Draft Building Regulations 2014

Technical Guidance Document E

Sound

Public Consultation Draft

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Building Regulations 2014
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Introduction

This document has been published by the Minister for the Environment, Community and Local Government, under article 7 of the Building Regulations 1997. It provides guidance in relation to Part E of the Second Schedule to the Regulations. The document should be read in conjunction with the Building Regulations 1997-2013, and other documents published under these Regulations. In general, Building Regulations apply to the construction of new buildings and to extensions and material alterations to buildings. In addition, certain parts of the Regulations apply to existing buildings where a material change of use takes place. Otherwise, Building Regulations do not apply to buildings constructed prior to 1 June 1992.

Transitional arrangements

In general, this document applies to works, or buildings in which a material change of use takes place, where the works or the change of use commence or takes place, as the case may be on or after 1 January 2015. Technical Guidance Document E – Sound dated 1997, also ceases to have effect from that date.

The guidance

The materials, methods of construction, standards and other specifications (including technical specifications) which are referred to in this document are those which are likely to be suitable for the purposes of the Regulations. Where works are carried out in accordance with the guidance in this document, this will, prima facie, indicate compliance with Part E of the Second Schedule to the Building Regulations. However, the adoption of an approach other than that outlined in the guidance is not precluded provided that the relevant requirements of the Regulations are complied with. Those involved in the design and construction of a building may be required by the relevant building control authority to provide such evidence as is necessary to establish that the requirements of the Building Regulations are being complied with.

Existing buildings

In the case of material alterations or changes of use of existing buildings, the adoption without modification of the guidance in this document may not, in all circumstances, be appropriate. In particular, the adherence to guidance, including codes, standards or technical specifications, intended for application to new work may be unduly restrictive or impracticable. Buildings of architectural or historical interest are especially likely to give rise to such circumstances. In these situations, alternative approaches based on the principles contained in the document may be more relevant and should be considered.

Technical specifications

Building Regulations are made for specific purposes, e.g. to provide, in relation to buildings, for the health, safety and welfare of persons, the conservation of energy and access for people with disabilities. Technical specifications (including harmonised European Standards, European Technical Approvals, National Standards and Agrément Certificates) are relevant to the extent that they relate to these considerations. Any reference to a technical specification is a reference to so much of the specification as is relevant in the context in which it arises. Technical specifications may also address other aspects not covered by the Regulations. A reference to a technical specification is to the latest edition (including any amendments, supplements or addenda) current at the date of publication of this Technical Guidance Document. However, if this version of the technical specification is subsequently revised or updated by the issuing body, the new version may be used as a source of guidance provided that it continues to address the relevant requirements of the Regulations.

A list of other standards and publications that deal with matters relating to this Part of the Building Regulations is included at the end of this document. These standards and publications maybe used as a source of further information but do not form part of the guidance.

Materials and workmanship

Under Part D of the Second Schedule to the Building Regulations, building work to which the Regulations apply must be carried out with proper materials and in a workmanlike manner. Guidance in relation to compliance with Part D is contained in Technical Guidance Document D.

Interpretation

In this document, a reference to a section, sub-section, part, paragraph or diagram is, unless otherwise stated, a reference to a section, sub-section, part, paragraph or diagram, as the case may be, of this document. A reference to another Technical Guidance Document is a reference to the latest edition of a document published by the Department of the Environment, Community and Local Government, under article 7 of the Building Regulations, (as amended). Diagrams are used in this document to illustrate particular aspects of construction - they may not show all the details of construction.

Sound

Part E - the requirement

Part E of the Second Schedule to the Building Regulations 2013, provides as follows: -

Sound.	E1	Each wall and floor separating a dwelling from: (a) another dwelling or dwellings, (b) other parts of the same building, or (c) adjoining buildings, shall be designed and constructed in such a way so as to provide reasonable resistance to sound.
Reverberation.	E2	The common internal part of a building which provides direct access to a dwelling shall be designed and constructed so as to limit reverberation in the common part to a level that is reasonable.
Definitions for this Part.	E3	In this Part – "Reverberation" means the persistence of sound in a space after a sound source has been stopped.

Section 0
General guidance

0.1 Application of the Regulations

0.1.1 General

0.1.1.1 The aim of Part E of the Second Schedule to the Building Regulations is to ensure that dwellings achieve reasonable levels of sound insulation from sound transmission emanating from attached buildings or differently occupied parts of the same building.

0.1.1.2 For the purposes of Part E of the Second Schedule of the Building Regulations (as amended), the types of sound to be considered are airborne and impact sounds and from reverberation.

0.1.1.3 Part E applies to new build dwellings, and works involving a material change of use that results in a building (or part thereof) becoming used as one or more dwellings.

0.1.1.4 The purpose of the requirement of Regulation E1 is to protect occupants from airborne and impact noise generated in and around dwellings. Diagram 1 illustrates the relevant location of walls and floors which are required to have reasonable sound insulation in order to satisfy the requirement of Regulation E1.

0.1.1.5 For dwellings, when the relevant walls and floors are designed and constructed using acceptable constructions in accordance with Section 3 and 4) and tested in accordance with Section 2, this will, prima facie, indicate compliance with the requirement of Regulation E1.

0.1.1.6 The purpose of the requirement of Regulation E2 is to protect occupants from noise produced from reverberation in common internal areas which provide direct access to a dwelling or dwellings.

0.1.1.7 Part E does not address environmental noise through the building facade from sources such as aircraft, trains, road traffic or industry.

0.1.2 Guidance

0.1.2.1 This document applies to dwellings and some common areas of buildings providing direct access to dwellings. It gives guidance in relation to the achievement of reasonable sound insulation insofar as it relates to non-complex buildings of normal design and construction. Specialist advice may be needed in certain situations to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level.

0.1.2.2 This Technical Guidance Document is divided into six sections.

Section 0 provides general information on sound.

Section 1 relates to the performance level required to meet the requirement of Regulation E1.

Section 2 provides guidance on testing as a means of demonstrating that the construction complies with the requirement of Regulation E1.

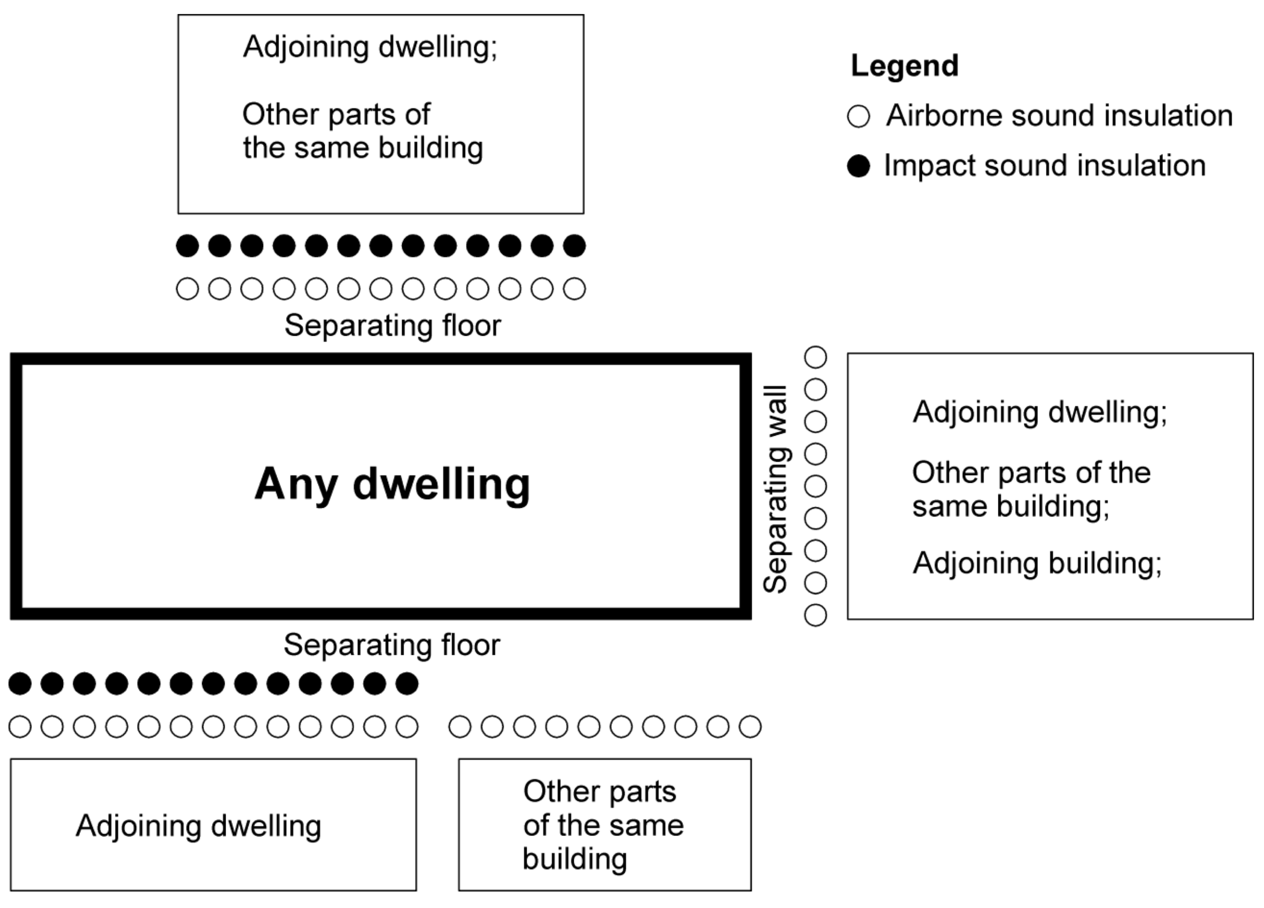
Section 3 provides examples of wall types which, if constructed correctly should achieve the performance level set out in Section 1.

Section 4 provides examples of floor types which, if constructed correctly should achieve the performance level set out in Section 1.

Section 5 provides guidance on the control of reverberation in certain common internal parts of buildings and relates to the requirement of Regulation E2.

0.1.2.3 It is important to recognise that the guidance in this document will not guarantee freedom from unwanted sound transmission. The guidance aims is to limit the effects from sound levels created from normal domestic activities, but not from excessive noise from other sources such as power tools, audio systems inconsiderately played at high volume or even raised voices.

Diagram 1 Scope of requirement of Part E1
(Par. 0.1.1.4)



0.1.3 Definitions

0.1.3.1 For the purposes of this document, the following terms and definitions apply:

Absorption - Conversion of sound energy to heat, often by the use of a porous material.

Absorption coefficient - A quantity characterising the effectiveness of a sound absorbing surface. The proportion of sound energy absorbed is given as a number between zero (for a fully reflective surface) and one (for a fully absorptive surface). Note that sound absorption coefficients determined from laboratory measurements may have values slightly larger than one. Refer to I.S. EN ISO 354.

Absorptive material - Material that absorbs sound energy.

Airborne sound - Sound which is propagated from a noise source through the medium of air, e.g. speech and sound from a television.

Airborne sound insulation - Sound insulation that reduces transmission of airborne sound between buildings or parts of buildings.

Air path - A direct or indirect air passage from one side of a structure to the other.

Cavity stop - A proprietary product or material such as mineral wool used to close the gap in a cavity wall to minimise flanking sound transmission along the wall cavity.

Cavity barrier - A construction provided to close a concealed space against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space.

Decibel (dB) - The unit used for many acoustic quantities to indicate the level with respect to a reference level.

Density - Mass per unit volume, expressed in kilograms per cubic metre (kg/m^3).

Direct transmission - Refers to the path of either airborne or impact sound through elements of construction.

DnT - The difference in sound level between a pair of rooms, in a stated frequency band, corrected for the reverberation time. Refer to I.S. EN ISO 140-4:1998.

DnT,w - The weighted standardised level difference. A single number quantity (weighted) which characterises the airborne sound insulation between rooms in accordance with I.S. EN ISO 717-1.

Dynamic stiffness - A parameter used to describe the ability of a resilient material or wall tie to transmit vibration. Specimens with high dynamic stiffness (dynamically 'stiff') transmit more vibration than specimens with low dynamic stiffness (dynamically 'soft'). Refer to I.S. EN 29052-1:1992 for resilient materials. See BRE Information Paper IP 3/01 for wall ties.

Flanking element - Any building element that contributes to sound transmission between rooms in a building that is not a separating floor or separating wall.

Flanking transmission - Sound transmitted between rooms via flanking elements instead of directly through separating elements or along any path other than a direct path.

Floating floor - A floating floor consists of a floating layer and resilient layer (see also floating layer and resilient layer).

Floating layer - A surface layer that rests on a resilient layer and is isolated from the base floor and the surrounding walls (see also resilient layer).

Frequency - The number of pressure variations (or cycles) per second that gives a sound its distinctive tone. The unit of frequency is the Hertz (Hz).

Frequency band - A continuous range of frequencies between stated upper and lower limits (see also octave band and one-third octave band).

Hertz (Hz) - The unit of frequency of a sound (cycles per second).

Impact sound - Sound resulting from direct impact on a building element.

Impact sound insulation - Sound insulation which reduces impact sound transmission from direct impacts such as footsteps on a building element.

Internal floor - Any floor other than a separating floor (see separating floor).

Intermediate landing - A landing between two floors (see also landing).

Internal wall - Any wall that does not have a separating function.

Isolation - The absence of rigid connections between two or more parts of a structure.

Landing - A platform or part of a floor structure at the end of a flight of stairs or ramp.

L'_{nT} - The impact sound pressure level in a stated frequency band, corrected for the reverberation time. See I.S. EN ISO 140-7:1998.

$L'_{nT,w}$ - The weighted standardised impact sound pressure level. A single-number quantity (weighted) to characterise the impact sound insulation of floors, in accordance with I.S. EN ISO 717-2.

Mass per unit area - An expression in terms of kilograms per square metre (kg/m^2).

Noise - Unwanted sound.

Octave band - A frequency band in which the upper limit of the band is twice the frequency of the lower limit.

One - third octave band - A frequency band in which the upper limit of the band is $2^{1/3}$ times the frequency of the lower limit.

Rw - A single number quantity (weighted) which characterises the airborne sound insulation of a building element from measurements undertaken in a laboratory, in accordance with I.S. EN ISO 717-1.

Resilient layer - A layer that isolates a floating layer from a base.

Reverberation - The persistence of sound in a space after a sound source has been stopped.

Reverberation time - The time, in seconds, taken for the sound to decay by 60dB after a sound source has been stopped.

Separating floor - A floor that separates dwellings for residential purposes.

Separating wall - A wall that separates adjoining dwelling houses or flats.

Sound pressure level - A quantity related to the physical intensity of a sound.

Sound reduction index (R) - A quantity, measured in a laboratory, which characterises the sound insulating properties of a material or building element in a stated frequency band. Refer to I.S. EN ISO I.S. EN ISO 10140-1 to 5.

Spectrum - The composition of a particular sound in terms of separate frequency bands.

Structure-borne sound - Sound which is carried via the structure of a building.

Timber framed wall - A partition consisting of boards or boards connected to both sides of a wood frame.

NSAI - National Standards Authority of Ireland.

ΔL_w - The measured improvement of impact sound insulation resulting from the installation of a floor covering or floating floor on a test floor in a laboratory (See I.S. EN ISO 717-2).

0.2 Sound

0.2.1 General

0.2.1.1 Sound is a form of energy which can be transmitted over a distance from its source through a medium, such as air or a solid element of construction, e.g. a wall or a floor. Sound may be transmitted directly or indirectly (flanking transmission) (see Diagram 2).

0.2.1.2 The principle methods of isolating the receiver from the source of the sound are:

(a) eliminating pathways along which the sound can travel, and

(b) using barriers formed of materials of sufficiently high mass which will not easily vibrate.

In practice, sound insulation is usually achieved by using a combination of both methods described above.

0.2.2 Direct transmission of sound

0.2.2.1 Direct transmission means the transmission of sound directly through a wall or a floor from one of its sides to the other.

0.2.2.2 The reduction in the level of airborne sound transmitted through a solid masonry wall depends on the mass of the wall. If the wall is heavy, it is not easily set into vibration. Walls comprising of two or three leaves depend partly on their mass and partly on structural isolation between the leaves.

0.2.2.3 With masonry walls, the mass is the main factor but stiffness and damping (which turns sound energy into heat) are also important. Cavity masonry walls need at least as much mass as solid walls because their lower degree of stiffness offsets the benefits of isolation.

0.2.2.4 Floors should reduce airborne sound and also, if they are above a dwelling, impact sound. A heavy solid floor depends on its mass to reduce airborne sound and on a resilient layer to reduce impact sound at source. A floating floor uses a resilient layer to isolate the walking surface from the base and this isolation contributes to both airborne and impact sound insulation. The resilient layer is only effective if it is not too stiff and so it is important to choose a suitable material and to make sure that it is not by passed with rigid bridges such as fixings and pipes.

0.2.2.5 Air paths must be avoided – porous materials and gaps at joints in the structure must be sealed. Resonances must be avoided; these may occur if some part of the structure (such as dry lining) vibrates strongly at a particular sound frequency (pitch) and transmits more energy at this pitch.

0.2.3 Flanking transmission of sound

0.2.3.1 Flanking transmission means the indirect transmission of sound from one side of a wall or floor to the other side.

0.2.3.2 Because a solid element may vibrate when exposed to sound waves in the air, it may cause sound waves in the air on both sides. Flanking transmission happens when there is a path along which sound can travel between elements on opposite sides of a wall or floor. This path may be through a continuous solid structure or through an air space (such as a cavity of an external wall). Usually, paths through a structure are more important with solid masonry elements, while paths through an air space are more important with thin panels (such as studwork and ceilings) in which structural waves do not travel as freely.

0.2.3.3 The junction of a sound resisting element and a flanking element provides resistance to structural waves, but it may not be enough unless the flanking element is heavy or is divided by windows or similar openings into small sections which do not vibrate freely. Usually a minimum mass is also needed for thin panels connected by paths through air spaces (such as ceilings connected by air in roof spaces and over the ridge of the separating wall). The mass which is required will be less if the path is blocked by non-porous material.

0.3 Other design considerations

0.3.1 General

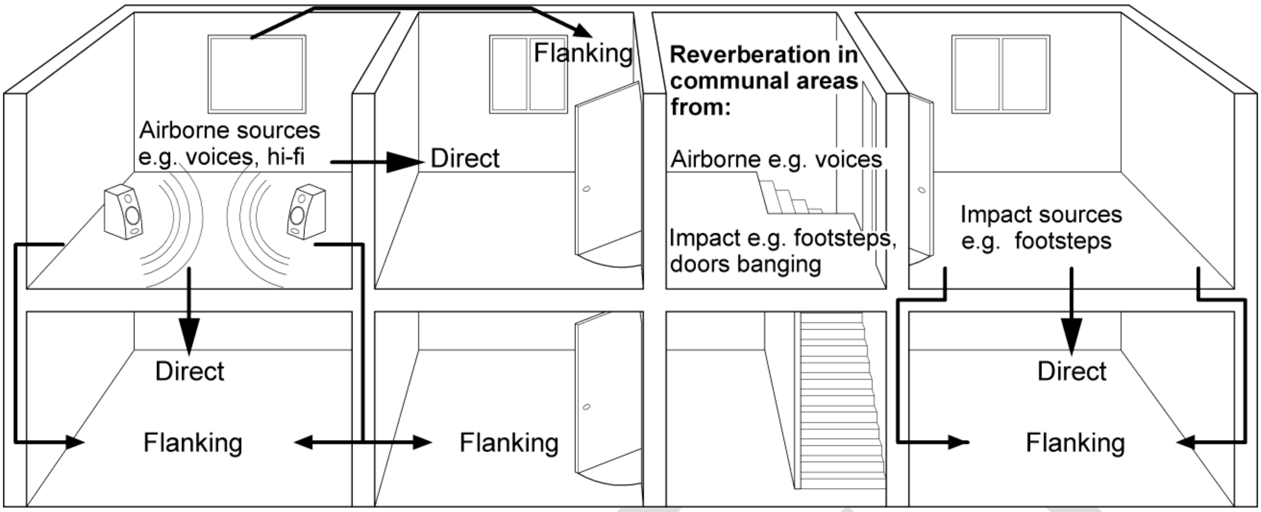
0.3.1.1 In addition to the importance of construction details and workmanship, other considerations such as the layout of rooms in a dwelling or the presence of steps or staggers between dwellings and adjoining dwellings or buildings are important factors to be considered.

0.3.2.2 Additional guidance is provided in BS 8233 Sound Insulation and noise reduction for buildings - Code of practice and sound control for homes.

0.3.2 Room layout and building services

0.3.2.1 Internal noise levels are affected by room layout. The layout should be considered at the design stage to avoid placing noise sensitive rooms next to rooms in which noise is generated where possible.

Diagram 2	**Sound transmission** *(Par. 0.2.1.1)*



Section 1
Performance

1.1 Performance

1.1.1 General

1.1.1.1 This section provides guidance relating to the performance level required to meet the requirement of Regulation E1. The sound insulation values specified in Table 1 shall apply to:

(a) new dwellings, and

(b) works involving a material change of use that results in a building (or part thereof) becoming used as one or more dwellings.

1.1.1.2 In general for dwellings, the performance required by Regulation E1 shall be satisfied by designing and constructing separating walls and floors in such a way that they will achieve sound insulation performance levels as specified in Table 1 below.

Note: In order to demonstrate compliance with the requirement of Part E1, the as-constructed performance achieved should meet the performance levels in Table 1 and be verified by testing in accordance with Section 2.

1.1.2 Performance level

1.1.2.1 The sound insulation values set out in Table 1 are deemed appropriate for walls and floors that separate spaces used for normal domestic purposes.

1.1.2.2 A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate performance level.

1.1.3 Acceptable constructions

1.1.3.1 Section 3 and 4 provide examples of wall and floor types which, if constructed correctly should achieve the performance level set out in Table 1.

1.1.4 Sound insulation testing

1.1.4.1 Where acceptable constructions are used (see par. 1.1.3) compliance with the requirement of Regulation E1 can be demonstrated by testing in accordance with Section 2 that the performance levels in Table 1 have been met

Table 1 Sound performance levels
(*Par. 1.1.1)*

Separating construction	Airborne sound insulation $D_{nT,w}$ dB	Impact sound insulation $L'_{nT,w}$ dB
Walls	53 (min)	-
Floors (including stairs with a separating function)	53 (min)	58 (max)

Section 2
Testing

2.1 Testing

2.1.1 General

2.1.1.1 This section provides guidance on an appropriate program of sound insulation testing to be carried out on site on a proportion of as-constructed dwellings in order to demonstrate compliance with the requirement of Regulation E1.

2.1.2 Competency of tester

2.1.2.1 To ensure a proper standard of testing, it is essential that persons are competent, possessing sufficient training, experience and knowledge appropriate to the nature of the work he or she is required to perform and having particular regard to the size and complexity of such works.

2.1.3 Requirements for testing

2.1.3.1 Testing should be carried out for:

(a) new dwellings, and

(b) works involving a material change of use that results in a building (or part thereof) becoming used as one or more dwellings.

2.1.3.2 The sound insulation tests should be carried out once the dwellings either side of a separating element are essentially complete, except for decoration.

2.1.3.3 The performance levels that should be demonstrated by testing are set out in Table 1.

2.1.3.4 Testing should be carried out on a proportion of dwellings on development sites as part of the construction process (see paragraph 2.2) in accordance with the procedure set out in Appendix A.

2.1.3.5 Sound insulation tests should be carried out between rooms or spaces that share a common area of separating wall or separating floor.

2.1.3.6 Impact sound insulation tests should be carried out without a soft covering[1] (e.g. carpet, foam backed vinyl) on the floor. For further information on impact sound insulation testing see Appendix A.

2.1.3.7 Sound insulation testing does not need to be carried out between the dwelling space and common circulation areas as testing between such spaces may give unreliable results due to the possible complex shape of the circulation spaces, and the possible difficulty of establishing the volume of a circulation space. However, compliance can be demonstrated by inference (by means of similar construction) i.e. that the sound insulation performance of the construction type of walls or floors at these interfaces is at least equivalent to that of the separating wall or floor respectively.

2.1.3.8 While only a proportion of dwellings must be tested, all separating walls or separating floors, subject to the requirement of Regulation E1, should be designed and constructed to achieve a reasonable resistance to sound.

2.1.3.9 When sound test measurements are made in small rooms, the results can be less accurate. Guidance on this is given in Appendix A, paragraph A.2.6.

2.1.4 Establishing the appropriate amount of testing required

2.1.4.1 The results of sound insulation tests only apply to the particular dwellings tested and are only indicative of the performance of others of the same construction type in the same development. Therefore in order for meaningful inferences to be made from tests, it is essential that developments are considered as a number of notional groups, with the same construction type in each group.

2.1.4.2 The two basic dwelling group types are dwelling houses (including bungalows) and apartments/ duplex dwellings.

[1] A bonded resilient layer is not a soft covering.

2.1.4.3 If differences in construction type occur within these dwelling groups, sub-groups should be established accordingly.

2.1.4.4 For dwelling houses (including bungalows) sub-grouping should be established by the type of separating wall construction.

2.1.4.5 For apartments / duplex dwellings sub-grouping should be established by the type of separating wall and / or separating floor construction.

2.1.4.6 Sub-grouping is generally not necessary for dwelling houses or apartments / duplex dwellings that have the same separating wall and / or separating floor construction type, with the same associated flanking construction(s), and where room dimensions and layouts are broadly similar.

2.1.5 Sets of tests

2.1.5.1 A number of individual sound tests is required to be carried out on a separating wall and / or separating floor construction to ensure accuracy. The aggregate number of individual tests conducted in a dwelling, apartment / duplex dwelling is referred to as a 'set of tests'. The number of individual sound insulation tests within a 'set of tests' is given in Table 2 below.

Table 2	**Number of individual tests in a 'set of tests'** *(Par. 2.1.5)*	
Type of test	**Dwelling Group Types**	
	Dwelling houses (including bungalows)	**Apartments and duplex dwellings[5]**
Airborne test of separating walls[1]	Yes	Yes
Airborne test of separating walls[2]	Yes	Yes
Airborne test of separating floors[3]	N/A	Yes
Airborne test of separating floors[4]	N/A	Yes
Impact test of separating floors[3]	N/A	Yes
Impact test of separating floors[4]	N/A	Yes
Total No. of individual tests in a 'set of tests'[5]	**2 No.**	**6 No.[6]**

NOTES:

1. A test of insulation against airborne sound between one pair of rooms. Living rooms on opposite sides of the separating wall should be chosen, where possible.
2. A test of insulation against airborne sound between another pair of rooms than in Note 1. Bedrooms on opposite sides of the separating wall should be chosen, where possible.
3. A test of insulation against airborne and impact sound between one pair of rooms. Living rooms above or below each other should be chosen, where possible.
4. A test of insulation against airborne and impact sound between another pair of rooms than in Note 3. Bedrooms above or below each other should be chosen, where possible.
5. To conduct a full 'set of tests' on any individual unit, access to at least two other adjoining units will be required.
6. If no separating walls or floors exist, the total number of individual tests required may be reduced by 2 or 4 respectively.

