SOUND INSULATION TESTING IN DWELLINGS

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This Presentation

- Discusses the standards by which we judge sound insulation performance.
- Presents the results of sound insulation tests performed over the last three years.
- Comments on the sound insulation performance and particular characteristics of a variety of constructions.
- Offers guidance in relation to appropriate remedial measures.

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Building Regulations Requirements

From Part E of the Second Schedule to the Building Regulations (1997):

"A wall which separates a dwelling from another dwelling … shall have reasonable resistance to airborne sound."

"A floor which separates a dwelling from another dwelling … shall have reasonable resistance to airborne sound."

"A floor above a dwelling which separates it from another dwelling … shall have reasonable resistance to impact sound."

Note that there is no absolute numerical requirement.

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Technical Guidance Document Part E - Sound

In the absence of an absolute numerical requirement in the Regulations themselves, sound insulation is typically assessed through reference to Part E Section 4 – Similar Construction.

"This Section describes methods by which a wall or floor, identical or similar to an existing construction, may satisfy the requirements in respect of airborne or impact sound resistance."

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Similar Construction Test Method

The results of sound insulation tests on an existing construction are compared with guideline values as follows:

Type of performance	Individual values	Mean values: Test in at least four pairs of rooms	Mean values: Test in at least eight pairs of rooms
Airborne sound (minimum values)*	49 (walls) 48 (floors)	53 (walls) 52 (floors)	52 (walls) 51 (floors)
Impact sound (maximum values)**	65	61	62

Notes:

* Airborne sound – Weighted Standardized Level Difference ($D_{nT,w}$)

** Impact sound – Weighted Standardized Sound Pressure Level ($L'_{nT,w}$)

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Limits on the use of test evidence

This method contains an important caveat.

"The values … are provided to enable an existing construction to be assessed before similar new construction is undertaken. A failure of new construction to achieve the values … is not in itself evidence of a failure to comply with the requirements of the Regulations."

In other words, even if a construction fails to achieve the guideline values, it could be argued that it offers *"reasonable resistance"* to airborne or impact sound.

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Sound Insulation Testing in Ireland

Average results from 359 airborne and impact sound insulation tests.

AIRBORNE SOUND INSULATION OF PARTY WALLS	
Plasterboard on dabs on dense concrete block	52.7dB $D_{nT,w}$
Plasterboard on metal channel on dense concrete block	53.9dB $D_{nT,w}$
Dense concrete block with thick render or plaster coat	55.1dB $D_{nT,w}$
Cavity blockwork (100/50/100)	58.5dB $D_{nT,w}$
Plasterboard on steel frame	61.5dB $D_{nT,w}$
Plasterboard on timber frame	61.7dB $D_{nT,w}$

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Sound Insulation Testing in Ireland

AIRBORNE SOUND INSULATION OF PARTY FLOORS	
Timber floor (i.e. floor type 3 as per Document E)	53.5dB $D_{nT,w}$
Concrete floor (i.e. floor type 1 or 2 as per Document E)	57.4dB $D_{nT,w}$
IMPACT SOUND INSULATION OF PARTY FLOORS	
Timber floor without resilient/floating layer	67.9dB $L'_{nT,w}$
Timber floor with resilient/floating layer	45.5dB $L'_{nT,w}$
Concrete floor with soft covering or floating layer	43.0dB $L'_{nT,w}$

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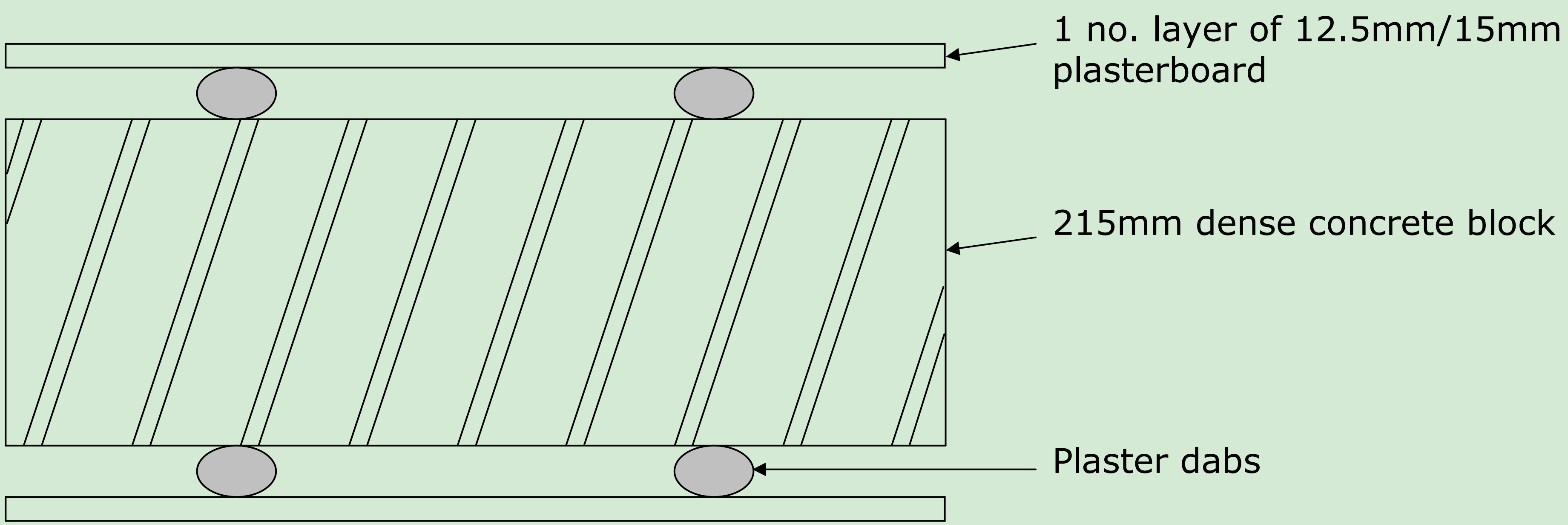
Plasterboard on Dabs



Typical arrangement of plasterboard on dabs

Plasterboard on Dabs

- Average airborne sound insulation performance 52.7dB $D_{nT,w}$
- 46% of the constructions tested gave results <53dB $D_{nT,w}$
- 32% of the constructions tested gave results <52dB $D_{nT,w}$
- 6% of the constructions tested gave results <49dB $D_{nT,w}$
- The vast majority of the examples tested exhibited a pronounced dip in sound insulation performance in the mid to high frequency region.
- The measured values ranged from 46 to 58dB $D_{nT,w}$.
- Fitted wardrobes can have a significant effect; the mean value in this instance is 57dB $D_{nT,w}$.

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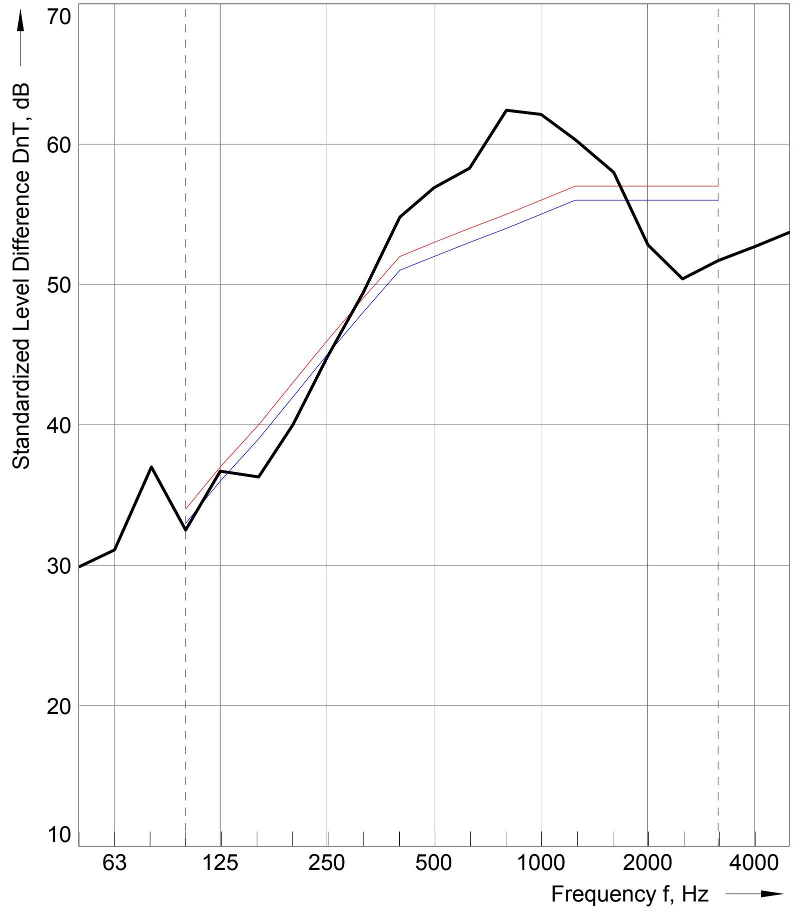
Plasterboard on Dabs

Frequency f Hz	DnT 1/3 Octave dB
50	29.9
63	31.1
80	37.0
100	32.5
125	36.7
160	36.3
200	40.0
250	44.8
315	49.4
400	54.8
500	56.9
630	58.3
800	62.4
1000	62.1
1250	60.3
1600	58.0
2000	52.8
2500	50.4
3150	51.7
4000	52.7
5000	53.7



Typical sound insulation spectrum

Single figure index: 53dB $D_{nT,w}$

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Plasterboard on Dabs

- In subjective terms, noise transfer across these constructions is often poor, even when the overall performance is equal to or greater than 52dB $D_{nT,w}$.
- This is a function of the “dip”.
- Conversation, televisions, alarm clocks etc. can be clearly audible.
- In the very worst instances, e.g. when conversation is not only audible but intelligible, it is clear that the construction fails to offer reasonable resistance to airborne sound even though the measured results achieve the guideline values as set down in the Similar Construction test method.

