6. Acoustic design

6.1 General

Limiting the amount of sound that is transmitted between rooms is an important consideration for the serviceability of buildings especially for residential, educational and healthcare buildings. For separating constructions between dwellings, Part E of the Building Regulations requires that both airborne and impact sound transmission is addressed.

Acoustic insulation is often associated with high mass constructions. However, this is constructionally and economically inefficient and inappropriate for dry assembled construction. Acoustic insulation is best provided by a combination of mass, isolation of separate layers and sealing of joints. Furthermore, there is a need for resilient layers to be introduced to deal with the effect of impact sound, even in concrete floors.

All of these attributes are encompassed within the Slimdek system which, combined with appropriate interface details, can easily provide a suitable solution for acoustic insulation as has been proven by numerous acoustic tests conducted both on and off site.

The mass is provided by the composite slab: acoustic testing in buildings has shown that generally the effective mass of the slab per m^2 of floor area can be used to predict performance. Additional mass is provided by the floor finish (screed or board) and ceiling plasterboard. The resilience is provided by mounting the plasterboard on resilient bars or on a proprietary metal frame ceiling. This decouples the ceiling from the slab and reduces sound transfer. In addition, a variety of acoustic floors can be used on top of the slab to decouple the floor finish from the slab. Examples of floor and ceiling details which more than meet the acoustic requirements of the Building Regulations are given later in this section.

Further information on acoustic performance of steel structures is given in SCI-P-372[31].

6.1.1 Sound paths

Clearly this manual is concerned with the construction of Slimdek floors but sound can travel between rooms either by direct transmission (i.e., through the separating structure) or by flanking transmission (around the separating structure through adjacent building elements).

Direct transmission depends upon the separating floor construction. Flanking transmission depends on the detailing of the interfaces between adjacent walls and floors. Both direct and flanking sound paths must be considered to achieve the required acoustic performance.

6.2 Regulations

The acoustic requirements for dwellings and rooms for residential purposes are specified in Approved Document E[43] of the Building Regulations for England and Wales. The equivalent document in Scotland is Section 5 of the Domestic Technical Handbook[44], in Northern Ireland it is Technical Booklet G[45]. For hospitals, Health Technical Memorandum 2045 *'Acoustic design considerations'*[35], produced by NHS Estates, specifies the requirements. For schools, Building Bulletin 93 *'Acoustic design of schools'*[46] produced by the Department for Education and Skills, should be adopted.

The acoustic requirements detailed in the documents stated above are expressed using different terms and methods as appropriate to the different building types. Therefore, a direct comparison of requirements is not straightforward. However, the principles of good acoustic detailing are consistent.

The acoustic requirements from Approved Document E[43] for separating floors are given in *Table 6.1.*

Table 6.1 Required acoustic performance from Approved Document E[43]

Building type	Separating floors	
	Airborne sound	Impact sound
	$D_{nT,w} + C_{tr}$	$L'_{nT,w}$
Purpose-built dwellings	⩾45 dB	⩽62 dB
Dwellings formed by material change of use	⩾43 dB	⩽64 dB
Purpose-built rooms for residential purposes	⩾45 dB	⩽62 dB
Rooms for residential purposes formed by material change of use	⩾43 dB	⩽64 dB

It can be seen from *Table 6.1* that both airborne sound and impact sound need to be considered for separating floors.

The C_{tr} term is a spectrum adaptation term, which is generally negative and adjusts the airborne performance to take additional account of the low-frequency sounds that often cause problems in residential buildings. C_{tr} is generally in the region of -6 dB to -9 dB for Slimdek floors.

Approved Document E explains that there are two methods of demonstrating compliance with the regulation:

a) Pre-completion testing (PCT) i.e., carry out on-site tests to measure the acoustic performance of separating walls and floors, to confirm that the performance standards in Approved Document E[43] are met.

b) Construction using Robust Details (RDs), as published in the Robust Details Handbook[47]. Before construction the developer must also register the site with Robust Details Limited, who administer the RD scheme.

