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SCOTTISH BUILDING STANDARDS AGENCY

Robin Mackenzie Partnership

Design of Separating Constructions that are Resistant to the Transmission of Noise

PART 2 of 2

EXAMPLE CONSTRUCTION DETAILS

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1 INTRODUCTION

This document outlines example separating wall and floor construction details which when built correctly should comply with the sound insulation requirements as outlined in the proposed Section 5.

The constructions presented are based on field test evidence from attached houses and apartments (flats).

The following construction detail examples are provided for the most common construction types:

Separating Walls

Wall Type 1 - Masonry solid walls (dense blockwork) for use in attached houses and apartments

Wall Type 2 - Masonry cavity walls (dense blockwork) for use in attached houses and apartments

Wall Type 3 - Timber frame twin stud walls (with and without sheathing) for use in attached houses and apartments

Wall Type 4 - Metal frame twin stud walls (for use in attached metal frame houses and in-situ concrete frame apartments)

Separating Floors

Floor Type 1A - In-situ concrete slab with isolating screed and bonded resilient cover

Floor Type 1B - In-situ concrete slab with floating floor treatment

Floor Type 2A - Precast concrete slab with isolating screed and bonded resilient cover

Floor Type 2B - Precast concrete slab with floating floor treatment

Floor Type 3A - Timber frame floor with solid joists

Floor Type 3B - Timber frame floor with engineered I-joists

1.1 Aims

The main aims in providing these example constructions are to illustrate a ready means:

- to reduce sound transmission between attached dwellings and between dwellings and other parts of the same building*
- to reduce airborne sound transmission through separating walls and floors (e.g. speech, television and general living noise)
- to reduce impact sound transmission through separating floors (e.g. footstep noise)
- to reduce flanking noise transmission via other construction elements which are not part of the direct separating wall or floor (such as the inner leafs of external walls)
- to reduce low frequency sound transmission (e.g. from household appliances and other low frequency noise sources)
- to provide separating floor constructions with suitable floor finishes which can reduce impact noise transmission from wood based floor coverings
- to reduce horizontal impact sound transmission (e.g. noise from switches, plugs being inserted into sockets, doors and cupboard doors closing)

* *the performance levels of separating walls and floors between dwellings and other parts of the same building (e.g. communal stairwells and entrance halls) are influenced by the presence of dwelling main entrance doors and bridging of cavities due to wall leaf returns and door jambs.*

The common factors which are illustrated in each detail are:

- the core wall or floor construction
- the wall linings and floor isolating, resilient or floating layers
- the interaction with other building elements
- the junction with the external wall
- the junction with separating wall or floor
- the junction for the ground floor
- the junction with internal walls or floors
- the junction with ceiling and roof space
- the lining and details for vertical SVP and wall mounted service penetrations
- the separating wall between dwelling and a common area (e.g. stairwell for apartments)

Other requirements of the Scottish building regulations which are not illustrated by these details, but which should be considered by the designer include:

- thermal performance of elements
- thermal bridging and air leakage
- structural
- fire resistance and flame spread
- ventilation
- damp-proofing arrangements
- precipitation

1.2 Selection of Materials

Sound insulation within a building is achieved through a combination of addressing a number of factors simultaneously. Ultimately having a sufficient quantity of **mass** or **isolation** will be the primary key factors:

Mass: can be provided via the core structure and linings (such as in-situ concrete or solid dense block walls)

Isolation: can be provided via twin frames (such as timber frame, metal stud or blockwork cavity walls) or independent frames

In addition to having one or both of these elements the presence of one or more of the following can increase the sound insulation performance for a range of different types of living noise:

Absorption: the presence of mineral wool quilts or batts

Resilience: the presence of floating floor treatments (e.g. resilient battens or cradles) or resilient ceiling bars

Stiffness: the correct spacing and depth of joists

Damping: where noise/vibration converts to heat (e.g. bonded resilient covers, render [parge] coats for blockwork walls)

1.3 Alternative designs which are not example constructions

Where the designer is adopting separating wall or floor constructions which are not included within the example constructions the designer should always seek expert acoustic advice.

1.4 Common Design and Specification Errors

Whilst errors during construction on-site are the most common cause of non-compliance many errors also occur during the design and specification stage. It is very important to reduce later on-site errors that the design specification is correct and drawings are clearly illustrated.