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Alternative Plasterboard Fixing Methods

- One alternative fixing method we have tested recently employs a metal “U” channel which is restrained to the wall using metal straps.
- Plasterboard is attached to the “U” channel and the metal strap is adjustable to give cavity depths of 30mm to 100mm.
- Sound insulation performance in excess of 60dB $D_{nT,w}$ has been measured with this system.

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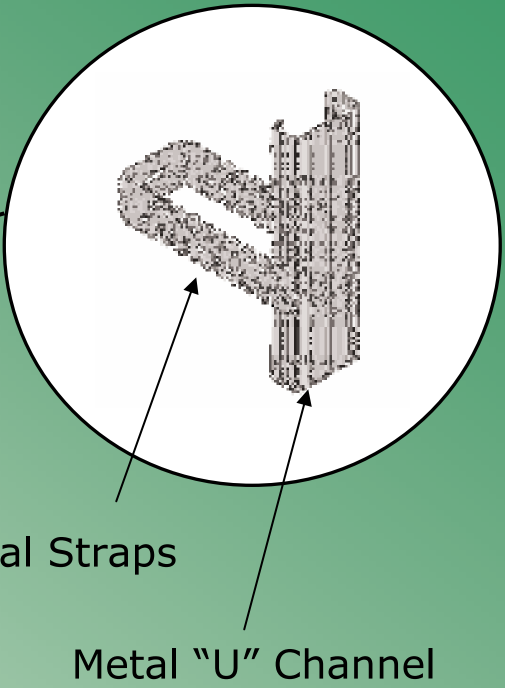
Alternative Plasterboard Fixing Methods



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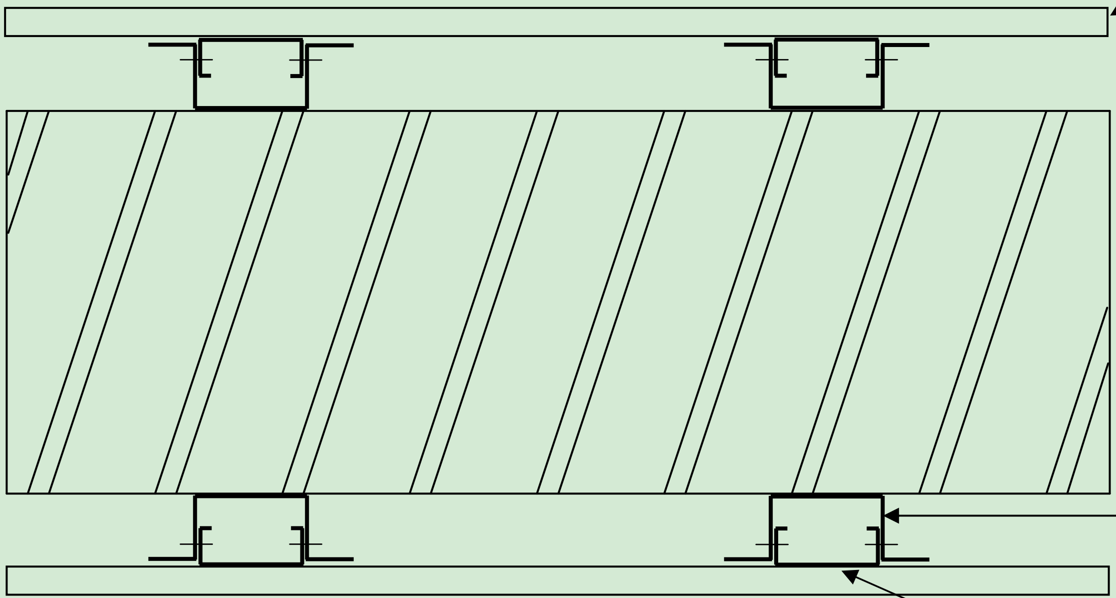
Alternative Plasterboard Fixing Methods



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Compare with Plasterboard on Dabs

Frequency f Hz	DnT 1/3 Octave dB
50	23.0
63	22.2
80	30.5
100	33.3
125	36.8
160	44.6
200	49.4
250	50.9
315	53.4
400	58.5
500	62.6
630	64.1
800	64.8
1000	64.7
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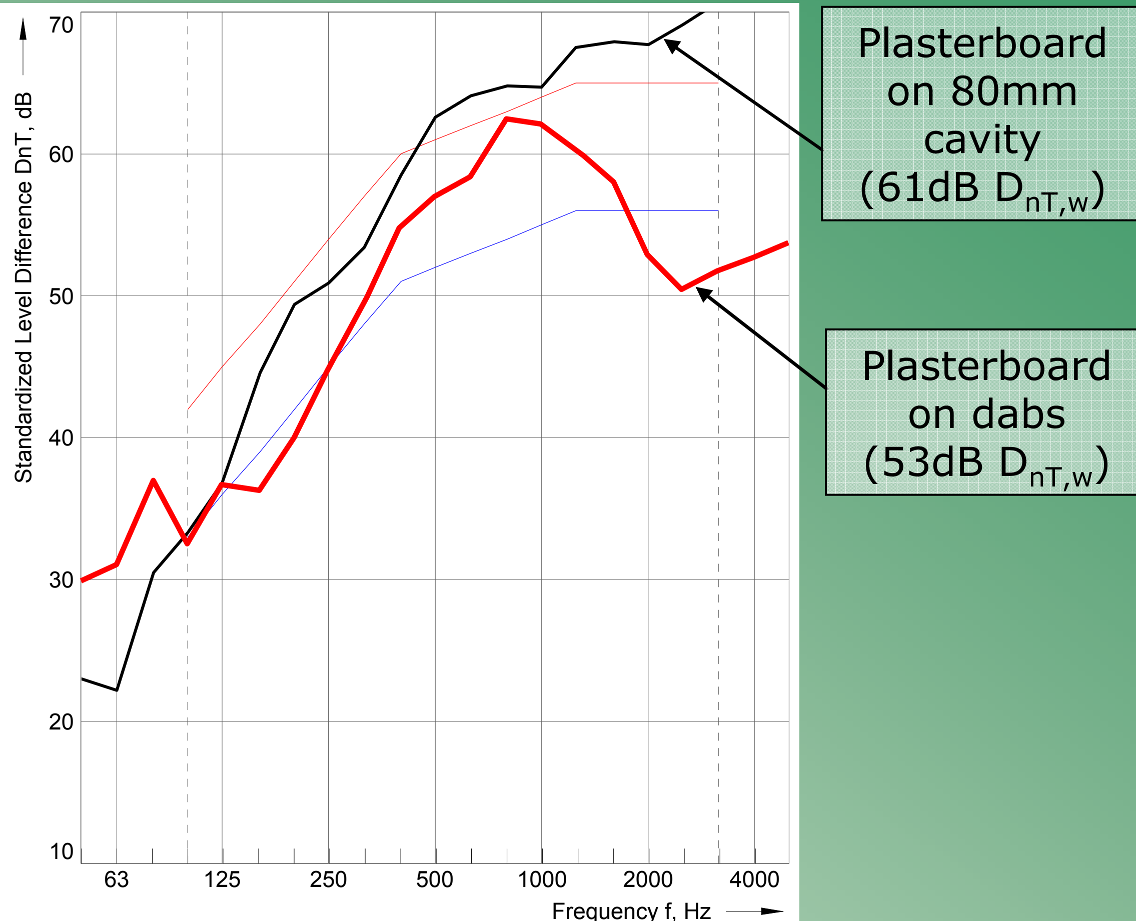
1600	67.9
2000	67.7
2500	69.1
3150	70.7
4000	72.0
5000	75.0



Typical sound insulation spectrum

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Alternative Plasterboard Fixing Methods

- Installing plasterboard using alternative fixing methods can offer significant improvements.
- When compared to plasterboard on dabs, it reduces/eliminates the mid to high frequency “dip”.
- The results presented here represent the upper end of what is achievable.
- We have also observed a reduction in the mid to high frequency “dip” when standard metal “top-hat” sections are used to attach the plasterboard.
- This type of construction also provides good good structure-borne isolation, i.e. “clicking” light switches and sockets.
- The **low-frequency** performance of the wall can be reduced.

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Alternative Plasterboard Fixing Methods

Summary:

- Attaching plasterboard to concrete block walls using dabs, typically results in a "dip" in sound insulation at **mid to high frequencies**.
- Attaching plasterboard to concrete block walls using metal channels offers better overall performance but can result in a "dip" in sound insulation at **low-frequencies** (this effect can minimised by large cavity depths).
- Using a traditional render finish does not result in either of the two negative effects noted above.

