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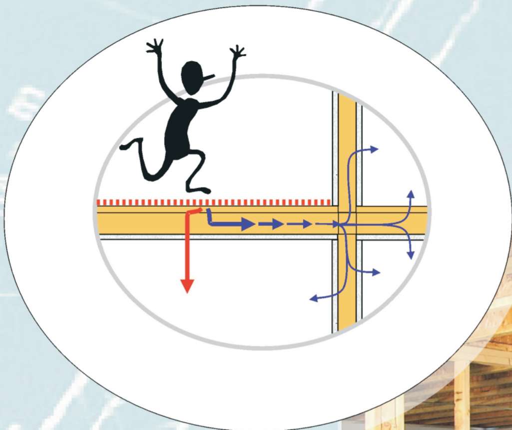
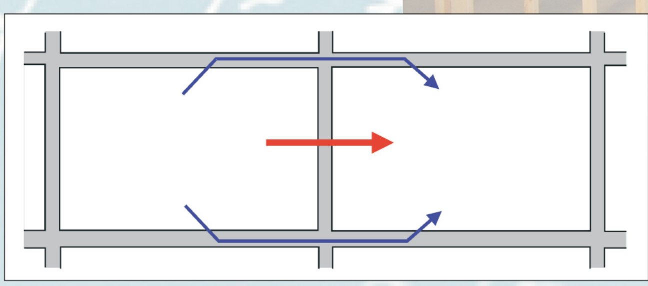
Guide for Sound Insulation in Wood Frame Construction

March 2006





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Preamble and Acknowledgement

This Guide addresses *flanking transmission* of sound through wood framed construction. Continuous structural elements and connections at the junctions of partition walls and floors provide transmission paths that by-pass the separating partition between two noise-sensitive spaces.

Flanking transmission is sound transmission between two rooms by paths other than directly through the nominally separating wall or floor assembly. Flanking exists in all buildings and its importance in determining the apparent sound insulation (that perceived by the occupants) depends on of the construction details of the walls, the floors and their junctions.

This Guide is the derivative of four industry-sponsored research projects conducted at IRC/NRC. The focus and construction details were decided by a Steering Committee of technical representatives from each of the supporting partners. Partners included Canada Mortgage and Housing Corporation, Forintek Canada Corporation, Marriott International, National Research Council Canada, Owens Corning, Trus Joist, and USG.

This Guide supersedes the version published in 2005. This version includes estimates of the flanking due to directly attached gypsum board on ceilings, corridor walls, and exterior walls. (The first version assumed that these surfaces were mounted on resilient channels, and thus had negligible effect.)

Overview of Content and Intended Application

The intent of this guide is to present the findings from a substantial experimental research study, in a form that can be used as a framework for design. The guide focuses on wood-framed assemblies because that was the priority of the study on which it is based. Other types of walls and floors with concrete or steel structural assemblies also have significant reduction of sound isolation due to flanking, but they are outside the scope of this guide.

The experimental study included only a limited set of constructions. Specific constraints imposed on the research specimens are discussed further in the section on performance of typical assemblies. Many materials and many construction details were kept constant, to avoid masking the effect of the systematic modifications. As a result, clear and consistent trends could be associated with specific construction changes, but it must be recognized that the results may not capture the effect of all significant variants.

To show trends clearly, and to provide a framework for design estimates, expected sound transmission ratings are presented for each construction. For a number of specific cases, detail drawings and specifications including identification of specific proprietary materials are presented, and these are documented further in a detailed report [1]. Although it is not repeated at every step of this guide, it should be understood that some variation is to be expected in practice due to changing specific design details, or poor workmanship, or substitution of "generic equivalents", or simply rebuilding the construction.

Despite this caveat, the authors believe that trends shown here do provide a good estimate of the flanking in typical wood-framed constructions.

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Organization of this Guide

After a brief presentation of the basic concepts for transmission of flanking sound in buildings, and a general design approach, this Guide divides into two main parts focusing in more detail on transmission of sound from airborne sources, and impact sound from footsteps.

Basic Concepts

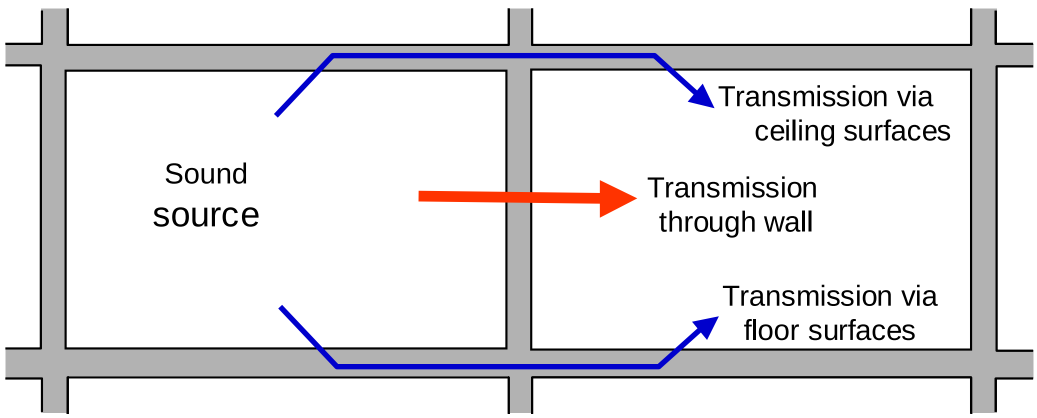
Basic Concepts for Structure-borne Transmission of Sound

Because all types of construction have some transmission of structure-borne vibration, the sound isolation between rooms in buildings is systematically less than the sound transmission class (STC) for the separating wall or floor.

This section introduces the basic concepts for describing structure-borne sound, and explains the terminology.

For adjacent rooms in a building, the sound isolation is often much less than would be expected from the rated STC of the separating wall or floor.

This happens because, in addition to direct transmission through the separating construction (which is what the STC indicates), the sound causes structure-borne vibration in all surfaces of the source room. Some of this vibration is transmitted across the surfaces (walls, floors or ceiling), through the junctions where these surfaces connect, and is radiated as sound into the receiving room.



The following diagrams show transmission at the floor/wall junction, in more detail. Vibration can be transmitted via many paths, but in practice a few paths transmit most of the energy.

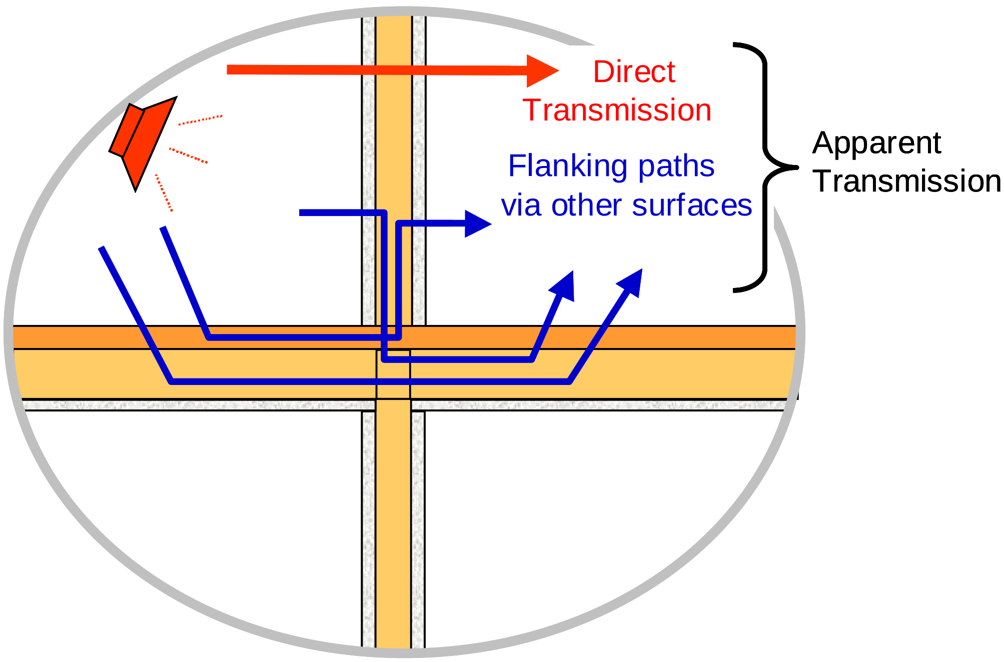
In wood-framed construction, the most important paths for this structure-borne transmission usually involve the wall/floor junction, so this is the focus for most of the following discussion.

Basic Concepts for Airborne Sound Sources

Sound in a room may come from many sources – someone talking, or the loudspeakers of a TV or stereo sound system. In the following drawings a red loudspeaker is used to indicate such sound sources, referred to as airborne sound sources.

The following section deals with the transmission of impact noise due to footsteps.

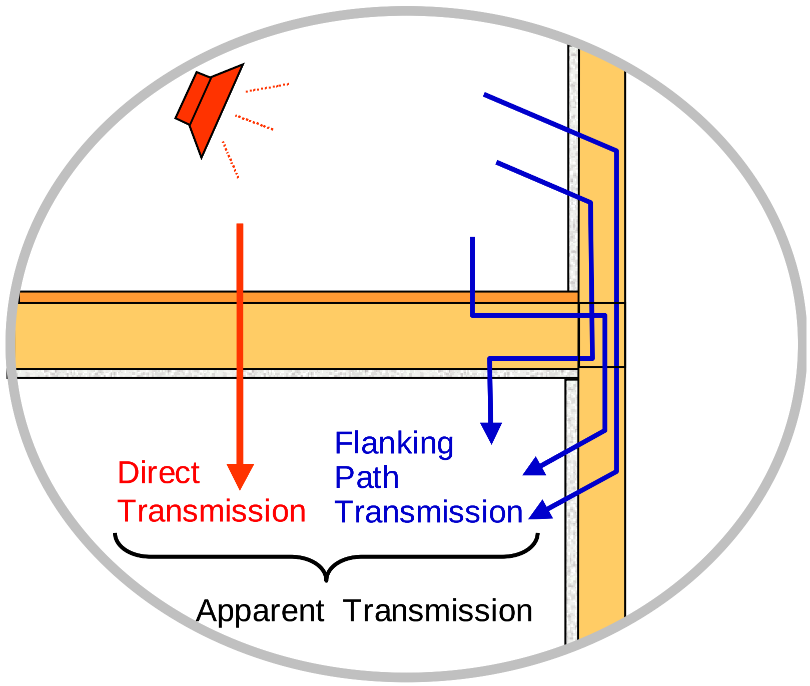
Some of the sound energy may be transmitted directly across the wall and floor assemblies and some via the floor/wall junction, as indicated by the arrows. In addition to the Direct Transmission through the separating wall (the STC for the wall describes this), there are other paths involving structure-borne transmission across the floor and wall surfaces, which acoustical standards call "Flanking Transmission" because they transmit vibration *around* the partition nominally separating the two rooms.



The Apparent Transmission includes both the Direct Transmission through the wall and the additional energy transmitted by Flanking Transmission via structure-borne paths, so the resulting Apparent-STC is lower than the STC rating for direct transmission through the wall.

From the occupants' perspective, all that matters is the overall sound isolation between the adjacent spaces, including the effect of all transmission paths. For airborne sound, the Apparent-STC provides a standardized estimate of this sound isolation.

For sound transmission between rooms separated by a floor, flanking transmission tends to reduce the Apparent-STC relative to the value for direct transmission through the floor assembly. As indicated by the arrows, there are generally a number of structure-borne flanking transmission paths in addition to direct transmission through the separating floor assembly.



Which paths are most significant depends on details of the wall and floor assemblies. Discussion of typical constructions later in this guide will show only the most important paths, but it should be remembered that changing some of the details could add other significant paths that reduce the overall sound isolation.

Whether for transmission from the room above to the room below, or vice versa, the Apparent-STC is the same (and the same transmission paths are important) for airborne sound.

Summary – Basic Concepts for Airborne Sources

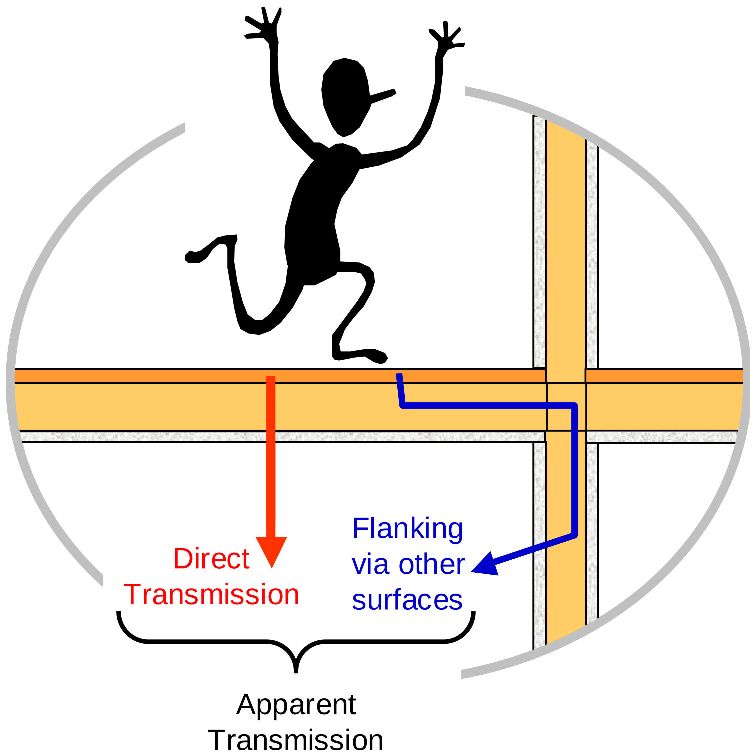
Because all types of construction have some flanking transmission, the Apparent-STC between rooms in buildings is systematically less than the STC for the separating wall or floor.

Flanking significantly reduces the apparent sound isolation for some constructions, but it can be systematically controlled.

Basic Concepts for Impact Sound Sources

The impact noise of primary concern is that due to footsteps. In the following drawings a small person is used to represent impact sound sources. This figure is sized to fit on the drawings; in the later drawings, scaling considerations would suggest a very small person, which is quite suitable because young children running and jumping pose some of the most severe tests of impact insulation for lightweight wood framed construction.

The preceding section deals with the parallel problem of controlling noise from airborne sound sources such as someone talking, or the loudspeakers of a TV or stereo sound system.

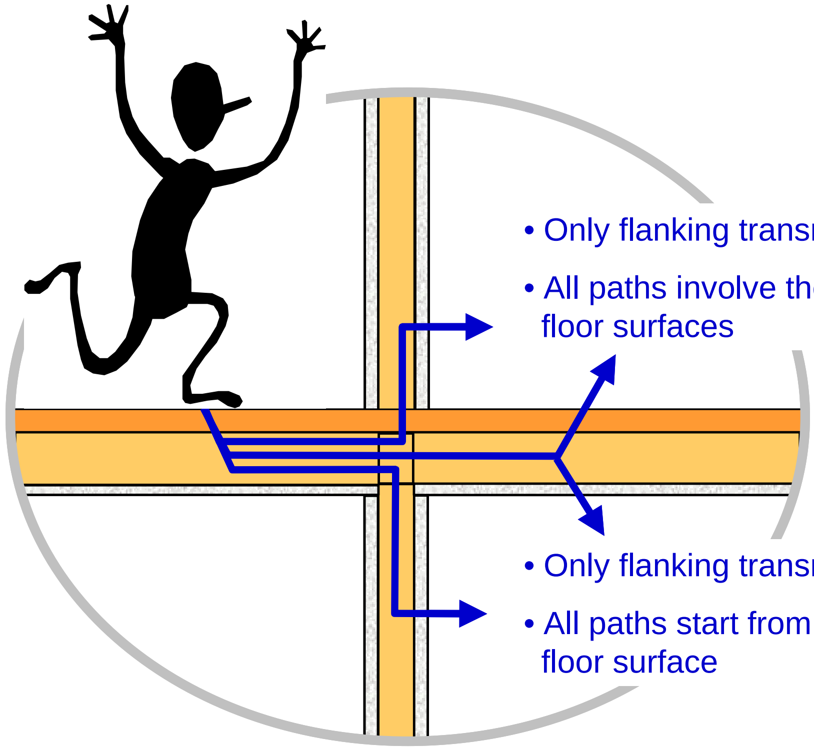


As indicated by the arrows, some of the impact sound energy may be transmitted directly through the floor assemblies (the laboratory impact insulation class (IIC) for the floor rates this) and some is structure-borne transmission (flanking) across the floor assembly and via the floor/wall junction into attached surfaces that radiate the sound. From the occupants' perspective, all that matters is the overall sound insulation between the adjacent spaces, including the effect of all transmission paths.

When the receiving room is below the impact source, the Apparent Transmission includes both the Direct Transmission through the floor and the additional Flanking Transmission via structure-borne paths, so the resulting Apparent-IIC[1] tends to be lower than the IIC rating for direct transmission.

[1] For consistency with terminology in the section on airborne sources, the term "*Apparent* Impact Insulation Class (*Apparent*-IIC)" is used here. The pertinent ASTM standard (E1007-04) calls this quantity Field Impact Insulation Class, but only applies to the case of vertical transmission.

For side-by side rooms, flanking may also cause serious impact sound transmission, despite the absence of direct transmission. As indicated by the arrows, there are generally a number of structure-borne flanking transmission paths.



Which transmission paths are most significant depends on details of the wall and floor assemblies. Discussion of typical constructions later in this guide will show only the most important paths, but it should be remembered that changing some of the details could add other significant paths that reduce the overall sound insulation.

Note that vibration transmitted across the floor can be radiated from several surfaces both in the room horizontally adjacent and on the diagonal.

Summary – Basic Concepts for Impact Sources

Flanking transmission of impact sound is a concern both for rooms beside and below the one where footsteps are creating impact sound.

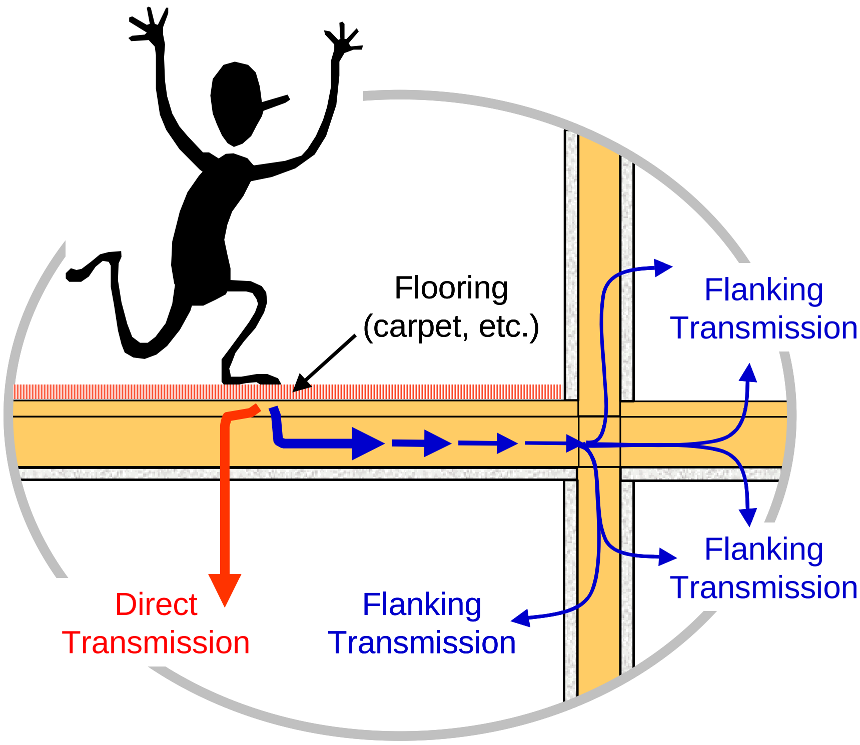
Because all types of construction have some flanking transmission, the Apparent-IIC to the room below is systematically less than the IIC for the separating floor.

Flanking significantly reduces the apparent sound insulation for some constructions, but it can be systematically controlled.

Basic Concepts for Impact Transmission on Joist Floors

For lightweight wood framed construction, the transmission of structure-borne sound is quite complicated, because several factors can change the strength of the transmitted footstep sound.

One obvious factor is the floor surface. Toppings that increase surface weight reduce impact sound at low frequencies, but hard surfaces increase the high frequency sound. Adding flooring such as carpet over the basic floor assembly gives a softer surface that reduces the impact energy injected into the underlying floor, especially for high frequencies.



Some of the impact energy is transmitted as structure-borne vibration across the floor assembly and via the floor/wall junction into attached surfaces that radiate the flanking sound into adjacent rooms, as indicated by the arrows.

For lightweight joist floors, the vibration energy at the point of impact is not the same as at floor/wall junction because vibration energy is reduced as it propagates across the floor. There is a greater vibration reduction perpendicular to the joists than in the direction parallel to the joists, and adding a topping to the floor changes this reduction.

Summary – Concepts for Impact Sound on Joist Floors

The strength of the structure-borne impact sound reaching adjacent rooms depends on:

- the floor surface,
- the direction of floor joists relative to the floor/wall junction,
- how far the impact source is from the floor/wall junction.

Design Approach

This section begins with a brief listing of some important findings for flanking involving the wall/floor junction that may influence the sound insulation achieved by a wood frame building.

Key Factors for Flanking:

Except where required for wind and seismic loads, building elements (such as OSB, gypsum board, joists, etc.) should not be continuous across or under a partition because they can introduce strong flanking paths.

Whether the room pairs are separated by a partition floor or a wall, unless the floor has a massive and resiliently isolated topping, the dominant flanking path typically involves the top surface of the floor and the flanking junction formed by intersection of the wall and floor. One of the most important factors in determining the magnitude of the floor flanking path(s) is joist orientation (parallel versus perpendicular to the flanking junction).

In comparison to the effects associated with continuity and joist orientation, other details (junction blocking details at the wall/floor junction, solid lumber versus wood-I joists, oriented strand board versus plywood subfloor) were not particularly important. Wall type (single versus double stud) was important for horizontally (side-by-side) and diagonally separated rooms, but not as important for one room above the other.

Flanking paths involving the floor can be significantly suppressed by adding a floor topping, but joist orientation remains a factor because the effectiveness of a topping depends on the floor to which it is applied. In general, a topping affects airborne and impact sources differently, and affects direct and flanking transmission paths differently:

- For airborne sound insulation, the most important factor is the mass of the applied topping. Topping installation (bonded, placed, or floating on a resilient material) is also significant but less important.
- For impact sound insulation, there are three important factors – topping mass, topping installation and, hardness of the exposed topping surface. A significant increase in mass is required to improve low frequency impact sound insulation. Resilient support of a topping tends to improve performance. A hard subfloor or topping surface (such as concrete) tends to worsen impact noise and lower the (Apparent-)IIC, but addition of a floor covering tends to mask this in practice

Floor coverings can significantly improve the apparent impact sound insulation when the floor covering reduces the hardness of the floor surface. Thus, carpet will be more effective than vinyl and both tend to be more effective when applied over hard concrete or gypsum concrete surfaces than over comparatively soft surfaces like OSB.

Flanking paths involving gypsum board surfaces can be significantly suppressed by mounting the gypsum board on resilient channels. Adding resilient channels is more effective than directly attaching another layer of gypsum board.

The preceding observations are limited to constructions examined in the supporting study [1] and are not necessarily applicable to an arbitrary construction, so the results should be used with care. However, they should be sufficient to identify the most important parameters when considering the acoustical design of a wood frame construction for noise sources other than plumbing or HVAC.

It should also be noted that there are factors such as room dimension (which determines the relative length of the junctions), and typical location for impact sources, that cannot be adequately addressed in a simple design approach like that presented here. Such factors may be important, but their effect can only be estimated using a more detailed calculation.

The following discussion assumes that the use for the rooms – and hence the apparent airborne and impact sound insulation needed between them – has been chosen.

There are basically four steps in the design approach. However, several iterations may be required to arrive at a design that satisfies requirements for sound insulation, fire resistance and structural integrity.

Step 1 – Select possible partitions

Possible partitions (wall and floor assemblies) must have a direct sound insulation rating (STC, and IIC if relevant) that is at least as great as the required apparent sound insulation between rooms.

Step 2 – Establish basic framing details

While basic framing details typically will not change which flanking path is dominant for a particular junction, they can change the magnitude of flanking transmission. Thus, the next step is to take the wall and floor assemblies chosen in Step 1, and to decide the configuration that will minimise flanking transmission and hence provide the greatest apparent sound insulation.

The tables below provide a listing of the factors and their effect on the dominant flanking path for horizontally, vertically, and diagonally separated rooms.

Because results from the supporting study indicated that flanking is most severe for horizontally separated rooms, the design should begin by considering design details for horizontally separated rooms.

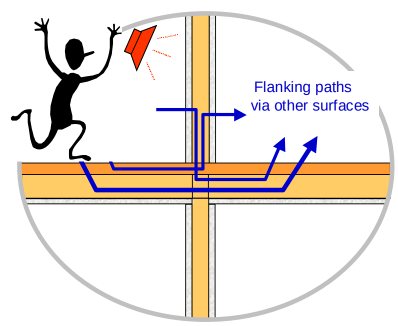
Step 2a – Horizontally separated rooms

The dominant flanking path for this room pair is from the floor in one room to the floor in the other. Other paths (floor-wall and wall-floor) are relatively unimportant except when a floor topping is applied.

Particular attention should be paid to floor and wall details that will affect transmission from one floor to the other.

The table indicates that – with or without a topping – the preferred joist orientation is parallel to the flanking junction when the partition wall is single stud construction. However, if the partition wall is double stud construction the preferred joist orientation is perpendicular, if there is no topping. (There are no data to indicate the trend when the partition wall is double stud and there is a topping).

Horizontally Separated Rooms



Floor Element and Choices		Wall Type (double stud best) [2]	
		Single Stud	**Double Stud**
Joist	**Orientation**	Parallel better than Perpendicular	Perpendicular better than Parallel
	Continuity	Avoid[3]	Avoid
	Wood-I *vs* Lumber	Minimal difference	Minimal difference
Subfloor	**Continuity**	Minimal difference	Discontinuous much better
	OSB *vs* plywood	Minimal difference	Minimal difference
Topping	**OSB overlay**	Improvement	Improvement
	Bonded concrete	Improves more	Improves more
	Floating concrete	Improves most	Improves most

It is recognised that the preferred joist orientation cannot be used at the junction with **all** noise sensitive spaces, so the preferred joist orientation should be reserved for the junction between those of greatest concern.

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[2] When the rooms are horizontally separated by a partition wall, there is less flanking involving the subfloor when the wall is of double stud construction

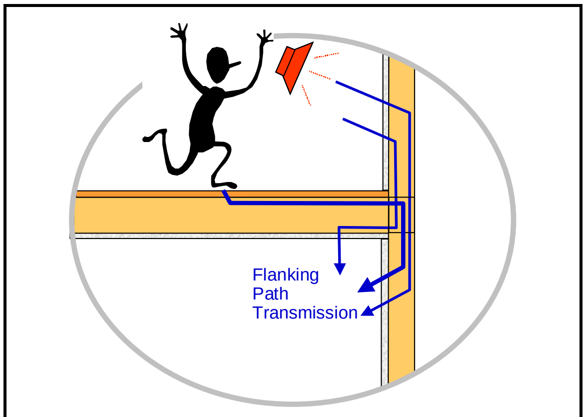
[3] Support joists on one side of the wall using joist hangers.

Step 2b – Vertically separated rooms

The dominant flanking path is from the floor in the room above to the wall(s) in the room below when the gypsum board ceiling is mounted on resilient channels. Other paths (wall-wall and wall-ceiling) are relatively unimportant except when a very effective floor topping is applied.

For vertically separated rooms, there will typically be four wall floor junctions contributing to the flanking transmission. This paradoxically makes the design process simpler. If the same wall type is used at each junction, then there is no advantage to a particular joist orientation, because the joists are parallel to two junctions and perpendicular to the other two.

Vertically Separated Rooms



Floor Element and Choices		Wall Type (minimal difference)[4] Single Stud	Double Stud
Joist	**Orientation**	Parallel better than Perpendicular	Perpendicular better than Parallel
	Continuity	N/A	N/A
	Wood-I *vs* Lumber	Minimal difference	Minimal difference
Subfloor	**Continuity**	N/A	N/A
	OSB *vs* plywood	Minimal difference	Minimal difference
Topping	**OSB overlay**	Improvement	Improvement
	Bonded concrete	Improves more	Improves more
	Floating concrete	Improves most	Improves most

The table suggests the only major advantage that can be gained from framing orientation occurs if two opposite walls are single stud and two are double stud, and joists are oriented parallel to the former (and hence perpendicular to the latter).

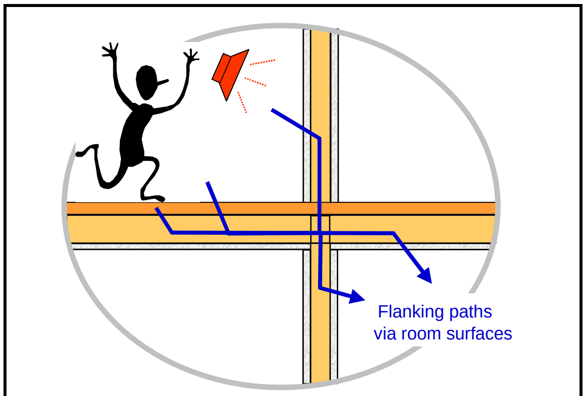
[4] When the rooms are vertically separated by a partition floor, the flanking involving the subfloor is not particularly sensitive to the type of wall

Step 2c – Diagonally separated rooms

The dominant flanking path is from the floor in the room above to the wall(s) in the room diagonally below when the gypsum board ceiling is mounted on resilient channels. However, when the gypsum board ceiling is fastened directly to the joists then the dominant path involves the ceiling.

For diagonally separated rooms,

Diagonally Separated Rooms



Floor Element and Choices		Wall Type (double stud best)[5] Single Stud	Double Stud
Joist	**Orientation**	Parallel better than Perpendicular	Perpendicular better than Parallel
	Continuity	Avoid[6]	Avoid
	Wood-I *vs* Lumber	Minimal difference	Minimal difference
Subfloor	**Continuity**	Minimal difference	Discontinuous much better
	OSB *vs* plywood	Minimal difference	Minimal difference
Ceiling	**Resilient *vs* Direct mounting**	Very significant difference	Very significant difference
	Layers 1 *vs* 2	Small difference	Small difference
Topping	**OSB overlay**	Improvement	Improvement
	Bonded concrete	Improves more	Improves more
	Floating concrete	Improves most	Improves most

The table suggests that the most effective approach would be to treat the ceiling of the receiving room by mounting the gypsum board on resilient channels. However, a floor topping in the source room will treat both horizontal and diagonal flanking paths.

