
800 Hz	53.6
1000 Hz	56.0
1250 Hz	58.4
1600 Hz	61.1
2000 Hz	63.6
2500 Hz	65.0
3150 Hz	65.0
4000 Hz	65.0
5000 Hz	65.0
STC	53

Figure A1.4:

Reference curve for the calculation of Δ STC values for wall assemblies with medium low coincidence frequency.



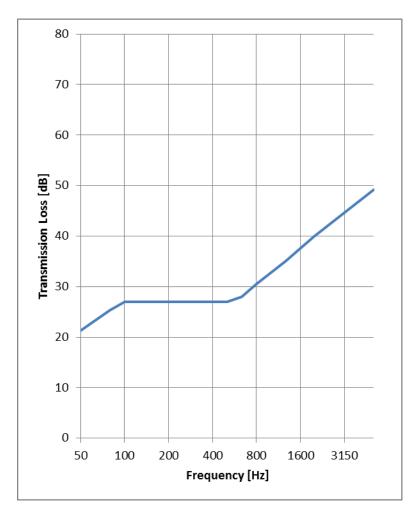
Reference Curve Wall 2

New curve produced by shifting Reference Curve B.3 from Annex B of ISO 140-16 to lower frequencies by two one-third octave bands.

Frequency, Hz	TL, dB
50 Hz	25.3
63 Hz	27.0
80 Hz	27.0
100 Hz	27.0
125 Hz	27.0
160 Hz	27.0
200 Hz	27.0
250 Hz	27.0
315 Hz	27.0
400 Hz	28.0
500 Hz	30.5
630 Hz	32.8
800 Hz	35.1
1000 Hz	37.6
1250 Hz	40.0
1600 Hz	42.3
2000 Hz	44.6
2500 Hz	46.9
3150 Hz	49.2
4000 Hz	51.3
5000 Hz	51.3
STC	36

Figure A1.5:

Reference curve for the calculation of Δ STC values **for wall** assemblies with medium high coincidence frequency.



Reference Curve Wall 3

(aka Reference Curve B.3 from Annex B of ISO 140-16).

Frequency, Hz	TL, dB
50 Hz	21.3
63 Hz	23.3
80 Hz	25.3
100 Hz	27.0
125 Hz	27.0
160 Hz	27.0
200 Hz	27.0
250 Hz	27.0
315 Hz	27.0
400 Hz	27.0
500 Hz	27.0
630 Hz	28.0
800 Hz	30.5
1000 Hz	32.8
1250 Hz	35.1
1600 Hz	37.6
2000 Hz	40.0
2500 Hz	42.3
3150 Hz	44.6
4000 Hz	46.9
5000 Hz	49.2
STC	33

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7. References and Endnotes

Technical Standards

- 1. ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements", ASTM International, West Conshohocken, PA.
- 2. ASTM E336-10, "Standard Test Method for Measurement of Airborne Sound Insulation in Buildings", ASTM International, West Conshohocken, PA.
- 3. ASTM E413-16, "Classification for Rating Sound Insulation", ASTM International, West Conshohocken, PA.
- ISO 717-2013, "Acoustics—Rating of sound insulation in buildings and of building elements—Part 1: Airborne sound insulation, Part 2: Impact sound insulation", International Organization for Standardization, Geneva.
- 5. ISO 10140-2011, Parts 1 to 5, "Laboratory measurement of sound insulation of building elements", International Organization for Standardization, Geneva. Note: In 2011 the ISO 10140 series replaced ISO 140 Parts 1, 3, 6, 8, 10, 11 and 16.
- 6. ISO 10848-2006, Parts 1 to 4, "Laboratory measurement of flanking transmission of airborne and impact sound between adjoining rooms", International Organization for Standardization, Geneva.
- 7. ISO 15712-2005, Part 1, "Estimation of acoustic performance of buildings from the performance of elements", International Organization for Standardization, Geneva.

Sources for Sound Transmission Data

Source references for sound transmission data (both collections of conventional laboratory test results for wall and floor assemblies according to ASTM E90, and flanking transmission tests according to ISO 10848) including many NRC Construction reports in the RR- and IR- series are available from the Publications Archive of the National Research Council Canada at http://nparc.cisti-icist.nrc-cnrc.gc.ca.