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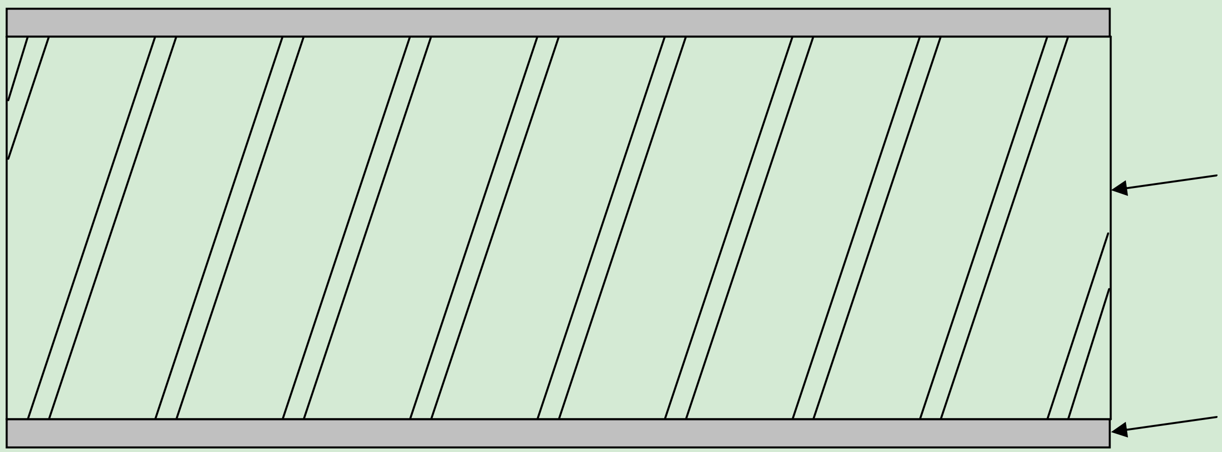
Dense Concrete Block with 12 to 18mm Rendered Finish



Typical arrangement of rendered concrete block

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Dense Concrete Block (Rendered)

- Average airborne sound insulation performance 55.1dB $D_{nT,w}$
- 2.1% of the constructions tested gave results <53dB $D_{nT,w}$
- 1.8% of the constructions tested gave results <52dB $D_{nT,w}$
- 1.1% of the constructions tested gave results <49dB $D_{nT,w}$ (the cause was flanking noise transfer in every instance)
- A typical sound insulation spectrum exhibits an upward trend from low to high frequency, with nothing significant by way of “dips”.
- The measured values ranged from 51 to 62dB $D_{nT,w}$ (excluding results significantly affected by flanking transmission).

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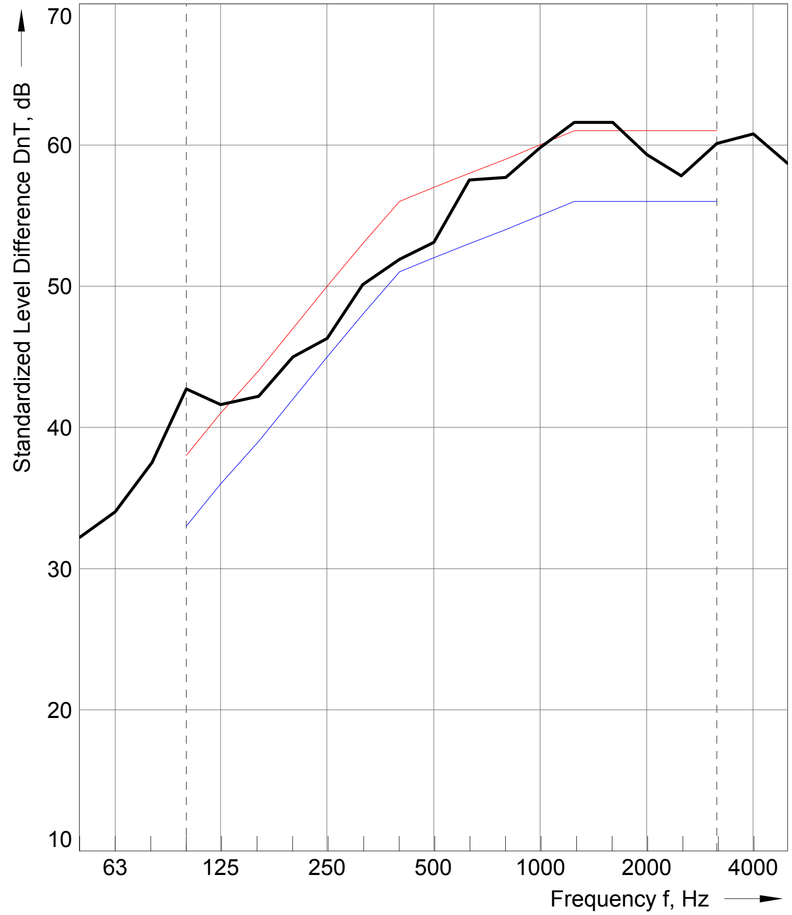
Dense Concrete Block (Rendered)

Frequency f Hz	DnT 1/3 Octave dB
50	32.2
63	34.0
80	37.5
100	42.7
125	41.6
160	42.2
200	45.0
250	46.3
315	50.1
400	51.9
500	53.1
630	57.5
800	57.7
1000	59.8
1250	61.6
1600	61.6
2000	59.3
2500	57.8
3150	60.1
4000	60.8
5000	58.7



Typical sound insulation spectrum

Single figure index: 57dB $D_{nT,w}$

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Dense Concrete Block (Rendered)

- Performance is consistent and less prone to shortfalls as a result of poor workmanship.
- In subjective terms, noise transfer is rarely perceived to be excessive.
- The construction comprises only a single leaf. When there are plug sockets or light switches in the party wall, there is potential for associated noise to be clearly audible on the other side of the wall.

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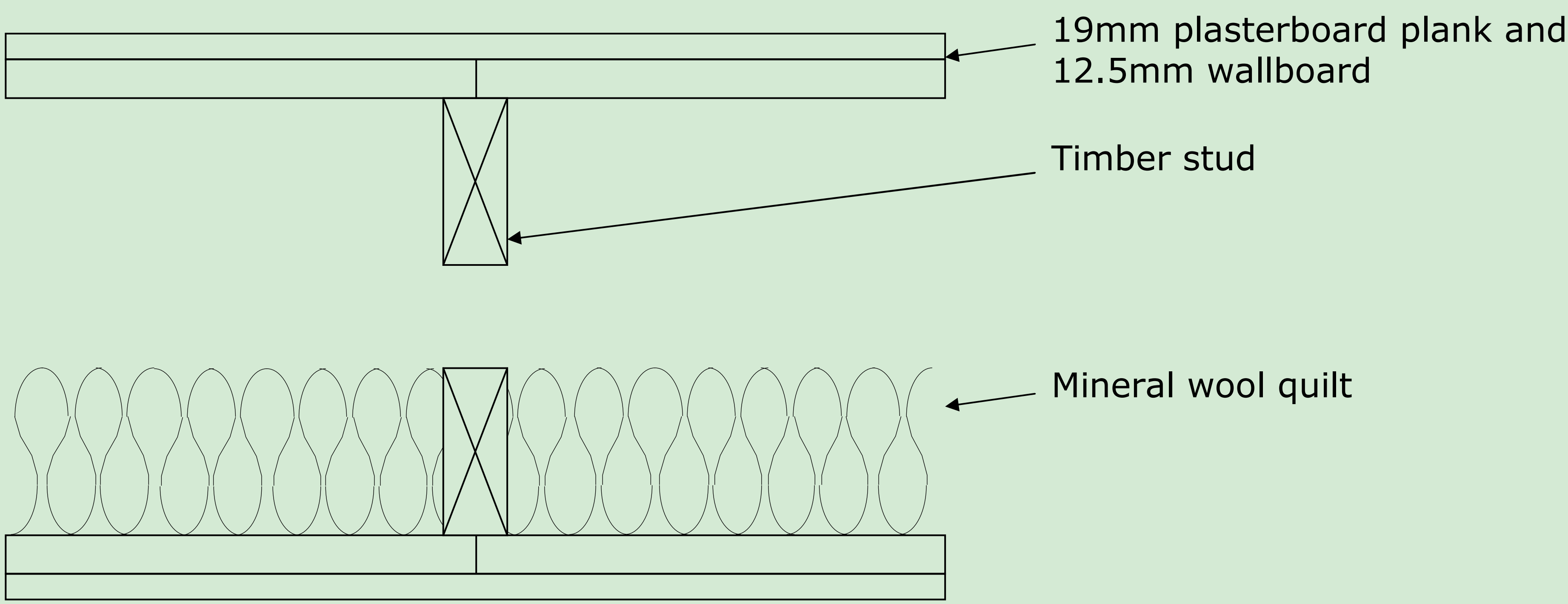
Timber Frame



Typical arrangement of timber frame

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Timber Frame

- Average airborne sound insulation performance 61.7dB $D_{nT,w}$
- None of the constructions tested gave results <53dB $D_{nT,w}$
- A typical sound insulation spectrum exhibits an upward trend from low to high frequency, with nothing significant by way of “dips”.
- The measured values ranged from 56 to 69dB $D_{nT,w}$.