2.2 Programme of testing

2.2.1 General

2.2.1.1 The 'set of tests' as required by Table 2 should be carried out as part of the construction process and in accordance with the procedure set out in Appendix A.

2.2.2 Initial testing

2.2.2.1 On each site, at least one 'set of tests' should be carried out on a dwelling group or sub-group within the first four dwellings which are planned for completion.

2.2.2.2 This applies regardless of the intended size of the group or sub-group. Therefore, if a site comprises of only one pair of dwelling houses or apartments / duplex dwellings they should be tested.

2.2.3 Minimum Frequency of testing

2.2.3.1 Assuming no initial tests have failed (else see 2.2.5), the minimum number of ‘sets of tests’ for each group type or sub-group is outlined in Table 3.

2.2.3.2 The minimum number of ‘sets of tests’ required as outlined in Table 3A is applicable if the construction types in Section 3 and 4 are adhered to. For other construction types, see paragraph 2.3 and 2.4.

2.2.3.3 Testing should be conducted more frequently at the beginning of a series of completions than towards the end, to allow any potential problems to be addressed at an early stage. On large developments testing should be carried out over a substantial part of the construction period.

Table 3A Minimum frequency of testing per group or sub-group type *(Par. 2.2.3)*

Number of attached dwellings	Minimum ‘sets of tests’ required
4 or less	One[1]
Greater than 4 but less than or equal to 20	Two
Greater than 20 but less than or equal to 40	At least 2 + 10% x No. of attached dwellings greater than 20
Greater than 40 but less than or equal to 100	At least 4 + 5% x No. of attached dwellings greater than 40
More than 100	At least 7 + 5% x No. of attached dwellings greater than 100

NOTES:

1. This also satisfies the initial testing requirements (see paragraph 2.2.2).
2. Refer to Table 2 for number of individual tests required in a ‘set of tests’.
3. Round up to the nearest whole number.
4. Refer to paragraph 2.3 where constructions other than those detailed in Section 3 and 4 are used.

2.2.4 Reporting procedure

2.2.4.1 A test report should be recorded in the recommended manner set out in Appendix A and retained as proof that the sound insulation performance has been met.

2.2.5 Actions following a failed set of tests

2.2.5.1 A ’set of tests’ is deemed to have failed if any of the individual tests of airborne or impact sound insulation do not show sound insulation values equal to or better than those set out in Table 1.

2.2.5.2 Where a failed test has occurred, remedial works to the failed element should be carried out until the element meets the performance levels of Table 1 when re-tested. Dwellings on the same site completed prior to the failed test (excluding those proven acceptable by previous tests) should either have similar remedial work carried out or also be tested.

2.2.5.3 Where remedial work and a new test is required on any dwelling, the number of ‘sets of tests’ required as per Table 3 (or Table 4 as applicable) should be increased by one, for that group or sub-group type.

2.2.5.4 Where the cause of the failure is attributed to the construction of the separating element and / or associated flanking provisions, other separating elements of similar construction (where compliance is demonstrated by inference) or that have not been tested may also fail to meet the performance levels of Table 1. Therefore, remedial treatment on all these elements should also be carried out.

2.3 Assessed Sound Details (ASDs)

2.3.1 General

2.3.1.1 Where construction types other than those in Section 3 or 4 are employed, the testing frequency outlined in Table 3 may still be used provided the construction type has been assessed and certified in accordance with Appendix B.

NOTE: It should be noted that all elements incorporated into the building works must comply with all parts of the Building Regulations and the guidance in Appendix B assesses compliance with Part E only.

2.4 Other constructions

2.4.1. General

2.4.1.1 Where construction types other than those in Section 3 or 4, or ASDs in accordance with paragraph 2.3.1.1 are employed, it is essential that these construction types can demonstrate their capability of meeting the required performance level on each individual site. Therefore, the frequency of initial testing in paragraph 2.2.2 should be increased.

NOTE: It should be noted that all elements incorporated into the building works must comply with all parts of the Building Regulations.

2.4.1.2 On each site, each separating element (wall or floor) should have a 'set of tests' carried out on each dwelling group or sub-group within the first eight dwellings which are planned for completion.

2.4.1.3 Assuming none of these tests have failed (else see 2.2.5), the minimum number of 'sets of tests' for each group type or sub-group is outlined in Table 3B.

Table 3B Other constructions - minimum frequency of testing per group or sub-group type *(Par. 2.4.1.2)*

Number of attached dwellings	Minimum 'sets of tests' required
Up to 8	Each separating element up to four[1]
Greater than 8 but less than or equal to 20	Six
Greater than 20 but less than or equal to 40	At least 6 + 10% x No. of attached dwellings greater than 20
Greater than 40 but less than or equal to 100	At least 8 + 5% x No. of attached dwellings greater than 40
More than 100	At least 11 + 5% x No. of attached dwellings greater than 100

NOTES:

1. This satisfies testing requirements of paragraph 2.4.1.2.
2. Refer to Table 2 for number of individual tests required in a 'set of tests'.
3. Round up to the nearest whole number.

Section 3
Separating walls and associated flanking construction details

3.1 Separating wall construction

3.1.1 General

3.1.1.1 This section gives examples of wall types which, if constructed correctly, should achieve the performance level set out in Table 1.

3.1.2 Types of wall

3.1.2.1 Separating walls are grouped into four main types as follows (refer to Diagram 3):

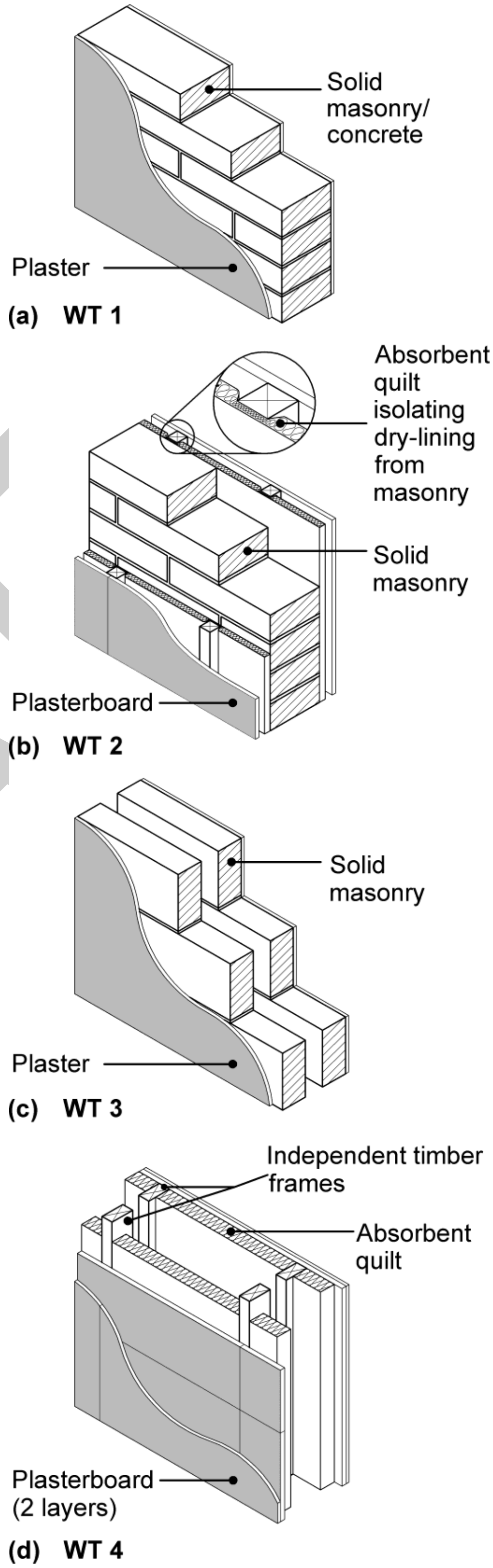
3.1.2.2 **Wall Type 1 (WT 1)** - *Solid masonry / concrete with plaster finish.* The resistance to airborne sound depends mainly on the mass per unit area of the wall (see Diagram 3(a)).

3.1.2.3 **Wall Type 2 (WT 2)** - *Solid masonry with dry lining.* The resistance to airborne sound depends mainly on the mass of the core (dense block), the absorption of the mineral wool and the isolation (de-coupling) of the dry lining (see Diagram 3(b)).

3.1.2.4 **Wall Type 3 (WT 3)** - *Cavity masonry with plaster finish.* The resistance to airborne sound depends mainly on the mass per unit area of the leaves of the wall and on the degree of isolation provided by the cavity. The isolation is affected by connections (such as wall ties and foundations) between the wall leaves and by the cavity width (see Diagram 3(c)).

3.1.2.5 **Wall Type 4 (WT 4) –** *Timber framed walls with absorbent material.* The resistance to airborne sound depends on the mass per unit area of the leaves, the isolation of the timber frames, and the absorption in the cavity between the frames (see Diagram 3(d)).

Diagram 3 Types of wall
(Par. 3.1.2.)



3.2 Flanking provisions

3.2.1 General

3.2.1.1 In order for the separating wall construction to be fully effective, care should be taken to correctly detail the junctions between the separating wall and other elements, such as floors, roofs, external walls and internal walls.

3.2.2 Junctions between separating walls and other building elements

3.2.2.1 Guidance is given below to control flanking transmission at the junction of the separating floor types and other building elements.

3.2.2.2 Table 4 outlines the illlustrations provided in this document on the junctions that may occur between each of the four separating wall types discussed in 3.1.2 and the various attached building elements.

3.2.3 Corridor walls

3.2.3.1 The separating walls described in this section should be used between corridors and rooms in apartments, in order to control flanking transmission and to provide the required sound insulation.

3.2.4 Entrance doors opening onto a common area of a building

3.2.4.1 An entrance door in a separating wall dividing a dwelling from a common area of a building can create a weak point acoustically in the wall, allowing unwelcome noise into the dwelling. However, it is not reasonable to maintain the same acoustic performance for doors as for separating walls.

3.2.4.2 However, to maximise the sound resistance of the door, it should be ensured that the door has good perimeter sealing (including the threshold where practicable) and a mass per unit area of 25 kg/m^2 (min) or a sound reduction index of 29 dB R_w (min) measured in accordance with I.S. EN ISO 717. The door should satisfy the requirements of Part B – Fire Safety.

3.2.5 Noise from services

3.2.5.1 Building service installations have the potential to cause noise nuisance, e.g. passenger lifts, air conditioning units, and ventilation systems. Drainage pipes running the height of a block of apartments have also been a source of complaints. The design of building services, their position in the building and the building structure should be considered at an early stage in the design process, to reduce their impact on occupants of apartment buildings.

3.2.5.2 Internal noise levels are affected by room layout. The layout should be considered at the design stage to avoid placing noise sensitive rooms next to rooms in which noise is generated where possible. Additional guidance is provided in BS 8233 Sound Insulation and noise reduction for buildings - Code of practice and sound control for homes.

3.2.5.3 Lightweight structures need special consideration and it may be appropriate to support noisy plant on a separate, rigid structure. Structure borne noise is a common cause of complaints and the most effective approach is to structurally de-couple service installations and mechanical equipment from separating walls and separating floors.

3.2.6 Refuse chutes

3.2.6.1 A wall separating the living space and a refuse chute should have a mass (including any plaster finishes) of 1320 kg/m^2 (min).

3.2.6.2 A wall separating any other room which is in a dwelling from a refuse chute should have a mass (including any plaster finishes) of 220 kg/m^2 (min).

Table 4 Reference table of illustrations provided on separating wall junctions *(Par 3.2.2.2)*

	Separating Wall Type				
Separating Floor Type	**WT 1** *Solid masonry/ concrete with plaster finish (Diagram 4)*	**WT 2** *Solid masonry with dry-lining (Diagram 8)*	**WT 3** *Cavity masonry with plaster finish (Diagram 12)*	**WT 4A** *Twin leaf timber frame without sheathing (Diagram 17A)*	**WT 4B** *Twin leaf timber frame with sheathing (Diagram 17B)*
FT 1 *Concrete base with ceiling and resilient material bonded to concrete base (Diagram 31)*	Diagram 32A	Diagram 32B	Diagram 33	Not applicable	Not applicable
FT 2 *Concrete base with ceiling and floating floor (Diagram 35)*	Diagram 36A	Diagram 36B	Diagram 37	Not applicable	Not applicable
FT 3 *Timber base with ceiling and platform floor (Diagram 39)*	Not applicable	Not applicable	Not applicable	Diagram 40A	Diagram 40B
Other flanking elements					
Ceiling and roof space	Diagram 5A	Diagram 9A	Diagram 13A	Diagram 18A	Diagram 23A
Internal floor - timber	Diagram 5B	Diagram 9B	Diagram 13B	Diagram 18B	Diagram 23B
Internal floor – concrete (in-situ or precast)	Diagram 5C	Diagram 9C	Diagram 13C	Not applicable	Not applicable
Ground floor – concrete (in-situ or precast)	Diagram 5D	Diagram 9D	Diagram 13D	Diagram 19A Diagram 20	Diagram 24A Diagram 25
Ground floor - timber	Diagram 5D	Diagram 9D	Diagram 13D	Diagram 19B	Diagram 24B
External cavity wall with masonry inner leaf*	Diagram 6 Diagram 7	Diagram 10 Diagram 11	Diagram 14 Diagram 15 Diagram 16	Not applicable	Not applicable
External solid masonry wall*	Diagram 6 Diagram 7	Diagram 10 Diagram 11	Diagram 14 Diagram 15 Diagram 16	Not applicable	Not applicable
External cavity wall with timber framed inner leaf*	Not applicable	Not applicable	Not applicable	Diagram 21	Diagram 26
Guidance on services	Diagram 6	Diagram 10	Diagram 14	Diagram 22	Diagram 27

NOTES:

1. Refer to Section 4 for guidance on separating floors and associated flanking construction details to determine which guidance should take precedence.

3.3 Wall Type 1 (WT 1) - Solid masonry / concrete with plaster finish

3.3.1 General

3.3.1.1 The resistance to airborne sound depends mainly on the mass per unit area of the wall.

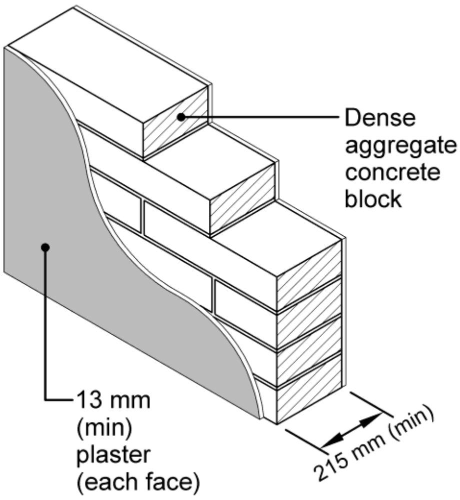
3.3.2 Wall specification

3.3.2.1 Two Wall Type 1 constructions are described in Diagram 4.

3.3.3 Key junctions and flanking details

3.3.3.1 Details of key junctions in the construction of WT 1A and details to limit flanking transmission are described in Diagrams 5 to 7. Similar details are also applicable to WT 1.

Diagram 4 WT1 Solid masonry / concrete with plaster finish —Specification *(Par 3.3.2)*

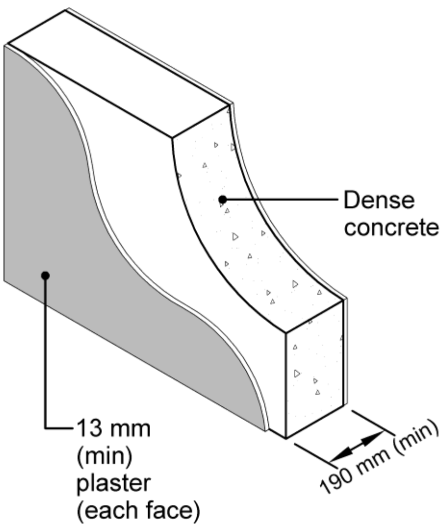


WT 1A - Solid masonry plastered on both faces

Specification
Dense aggregate concrete blockwork plastered on both faces.
The minimum mass of the wall (including the plaster) should be 415 kg/m².
The thickness of the plaster should be at least 13 mm per face.
Use blocks that are laid full wall width i.e. 215 mm wide blocks laid on flat using single course stretcher bond only (not double coursing).

Example
215mm dense aggregate concrete block (density of 1900 kg/m³ min) laid flat, 112.5 mm coursing (single course stretcher bond only), plastered with 13 mm plaster (mass per unit area 10 kg/m² min) on both faces.

Key Points to Watch
- **DO NOT** use double coursing.
- Fill all joints between blocks with mortar, and seal the joints between the wall and the other parts of the construction (to achieve the mass and avoid air paths).
- Refer to Diagram 5, 6 and 7 for details showing how to limit flanking transmission between elements on opposite sides of the wall.



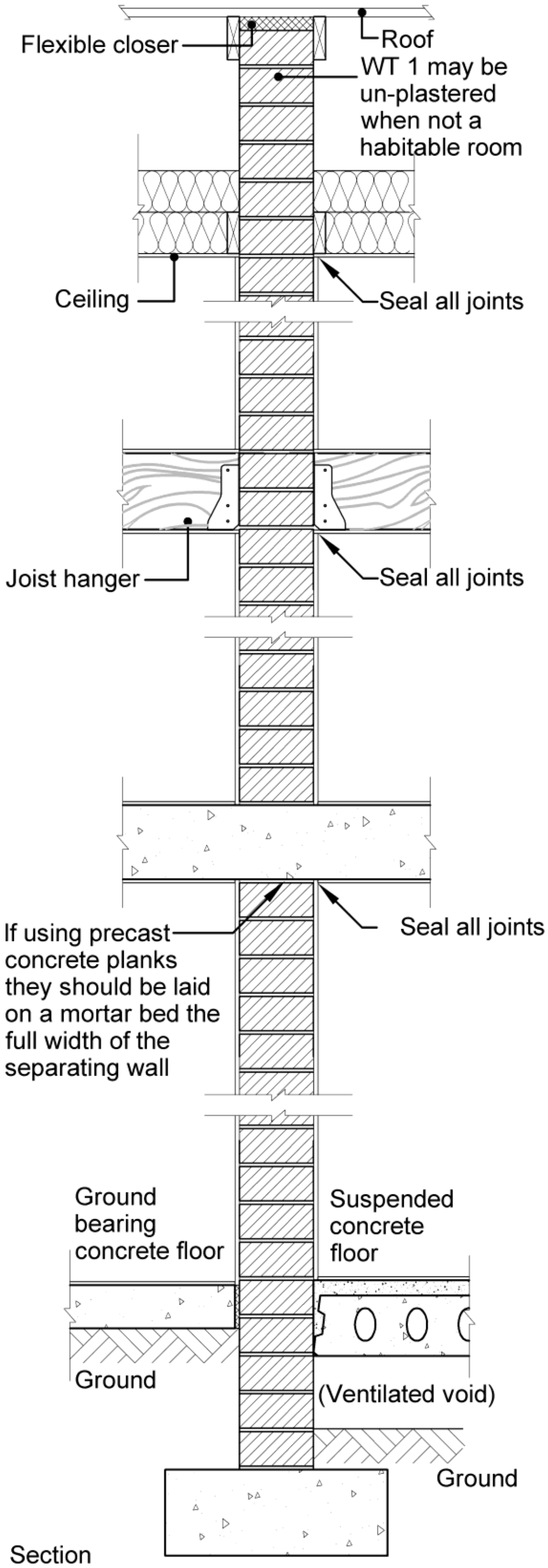
WT 1B - Dense concrete plastered on both faces

Specification
The minimum mass of the wall (including the plaster) should be 415 kg/m².
The thickness of the plaster should be at least 13 mm per face.

Example
Dense concrete (cast insitu or precast), 190 mm (min) thickness with a density of 2200 kg/m² (min), plastered with 13 mm (min) plaster with a mass per unit area 10 kg/m² (min) on both faces.

Key Points to Watch
- Fill all joints between precast panels with mortar to full depth of panel, and seal the joints between the wall and the other parts of the construction (to achieve the mass and avoid air paths).

Diagram 5 WT 1 Solid masonry with plaster finish – Key junction details
(Par. 3.3.3)



A) Junctions with ceiling and roof

Key Points to Watch

- WT 1 should be continuous to the underside of the roof (but may be un-plastered) and the junction between the separating wall and the roof should be filled with a flexible closer which is also suitable as a fire stop.
- Close the cavity of external cavity walls at eaves level with a suitable flexible material (e.g. mineral wool).

B) Junction with an internal timber floor

Key Points to Watch

- Where possible run joists parallel to separating walls
- If timber joists are supported on a separating wall joist hangers must be used.
- **DO NOT** use saddle type joist hangers.
- **DO NOT** build timber floor joists into a separating wall.

C) Junction with internal concrete floor

Key Points to Watch

- The concrete slab may be carried continuous through a separating wall if the floor base has a mass per unit area of at least 365 kg/m³.
- If hollow core planks are used of a type where the cores are continuous through the planks and the planks are laid so that the cores join up, the cores should be sealed with mortar at the separating wall junction.
- Hollowcore concrete plank floors should not be continuous through a WT 1.
- All gaps between the underside of the floor plate and the top of the wall must be filled.

D) Junction with ground floors

Key Points to Watch

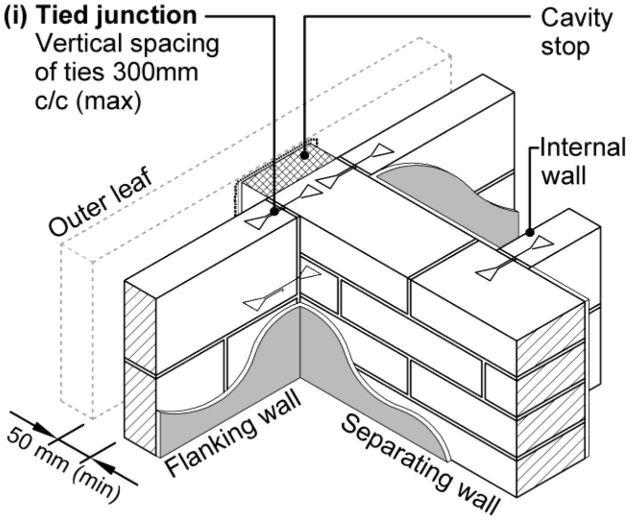
(i) Concrete ground floors

- Ground floor may be a solid concrete slab, suspended concrete floor or laid on the ground.
- Suspended concrete floor may only pass under a WT 1 if the floor mass is greater than 365 kg/m².
- Hollowcore concrete plank floors should not be continuous across a WT 1.

(ii) Timber ground floors

- The notes in B) above apply.

Diagram 6	**WT 1A Solid masonry with plaster finish - Flanking requirements at an external (flanking) wall** *(similar details are applicable for WT 1B)* *(Par 3.3.3)*

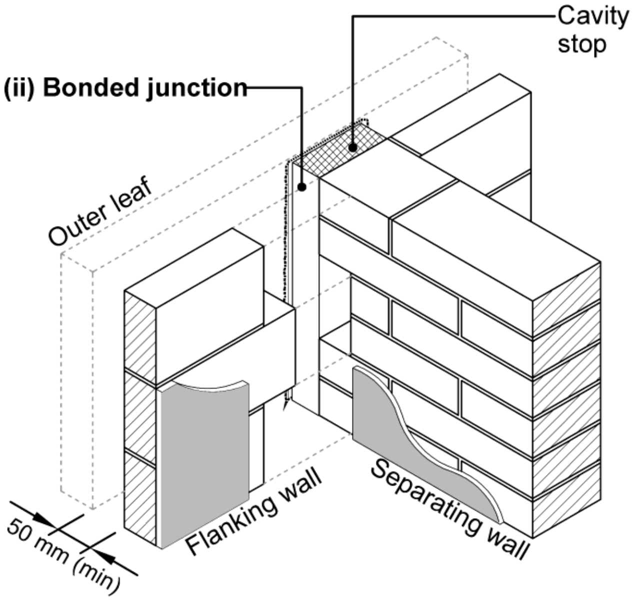


Flanking wall requirements
The flanking wall should be of masonry construction and should have a mass of at least 120 kg/m² excluding any finish.

The flanking wall should be joined to the separating wall using one of the following methods:
(i) butted to it and secured with wall ties spaced at 300 mm (max) vertical c/c, or
(ii) bonded to the separating wall ensuring that the separating wall contributes at least 50% of the bond at the junction.

Note: using method (i) of butted and tied, typically improves sound insulation performance by 2 - 3 dB, versus method (ii) bonded junction.

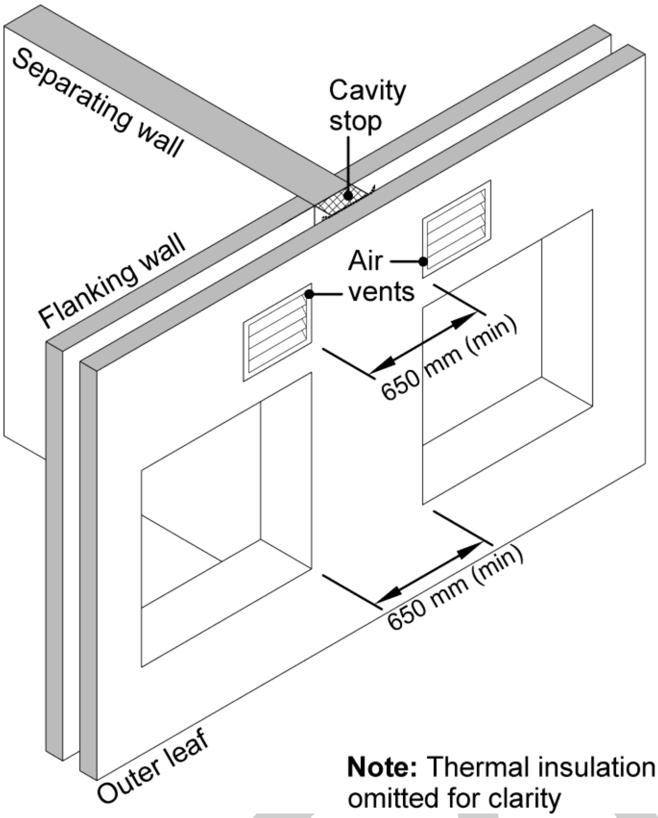
Where the external wall is a cavity wall:
a) the outer leaf may be of any construction,
b) the cavity should be stopped with a flexible closer to minimise sound transmission along the cavity (unless c)).
c) If the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturers advice for other suitable materials), and
d) the external cavity width should be 50 mm (min)



Key Points to Watch
- Fill all the joints between the blocks with mortar.
- Seal the joints between the wall and other parts of the construction (to acheive the mass and avoid airpaths), including those behind plasterboard dry-linings.
- **DO NOT** use deep sockets and chases in separating walls.
- **DO NOT** place sockets back to back on opposite sides of separating walls.
- **DO NOT** use double coursing. Use single course stretcher bond only.