Both methods of compliance can be used for Slimdek floors although pre-completion testing is probably the most appropriate because it allows more flexibility in the design and detailing.

6.3 Floor construction

The acoustic insulation of Slimdek floors is provided by the combination of the structural floor, a ceiling and a floor treatment, *see Figure 6.1.*

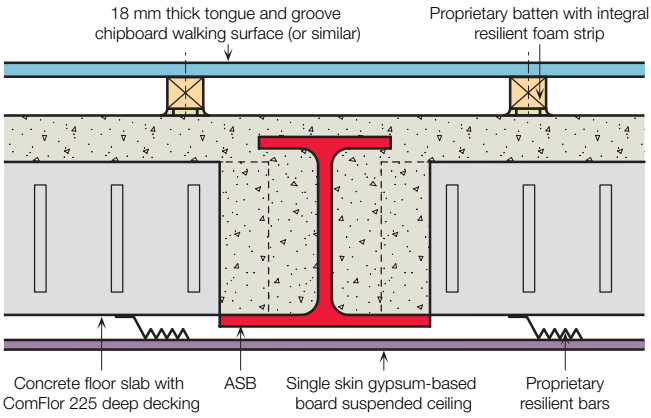

Figure 6.1 Slimdek separating floor

For Slimdek floors to be compliant with the relevant Robust Detail (E-FS-1) the following must be satisfied:

a) Concrete thickness must be at least 80mm at the shallowest point i.e., a slab depth of 305mm is required with ComFlor 225 decking.

b) Concrete density must be at least 2200kg/m^3.

c) A ceiling must be provided of at least 8kg/m^2 of gypsum-based board.

d) One of the floating floor treatments described in the Robust Details Handbook[47] must be applied. An isolated screed floor treatment is not applicable for an RD compliant Slimdek floor.

For Slimdek floors that are not designed to be RD compliant the options are less restrictive. All of the floor treatments shown in *Figures 6.2 to 6.7* may be used and thickness of concrete at the shallowest point may be less than 80mm depending on the type of floor treatment and ceiling used.

All separating floors should have a ceiling treatment of at least one layer of nominal 8kg/m^2 of gypsum-based board. Ceiling boards may be supported by resilient bars, timber battens or a propriety metal frame system.

The expected acoustic performances for Slimdek floors with different floor treatments are provided in *Table 6.2.*