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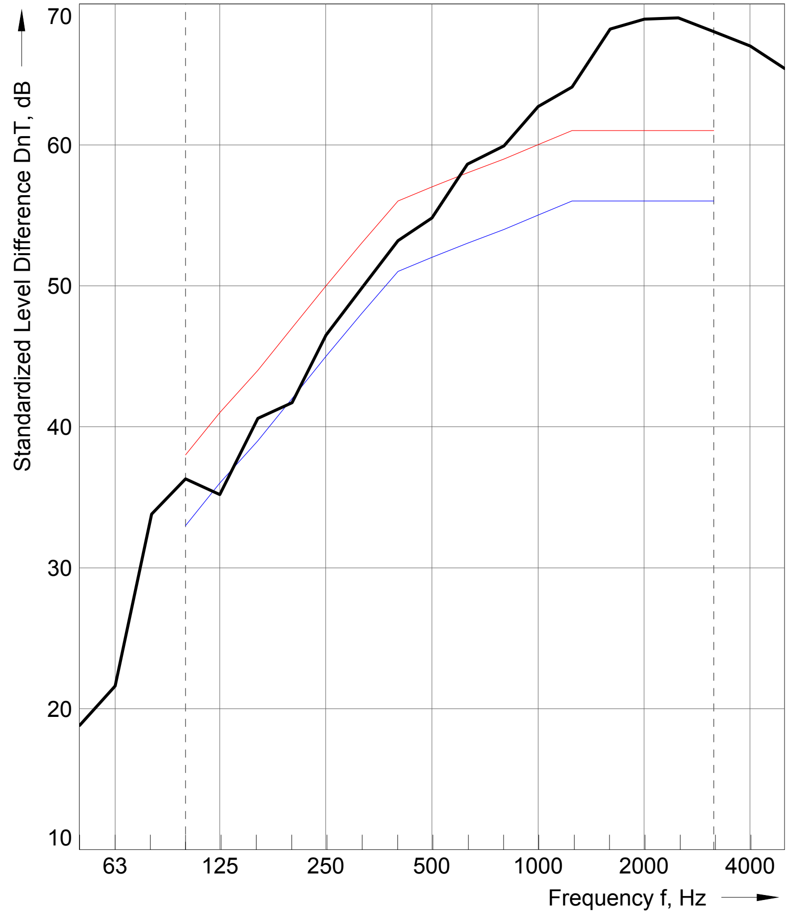
Timber Frame

Frequency f Hz	DnT 1/3 Octave dB
50	18.8
63	21.6
80	33.8
100	36.3
125	35.2
160	40.6
200	41.7
250	46.5
315	49.8
400	53.2
500	54.8
630	58.6
800	59.9
1000	62.7
1250	64.1
1600	68.2
2000	68.9
2500	69.0
3150	68.0
4000	67.0
5000	65.4



Typical sound insulation spectrum

Single figure index: 57dB $D_{nT,w}$

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Timber Frame

- Performance is consistent and is not prone to shortfalls as a result of poor workmanship.
- In subjective terms, noise transfer is rarely perceived to be excessive.
- The construction comprises two leaves of plasterboard on timber studs that are nominally independent of one another. Hence there is little transfer of noise from the use of plug sockets or light switches in the party wall. However, careful consideration must be given to the potential for airborne noise transfer via such fittings.

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Timber Frame

- Where possible, electrical sockets should not be located on party walls. If this is unavoidable, they should be offset such that they are not back-to-back and should be “boxed-in” at the rear with plasterboard.
- Water and waste pipes should not be located within the party wall cavity; these should be located within the demise of the dwelling they serve (i.e. using suitable risers).

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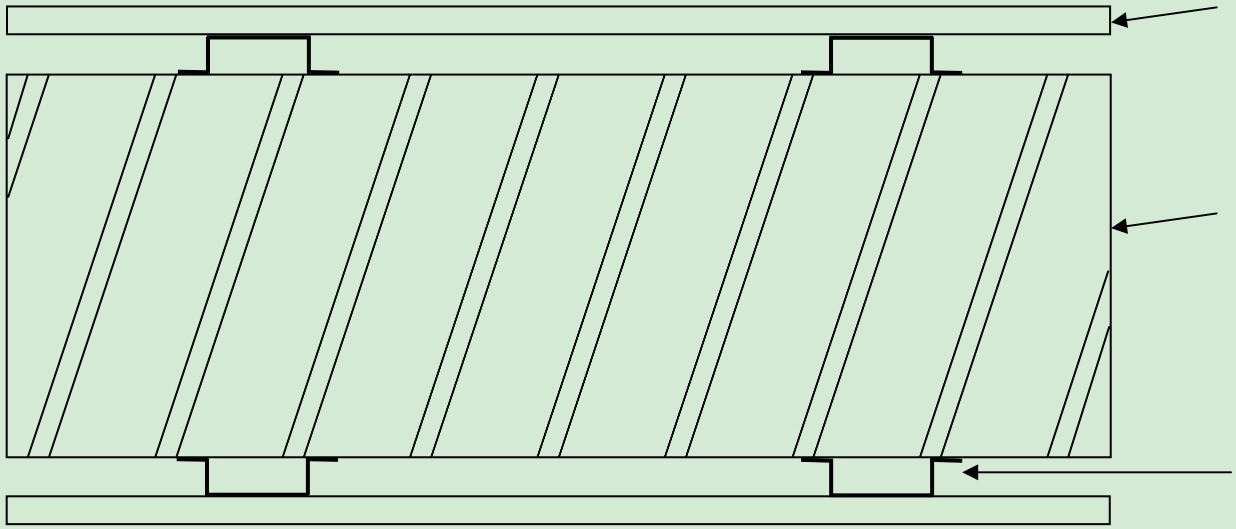
Lightweight Block



Typical arrangement of lightweight aerated concrete block

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Lightweight Block

- We have seen a reduction in the use of lightweight aerated concrete block in party walls over the last 2 years.
- Standard party wall construction is 1 layer plasterboard each side of the lightweight block fixed using either metal channels or dabs.
- Measured sound insulation for this construction is typically in the range 48 to 50dB $D_{nT,w}$.

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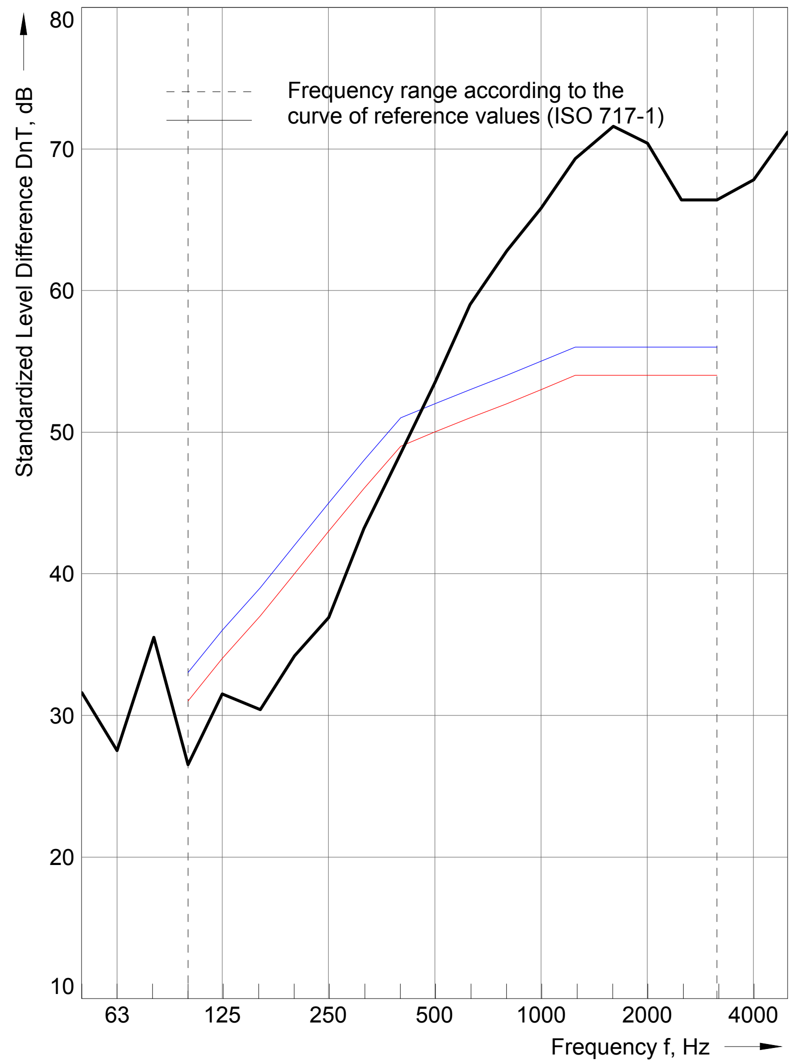
Lightweight Block with 1 Layer Plasterboard

Frequency f Hz	DnT 1/3 Octave dB
50	31.6
63	27.5
80	35.5
100	26.5
125	31.5
160	30.4
200	34.2
250	36.9
315	43.2
400	48.5
500	53.5
630	59.0
800	62.8
1000	65.8
1250	69.3
1600	71.6
2000	70.4
2500	66.4
3150	66.4
4000	67.8
5000	71.2



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Single figure index: 50dB $D_{nT,w}$

Improving the Sound Insulation Performance of Lightweight Block

- The density of **lightweight** concrete block is **~650kg/m^3**.
- This density of **standard** concrete block is **~1850kg/m^3**.
- This is one of the factors for the relatively poor mid to low frequency performance apparent in the sound insulation performance of lightweight block.
- Upgrading the construction by installing 2 layers of plasterboard can result in significant increases in the measured sound insulation performance.
- Tests have indicated that increases of up to 7dB are possible.