Note: Thermal insulation omitted for clarity

Diagram 7	**WT 1 Solid masonry/ concrete with plaster finish - Position of openings in an external (flanking) wall** *(Par. 3.3.3)*



There should be 650 mm (min) clear between all vents and openings (doors, windows or vents) in the external wall on either side of the separating wall.

Note: Thermal insulation omitted for clarity

3.4 Wall Type 2 (WT 2) - Solid masonry with dry lining

3.4.1 General

3.4.1.1 The resistance to airborne sound depends mainly on the mass of the core mass (dense block), the absorption of the mineral wool and the isolation (de-coupling) of the dry lining.

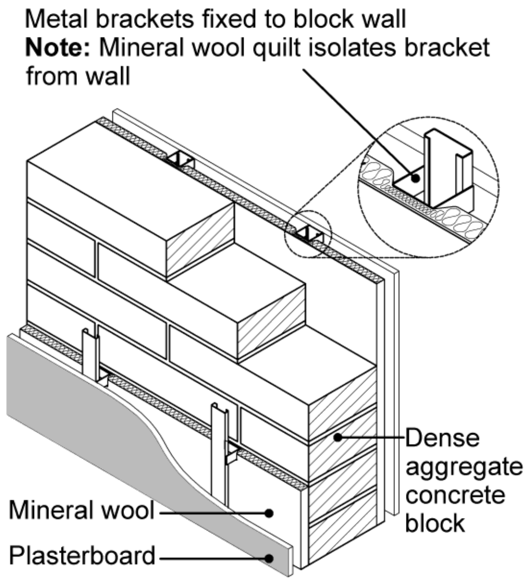
3.4.2 Wall specification

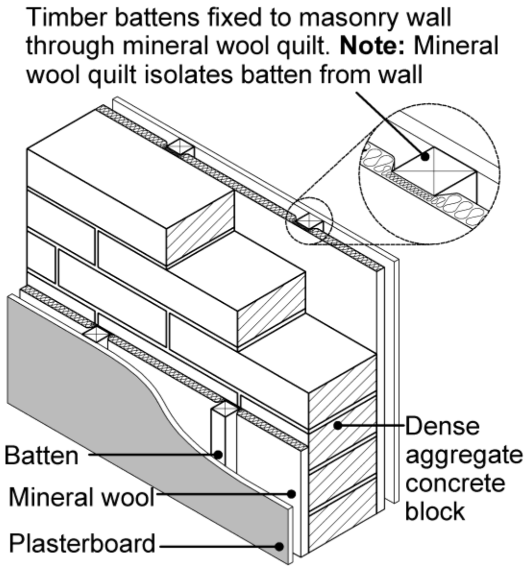
3.4.2.1 One Wall Type 2 construction (with different lining options) is described in Diagram 8.

3.4.3 Key junctions and flanking details

3.4.3.1 Details of key junctions in the construction of WT 2 and details to limit flanking transmission are described in Diagrams 9 to 11.

Diagram 8 WT 2 Solid masonry with dry lining – Specification
(Par 3.4.2)





WT 2 - Solid masonry with drylining

Specification
The minimum mass of the wall (including linings) should be 415 kg/m².
Use blocks that are laid full wall width i.e. 215 mm wide blocks laid on flat using single course stretcher bond only (No double coursing).

Wall lining options
The block wall faces should be lined with a mineral wool quilt of either:

- 13 mm mineral wool roll with a density of 30 kg/m³ (min), or
- 25 mm mineral wool quilt with a density of 10 kg/m³ (min).

The wall linings should consist of a gypsum based board with a mass per unit area of 10 kg/m² fixed to either:

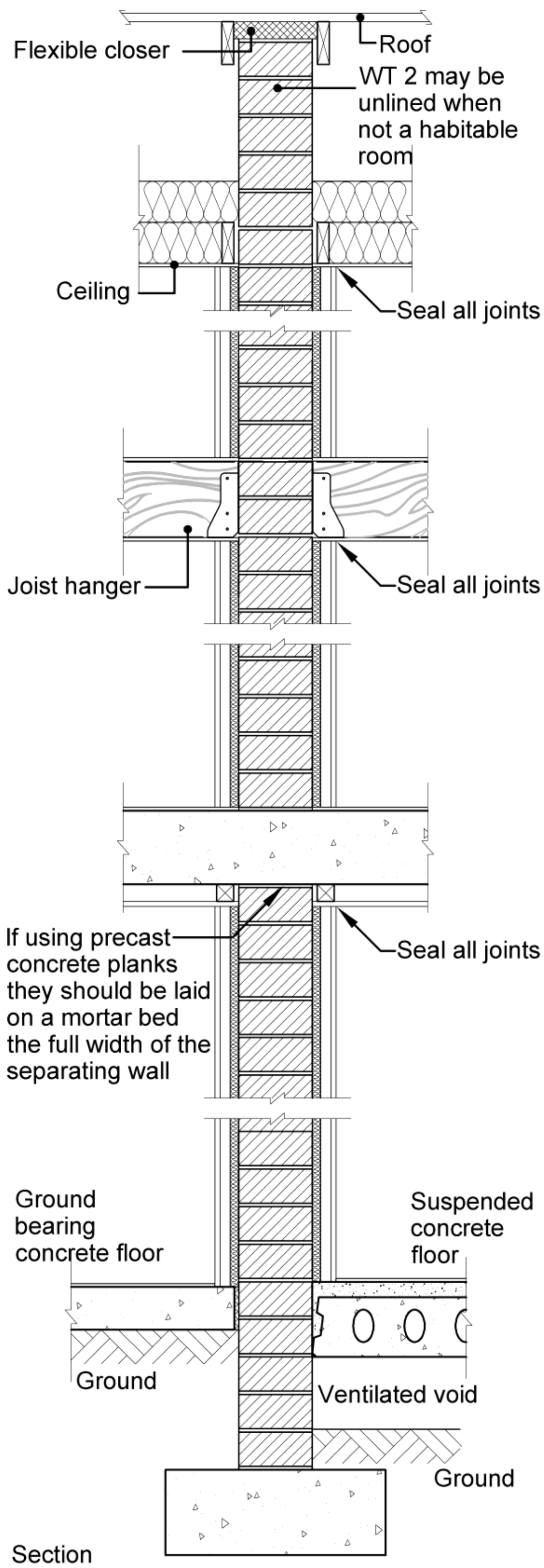
- 45 mm x 45 mm timber battens spaced at 400 mm centres (max), or
- 45 mm (min) wide metal frame spaced at 400 mm centres (max) and secured to wall by brackets.

Example
215 mm solid dense block laid on flat (density 1900 kg/m³)
112.5 mm coursing (single course stretcher bond)
25 mm mineral wool quilt (min. density 10 kg/m³) both sides
45 mm x 45 mm timber battens at 400 mm centres both sides (affixed to wall through quilt - such that the quilt is compressed and isolates timber batten from core wall)
1 layer of gypsum based board mass per unit area 10 kg/m² (min) both sides.

Key Points to Watch

- **DO NOT** use double coursing.
- The mineral wool must be located over the whole wall face and be sandwiched between the 'battens or bracket' and the masonry wall.
- On NO account must the timber batten or metal bracket make direct contact with the masonry wall. Any contact should ONLY be possible via the fixing mechanism for the bracket or batten.

Diagram 9 WT 2 Solid masonry with dry lining – Key junction details
(Par 3.4.3)



A) Junctions with ceiling and roof

Key Points to Watch

- WT 2 should be continuous to the underside of the roof and the junction between the separating wall and the roof should be filled with a flexible closer which is also suitable as a fire stop.
- Close the cavity of external cavity walls at eaves level with a suitable flexible material (e.g. mineral wool).
- Ceiling lining to be one layer of gypsum based board 10 kg/m² (min).

B) Junction with internal timber floor

Key Points to Watch

- Where possible internal floor joists should run parallel to the separating wall. If timber or lightweight steel joists are to be supported on a separating wall joist hangers **MUST** be used. **DO NOT** build in floor joists to the separating core wall.
- **DO NOT** use saddle type joist hangers.
- The separating wall linings should cover the whole of the room face of the separating wall. They are NOT required between the joists.
- **ENSURE** the flooring boards closes off the cavity at the base of the separating wall linings.
- **ENSURE** the ceiling board closes off the cavity at the top of the separating wall linings and shields the slab.

C) Junction with internal concrete floor

Key Points to Watch

- Concrete slabs may be carried continuous through a separating wall provided:
  a) the core slab is solid and has a mass per unit area of 365 kg/m² (min), and
  b) a gypsum based ceiling system is mounted to the underside of the slab, either on timber straps or metal frame, which shields the slab.
- Precast hollowcore concrete slabs may be built into the separating core wall but slabs **MUST NOT** be continuous between adjoining dwellings. The junctions between the slabs must be fully grouted and sealed.
- For all concrete floors the junctions between the head of the separating wall and the slab **must be** fully sealed with mortar and no gaps should remain.

D) Junction with ground floors

Key Points to Watch

(i) Concrete ground floors

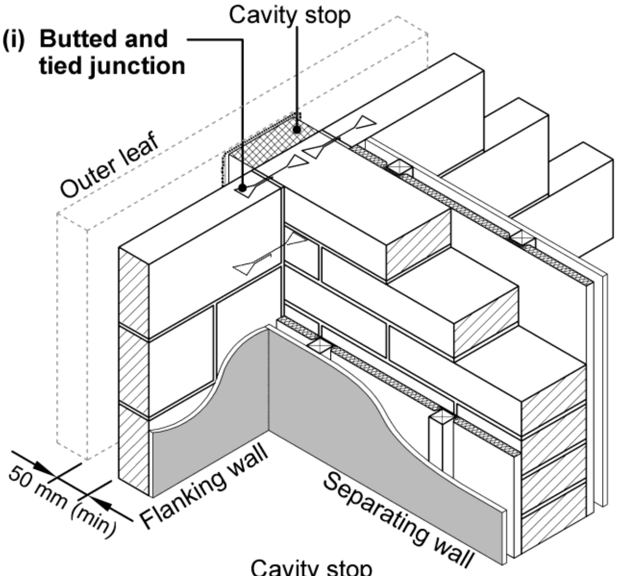
- The ground floor may be a solid concrete slab, laid on the ground or suspended concrete floor.
- A concrete floor may only be continuous under WT 2 if:
  a) the concrete floor has a mass per unit area of 365 kg/m² (min), and
  b) the concrete floor is solid.
- Precast hollowcore concrete slabs/ planks or concrete beams with infilling blocks **SHOULD NOT** be continuous under a WT 2 separating wall.

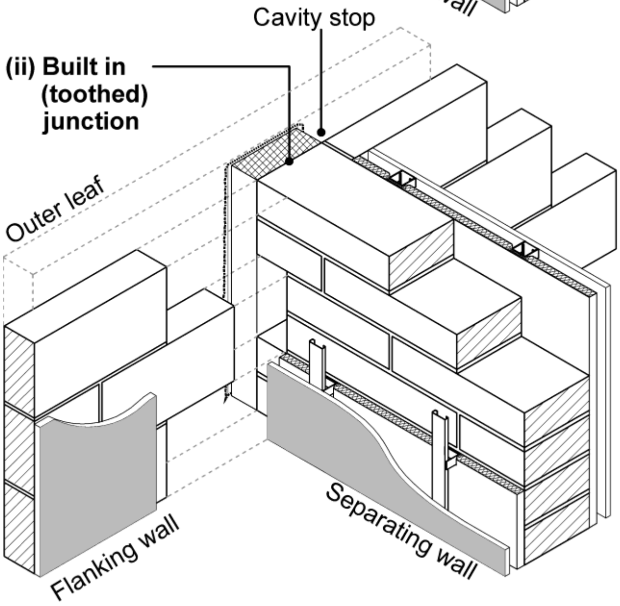
(ii) Timber ground floors

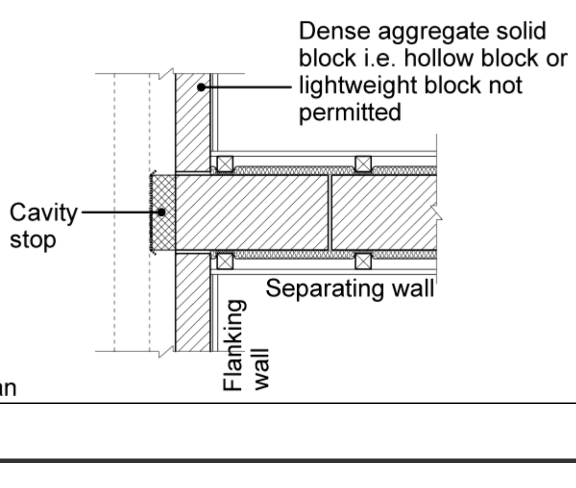
- The notes for B) above apply.

Diagram 10 WT 2 Solid masonry with dry lining – Flanking requirements at an external (flanking) wall
(Par 3.4.3)

A) Junction requirments for an external wall







External flanking wall
The flanking wall (inner leaf) must be 100 mm (min) thick dense aggregate block with a density of 1900 kg/m³ (min). This detail does not support the use of hollow block or light weight block flanking walls.

The continuity of the flanking wall (inner leaf) must be broken by the separating wall and should be joined to the separating wall using one of the two following methods:

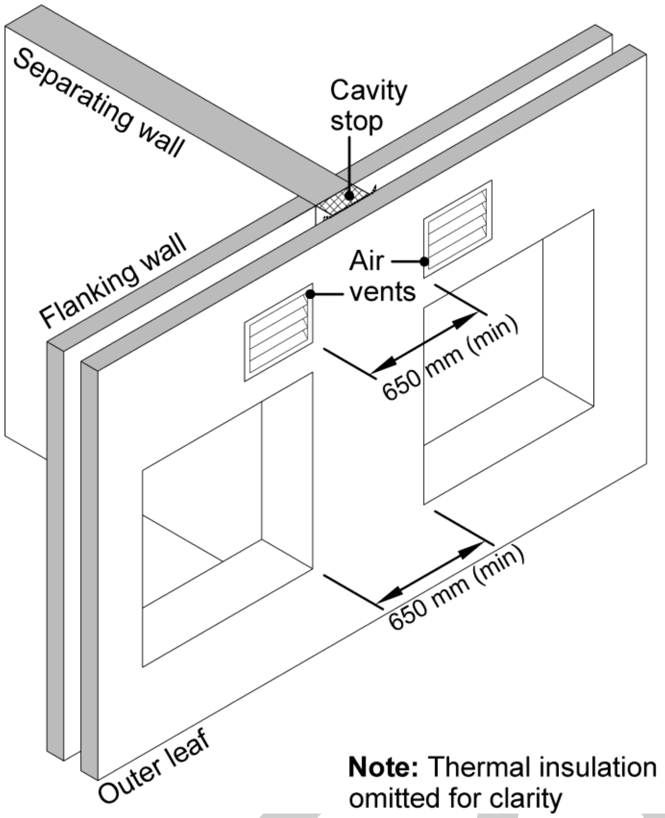
(i) butted and tied and secured with integral wall ties at no more than 300mm vertical centres, or
(ii) built-in (toothed) every second course of the inner leaf.

Note: using method (i) of butted and tied, typically improves sound insulation performance by 2 - 3 dB, versus method (ii) of built-in (toothed).

Where the external flanking wall is a cavity wall:
a) the outer leaf may be of any construction.
b) the cavity should be stopped with a flexible closer to minimise sound transmission along the cavity (unless c)).
c) If the cavity if fully filled with mineral wool or expanded polystyrene beads (seek manufacturers advice for other suitable materials).
d) the cavity width should be 50 mm (min).

Key Points to Watch
- **DO NOT** use double course, use single coursing only.
- Fill all the mortar joints and perpends.
- **ENSURE** there is a good seal between the flanking wall (inner leaf) and the separating wall with full depth mortar joints.
- **ENSURE** the separating wall linings are taken up to the face of the inner leaf core wall of the flanking wall.
- **DO NOT** chase the masonry wall for sockets as the drylining void may be used for this purpose.
- Lining to the flanking wall (inner leaf) may be gypsum based board or insulation backed gypsum based board on dabs.

Diagram 11 WT 2 Solid masonry with dry lining - Position of openings in an external (flanking) wall
(Par. 3.3.3)



There should be 650 mm (min) clear between all vents and openings (doors, windows or vents) in the external wall on either side of the separating wall.

3.5 Wall Type 3 (WT 3) Cavity masonry wall with plaster finish

3.5.1 General

3.5.1.1 The resistance to airborne sound depends mainly on the mass per unit are of the leaves of the wall and on the degree of isolation provided by the cavity. The isolation is affected by connections (such as wall ties and foundations) between the wall leaves and by the cavity width.

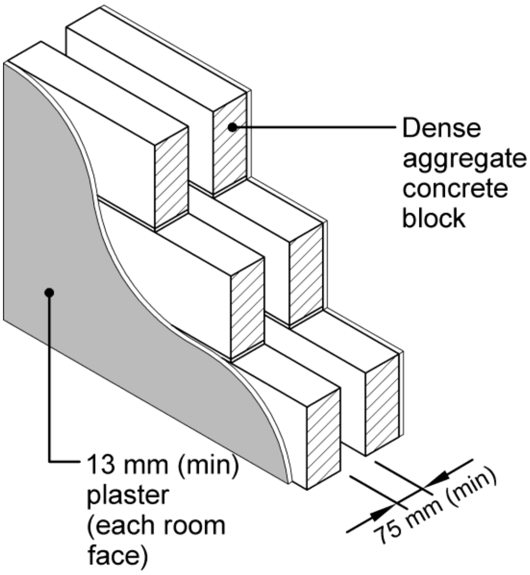
3.5.2 Wall specification

3.5.2.1 One Wall Type 3 construction is described in Diagram 12.

3.5.3 Key junctions and flanking details

3.5.3.1 Details of key junctions in the construction of WT 3 and details to limit flanking transmission are described in Diagrams 13 to 16.

Diagram 12 WT 3 Cavity masonry wall with plaster finish – Specification
(Par 3.5.2)



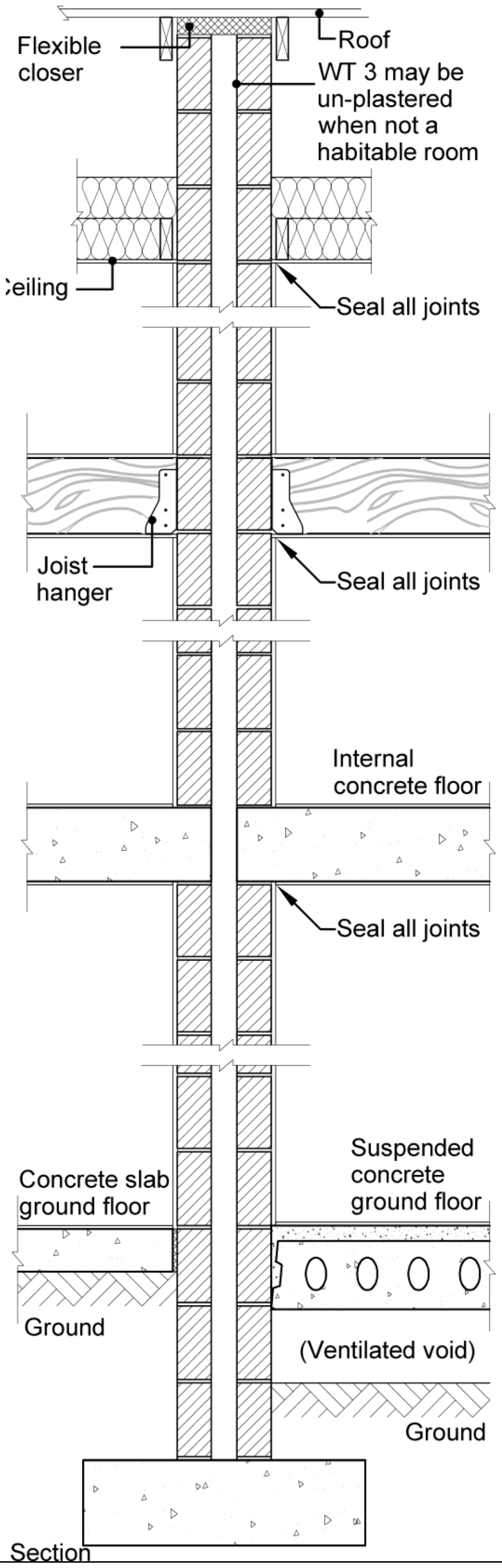
WT 3 - Cavity masonry with plaster finish

Specification
Dense aggregate concrete blockwork plastered on both room faces.
The minimum mass of the wall (including the plaster) should be 415 kg/m^2.
The thickness of the plaster should be 13 mm (min) per room face.
The width of the cavity should be 75 mm (min).
Connect the block leafs with wall ties with a dynamic stiffness < 4.8MN/m^3 for the specified minimum cavity, at a standard density.

Example
Two leaves of 100 mm dense aggregate concrete block of block density 1900 kg/m^3 (min). Provide 75 mm (min) cavity between leafs. 225 mm coursing (single course stretcher bond only), plaster on both faces with 13 mm (min) lightweight plaster of mass per unit area 10 kg/m^2 (min).

Key Points to Watch
- Fill all joints between blocks with mortar, and seal the joints between the wall and the other parts of the construction (to achieve the mass and avoid air paths)

Diagram 13 WT 3 Cavity masonry wall with plaster finish – Key junction details *(Par. 3.5.3)*



A Junctions with ceiling and roof

Key Points to Watch

Where a WT 3 is used it should be continuous to the underside of the roof.

The junction between the separating wall and the roof should be filled with a flexible closer which is also suitable as a fire stop.

Where there is an external cavity wall, the cavity should be closed at eaves level with a suitable flexible material (e.g. mineral wool).

B Junction with internal timber floor

Key Points to Watch

Where possible run joists parallel to separating walls.
If timber joists are supported on a separating wall joist hangers must be used. Saddle hangers should not be used.

DO NOT build in timber floor joists.

There are no restrictions on the timber floor construction nor on the ceiling material.

C Junctions with internal concrete floors

Key Points to Watch

Internal concrete floors should generally be built into a WT 3 and carried through to the cavity face of the leaf.

DO NOT bridge the cavity (except for wall ties)

D Junction with ground floors

Key Points to Watch

Concrete ground floors

The ground floor may be a solid concrete slab, laid on the ground or a suspended concrete floor.

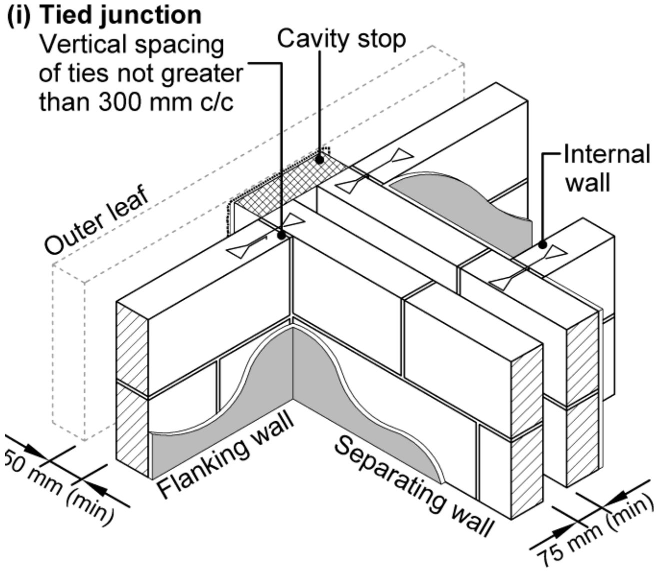
A concrete slab floor on the ground should not be continuous under a WT 3 separating wall.

A suspended concrete floor should not be continuous under a WT 3 separating wall, and should be carried through to the cavily face of the leaf. The cavity should not be bridged.

Timber ground floors

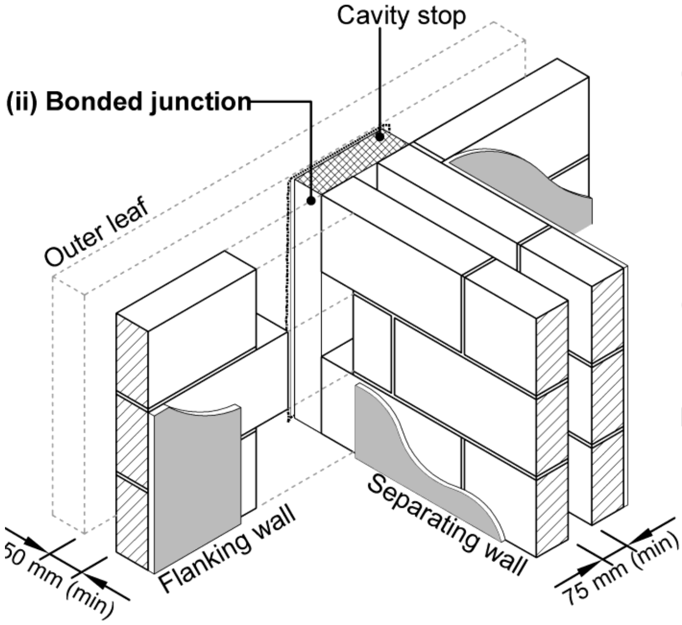
If the floor joists are to be supported on the separating wall then they should be supported on hangers and should not be built in. See Diagram 14B.

Diagram 14 WT 3 - Cavity masonry wall with plaster finish - Flanking requirements for an external (flanking) wall
(Par. 3.5.3)



Flanking wall requirements
The flanking wall should be of masonry construction and should have a mass of at least 120 kg/m² excluding any finish.

The flanking wall (either a solid wall or the inner leaf of a cavity wall) should be joined to the separating wall using one of the following methods:
(i) butted to it and secured with wall ties (or similar) spaced at no more that 300 mm vertical c/c; or
(ii) bonded to the sound resisting wall ensuring that the separating wall contributes at least 50 % of the bond at the junction.