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[5] When the rooms are horizontally separated by a partition wall, there is less flanking involving the subfloor when the wall is of double stud construction

[6] Support joists on one side of the wall using joist hangers.

Step 3 – Decide on gypsum board treatments

As a general rule, the gypsum board of a wall should not be continuous across the end of a partition.

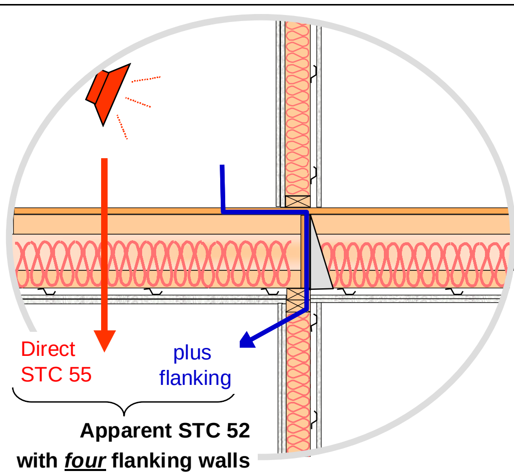
Locate extra surface layers where they provide most benefit. Increase the weight of direct attached gypsum board surfaces expected to involve a significant flanking path, or resiliently mount the gypsum board.

Whether it is necessary to resiliently mount the gypsum board of a sidewall depends on the design target for sound insulation.

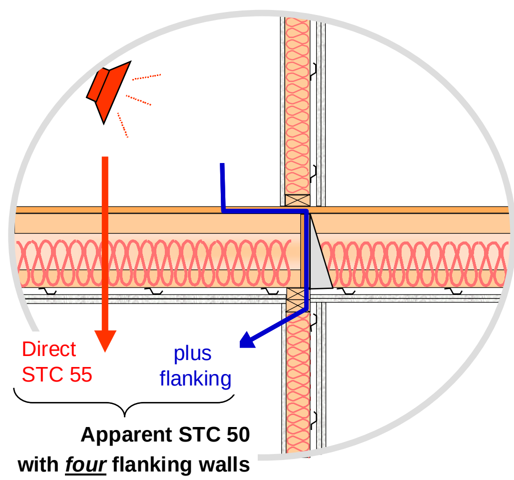
> For horizontally separated rooms, a resilient mounting should be used when the desired Apparent-STC exceeds 55.
> For diagonally separated rooms, a resilient mounting should be used when the desired Apparent-STC exceeds 60.
> For vertically separated rooms, consider both the number of layers and location of resilient channels, because all surfaces of the supporting walls are potential flanking paths for airborne and impact sound.

An example for vertical transmission is given to illustrate the point.

The example has a single stud wall with resilient channels on one side of the partition wall, in apartment construction. The dominant vertical flanking path involves the supporting wall(s) below, and the same wall(s) must adequately suppress direct transmission between horizontally separated rooms. As shown in the sketches, layers of gypsum board should be placed to maximize the number of direct attached layers, while meeting the sound insulation and fire resistance requirements for the wall.



Better for Flanking
Two layers on flanking surface



Worse for Flanking
One layer on flanking surface

Best for Flanking: Mounting the gypsum board on both sides of the wall on resilient channels minimises flanking for all paths, but requirements for racking resistance of the wall may prevent this.

Vertical insulation between the rooms to the right of the wall should approach the direct STC of 55 in all cases, because the resilient channels on the walls reduce flanking to an insignificant amount.

Adding more layers of material is effective ***only*** if they are properly positioned. In general, it is most effective to increase the mass of the subfloor, which attenuates ***all*** the flanking paths (vertical and horizontal) as well as the direct path for vertical transmission.

The final task is to estimate the apparent airborne and apparent impact sound insulation and determine whether the chosen joist orientation and basic wall type will meet the design goals.

If the apparent airborne or impact sound insulation is deficient, then Steps 1 to 3 must be repeated with some changes, or one must accept that a topping will be required and go to Step 4.

Step 4 – Establish the topping and floor covering

Because the dominant flanking path involves the floor for both horizontally and vertically separated rooms, a floor topping can be a very effective treatment to make-up for any deficiencies remaining after Step 3.

Tables of changes in apparent airborne and changes in apparent impact sound insulation for specific toppings can be used to select a possible topping.

Using softer floor covering (carpet instead of vinyl) in the source room can be used to improve the impact sound insulation, but this will not significantly improve the airborne sound insulation because these coverings are relatively lightweight.

Sound from Airborne Sources

This section gives information on flanking transmission for some common wood-frame constructions. It deals with sound transmission from airborne sound sources such as loudspeakers or people speaking. A similar section on Impact Sound Transmission presents the corresponding cases with noise from footsteps.

This section is divided into three parts, considering the apparent sound transmission between two adjacent occupancies that are:

1. one apartment above another (separated by a floor)
2. one apartment beside another (separated by a wall)
3. side-by-side "row housing" (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.

As noted in the introduction, the experimental study included only a limited set of constructions, all of them wood-framed with wood-I (or dimensional) joists 406 mm on centre, and a subfloor surface of 19 mm OSB or plywood.

Other specific constraints on the research specimens included the following:

- Two ceiling options were evaluated. For "apartments", the ceilings had 2 layers of 15.9 mm fire-rated gypsum board, installed on resilient metal channels, spaced 406 mm on centre. For "row housing" (multiple stories with no requirement for sound insulation between stories) the ceiling of single-layer 12.7 mm regular gypsum board was applied directly to the bottom of the floor joists.
- Wall-wall paths were evaluated for a subset of the constructions with one or two layers of gypsum board either screwed directly to the studs or mounted on resilient metal channels:
  - For horizontally separated rooms sharing a common sidewall (exterior wall or corridor wall), transmission via the wall-wall path was insignificant when the gypsum board was mounted on resilient channels. However, when the gypsum board was screwed directly to the sidewall studs, Apparent-STC due to the wall-wall path was 54 to 58, depending on junction details and the number of layers. The wall-wall path for horizontally separated rooms is considered in this Guide.
  - For vertically separated rooms (one above the other), transmission via the wall-wall path was insignificant when the gypsum board was mounted on resilient channels. With directly attached gypsum board the Flanking-STC was consistently over 60. This Guide ignores such wall-wall paths.
  - For diagonally separated rooms sharing a common sidewall (exterior or corridor wall), transmission via the wall-wall path was insignificant when the gypsum board was either directly attached or resiliently mounted to the studs.

Many of the materials were specific proprietary products, which are identified in individual assembly specifications. It should be understood that significant variations must be expected if “generic equivalents” are incorrectly chosen, or details are changed.

An earlier NRC study [2] showed a range of 5 in STC values among a set of floor assemblies when all materials and component dimensions were consistent, except that the wood-I joists were from different manufacturers. Presumably, joist depth is insufficient to establish “equivalence” because of differences in materials, flange dimensions, etc. Thus, large variations can be expected when the basis of deciding “equivalence” does not completely define the vibration and acoustic performance. While the variation due to other construction materials like gypsum board, fibrous batt insulation, has been much smaller, the example highlights the magnitude of possible errors due to assessing “generic equivalence” on an inappropriate physical property.

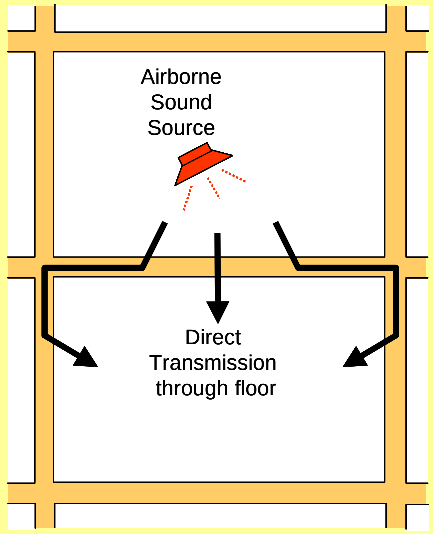
It must also be recognized that the values given in this Guide are design estimates representative of typical constructions using the construction materials indicated. Variation in sound transmission for wood frame wall and floors is significant [1] and it must be realized that individual values for “exactly replicated” constructions may differ from those indicated in this Guide. Any deviation will be a function of the exact construction, but Apparent-STC or Apparent-IIC changes of two, or more, should not be surprising.

Complete construction details are included at the end of this Guide so that the assemblies can be replicated exactly, or detailed technical information can be obtained from the manufacturer to refine selection of “generic equivalents”.

Vertical Flanking in Basic Wood-framed Constructions (One apartment __above__ the other, airborne sound source)

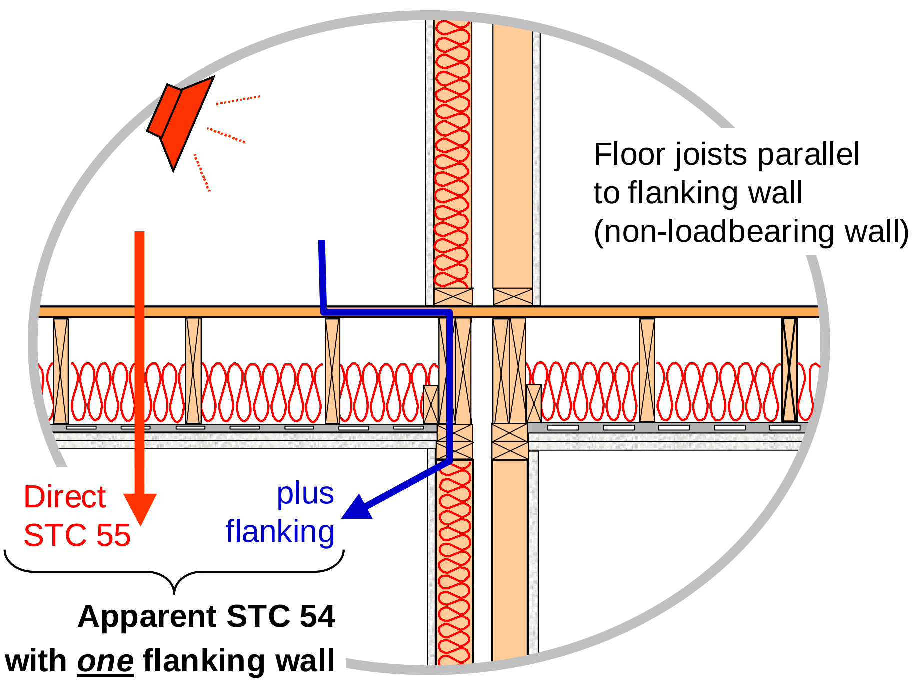
For the case of two apartments vertically separated by a floor/ceiling assembly, there are two key issues:

1. The main flanking path is consistently from the subfloor of the room above to the walls of the room below or vice versa, if the floor surface is a layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.
2. Reduction of Apparent-STC by flanking depends on the flanking transmission via ***all*** walls of the room below.



The discussion starts with flanking via just one wall (to explain relative significance of specific aspects of the constructions), and then shows the combined effect of flanking via all wall surfaces in the room below.

Sound transmission paths are shown in the figure below, for the case where floor joists are parallel to the flanking wall and that wall has double wood stud framing. The dominant flanking path is via the subfloor of the room above and wall of the room below.



The STC of 55 for direct sound transmission through the floor/ceiling system would be good enough to satisfy most occupants most of the time. The

Apparent-STC was 1 or 2 lower than Direct-STC in all cases studied, even including only the flanking by ***one*** wall.

Changes in the construction can alter the flanking transmission and hence the Apparent-STC, and a number of specific variants are listed in the table below, with their typical effect.

Change in Construction	Typical Effect due to ***one*** flanking wall	Resulting Apparent-STC
Changing Floor Materials OSB subfloor ⇒ plywood, or dimensional wood floor joists ⇒ wood-I joists	not significant	53-55
Changing Framing of floors, or of walls, or of floor/wall junction	may be significant (see next case)	53-55
Changing Walls Below On walls below, 1 layer ⇒ 2 layers of gypsum board	less flanking	54-55
On walls below, mount gypsum board on resilient metal channels	negligible flanking	55

Note 1: Apparent-STC values in this table include only the direct transmission via the floor (STC 55) and flanking via one wall – how to include flanking via all significant walls of the room below is explained later.

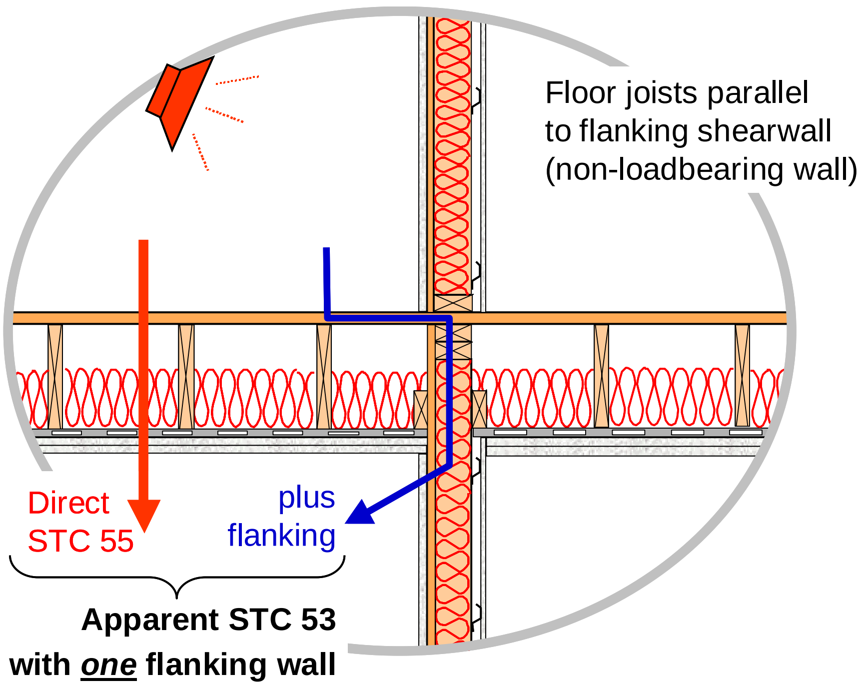
Note 2: All cases shown in the table above assume a floor assembly with 19 mm OSB subfloor attached over joists spaced 400 mm on centre, and a ceiling with two layers of fire-rated gypsum board supported on resilient metal channels, spaced 400 mm apart (typical STC=55 for direct transmission). With changes to the floor/ceiling system, the direct transmission through the ceiling and hence the significance of the flanking could change appreciably, as illustrated in the next table.

In practice, the Apparent-STC may vary depending on the specific products used and the details of installation as noted above, but this table (like similar tables in later sections) shows explicit values to clarify the trends to be expected with the listed individual changes.

Changing the orientation of the floor joists relative to the wall of concern (from parallel to the wall to perpendicular to the wall), or changing the wall framing from double row of studs to single studs or to staggered studs with a common plate, or changing the construction at the floor/wall junction all have some effect on the flanking transmission from the upper room to the one below, or vice versa. Most of these changes in vertical flanking transmission due to framing variations are small enough so they can be ignored in practice.

There seems to be slightly more vertical flanking when the floor joists are perpendicular to the wall (i.e., for a load-bearing wall) than when joists are parallel. However, the difference is small and floor joists are normally parallel to some walls in the room below and perpendicular to others, so an average value can be used with reasonable confidence.

Vertical flanking has been found to be significantly worse only for the case with a shear wall where the joists are parallel to the wall and the plates at top/bottom of the wall framing are directly connected to the subfloor, as illustrated below.



In this case, the Apparent-STC of 53 was consistently lower than for other cases tested. Hence this case is treated differently in the following table showing the combined effect of flanking paths via all the significant walls in the room below.

Table of Typical Vertical Flanking (basic floor)

The following table gives Apparent-STC due to the combined effect of direct transmission through the basic floor/ceiling, plus total flanking transmission via four walls of the room below, for four specific cases.

	Worse Floor 1 layer of gypsum board on resilient metal channels spaced @400 mm (Direct STC 51 with no topping)	**Basic Floor** 2 layers of gypsum board on resilient metal channels spaced @400 mm (Direct STC 55 with no topping)	**Better Floor** 2 layers of gypsum board on resilient metal channels spaced @600 mm (Direct STC 59 with no topping)
Worst Case Walls: Single layer applied to all walls, one is shear wall	48	49	50
Walls with 1 layer of gypsum board applied directly to the studs	49	51	52
Walls with 2 layers of gypsum board applied directly to the studs	49	52	54
All Walls with resilient channels supporting gypsum board in room below **(Best case: no flanking)**	51	55	59

Note1: This table presents Apparent-STC expected with a basic OSB or plywood subfloor. The corresponding Table of Change in Vertical Flanking due to Toppings gives the effect of modifying the floor surface.

Note2: Results will be about the same for one or two layers of resiliently mounting the gypsum board because in either case flanking paths do not contribute significantly relative to the direct path.

For intermediate situations where walls are a mix of these cases, a weighted linear average should be used. For example, when the gypsum board of one wall in the lower room is on resilient channels, two walls have 2 layers directly attached to the studs, and the fourth wall has a single layer directly attached gypsum board, the weighted linear average of the values for the “Better Floor” would be [(59+2x54+52)/4], giving Apparent-STC 55.

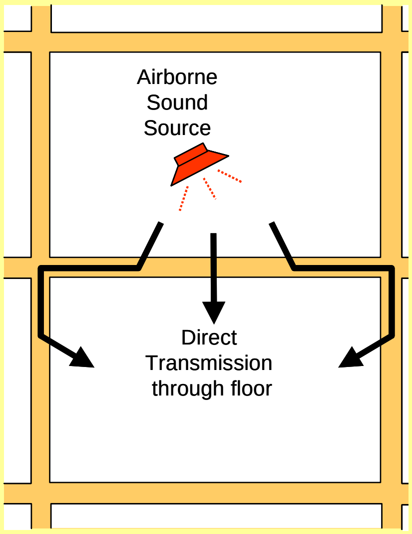
The Apparent-STC expected due to all paths was calculated from the best estimates for direct transmission plus flanking paths for all significant walls in the room below. The latter were based on an average of the flanking transmission with floor joists parallel or perpendicular to the wall, for single stud or double stud walls. As noted above, the difference among these configurations is small and floor joists are normally parallel to some walls in the room below and perpendicular to others, so an average value can be used with reasonable confidence.

Summary – Vertical Flanking in Typical Constructions

For the case of two apartments vertically separated by a floor/ceiling assembly, the Apparent-STC between the two occupancies is systematically less than the STC for direct transmission through the separating floor.

There are three main issues:

1. The main flanking path is consistently from the subfloor of the room above to the walls of the room below or vice versa, if the subfloor is a layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.
2. Some changes in the wall below can significantly reduce transmission via a specific wall surface. Adding a second layer of gypsum board reduces flanking. Mounting gypsum board on resilient channels should reduce flanking to insignificance for most practical floor assemblies.
3. Reduction of Apparent-STC by flanking depends on the flanking transmission via ***all*** walls of the room below.



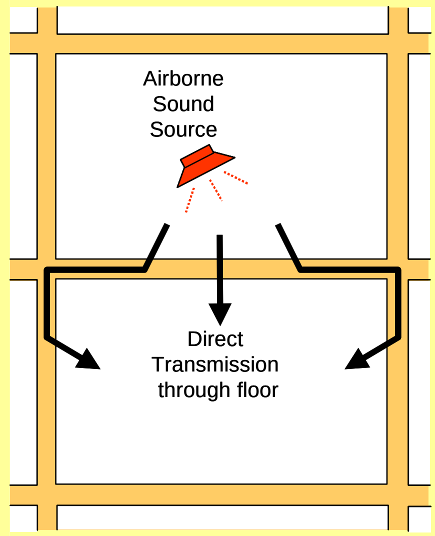
As discussed in the detailed report [1], the estimates in this section should be applied only for cases where wall and floor details are within the range of the tested specimens (links to specifications are in section on [Changes to Control Horizontal Flanking])

This Guide ignores the vertical sound transmission between stories within a single occupancy where the gypsum board ceiling is screwed directly to the floor joists (called “row housing” in later sections)

Changes to Control Vertical Flanking between Apartments
(One apartment <u>above</u> another, Airborne Sound Source)

For the case of two apartments vertically separated by a floor/ceiling assembly (vertical transmission):

1. Changes to control flanking must be focused on the elements of the dominant flanking path.
2. The two surfaces that can be modified to reduce flanking transmission are the walls in the room below, and the floor surface in the room above.
3. Effects of some common changes are presented in this section



The effects of simple changes to the walls of the room below are presented in detail in the earlier section on flanking in typical basic constructions. The combined flanking transmission via all walls of the room below must be considered. Typical Apparent-STC values are listed in the Table of Typical Vertical Flanking

- The worst case is with a single layer of gypsum board directly attached to the studs of all the walls below.
- Adding a second layer of directly attached gypsum board provides slight reduction in the flanking transmission.
- If the gypsum board is mounted on resilient metal channels, the flanking via that surface is reduced enough so that it can be ignored. Any such walls need not be included as significant when assessing flanking transmission.

Note that resilient channels ***must*** be mounted between the studs and the gypsum board, not between two layers of gypsum board.

In addition to the effect of specific gypsum board treatment of the walls in the room below, the Apparent-STC can also be improved by changing the floor surface.

- Adding a topping over a basic plywood or OSB subfloor gives more attenuation both for direct transmission through the floor and for the dominant flanking transmission paths.
- The change in flanking due to adding a topping depends on the type of topping and on the orientation of the floor joists relative to the flanking wall. However, an average value can be used as a slightly conservative design estimate because the floor joists are normally parallel to some walls in the room below and perpendicular to others.

Table of Change in Vertical Flanking due to Toppings

The following Table shows the change in Apparent-STC expected from adding a topping, including both direct transmission through the floor/ceiling and flanking transmission via the walls of the room below.

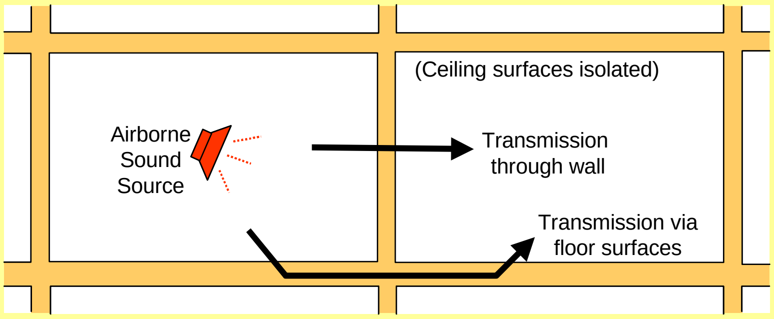
		Worse Ceiling 1 layer of gypsum board on resilient metal channels @400mm (Direct STC 51 with no topping)	**Basic Ceiling** 2 layers of gypsum board on resilient metal channels @400mm (Direct STC 55 with no topping)	**Better Ceiling** 2 layers of gypsum board on resilient metal channels @600 mm (Direct STC 59 with no topping)
Walls in room below	**Floor Topping**	For case with no floor topping, get Apparent-STC from the *Table of Typical Vertical Flanking* For the complete system including a topping, add (to the Apparent-STC without a topping) a value chosen from table below		
All Walls with 1 or 2 layers of gypsum board applied directly to the studs in room below	Stapled 19 mm OSB topping	+5	+6	+7
	Bonded 25 mm gypsum concrete topping	+10	+9	+9
	38 mm gypsum concrete topping on resilient mat	+14	+13	+12
All Walls with resilient channels supporting gypsum board in room below **(No flanking)**	Stapled 19 mm OSB topping	+4	+5	+5
	Bonded 25 mm gypsum concrete topping	+11	+11	+11
	38 mm gypsum concrete topping on resilient mat	+15	+15	+15

Note1: Specifications and detail drawings for the basic assemblies and added toppings are given in the following section on Changes to Control Horizontal Flanking. Values in this table were obtained from evaluation of a limited set of specimens built with specific products that are identified in the detailed descriptions. Using "generic equivalents" may change results.

Note2: Results will be about the same for one or two layers of resiliently mounting the gypsum board because in either case flanking paths do not contribute significantly relative to the direct path.

Horizontal Flanking in Wood-framed Constructions One apartment beside the other, airborne sound source)

For the case of two apartments horizontally separated by a partition wall assembly, there are two key issues:



1. The main flanking path is consistently from the floor of one room to the floor of the room beside, if the subfloor is a continuous layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.

2. Reduction of Apparent-STC may be affected by details of the floor assembly, the wall assembly, and the continuity of structural elements across the floor/wall junction.

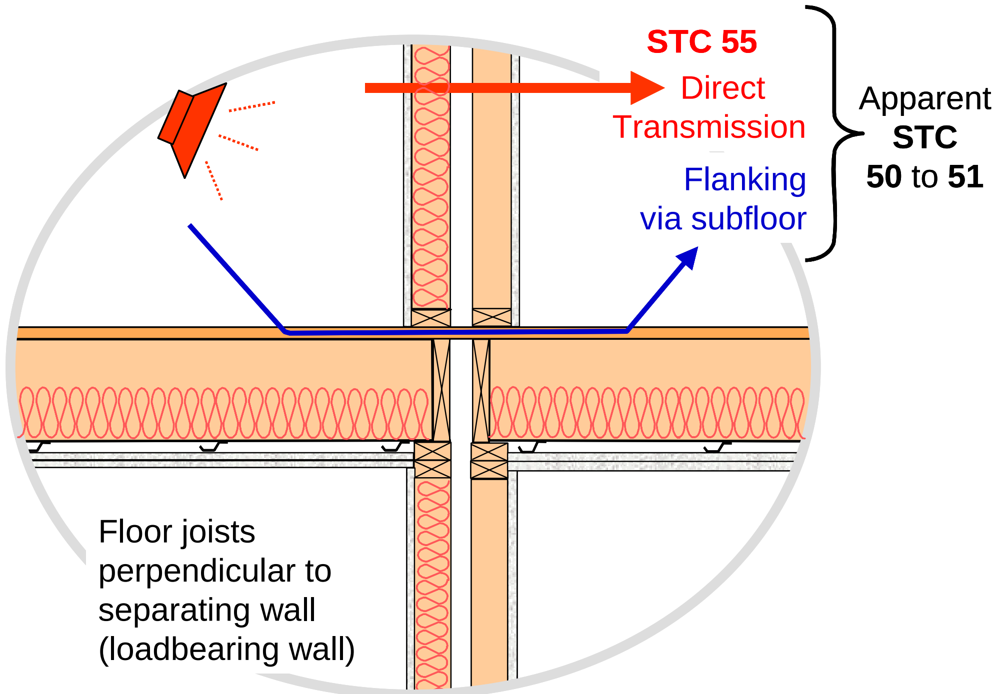
Note that the above assumes that other horizontal paths (wall-wall and ceiling-ceiling paths) are not significant. This will be the case if there are resilient channels or other vibration breaks in such paths.

Several "row housing" cases, where the ceiling is not on resilient channels, are presented in a later section; with a basic subfloor, they exhibit very similar horizontal flanking to the cases in this section.

To highlight the key factors influencing horizontal flanking across floor/wall junctions, a number of typical configurations are presented, proceeding from cases where the flanking effect is rather small to cases where flanking drastically reduces the sound isolation.

With the subfloor continuous across the junction at a double stud wall, Apparent-STC is appreciably below the STC 55 for direct transmission through the separating wall.

Link to Corresponding Impact



The Apparent-STC may be changed by specific changes in the floor assembly, or the wall assembly, or the fire block at floor/wall junction.

Change in Construction	Typical Effect	Apparent STC
Changing Floor 16 mm OSB subfloor ⇒ plywood subfloor	not significant	50 — 51
Changing Wall Double gypsum board on each side and insulation on each side (Direct STC 66)	Improvement depends on fire block	52 — 66 depends on fire block
Changing Floor/Wall Junction Subfloor break at wall cavity	Improvement depends on fire block	50 — 50 depends on fire block

Some of the changes listed in the table are inter-dependent. As well, flanking via sidewalls (such as an exterior wall or corridor wall perpendicular to the separating wall shown) can cause further reduction of the Apparent-STC.

The effects of these combined flanking paths are presented on the following page, for some typical generic fire blocks.

Fire blocks are required to stop the spread of fire through concealed cavities such as that between the two rows of studs in the wall illustrated above. The performance of such systems is discussed in an IRC/NRC publication [3]. As noted in that publication, as well as performing their intended function of controlling fire, these treatments at the floor/wall junction can significantly worsen flanking transmission.

The effect of fire blocks depends on the associated constructions. Two separating walls are considered – basic (as shown above in the figure) that provides Direct-STC 55, and a better wall (with double gypsum board on each side, and cavity insulation on each side) that provides Direct-STC 66. The table also presents two alternatives for the sidewall – with the gypsum board either directly screwed to the studs and continuous across the partition wall or mounted on resilient channels and discontinuous across the partition wall. For each of these construction cases, the table presents the Apparent –STC for four variants of fire block at the floor/wall junction.

Separating wall	Basic Wall (STC 55)	Better Wall (STC 66)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Fire Block Alternatives	**(Apparent-STC)**		
Continuous OSB or Plywood	49	51	52
0.38 mm sheet steel	50	54	57
Coreboard (between joist headers)	50	54	57
Fibrous material (glass fibre or rock fibre of suitable density)	50	54	66
No material in gap	N/A	N/A	66

The performance of fire blocks (for both sound and fire) is addressed further in References 3 and 4.

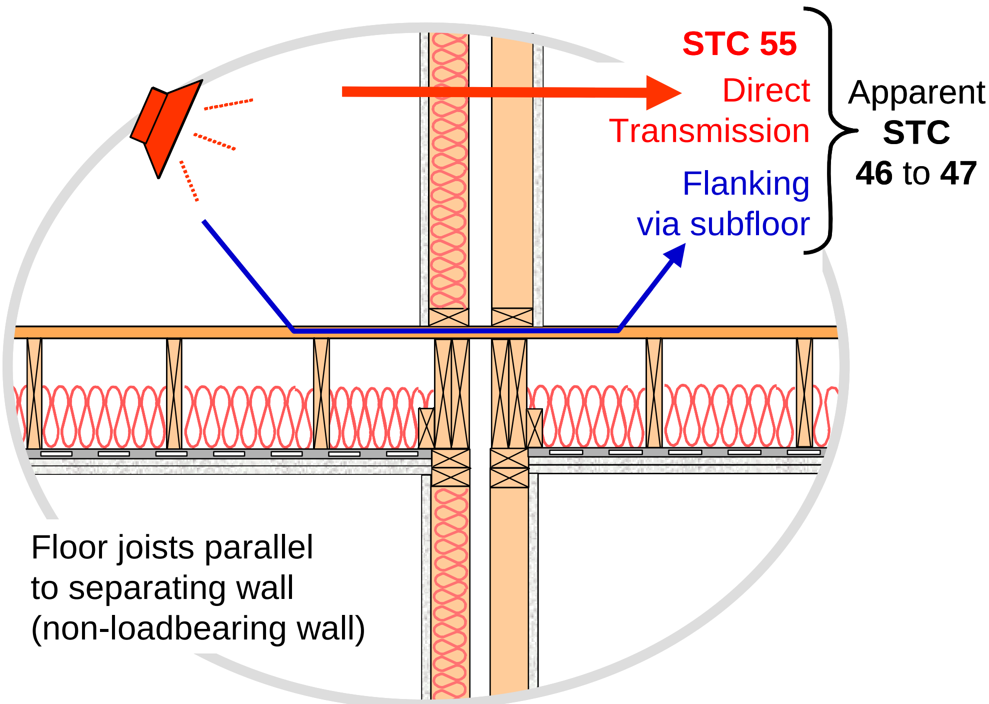
The tabulated values show that to attain Apparent-STC 55 or better with the basic OSB subfloor, it may be necessary to select an appropriate fire block **and** an improved separating wall **and** adequately treat flanking paths involving the sidewalls.