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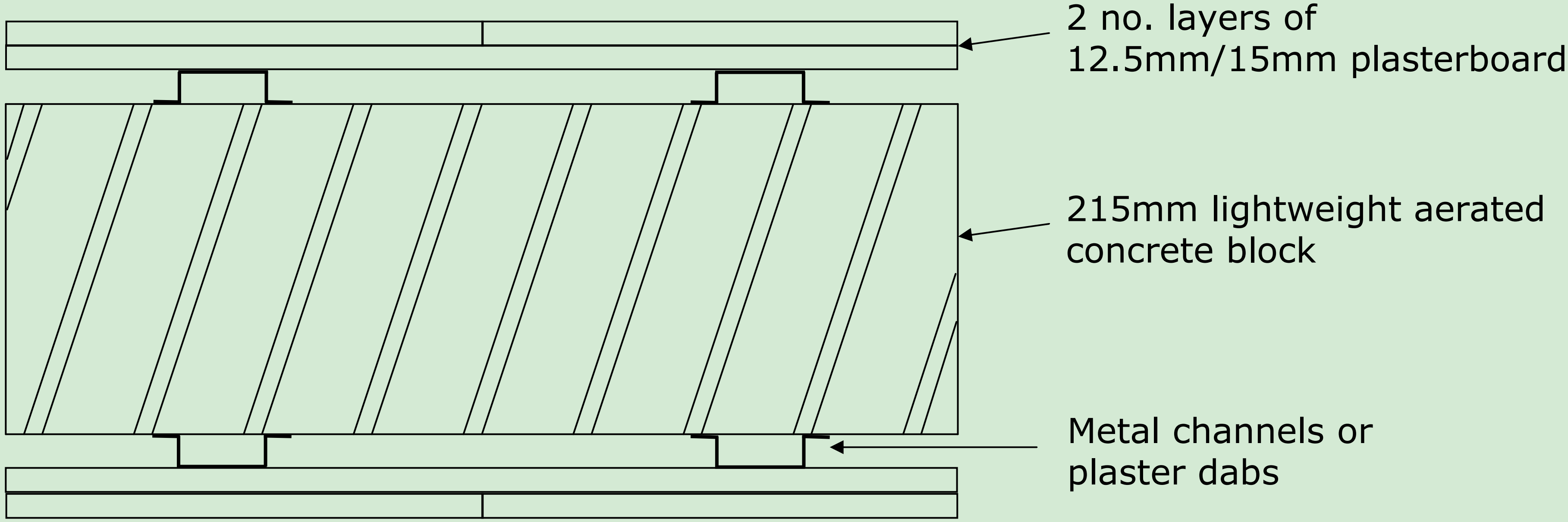
Lightweight Block



Typical arrangement of lightweight aerated concrete block with enhanced lining

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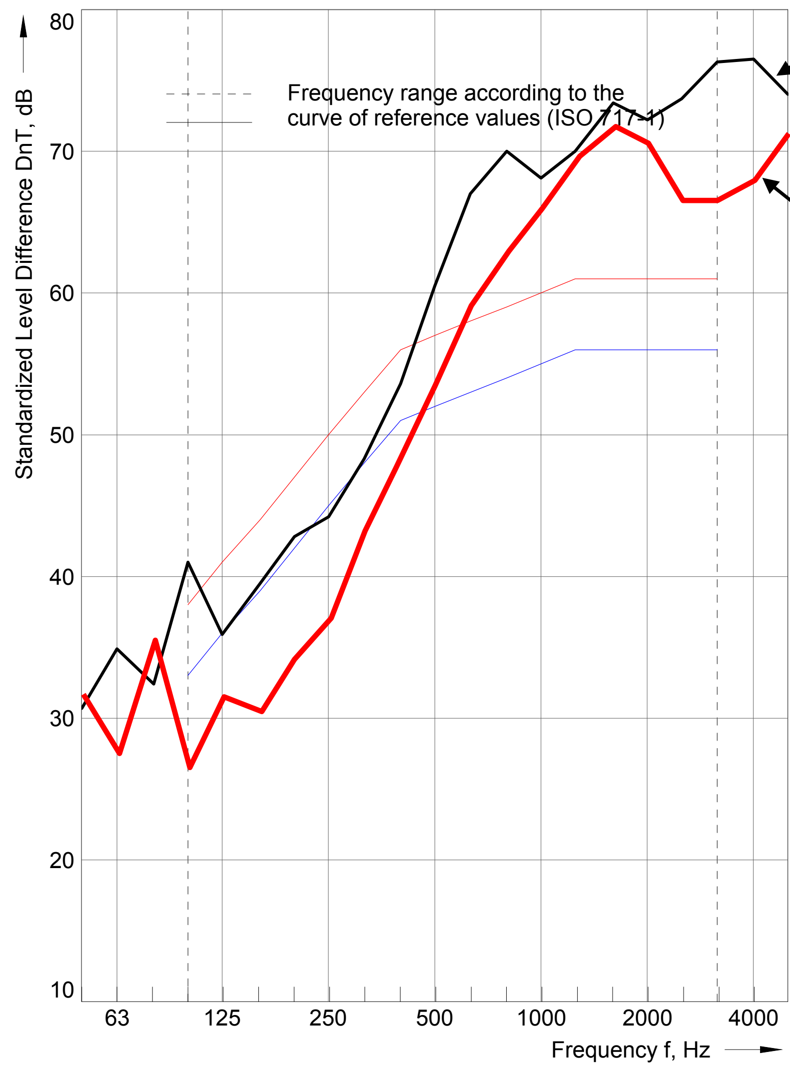
Compare 1 and 2 Layers Plasterboard

Frequency f Hz	DnT 1/3 Octave dB
50	30.7
63	34.9
80	32.4
100	41.0
125	35.9
160	39.5
200	42.8
250	44.2
315	48.3
400	53.6
500	60.5
630	67.0
800	70.0
1000	68.1
1250	70.0
1600	73.4
2000	72.2
2500	73.7
3150	76.3
4000	76.5
5000	74.0



2 layers plasterboard ($57dB\ D_{nT,w}$)

1 layer plasterboard ($50dB\ D_{nT,w}$)

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Typical sound insulation spectrum

Remedial Measures in Occupied Dwellings

- The alternative wall constructions discussed so far require works to be undertaken on **both sides** of the party wall.
- This invariably results in significant nuisance for dwelling occupants on both sides of the party wall.
- It also increases the costs (i.e. plasterer, painter, carpenter, and electrician required to work on both sides of the wall).
- It is possible to carry out works to only **one side** of the wall and still achieve improvements in the sound insulation performance of up to 10dB.

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Remedial Measures in Occupied Dwellings

- Suitable wall linings to be applied to one side of the wall must offer both **mass** and **isolation**.

- **Mass** is provided by using two layers of 15mm plasterboard.

- **Isolation** is provided by installing the plasterboard on an independent stud system or proprietary isolating “battens”.