- 8. Collections of conventional laboratory test results for wall or floor assemblies evaluated according to ASTM E90 are presented in a series of NRC publications:
 - 8.1. IR-761 "Gypsum Board Walls : Transmission Loss Data", A.C.C. Warnock and J.A. Birta (1998),
 - 8.2. IR-832 "Sound Insulation of Load Bearing Shear Resistant Wood and Steel Stud Walls", T.R.T. Nightingale R.E. Halliwell, J.D. Quirt and J.A. Birta (2002),
 - 8.3. IR-811 "Detailed Report for Consortium on Fire Resistance and Sound Insulation of Floors: Sound Transmission and Impact Insulation Data in 1/3 Octave Bands", A.C.C. Warnock and J.A. Birta (2000),
 - 8.4. RR-169 "Summary Report for Consortium on Fire Resistance and Sound Insulation of Floors: Sound Transmission and Impact Insulation Data", A.C.C. Warnock (2005),
 - 8.5. IR-586 "Sound Transmission Loss Measurements Through 190 mm and 140 mm Blocks With Added Drywall and Through Cavity Block Walls", A.C.C. Warnock (1990)

- 9. The software application soundPATHS is accessible online at the website of National Research Council Canada at <u>http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/soundpaths/index.html.</u> Calculations are based on experimental studies in the laboratories of the National Research Council. Technical details concerning the measurement protocol and discussion of the findings of the experimental studies are presented in a series of NRC reports:
- 9.1. IR-754, "Flanking Transmission at Joints in Multi-Family Dwellings. Phase 1: Effects of Fire Stops at Floor/Wall Intersections", T.R.T. Nightingale and R.E. Halliwell, (1997),
- 9.2. RR-103, "Flanking Transmission in Multi-Family Dwellings Phase II : Effects of Continuous Structural Elements at Wall/Floor Junctions", T.R.T. Nightingale R.E. Halliwell J.D. Quirt (2002),
- 9.3. RR-168, "Flanking Transmission at the Wall/Floor Junction in Multifamily Dwellings -Quantification and Methods of Suppression", T.R.T. Nightingale, R.E. Halliwell, J.D. Quirt and F. King (2005),
- 9.4. RR-218 "Flanking Transmission in Multi-Family Dwellings Phase IV", T.R.T. Nightingale, J.D. Quirt, F. King and R.E. Halliwell, (2006),
- Research Report RR-219 "Guide for Sound Insulation in Wood Frame Construction", J.D. Quirt, T.R.T. Nightingale, and F. King, NRC Canada, Ottawa. (2006). See also NRC Construction Technology Update 66 "Airborne Sound Insulation in Multi-Family Buildings", J.D. Quirt and T.R.T. Nightingale (2008)
- 11. The databases of flanking transmission data used in this Guide and in *soundPATHS* will be consolidated in a series of NRC publications presenting data from recent studies in collaboration with industry partners, which will be updated as new data become available:
 - 11.1. RR-333 Apparent Sound Insulation in Concrete Buildings (2017)
 - 11.2. RR-334 Apparent Sound Insulation in Concrete Block Buildings (2015)
 - 11.3. RR-335 Apparent Sound Insulation in Cross-Laminated Timber Buildings (2017)
 - 11.4. RR-336 Apparent Sound Insulation in Wood-Framed Buildings (2017)
 - 11.5. RR-337 Apparent Sound Insulation in Cold-Formed Steel-Framed Buildings (2017)

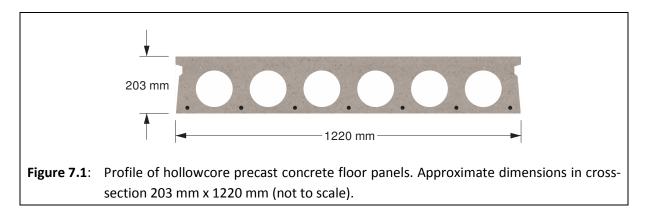
Other Technical References

- 12. L. Cremer and M. Heckl, "Structure-borne sound", edited by E.E. Ungar, Springer-Verlag, New York (original edition 1973, 2nd edition 1996).
- E. Gerretsen, "Calculation of the sound transmission between dwellings by partitions and flanking structures", Applied Acoustics, Vol. 12, pp 413-433 (1979), and "Calculation of airborne and impact sound insulation between dwellings", Applied Acoustics, Vol. 19, pp 245-264 (1986).
- 14. R.J.M. Craik, "Sound transmission through buildings: Using statistical energy analysis", Gower Publishing (1996).
- 15. D.B. Pedersen, "Evaluation of EN 12354 part 1 and 2 for Nordic Dwelling Houses", Applied Acoustics, Vol. pp 259-268 (2000), (Validation and background studies for the ISO 15712 procedures).
- 16. J. K. Richardson, J. D. Quirt, R. Hlady, "Best Practice Guide on Fire Stops and Fire Blocks and their Impact on Sound Transmission, NRCC #49677 (2007)

Endnotes

1 For the concrete block walls in these examples, the value of 238 kg/m² is the measured mass per unit area for the tested wall specimen including mortar. Normal weight concrete block masonry units conform to CSA A165.1 and have a concrete mass density of not less than 2000 kg/m³. 190 mm hollow block units are not less than 53% solid, and 140 mm hollow block units are not less than 73% solid, each giving a minimum wall mass per area over 200 kg/m². Additional information on material properties and sound transmission for other concrete block wall assemblies are given in NRC Research Report RR-334.