In practice, a fire block formed by continuous OSB or plywood subfloor may be required to provide structural support, especially in regions where strong lateral loading from winds or seismic activity is expected.

- For row housing this may be a lesser concern. The fibrous fire blocks that cause negligible flanking transmission across the cavity of the separating double stud wall offer an effective solution in those cases.
- Continuous OSB or plywood subfloor is the typical solution for multi-storey apartment construction. In such cases, the use of a topping may be required, and this is addressed in later sections.

With the subfloor continuous across the junction at a double stud wall, and floor joists parallel to the wall, the Apparent-STC is even farther below the STC 55 for direct transmission through the separating wall.

Link to Corresponding Impact



The Apparent-STC may be changed by specific changes in the floor assembly, or the wall assembly, or the fire block at floor/wall junction.

Change in Construction	Typical Effect	Apparent STC
Changing Floor 16 mm OSB subfloor ⇒ plywood subfloor dimensional wood floor joists ⇒ wood-I joists	not significant	46 — 47
Changing Wall Double gypsum board on each side and insulation on each side (Direct STC 66)	Improvement depends on fire block	45 — 62 depends on fire block
Changing Floor/Wall Junction Subfloor break at wall cavity	Improvement depends on fire block	45 — 49 depends on fire block

Some of the changes listed in the table are inter-dependent. As well, flanking via sidewalls (such as an exterior wall or corridor wall perpendicular to the separating wall shown) can cause further reduction of the Apparent-STC.

The effect of fire blocks depends on the associated constructions. Two separating walls are considered – basic (as shown above in the figure) that provides Direct-STC 55, and a better wall (with double gypsum board on each side, and cavity insulation on each side) that provides Direct-STC 66.

The table also presents two alternatives for the sidewall – with the gypsum board either directly screwed to the studs and continuous across the separating wall or mounted on resilient channels and discontinuous across the separating wall. For each of these construction cases, the table presents the Apparent-STC for four variants of fire block at the floor/wall junction.

Separating wall	Basic Wall (STC 55)	Better Wall (STC 66)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Fire Block Alternatives	**(Apparent–STC)**		
Continuous OSB or Plywood	45	47	48
None, or fibrous material	--	54	62

The tabulated values show that it is not possible to attain Apparent-STC 50 or better with the continuous basic OSB subfloor, regardless of the separating wall, or the mounting and continuity of the sidewall gypsum board.

Not all of the fire blocking materials were examined when the joists are parallel to the wall/floor junction. However, comparing the case of the continuous OSB of this case (parallel) to the previous (perpendicular) suggests that the Apparent-STC will be lower when the joists are parallel to the junction.

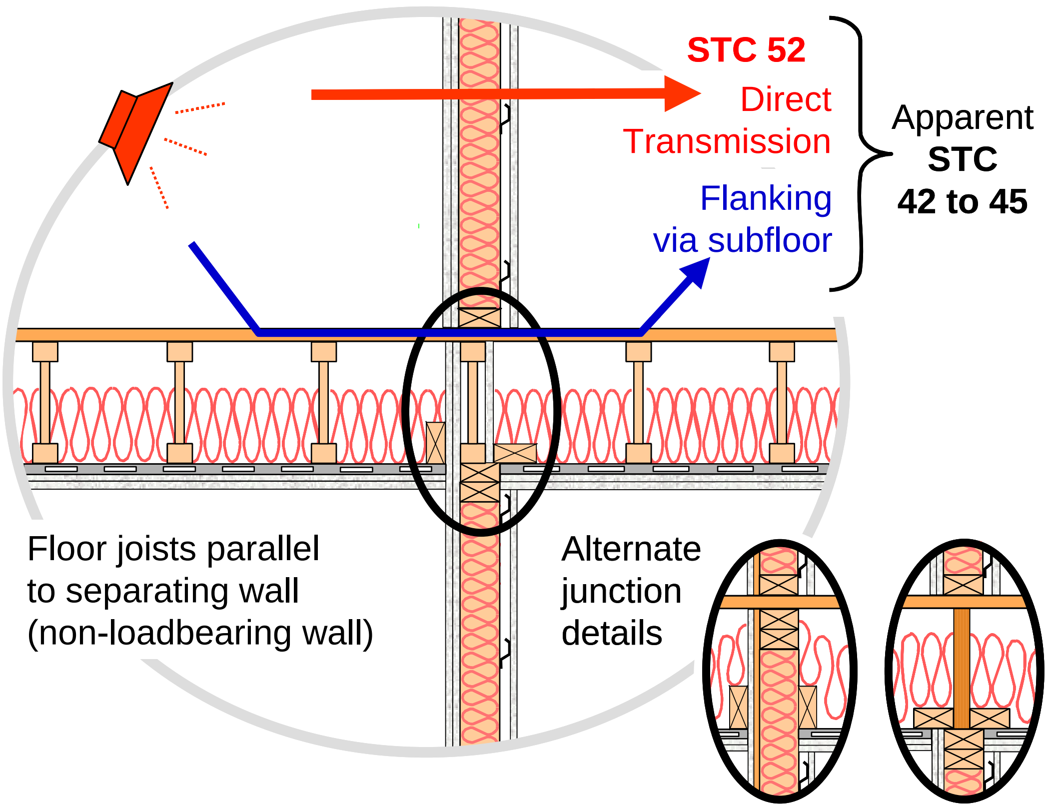
As with the case where the joists are perpendicular to the wall/floor junction (previous case), attaining an Apparent-STC of 55 or better can only be done through attention to an appropriate fire block **and** an improved separating wall **and** adequate treatment of flanking paths involving the sidewalls.

In practice, a fire block formed by continuous OSB or plywood subfloor may be required to provide structural support, especially in regions where strong lateral loading from winds or seismic activity is expected.

- For row housing this may be a lesser concern. The fibrous fire blocks that cause negligible flanking transmission across the cavity of the separating double stud wall offer an effective solution in those cases.
- Continuous OSB or plywood subfloor is the typical solution for multi-storey apartment construction. In such cases, the use of a topping may be required, and this is addressed in later sections.

With the floor joists parallel to the separating wall, changing from the double stud wall to a simpler single stud wall assembly permits more transfer of structural vibration across the junction, and hence lowers the Apparent-STC to about 45.

Link to Corresponding Impact



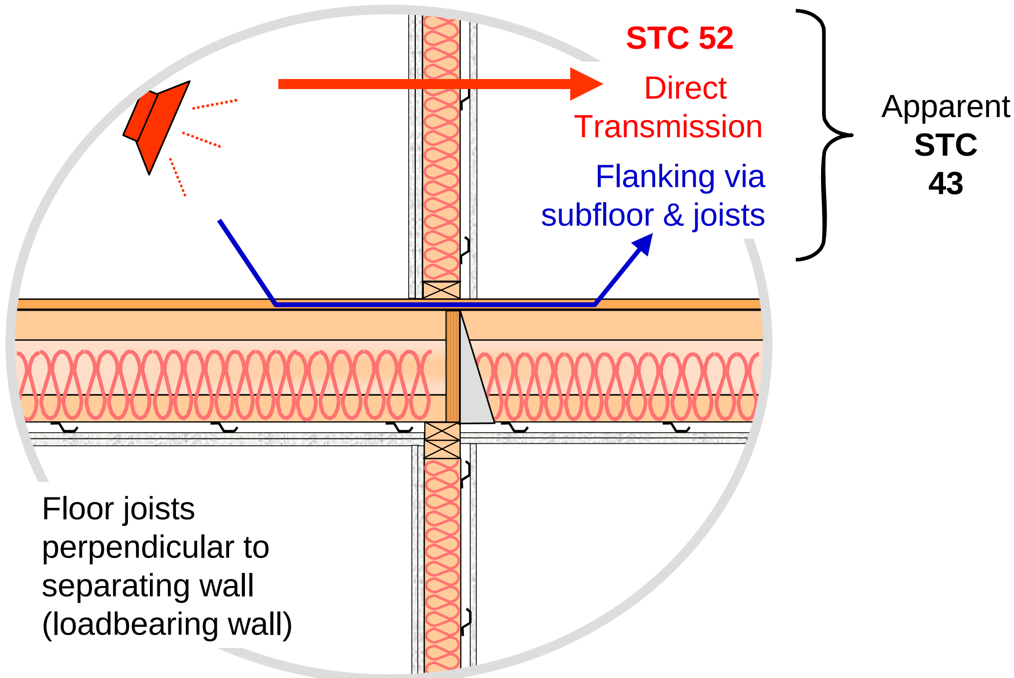
Changing the wall assembly has only slight effect on the Apparent-STC, except that the shear wall lowers the Apparent-STC to 42.

Separating wall		Basic Wall (STC 52)	Better Wall (STC 57)
Change in Construction	**Effect**	**(Apparent–STC)**	
Changing Floor/Wall Junction Subfloor break at wall or alternate fire block details	slightly worse (shear wall is worst)	42 — 45	43 — 46
Sidewall Gypsum Board Directly attached ⇒ Resiliently mounted	not significant*	44	46

*Note *   Directly attaching the gypsum board of the sidewall is not significant when the subfloor is continuous and bare, as shown here. When a topping is applied, however, sidewall paths become important and can limit the Apparent-STC to 54, as shown later.*

With the single stud wall assembly, changing orientation of the floor joists from parallel to the separating wall to perpendicular gives more transfer of structural vibration across the floor and alters the junction; this lowers the Apparent-STC even further, to about 43.

Link to Corresponding Impact



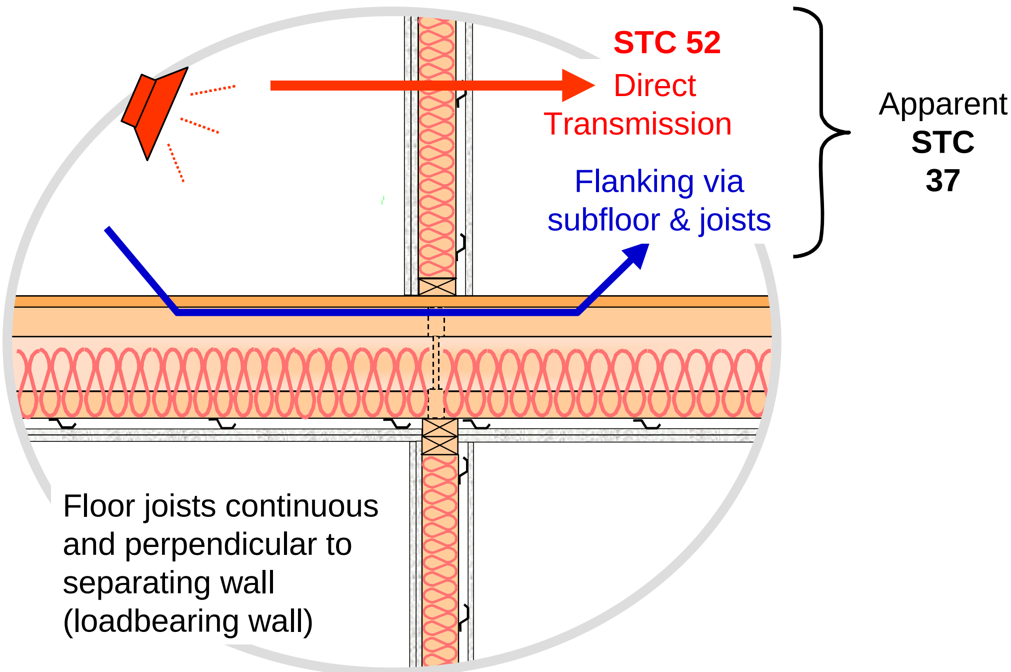
In this case, the transmission from floor to floor is clearly dominant, so improving the separating wall to Direct STC 57 does not affect the overall Apparent-STC (and greater improvements in the wall would have the same minimal benefit.)

Separating wall		Basic Wall (STC 52)	Better Wall (STC 57)
Change in Construction	**Effect**	**(Apparent–STC)**	
Changing Floor/Wall Junction Subfloor break at wall	not significant	43	43
Sidewall Gypsum Board Directly attached ⇒ Resiliently mounted	not significant*	43	43

Note * *Directly attaching the gypsum board of the sidewall is not significant when the subfloor is continuous and bare, as shown here. When a topping is applied, however, sidewall paths become important and can limit the Apparent-STC to 54,* *as shown later*.

With the subfloor and the joists continuous across the floor/wall junction, but the same single stud wall assembly and floor details, there is more transfer of structural vibration across the junction. This lowers Apparent-STC below 40.

Link to Corresponding Impact



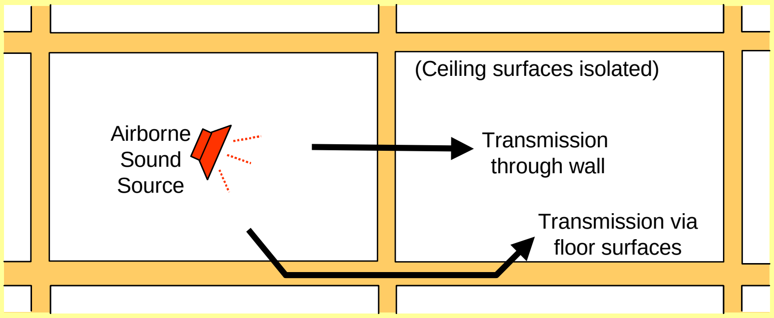
In this case, the transmission from floor to floor is so dominant that improving the separating wall to a Direct STC of 57 has negligible effect on the overall Apparent-STC.

Separating wall		Basic Wall (STC 52)	Better Wall (STC 57)
Change in Construction	**Effect**	**(Apparent–STC)**	
Changing Floor/Wall Junction Subfloor break at wall	not significant	37	37
Sidewall Gypsum Board Directly attached ⇒ Resiliently mounted	not significant*	37	37

*Note ***** Directly attaching the gypsum board of the sidewall is not significant when the subfloor is continuous and bare, as shown here. When a topping is applied, however, sidewall paths become important and can limit the Apparent-STC to 54, as shown later.*

Summary – Horizontal Flanking in Typical Apartment Constructions

For the case of two apartments horizontally separated by a partition wall assembly, the Apparent-STC between two rooms is systematically less than the STC for direct transmission through the separating wall.

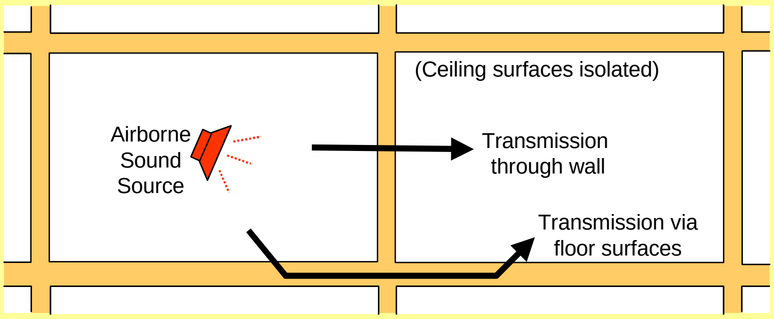


There are four main issues:

1. The main flanking path is consistently from the floor of one room to the floor of the other, if the subfloor is a layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.
2. Reduction of Apparent-STC by flanking is mainly due to the continuity of floor components across the floor/wall junction.
3. Changes in the orientation of the floor joists, or the details of the floor/wall junction can significantly alter the flanking transmission.
4. In the worst cases, the flanking transmission can be much stronger than direct transmission through the nominally separating wall, so that improvements to the separating wall, and/or sidewalls, have negligible effect on the Apparent-STC.

Changes to Control Horizontal Flanking
(One apartment beside another, Airborne Sound Source)

For the case of two apartments horizontally separated by a partition wall assembly (horizontal transmission), there are four key issues:



1. The main horizontal flanking path is consistently from the floor of one room to the floor of the room beside, if the basic floor surface is a layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.

2. The only surfaces that can be modified to significantly reduce flanking transmission are the floors in the two rooms.

3. The incremental effect of adding a floor topping depends not just on the topping but also on the floor over which it is applied. In particular, the improvement due to a topping may depend strongly on the orientation of the floor joists relative to the floor/wall junction.

4. In some cases, the change in the flanking transmission is substantial, and coupled with improvements to the wall itself may provide a very high Apparent-STC.

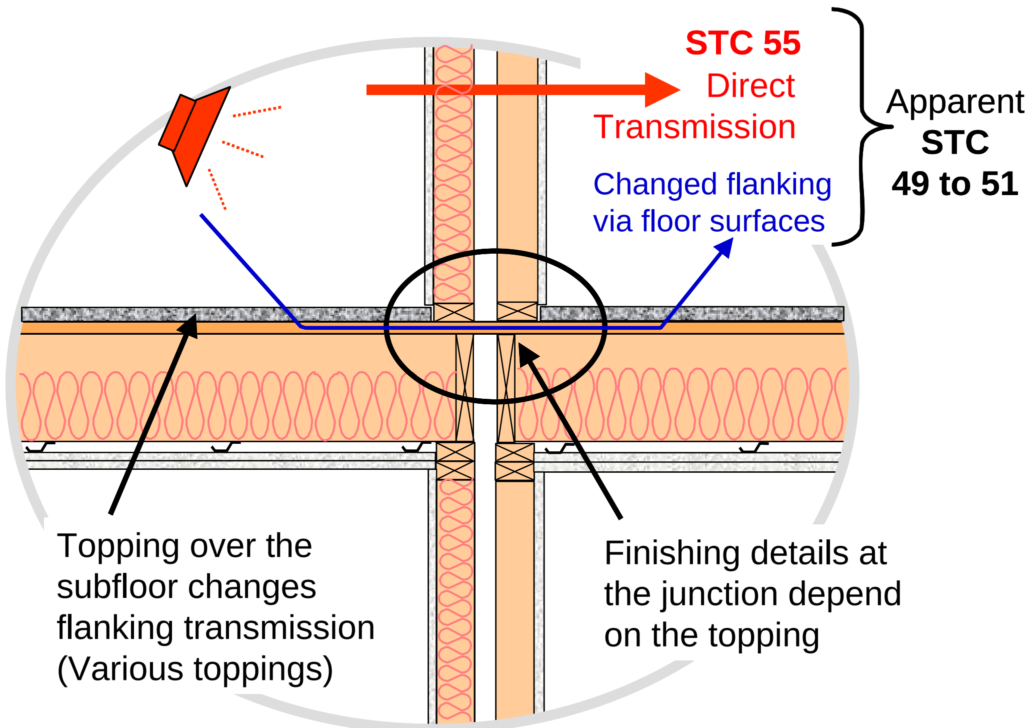
Note that the data and analysis in this section are only suitable if ceiling-ceiling paths are not significant. This will be the case if there are resilient channels supporting the ceiling, which is assumed to be characteristic for “apartment” construction – the focus of this section.

“Row housing” cases, where the ceiling is not on resilient channels, are presented in a later section.

Because the effect of toppings depends quite strongly on the supporting floor assembly, the effect is shown for each of the basic floor assemblies in turn, in the same order as the preceding section presenting performance with the basic subfloor.

With a double stud wall, the horizontal flanking depends strongly on the fire block details at the floor/wall junction. The worst flanking occurs when the subfloor is continuous across the junction. Even in that case, the Apparent-STC between the side-by-side rooms can be improved by installing a floor topping over the basic OSB or plywood subfloor. Direct transmission through the separating wall (or flanking via the sidewalls) can limit Apparent-STC.

Link to Corresponding Impact



The table lists Apparent–STC for cases with two variants of the separating wall (the illustrated basic wall with STC 55 and a better wall with STC 66 that has double gypsum board on each face and insulation in both stud cavities) and two sidewall cases (with gypsum board screwed directly to the studs, or mounted on resilient channels).

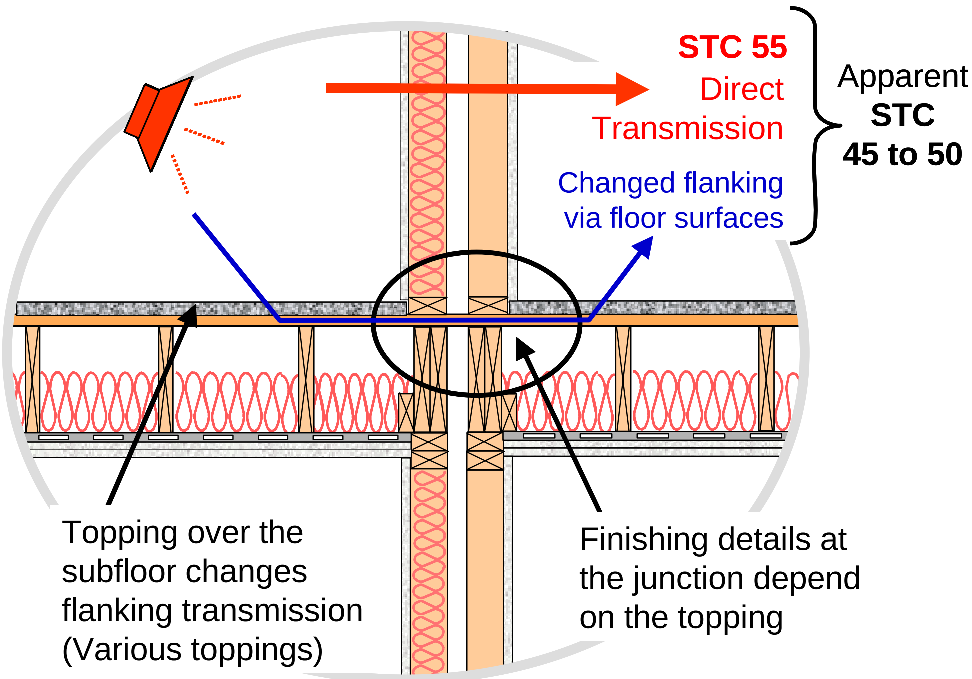
Separating wall	Basic Wall (STC 55)	Better Wall (STC 66)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	49	51	52
19 mm OSB stapled to subfloor	51	54	60

Note: *These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.*

With the joists parallel to the separating wall, the improvement in Apparent-STC due to adding toppings is significant.

With a double stud wall, the horizontal flanking depends strongly on the fire block details at the floor/wall junction. The worst flanking occurs when the subfloor is continuous across the junction. Even in that case, the Apparent-STC between the side-by-side rooms can be improved by installing a floor topping over the basic OSB or plywood subfloor. Direct transmission through the separating wall (or flanking via the sidewalls) can limit Apparent-STC.

Link to Corresponding Impact



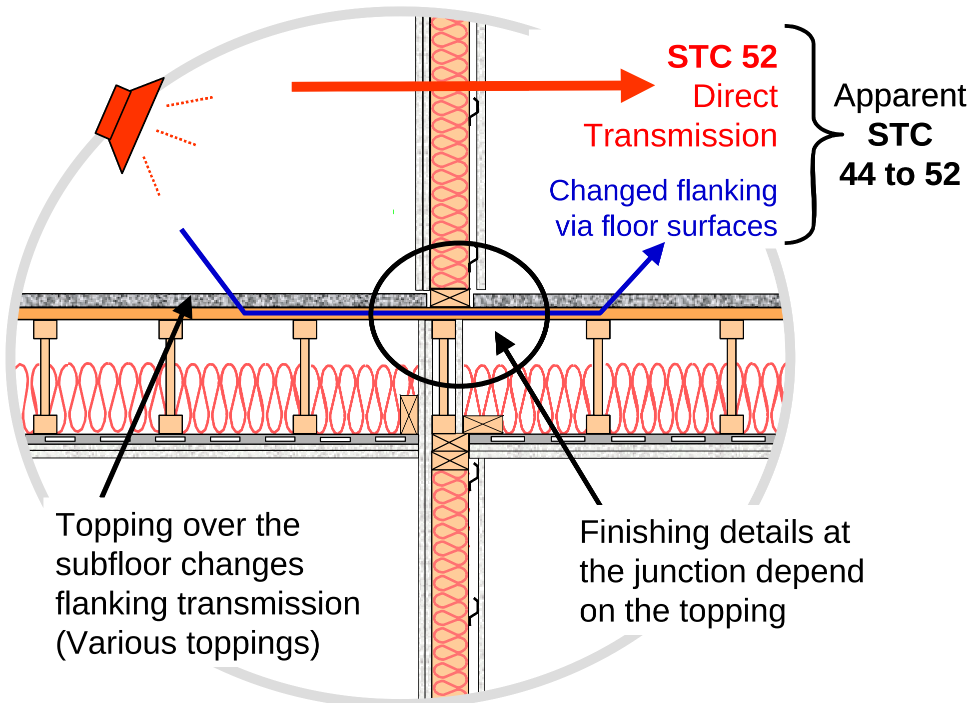
The table lists Apparent–STC for cases with two variants of the separating wall (the illustrated basic wall with STC 55 and a better wall with STC 66 that has double gypsum board on each face and insulation in both stud cavities) and two sidewall cases (with gypsum board screwed directly to the studs, or mounted on resilient channels).

Separating wall	Basic Wall (STC 55)	Better Wall (STC 66)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	45	47	48
19 mm OSB stapled to subfloor	50	53	55

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the single stud wall, the improvement in Apparent-STC is limited by direct transmission through the wall in many cases. With a better wall, reduction of flanking transmission via the floor is more evident.

Link to Corresponding Impact



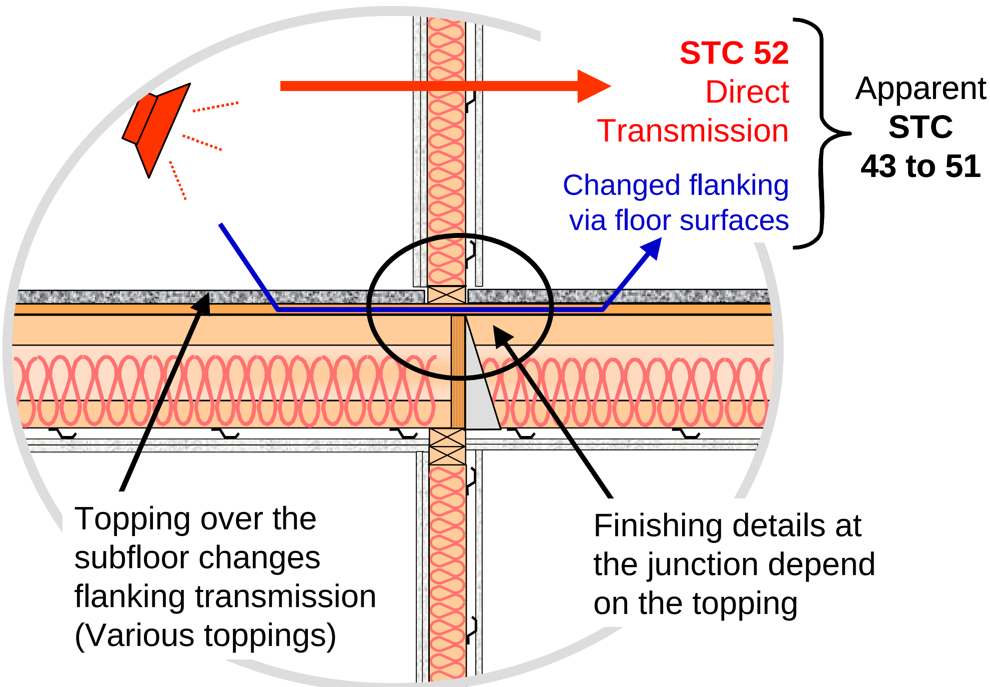
The table lists Apparent–STC for cases with two variants of separating wall (the illustrated basic wall with STC 52 and a better wall with STC 57 that has double gypsum board on each face), and two sidewall cases (with gypsum board screwed directly to the studs, or mounted on resilient channels).

Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	44	45	46
19 mm OSB stapled to subfloor	50	51	53
25 mm gypsum concrete bonded to subfloor	50	52	54
38 mm gypsum concrete on resilient mat covering subfloor	52	55	57

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the joists perpendicular to the separating wall, the improvement in Apparent-STC due to adding toppings is greater.

Link to Corresponding Impact



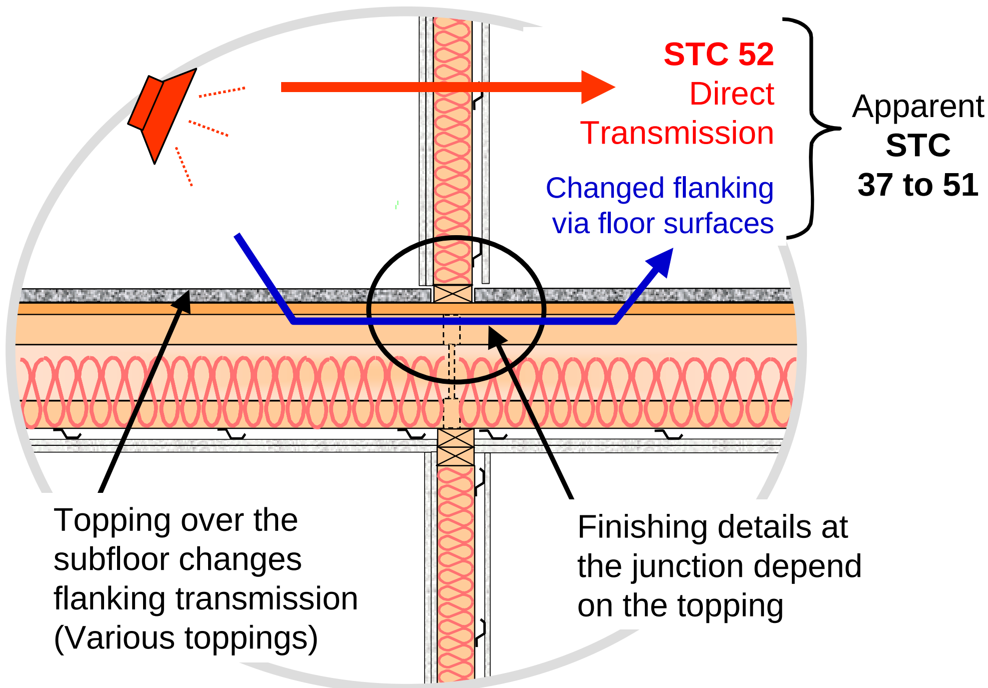
The table lists Apparent–STC for cases with two variants of the separating wall (the illustrated basic wall with STC 52 and a better wall with STC 57 that has double gypsum board on each face), and two sidewall cases (with gypsum board screwed directly to the studs, or mounted on metal channels).

Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	43	43	43
19 mm OSB stapled to subfloor	48	50	50
25 mm gypsum concrete bonded to subfloor	49	51	52
38 mm gypsum concrete on resilient mat covering subfloor	51	53	55

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the joists perpendicular to the separating wall, the improvement in Apparent-STC due to adding toppings is greater, especially in the case of the gypsum concrete topping bonded to the subfloor.

Link to Corresponding Impact



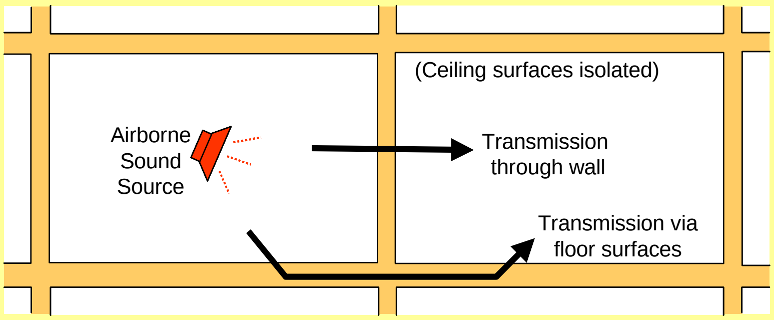
The table lists Apparent–STC for cases with two variants of the separating wall (the illustrated basic wall with STC 52 and a better wall with STC 57 that has double gypsum board on each face), and two sidewall cases (with gypsum board screwed directly to the studs, or mounted on resilient channels).

Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	37	37	37
19 mm OSB stapled to subfloor	46	47	48
25 mm gypsum concrete bonded to subfloor	50	52	54
38 mm gypsum concrete on resilient mat covering subfloor	51	54	56

Note: *These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.*

Summary – Changes to Control Horizontal Flanking
(One apartment beside the other, Airborne sound source)

For the case of two apartments horizontally separated by a partition wall assembly (horizontal transmission):

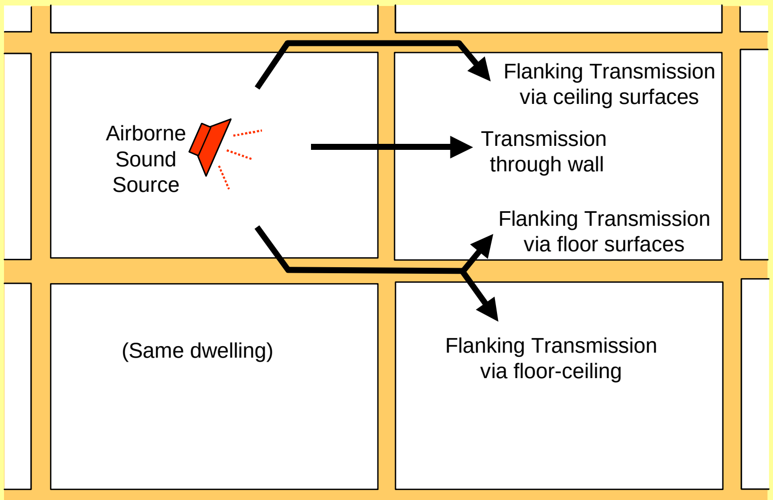


1. The main flanking paths are consistently from the floor of one room to the floor and the separating wall surface of the adjacent room. Hence, the two surfaces that can be modified to reduce flanking transmission are the floor surface and the wall.
2. The effects of specific floor toppings are listed in the tables above.
3. The Apparent-STC also depends on the separating wall. Values are listed for cases with an improved wall. With a better separating wall, adding a topping yields a greater improvement in Apparent-STC.
4. Flanking paths involving sidewalls (those of a corridor or the exterior) are relatively unimportant compared to the floor-floor path, unless the floor has a topping. With a topping, and a partition wall with a Direct-STC of 57, or better, significant benefit can be obtained by mounting the gypsum board of sidewalls on resilient channels.

Note that the data and analysis in this section are only suitable if ceiling-ceiling paths are not significant. This will be the case if there are resilient channels supporting the ceiling, which is assumed to be characteristic for “apartment” construction. “Row housing” cases, where the ceiling is not on resilient channels, are presented in the next section.

Flanking between Row Housing Units (Side-by-side Row Housing, Airborne Sound Source)

This section concerns "row housing" (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.

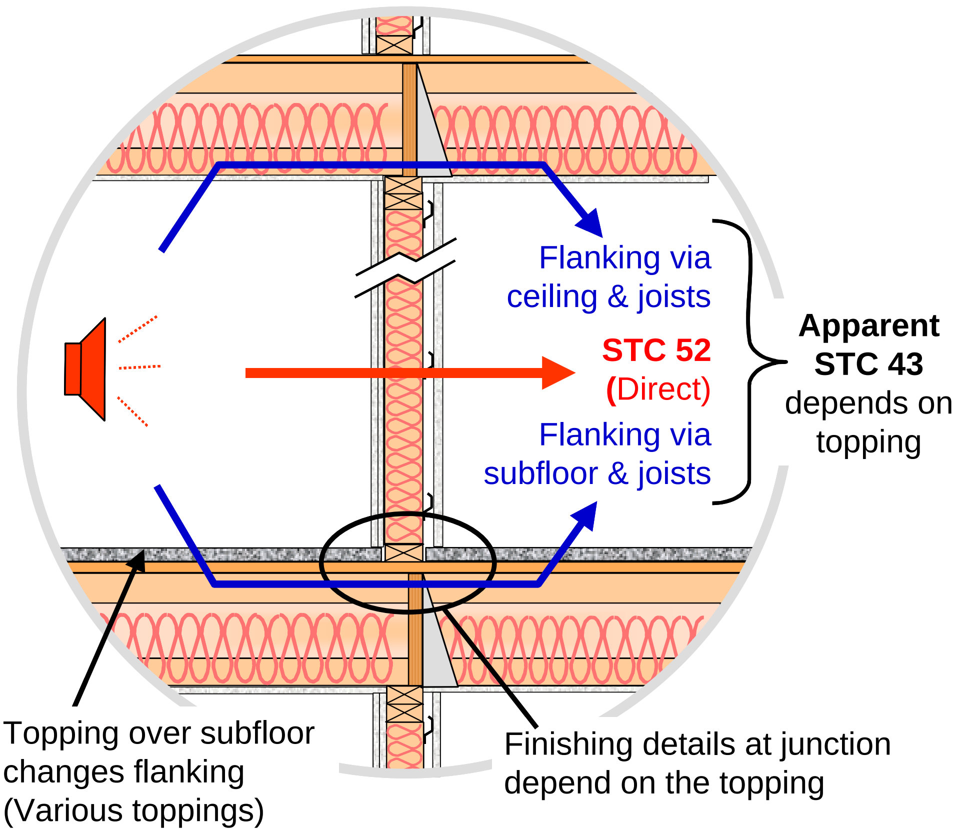


1. There are up to four flanking surfaces in receive room (floor, ceiling, and possibly two sidewalls formed by a corridor and/or exterior wall). The main horizontal flanking path is consistently from the floor of one room to the floor of the room beside, if the basic floor surface is a layer of OSB or plywood directly fastened to the top of the floor joists. With a basic subfloor, these constructions exhibit very similar horizontal flanking to the "apartment" cases.
2. The incremental effect of adding a floor topping depends not just on the topping but also on the orientation of the floor joists relative to the floor/wall junction.
3. The Apparent-STC also depends on the separating wall. With a better separating wall, adding a topping yields a greater improvement in Apparent-STC.
4. The increase in Apparent-STC due to adding a topping is limited by flanking transmission via the direct-applied ceiling, and to a lesser extent by direct sidewall surfaces.

Note that the data and analysis in this section apply only to the "row housing" case where the gypsum board of the ceiling is screwed directly to the bottom of the floor joists. "Apartment" cases, where the ceiling is on resilient channels, are presented in preceding sections.

"Row housing construction" was evaluated for only a limited set of cases. Comparisons with corresponding "apartment" cases indicate that significant effects can be treated simply by adding the flanking transmission via the direct-attached gypsum board ceiling. Only one case is illustrated here.

This construction replicates one of the cases illustrated for apartment constructions, except that in this "row housing" example, the ceiling was attached directly to the underside of the joists for each storey. This adds another potentially significant flanking path.

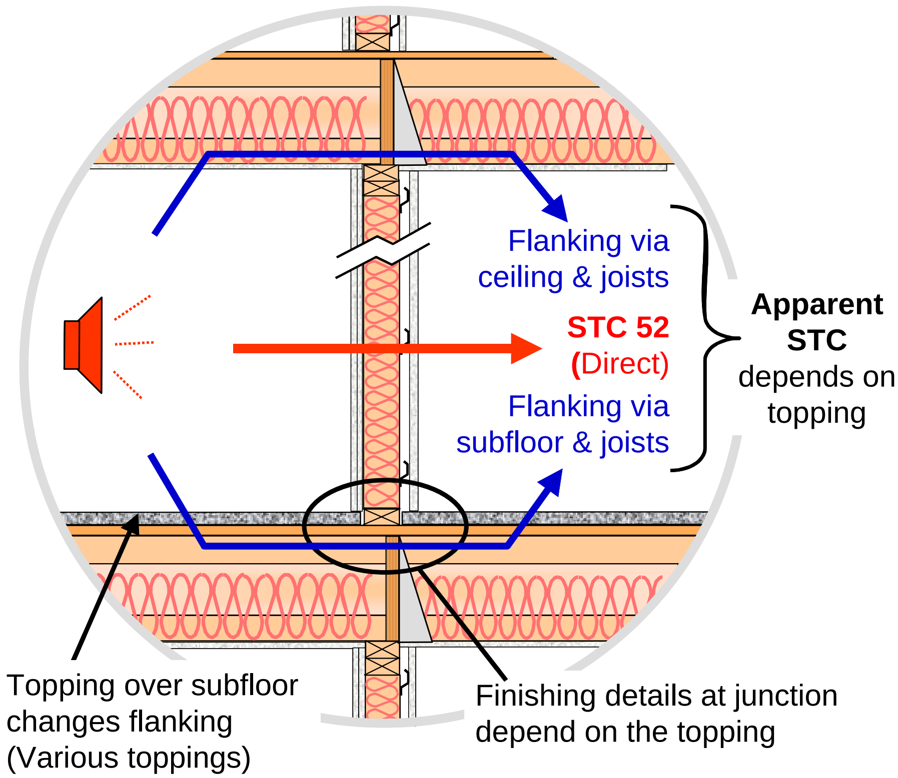


With a bare OSB subfloor, the transmission from floor to floor is dominant and flanking transmission involving the ceiling or the sidewalls are relatively unimportant, even if the gypsum board is directly attached to the studs.

For the same reason, improving the separating wall to Direct-STC 57 does not affect the overall Apparent-STC (and greater improvements in the wall would have the same minimal benefit.)

Separating wall		Basic Wall (STC 52)	Better Wall (STC 57)
Change in Construction	**Effect**	**(Apparent–STC)**	
Changing Floor/Wall Junction Subfloor break at wall	not significant	43	43
Changing Ceiling Mounting gypsum board ceiling on resilient channels	not significant	43	43
Sidewall Gypsum Board Directly attached ⇒ Resiliently mounted	not significant	42	43

When floor toppings are added (reducing flanking via the floor-floor path), the effect of the flanking transmission via direct-applied gypsum board on the ceiling or the sidewalls becomes significant, and limits Apparent-STC.



The table lists Apparent-STC for cases with two variants of the separating wall (the illustrated basic wall with STC 52 and a better wall with STC 57 that has double gypsum board on each face), and two sidewall cases (with gypsum board screwed directly to the studs, or resiliently mounted).

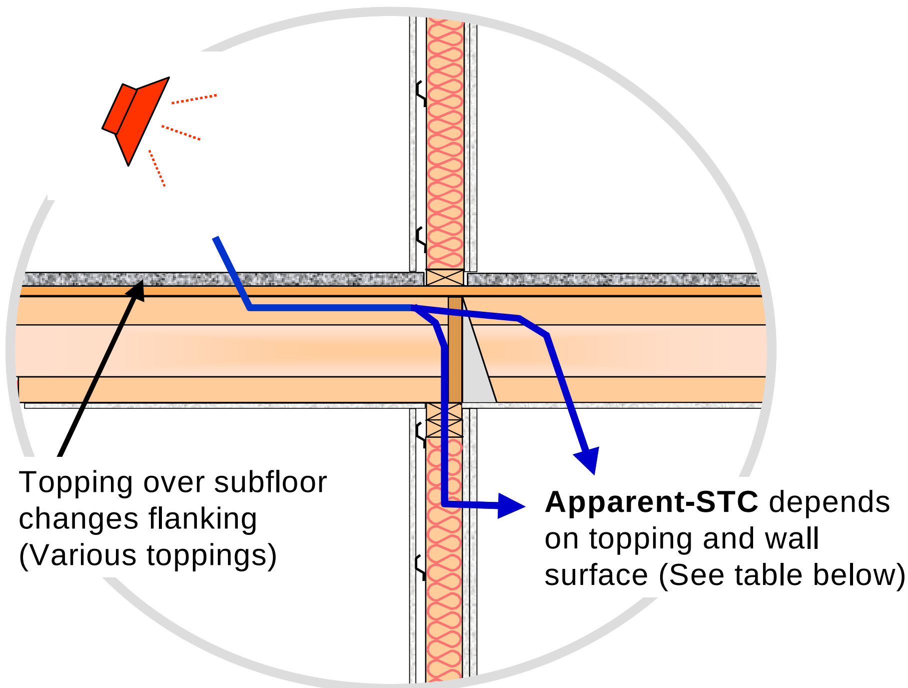
Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	**(Apparent–STC)**		
No topping (basic subfloor)	42	43	43
19 mm OSB stapled to subfloor	47	48	49
25 mm gypsum concrete bonded to subfloor	48	49	50
38 mm gypsum concrete on resilient mat over subfloor	49	51	52

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

In this "row housing" example, the directly attached ceiling also introduces significant transmission on the diagonal. With a bare OSB subfloor, there are two important diagonal paths – from the floor surface on the upper level to the ceiling and the separating wall in the room diagonally below.

Floor toppings provide significant improvements in both paths. Changing the mounting of the gypsum board on the sidewalls (or adding layers) has no significant effect for diagonal transmission.

Link to Corresponding Impact

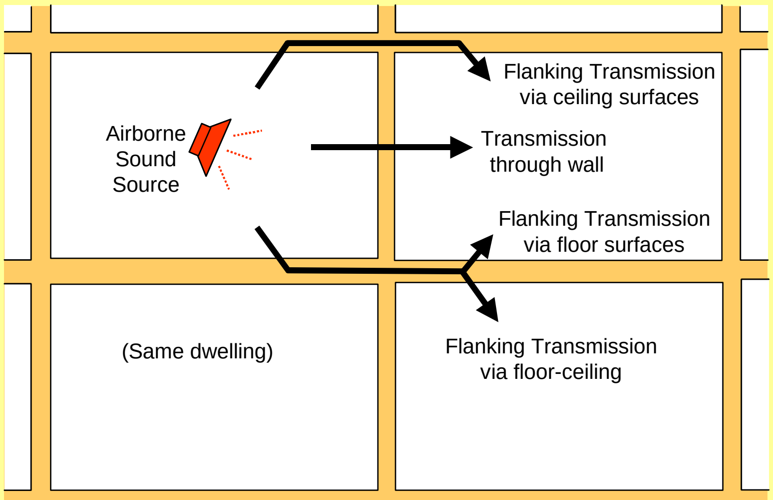


Separating wall in lower room	Gypsum Board 2 layers directly attached	Gypsum Board 1 layer resiliently mounted
Floor Surface	**(Apparent–STC)**	
No topping (basic subfloor)	54	52
19 mm OSB stapled to subfloor	57	56
25 mm gypsum concrete bonded to subfloor	61	58
38 mm gypsum concrete on resilient mat over subfloor	62	61

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

Summary – Flanking between Row Housing Units
(Side-by-side Row Housing, Airborne Sound Source)

This section concerns “row housing” (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.



1. The main horizontal flanking paths are from the floor of one room to the floor of the adjoining unit. Hence, only the floor surfaces can be modified to reduce flanking transmission.
2. The effects with specific floor toppings are listed.
3. The Apparent-STC depends on the separating wall when there is a topping. Values are listed for cases with an improved wall. With a better separating wall, adding a topping yields a greater improvement in Apparent-STC.
4. The increase in Apparent-STC due to adding a topping is limited by flanking transmission via the direct-applied ceiling.
5. Flanking transmission via the direct-applied ceiling introduced significant diagonal transmission, but the sound isolation between diagonally separated rooms was always greater than that for horizontally separated ones.

Note that the data and analysis in this section apply only to the “row housing” case where the gypsum board of the ceiling is screwed directly to the bottom of the floor joists. “Apartment” cases, where the ceiling is on resilient channels, are presented in preceding sections.

Sound from Impact Sources

This section gives information on flanking transmission for some common wood-frame constructions. It deals with sound transmission from Impact sound sources such as footsteps. A similar section on Airborne Sound Transmission presents the corresponding cases with noise from speech, TV, or other airborne sources.

This section is divided into three parts, considering the apparent sound transmission between two adjacent occupancies that are:

1. one apartment above another (separated by a floor)
2. one apartment beside another (separated by a wall)
3. side-by-side "row housing" (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.

It should be recognized that the results do not capture the effect of all significant variants. As noted in the introduction, the experimental study included only a limited set of constructions, all of them wood-framed with wood-I (or dimensional) joists 406 mm on centre, and a subfloor surface of 19 mm OSB or plywood. Room dimensions were kept constant.

All cases shown in the drawings and tables that follow (unless specifically identified as different) assume these common construction details. Unlike the situation for airborne sound, these consistent factors do not appreciably limit the significant flanking paths, because flanking is inherently limited to those surfaces sharing junctions with the floor surface where the footstep impacts occur.

Other specific constraints imposed on the research specimens included the following:

- Two ceiling options were evaluated. For "apartments", the ceilings had 2 layers of 15.9 mm fire-rated gypsum board, installed on resilient metal channels, spaced 406 mm on centre. For "row housing" (multiple stories with no requirement for sound insulation between stories) the single-layer (12.7 mm regular) gypsum board of the ceiling was applied directly to the bottom of the floor joists.
- For vertically separated rooms in "apartments", floor-wall path (the only significant structure borne path) was evaluated for a range of wall types including single stud assemblies (including one shear wall), double stud assemblies and one that might be typical of a corridor or exterior wall.
- For horizontally separated rooms, in both apartment and row constructions, there are two important paths: floor-floor and floor-wall involving the separating wall. These were characterized for all wall cases listed above.
- For diagonally separated rooms, there are two important paths: floor-ceiling and floor-wall. Their relative importance is a function of how the gypsum board surfaces are mounted. Relative to these, paths involving the sidewall(s) are believed to be unimportant.

Many of the materials were specific proprietary products, which are identified in individual assembly specifications. It should be understood that significant variations must be expected if “generic equivalents” are incorrectly chosen, or details are changed.

An earlier NRC study [2] showed a range of 3 in IIC values among a set of floor assemblies when all materials and component dimensions were consistent, except for substitution of wood-I joists of the same nominal depth from different manufacturers. Presumably, joist depth is insufficient to establish “equivalence” because of differences in materials, flange dimensions, etc. Thus, large variations can be expected when the basis of deciding “equivalence” does not completely define the vibration and acoustic performance. While the variation due to other construction materials like gypsum board, fibrous batt insulation, has been much smaller, the example highlights the magnitude of possible errors due to assessing “generic equivalence” on an inappropriate physical property.

It must also be recognized that the values given in this Guide are design estimates representative of typical constructions using the construction materials indicated. Variation in sound transmission for wood frame wall and floors is significant [1] and it must be realized that individual values for “exactly replicated” constructions may differ from those indicated in this Guide. Any deviation will be a function of the exact construction, but Apparent-STC or Apparent-IIC changes of two, or more, should not be surprising.

Complete construction details are included at the end of this Guide so that the assemblies can be replicated exactly, or detailed technical information can be obtained from the manufacturer to refine selection of “generic equivalents”.

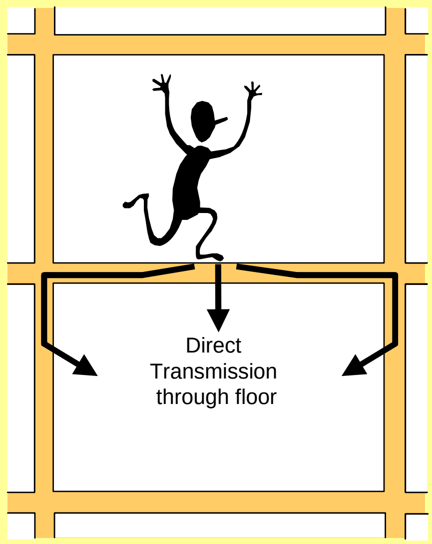
Despite these caveats, the authors believe that trends shown here do provide a good estimate of the main flanking problems in typical wood-framed constructions.

Vertical Flanking in Basic Wood-framed Constructions (One apartment above the other, Impact sound source)

For the case of two apartments vertically separated by a floor/ceiling assembly, there are two key issues:

1. The main flanking path is consistently from the subfloor of the room above to the walls of the room below.

2. Reduction of Apparent-IIC by flanking depends on the flanking transmission via ***all*** walls of the room below.

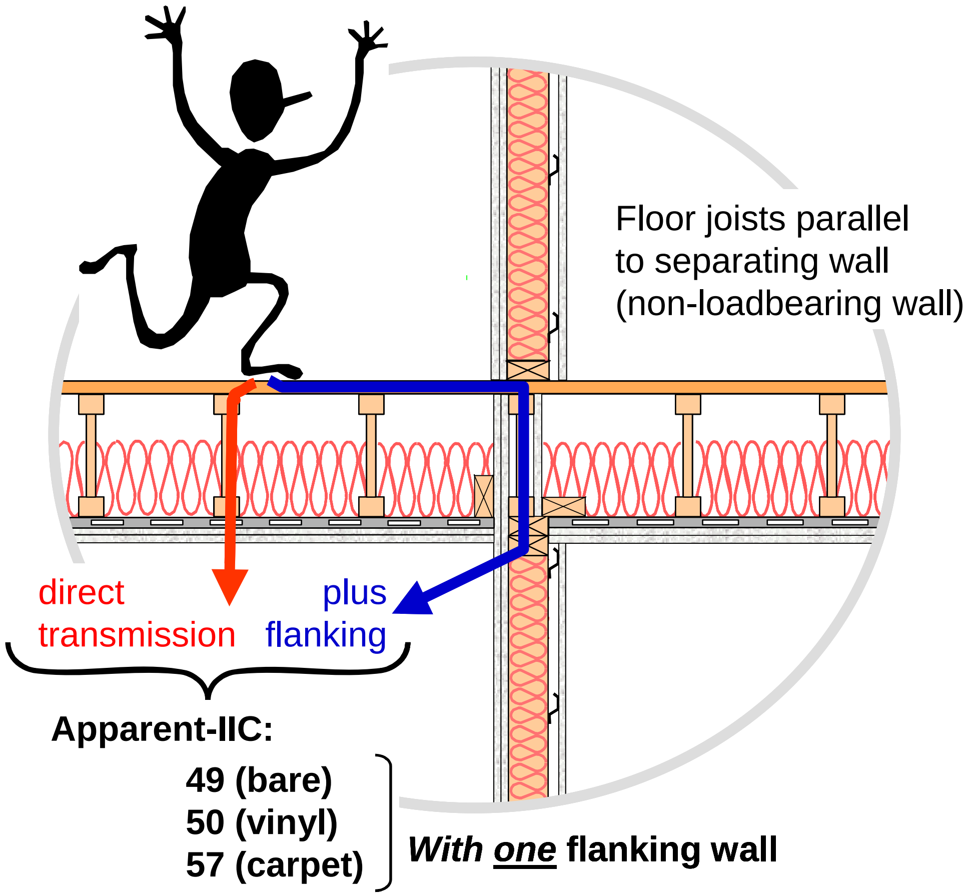


The discussion starts with flanking via just one wall (to explain relative significance of specific aspects of the constructions).

In normal practice, especially with flanking via all four walls of the room below, more flanking energy would be transmitted, resulting in even lower Apparent-IIC. This is presented in more detail later in this section, for representative scenarios.

Changes in the construction can alter the flanking transmission and hence the Apparent-IIC, and a number of specific variants are listed in the following example, with their typical effects. The table in the following example (like similar tables in later sections) shows explicit values for Apparent-IIC, to illustrate the trends to be expected with the specified changes. Obviously, in practice the Apparent-IIC may vary from the values given here, depending on the specific products used and the details of installation.

Sound transmission paths are shown in the figure below, for the case with floor joists parallel to the flanking wall, which has single wood stud framing.



Adding vinyl flooring or carpet over the subfloor generally improved the Apparent-IIC. The same treatment was used for all cases reported here, to show typical benefit.

Flooring Finish		**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor Materials OSB subfloor ⇒ plywood	not significant	49	50	57
Changing Walls Below On walls below, 2 layers ⇒ 1 layer of gypsum board	not significant	49	50	57
On walls below, mount gypsum board on resilient metal channels	flanking insignificant	49 (Approaches direct IIC of floor)	50	58

Quite similar results were observed for many wall-floor cases.

Flanking transmission from the upper room to the one below may also be affected by:

- changing orientation of the floor joists, from parallel to perpendicular to the separating wall. (Vertical flanking tends to be stronger with floor joists perpendicular to the wall than with the joists parallel.)
- changing the wall framing from single studs to double row of studs or to staggered studs with a common plate, or
- changing the construction at the floor/wall junction.

Most changes in vertical flanking transmission due to these framing variations are small enough so the performance can be presented here in terms of average values.

Estimating Apparent-IIC for Combined Paths (Vertical Transmission)

The following *Table of Typical Vertical Flanking (Impact)* presents an estimate of the Apparent-IIC due to direct transmission plus flanking paths for all significant walls in the room below.

- This had to account for the attenuation of vibration across the floor assembly, which is more rapid perpendicular to the joists than parallel to the joists. The estimates were based on the measured transmission in each direction, averaged over the single stud and double stud wall cases studied. Two scenarios were considered:
- In one scenario, the impact source was at the middle of a moderate-sized (4.5 m x 4.5 m) room, and all four walls of the room below were included as flanking paths. Although vibration transmission across the floor is very different parallel versus perpendicular to the joists, floor joists are normally parallel to two walls in the room below and perpendicular to the others, so a value based on this combination should be representative.
- In the second scenario, the source was located near a corner, 1 m from each of two walls. Because of attenuation across the floor, more vibration would reach the nearby walls, but the transmission via the two distant walls would be relatively unimportant.

The two cases led to predictions for Apparent-IIC that differed by 1 or less for all of the floor/wall cases considered here.

***For all the wall/floor cases studied**,* the following table provides a design estimate of the Apparent-IIC (due to direct transmission plus flanking paths for all significant walls in the room below) if the floor has a basic OSB or plywood subfloor.

In essence, the effects of impact source location tend to average out for vertical flanking transmission, and estimates for the following tables were calculated using the second scenario above.

If all walls in the room below have their gypsum board mounted on resilient channels, those wall surfaces will not contribute significantly to the flanking. This yields the best case, with only direct transmission through the floor, given in the top row of the table.

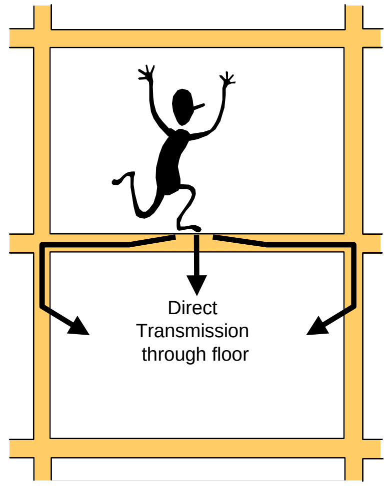
With the gypsum board attached directly to the wall studs, the Apparent-IIC will be considerably lower. Results with a double layer of gypsum board are only marginally better than a single layer, but one row of the table presents values for each of these cases.

For intermediate situations where walls are a mix of these cases, a weighted linear average should be used. For example, when the gypsum board of one wall in the lower room is on resilient channels, two walls have 2 layers directly attached to the studs, and the fourth wall has a single layer directly attached gypsum board, the weighted linear average of the values for the “Better Floor” would be [(53+2x48+46)/4], giving Apparent-IIC 49.

Table of Typical Vertical Flanking (Impact)

The following table gives Apparent-IIC due to the combined effect of direct transmission through the floor/ceiling, plus total flanking transmission via all walls of the room below.

The estimates in this table should be applied only for cases where wall and floor details are within the range of the tested specimens.



	Worse ceiling 1 layer of gypsum board on resilient metal channels spaced @400 mm	**Basic ceiling** 2 layers of gypsum board on resilient metal channels spaced @400 mm	**Better ceiling** 2 layers of gypsum board on resilient metal channels spaced @600 mm
Walls with 1 layer of gypsum board applied directly to the studs in room below	44 (bare) 45 (vinyl) 54 (carpet)	45 (bare) 46 (vinyl) 55 (carpet)	46 (bare) 47 (vinyl) 57 (carpet)
Walls with 2 layers of gypsum board applied directly to the studs in room below	45 (bare) 46 (vinyl) 54 (carpet)	46 (bare) 47 (vinyl) 56 (carpet)	48 (bare) 49 (vinyl) 59 (carpet)
All Walls with resilient channels supporting the gypsum board in room below (No flanking)	47 (bare) 48 (vinyl) 55 (carpet)	49 (bare) 50 (vinyl) 57 (carpet)	53 (bare) 54 (vinyl) 62 (carpet)

Note1: This table presents Apparent-IIC expected with a basic OSB or plywood subfloor. For the effect of modifying the floor surface by adding a topping, see Table of Change in Vertical Flanking due to Toppings (Impact).