Design and specification errors may include:

- wrong block density (i.e. too low and not dense block)
- wrong floating floor treatment (i.e. does not comply with specific performance requirements for airborne and/or impact performance)
- wrong resilient bar (i.e. does not comply with specific performance requirements for airborne and/or impact performance)
- wrong wall tie type for blockwork cavity separating walls, should always be Wall Tie Type A (see Section 2)
- wrong cavity width or floor cavity depth
- wrong gypsum board density (too low and thus not enough mass)
- specifying rigid insulation boards (no acoustic absorption properties) when they should in fact be mineral wool based (which have acoustic absorption properties)
- not detailing correctly the design drawings which will be used on site during build stage
- drawings incorrectly showing external wall inner leaf running through between dwellings
- drawings not showing floor slab or joists being built into wall

1.5 Common On-Site Construction Errors (Separating Walls)

The following issues are typical on-site construction errors which can lead to a reduction in the sound insulation performance.

Typical on-site errors - Wall Type 1 (Dense block solid wall)

- Not using a dense block
- Not laying the 215mm block full width (on its side)
- Not fully filling perpends and mortar joints
- Not breaking the inner leaf continuity with the separating wall
- Installing independent metal frame stud at less than 30mm offset
- Not fully filling stud width and height with quilt insulation

Typical on-site errors - Wall Type 2 (Dense block cavity wall)

- Not using a dense block
- Not fully filling perpends and mortar joints
- Not using Wall Tie Type A in the separating wall leafs (see Section 2) Allowing mortar and other debris to build up on wall ties and base of the wall cavity, thus bridging cavity wall leafs (*Always clean the cavity and keep your wall ties clean*)
- Building the cavity too small, (*Always minimum 75mm*)
- Not scratching the render, which reduces the adhesive bond for the dab and gypsum based board

Typical on-site errors - Wall Type 3 (Timber frame twin stud wall)

- Not building correct minimum width between cavity side of linings
- Building sheathed stud walls too close together (*Always 50mm min.*)
- Not fully covering the wall face of the stud bay with quilt insulation
- Not staggering the gypsum board linings
- Using too low a gypsum board density, not enough mass and may also reduce fire resistance
- Bridging twin frame incorrectly by spanning joists into wall cavity
- Bridging twin frame using rigid cavity stop incorrectly fixed to both frames (one side only for fixing)

Typical on-site errors - Wall Type 4 (Metal frame twin stud wall)

- Not maintaining the minimum width between cavity side of linings (*Always 200mm minimum*)
- Not fully covering the wall face of the stud bay with quilt insulation
- Not staggering the gypsum board linings
- Using too low a gypsum board density, not enough mass and may also reduce fire resistance
- Bridging twin frame using rigid cavity stop incorrectly fixed to both frames (one side only for fixing)

1.6 Common On-Site Construction Errors (Separating Floors)

The following issues are typical on-site construction errors which can lead to a reduction in the sound insulation performance. One of the major causes of failure to meet performance requirements is by incorrect product substitution on-site, where the site manager has failed to check whether the product or component meets specific performance criteria.

Typical on-site errors

Isolated Screeds

- Not installing both isolating layers
- Not isolating the screed properly and allowing the screed to connect or touch the core slab (known as bridging)
- Not isolating the screed properly and allowing the screed to connect or touch the perimeter wall, wall linings and skirting (known as bridging)
- Not using correct depth of sand:cement screeds (minimum 65mm)

Bonded Resilient Covers

- Using the wrong resilient cover which does not meet the performance requirements of Section 2
- Using a resilient cover which claims to meet Section 2 but has not been tested with a wood based floor covering present during the lab test (this leads to artificially high performance)

Floating Floor Treatments (FFT)

- Not using the correct FFT depth as specified in the detail
- Not using a FFT that meets the performance requirements for airborne and/or impact (see Section 2)
- Not installing the perimeter flanking strip to isolate flooring boards from skirtings and wall linings
- Using too long screws or nails and bridging the resilient layer
- Installing services which bridge the resilient layer by touching timber batten and core floor
- Not following the manufacturer’s instructions

Suspended Ceiling Treatments

- Not using a metal frame ceiling where required
- Not building to the correct ceiling void depth
- Not using correct ceiling board, too low a mass per unit area

Resilient Ceiling Bars

- Using resilient ceiling bar that does not comply with Section 2
- Using ceiling board screw fixings which are too long and thus allowing board screws to touch joist (these should never touch)

2 COMPONENT SPECIFICATION AND ACOUSTIC PERFORMANCE REQUIREMENTS

2.1 WALL TIES FOR BLOCKWORK CAVITY WALLS

Specification of the correct wall tie is important. If the wall tie is too thick or too stiff sound transmission can easily transmit. In the case of blockwork cavity separating walls incorrect specification can significantly affect the sound insulation performance.