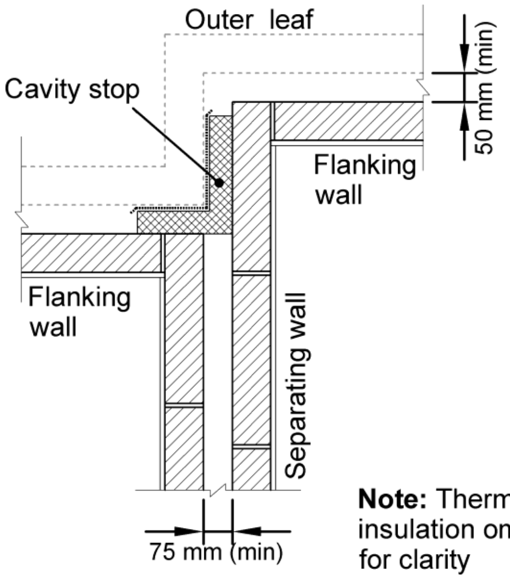


Thermal insulation omitted for clarity

Where the external wall is a cavity wall:
a) the outer leaf may be of any construction.
b) the cavity should be stopped with a flexible closer to minimise sound transmission along the cavity (unless c)).
c) If the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturers advice for other suitable materials). If a cavity in an external wall is completely filled with an insulating material other than loose fibre, care should be taken that the insulating material does not enter the cavity in the separating wall.
d) external cavity width should be 50 mm (min).

Key Points to Watch
- Fill all the joints between the blocks with mortar.
- Seal the joints between the wall and other parts of the construction (to acheive the mass and avoid airpaths), including those behind plasterboard dry-linings.
- **DO NOT** use deep sockets and chases in separating walls.
- **DO NOT** place sockets back to back on opposite sides of separating walls.

Diagram 15 WT 3 Cavity masonry with plaster finish – Flanking requirements in staggered external wall
(Par. 3.5.3)

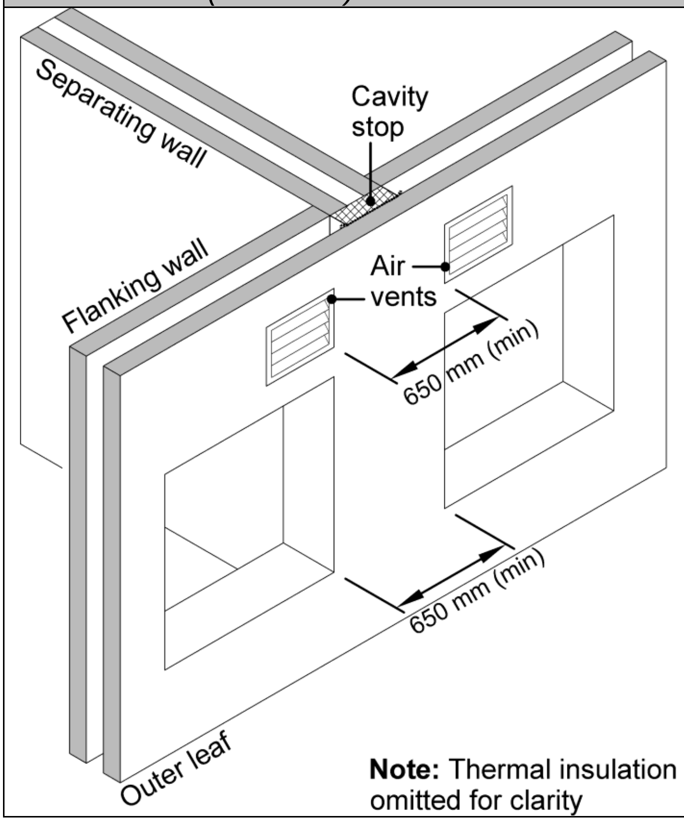


Note: Thermal insulation omitted for clarity

Key Points to Watch

- The cavity should be stopped with a flexible closer to minimise sound transmission along the cavity, unless the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturers advice for other suitable materials).
- The external cavity width should be 50 mm (min).

Diagram 16 WT 3 Cavity masonry with plaster finish - Position of openings in an external (flanking) wall
(Par. 3.3.3)



Note: Thermal insulation omitted for clarity

There should be 650 mm (min) clear between all vents and openings (doors, windows or vents) in the external wall on either side of the separating wall.

3.6 Wall Type 4 (WT 4) – Timber framed walls with absorbent material

3.6.1 General

3.6.1.1 The resistance to airborne sound depends on the mass per unit area of the leaves, the isolation of the frames, and the absorption in the cavity between the timber frames.

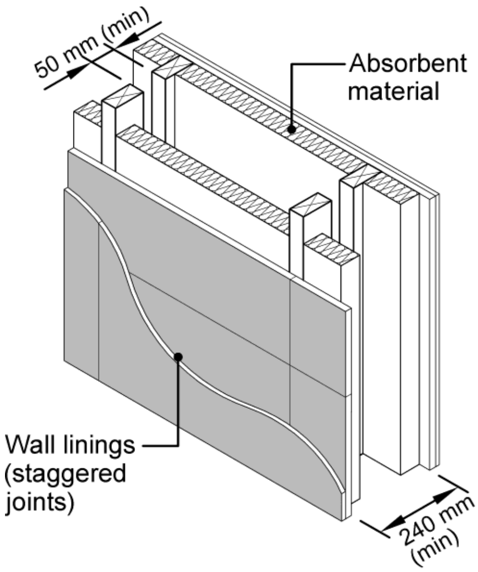
3.6.2 Wall specification

3.6.2.1 Two Wall Type 4 constructions are outlined in Diagram 17.

3.6.3 Key junctions and flanking details

3.6.3.1 Details of key junctions in the construction of WT 4A and WT 4B and details to limit flanking transmission are described in Diagrams 18 to 27.

Diagram 17	**WT 4 Timber framed walls with absorbent material – Specification** *(Par. 3.6.2)*



A) WT 4A - Twin leaf timber frame without sheathing

Specification

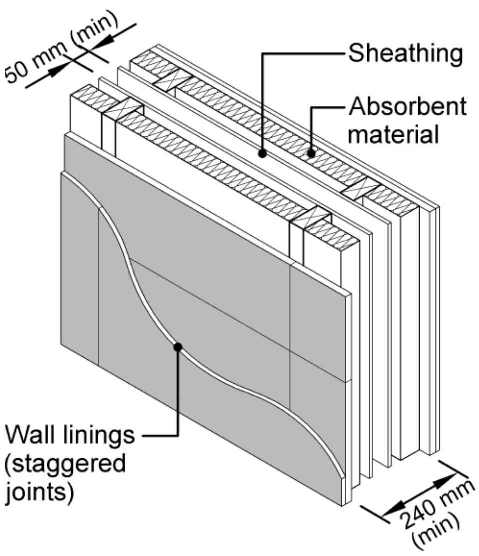
Wall width: 240 mm (min) between the inner faces of the wall linings. 50 mm (min) gap between studs. (Twin leaves must not be bridged by diagonal bracing).

Wall lining: two or more layers of gypsum based board with staggered joints (total nominal mass per unit area = 22 kg/m² (min) both sides).

Absorbent material: 60 mm (min) mineral wool batts or quilt (paper faced, unfaced or wire reinforced) both sides (density 10-60 kg/m³)

Ties: Ties between frames (no more than 40 mm x 3 mm) at 1200 mm (min) c/c horizontally, one tie per storey height vertically.

External flanking wall: Outer leaf masonry (50 mm (min) cavity)



B) WT 4B - Twin leaf timber frame with sheathing

Specification

Wall width: 240 mm (min) between inner faces of the wall linings. 50mm (min) gap between inner sheathing faces. (Twin leaves must not be bridged by diagonal bracing).

Wall lining: two or more layers of gypsum based board with staggered joints (total nominal mass per unit area 22 kg/m² (min) both sides).

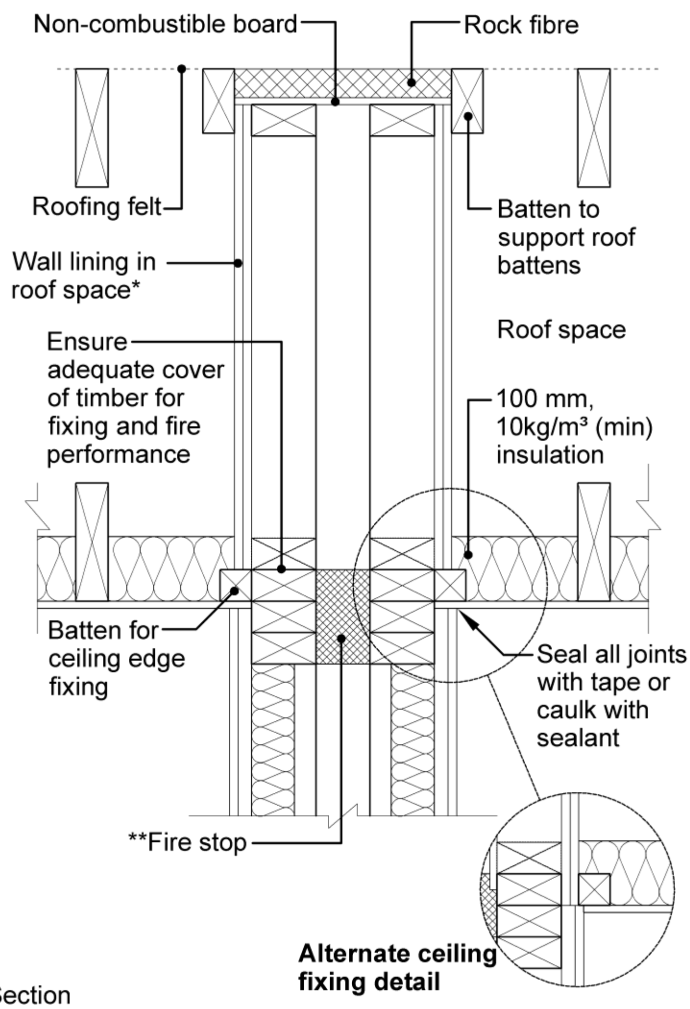
Absorbent material: 60mm (min) mineral wool batts/ quilt (paper faced, unfaced or wire reinforced) both sides (density 10-60 kg/m³)

Ties: Ties between frames (no more than 40 mm x 3 mm) at 1200 mm (min) c/c horizontally, one tie per storey height vertically.

External flanking wall: Outer leaf masonry (50 mm (min) cavity)

Diagram 18 WT 4A Twin leaf timber frame without sheathing - Key junction details (1 of 3)

(Par. 3.6.3)



Section

A) Junction with ceilings and roof spaces

The separating wall should be continuous to the underside of the roof.

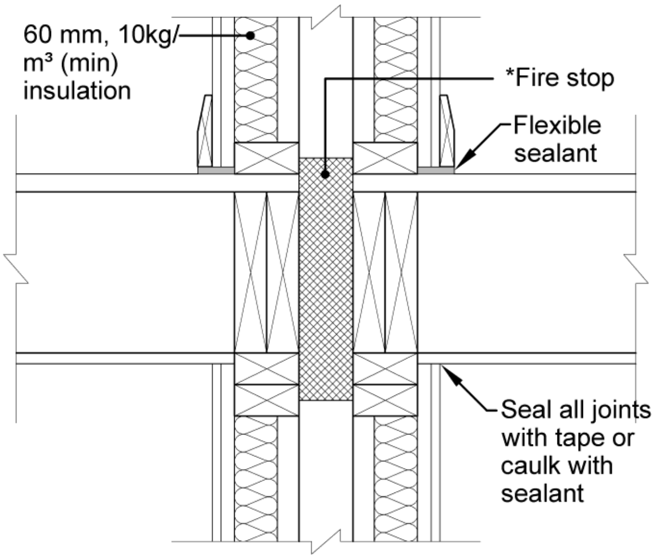
The junction between the separating wall at ceiling level should be filled with a flexible closer.

The junction between the ceiling and the wall linings should be sealed with tape or caulked with a sealant.

Where there is an external wall the cavity should be closed at eaves level with a suitable material.

* Wall lining in roof space to consist of a minimum 2 layers of gypsum based board with a toal mass per unit area of 16 kg/m² , both sides, all joints staggered.

** Fire stop to fill cavity and tight to vertical fire stop at the ends of party walls and to non-combustable board.
Ensure that fire stop covers horizontal joints between wall members.



Section

B) Junction with internal floor

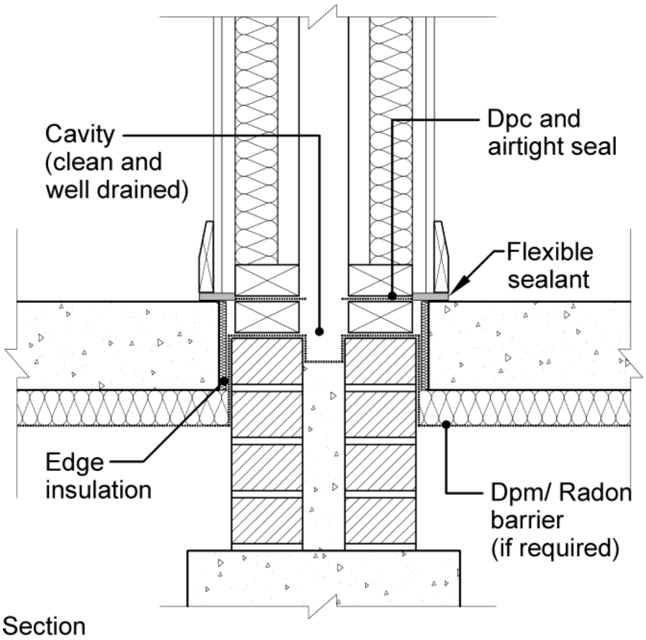
Block the air paths through the wall into the cavity by using full depth solid timber blockings or continuous header joist where joists span at right angles to the wall.

Internal floors should not be continuous between dwellings.

Floor joists may span in either direction
.
* Fire stop to fill cavity and tight to vertical fire stop at the ends of party walls and to non-combustable board.
Ensure that fire stop covers horizontal joints between wall members.

See Diagram 40 for junction with separating floor.

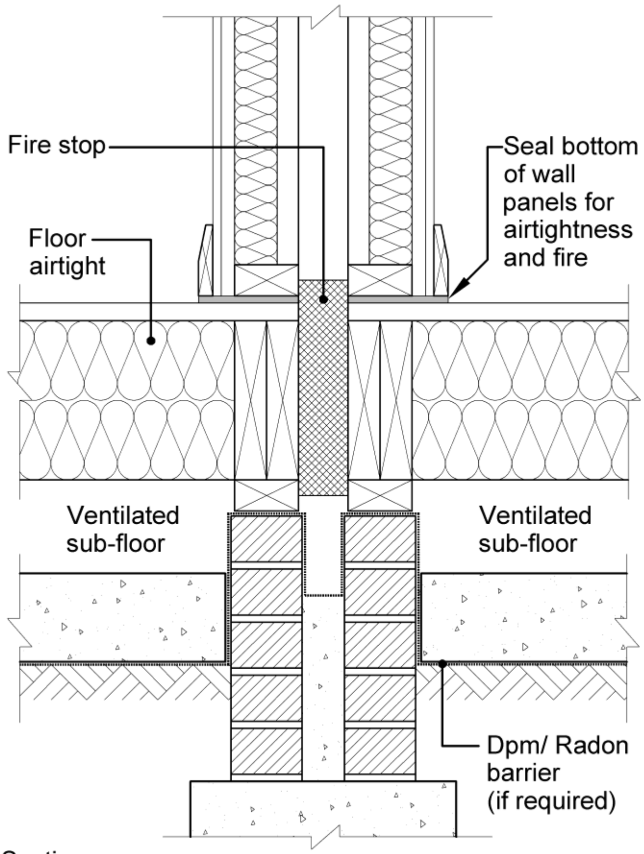
Diagram 19 WT 4A Twin leaf timber frame without sheathing - Key junction details (2 of 3)
(Par. 3.6.3)



Section

A) Ground floor junction with ground bearing slab

The ground floor should not be continuous between dwellings.



Section

B) Ground floor junction with suspended timber ground floor

The ground floor should not be continuous between dwellings.

Timber floor joists may span in either direction.

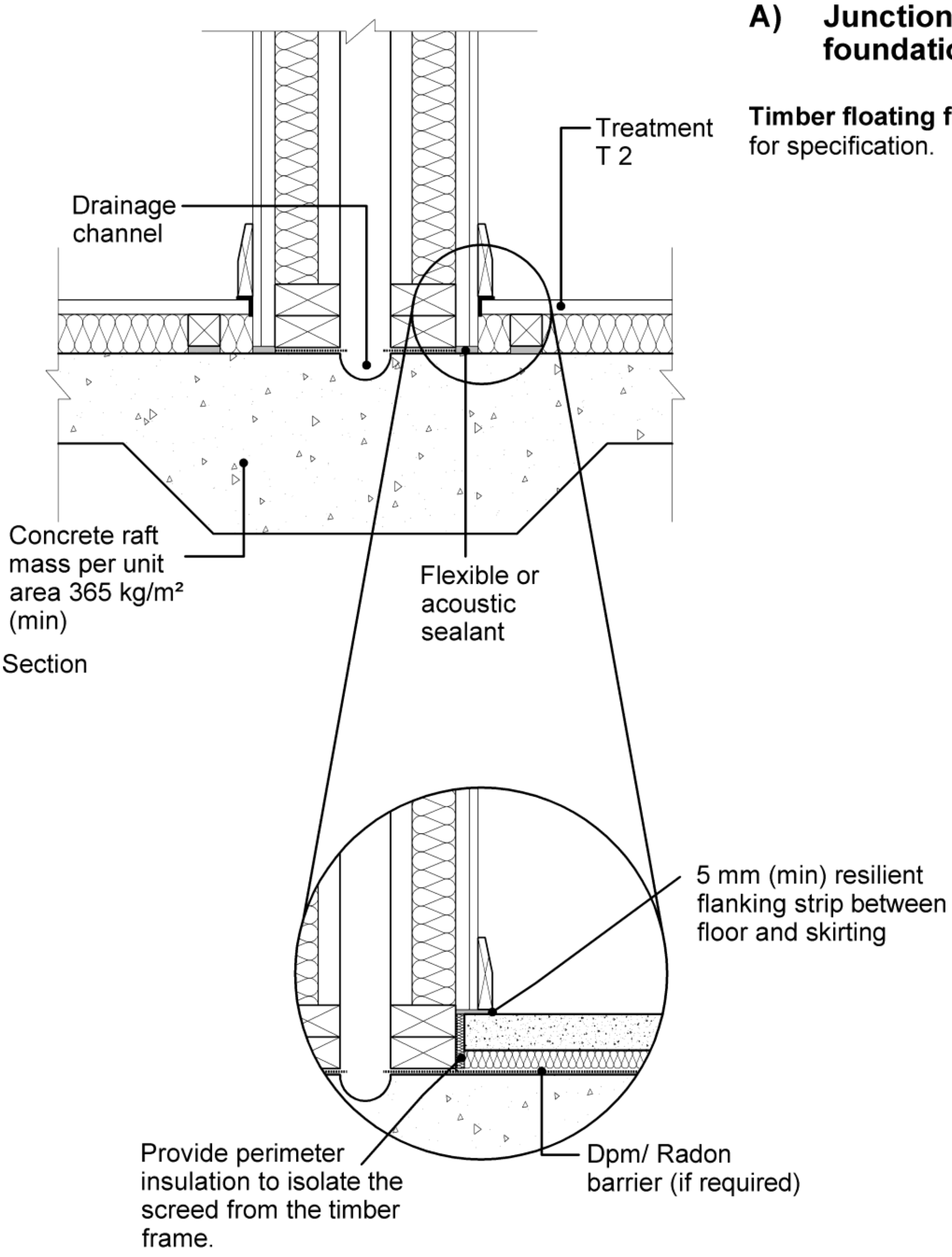
Floor decking may run under sole plates.

Close spaces between floor joists with full depth timber blocking where joists are at right angles to the wall.

Diagram 20 WT 4A Twin leaf timber frame without sheathing - Key junction details (3 of 3)
(Par. 3.6.3)

A) Junction with raft foundation

Timber floating floor: Refer to par. 4.5.4 for specification.

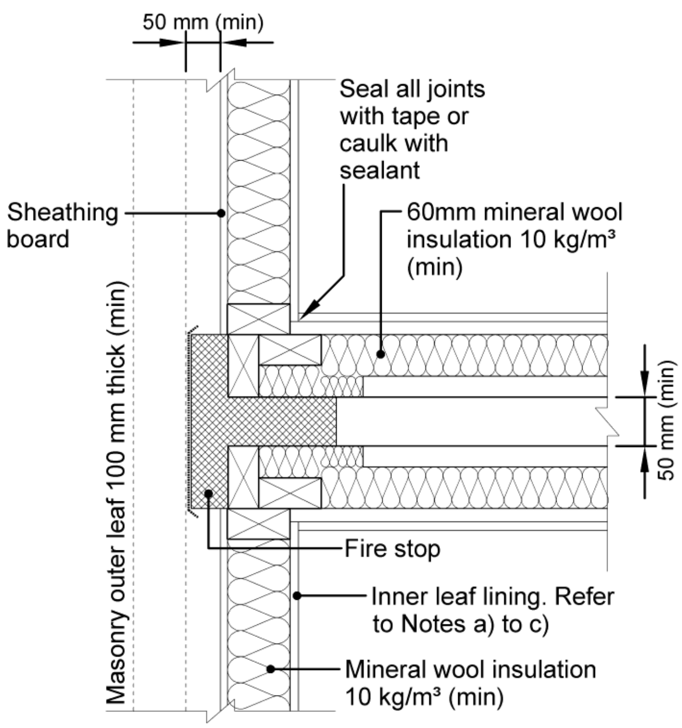


Alternative concrete screed finish

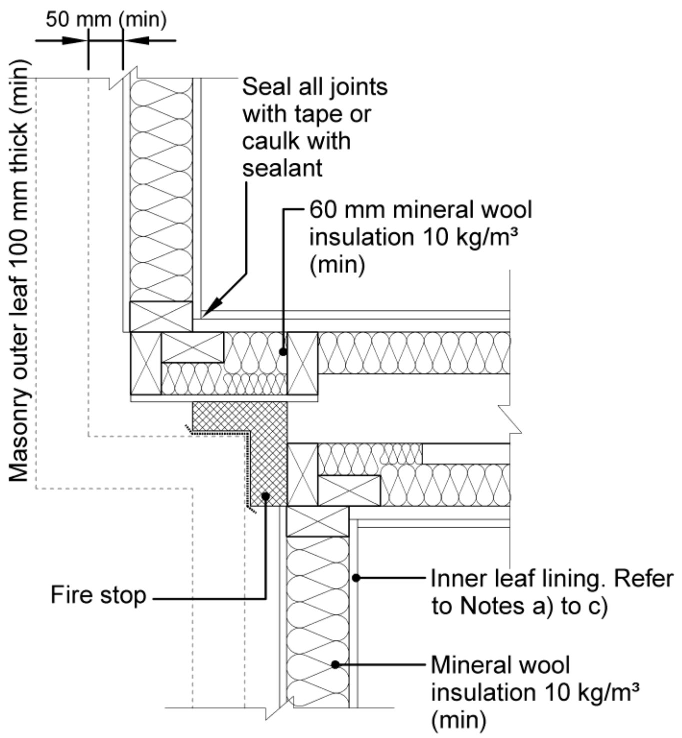
Diagram 21 WT 4A Twin leaf timber frame without sheathing - Flanking requirements for an external (flanking) wall

(Par. 3.6.3)

(i) External (flanking) wall junction



(ii) Staggered wall junction



Plan

Key Points to Watch

Flanking wall

The wall finish on the flanking wall (inner leaf of the external wall) should be:

a) one layer of plasterboard with a minimum mass per unit area of 10 kg/m²; or

b) in buildings with separating floors two layers of plasterboard (staggered joints) should be used (minimum density 10 kg/m²);

c) all joints should be sealed with tape or caulked with sealant.

Where the external wall is a cavity wall:

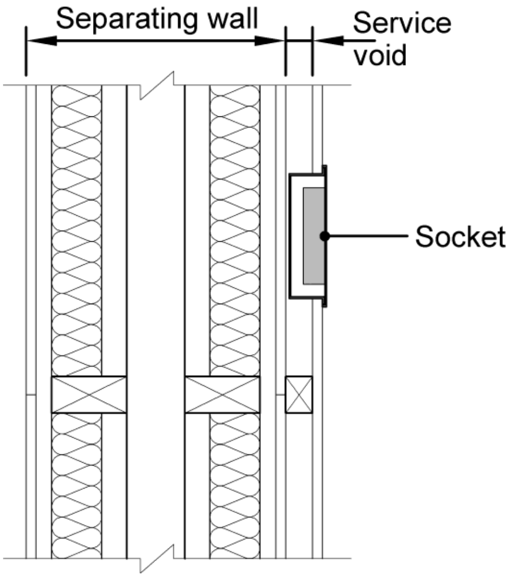
d) the outer masonry leaf should be 100 mm (min) thick;

e) the cavity should be 50 mm (min);

f) the cavity should be stopped between the ends of the separating wall and the outer leaf with a flexible cavity stop;

d) ensure that all cavity stops/ closers are flexible and are fixed to one frame only.

Diagram 22 WT 4A Twin leaf timber frame without sheathing - Services and sockets in separating walls
(Par. 3.6.3)

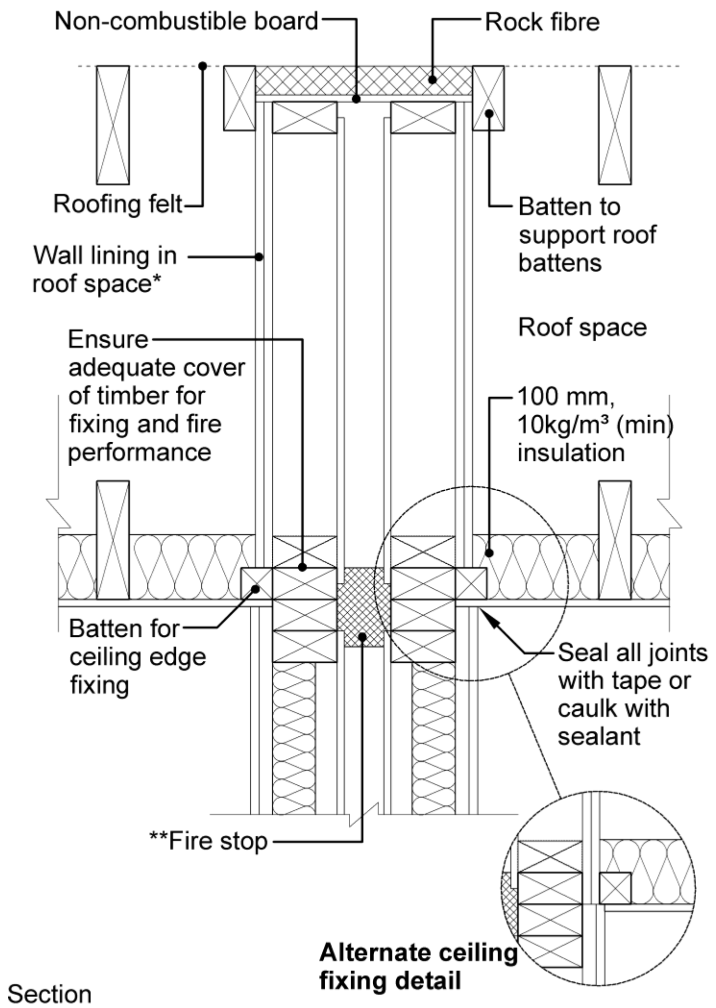


Plan

Key Points to Watch

- **DO NOT** locate services and sockets in the separating wall. Where this is unavoidable (e.g. in a kitchen) provide a service void on the surface of separating wall.
- Studs or battens used to create the service zone should be securely fixed back to the separating wall structure.