Precast concrete wall and floor panels are structural panels formed from normal weight concrete aggregate. The walls are typically formed as solid panels and the floors as hollowcore planks. The hollowcore floors considered in the worked examples in this Guide, as shown in Figure 7.1, were 203 mm thick with a mass per area of 344 kg/m^2 including grout. The hollowcore floors used in junction mock-up tests to confirm the validity of the vibration reduction index values from Annex E of ISO 15712-1 were 203 mm thick with a mass per area of 323 kg/m^2 without grout. This means that the methods described in Chapter 2 of this Guide are appropriate for hollowcore floors with a mass per area down to at least 323 kg/m^2 without grout.



3 Sound absorbing material is porous (closed-cell foam is not included) and readily-compressible, and includes fiber processed from rock, slag, glass or cellulose fiber. Such material provides acoustical benefit for direct transmission through lightweight framed wall or floor assemblies, and for flanking transmission when installed in the cavities between lining surfaces and heavy homogeneous structural elements of concrete, concrete block or CLT. Note that overfilling the cavity could diminish the benefit.

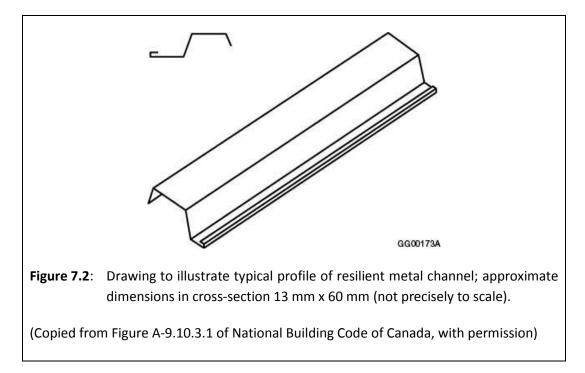
4 Gypsum board panels commonly form the exposed surface on lightweight framed wall or floor assemblies and on linings for heavy homogeneous structural wall or floor assemblies of concrete, concrete block or CLT. The gypsum board panels are installed with framing, fasteners, and fastener spacing conforming to installation details required by CSA A82.31-M or ASTM C754. Sound transmission results should only be used where the actual construction details correspond to the details of the test specimens on which ratings are based. "Fire-rated gypsum board" is typically heavier than non-fire-rated gypsum board, which gives improved resistance to sound transmission through the assembly. The term "fire-rated" is used in this Guide to denote gypsum board with mass per unit area of at least 8.7 kg/m² for 12.7 mm thickness, or 10.7 kg/m² for 15.9 mm thickness.

5 Non-loadbearing steel studs are made from sheet steel into standard profiles by roll-forming the steel sheets through a series of dies. The process does not require heat to form the profiles, hence their description as cold-formed steel framing. The studs are formed from sheet steel with a "C-shaped" cross-section profile in accordance with AISI S201, and are joined top and bottom by a rectangular U-shaped runner. "Non-loadbearing steel studs" are formed from sheet steel with a maximum thickness of 0.46 mm (25 gauge). Their profile permits some flexing of the faces to which gypsum board is attached, which limits vibration transmission between the gypsum board layers comprising the two faces of a wall assembly. Appropriate fastening details are specified in Section 9.29 of the National Building Code of Canada or in CSA A82.31-M or ASTM C754.

6 Cross-Laminated Timber (CLT) assemblies are structural panels fabricated by bonding wood elements together in layers with alternating perpendicular orientation of the timber elements. The CLT panels evaluated in this study had adhesive bonding between the faces of timber elements in adjacent layers, but no adhesive bonding the adjacent timber elements within a given layer. There were noticeable gaps between the timber elements comprising each layer of the CLT assembly. These CLT panels could be called "Face-laminated CLT Panels" but are simply referred to as CLT panels in the body of this Guide. For the 3-ply panels considered in this Guide, each layer or ply has a thickness of 26 mm and is comprised of parallel wood boards whose cross section is 26 x 89 mm. For the 5-ply and 7-ply panels, the ply thickness increases from 26 mm to 35 mm. The physical properties of the tested bare laminated panels are:

- 3-ply panels: 78 mm thick, 42.4 kg/m²
- 5-ply panels: 175mm thick, 91.4 kg/m²
- 7-ply panels: 245 mm thick, 130 kg/m 2

7 Resilient metal channels are formed from sheet steel with maximum thickness 0.46 mm (25 gauge), with profile essentially as shown in Figure 7.2, with slits or holes in the single "leg" between the faces fastened to the framing and to the gypsum board. Installation must conform to ASTM C754.



8 Loadbearing cold-formed steel (CFS) framing includes floor joists and wall studs that are made from sheet steel into standard profiles by roll-forming the steel sheets through a series of dies. The process does not require heat to form the profiles, hence the name cold-formed steel. Joists and studs are available in a variety of steel thicknesses, for applications in loadbearing and non-loadbearing walls and floors.