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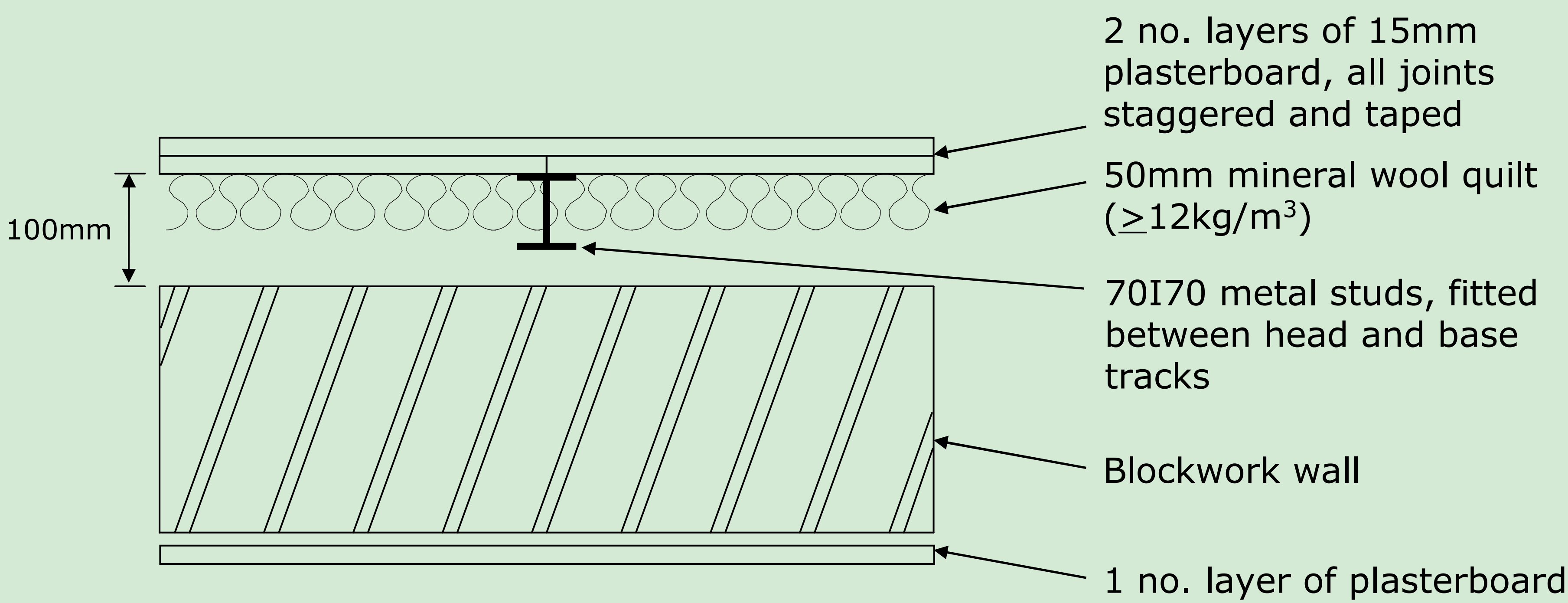
Remedial Measures in Occupied Dwellings



Independent wall lining

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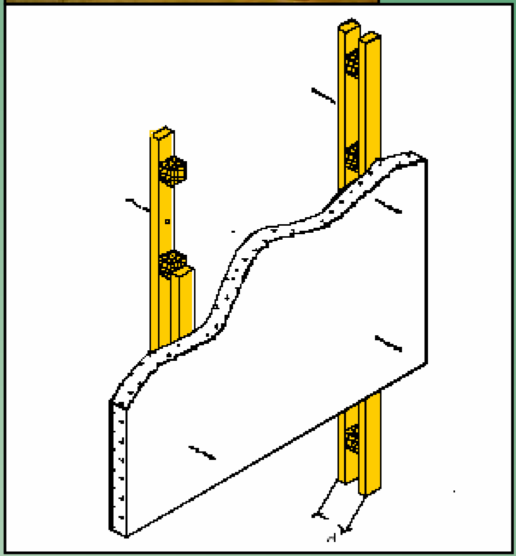
Remedial Measures in Occupied Dwellings



Proprietary isolating battens

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Junction Details

- The sealing of junctions between party walls and the surrounding structural elements can have a significant effect on the measured sound insulation performance.
- The most common acoustic weakness witnessed during testing is at the junction between the party wall and the underside of the floor/ceiling structure above.
- Some party walls are also affected by leakage at the base of the wall.

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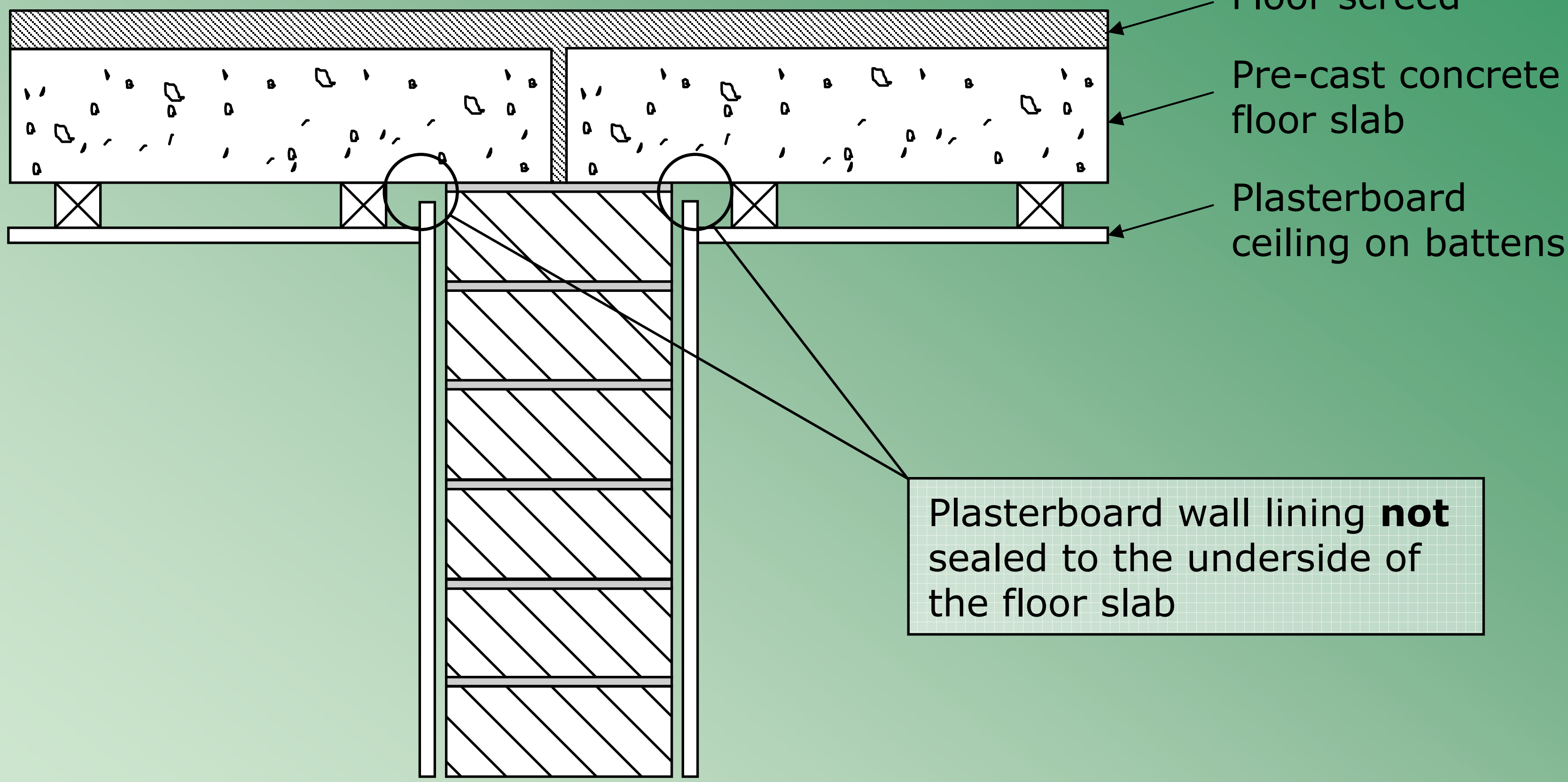
Noise Transfer Through Ceiling Cavity



Typical section through party wall and floor/ceiling junction

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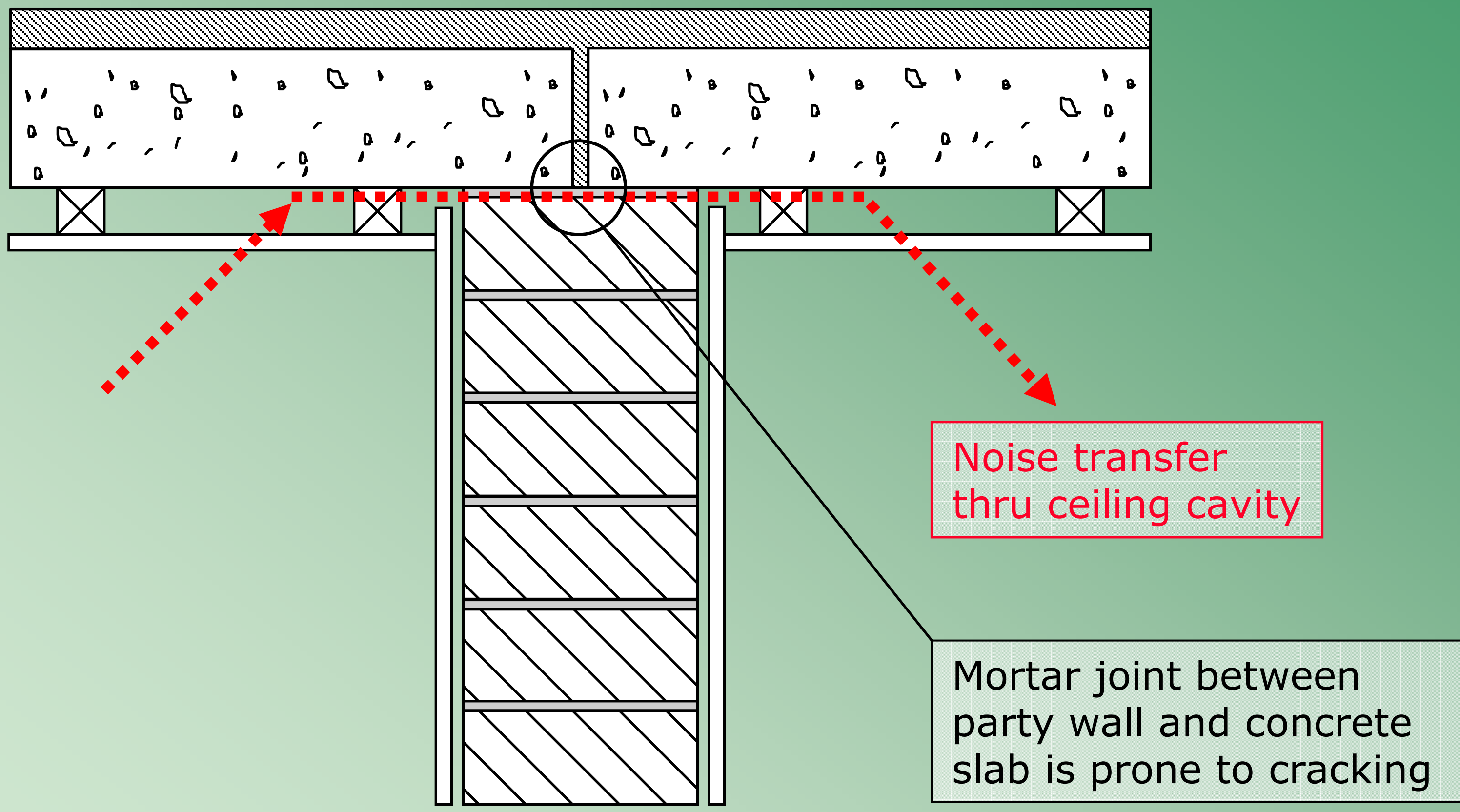
Noise Transfer Through Ceiling Cavity