Diagram 23 WT 4B Twin leaf timber frame with sheathing - Key junction details (1 of 3) *(Par. 3.6.3)*



A) Junction with ceilings and roof spaces

The separating wall should be continuous to the underside of the roof.

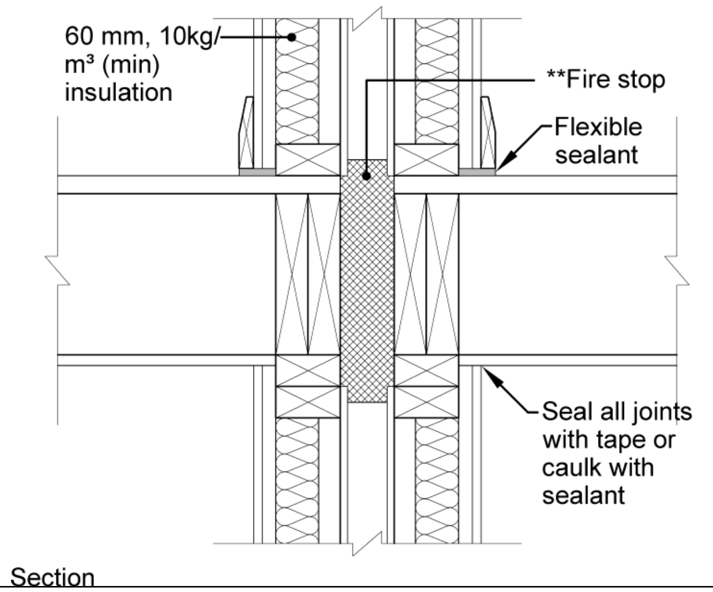
The junction between the separating wall at ceiling level should be filled with a flexible closer.

The junction between the ceiling and the wall linings should be sealed with tape or caulked with a sealant.

Where there is an external wall the cavity should be closed at eaves level with a suitable material.

* Wall lining in roof space to consist of a minimum 2 layers of gypsum based board with a toal mass per unit area of 16 kg/m^2, both sides, all joints staggered.

**Fire stop to fill cavity and tight to vertical fire stop at the ends of party walls and to non-combustable board.
Ensure that fire stop covers horizontal joints between wall members.



B) Junction with internal floor

Block the air paths through the wall into the cavity by using full depth solid timber blockings or continuous header joist where joists span at right angles to the wall.

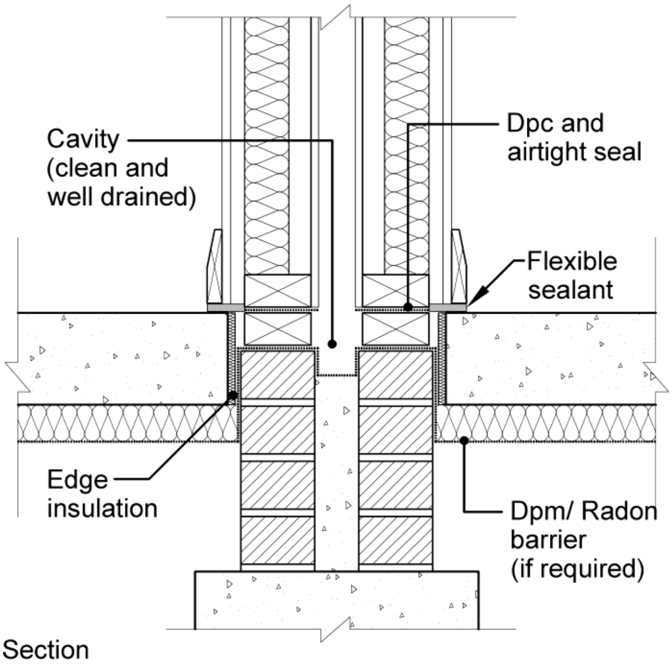
Internal floors should not be continuous between dwellings.

Floor joists may span in either direction.

** Fire stop to fill cavity and tight to vertical fire stop at the ends of party walls and to non-combustable board.
Ensure that fire stop covers horizontal joints between wall members.

See Diagram 40 for junction with separating floor.

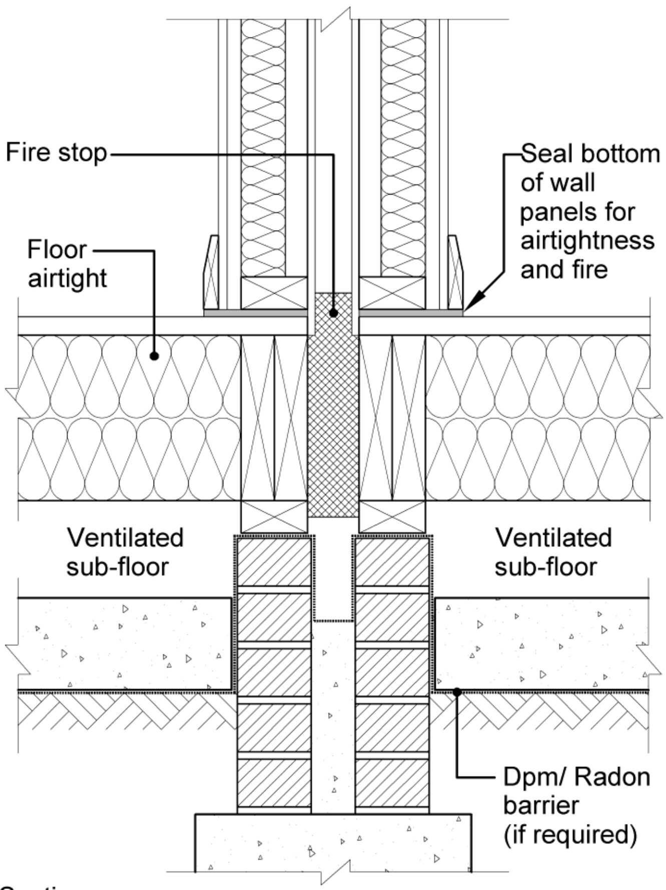
Diagram 24 WT 4B Twin leaf timber frame with sheathing - Key junction details (2 of 3) *(Par. 3.6.3)*



Section

A) Ground floor junction with ground bearing slab

The ground floor should not be continuous between dwellings.



Section

B) Ground floor junction with suspended timber ground floor

The ground floor should not be continuous between dwellings.

Timber floor joists may span in either direction.

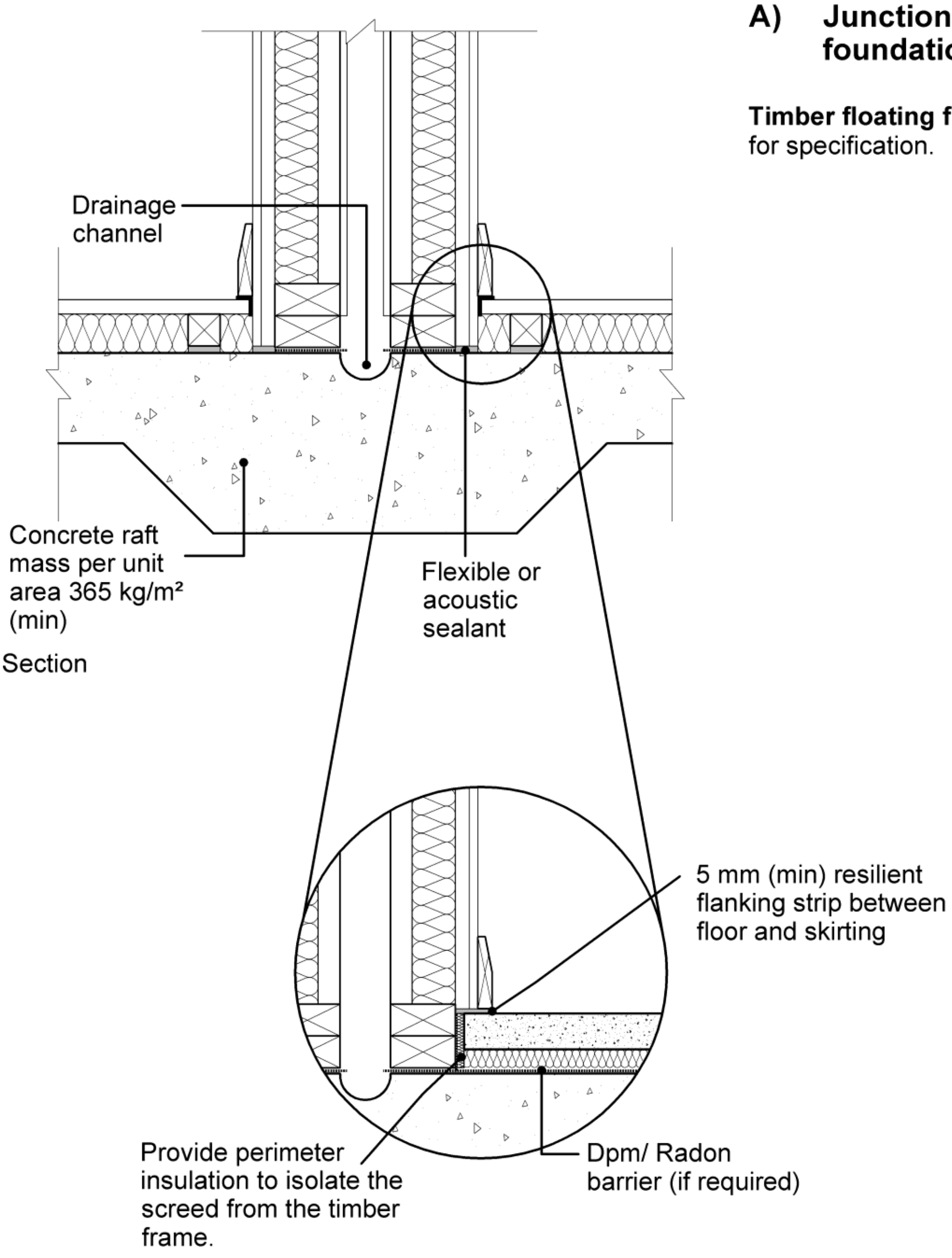
Floor decking may run under sole plates.

Close spaces between floor joists with full depth timber blocking where joists are at right angles to the wall.

Diagram 25 WT 4B Twin leaf timber frame with sheathing - Key junction details (3 of 3) *(Par. 3.6.3)*

A) Junction with raft foundation

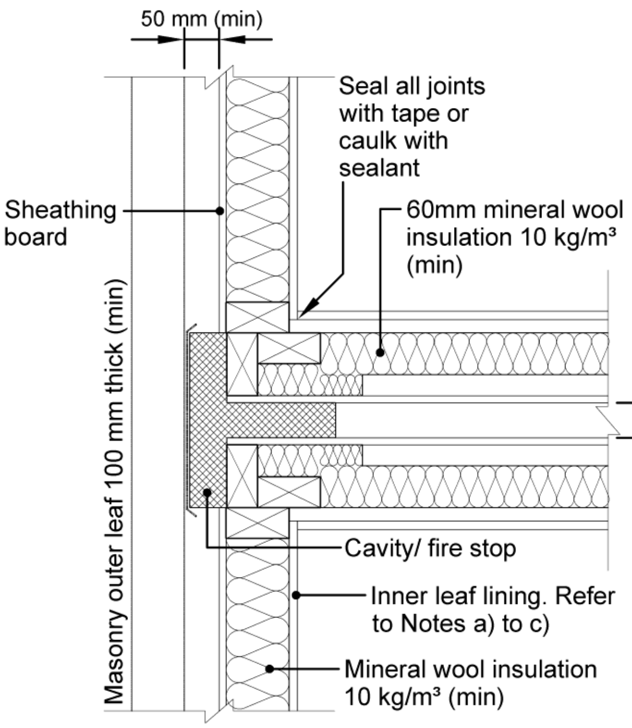
Timber floating floor: Refer to par. 4.5.4 for specification.



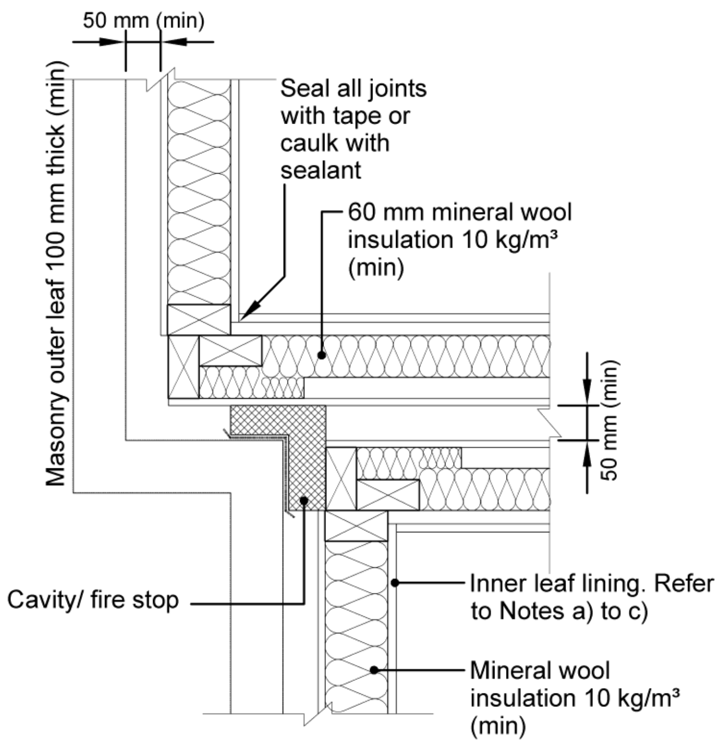
Alternative concrete screed finish

Diagram 26 WT 4B Twin leaf timber frame with sheathing- - Flanking requirements for an external (flanking) wall
(Par. 3.6.3)

(i) External (flanking) wall junction



(ii) Staggered wall junction



Plan

Key Points to Watch

Flanking wall
The wall finish on the flanking wall (inner leaf of the external wall) should be:

a) one layer of plasterboard with a minimum mass per unit area of 10 kg/m²; or

b) in buildings with separating floors two layers of plasterboard (staggered joints) should be used (minimum density 10 kg/m²);

c) all joints should be sealed with tape or caulked with sealant.

Where the external wall is a cavity wall:

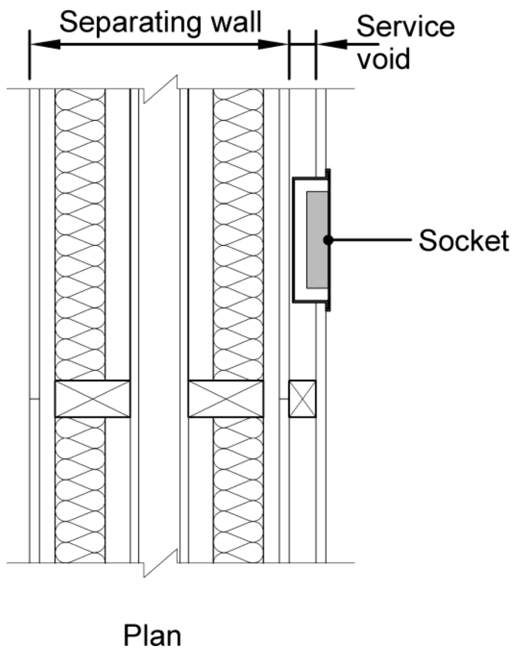
d) the outer masonry leaf should be 100 mm (min) thick;

e) the cavity should be 50 mm (min);

f) the cavity should be stopped between the ends of the separating wall and the outer leaf with a flexible cavity stop;

d) ensure that all cavity stops/ closers are flexible and are fixed to one frame only.

Diagram 27	WT 4B Twin leaf timber frame with sheathing - Services and sockets in separating walls *(Par. 3.6.3)*



Key Points to Watch

- **DO NOT** locate services and sockets in the separating wall. Where this is unavoidable (e.g. in a kitchen) provide a service void on the surface of separating wall.
- Studs or battens used to create the service zone should be securely fixed back to the separating wall structure.

Section 4
Separating floors and associated flanking construction details

4.1 Separating floor construction

4.1.1 General

4.1.1.1 This section gives examples of floor types which, if constructed correctly, should achieve the performance level set out in Table 1.

4.1.2 Types of floors

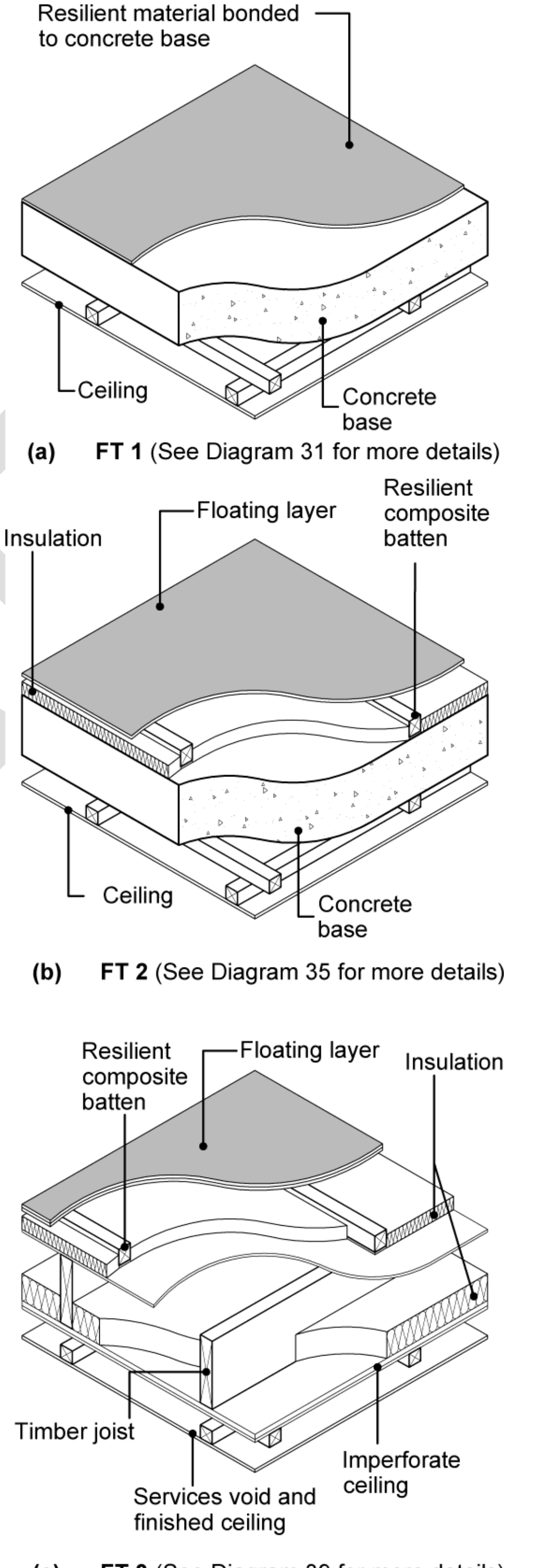
4.1.2.1 The floors are grouped into three main types as follows (refer to Diagram 28):

4.1.2.2 Floor Type 1 (FT 1) - *Concrete base with ceiling and resilient material bonded to concrete base.*
The resistance to airborne sound depends mainly on the mass per unit area of the concrete base and partly on the mass per unit area of the ceiling. The resilient material reduces impact sound at source (see Diagram 28 (a)).

4.1.2.3 Floor Type 2 (FT 2) - *Concrete base with ceiling and floating layer.*
The resistance to airborne sound depends on the mass per unit area of the concrete base, as well as the mass per unit area and isolation of the floating layer and the ceiling. The floating layer reduces the transmission of impact sound to the base and to the surrounding construction (see Diagram 28 (b)).

4.1.2.4 Floor Type 3 (FT 3) - *Timber base with ceiling and a floating layer.*
The resistance to airborne sound depends partly on the mass of the base and the absorbent blanket and partly on the mass of the floating layer. The floating layer reduces the transmission of impact sound to the base and to the surrounding construction. A timber floor needs less mass than a concrete floor because of the material is softer and radiates sound less efficiently (see Diagram 28 (c)).

Diagram 28 Types of floors
(Par. 4.1.2)



(a) **FT 1** (See Diagram 31 for more details)

(b) **FT 2** (See Diagram 35 for more details)

(c) **FT 3** (See Diagram 39 for more details)

4.2 Flanking provisions

4.2.1 General

4.2.1.1 In order for the floor construction to be fully effective, care should be taken to correctly detail the junctions between the separating floor and other elements such as external walls, separating walls and floor penetrations.

4.2.2 Junctions between separating floors and other building elements

4.2.2.1 Guidance is given below to control flanking transmission at the junction of the separating floor types and other building elements.

4.2.2.2 In addition, Table 5 outlines the illustrations provided in this document of the junctions that may occur between each of the three separating floor types discussed in 4.1.2 and the various attached building elements.

4.3 Mass per unit area of floors

4.3.1 General

4.3.1.1 The density of the materials used (and on which the mass of the floor depends) is expressed in kilograms per square metre (kg/m^2). The mass per unit area of floors should be obtained from the manufacturer's data.

Note: Manufacturers' products and systems are continually being developed and additional information on the most up-to-date specifications available should be obtained directly from the manufacturers.

4.4 Ceiling treatments

4.4.1 General

4.4.1.1 Each floor type should use one of the following ceiling treatments. Use of a better performing ceiling than that described in this guidance should improve the sound insulation of the floor provided there is no significant flanking transmission.

4.4.2 Ceiling treatments for concrete separating floors

4.4.2.1 Ceiling Treatment 1 (CT 1) - *Plasterboard on timber battens and counter battens*. CT 1 should meet the following specification:

- Create a ceiling of 100 mm (min) deep using a single layer of plasterboard with a mass per unit area of 10 kg/m^2 (min), fixed to the concrete floor using timber battens and counter battens or proprietary resilient channels;
- If resilient channels are used, incorporate an absorbent layer of mineral wool with a density of 10 kg/m^3 (min) that fills the ceiling void.

4.4.2.2 Electric cables give off heat when in use and special precautions may be required when they are covered by thermally insulating materials. Refer to BRE BR 262, Thermal Insulation: avoiding risks, section 2.4.

4.4.2.3 Installing recessed light fittings in CT1 can reduce their resistance to the passage of airborne and impact sound.

4.4.3 Ceiling treatments for timber separating floors

4.4.3.1 Ceiling Treatment 2 (CT 2) – *Plasterboard on timber battens and counter battens*. CT2 should meet the following specification:

- Minimum thickness of 30 mm plasterboard imperforate ceiling in two layers with joints staggered, fixed to timber joists to form fire resisting ceiling.
- Provide a sub-ceiling consisting of a single layer of plasterboard with a mass per unit area 10 kg/m^2 (min) fixed to the imperforate ceiling using timber battens or proprietary resilient channels.

4.4.3.2 Fire resisting ceilings in a timber separating floor should not normally be penetrated without specific fire design complying with Part B – Fire Safety. Therefore, it is recommended that a sub-ceiling should be provided below the fire resisting ceiling in order to accommodate services, electric cable runs etc. The mass per unit area of a sub ceiling should not be included in the calculation of the mass per unit area of the floor.

4.5 Floor treatments

4.5.1 General

4.5.1.1 Each floor type should use an appropriate floor treatment. This section details three specific floor treatments. Alternative floating floor constructions may be adopted by following the performance based approach in 4.6.

4.5.1.2 Where proprietary acoustic products are used, they should have third party certification and should be installed strictly in accordance with the manufacturers recommnedations.

4.5.2 Resilient material

4.5.2.1 A resilient material is a material which returns to its original thickness after it has been compressed. Resilient material appropriate for impact sound is a resilient material, or material with a resilient base, with an overall uncompressed thickness of at least 4.5 mm. A material less than 4.5 mm may be suitable where it consists of a resilient covering with a weighted reduction in impact sound pressure level (ΔL_w) of not less than 17 dB when measured in accordance with I.S. EN ISO 717-2.

4.5.3 Impact sound reduced at source for concrete separating floors

4.5.3.1 Treatment 1 (T 1) – *Resilient material bonded to concrete base.*

T 1 should consist of a resilient material as described in paragraph 4.5.2 bonded to the concrete floor (see Diagram 31)[2].

4.5.4 Floating floors for concrete separating floors

4.5.4.1 Treatment 2 (T 2) – *Timber raft of board material fixed to resilient layer laid on top of the concrete floor*.
Floating floors isolate the finished floor from the base and also reduces impact sound at source. T 2 (see Diagram 29) when used with a concrete base separating floor should meet the following specification:

- Timber raft of board material (with bonded edges, e.g. tongued and grooved) of thickness 18 mm (min) and mass per unit area of 12 kg/m^2 (min) fixed to resilient composite battens of 45 mm (min) deep to meet the performance requirements in paragraph 4.5.2. The resilient layer must be continuous and pre-bonded to the bottom of the batten, and

- provide 45 mm (min) mineral wool quilt with 10-36 kg/m^3 laid between battens.

4.5.5 Floating floors suitable for use with timber base separating floors

4.5.5.1 Treatment 3 (T 3) - *Timber raft of board material fixed to resilient layer laid on top of a timber base separating floor.*
T 3 (see Diagram 30) when used with a timber base separating floor should meet the following specification:

- Floating layer of 18 mm (min) thick timber or wood-based board with tounge and grooved edges with all joints glued and spot bonded to a substrate of 19 mm (min) plasterboard, or material with at least the same mass secured to:

[2] Products which do not form part of the permanent works and can be readily removed, e.g. carpet, underlay etc are not apropriate for use as resilient layers.