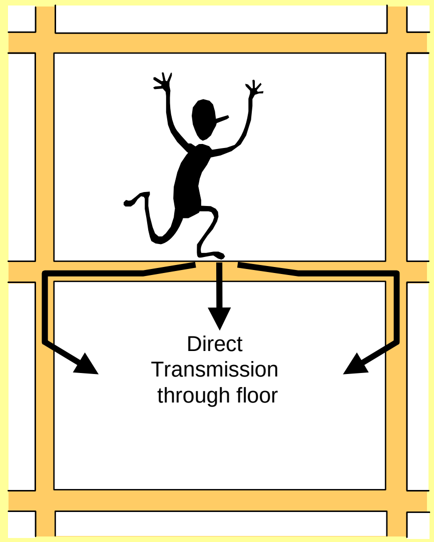
Note2: Results will be about the same for one or two layers of resiliently mounting the gypsum board because in either case flanking paths do not contribute significantly relative to the direct path.

Summary – Vertical Flanking in Typical Constructions, for Impact

For the case of two apartments vertically separated by a floor/ceiling assembly, the Apparent-IIC between two rooms is systematically less than the IIC for direct transmission through the separating floor.

There are four main issues:

1. The flanking path is from the floor of the room above to the walls of the room below.
2. Adding flooring finishes such as carpet can significantly change the Apparent-IIC.
3. Reduction of the Apparent-IIC by flanking depends on the flanking transmission via ***all*** walls of the room below.
4. Some changes in the wall below can significantly reduce transmission via a specific wall surface. Adding a second layer of gypsum board slightly reduces flanking. Mounting gypsum board on resilient channels should reduce flanking to insignificance for most practical floor assemblies.



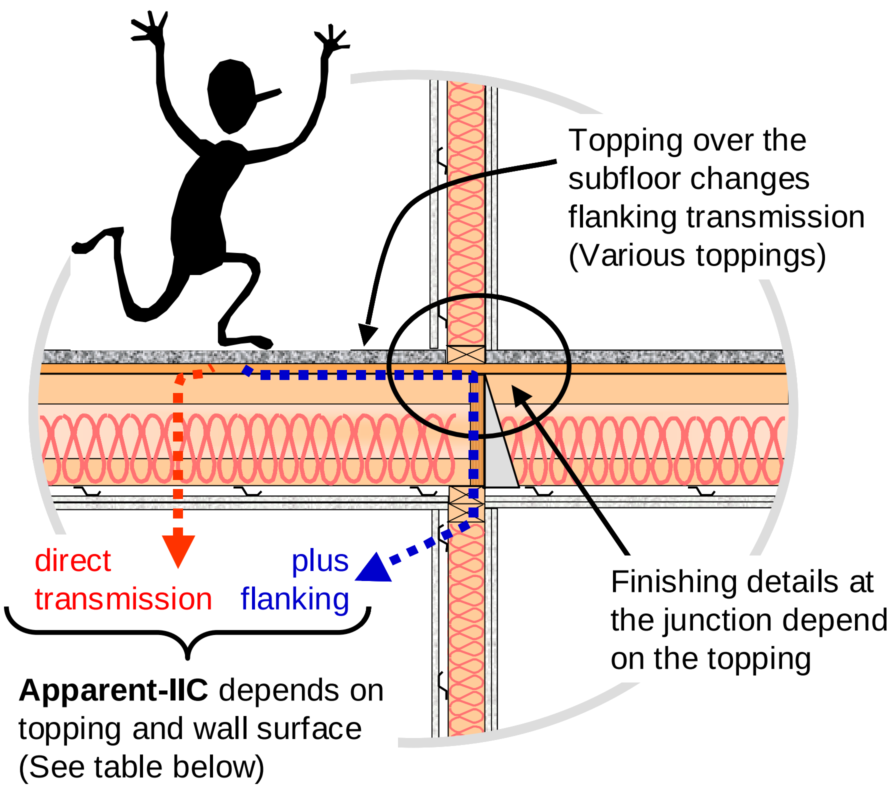
Changes to Control Vertical Flanking
(One apartment above another, Impact sound source)

For the case of two apartments vertically separated by a floor/ceiling assembly (vertical transmission):

1. The flanking path is consistently from the subfloor of the room above to the walls of the room below.

2. The two surfaces that can be modified to reduce flanking transmission are the walls below and the floor surface above.

The Apparent-IIC can be improved by changing the floor surface, or the gypsum board surfaces of the walls in the room below. Adding a topping over the basic plywood or OSB subfloor changes attenuation both for direct transmission through the floor and for the dominant flanking transmission path. Changes for direct transmission through the floor and for flanking transmission are ***not*** equal.



The change in flanking due to adding a topping depends on the type of topping and on the orientation of the floor joists relative to the flanking wall. However, an average value can be used as a representative design estimate because the floor joists are normally parallel to some walls in the room below and perpendicular to others.

The combined flanking transmission via ***all*** walls of the room below was considered, for representative scenarios listed in the following table.

Table of Change in Vertical Flanking due to Toppings (Impact)

The following Table gives change in Apparent-IIC expected from adding a topping, due to direct transmission through the floor/ceiling plus flanking transmission via the walls of the room below.

		Worse Ceiling with 1 layer of gypsum board on resilient channels @400 mm (Direct-IIC with no topping: 46, 47, 55)			**Basic Ceiling** with 2 layers of gypsum board on resilient channels @400 mm (Direct-IIC with no topping: 48, 50, 57)			**Better Ceiling** with 2 layers of gypsum board on resilient channels @600 mm (Direct-IIC with no topping: 53, 54, 64)		
		For case with no floor topping, get Apparent–IIC from *Table of Typical Vertical Flanking (Impact)* For the complete system including a topping, add (to the Apparent-IIC without a topping) a value chosen from table below								
		Bare	Vinyl	Carpet	Bare	Vinyl	Carpet	Bare	Vinyl	Carpet
Walls with 1 or 2 layers of gypsum board applied directly to the studs	Stapled 19 mm OSB topping	+1	+1	+3	+1	+1	+3	+1	+1	+3
	Bonded 25 mm gypsum concrete topping	-8	-3	+7	-8	-2	+7	-8	-3	+6
	38 mm gypsum concrete topping on resilient mat	+4	+6	+9	+3	+5	+9	+3	+5	+8
All Walls with resilient channels supporting the gypsum board in room below (No flanking)	Stapled 19 mm OSB topping	+2	+2	+3	+1	+2	+3	+2	+2	+3
	Bonded 25 mm gypsum concrete topping	-8	-1	+7	-8	-1	+7	-7	0	+8
	38 mm gypsum concrete topping on resilient mat	+6	+8	+12	+6	+9	+12	+7	+8	+11

Note: Specifications and detail drawings for the basic assemblies and added toppings are given in the section on Changes to Control Horizontal Flanking (impact).

Note2: Results will be about the same for one or two layers of resiliently mounting the gypsum board because in either case flanking paths do not contribute significantly relative to the direct path.

For all the wall/floor cases studied, the preceding table provides a representative design estimate of the *change* in Apparent-IIC (due to direct transmission plus flanking paths for all significant walls in the room below) when toppings are added.

- If all walls in the room below have their gypsum board mounted on resilient channels, those wall surfaces will not contribute significantly to the flanking. This yields the best case, with only direct transmission through the floor, given in the top row of the table.

Note that resilient channels ***must*** be mounted between the studs and the gypsum board, not between two layers of gypsum board.

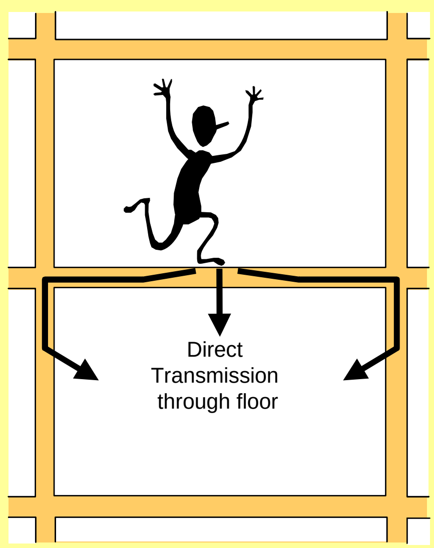
- With the gypsum board attached directly to the wall studs in the room below, the Apparent-IIC will be considerably lower. The change due to a topping is almost identical whether the wall has a double layer of gypsum board or a single layer, so one row of the table presents the change expected for both cases.

For intermediate situations where walls are a mix of these cases, a weighted linear average should be used. As an example consider the case with bare OSB topping, when the gypsum board of one wall in the lower room is on resilient channels, two walls have 2 layers directly attached to the studs, and the fourth wall has a single layer directly attached gypsum board, the weighted linear average of the values for the “Better Floor” would be [((53+2)+2x(48+1)+(46+1))/4], giving Apparent-IIC 50.

Summary – Changes to Control Vertical Flanking
(One apartment above another, Impact sound source)

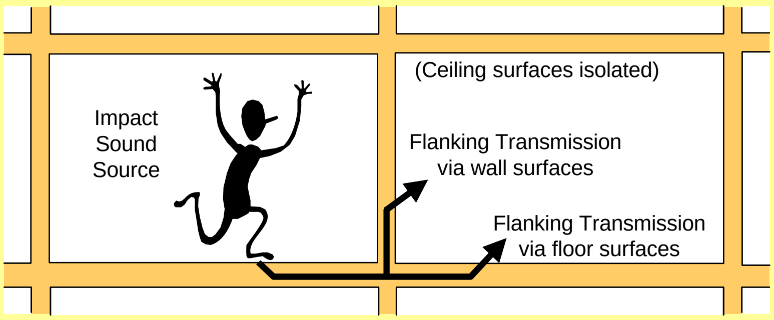
For footstep noise in the case where one apartment is above the other (vertical transmission):

1. The flanking path is from the floor of the room above to the walls of the room below.
2. The two surfaces that can be modified to reduce flanking transmission are the walls below and the floor surface above.
3. The effects of specific changes to the walls and floor surface are listed in the table above.



Horizontal Flanking in Wood-framed Constructions (One apartment beside the other, Impact sound source)

For the case of two apartments horizontally separated by a partition wall assembly, there are four key issues:



1. The flanking paths for impact sound are from the floor of the room where the impact occurs to the floor and the surface of the separating wall in the room beside.
2. If the impact source moves closer to the separating wall/floor junction, the Apparent-IIC decreases. (important for corridors)
3. Apparent-IIC is changed by a flooring surface, such as vinyl flooring or carpet, but the improvement depends on the underlying floor.
4. Apparent-IIC is affected by details of the floor assembly, the wall assembly, and the continuity of structural elements across the floor/wall junction.

In all these cases, the horizontally transmitted impact sound is ***entirely*** due to structure-borne flanking transmission.

Note that the above summary assumes that other horizontal paths are not significant. Flanking involving sidewalls (i.e., floor-sidewall path) is relatively unimportant compared to the floor-floor path and in most situations can be safely ignored. Floor-ceiling paths will be relatively unimportant if there are resilient channels supporting the gypsum board ceiling, which is designated as "apartment" construction in this Guide.

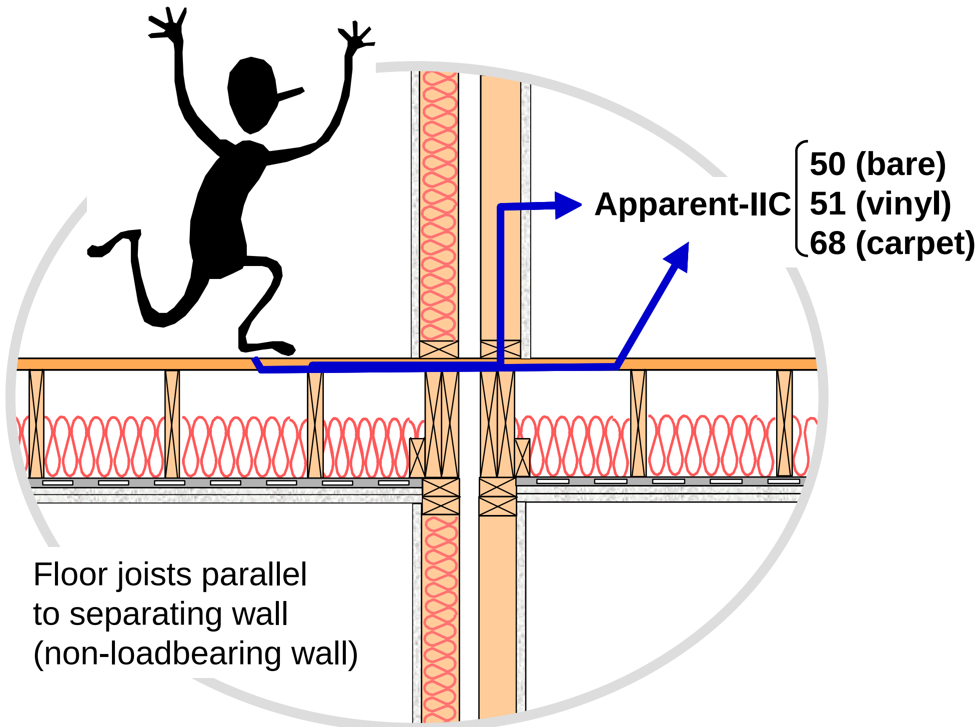
Several "row housing" cases, where the ceiling is not on resilient channels, are presented in a later section.

Some of the above issues assume different significance when considering design for a room adjacent to a corridor, as opposed to two side-by-side rooms with similar use. In particular, a corridor will typically involve impacts close to the separating wall (1 m is used as representative), whereas a distance of 2 m is more appropriate for a typical room. Hence, two representative distances are used in this section.

To highlight the key factors influencing flanking across floor/wall systems, a number of typical configurations are presented, proceeding from cases where the flanking effect is rather small to cases where flanking causes rather poor sound insulation.

With the subfloor continuous across the junction at a double stud wall, Apparent-IIC is low enough to be a problem, especially if the source is close to the separating wall.

Link to Corresponding Airborne



The Apparent-IIC may be changed by specific changes in the floor assembly, the floor/wall junction, or the wall assembly.

Flooring Finish		**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor 16 mm OSB subfloor ⇒ plywood or wood joists ⇒ wood-I joists	not significant	49—51	50—51	65—68
Changing Floor/Wall Junction Subfloor break at wall cavity	Depends on fire block	55	56	75
Changing Wall Double gypsum board and insulation on both sides	Depends on fire block	52	52	70
For Corridors (impact source 1 m from wall): No data for quantitative values, but qualitatively expect lower Apparent-IIC, as with joists parallel to single stud wall. (See following cases).				

Some of the changes listed in the table are inter-dependent. The effects of these combined flanking paths are presented on the following page, for some typical generic fire blocks.

As noted in the corresponding section on airborne sound, fire blocks are required to stop the spread of fire through concealed cavities such as that between the two rows of studs in the wall illustrated above. The performance of such systems is discussed in an IRC/NRC publication [3]. As noted in that publication, as well as performing their intended function of controlling fire, these treatments at the floor/wall junction can significantly worsen flanking transmission.

The effect of fire blocks depends on the associated constructions. Two separating walls are considered – basic (as shown above in the figure), and a better wall (with double gypsum board on each side, and cavity insulation on each side).

Separating wall	**Basic Wall**			**Better Wall**		
Floor covering	Bare	Vinyl	Carpet	Bare	Vinyl	Carpet
Fire Block Alternatives	**Apparent-IIC** *(Impact at 2 m)*					
Continuous OSB or Plywood	51	51	68	52	52	70
None, or fibrous material	--	--	--	66	66	82

The tabulated values show that the Apparent-IIC increases as the magnitude of structural coupling introduced by the fire block decreases. To attain Apparent-IIC 55 or better with the basic OSB subfloor (strongly coupled), it will be necessary to have a very compliant floor covering, like carpet.

The table also shows that depending on the fire block there may be a significant benefit to increasing the number of layers of gypsum board of the separating wall in the receiving room. If this gypsum board were mounted on resilient channels then a greater improvement might be expected.

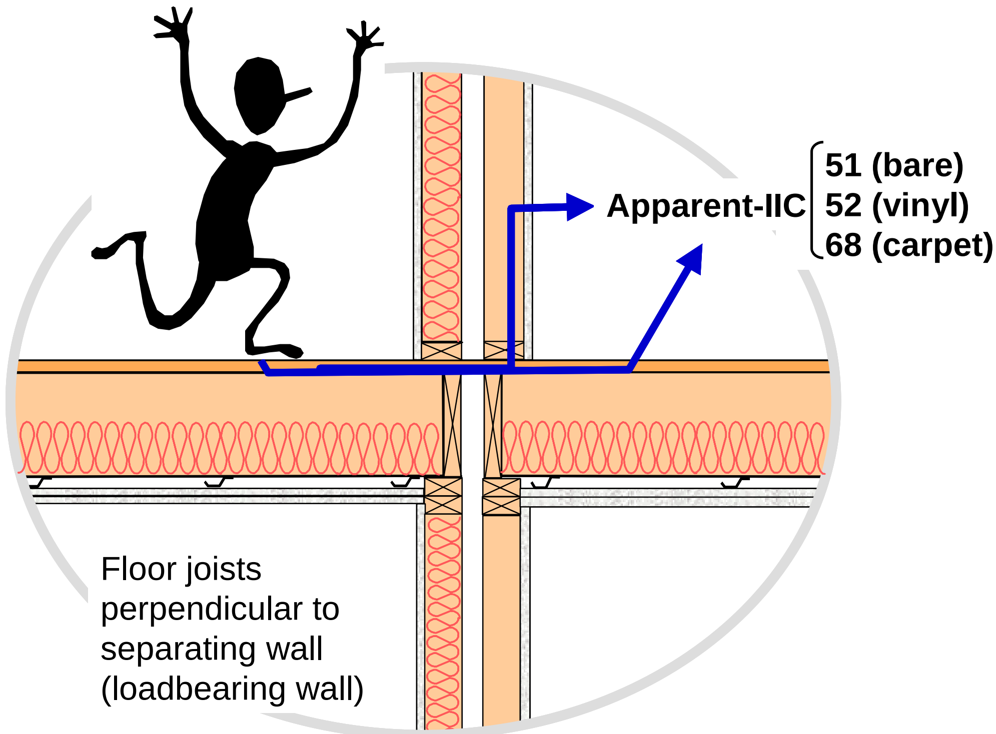
In practice, a fire block formed by continuous OSB or plywood subfloor may be required to provide structural support, especially in regions where strong lateral loading from winds or seismic activity is expected.

- For row housing this may be a lesser concern. The fibrous fire blocks that cause negligible flanking transmission across the cavity of the separating double stud wall offer an effective solution in those cases.

Continuous OSB or plywood subfloor is the typical solution for multi-storey apartment construction. In such cases, the use of a topping may be required, and this is addressed in later sections.

With the subfloor continuous across the junction at a double stud wall, and floor joists parallel to the wall, the Apparent-IIC is slightly better, especially with carpet applied over the OSB subfloor.

Link to Corresponding Airborne



The Apparent-IIC may be changed by specific changes in the floor assembly, the floor/wall junction, or the wall assembly.

Flooring Finish		Bare	Vinyl	Carpet
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor 16 mm OSB subfloor ⇒ plywood	not significant	50—52	51—53	65—68
Changing Floor/Wall Junction Subfloor break at wall cavity	depends on fire block	50—61	51—61	65—67
Changing Wall Double gypsum board and insulation on both sides	depends on fire block	51—66	52—66	71—79
For Corridors (impact source 1 m from wall): No data for quantitative values, but qualitatively expect lower Apparent-IIC as with joists perpendicular to single stud wall. (See following cases).				

Some of the changes listed in the table are inter-dependent. The effects of these combined flanking paths are presented on the following page, for some typical generic fire blocks.

The effect of fire blocks depends on the associated constructions. Two separating walls are considered – basic (as shown above in the figure), and a better wall (with double gypsum board on each side, and cavity insulation on each side).

Separating wall	**Basic Wall**			**Better Wall**		
Floor covering	Bare	Vinyl	Carpet	Bare	Vinyl	Carpet
Fire Block Alternatives	**Apparent-IIC** *(Impact at 2 m)*					
Continuous OSB or Plywood	50	51	65	51	52	71
Coreboard (between joist headers)	52	52	65	57	57	73
0.38 mm sheet steel	54	55	68	55	56	71
Fibrous material (glass fibre or rock fibre of suitable density)	61	61	67	66	66	79
No material in gap	N/A	N/A	N/A	66	66	79

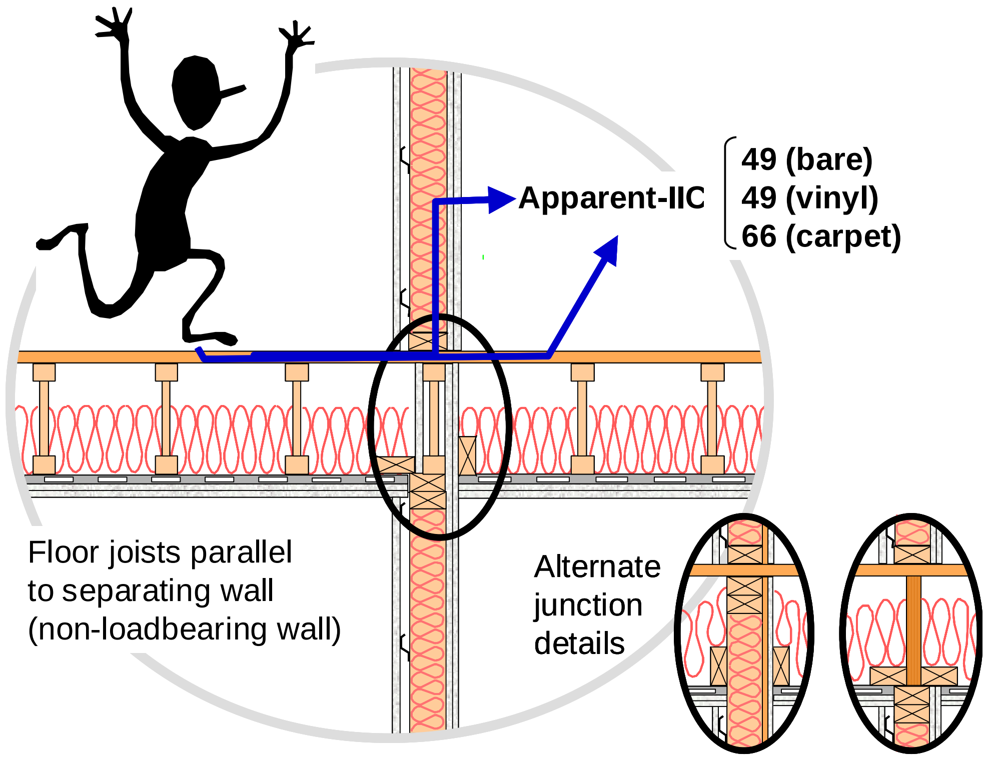
The performance of fire blocks (for both sound and fire) is addressed further in References 3 and 4.

The tabulated values show that the Apparent-IIC increases as the structural coupling introduced by the fire block decreases. To attain Apparent-IIC 55 or better with the basic OSB subfloor (strongly coupled), it will be necessary to have a very compliant floor covering, like carpet.

The table also shows that depending on the fire block there may be a significant benefit to increasing the number of layers of gypsum board of the separating wall in the receiving room. If this gypsum board were mounted on resilient channels then a greater improvement might be expected.

With the floor joists parallel to the separating wall, changing from the double stud wall to a simpler single stud wall assembly permits more transfer of structural vibration across the junction, and hence lowers Apparent-IIC for the bare floor to 49 for impacts 2m from the wall.

Link to Corresponding Airborne



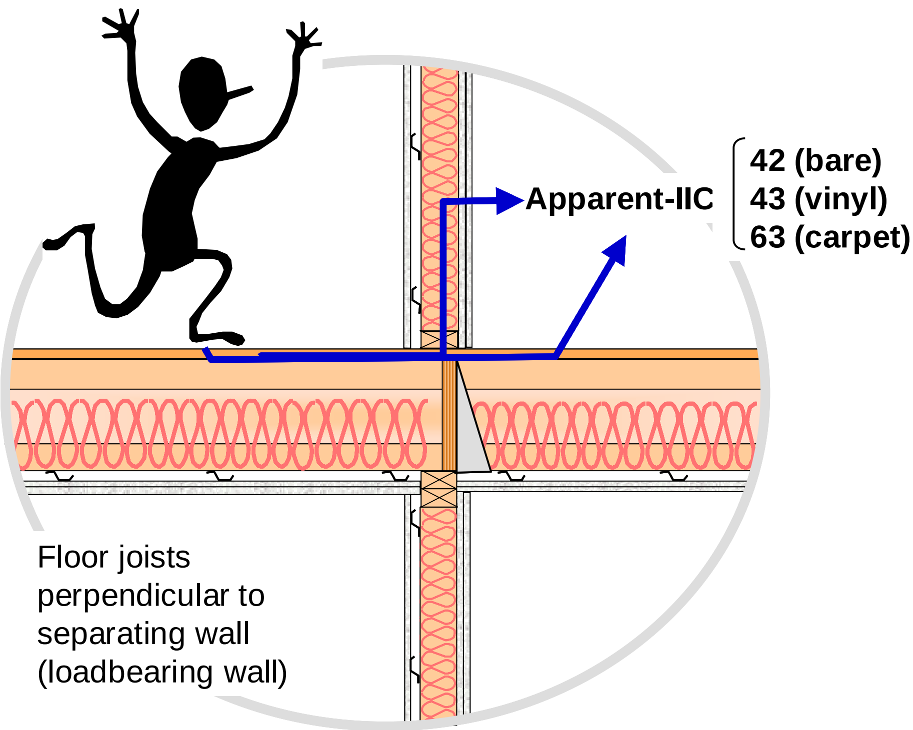
Changing the fire blocking detail at the junction has little effect on the Apparent-IIC. Changing the wall surface facing the receiver has some effect.

Altering the layers of gypsum board on the receiving room side of the separating wall (or how they are attached) significantly changes Apparent-IIC

Flooring Finish		**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor/Wall Junction Subfloor break under wall or alternate junction details shown	not significant	49	49	66
Wall (receiving room side) Gypsum board alternatives - direct-attached, 1 layer direct-attached, 2 layers on resilient channels, 1 layer	Improves ↓	 48 49 51	 48 49 52	 66 66 71
For Corridors (impact source 1 m from wall) expect change in Apparent IIC		-6	-5	-3

With the single stud wall assembly, changing orientation of the floor joists (from parallel to the separating wall to perpendicular) transmits more structural vibration across the floor and alters the junction. This lowers Apparent-IIC for the bare floor to 42 for impacts 2m from the wall.

Link to Corresponding Airborne



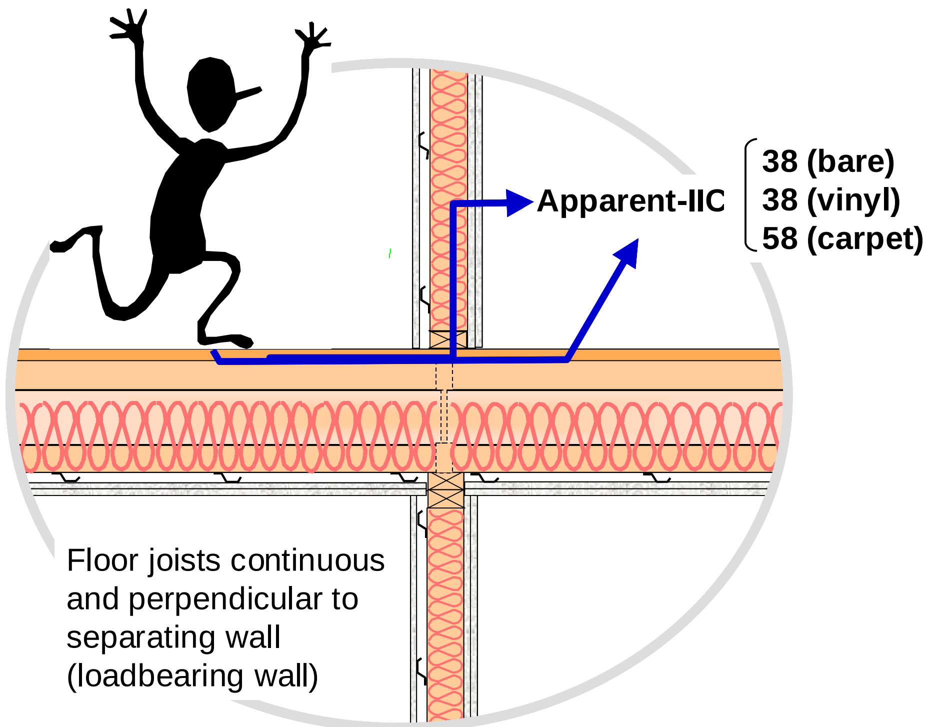
Cutting the subfloor at the junction has little effect on the Apparent-IIC.

Changing the wall surface facing the receiver has some effect (but less than with the joists parallel, because the floor-floor path is more dominant).

Flooring Finish		**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor/Wall Junction Subfloor break under wall	not significant	42	43	63
Wall (receiving room side) Gypsum board alternatives - direct-attached, 1 layer direct-attached, 2 layers on resilient channels, 1 layer	Improves slightly ↓	41 42 43	42 43 44	63 63 65
For Corridors (impact source 1 m from wall) expect change in Apparent IIC		-4	-3	-1

With subfloor and joists **both** continuous across the floor/wall junction, but the same single stud wall and floor details, there is more transfer of structural vibration across the junction. This lowers Apparent-IIC for the bare floor to 38 for impacts 2m from the wall.

Link to Corresponding Airborne



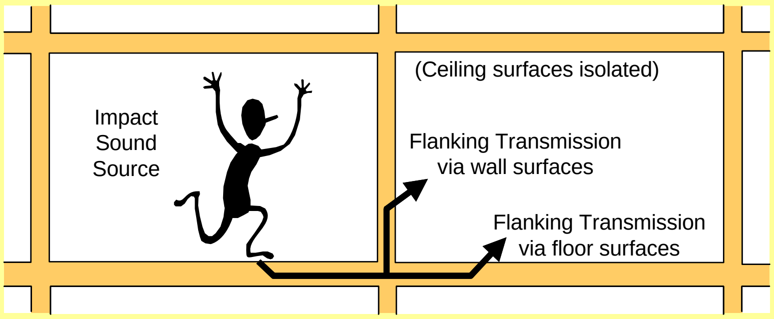
Cutting the subfloor under the wall at the junction, has little effect on the Apparent-IIC.

Changing the wall surface facing the receiver has negligible effect, because the floor-floor path is dominant. (See table).