Typical section through party wall and floor/ceiling junction

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Noise Transfer Through Ceiling Cavity

- The degree of noise transfer through the ceiling cavity varies significantly.
- In some cases, this transfer path is insignificant.
- In other cases, the reduction in the measured $D_{nT,w}$ sound insulation could be as high as 3 to 5dB.
- Therefore, a wall with an “on-site” measured sound insulation rating of 53dB may be capable of 56 to 58dB if this noise transfer path is treated.

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Noise Transfer Through Ceiling Cavity

Treatments:

- The plasterboard wall layers should extend up to the underside of the concrete floor slab above with a gap of ~5mm and a continuous bead of acoustic sealant applied along the junction.
- The sealant can accommodate small deflections/movement of building elements whilst still maintaining a continuous seal.

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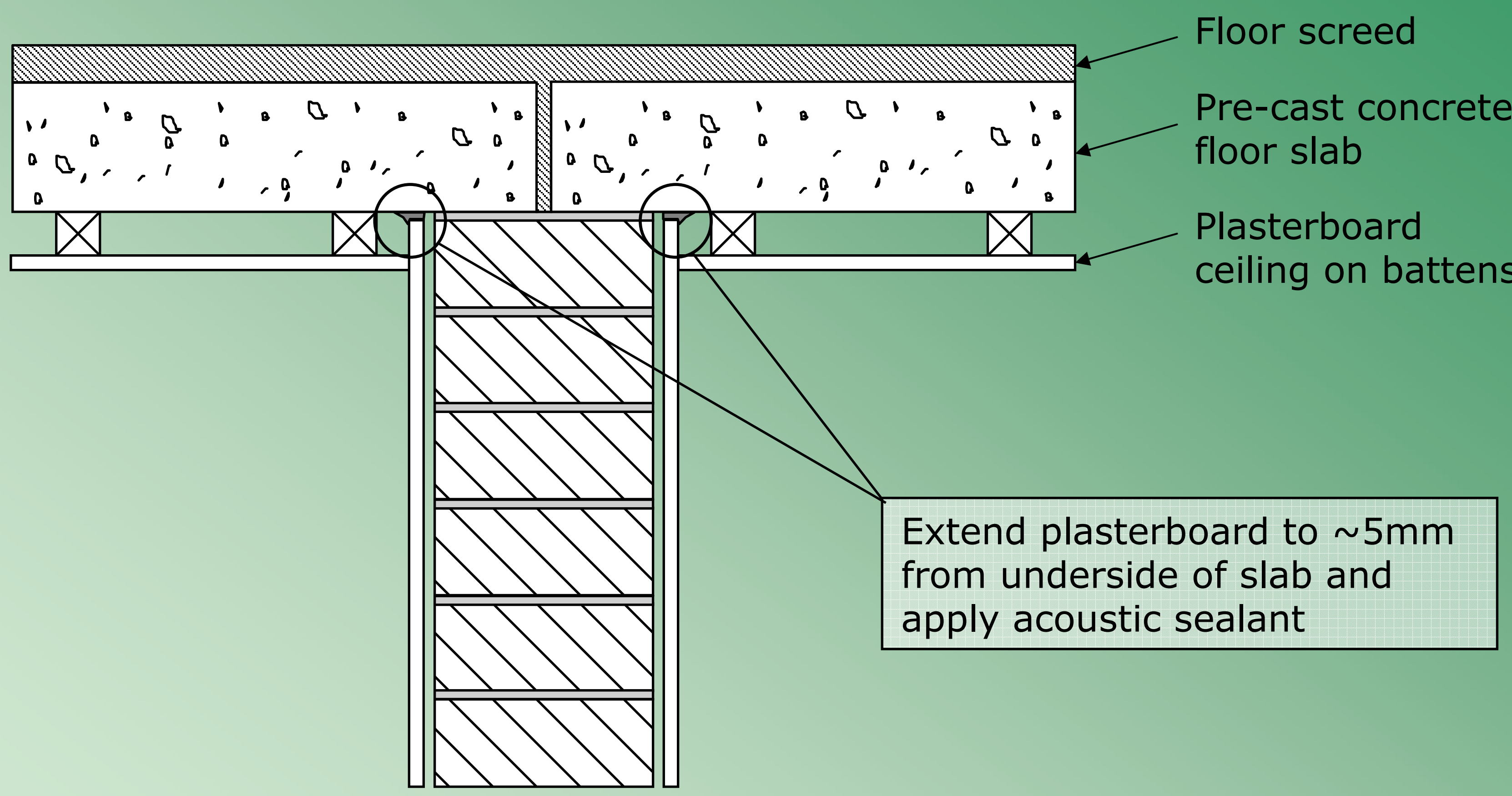
Noise Transfer Through Ceiling Cavity



Typical section through party wall and floor/ceiling junction

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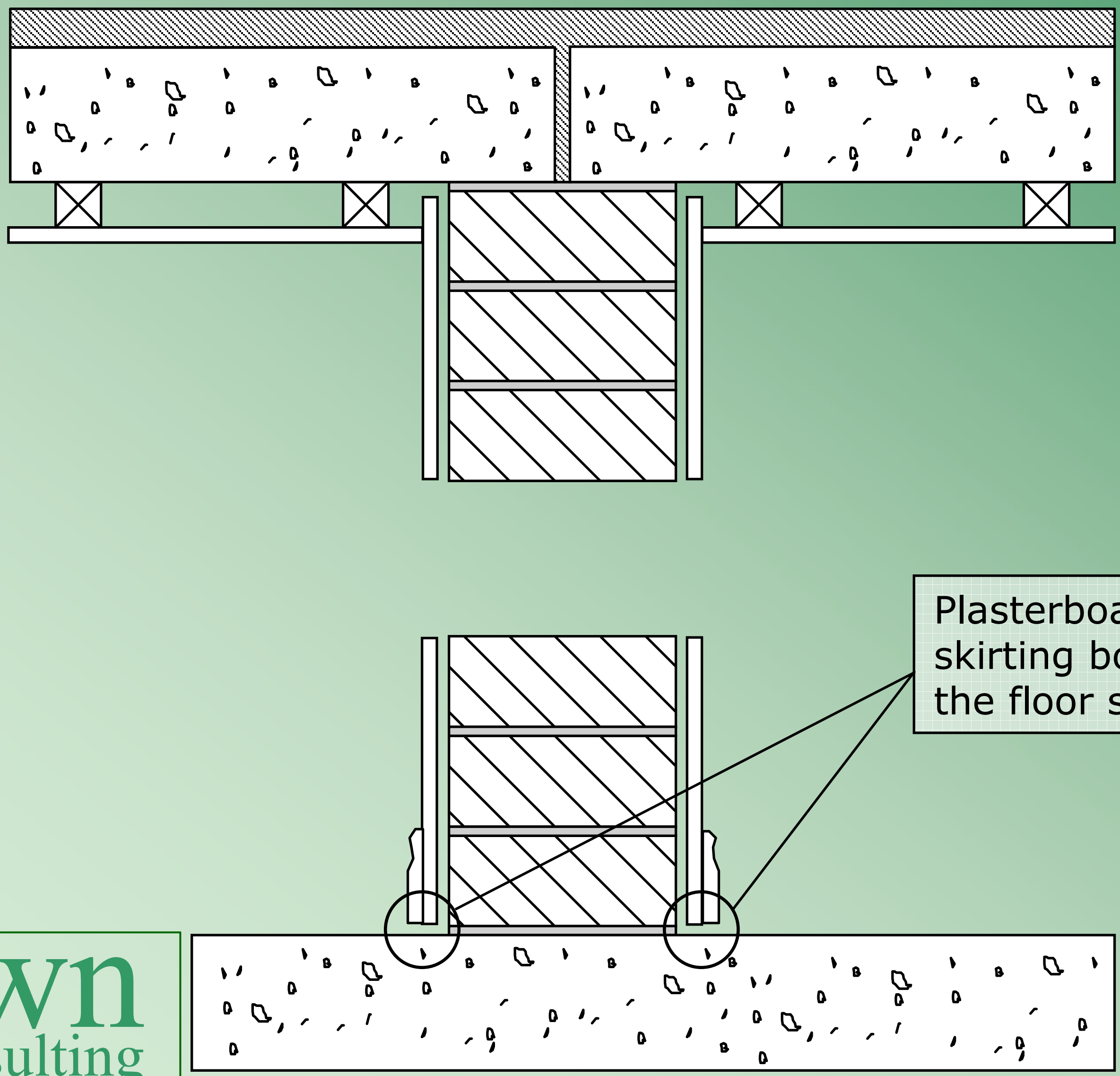
Noise Transfer at Floor Junction