- Resilient composite battens 70 mm (min) deep complying with performance requirements of 4.5.2. The resilient layer must be continuous and pre-bonded to bottom of batten;

- provide 60 mm (min) mineral wool quilt with a density of 10-36 kg/m^3 laid between battens.

4.6. Performance based approach

4.6.1 Where a floating floor treatment other than T 2 or T 3 is used, it should meet the following specification:

- rigid boarding above a resilient and / or damping layer; with

- weighted reduction in impact sound pressure level (ΔL_w) of not less than 29dB when measured according to I.S. EN 10140-3 and rated according to I.S. EN ISO 717-2. (Refer to Annex B: supplementary guidance on acoustics measurement standards). The performance value ΔL_w should be achieved when the floating floor is loaded and unloaded as described in I.S. EN ISO 10140 for category II systems.

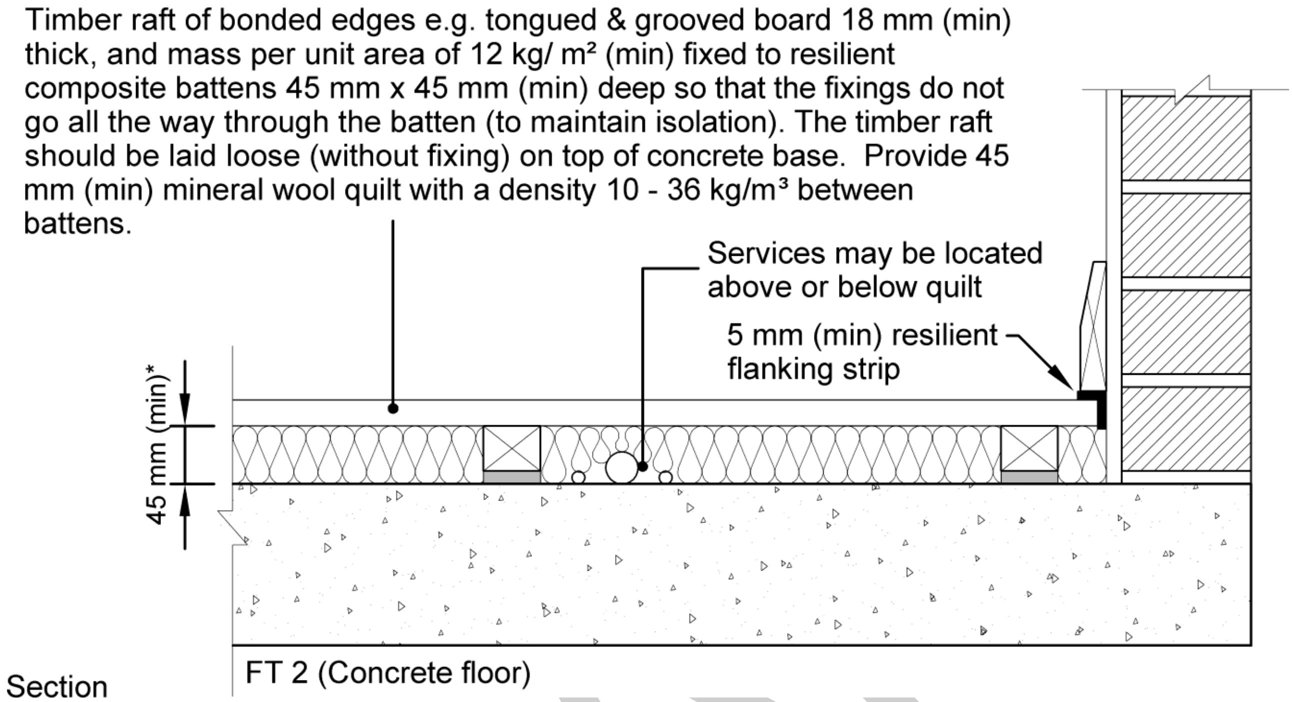
Table 5 Reference table to illustrations provided on separating floor junctions *(Par 4.2.2.1)*

	Separating Floor Type		
Separating Wall Type	**FT 1** *Concrete base with ceiling and resilient material bonded to concrete base (Diagram 31)*	**FT 2** *Concrete base with ceiling and floating floor (Diagram 35)*	**FT 3** *Timber base with ceiling and floating floor (Diagram 39)*
WT 1 *Solid masonry / concrete with plaster finish (Diagram 4)*	Diagram 32A	Diagram 36A	Not applicable
WT 2 *Solid masonry with dry-lining (Diagram 8)*	Diagram 32B	Diagram 36B	Not applicable
WT 3 *Cavity masonry wall with plaster finish (Diagram 21)*	Diagram 33	Diagram 37	Not applicable
WT 4A *Twin leaf timber frame without sheathing (Diagram 17A)*	Not applicable	Not applicable	Diagram 40A
WT 4B *Twin leaf timber frame with sheathing (Diagram 17B)*	Not applicable	Not applicable	Diagram 40B
Other flanking elements			
External cavity wall with masonry inner leaf*	Diagram 34A	Diagram 38A	Not applicable
External solid masonry wall*	Diagram 34A	Diagram 38A	Not applicable
External cavity wall with timber framed inner leaf*	Not applicable	Not applicable	Diagram 41A
Service penetrations	Diagram 34B	Diagram 38B	Diagram 41B

Notes:

*Refer to Section 3 for guidance on separating walls and associated flanking construction details.

Diagram 29 Floating floor treatment (T 2) suitable for Floor Type 2 (FT 2)
(Par. 4.5.4)



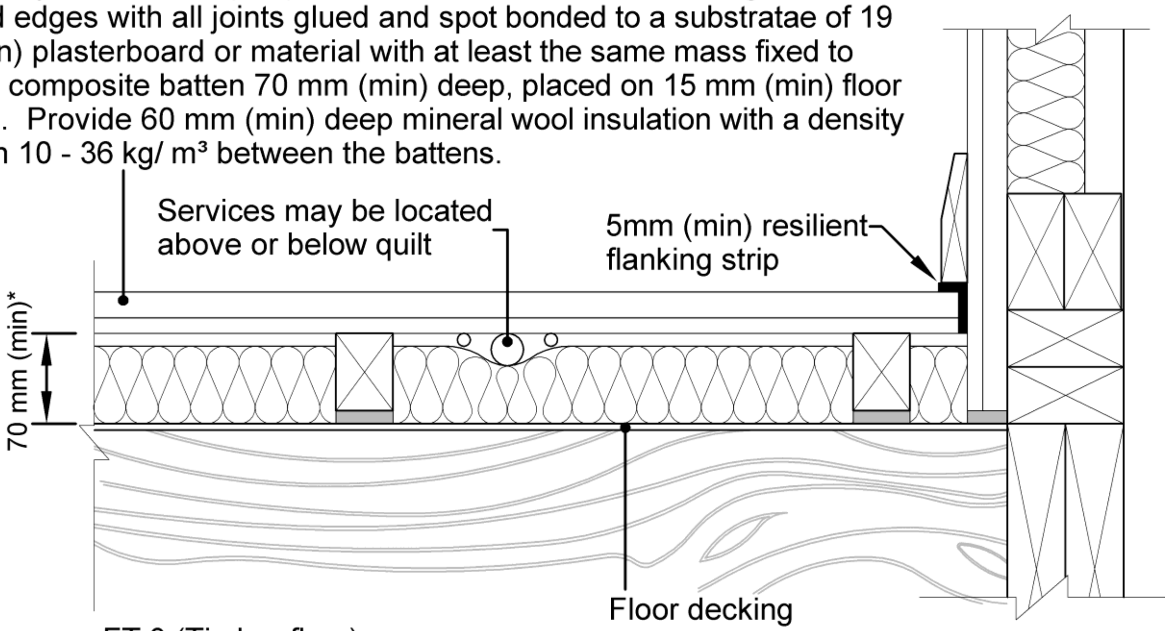
General notes applicable to all floating floor treatments:

1. All floor treatments must be installed in accordance with the manufacturer's instructions;
2. Provide 5mm (minimum) resilient flanking strips around the perimeter of the flooring boards to isolate floor from walls and skirting;
3. Services, where required, may be located above or below the quilt;
4. Ensure services, where provided, do not bridge the resilient layer.

* Void dimension indicated when floor is loaded to 25 kg/m^2.

Diagram 30 Floating floor treatment (T 3) suitable for Floor Type 3 (FT 3)
(Par. 4.5.5)

Floating layer of 18 mm (min) thick wood based board with tongued and grooved edges with all joints glued and spot bonded to a substratae of 19 mm (min) plasterboard or material with at least the same mass fixed to resilient composite batten 70 mm (min) deep, placed on 15 mm (min) floor decking. Provide 60 mm (min) deep mineral wool insulation with a density between 10 - 36 kg/ m³ between the battens.



Section FT 3 (Timber floor)

General notes applicable to all floating floor treatments:

1. All floor treatments must be installed in accordance with the manufacturer's instructions;
2. Provide 5mm (minimum) resilient flanking strips around the perimeter of the flooring boards to isolate floor from walls and skirting;
3. Services, where required, may be located above or below the quilt;
4. Ensure services, where provided, do not bridge the resilient layer.

* Void dimension indicated when floor is loaded to 25kg/m^2.

4.7 Floor Type 1 (FT 1) - Concrete base with ceiling and resilient layer bonded to concrete base

4.7.1 General

4.7.1.1 The resistance to airborne sound depends mainly on the mass per unit area of the concrete base and partly on the mass per unit area of the ceiling. The resilient layer reduces impact sound at source.

4.7.2 Floor specification

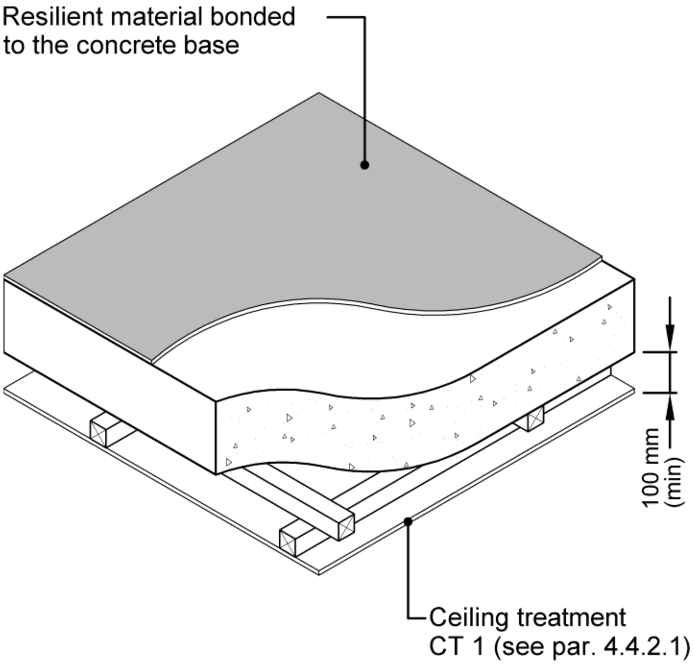
4.7.2.1 Two FT1 constructions are described in Diagram 31.

4.7.3 Key junctions and flanking details

4.7.3.1 Details of how junctions with FT1 should be constructed to limit flanking transmission are described in Diagrams 32 to 34.

Diagram 31 FT1 Concrete base with ceiling and resilient material bonded to concrete base – Specification
(Par. 4.7.2)

A) FT 1A - Solid concrete floor with resilient material bonded to concrete base

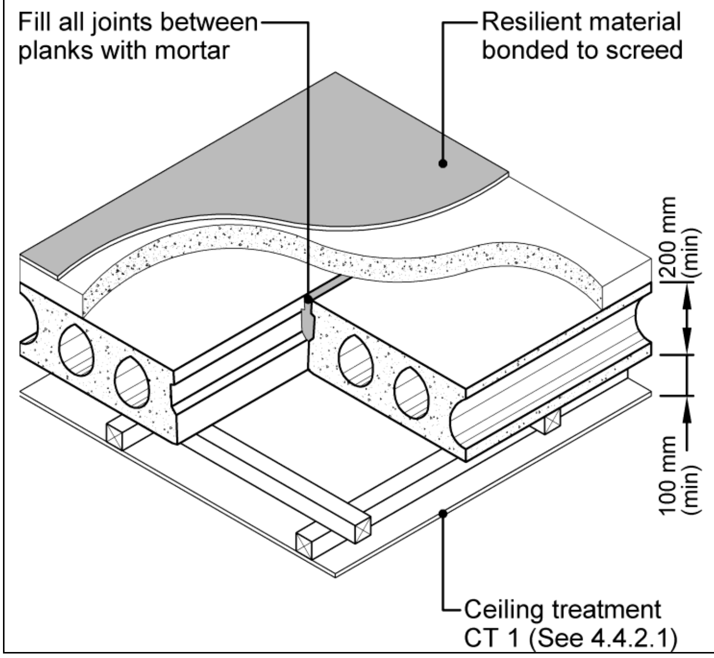


Specification
The mass per unit area (cast insitu, with or without permanent shuttering), resilient material and ceiling treatment should be 365 kg/m² (min).

Example
Resilient material (see par. 4.5.2) bonded to 200 mm (min) deep concrete floor slab (in-situ/ permanent shuttering) with a concrete density of 2400 kg/m³ (min). Create a ceiling of 100 mm (min) deep using a single layer of plasterboard with a mass per unit area of 10 kg/m² (min), fixed to the concrete floor using timber battens and counter battens or proprietary resilient channels (see par. 4.4.2.1).

Key Points to Watch
- Ensure floor slab density is 2400 kg/m³ (min)
- Fill all voids between separating wall and separating floor.
- Ensure resilient material is fully bonded to the floor slab.
- If resilient channels are used, incorporate an absorbent layer of mineral wool with a density of 10kg/ m³ (min) that fills the ceiling void.

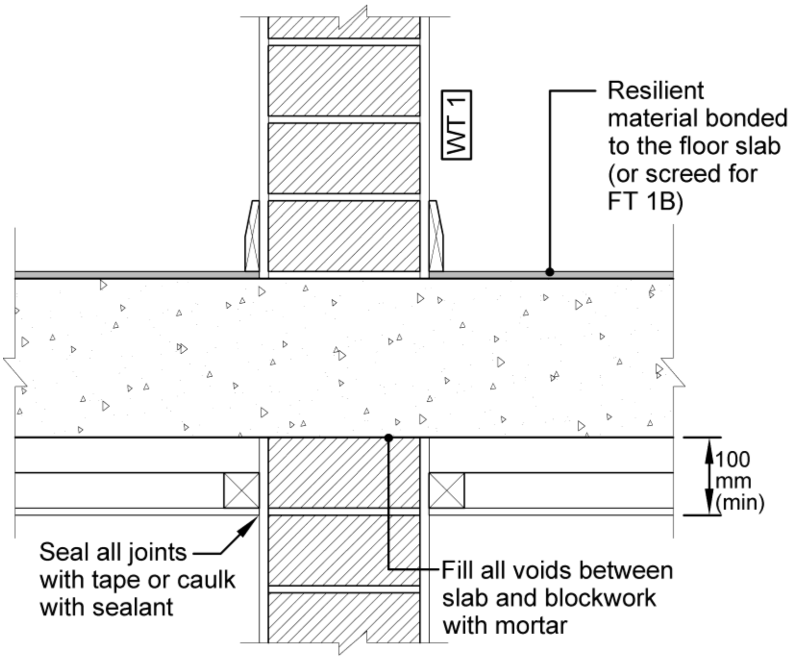
B) FT 1B - Precast concrete hollowcore floor with resilient material bonded to concrete screed



Example
Resilient material (see par. 4.5.2 for specification) bonded to 65 mm (min) screed on 200 mm (min) deep precast concrete floor planks (solid or hollow). Create a ceiling of 100 mm (min) deep using a single layer of plasterboard with a mass per unit area of 10 kg/m² (min), fixed to the concrete floor using timber battens and counter battens or proprietary resilient channels (see par. 4.4.2.1).

Key Points to Watch
- Butt planks tightly together and grout all joints between planks.
- Fill all voids between separating wall and separating floor.
- Ensure resilient material is fully bonded to the screed surface.
- Provide a ceiling void of 100 mm (min) between the underside of the structural floor and the finished ceiling.
- If resilient channels are used, incorporate an absorbent layer of mineral wool with a density of 10kg/ m³ (min) that fills the ceiling void

Diagram 32 FT 1 Concrete base with ceiling and resilient material bonded to concrete base – Key junction details (1 of 2)
(Par. 4.73)

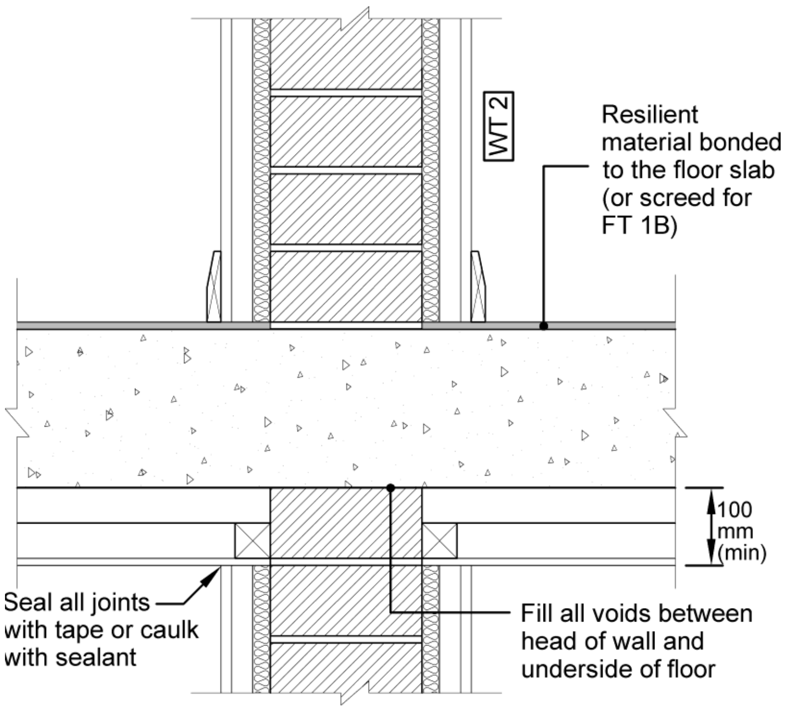


Section

A) Junction between FT 1 and WT 1

Key Points to Watch

- FT 1 should be continuous through WT 1.
- If hollow core planks are used, the cores should be sealed with mortar at the separating wall junction.



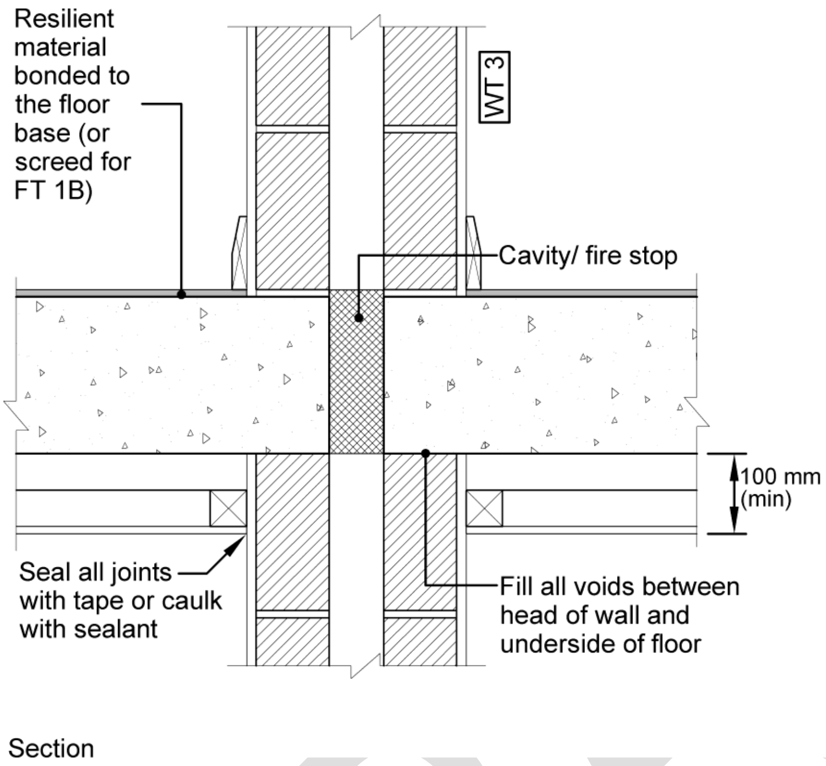
Section

B) Junction between FT 1 and WT 2

Key Points to Watch

- FT 1 should be continuous through WT 2.
- If hollow core planks are used of a type where the cores are continuous through the planks and the planks are laid so that the cores join up, the cores should be sealed with mortar at the separating wall junction.

Diagram 33	**FT 1 Concrete base with ceiling and resilient material bonded to concrete base – Key junction details (2 of 2)** *(Par. 4.7.3)*

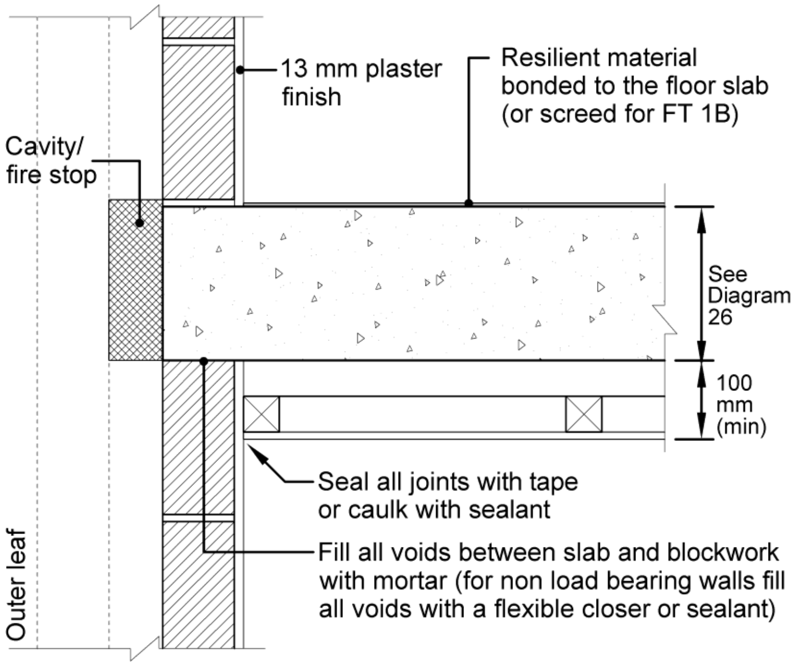


Junction between FT 1 and WT 3

Key Points to Watch

- The floor base should be carried through to the cavity face of the inner leaf.
- The wall cavity should not be bridged.
- If hollow core planks are used, the ends of the cores should be sealec with concrete at the separating wall junction.

Diagram 34 FT1 Concrete base with ceiling and resilient material bonded to concrete base - Flanking requirements
(Par. 4.7.3)

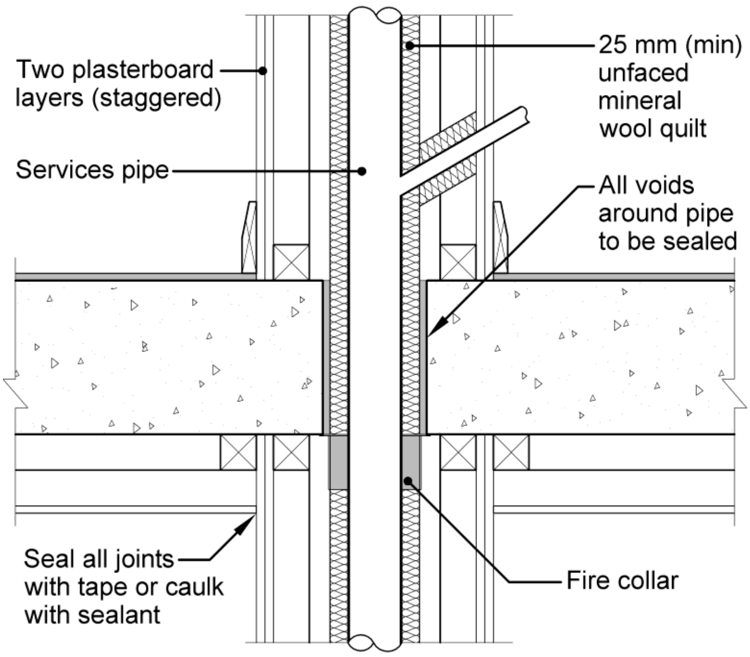


A) External flanking wall

(a) The flanking wall should be of masonry construction and should have a mass per unit area of at least 120kg/m² (excluding any finish).
(b) the outer leaf may be of any construction; and
(c) the cavity should be stopped with a flexible closer ensuring adequate drainage unless the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturers advice for suitable materials).

Key Points to Watch

- The floor base should be built into a cavity masonry external wall and carried through to the cavity face of the inner leaf.
- If hollow core planks are used, the ends of the cores should be sealed with concrete at the separating wall junction.



Section

B) Services pipes through FT 1 (excluding gas pipes)*

- Fully wrap service pipe over its full height and any branches in the duct with at least 25 mm unfaced mineral wool quilt.
- The pipe should be boxed in with two layers of plasterboard, each layer to have a minimum mass of 8 kg/m² (all joints staggered).
- Penetrations through a separating floor by ducts and pipes should have fire protection to satisfy Building Regulations Part B - Fire Safety.
- Fire stopping should be flexible and also prevent rigid contact between the pipe and floor.

Note:
*Where gas pipes are being ducted special requirements apply. All gas services should be installed in accordance with the relevant codes and standards to ensure safe and satisfactory operation.

4.8 Floor Type 2 (FT 2) - Concrete base with ceiling and floating layer

4.8.1 General

4.8.1.1 The resistance to airborne and impact sound depends on the mass per unit area of the concrete base, as well as the mass per unit area and isolation of the floating layer and the ceiling. The floating layer reduces the transmission of impact sound to the base and to the surrounding construction.