In addition, the build up of mortar or debris on wall ties can also increase sound transmission leaf to leaf. As such it is important that wall ties and cavities are regularly cleaned to avoid mortar or debris collecting on the ties leading to increased acoustic bridging.

2.1.1 Separating Walls – Wall Tie Type A

For the purposes of wall tie specification for separating walls involving cavity blockwork ONLY Type A wall ties should be used.
Wall ties used in separating walls must be Tie Type A which have an appropriate measured dynamic stiffness for the cavity width. The specification for wall ties of dynamic stiffness, K_{Xmm} in MN/m with a cavity width of X mm and *n* ties/m2 is $n.k_{Xmm}$<4.8 MN/m^3. Contact wall tie manufacturer for product specification details which comply for wall tie Type A for separating walls.

2.1.2 External Walls - Tie Type A or B

Wall ties used in external blockwork cavity walls can be Tie Type A (as above) or Tie Type B (depending on strength requirements), which have an appropriate measured dynamic stiffness for the cavity width. The specification for wall ties of dynamic stiffness, K_{Xmm} in MN/m with a cavity width of X mm and *n* ties/m2 is $n.k_{Xmm}$<4.8 MN/m^3 (Tie Type A) or <113 MN/m^3 (Tie Type B). Contact wall tie manufacturer for product specification details which comply for Tie Type A or Tie Type B for external walls.

2.2 Bonded Resilient Covers (over isolated screeds)

Isolating layers underneath screeds can improve airborne and impact performance. However, isolating layers on their own are not sufficient to repeatedly achieve the required impact insulation performance against impact noise such as footsteps. In addition, the increasing use of wood based floor coverings directly laid on a screed finish without a resilient underlay (between wood based floor covering and screed) can increase noise transmission into the dwelling below.

As such a bonded resilient covering should also be used. The bonded resilient covering may be a minimum of 3mm thick and should cover the entire room floor surface.

Where specified in the example constructions for concrete core floors the bonded resilient covering:
- must be tested in an acoustic laboratory, as outlined in Annex B
- and must achieve the required impact sound insulation performance as described in Table 2.2

Table 2.2

Performance requirements for resilient floor covering when used with concrete core floors
Impact ΔL_w
min. 17 dB *(see Note 2)*

Notes:
1) Designers, specifiers and site managers should ensure that products selected and being installed on site conform to all of the above requirements.
2) The above performance requirement is based on a resilient floor covering which has been tested in accordance with Annex B under a wood based floor covering.
3) Annex B outlines the laboratory test requirements for resilient floor coverings with concrete core floors.

Note that the performance requirement must be achieved when the resilient cover has been laboratory tested under a wood based floor finish. Testing directly onto the resilient cover is not sufficient evidence as this leads to exaggerated performance which does not reflect its performance under a wood based floor covering as may be found in real apartments and flats.

2.3 Floating Floor Treatments

Floating floor treatments applies to resilient battens and cradle systems which support a timber based t&g flooring board (e.g. 18-22mm chipboard). Floating floor treatments are described by a coding (e.g. FFT1, FFT2, FFT3) which relates to their structure type, design depth and their acoustic performance. Further descriptive information relating to the relative FFT is provided in each example separating floor construction.

In addition to the physical description of the floating floor treatment it is important that the acoustic insulation performance is also achieved. Floating floor treatments can increase both the impact and airborne sound insulation performance of the separating floor.

2.3.1 Floating Floor Treatments (for concrete core floors)

Where specified in the example constructions for concrete core floors the floating floor treatments:

- must be tested in an acoustic laboratory, as outlined in Annex B
- and must achieve the required impact sound insulation performance as described in Table 2.3A

Table 2.3A

Performance requirements for Floating Floor Treatments when used with concrete core floors FFT1, FFT2 and FFT3	
Airborne ΔRw	Impact ΔLw
min. 5 dB	min. 22 dB

Notes:
1) Designers, specifiers and site managers should ensure that products selected and being installed on site conform to all of the above requirements.
2) Annex B outlines the laboratory test requirements for floating floor treatments on concrete core floors.