Plasterboard wall lining and skirting board **not** sealed to the floor slab

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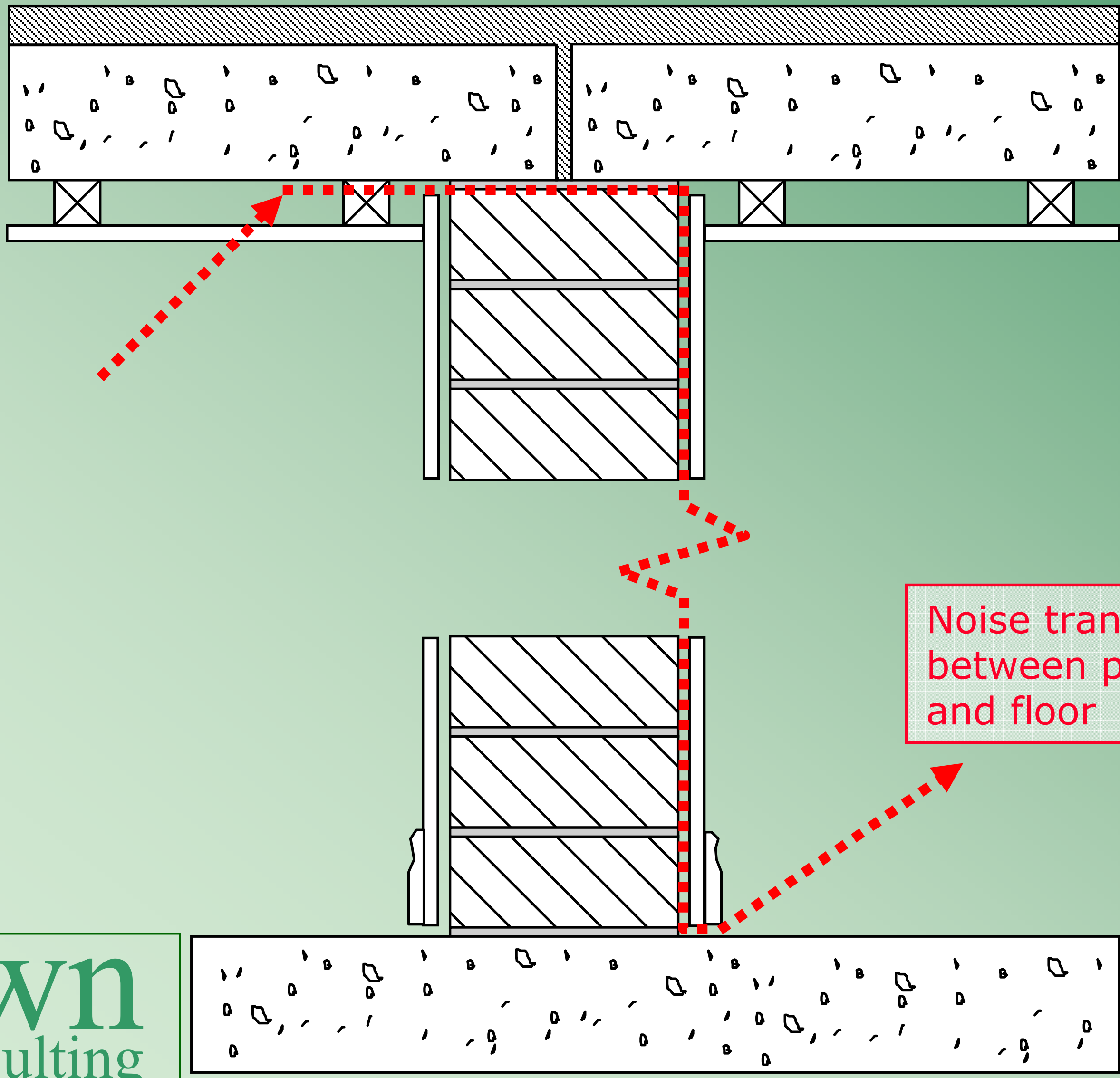
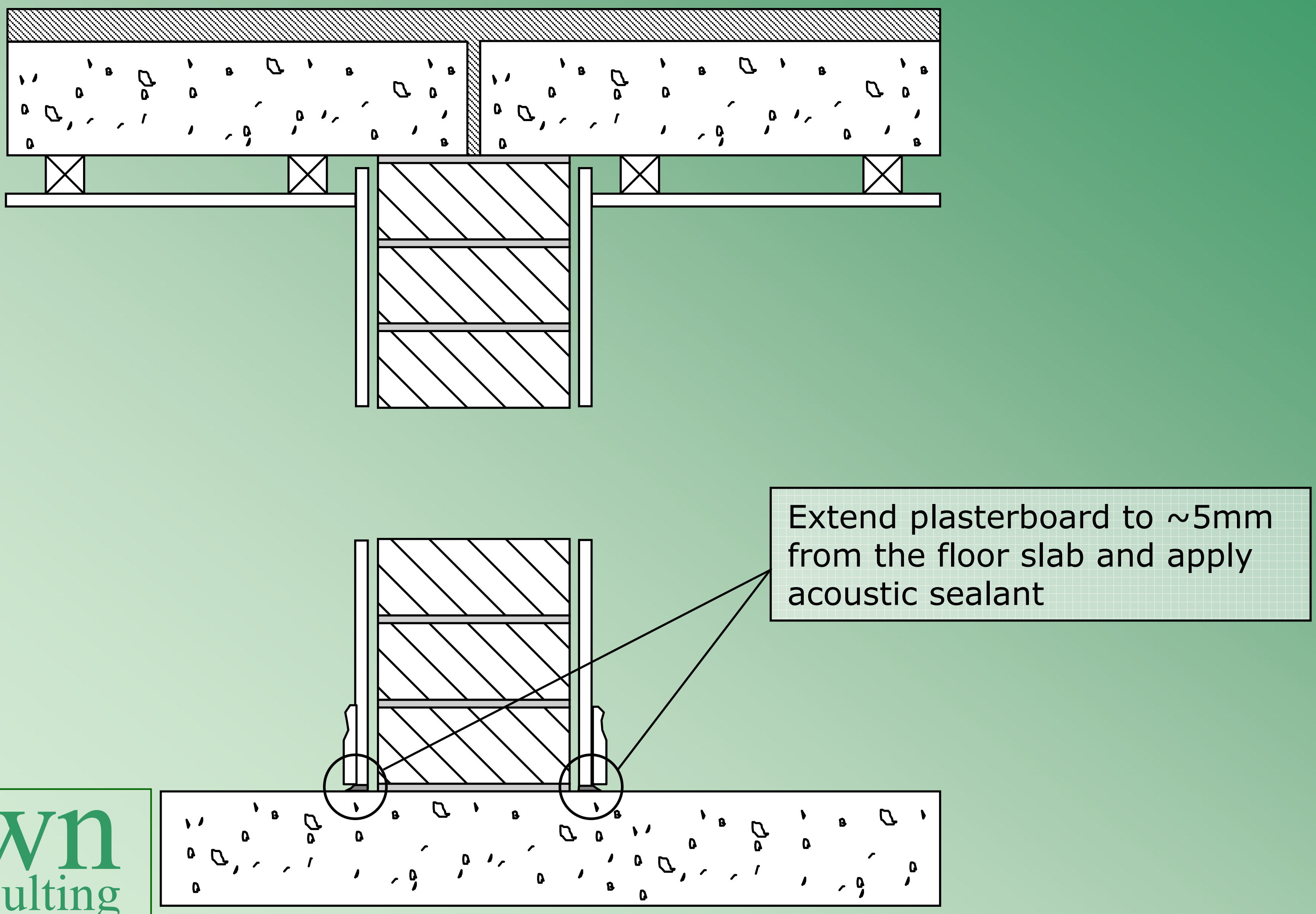
Noise Transfer at Floor Junction



Noise transfer at gap between plasterboard and floor

Noise Transfer at Floor Junction



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Junction Details

Summary:

- It is recommended that acoustic sealant is applied to the full perimeter of plasterboard lining to party walls.
- This reduces noise transfer via the ceiling cavity and at floor level.
- This simple treatment can provide a noticeable increase in the sound insulation performance of party walls.

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ANY QUESTIONS ?

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