4.8.2 Floor specification

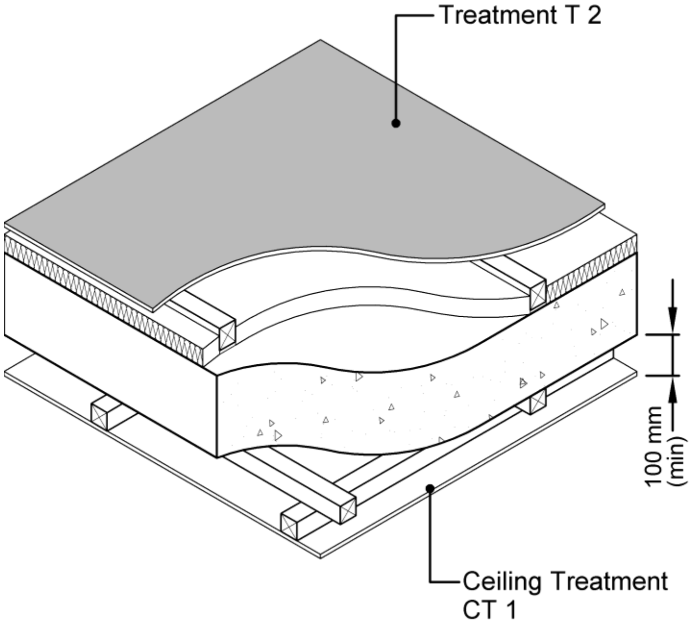
4.8.2.1 Two FT2 constructions are described in Diagram 35.

4.8.3 Key junctions and flanking details

4.8.3.1 Details of how junctions with FT1 should be constructed to limit flanking transmission are described in Diagrams 36 to 38.

Diagram 35 FT2 Concrete base with ceiling and floating floor – Specification
(Par. 4.8.2)

A) FT 2A - Solid concrete slab with a floating floor

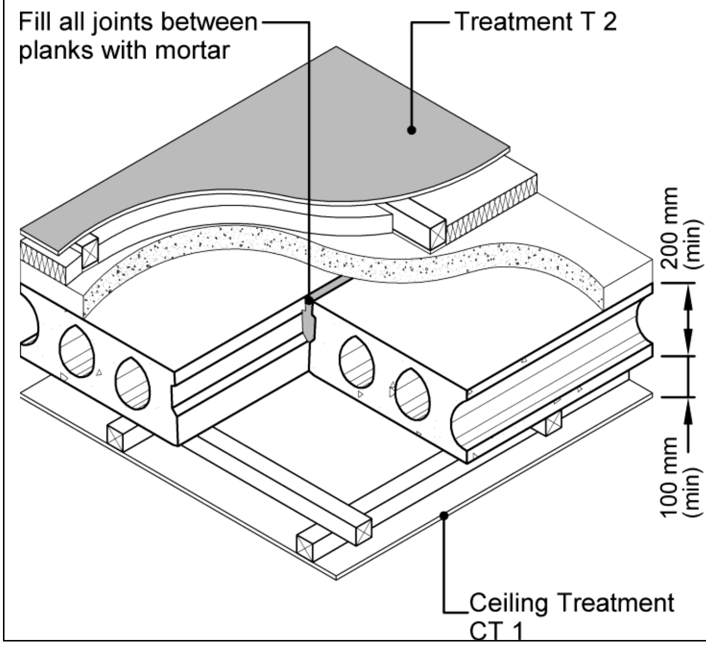


Specification
The mass per unit area of the floor (cast insitu, with or without permanent shuttering), floating floor and ceiling treatment should be 365 kg/m² (min).

Example
Floor Treatment T 2 (see par. 4.5.4 for specification) laid on 200 mm (min) deep concrete floor slab (in-situ/ permanent shuttering) with a concrete density of 2400 kg/m³ (min). Create a ceiling of 100 mm (min) deep using a single layer of plasterboard with a mass per unit area of 10 kg/m² (min), fixed to the concrete floor using timber battens and counter battens or proprietary resilient channels (see par. 4.4.2.1).

Points to Watch
- Ensure floor slab density is 2400 kg/m³ (min)
- Fill all voids between separating wall and separating floor.
- If resilient channels are used, incorporate an absorbent layer of mineral wool with a density of 10kg/ m³ (min) that fills the ceiling void

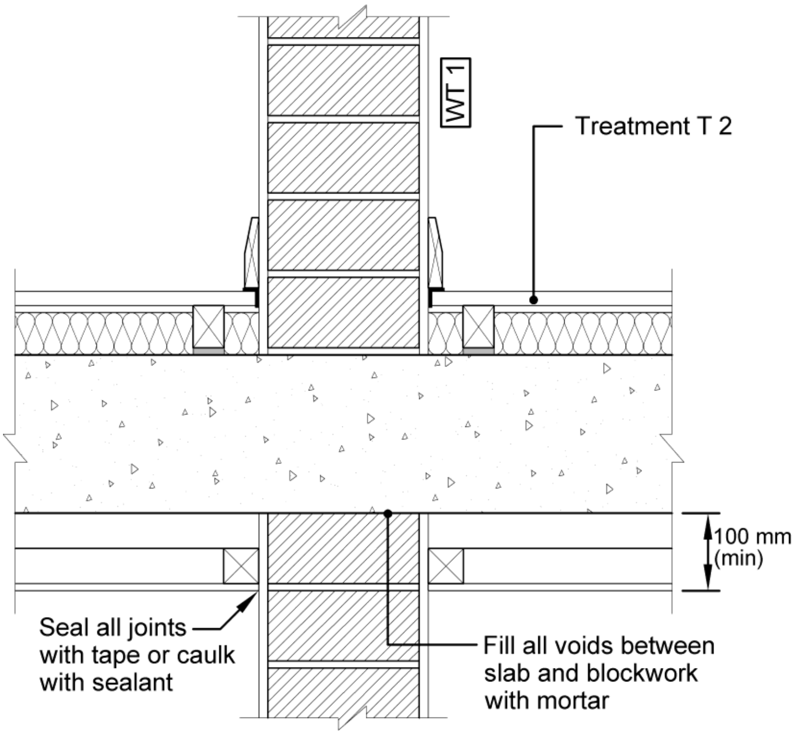
B) FT 2B - Precast hollowcore concrete with a screed and a floating floor



Example
Floor Treatment T 2 (see par. 4.5.4) laid on 65 mm (min) screed on 200 mm (min) deep precast concrete floor planks (solid or hollow). Create a ceiling of 100 mm (min) deep using a single layer of plasterboard with a mass per unit area of 10 kg/m² (min), fixed to the concrete floor using timber battens and counter battens or proprietary resilient channels (see par. 4.4.2.1).

Points to Watch
- Butt planks tightly together and grout all joints between planks.
- Fill all voids between separating wall and separating floor.
- Provide a ceiling void of 100 mm (min) between the underside of the structural floor and the finished ceiling.
- If resilient channels are used, incorporate an absorbent layer of mineral wool with a density of 10kg/ m³ (min) that fills the ceiling void

Diagram 36 FT 2 Concrete base with ceiling and floating floor – Key junction details (1 of 2)
(Par. 4.8.3)

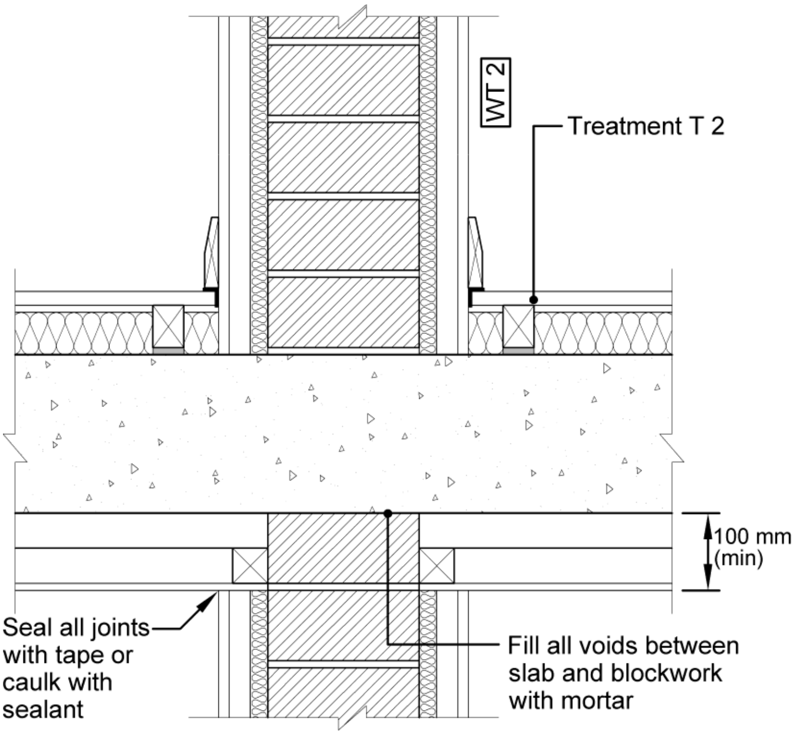


Section

A) Junction between FT 2 and WT 1

Key Points to Watch

- FT 2 should be continuous through WT 1.
- If hollow core planks are used, the cores should be sealed with mortar at the separating wall junction.



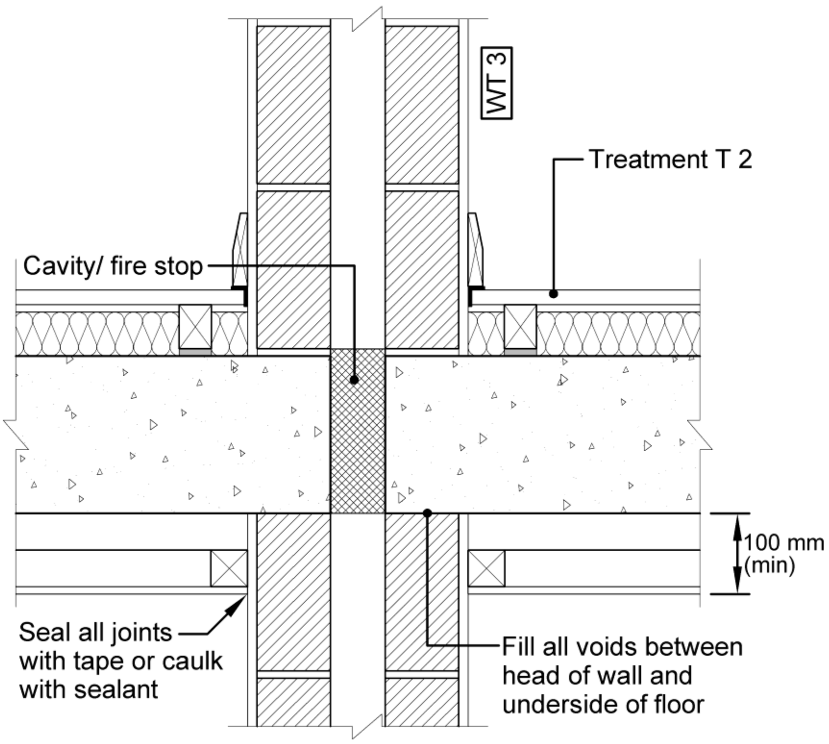
Section

B) Junction between FT 2 and WT 2

Key Points to Watch

- FT 2 should be continuous through WT 2.
- If hollow core planks are used of a type where the cores are continuous through the planks and the planks are laid so that the cores join up, the cores should be sealed with mortar at the separating wall junction.

Diagram 37 FT 2 Concrete base with ceiling and floating floor – Key junction details (2 of 2)
(Par. 4.8.3)



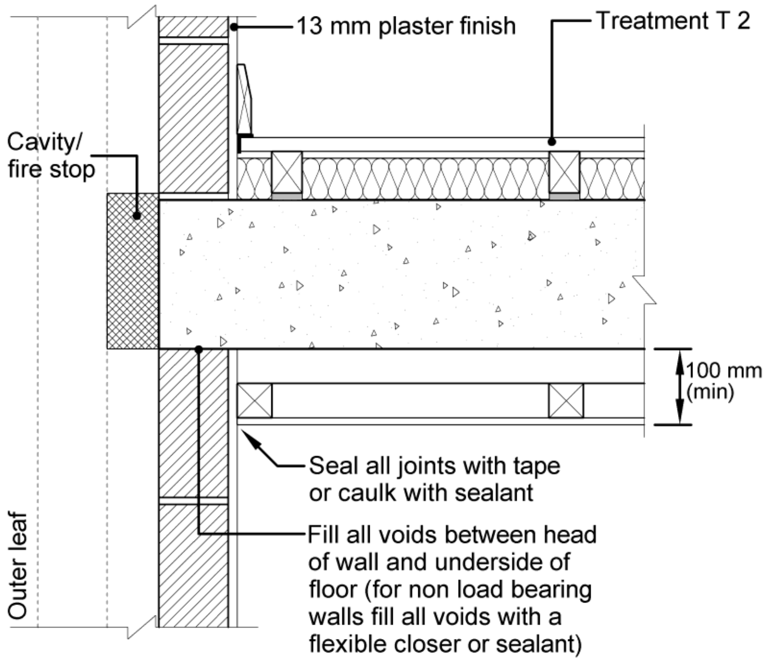
Section

Junction between FT 2 and WT 3

Key Points to Watch

- The floor base should be carried through to the cavity face of the inner leaf.
- The wall cavity should not be bridged.
- If hollow core planks are used, the ends of the cores should be sealed with concrete at the separating wall junction.

Diagram 38 FT1 Concrete base with ceiling and floating floor - Flanking requirements
(Par. 4.8.3)

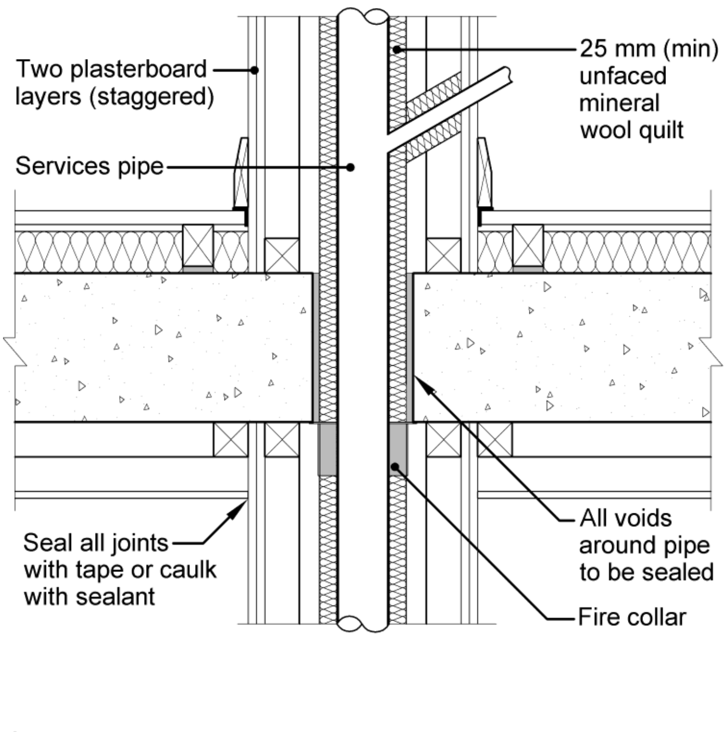


A) External flanking wall

(a) The flanking wall should be of masonry construction and should have a mass per unit area of at least 120kg/m² (excluding any finish).
(b) the outer leaf may be of any construction; and
(c) the cavity should be stopped with a flexible closer ensuring adequate drainage unless the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturer's advice for suitable materials).

Key Points to Watch

- The floor slab should be built into a cavity masonry external wall and carried through to the cavity face of the inner leaf.
- If hollow core planks are used, the ends of the cores should be sealed with concrete at the separating wall junction.
- Install flanking strips around the perimeter of the flooring treatment to isolate the floating floor from the walls and skirting.



Section

B) Services pipes through FT 2 (excluding gas pipes)*

- Fully wrap service pipe over its full height and any branches in the duct with at least 25 mm unfaced mineral wool quilt.
- The pipe should be boxed in with two layers of plasterboard, each layer to have a minimum mass of 8 kg/m² (all joints staggered).
- Penetrations through a separating floor by ducts and pipes should have fire protection to satisfy Building Regulations Part B - Fire Safety.
- Fire stopping should be flexible and also prevent rigid contact between the pipe and floor.

Note:
*Where gas pipes are being ducted special requirements apply. All gas services should be installed in accordance with the relevant codes and standards to ensure safe and satisfactory operation.

4.9 Floor Type 3 (FT 3) - Timber base with ceiling and a floating floor

4.9.1 General

4.9.1.1 The resistance to airborne and impact sound depends on the mass per unit area of the concrete base, as well as the mass per unit area and isolation of the floating layer and the ceiling. The floating layer reduces the transmission of impact sound to the base and to the surrounding construction.

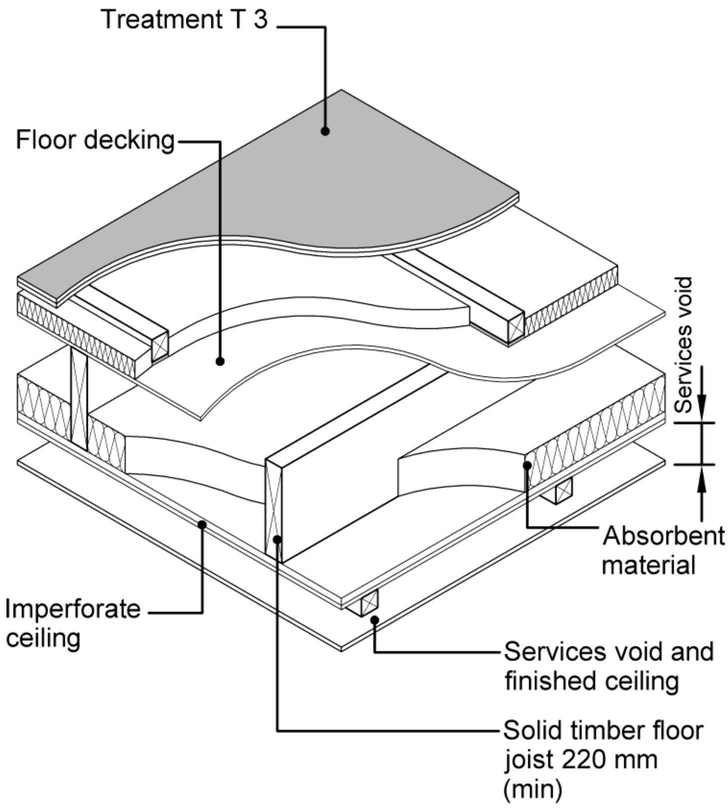
4.9.2 Floor specification

4.9.2.1 One FT3 construction is described in Diagram 39.

4.9.3 Key junctions and flanking details

4.9.3.1 Details of how junctions with FT3 should be constructed to limit flanking transmission are described in Diagrams 40 to 41.

Diagram 39 FT3 Timber base with ceiling and floating floor – Specification *(Par. 4.9.2)*



Specification

Floating floor: Treatment T 3 **(s**ee par.4.5.5 for floating floor specification).

Floor decking: 15 mm (min) wood based board, density not less than 60 kg/m³ secured to;

Joists: 220 mm (min) deep solid timber joists at 400 mm c/c (max);

Absorbent material: 100 mm (min) deep mineral wool quilt insulation (10 - 36 kg/m³) between joists.

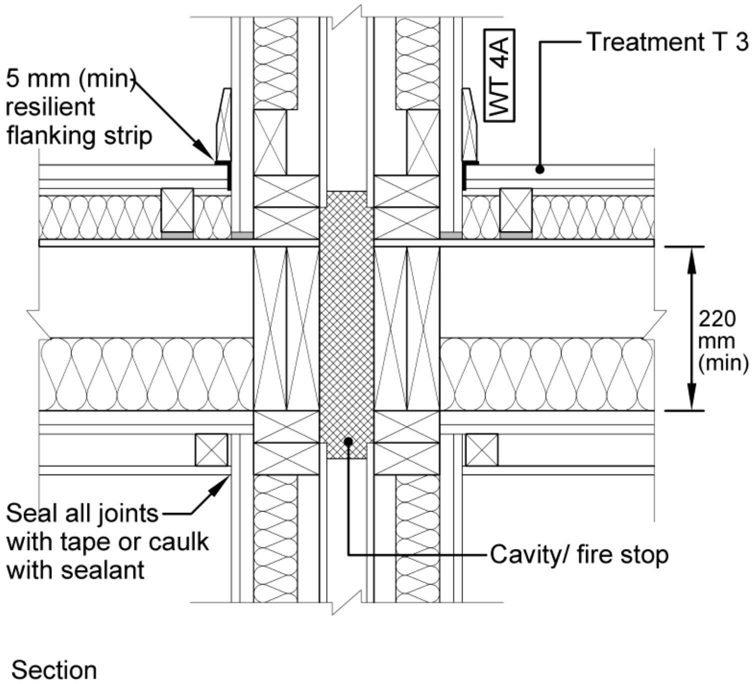
Imperforate ceiling: 30 mm (min) thickness of plasterboard imperforate ceiling in two layers with joints staggered (to provide appropriate fire resistance). There should be no penetrations in this layer.

Services Void and Finished Ceiling: Provide a sub-ceiling consisting of a single layer of plasterboard with a mass per unit area 10 kg/m² (min) fixed to the imperforate ceiling using timber battens or proprietary resilient channels (see par. 4.4.3).

Points to Watch

- Ensure floating floor is installed in accordance with Diagrams 30;
- Lay quilt between all joists and ensure no gaps remain;
- Stagger joints in double plasterboard ceiling and seal the outer plasterboard layer with tape or caulk with sealant;
- Provide a services void between the underside of double plasterboard ceiling and the finished ceiling;
- **DO NOT** penetrate the imperforate ceiling (double plasterboard ceiling) with services.

Diagram 40 FT3 Timber base with ceiling and floating floor – Key junction details
(Par. 4.8.3)



A) Junction between FT 3 and WT 4A

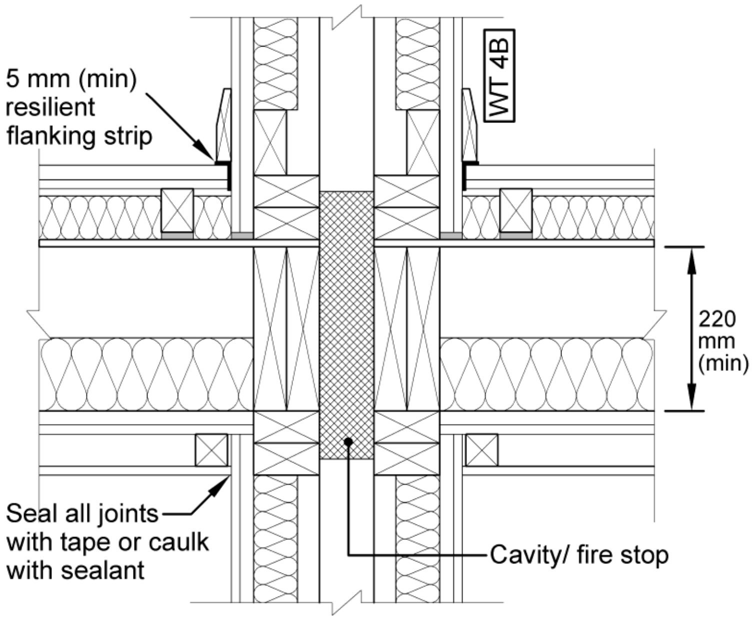
Key Points to Watch

Separating Wall

- See Diagram 17A for separating wall specification.
- Close spaces between the floor joists with full depth timber blocking or continuous header joist where joists are at right angles to the wall.
- Close cavity with a fire stop.

Separating Floor

- See Diagrams 30 for floating floor specification. Ensure 5 mm minimum resilient flanking strip is provide adjacent the separating wall.
- Joists may span in either direction.
- Lay quilt between all joists and ensure no gaps remain.
- Stagger joints in double plasterboard ceiling and seal the outer plasterboard layer with tape or caulk with sealant.
- **DO NOT** penetrate the double plasterboard ceiling with services.
- Provide a services void between the underside of the imperforate ceiling and the finished ceiling.
- Seal all perimeter joints with tape or caulk with sealant.



B) Junction between FT 3 and WT 4B

Key Points to Watch

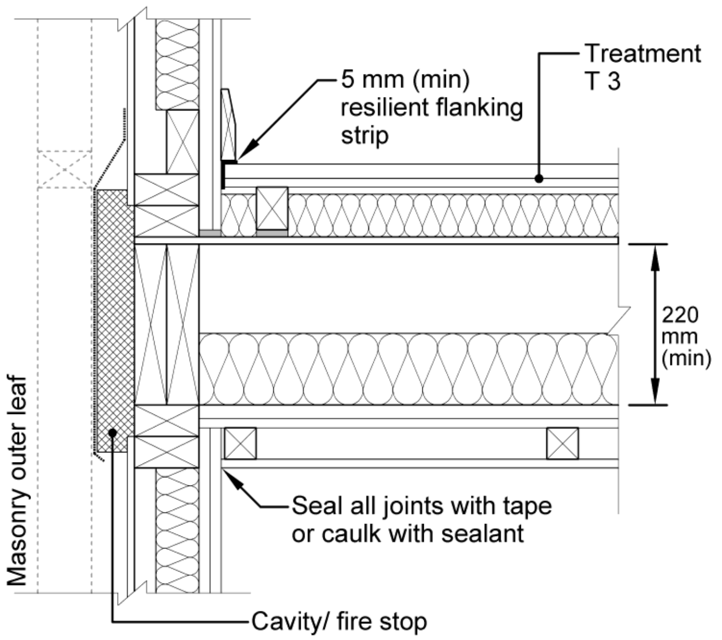
Separating Wall

- See Diagram 17B for separating wall specification.
- Close spaces between the floor joists with full depth timber blocking or continuous header joist where joists are at right angles to the wall.
- Close cavity with a fire stop.

Separating Floor

- As per note above on junction between FT 3 and WT 4A

Diagram 41 FT3 Timber base with ceiling and floating floor – Flanking requirements
(Par. 4.8.3)



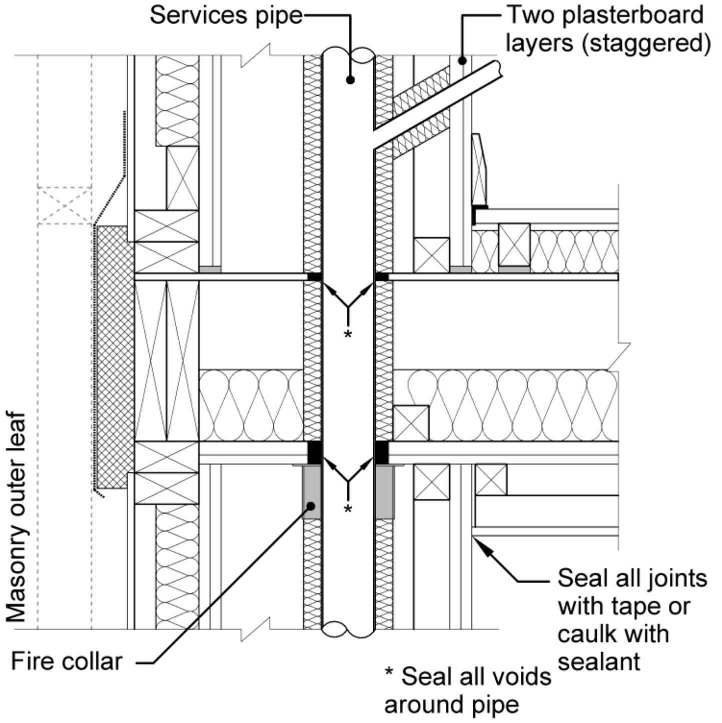
Section

A) External flanking wall

Key Points to Watch

Flanking Wall

- Ensure masonry outer leaf.
- External cavity width minimum 50 mm.
- Minimum 10 kg/m³ mineral wool insulation to be provided in flanking wall.
- Provide two layers of plasterboard (with joints staggered) on minimum density 10 kg/m² each layer.
- Close spaces between the floor joists with full depth timber blocking or continuous header joist where joists are at right angles to the wall.
- Close cavity with a fire stop.