2.3.2 Floating Floor Treatments (for timber joist or lightweight frame core floors)

Where specified in the example constructions for concrete core floors the floating floor treatments:

- must be tested in an acoustic laboratory, as outlined in Annex B
- and must achieve the required impact sound insulation performance as described in Table 2.3B

Table 2.3B

Performance requirements for Floating Floor Treatments when used with timber joist or lightweight frame floors FFT1		
Airborne ΔRw	Airborne ΔRw + Ctr	Impact ΔLw
min. 17 dB	min. 13 dB	min. 16 dB

Notes:
1) Designers, specifiers and site managers should ensure that products selected and being installed on site conform to all of the above requirements.
2) Annex B outlines the laboratory test requirements for floating floor treatments with timber joist or lightweight frame floors

2.4 Resilient Ceiling Bars

Resilient ceiling bars are used to support ceiling board linings and mounted perpendicular to the joist span. To obtain the best acoustic performance on site for both airborne and impact sound insulation the ceiling board fixings must not come into direct contact with the joist. Care should be taken to ensure the correct screw length is used when fixing on site.

Where specified in the example constructions for timber joist floors the resilient ceiling bars:

- must be tested in an acoustic laboratory, as outlined in Annex B
- and must achieve the required impact sound insulation performance as described in Table 2.4

Table 2.4

Performance requirements for Resilient Ceiling Bars when used with timber joist or lightweight frame floors		
Airborne ΔRw	Airborne ΔRw + Ctr	Impact ΔLw
min. 16 dB	min. 14 dB	min. 16 dB

Notes:
1) Designers, specifiers and site managers should ensure that products selected and being installed on site conform to all of the above requirements.
2) Annex B outlines the laboratory test requirements for resilient ceiling bars with timber joist or lightweight frame core floors.

2.5 Downlighters (recessed lighting)

Downlighters (or recessed lighting) are often mounted such that they penetrate the ceiling board lining. The junction between the ceiling board and downlighter perimeter should be well sealed.

Downlighters:

- should be at centres of not less than 0.75m
- should have openings no greater than 100mm diameter or 100x100mm
- should be installed at no more than one downlighter per 2m^2 of total ceiling area in each room

Downlighters may be installed at a greater density than 1 per 2m^2 if the light fittings are supported by test evidence undertaken in accordance with Annex B.

Particular attention should also be paid to Technical Handbook (Domestic) Section 2 – Fire.

3 EXAMPLE CONSTRUCTION DETAILS

Separating Walls

Table 3.1 lists the separating wall example construction details

Wall Type 1 (Details 1.01 to 1.08)
Masonry solid walls (dense blockwork) for use in attached houses and apartments

Wall Type 2 (Details 2.01 to 2.09)
Masonry cavity walls (dense blockwork) for use in attached houses and apartments

Wall Type 3 (Details 3.01 to 3.11)
Timber frame twin stud walls (with and without sheathing) for use in attached houses and apartments

Wall Type 4 (Details 4.01 to 4.12)
Metal frame twin stud walls (for use in attached metal frame houses and in-situ concrete frame apartments)

Separating Floors

Table 3.2 lists the separating floor example construction details

Floor Type 1A (Details 5.01 to 5.07)
In-situ concrete slab with isolating screed and bonded resilient cover

Floor Type 1B (Details 6.01 to 6.07)
In-situ concrete slab with floating floor treatment

Floor Type 2A (Details 7.01 to 7.07)
Precast concrete slab with isolating screed and bonded resilient cover

Floor Type 2B (Details 8.01 to 8.07)
Precast concrete slab with floating floor treatment

Floor Type 3A (Details 9.01 to 9.08)
Timber frame floor with solid joists

Floor Type 3B (Details 10.01 to 10.08)
Timber frame floor with engineered I-joists

Table 3.1 – Separating Wall Example Details

SEPARATING WALLS	DETAIL	
Wall Type 1	**1.00**	**DENSE BLOCK SOLID WALL**
	1.01	Isometric and construction details
	1.02	External wall junction
	1.03	Separating floor junction: Floor Type 2A
	1.04	Separating floor junction: Floor Type 2B
	1.05	Ground floor junction: floating floor treatment
	1.06	Ground floor junction: isolated screed
	1.07	Ceiling and roof junction
	1.08	Separating wall (dwelling to common area)