Flooring Finish		**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Effect**	**Apparent-IIC** *(Impact at 2 m)*		
Changing Floor/Wall Junction Subfloor break under wall at floor/wall junction	not significant	38	38	58
Changing Wall Gypsum board on receiving room side on resilient channels	not significant	38	39	59
For Corridors (impact source 1 m from wall) expect change in Apparent IIC		-3	-3	0

Summary – Horizontal Flanking in Typical Constructions
(One apartment beside the other, Impact sound source)

For the case of two apartments horizontally separated by a partition wall assembly, or beside a corridor, the Apparent-IIC is entirely due to flanking transmission.

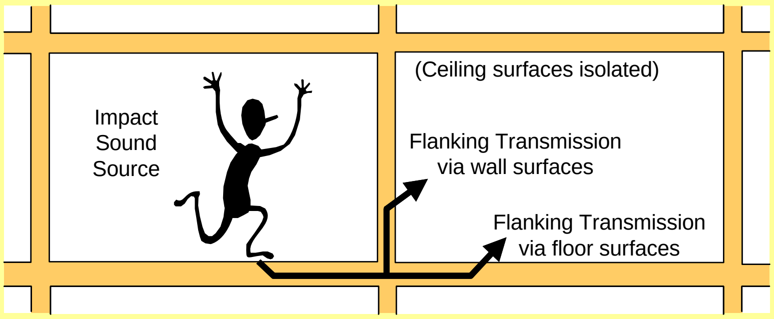


There are three main issues:

1. When the floor assembly has a basic OSB or plywood subfloor, the main flanking path is consistently from the floor of one room to the floor of the other, although the wall of the receiving room also contributes in some cases.
2. Apparent-IIC is strongly affected by joist orientation and the continuity of floor components across the floor/wall junction.
3. Because vibration is attenuated across the floor assembly, as it spreads away from the source, the Apparent-IIC is lower when the impact occurs near the separating wall (as it would for corridors).

Changes to Control Horizontal Flanking
(One apartment beside another, Impact sound source)

For footstep noise in the case of apartments horizontally separated by a partition wall assembly, or beside a corridor (horizontal transmission), the Apparent-IIC is entirely due to flanking transmission.



1. The main flanking path is consistently from the floor of one room to the floor of the room beside, if the basic floor surface is a layer of oriented strand board (OSB) or of plywood directly fastened to the top of the floor joists.

2. To significantly reduce flanking transmission, the key surfaces to modify are the floors in the two rooms.

3. The incremental effect of adding a floor topping depends not just on the topping but also on the floor over which it is applied. In particular, the improvement due to a topping depends strongly on the orientation of the floor joists relative to the floor/wall junction.

4. The improvement depends on whether the impacts are close to the separating wall (corridor *vs*. adjacent apartment)

5. In some cases, the change in the floor-floor flanking transmission is substantial, and coupled with improvements to the wall itself may provide a very high Apparent-IIC.

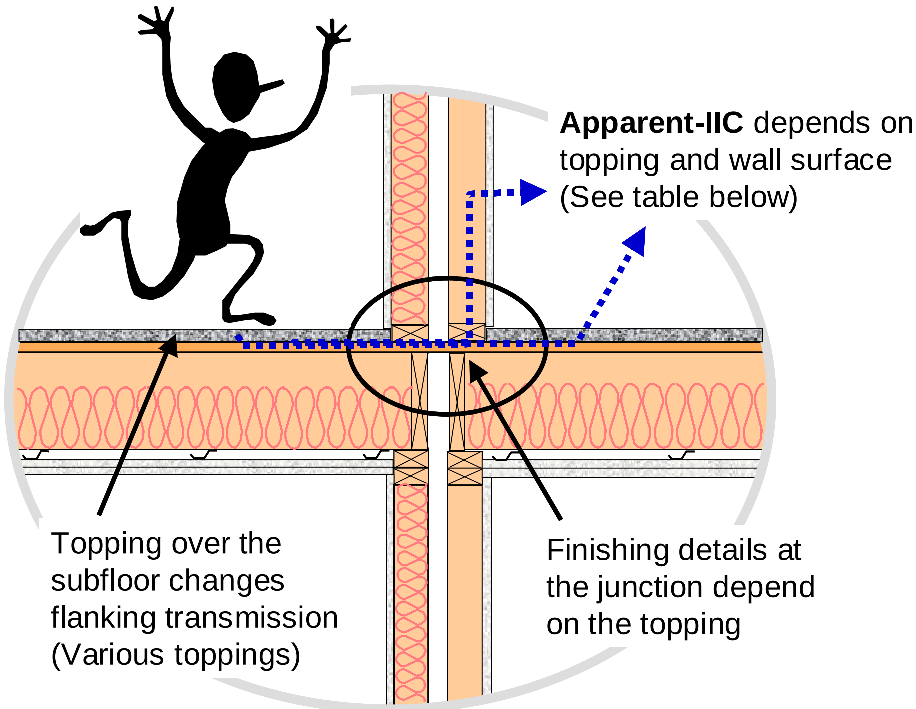
Note that data and analysis in this section are all for the case with resilient channels supporting the ceiling, which is assumed to be characteristic for "apartment" construction – the focus of this section.

"Row housing" cases, where the ceiling is not on resilient channels, are presented in the following section. These constructions exhibit similar horizontal flanking to the cases in this section; apparently attachment of the ceiling only weakly affects flanking transmission across the floor. However, on the diagonal, the effect of flanking transmission via the direct-applied ceiling becomes evident in row housing.

Because the effect of toppings depends quite strongly on the supporting floor assembly, the effect is shown for each of the basic floor assemblies in turn, in the same order as the preceding section presenting performance with the basic subfloor.

The Apparent-IIC between the side-by-side rooms can be improved by installing a floor topping over the basic OSB or plywood subfloor.

[Link to Corresponding Airborne]



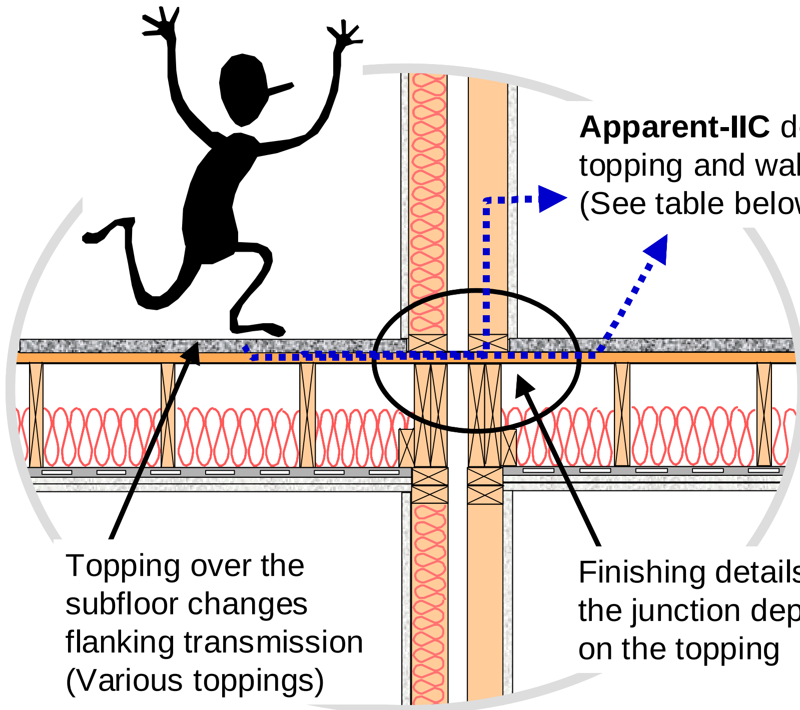
Expected performance with each topping is listed in the table, with a bare floor and with two added flooring finishes. No data are available for gypsum concrete toppings.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Apparent-IIC** *(Impact 2 m from wall)*		
No topping (basic subfloor)	50	51	65
19 mm OSB stapled to subfloor	55	57	71

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the joists parallel to the separating wall, the improvement in Apparent-IIC due to adding toppings is similar to that with the joists perpendicular.

Link to Corresponding Airborne



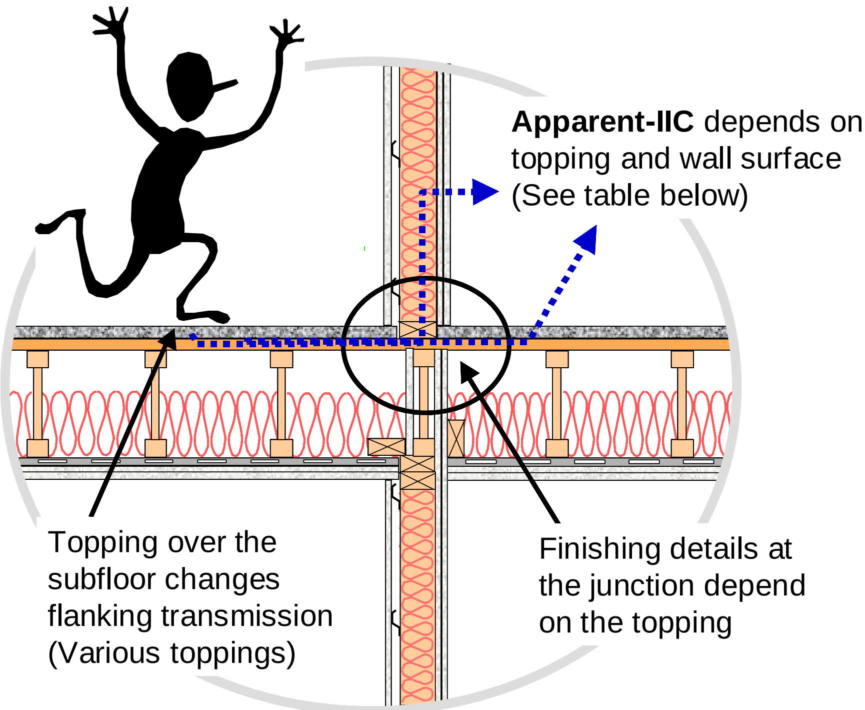
Expected performance with each topping is listed in the table, with a bare floor and with two added flooring finishes. No data are available for gypsum concrete toppings.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Apparent-IIC** *(Impact 2 m from wall)*		
No topping (basic subfloor)	51	51	68
19 mm OSB stapled to subfloor	55	56	70

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the single stud wall, the Apparent-IIC was evaluated for each topping, including the effect of flanking via the wall in the receiving room.

Link to Corresponding Airborne



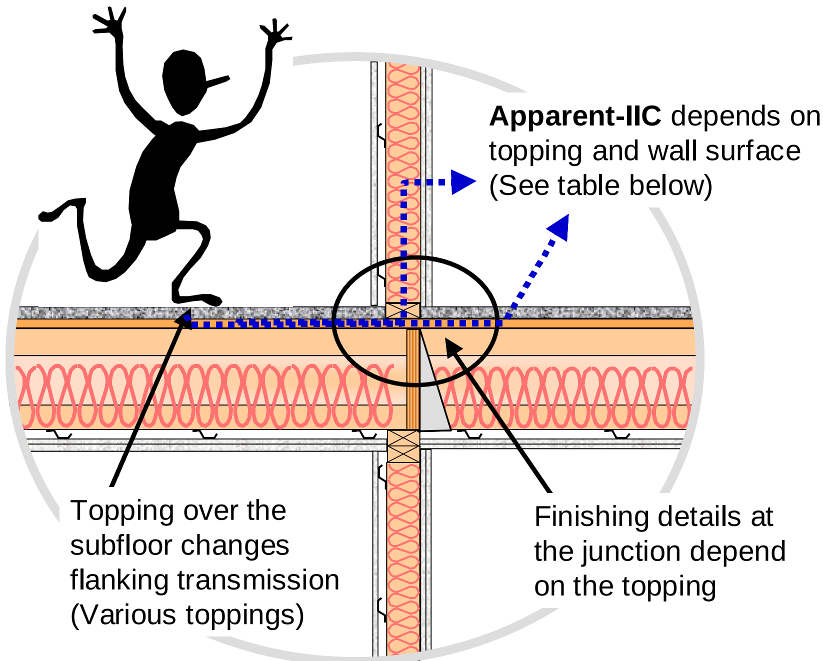
Expected performance with each topping is listed in the table, with a bare floor and with two added flooring finishes. Changes expected due to modifying the wall surface are given in preceding data for the basic subfloor.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Apparent-IIC** *(Impact 2 m from wall)*		
No topping (basic subfloor)	49	49	66
19 mm OSB stapled to subfloor	53	54	67
25 mm gypsum concrete bonded to subfloor	36	42	72
38 mm gypsum concrete on resilient mat covering subfloor	53	57	76
For Corridors *(impact 1 m from wall)* ***Apparent-IIC changes by:***			
No topping, or 19 mm OSB	-5	-5	-2
25 mm bonded gypsum concrete	-3	-3	-2
38 mm floating gypsum concrete	-1	-1	-2

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the joists perpendicular to the separating wall, the Apparent-IIC was generally lower. Apparent-IIC was evaluated for each topping, including the effect of flanking via the wall in the receiving room.

Link to Corresponding Airborne



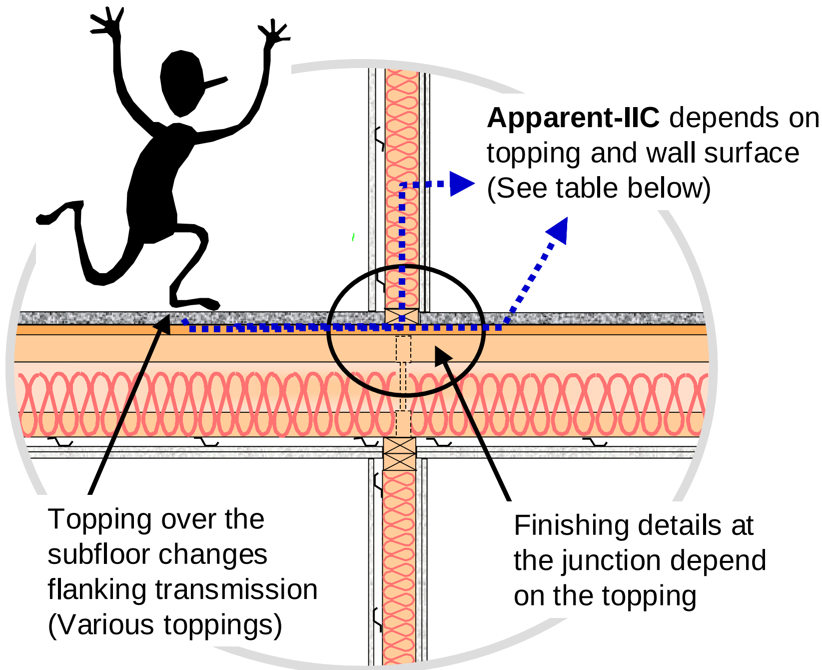
Expected performance with each topping is listed in the table, with a bare floor and with two added flooring finishes. Changes expected due to modifying the wall surface are given in preceding data for basic subfloor.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Apparent-IIC** *(Impact 2 m from wall)*		
No topping (basic subfloor)	42	43	63
19 mm OSB stapled to subfloor	47	47	61
25 mm gypsum concrete bonded to subfloor	38	43	62
38 mm gypsum concrete on resilient mat covering subfloor	46	50	68
For Corridors** (impact 1 m from wall) **Apparent-IIC changes by:			
No topping, or 19 mm OSB	-3	-3	0
25 mm bonded gypsum concrete	-3	-3	-1
38 mm floating gypsum concrete	0	-1	-2

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

With the joists perpendicular to the separating wall and continuous, the Apparent-IIC was even lower. Apparent-IIC was evaluated for each topping, including the effect of flanking via the wall surface in the receiving room.

Link to Corresponding Airborne



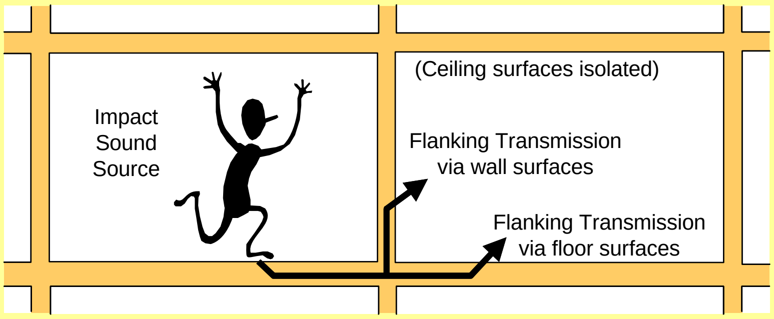
Expected performance with each topping is listed in the table, with a bare floor and with two added flooring finishes. Changes expected due to modifying the wall surface are given in preceding data for basic subfloor.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Apparent-IIC** *(Impact 2 m from wall)*		
No topping (basic subfloor)	38	38	58
19 mm OSB stapled to subfloor	46	47	60
25 mm gypsum concrete bonded to subfloor	41	46	65
38 mm gypsum concrete on resilient mat covering subfloor	45	49	69
For Corridors *(impact 1 m from wall)* ***Apparent-IIC changes by:***			
No topping, or 19 mm OSB	-3	-2	0
25 mm bonded gypsum concrete	-4	-3	-1
38 mm floating gypsum concrete	0	0	-2

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

Summary – Changes to Control Horizontal Flanking
(One apartment beside another, Impact sound source)

For footstep noise in the case of apartments horizontally separated by a partition wall assembly, or beside a corridor (horizontal transmission), the Apparent-IIC is entirely due to flanking transmission.

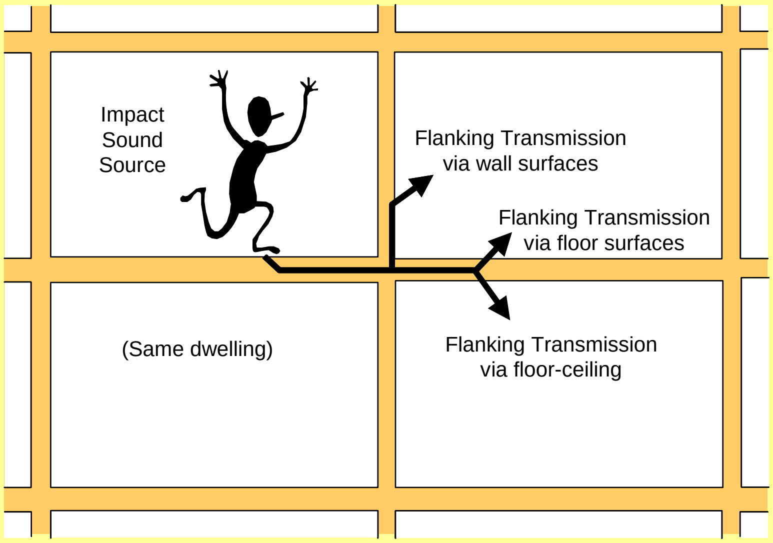


1. The main flanking paths are consistently from the subfloor of the room where the impact occurs to the floor and separating wall surface of the adjacent room.
2. The two surfaces that can be modified to reduce flanking transmission are the floor surface and the wall in the receiving room. The effects of specific toppings are listed in the tables above.
3. The Apparent-IIC also depends on how close the impact source is to the separating wall. Values are listed for typical rooms, and for the source close to the wall (as expected for a corridor).

Note that data and analysis in this section are all for the case with resilient channels supporting the ceiling, which is assumed to be characteristic for "apartment" construction – the focus of this section. "Row housing" cases, where the ceiling is not on resilient channels, are presented in the following section.

Flanking between Row Housing Units (Side-by-side Row Housing, Impact Sound Source)

This section concerns “row housing” (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.



1. The dominant horizontal flanking paths for impact sound are from the floor of the room where the impact occurs to the floor and the surface of the separating wall in the room beside.
2. With a basic subfloor, “row housing” constructions exhibit very similar horizontal flanking to the corresponding “apartment” cases.
3. Flanking transmission via the direct-applied ceiling introduced significant transmission of impact sound on the diagonal.
4. Adding a topping improved performance.

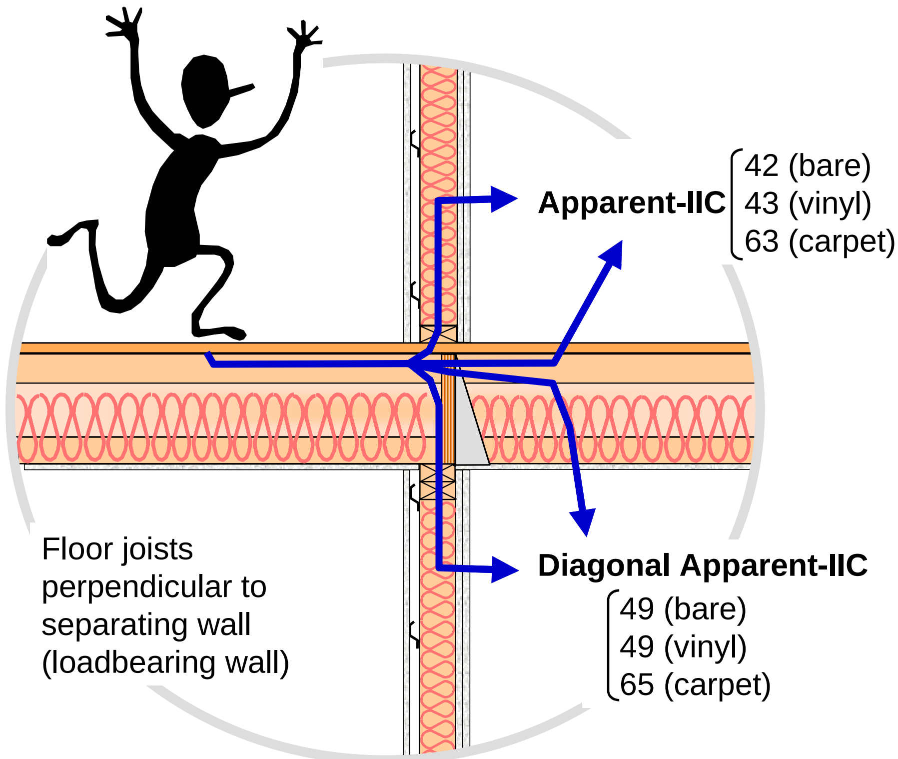
In all these cases, the horizontally and diagonally transmitted impact sound is ***entirely*** due to structure-borne flanking transmission.

Note that the data and analysis in this section apply only to the “row housing” case where the gypsum board of the ceiling is screwed directly to the bottom of the floor joists. “Apartment” cases, where the ceiling is on resilient channels, are presented in preceding sections.

The “row housing” construction variant was evaluated for only a limited set of cases. Systematic comparisons with the corresponding “apartment” cases indicate the significant effects can be accounted for by simply adding the flanking transmission via the direct-attached gypsum board ceiling. Only one case is illustrated here.

This construction replicates one of the cases illustrated for apartment constructions, except that in this "row housing" example, the ceiling was attached directly to the underside of the floor joists. This adds another potentially significant flanking path.

Link to Corresponding Airborne



For horizontal transmission of impact sound, the change in ceiling attachment has little effect on the Apparent-IIC.

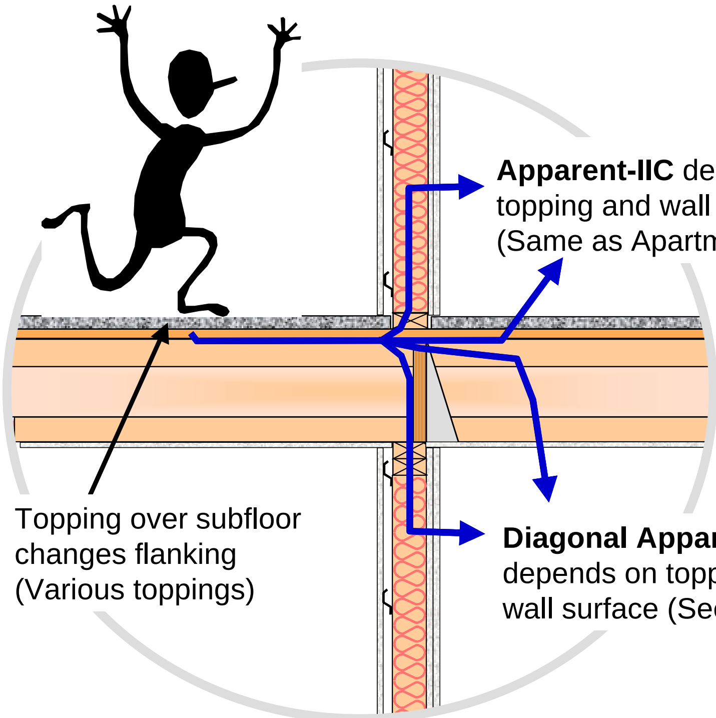
As in the "apartment" case, changing the wall surface facing the receiver has some effect.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Change in Construction	**Diagonal Apparent-IIC** *(Impact 2 m from separating wall)*		
Separating Wall (on receiving room side)			
Gypsum board alternatives			
- direct-attached, 2 layers	49	49	65
- on resilient channels, 1 layer	51	51	65

For diagonal transmission, the Apparent-IIC is consistently better than for the corresponding horizontal case.

When floor toppings are added (reducing flanking via the floor-floor path), the horizontal flanking is similar to that for the "apartment" configuration. However, the more effective vibration transmission via the direct-applied gypsum board ceiling introduces more flanking on the diagonal.

Link to Corresponding Airborne



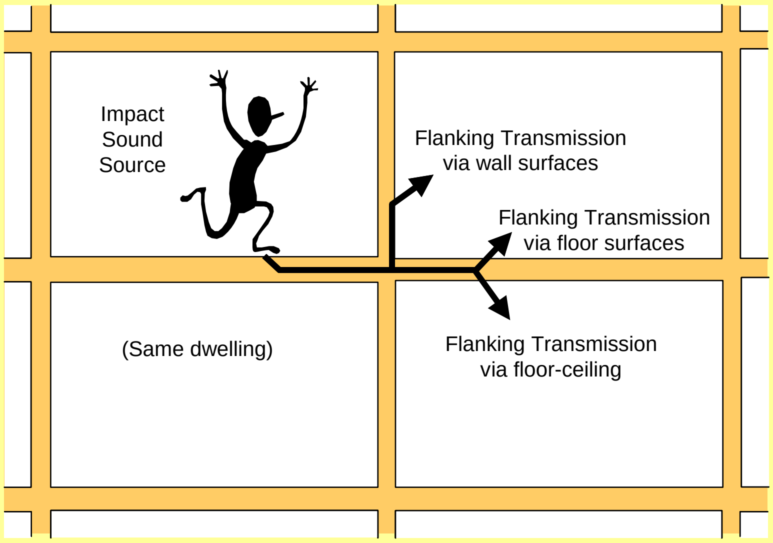
Expected performance for diagonal transmission of impact sound with each topping is listed in the table. Changes expected due to adding the topping are less than for the corresponding horizontal transmission case.

Flooring Finish	**Bare**	**Vinyl**	**Carpet**
Floor Topping	**Diagonal Apparent-IIC** *(Impact 2 m from separating wall)*		
No topping (basic subfloor)	49	49	65
19 mm OSB stapled to subfloor	60	61	75
25 mm gypsum concrete bonded to subfloor	46	52	81
25 mm gypsum concrete on resilient mat covering subfloor	46	52	84
For Corridors *(impact 1 m from wall)* ***Diagonal Apparent-IIC changes by:***			
No topping, or 19 mm OSB	-3	-3	-1
25 mm bonded gypsum concrete	-3	-3	-1
25 mm floating gypsum concrete	0	0	-2

Note: These estimates were obtained from evaluation of a limited set of specimens built with specific products that are identified in the descriptions. [See detail drawings] Using "generic equivalents" may change results.

Summary – Flanking between Row Housing Units
(Side-by-side Row Housing, Impact Sound Source)

This section concerns “row housing” (multiple stories with no requirement for sound insulation between stories) where the gypsum board of the ceiling is applied directly to the bottom of the floor joists.



1. The main flanking paths are from the floor to the floor/ceiling assembly of the adjoining unit. This means the dominant paths are floor-floor for horizontally separated rooms and floor-ceiling for those on the diagonal. Hence, the most effective approach is to treat the floor surface(s), to reduce flanking transmission for both room pairs.
2. For all cases considered here, the impact sound insulation is greater for diagonally separated rooms than for horizontally separated ones.
3. The effects of specific floor toppings are listed.

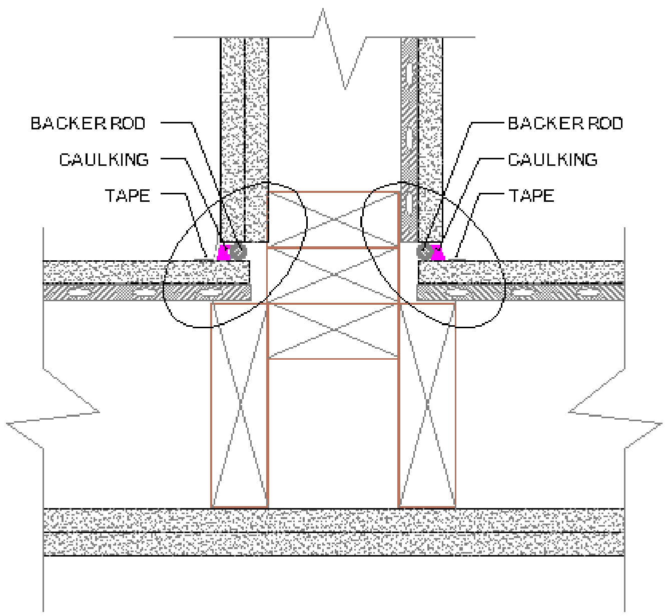
Note that the data and analysis in this section apply only to the “row housing” case where the gypsum board of the ceiling is screwed directly to the bottom of the floor joists. “Apartment” cases, where the ceiling is on resilient channels, are presented in preceding sections.

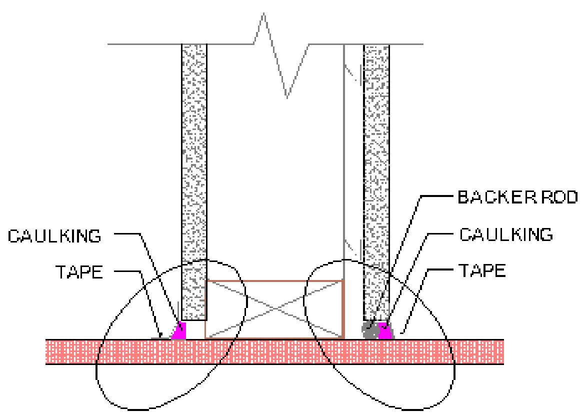
Appendix – Construction drawings

The following tables provide hyperlinks to Adobe Acrobat files (pdf) files containing AutoCAD drawings of the assemblies referenced by this Guide. The corresponding AutoCAD drawing files have the same name as the pdf files but with the AutoCAD extension (drw), and are supplied with the CD-ROM.