Section

B) Services pipes through FT 3 (excluding gas pipes)*

Key Points to Watch

- Fully wrap service pipe over its full height and any branches in the duct with at least 25 mm unfaced mineral wool quilt.
- The pipe should be boxed in with two layers of plasterboard, each layer to have a minimum mass of 8 kg/m² (all joints staggered).
- Penetrations through a separating floor by ducts and pipes should have fire protection to satisfy Building Regulations Part B - Fire Safety.
- Fire stopping should be flexible and also prevent rigid contact between the pipe and floor.

Note:
*Where gas pipes are being ducted special requirements apply. All gas services should be installed in accordance with the relevant codes and standards to ensure safe and satisfactory operation.

Section 5
Reverberation control

5.1 Reverberation control

5.1.1 General

5.1.1.1 The purpose of the requirement of Regulation E2 is to protect residents from noise produced from reverberation in common internal areas outside the dwellings. This section provides guidance on how to limit the amount of reverberation around the common spaces to a level that is reasonable in order to demonstrate compliance with the requirement of Regulation E2.

5.1.2 Common spaces

5.1.2.1 The common parts of buildings tend to be constructed with hard durable surface finishes, which are easily maintained. Unfortunately, such surfaces lack the soft open texture which efficiently absorbs sound and so the level of reflected, or reverberated, sound tends to be high in such places and can lead to an unreasonable level of noise for occupants of dwellings which open directly onto these common spaces.

5.1.2.2 Whilst paragraph 3.2.4 outlines the inherent acoustic weak point in a separating wall caused by an entrance doors opening onto a common area of a building and addresses the acoustic performance of entrance doors, section 5 deals with ways of reducing the reverberation level at source.

5.1.2.3 It is relatively easy to increase sound absorption and hence reduce reverberant noise levels by surface treatment with absorbent material. In general this can be achieved through the application of absorbent treatment to common areas onto which dwellings open directly[3].

5.1.2.4 For the purposes of this section, a corridor or hallway is a space for which the ratio of the longest to the shortest floor dimension is greater than three.

5.1.2.5 For the purposes of this section, an entrance hall is a space for which the ratio of the longest to the shortest floor dimension is three or less.

5.1.2.6 Where an entrance hall, corridor, hallway or stairwell opens directly into another of these spaces, the guidance should be followed for each space individually.

5.1.2.7 Where separating walls, without doors or windows, are adjacent to common areas it would not normally be necessary to treat the common areas, assuming normal usage.

5.1.3 Choice of material

5.1.3.1 The choice of absorptive material should be of an appropriate class that has been rated according to I.S. EN ISO 11654:1997.and should meet the requirements of Part B – Fire Safety.

5.2 Methods of satisfying the requirement of Regulation E2

5.2.1 General

5.2.1.1 There are two methods (Method A or Method B) described below that will satisfy the requirement of Regulation E2.

5.2.1.2 Method A is intended for corridors, hallways and stairwells.

5.2.1.3 Method B is intended only for corridors, hallways and entrance halls as is not suited to stairwells.

5.2.2 Method A

5.2.2.1 For entrance halls, corridors or hallways the absorbent material should cover an area equal to or greater than the floor area, with a Class C absorber or better, rated according to I.S. EN ISO 11654:1997. It will normally be convenient to cover the ceiling area with the additional absorption.

5.2.2.2 For stairwells or a stair enclosure, calculate the combined area of the stair treads the upper surface of the intermediate landings, the upper surface of the landings

[3] The common area under consideration should be limited to the space contained by walls and doors (including fire doors) immediately outside the dwelling entrance.

(excluding the ground floor) and the ceiling area on the top floor. Either cover an area at least equal to this calculated area with a Class D absorber, or cover an area equal to at least 50% of this calculated area with a Class C absorber or better. The absorptive material should be equally distributed between all floor levels. It will normally be convenient to cover the underside of intermediate landings, the underside of the other landings, and the ceiling area on the top floor.

5.2.2.3 Method A can generally be satisfied by the use of proprietary acoustic ceilings. However, the absorptive material can be applied to any surface that faces into the space.

5.2.3 Method B

5.2.3.1 In comparison with Method A, this method takes into account the actual absorption power of the surfaces of the enclosure prior to the provision of additional absorbent material. This allows the amount of additional material which is required to be calculated and directed at the sound frequencies at which it is most needed.

5.2.3.2 In some cases Method B should allow greater flexibility in satisfying the requirement of Regulation E2 and require less additional absorption than Method A. The approach to be adopted for Method B is outlined by worked example in Appendix B.

5.3 Report Format

5.3.1 General

5.3.1.1 Evidence that the requirement of Regulation E2 has been satisfied should be retained in the form of a report or drawing which should include the following:

(a) a description of the enclosed space (entrance hall, corridor, stairwell etc.);

(b) the method used to satisfy the requirement of Regulation E2, i.e. Method A or Method B;

(c) the absorber class and the area to be covered;

(d) plans indicating the assignment of the absorptive material in the enclosed space.

Appendix A
Procedure for sound insulation testing and reporting

A.1 Introduction

This Appendix describes the sound insulation testing procedure, and provides guidance on sound insulation test reports.

Sound insulation testing should be carried out by a competent person, possessing sufficient training, experience and knowledge appropriate to the nature of the work he or she is required to perform and having particular regard to the size and complexity of such works.

A.2 Field measurement of sound insulation of separating walls and floors

The measurement instrumentation used should have a valid, traceable certificate of calibration, and should have been tested within the past two years.

Sound insulation testing must be carried out in accordance with the following documents:

I.S. EN ISO 140-4:1998;

I.S. EN ISO 140-7: 1998;

I.S. EN ISO 717-1: 2013;

I.S. EN ISO 717-2: 2013;

I.S. EN ISO 354: 2003.

When calculating sound insulation test results, no rounding should occur in any calculation until required by the relevant standards, the I.S. EN ISO series and the I.S. EN ISO 717 series.

A.2.1 Airborne sound insulation testing of a separating wall or floor

The airborne sound insulation testing of a separating wall or floor should be measured in accordance with I.S. EN 140-4:1998. All measurements and calculations should be carried out using one-third octave frequency bands. Performance should be rated in terms of the weighted standardized level difference, $D_{nT,w}$ in accordance with I.S. EN ISO 717-1.

A.2.2 Measurements using a single sound source

For each source position, the average sound pressure level in the source and receiving rooms is measured in one-third octave bands using either fixed microphone positions (and averaging these values on an energy basis) or a moving microphone.

For the source room measurements, the difference between the average sound pressure levels in the adjacent one-third octave bands should be no more than 6 dB. If this condition is not met, the source spectrum should be adjusted and the source room measurement repeated. If the condition is met, the average sound pressure level in the receiving room, and hence a level difference, should be determined.

It is essential that all measurements made in the source and receiving rooms to determine a level difference should be made without moving the sound source or changing the output level of the sound source, once its spectrum has been achieved.

The sound source should now be moved to the next position in the source room and the above procedure repeated to determine another level difference. At least two positions should be used for the source. The level difference obtained from each source should be arithmetically averaged to determine the level difference, D as defined in I.S. EN ISO 140-4:1998.

A.2.3 Measurements using multiple sound sources operating simultaneously

For multiple sound sources operating simultaneously, the average sound pressure level in the source and receiving rooms is measured in one-third octave bands using either fixed microphone positions (and averaging these values on an energy basis) or a moving microphone.

For the source room measurements, the difference between the average sound pressure levels in the adjacent one-third octave bands should be no more than 6dB. If this condition is not met, the source spectrum should be adjusted and the source room measurement repeated. If the condition is met, determine the average sound pressure level in the receiving room, and hence the level difference, D as defined in I.S. EN ISO 140-4:1998.

A.2.4 Impact sound transmission of a separating floor

The impact sound transmission of a separating floor should be measured in accordance with I.S. EN ISO 140-7:1998. All measurements and calculations should be carried out using one-third octave frequency bands. Performance should be rated in terms of the weighted standardised impact sound pressure level difference, $L'_{nT,w}$ in accordance with I.S. EN ISO 717-2.

A.2.5 Measurement of reverberation time

I.S. EN ISO 140-4:1998 and I.S. EN ISO 140-7:1998 refer to the I.S. EN ISO 354:2003 method for measuring reverberation time. However, for the approved procedure, the guidance in I.S. EN ISO 140-7:1998 relating to the source and microphone positions, and the number of decay measurements required, should be followed.

A.2.6 Room requirements

Test rooms should be restricted to living rooms and bedrooms where possible. Kitchens and dining rooms may be considered where this is not possible.

Test rooms should have volumes of at least $25m^3$. If this is not possible then the volumes of the rooms used for testing should be noted in the test report.

In apartment buildings, the dwellings chosen for test should be representative of the various dwelling layouts.

A.2.7 Tests between rooms

Tests should be conducted in completed but unfurnished rooms.

When tests are being carried out doors and windows should be closed; kitchen units, cupboards etc., on all walls should have their doors open and be unfilled.

When measuring airborne sound insulation between a pair of rooms of unequal volume, the sound source should be in the larger room.

For separating walls, two individual tests should be carried out on any one separating wall, providing there are two pairs of valid rooms either side of the wall (e.g. in a pair of dwelling houses with living room pairs on the ground floor and bedroom pairs on the first floor), two tests can be carried out, one at ground floor and one at first floor.

For separating floors, two individual tests may be carried out on any one separating floor, providing there are two pairs of valid rooms between the floor (e.g. in a pair of flats with living rooms stacked one directly above another and bedrooms stacked one directly above another) then two tests can be carried out, living room pairs and bedroom pairs.

For separating floors, the airborne and impact tests should be treated as a set and must be carried out on the same separating floor. Therefore, the minimum number of tests must include both an airborne sound insulation test and an impact sound transmission test (e.g. 2 airborne and 2 impact tests should be carried out to make up 2 test floor constructions).

Impact sound insulation tests should be conducted on a floor without a soft covering[4] e.g. carpet, foam backed vinyl. If a soft covering has been installed, it should be taken up. If that is not possible, at least half of the floor should be exposed and the tapping machine should be placed only on the exposed part of the floor.

[4] A bonded resilient layer is not a soft covering.

In Floor Type 1 the tapping machine should be placed on the fixed resilient layer.

A.2.8 Measurement precision

Sound pressure levels should be measured to 0.1 dB precision.

Reverberation times should be measured to 0.01s precision.

A.2.9 Measurements using a moving microphone

At least two positions relating to the sound source should be used.

For measurements of reverberation time, discrete positions should be used rather than a moving microphone.

A.3 Information for inclusion in test reports

The test report should contain at least the following information, in the order listed below:

(a) Address of building;

(b) Types(s) of property, i.e. dwelling house, apartment;

(c) Date(s) of testing;

(d) Organisation carrying out testing, including:

- (i) Name and address,
- (ii) Proof of competency,
- (iii) Name(s) of person(s) in charge of the test,
- (iv) Name(s) of client(s);

(e) A statement (preferably in a table) giving the following information:

- (i) Rooms used for each test within the 'set of tests',
- (ii) The measured single-number quantity ($D_{nT,w}$ for airborne sound insulation and $L'_{nT,w}$ for impact sound insulation) for each individual test within a 'set of tests',
- (iii) Description of separating walls, external walls, separating floors, and internal walls and floors including details of materials used in their construction and finishes. **Note:** Where certified constructions types (see paragraph 2.3) are employed the certificate number and issuing body should also be provided;
- (iv) The sound insulation values that should be achieved according to the values set out in Table 1.

(f) Brief details of test, including:

- (i) equipment used,
- (ii) a statement that the test procedures in Appendix A have been followed,
- (iii) results of tests shown in tabular and graphical form for third octave bands according to the relevant part of the I.S. EN ISO 140 series and I.S. EN ISO 717 series, including:
  - single number quantities and the spectrum adaptation terms, and
  - the D_{nT} and L'_{nT} data from which the single quantities are calculated.

Although not specifically required, it may be useful to have a description of the building including:

(i) sketches showing the layout and dimensions of the rooms tested;

(ii) mass per unit area in kg/m^2 of

separating walls and separating floors;

(iii) dimensions of any step or stagger between rooms tested;

(iv) dimensions and position of any windows or doors in external walls.

Appendix B
Assessed Sound Details

B.1 Introduction

This Appendix describes a method for assessing and certifying construction types which, if constructed correctly, should achieve the performance level set out in Table 1.

NOTE: It should be noted that all elements incorporated into the building works must comply with all parts of the Building Regulations and the following guidance assesses compliance with Part E only.

B.2 Description of construction type

The sound insulation between walls on either side of a sound resisting wall or floor depends not only on the wall or floor specification but also on other factors, including the size and shape of the rooms.

For buildings constructed in masonry, the positions of doors and windows may also be important in reducing flanking transmission.

A report should be prepared providing a detailed description of the construction type, in addition to:

- details of materials used in construction and finishes;
- mass per unit area in kg/m^2 of separating walls and separating floors;
- flanking construction details.

B.3 Target performance recommendations

The performance of any construction can ultimately be let down by poor workmanship on site. Whilst it is not essential to show compliance with the requirement of Part E, it is recommended that the target sound insulation performance level of assessed construction should have a mean value of 4 dB better than the minimum values set out in Table 1.

B.4 Test sampling requirements

In order to gain a more representative sample of what sound insulation performance and repeatability might be typical of any given construction type in practice, test data should be obtained from a range of testers and sites. Table B.2 outlines the test sampling requirements.

Table B.2 Test sampling requirements[1]

Min no. of individual tests[2]	Min number of Sites	Max number of tests per site	Min number of test bodies
30	2	16	2

NOTES:

1. Test constructions must be carried out on new dwellings on actual building sites (i.e. not laboratory testing).
2. Tests should be carried out in accordance with the procedure for sound insulation testing outlined in Appendix A of this document.
3. The flanking construction details must be the same for all tests conducted.
4. For separating floors, the airborne and impact tests should be treated as a set and must be carried out on the same separating floor. Therefore, the minimum number of tests must include both an airborne sound insulation test and an impact sound transmission test (e.g. 8 airborne and 8 impact tests should be carried out to make up 8 test floor constructions).

B.5 Competency of tester

For the purposes of this Appendix, sound insulation tests referred to in B.4 must be carried out by a competent person, possessing sufficient training, experience and knowledge of construction technology and the measurement of sound insulation in buildings to ISO EN 140 series and should be independent of the promoter of the system, e.g. builder/ manufacturer.

B.6 Use of historic test data

Historic sound insulation test data may be used (in part or in full) to satisfy the requirements of B.4 provided that the test data:

(a) is relevant to the same construction type and has the same flanking details;

(b) meets the performance levels outlined in Table 1;

(c) fulfils the sampling requirements outlined in Table B.2, and

(d) has been established in accordance with the procedure for sound insulation testing outlined in Appendix A.

B.7 Assessment and Certification

The report referred to in B.2 and the test results in accordance with B.4, 5 and 6 meeting target recommendations in B.3 should be assessed by an independent approved body[5] e.g. the National Standards Authority of Ireland (NSAI) and certified accordingly as meeting the criteria of this Appendix or otherwise.

[5] Accreditation of an approved body, by a member of the European cooperation for Accreditation (EA) such as the Irish National Accreditation Board (INAB) also offers a way of ensuring that such certification can be relied on.

Appendix C
Reverberation control - Method B calculation

C.1 Introduction

Method B takes into account the actual absorption power of the surfaces of the enclosure prior to the provision of additional absorbent material. This allows the amount of additional material which is required to be calculated and directed at the sound frequencies at which it is most needed. In some cases Method B should allow greater flexibility in meeting the requirement of Regulation E2 and require less additional absorption than Method A.

This Appendix demonstrates by means of a worked example the differences between Method A and B.

C.2 Technical

C.2.1 For an absorptive material of surface area S in m^2, and sound absorption coefficient α, the absorption area A is equal to the product of S and α.

C.2.2 The total absorption area A_T in square metres is defined as the hypothetical area of a totally absorbing surface, which if it were the only absorbing element in the space would give the same reverberation time as the space under consideration.

C.2.3 For *n* surfaces in a space, the total absorption area A_T, can be found using the following equation.

$$A_T = \alpha S_1 + \alpha S_2 + \ldots\ldots. \alpha_n S_n$$

C.3 Provision of absorptive material

C.3.1 For entrance halls, provide a minimum of **0.2 m^2** total absorption area per cubic metre of the volume. The additional absorptive material should be distributed over the available surfaces.

C.3.2 For corridors and hallways, provide a minimum of **0.25 m^2** total absorption area per cubic metre of the volume. The additional absorptive material should be distributed over one or more of the available surfaces.

C.4 Method B calculation

C.4.1 Absorption areas should be calculated for each octave band. The requirement of Part E2 will be satisfied when the appropriate amount of absorption area is provided for each octave band between 250 Hz and 4000 Hz inclusively.

C.4.2 Absorption coefficient data (to two decimal places) should be taken from the following:

- For specific products, use laboratory measurements of the absorption coefficient data using I.S. EN 354:2003 Acoustics. Measurement of sound absorption in a reverberation room. The measured third octave band data should be converted into practical sound absorption coefficient data α_p in octave bands, according to I.S. EN 11654:1997;

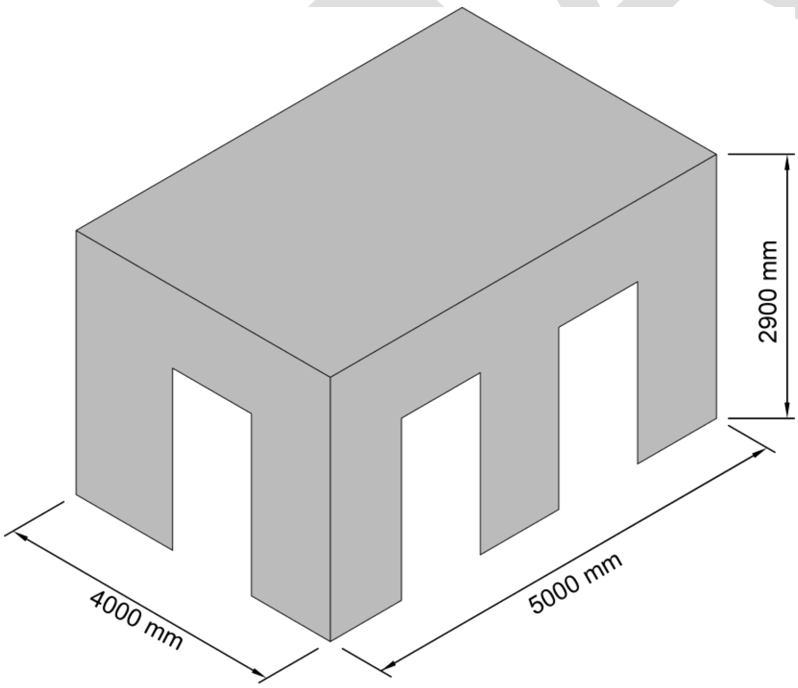
- For generic materials use Table C.1. This contains typical absorption coefficient data for the common materials used in buildings. This data may be supplemented by published octave band data for other generic materials.

Table C.1	**Absorption coefficient data for common materials in buildings** *(Par. C.4.2)*				
Material	**Sound absorption coefficient, α in octave frequency bands (Hz)**				
	250	**500**	**1000**	**2000**	**4000**
Fair-faced concrete or plastered masonry	0.01	0.01	0.02	0.02	0.03
Fair-faced brick	0.02	0.03	0.04	0.05	0.07
Painted concrete block	0.05	0.06	0.07	0.09	0.08
Windows, glass façade	0.08	0.05	0.04	0.03	0.02
Doors (timber)	0.10	0.08	0.08	0.08	0.08
Glazed tile / marble	0.01	0.01	0.01	0.02	0.02
Hard floor coverings (e.g. lino, parquet) on concrete floor	0.03	0.04	0.05	0.05	0.06
Soft floor coverings (e.g. carpet) on concrete floor	0.03	0.06	0.15	0.30	0.40
Suspended plaster or plasterboard ceiling with large air space behind	0.15	0.10	0.05	0.05	0.05

C.5 Worked Example

C.5.1 The following section describes the application of Method A and B to an entrance hall of a building (refer to Diagram C.1). Each calculation step is to be rounded to two decimal places.

Diagram C.1 Worked example
(Par. C.5.1)



Criteria:

- Concrete floor covered with carpet;
- Painted concrete block walls;
- 3 No. timber doors (1.0 m x 2.4 m).

Note: All dimensions are internal dimensions.

C.5.2 Application of Method A

In accordance with Method A (see paragraph 5.5.2) for entrance halls, the absorbent material should cover an area equal to or greater than the floor area, with a Class C absorber or better, rated according to I.S. EN ISO 11654:1997.

Therefore, cover at least 12 m^2 (i.e. 4.0 x 5.0) with a Class C absorber or better.

C.5.3 Application of Method B

Provide a minimum of 0.2 m^2 absorption area per cubic metre of the volume.

Calculation to Method B is described in steps 1 to 8 of Table C.2. In this example, the designer considers that covering the entire ceiling is a convenient way to provide absorption. The aim of the calculation is to determine the absorption coefficient $\alpha_{ceiling}$ needed for the entire ceiling.

In this example, the absorption coefficients from Method B indicate that a Class D absorber could be used to cover the entire ceiling. This can be compared against the slightly higher absorption requirement of Method A, which would have used a Class C absorber or better to cover the ceiling

Table C.2 Example calculation using Method B
(Par. C.5.2)

Step 1 Calculate the surface area related to each absorptive material (i.e. for the floor, walls, doors & ceiling).

Surface	Surface finish	Area (m^2)
Floor	Carpet covered	20
Doors	Timber	7.2
Walls (excluding door area)	Painted concrete block	45
Ceiling	***To be determined from the calculation***	20

Step 2 Obtain the absorption coefficient for the carpet, painted concrete block walls and the timber doors. In this case the values are taken from Table C.1

Surface	Area (m^2)	Absorption coefficient (α) in octave frequency bands				
		250 Hz	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Floor	20	0.03	0.06	0.15	0.30	0.40
Doors	7.2	0.10	0.08	0.08	0.08	0.08
Walls	45	0.05	0.06	0.07	0.09	0.08
Ceiling	20	**To be determined from this calculation**				

Step 3 Calculate the absorption area (m^2) related to each absorptive surface (i.e. for the floor, walls and doors) in octave frequency bands.
(Absorption area = surface area x absorption coefficient).

Surface	Area (m^2)	Absorption area (m^2)				
		250 Hz	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Floor	20	0.6 *(20x0.03)*	1.2	3.0	6.0	8.0
Doors	7.2	0.72 *(7.2x0.10)*	0.58	0.58	0.58	0.58
Walls	45	2.25 *(45x0.05)*	2.7	3.15	4.05	3.60

Step 4 Calculate the sum of the absorption area (m^2) obtained in Step 3.

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Existing absorption area (m^2)	3.57 *(0.6+0.72+2.25)*	4.48	6.73	10.63	12.18

Step 5 Calculate the total absorption area (A_T) required for the entrance hall.
(See C.3.1; Provide a minimum of 0.2 m^2 absorption area per cubic metre of the volume).

Therefore: A_T = **0.2** x 5 x 4 x 2.9 = **11.60 m^2** of absorption area required.

Step 6 Calculate the total absorption area (A) to be provided by ceiling (m^2). If any values of minimum absorption area are negative e.g. 4000 Hz, then, there is sufficient absorption from the existing surfaces to meet the requirement without any additional absorption in this octave band.
(Additional absorption = A_T – existing absorption area (from Step 5)).
N.B. negative values indicate that no additional absorption is necessary.

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Additional absorption area (m^2)	8.03 *(11.6 - 3.57)*	7.12	4.87	0.97	-0.58

Step 7 Calculate the required absorption coefficient α to be provided by ceiling. (Required absorption coefficient α = Additional absorption area/ area of ceiling).

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Required absorption coefficient α	0.40 *(8.03 ÷ 20)*	0.36	0.24	0.05	Any Value

Step 8 Identify a ceiling product from the manufacturer's laboratory measurement data that provides absorption coefficients that exceed the values in Step 7.

Referenced standards and publications

Standards referred to:

I.S. EN ISO 140-4:1999 Acoustics - Measurement of sound insulation in building elements - Field measurements of airborne sound insulation between rooms.

I.S. EN ISO 140-7:1999 Acoustics. Measurement of sound insulation in building elements. Field measurements of impact sound insulation of floors.

I.S. EN ISO 354:2003 Acoustics - Measurement of sound absorption in a reverberation room.

I.S. EN ISO 717-1: 2013 Acoustics. Rating of sound insulation in buildings and of building elements. Airborne sound insulation.

I.S. EN ISO 717-2: 2013 Acoustics. Rating of sound insulation in buildings and of building elements. Impact sound insulation.

I.S. EN ISO 10140:2010 Acoustics - Laboratory measurement of sound insulation of building elements (Part 1 to 5).

I.S. EN ISO 11654:1997 Acoustics - Sound absorbers for use in buildings - Rating of sound absorption.

I.S. EN ISO 24340:2012 Resilient Floor Coverings - Determination of the Thickness of Layers.

BS 8233: 1999 Sound insulation and noise reduction for buildings. Code of practice.

BRE Report 238 Sound control for homes 1993.

BRE Information Paper IP 9/88 Methods for reducing impact sounds in buildings.

Further Information

Legislation

Building Regulations (1997-2013).

Safety, Health and Welfare at Work (General application) Regulations 2007 (S.I. No. 299 of 2007).

General Acoustics

BRE Information Paper IP 9/88 Methods for reducing impact sounds in buildings.