Wall Type 2	**2.00**	**DENSE BLOCK CAVITY WALL**
	2.01	Isometric and construction details
	2.02	External wall junction
	2.03	Separating floor junction: Floor Type 2A
	2.04	Separating floor junction: Floor Type 2B
	2.05	Ground floor junction
	2.06	Internal floor junction: floor joists on hangers
	2.07	Internal floor junction: floor joists built-in
	2.08	Ceiling and roof junction
	2.09	Separating wall (dwelling to common area)

Wall Type 3	**3.00**	**TIMBER FRAME TWIN STUD WALL**
	3.01	Isometric and construction details
	3.02	External wall junction
	3.03	Separating floor junction: Floor Type 3A
	3.04	Separating floor junction: Floor Type 3B
	3.05	Ground floor junction
	3.06	Ground floor junction: raft foundation
	3.07	Internal wall junction
	3.08	Internal floor junction
	3.09	Ceiling and roof junction
	3.10	Services and sockets
	3.11	Separating wall (dwelling to common area)

Wall Type 4	**4.00**	**METAL FRAME TWIN STUD WALL**
	4.01	Isometric and construction details
	4.02	External wall junction: metal stud framing
	4.03	External wall junction: in-situ concrete framing
	4.04	Separating floor junction: Floor Type 1A
	4.05	Separating floor junction: Floor Type 1B
	4.06	Ground floor junction
	4.07	Ground floor junction: raft foundation
	4.08	Internal wall junction
	4.09	Internal floor junction
	4.10	Ceiling and roof junction
	4.11	Services and sockets
	4.12	Separating wall (dwelling to common area)

Table 3.2 – Separating Floor Example Details

SEPARATING FLOORS	DETAIL	
Floor Type 1A	**5.00**	**IN-SITU CONCRETE: with isolated screed and bonded resilient cover**
	5.01	Isometric and construction details
	5.02	Isolated screed and bonded resilient cover
	5.03	Ceiling treatment
	5.04	External wall junction: metal stud inner leaf
	5.05	External wall junction: dense block inner leaf
	5.06	Separating wall junction: Wall Type 4
	5.07	Services: vertical SVP's
Floor Type 1B	**6.00**	**IN-SITU CONCRETE: with floating floor treatment**
	6.01	Isometric and construction details
	6.02	Floating floor treatment
	6.03	Ceiling treatment
	6.04	External wall junction: metal stud inner leaf
	6.05	External wall junction: dense block inner leaf
	6.06	Separating wall junction: Wall Type 4
	6.07	Services: vertical SVP's
Floor Type 2A	**7.00**	**PRECAST CONCRETE SLAB: with isolated screed and bonded resilient cover**
	7.01	Isometric and construction details
	7.02	Isolated screed and bonded resilient cover
	7.03	Ceiling treatment
	7.04	External wall junction: dense block inner leaf
	7.05	Separating wall junction: Wall Type 1
	7.06	Separating wall junction: Wall Type 2
	7.07	Services: vertical SVP's
Floor Type 2B	**8.00**	**PRECAST CONCRETE SLAB: with floating floor treatment**
	8.01	Isometric and construction details
	8.02	Floating floor treatment
	8.03	Ceiling treatment
	8.04	External wall junction: dense block inner leaf
	8.05	Separating wall junction: Wall Type 1
	8.06	Separating wall junction: Wall Type 2
	8.07	Services: vertical SVP's
Floor Type 3A	**9.00**	**TIMBER FRAME FLOOR: with solid joists**
	9.01	Isometric and construction details
	9.02	Floating floor treatment
	9.03	Ceiling treatment
	9.04	External wall junction: timber frame inner leaf
	9.05	Separating wall junction: Wall Type 3
	9.06	Internal wall junction: loadbearing
	9.07	Internal wall junction: non-loadbearing
	9.08	Services: vertical SVP's

Floor Type 3B	**10.00**	**TIMBER FRAME FLOOR: with engineered I-joists**
	10.01	Isometric and construction details
	10.02	Floating floor treatment
	10.03	Ceiling treatment
	10.04	External wall junction: timber frame inner leaf
	10.05	Separating wall junction: Wall Type 3
	10.06	Internal wall junction: loadbearing
	10.07	Internal wall junction: non-loadbearing
	10.08	Services: vertical SVP's