Joint Finishing Details

Drawing SFFIGB1-2.pdf





Load Bearing Double Stud Partition Wall

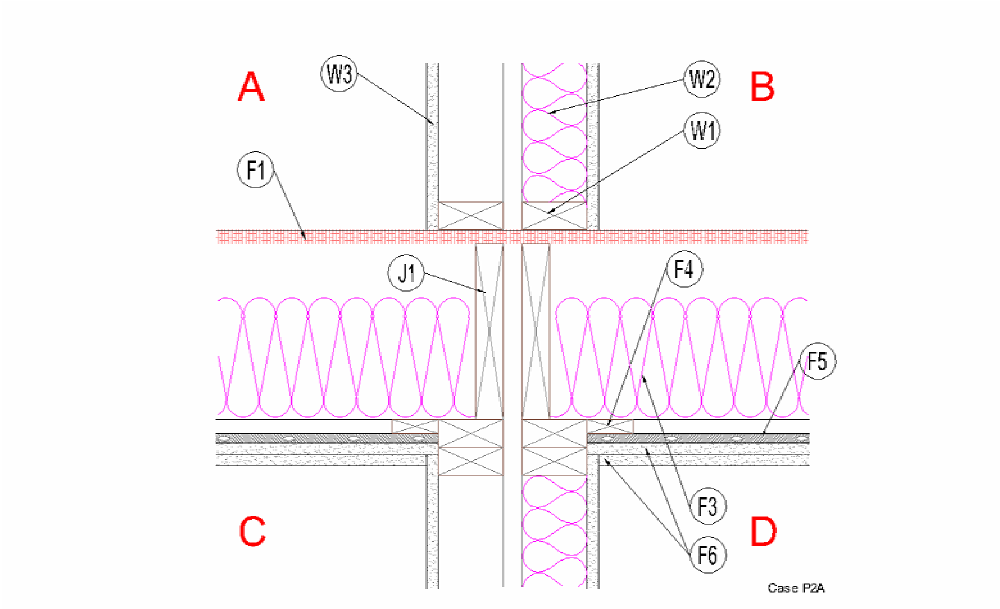
Users are urged to see the drawings of joint finishing details.

Floor topping	Partition Wall/Floor	Sidewall
No topping (basic subfloor)	SFCASP2A.pdf	_SFFIGB32.pdf
19 mm OSB stapled to subfloor	SFCASP2B.pdf	Same as above

Corresponding AutoCAD drawings (*.dwg) are given with the CD-ROM.

Return to Airborne Table Return to Impact Table

Drawing SFCASP2A.pdf



Partition Wall

W1: Double 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double sole plates. 1" (25 mm) separation between the rows of studs.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c.

Topping

None

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field

F2: 2x10 (38x235 mm) wood joists spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Bridging and strapping; 1x3 (19x64 mm) strapping 24" (610 mm) o.c. used as furring strips, 1x3 (19x64 mm) bracing no more than 72" (1800 mm) o.c. located at strapping points.

F5: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the strapping using 1-5/8" (42 mm) drywall screws.

F6: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. The screws placed so as not to penetrate into the strapping or joists.

Floor/Partition-Wall Intersection

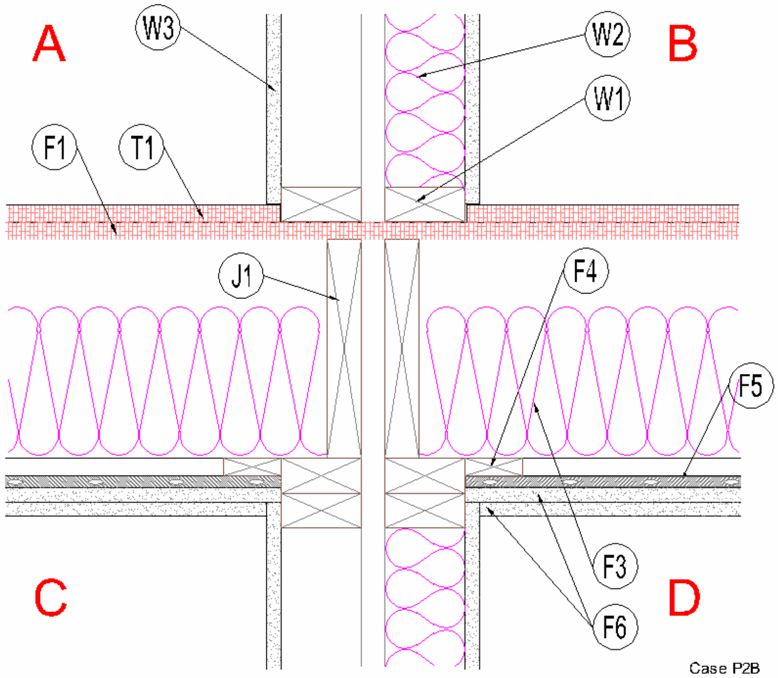
J1: Two 2x10 (38x235 mm) wood joists.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support strapping.

Common Details

Corridor walls, Caulking details.

Drawing SFCASP2B.pdf



Partition Wall

W1: Double 2x4 (38x89 mm) wood stud load-bearing wall having studs spaced 16" (406 mm) o.c., with double head plates. 1" (25 mm) separation between the rows of studs.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c.

Topping

T1: 3/4" (19 mm) OSB overlay installed perpendicular to the subfloor with staggered joints fastened with staples not less than 1/16" (1.6 mm) diameter, and 1/2" (12.5 mm) crown and 1-1/2" (38 mm) length spaced at 6" (150 mm) o.c. along edge and 8" (203 mm) o.c. in the field.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: 2x10" (38x235 mm) wood joists spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Bridging and strapping; 1x3 (19x64 mm) strapping 24" (610 mm) o.c. used as furring strips, 1x3 (19x64 mm) bracing no more than 72" (1800 mm) o.c. located at strapping points.

F5: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the strapping using 1-5/8" (42 mm) drywall screws.

F6: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. The screws placed so as not to penetrate into the strapping or joists.

Floor/Partition-Wall Intersection

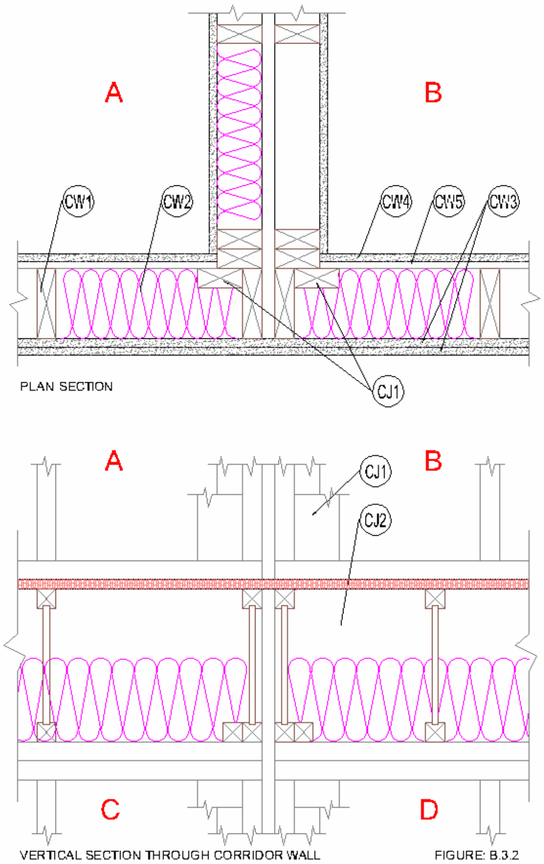
J1: Two 2x10 (38x235 mm) wood joists.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support strapping.

Common Details

Corridor walls, Caulking details.

***Drawing** SFFIGB32.pdf*



Partition Wall

Double stud, details specific to the wall/floor junction case.

Corridor Wall

CW1: Single 2x6 (38x140 mm) wood stud wall with studs spaced 16" (406 mm) o.c., with double head plate.

CW2: 6" (140 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

CW3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

CW4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

CW5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Corridor Wall/Partition Wall Intersection

CJ1: 2x4 (38X89 mm) blocking material as required to support the RC's of the corridor wall.

CJ2: TimberStrand® laminated strand lumber (LSL) rimboard continuous across end of partition wall.

Non-Load Bearing Double Stud Partition Wall

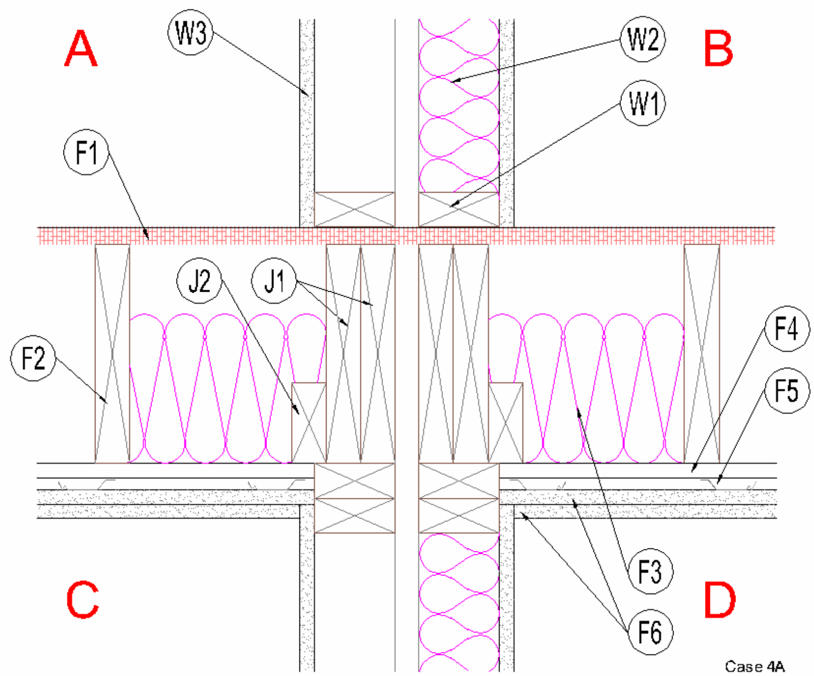
Users are urged to see the drawings of joint finishing details.

Floor topping	**Partition Wall/Floor**	**Sidewall**
No topping (basic subfloor)	_Drawing_SFCAS4A.pdf	_Drawing_SFFIGB32.pdf_1
19 mm OSB stapled to subfloor	_Drawing_SFCAS4D.pdf	Same as above

Corresponding AutoCAD drawings (*.dwg) are given with the CD-ROM.

Return to Airborne table Return to Impact table

***Drawing** SFCAS4A.pdf*



Partition Wall

W1: Double 2x4 (38x89 mm) wood stud wall having studs spaced 16” (406 mm) o.c., with double sole plates. 1” (25 mm) separation between the rows of studs.

W2: 3-1/2” (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: One layer of 5/8” (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached attached vertically and fastened with 2” (52 mm) or longer screws placed 16” (406 mm) o.c.

Topping

None

Floor

F1: 3/4” (19 mm) OSB floor decking fastened with 2” (51 mm) or longer #10 straight shank wood screws placed 6” (150 mm) o.c. at edges and 12” (305 mm) o.c. in the field

F2: 2x10 (38x235 mm) wood joists spaced 16” (406 mm) o.c.

F3: 6” (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Bridging and strapping; 1x3 (19x64 mm) strapping 24” (610 mm) o.c. used as furring strips, 1x3 (19x64 mm) bracing no more than 72” (1800 mm) o.c. located at strapping points.

F5: Resilient channels spaced 16” (406 mm) o.c. The resilient channels installed perpendicular to the strapping using 1-5/8” (42 mm) drywall screws.

F6: Two layers of 5/8” (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with 1-5/8” (42 mm) or longer screws placed 12” (305 mm) o.c. at the edges and 24” (610 mm) o.c. in the field. The face layer attached with 2” (52 mm) or longer screws placed 12” (305 mm) o.c. at the edges and in the field. The screws placed so as not to penetrate into the strapping or joists.

Floor/Partition-Wall Intersection

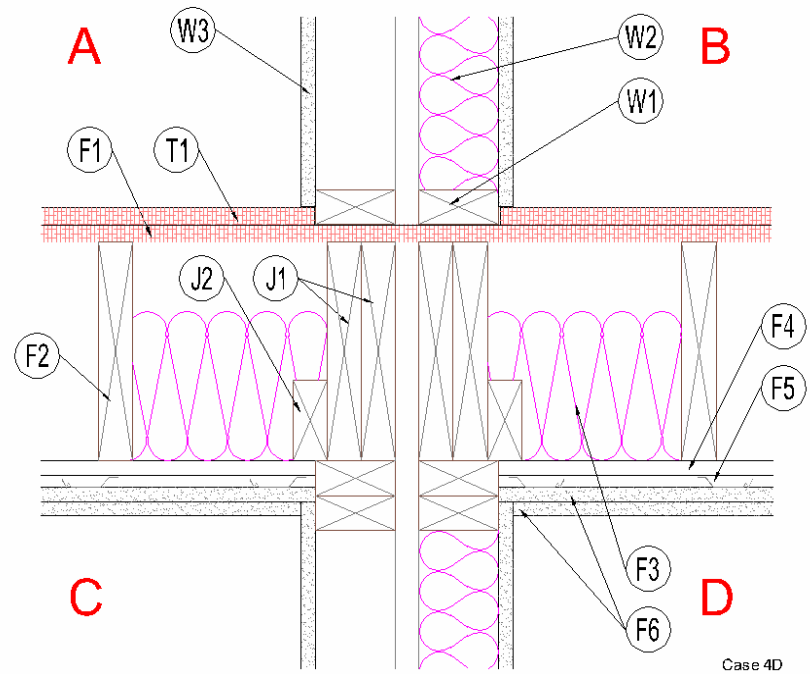
J1: Two 2x10 (38x235 mm) wood joists.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support strapping.

Common Details

Corridor walls, Caulking details.

***Drawing** SFCAS4D.pdf*



Partition Wall

W1: Double 2x4 (38x89 mm) wood stud load-bearing wall having studs spaced 16" (406 mm) o.c., with double head plates. 1" (25 mm) separation between the rows of studs.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c.

Topping

T1: 3/4" (19 mm) OSB overlay installed perpendicular to the subfloor with staggered joints fastened with staples not less than 1/16" (1.6 mm) diameter, and 1/2" (12.5 mm) crown and 1-1/2" (38 mm) length spaced at 6" (150 mm) o.c. along edge and 8" (203 mm) o.c. in the field.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: 2x10" (38x235 mm) wood joists spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Bridging and strapping; 1x3 (19x64 mm) strapping 24" (610 mm) o.c. used as furring strips, 1x3 (19x64 mm) bracing no more than 72" (1800 mm) o.c. located at strapping points.

F5: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the strapping using 1-5/8" (42 mm) drywall screws.

F6: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. The screws placed so as not to penetrate into the strapping or joists.

Floor/Partition-Wall Intersection

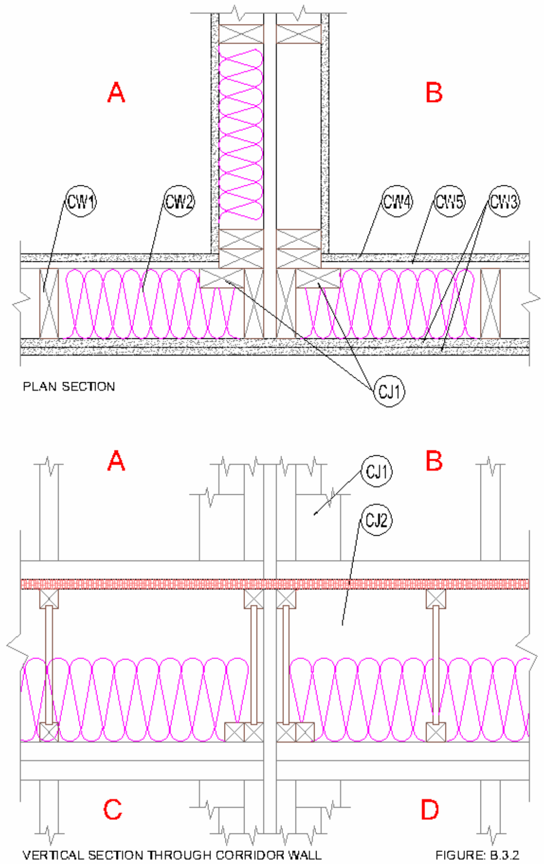
J1: Two 2x10 (38x235 mm) wood joists.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support strapping.

Common Details

Corridor walls, Caulking details.

***Drawing** SFFIGB32.pdf*



Partition Wall

Double stud, details specific to the wall/floor junction case.

Corridor Wall

CW1: Single 2x6 (38x140 mm) wood stud wall with studs spaced 16" (406 mm) o.c., with double head plate.

CW2: 6" (140 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

CW3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

CW4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

CW5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Corridor Wall/Partition Wall Intersection

CJ1: 2x4 (38X89 mm) blocking material as required to support the RC's of the corridor wall.

CJ2: TimberStrand® laminated strand lumber (LSL) rimboard continuous across end of partition wall.

Single Stud Non-Load Bearing Partition Wall

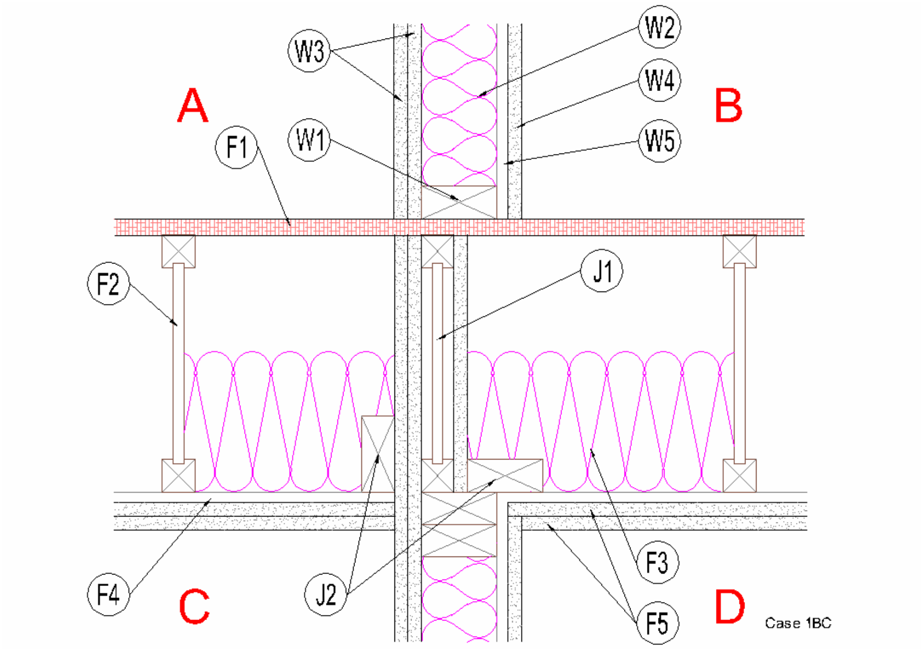
Users are urged to see the drawings of joint finishing details.

Floor topping	Partition Wall/Floor	Sidewall
No topping (basic subfloor)	_Drawing_SFCAS1BC.pdf	_Drawing_SFFIGB31.pdf
19 mm OSB stapled to subfloor	_Drawing_SFCAS1H.pdf	Same as above
25 mm LEVELROCK gypsum concrete bonded to subfloor	_Drawing_SFCAS1I.pdf	Same as above
38 mm LEVELROCK gypsum concrete on resilient mat covering subfloor	_Drawing_SFCAS1K.pdf	Same as above

Corresponding AutoCAD drawings (*.dwg) are given with the CD-ROM.

Return to Airborne Table Return to Impact Table

***Drawing** SFCAS1BC.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The panels extend through the floor cavity to the underside of the subfloor. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

None

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

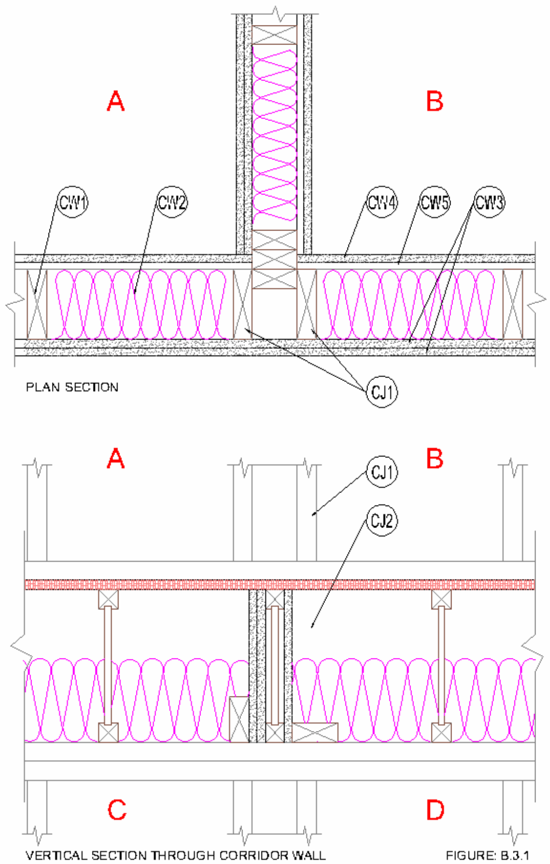
J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep, covered with 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panel.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support ceiling resilient channels.

Common Details

Corridor walls, Caulking details

***Drawing** SFFIGB31.pdf*



Partition Wall

Single stud, details specific to the wall/floor junction case.

Corridor Wall

CW1: Single 2x6 (38x140 mm) wood stud wall with studs spaced 16" (406 mm) o.c., with double head plate.

CW2: 6" (140 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

CW3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

CW4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

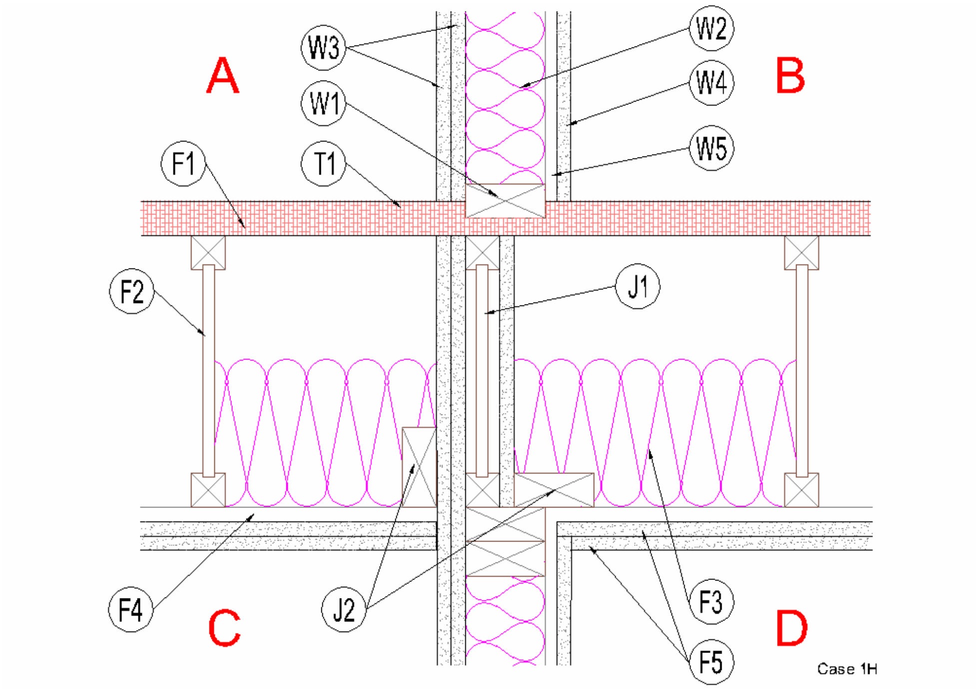
CW5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Corridor Wall/Partition Wall Intersection

CJ1: 2x6 (38X140 mm) blocking material as required to support the RC's of the corridor wall.

CJ2: TimberStrand® laminated strand lumber (LSL) rimboard continuous across end of partition wall.

***Drawing** SFCAS1H.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The panels extend through the floor cavity to the underside of the subfloor. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 3/4" (19 mm) OSB overlay installed perpendicular to the subfloor with staggered joints fastened with staples not less than 1/16" (1.6 mm) diameter, and 1/2" (12.5 mm) crown and 1-1/2" (38 mm) length spaced at 6" (150 mm) o.c. along edge and 8" (203 mm) o.c. in the field.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

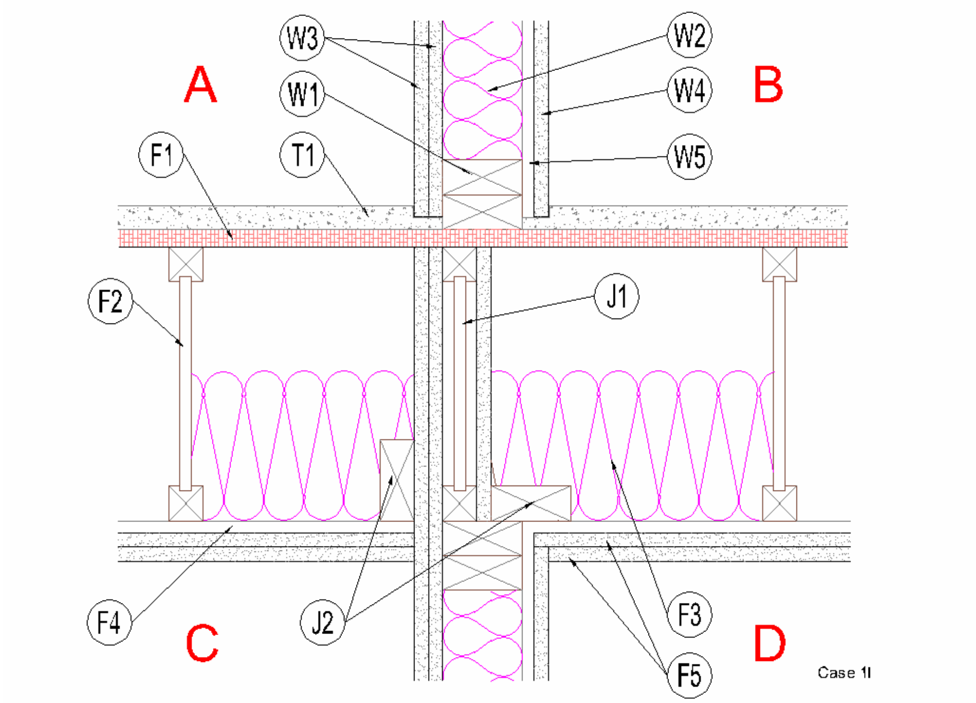
J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep, covered with 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panel.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support ceiling resilient channels.

Common Details

Corridor walls, Caulking details.

Drawing *SFCAS1I.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The panels extend through the floor cavity to the underside of the subfloor. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1" (25 mm) nominal thickness levelrock® Brand Floor Underlayment 2500 poured directly on the OSB subfloor.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

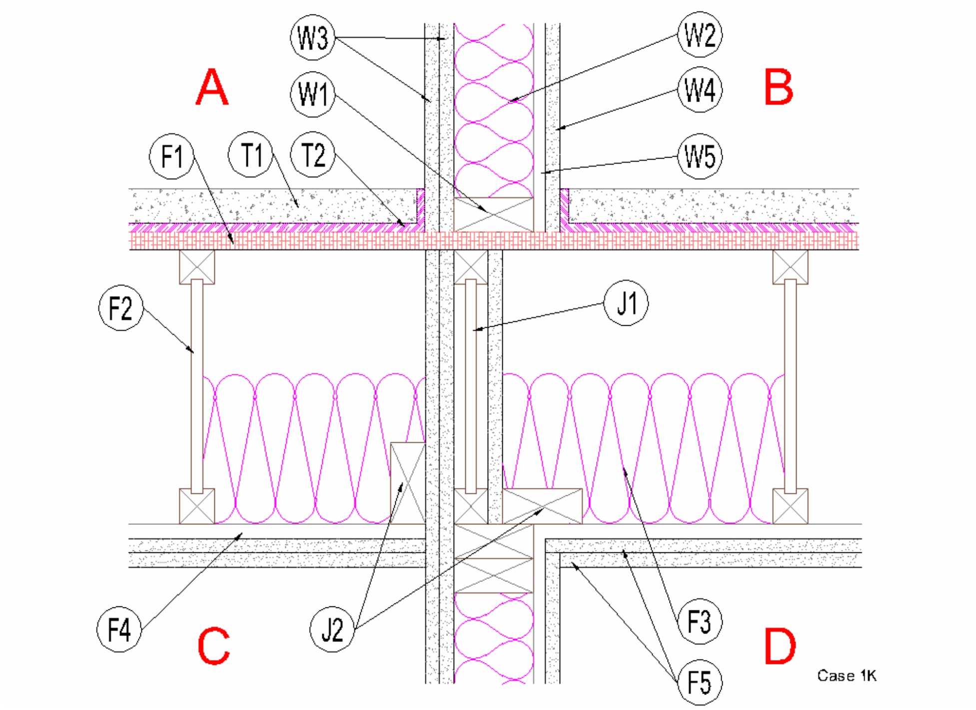
J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep, covered with 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panel.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support ceiling resilient channels.

Common Details

Corridor walls, Caulking details.

***Drawing** SFCAS1K.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The panels extend through the floor cavity to the underside of the subfloor. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1-1/2" (38 mm) nominal thickness LEVELROCK® Brand Floor Underlayment 2500.

T2: QuietZoneTM Acoustic Floor Mat nominal thickness 3/8" (9 mm). Tape all seams.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep, covered with 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panel.

J2: 2x4 (38x89 mm) nailing plates attached to studs in floor cavity to support ceiling resilient channels.

Common Details

Corridor walls, Caulking details.

Single Stud Load Bearing Partition Wall with Discontinuous Joists

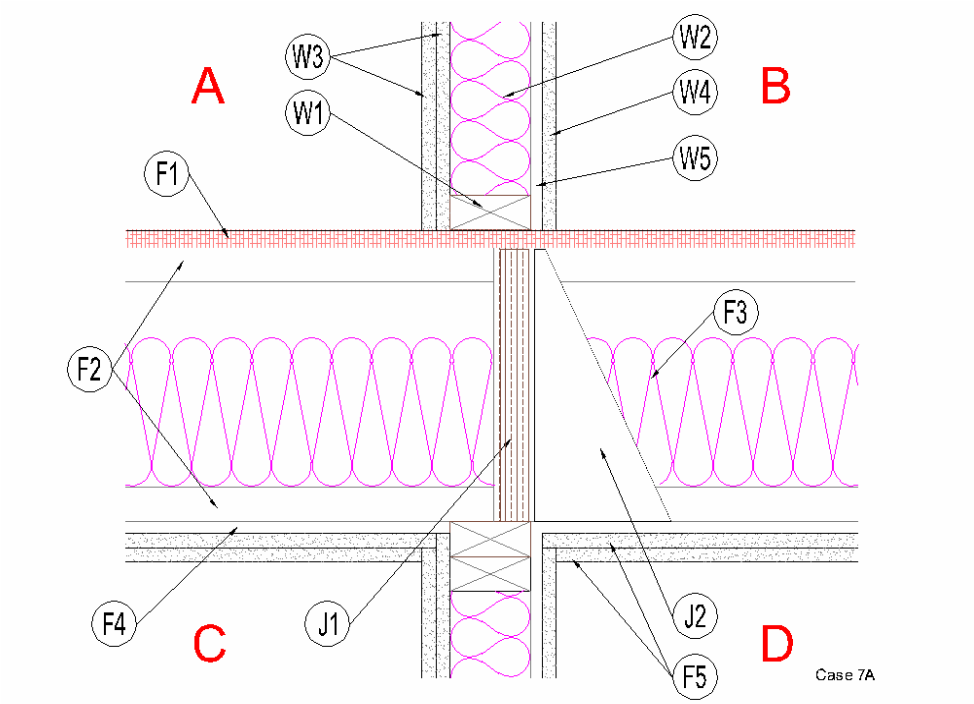
Users are urged to see the drawings of joint finishing details.

Floor topping	**Partition Wall/Floor**	**Sidewall**
No topping (basic subfloor)	_Drawing_SFCAS7A.pdf	_Drawing_SFFIGB34.pdf
19 mm OSB stapled to subfloor	_Drawing_SFCAS7E.pdf	Same as above
25 mm LEVELROCK gypsum concrete bonded to subfloor	_Drawing_SFCAS7F.pdf	Same as above
38 mm LEVELROCK gypsum concrete on resilient mat covering subfloor	_Drawing_SFCAS7D.pdf	Same as above

Corresponding AutoCAD drawings (*.dwg) are given with the CD-ROM.

Return to Airborne Table   Return to Impact Table

***Drawing** SFCAS7A.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

None

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

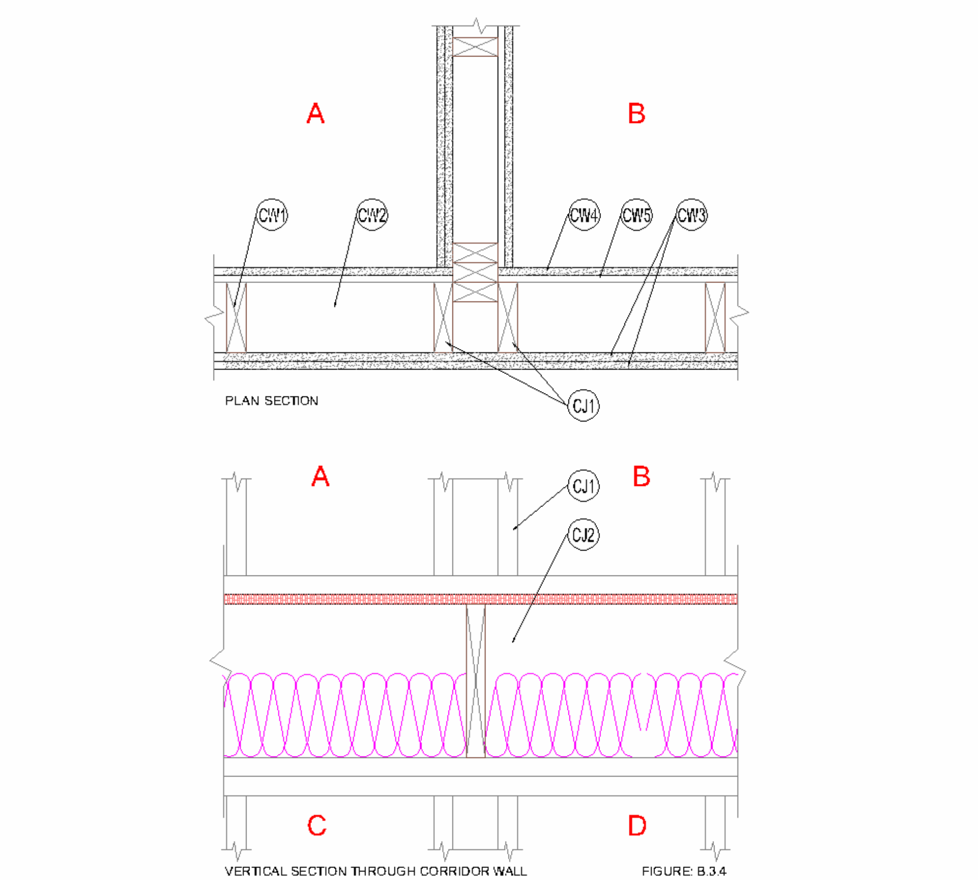
J1: The joists of one room rest on the partition wall butting into a TimberStrand® laminated strand lumber (LSL) rimboard, 1-1/4" (32 mm) thick by 11-7/8" (300 mm) deep.

J2: Simpson Strong-Tie ITT211.88 joist hangers attached to the rimboard.

Common Details

Corridor walls, Caulking details.

***Drawing** SFFIGB34.pdf*



Partition Wall

Single stud, details specific to the wall/floor junction case.

Corridor Wall

CW1: Single 2x6 (38x140 mm) wood stud wall with studs spaced 16" (406 mm) o.c., with double head plates continuous across the end of the partition wall.

CW2: 6" (140 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

CW3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

CW4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

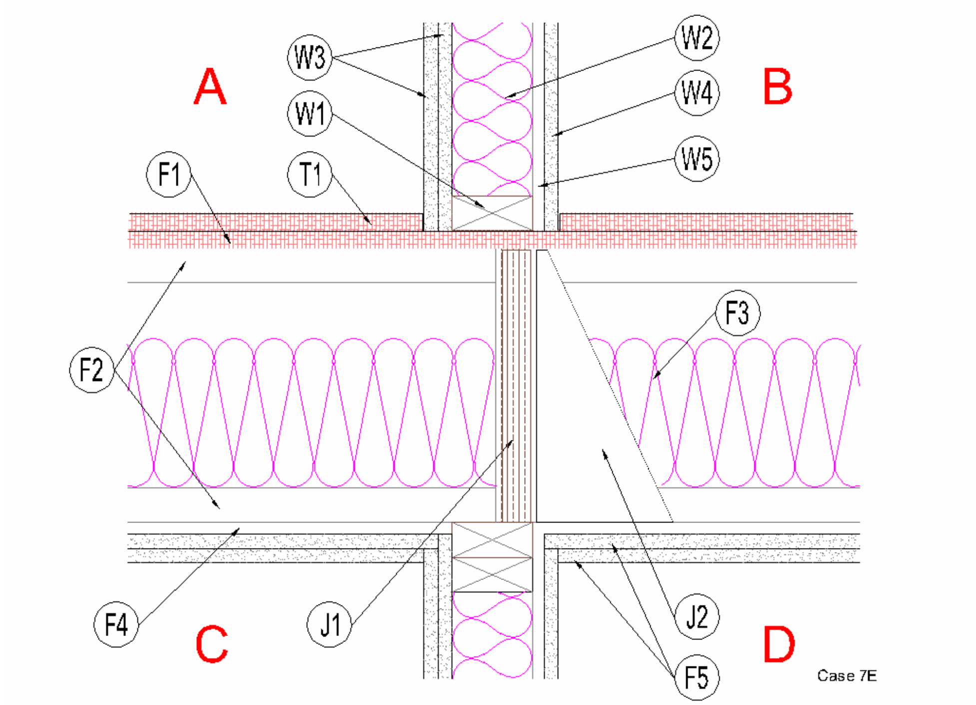
CW5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Corridor Wall/Partition Wall Intersection

CJ1: 2x6 (38X140 mm) blocking material as required to support the RC's of the corridor wall.

CJ2: TimberStrand® rimboard is discontinuous across end of partition wall. TimberStrand® butts up on either side of blocking over partition wall.

Drawing *SFCAS7E.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 3/4" (19 mm) OSB overlay installed perpendicular to the subfloor with staggered joints fastened with staples not less than 1/16" (1.6 mm) diameter, and 1/2" (12.5 mm) crown and 1-1/2" (38 mm) length spaced at 6" (150 mm) o.c. along edge and 8" (203 mm) o.c. in the field.

Floor:

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

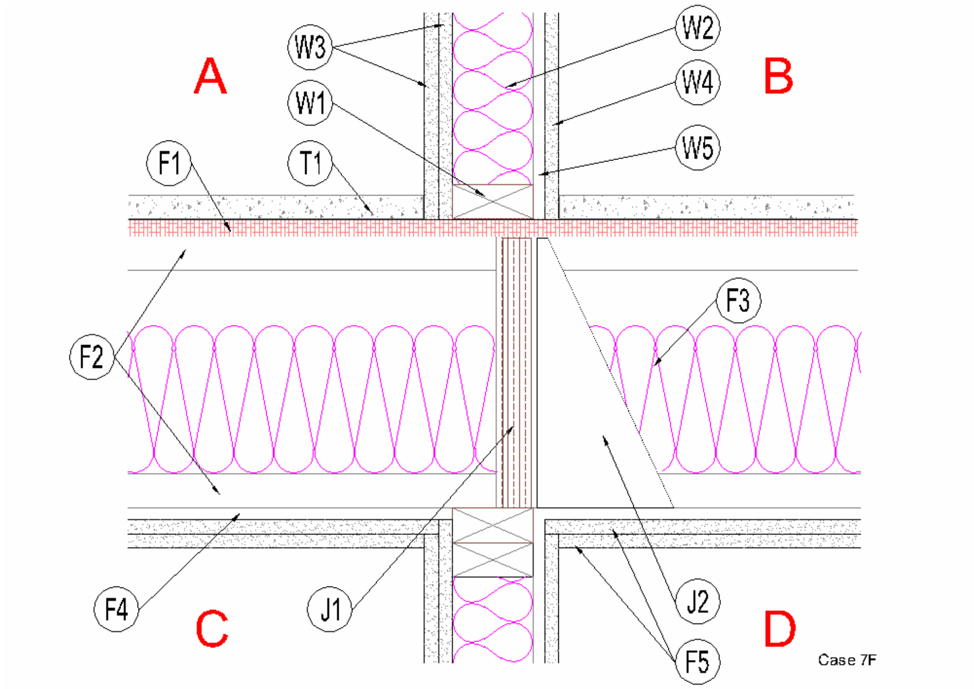
J1: The joists of one room rest on the partition wall butting into a TimberStrand® laminated strand lumber (LSL) rimboard, 1-1/4" (32 mm) thick by 11-7/8" (300 mm) deep.

J2: Simpson Strong-Tie ITT211.88 joist hangers attached to the rimboard.

Common Details

Corridor walls, Caulking details.

***Drawing** SFCAS7F.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1" (25 mm) nominal thickness LEVELROCK® Brand Floor Underlayment 2500 poured directly on the OSB subfloor.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

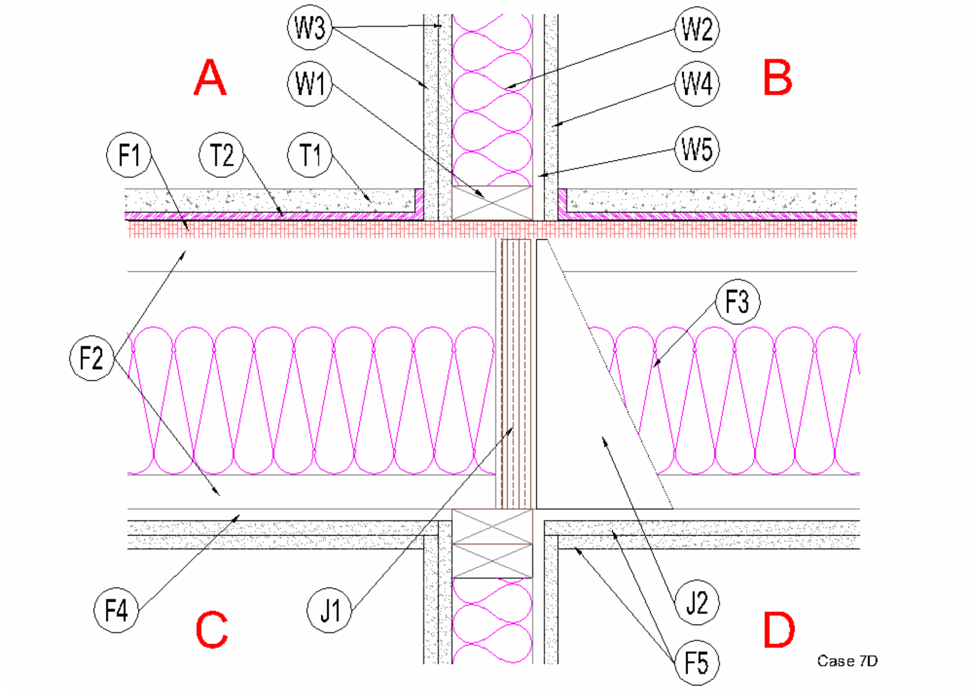
J1: The joists of one room rest on the partition wall butting into a TimberStrand® laminated strand lumber (LSL) rimboard, 1-1/4" (32 mm) thick by 11-7/8" (300 mm) deep.

J2: Simpson Strong-Tie ITT211.88 joist hangers attached to the rimboard.

Common Details

Corridor walls, Caulking details

***Drawing** SFCAS7D.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1" (25 mm) nominal thickness levelrock® Brand Floor Underlayment 2500.

T2: QuietZoneTM Acoustic Floor Mat nominal thickness 3/8" (9 mm). Tape all seams.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

J1: The joists of one room rest on the partition wall butting into a TimberStrand® laminated strand lumber (LSL) rimboard, 1-1/4" (32 mm) thick by 11-7/8" (300 mm) deep.

J2: Simpson Strong-Tie ITT211.88 joist hangers attached to the rimboard.

Common Details

Corridor walls, Caulking details.

Single Stud Load Bearing Partition Wall with Continuous Joists

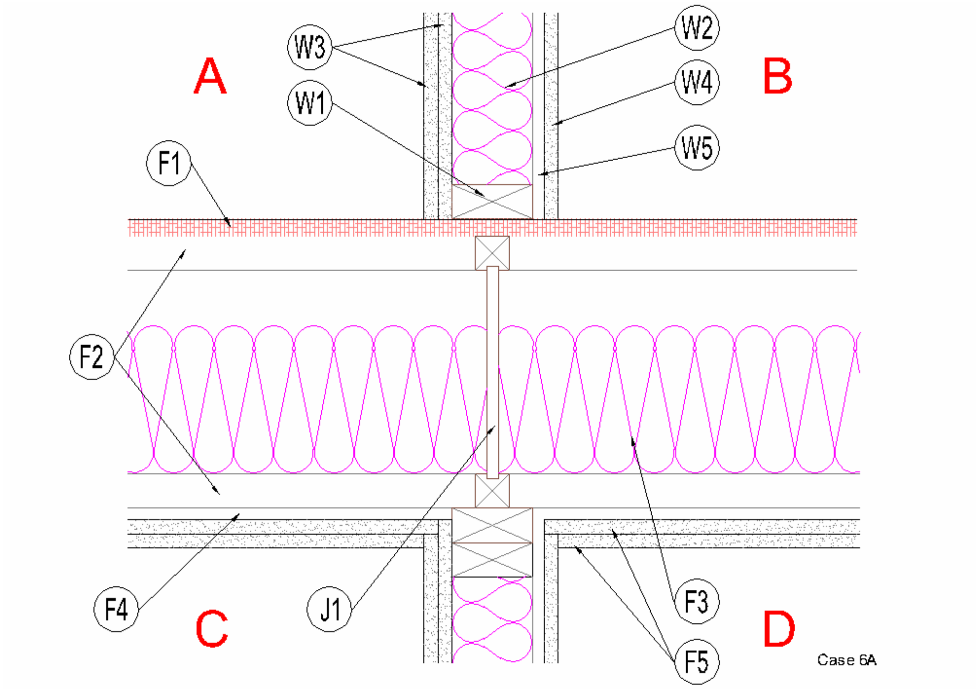
Users are urged to see the drawings of joint finishing details.

Floor topping	Partition Wall/Floor	Sidewall
No topping (basic subfloor)	_Drawing_SFCAS6A.pdf	_Drawing_SFFIGB33.pdf
19 mm OSB stapled to subfloor	_Drawing_SFCAS6C.pdf	Same as above
25 mm LEVELROCK gypsum concrete bonded to subfloor	_Drawing_SFCAS6E.pdf	Same as above
38 mm LEVELROCK gypsum concrete on resilient mat covering subfloor	_Drawing_SFCAS6B.pdf	Same as above

Corresponding AutoCAD drawings (*.dwg) are given with the CD-ROM.

Return to Airborne Table Return to Impact Table

***Drawing** SFCAS6A.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

None

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

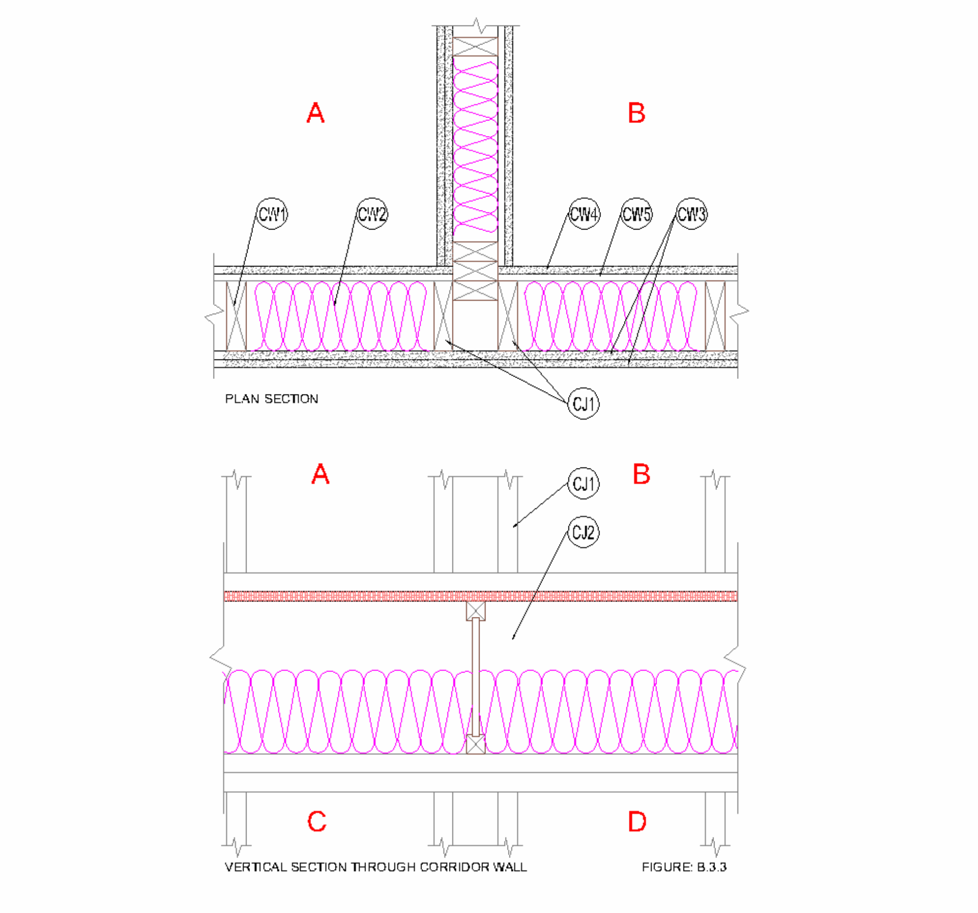
Floor/Partition-Wall Intersection

J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep.

Common Details

Corridor walls, Caulking details

***Drawing** SFFIGB33.pdf*



Partition Wall

Single stud, details specific to the wall/floor junction case.

Corridor Wall

CW1: Single 2x6 (38x140 mm) wood stud wall with studs spaced 16" (406 mm) o.c., with double head plate.

CW2: 6" (140 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

CW3: Two layers of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

CW4: One layer of 5/8" (15.9 mm) SHEETROCK® BRAND FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

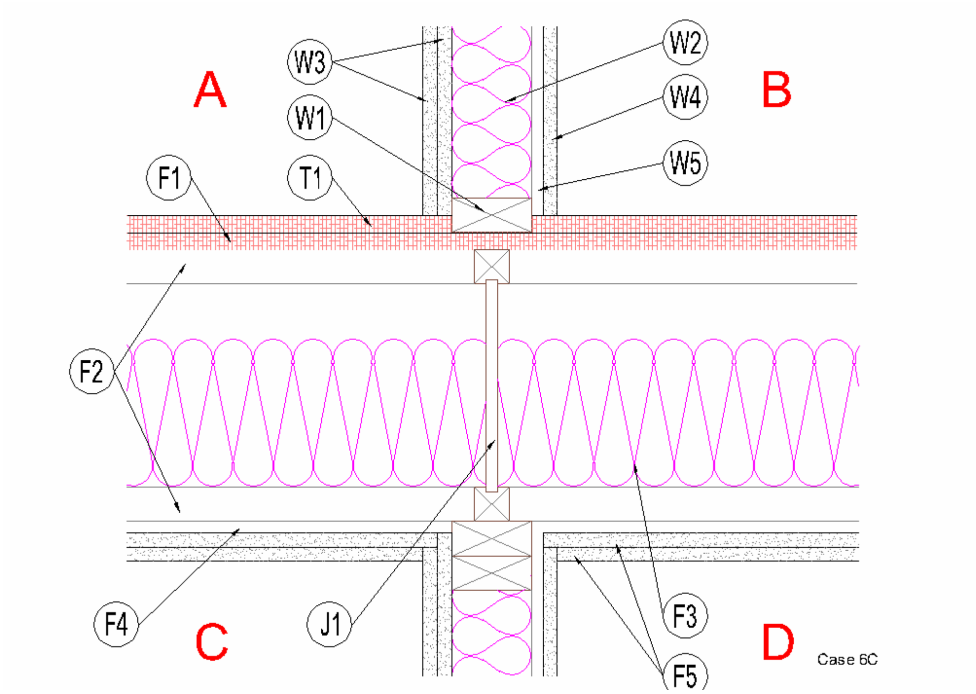
CW5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Corridor Wall/Partition Wall Intersection

CJ1: 2x4 (38X89 mm) blocking material as required to support the RC's of the corridor wall.

CJ2: TimberStrand® laminated strand lumber (LSL) rimboard continuous across end of partition wall.

Drawing *SFCAS6C.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 3/4" (19 mm) OSB overlay installed perpendicular to the subfloor with staggered joints fastened with staples not less than 1/16" (1.6 mm) diameter, and 1/2" (12.5 mm) crown and 1-1/2" (38 mm) length spaced at 6" (150 mm) o.c. along edge and 8" (203 mm) o.c. in the field.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

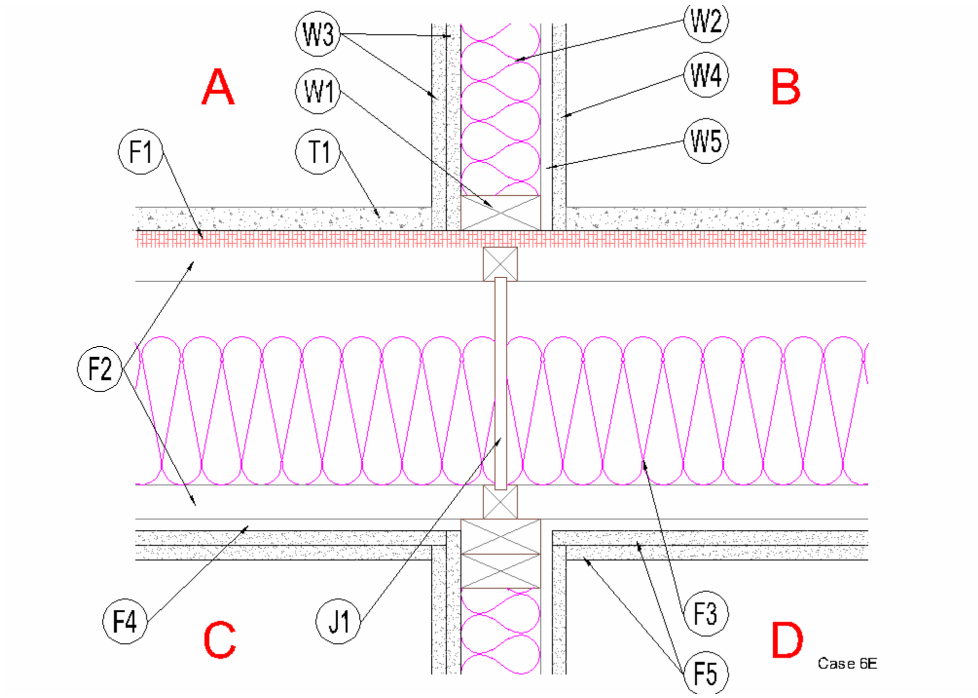
Floor/Partition-Wall Intersection

J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep.

Common Details

Corridor walls, Caulking details.

***Drawing** SFCAS6E.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1" (25 mm) nominal thickness levelrock® Brand Floor Underlayment 2500 poured directly on the OSB subfloor.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

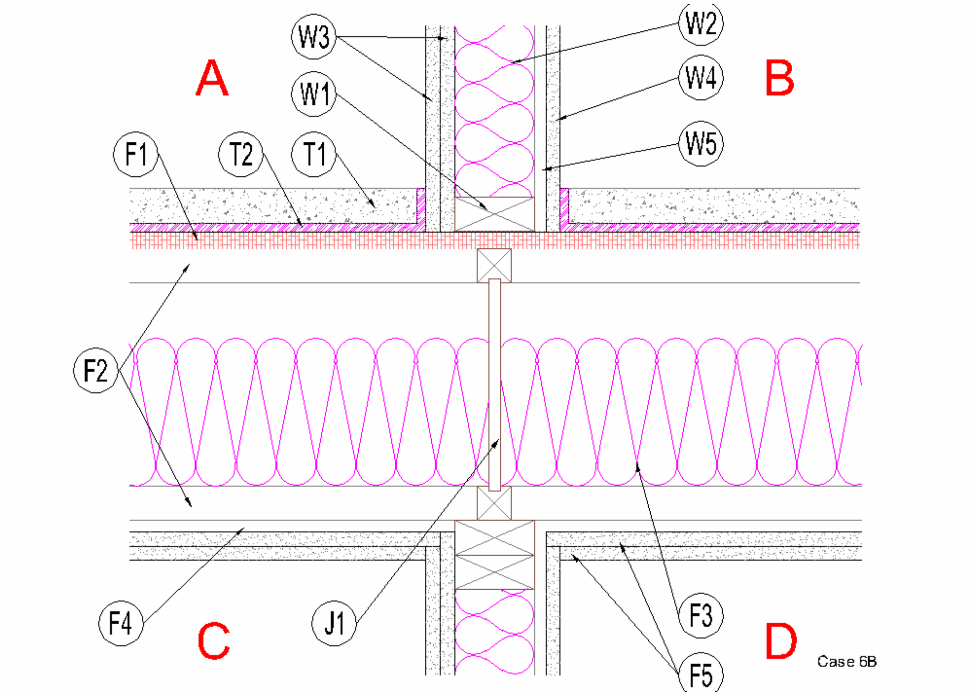
Floor/Partition-Wall Intersection

J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep.

Common Details

Corridor walls, Caulking details.

***Drawing** SFCAS6B.pdf*



Partition Wall

W1: Single 2x4 (38x89 mm) wood stud wall having studs spaced 16" (406 mm) o.c., with double head plate.

W2: 3-1/2" (90 mm) Unfaced Thermal/Acoustic Batt Insulation filling the wall cavity.

W3: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached directly to the studs. The base layer attached vertically using 1-5/8" (42 mm) drywall screws spaced 24" (610 mm) o.c. The face layer attached vertically and fastened with 2" (52 mm) or longer screws placed 16" (406 mm) o.c. Joints staggered by at least 16" (406 mm).

W4: One layer of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels attached via resilient channels. The panels attached to the channels using 1-5/8" (42 mm) drywall screws placed 12" (305 mm) o.c. The screws placed so as not to penetrate into the studs.

W5: Resilient channels spaced 24" (610 mm) o.c. The resilient channels installed perpendicular to the studs using 1-5/8" (42 mm) drywall screws.

Topping

T1: 1-1/2" (38 mm) nominal thickness levelrock® Brand Floor Underlayment 2500.

T2: QuietZoneTM Acoustic Floor Mat nominal thickness 3/8" (9 mm). Tape all seams.

Floor

F1: 3/4" (19 mm) OSB floor decking fastened with 2" (51 mm) or longer #10 straight shank wood screws placed 6" (150 mm) o.c. at edges and 12" (305 mm) o.c. in the field.

F2: TJI® Pro 150 wood I-joists with 1-1/2" (38 mm) square flange and 11-7/8" (300 mm) depth spaced 16" (406 mm) o.c.

F3: 6" (150 mm) Unfaced Thermal/Acoustic Batt Insulation.

F4: Resilient channels spaced 16" (406 mm) o.c. The resilient channels installed perpendicular to the joists using 1-5/8" (42 mm) drywall screws.

F5: Two layers of 5/8" (15.9 mm) SHEETROCK® Brand FIRECODE C CORE gypsum panels. The base layer attached with the long axis perpendicular to the resilient channels using 1-5/8" (42 mm) or longer screws placed 12" (305 mm) o.c. at the edges and 24" (610 mm) o.c. in the field. The face layer attached with 2" (52 mm) or longer screws placed 12" (305 mm) o.c. at the edges and in the field. Stagger joints by at least 16" (406 mm) in both directions. The screws placed so as not to penetrate into the joists.

Floor/Partition-Wall Intersection

J1: TJI® Pro 150 wood I-joist, 11-7/8" (300 mm) deep.

Common Details

Corridor walls, Caulking details

Technical References

1 T.R.T Nightingale, J.D. Quirt, F. King, and R.E. Halliwell, *Flanking transmission in multi-family dwellings: Phase IV*, IRC-RR-218, Institute for Research in Construction, National Research Council Canada, March 2006)

2 *Summary report for consortium on fire resistance and sound insulation of floors: Sound insulation class and impact insulation class results*, Internal Report IRC-IR-776, Institute for Research in Construction, National Research Council Canada, 1998

3 *Construction Technology Update 16, "Sound Isolation and Fire Resistance of Assemblies with Fire Stops"* available from Institute for Research in Construction, National Research Council Canada.

4 *Best Practice Guide on Fire Stops and Fire Blocks and their Impact on Sound Transmission* available from Institute for Research in Construction, National Research Council Canada (publication expected late 2006)