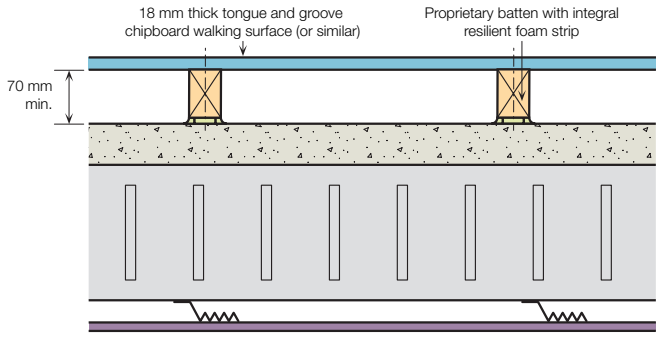

Figure 6.2 Deep batten floor treatment

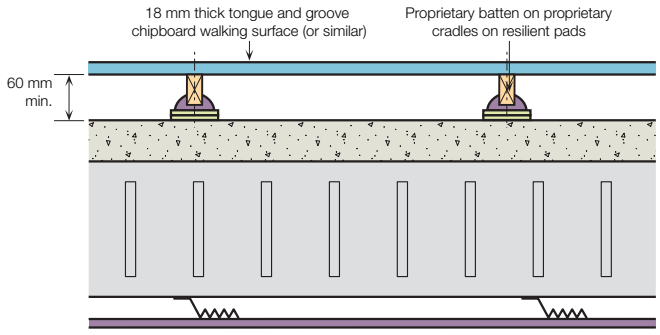

Figure 6.3 Cradle and batten floor treatment

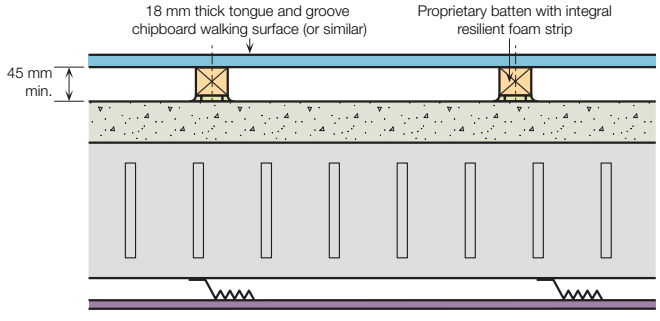

Figure 6.4 Standard batten floor treatment

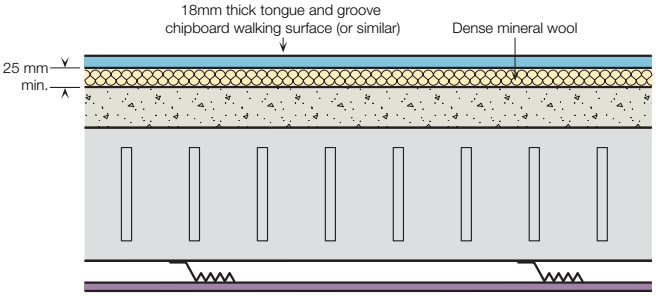

Figure 6.5 Platform floor treatment

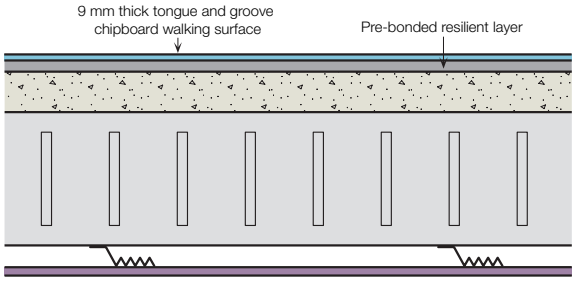

Figure 6.6 Shallow Platform floor treatment

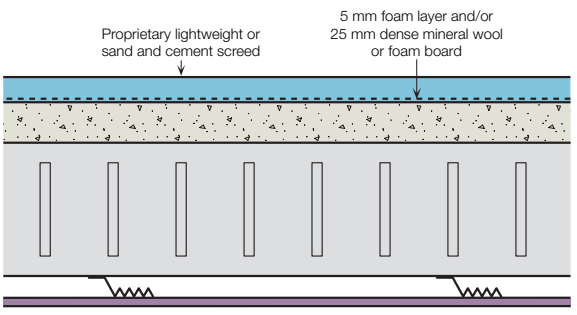

Figure 6.7 Isolated screed floor treatment

Table 6.2 Expected acoustic performance of Slimdek floors

Structural slab	Ceiling	Floor treatment	Expected acoustic performance	
			Airborne sound $D_{nT,w} + C_{tr}$	Impact sound $L'_{nT,w}$
Slab depth of 300mm on ComFlor 225 decking. Normal weight concrete (at least 2200 kg/m^3).	Gypsum-based board at least 8kg/m^2 supported on resilient bars.	Deep batten	54 – 58 dB	38 – 48 dB
		Cradle and batten	54 – 58 dB	38 – 48 dB
		Standard batten	54 – 58 dB	38 – 48 dB
		Platform	52 – 57 dB	40 – 45 dB
		Shallow platform	50 – 55 dB	40 – 45 dB
		Isolated screed	50 – 57 dB	40 – 50 dB

Note: Actual acoustic performance is dependent on the junction details as well as the floor construction.

Acoustic performance of the floor system can be enhanced by increasing the depth of concrete, increasing the mass of the ceiling, providing mineral wool insulation within the ceiling void or for a battened floor treatment, including insulation between the battens.

6.4 Separating walls

Either light steel or masonry separating walls can be used with Slimdek floors. Light steel walls are generally recommended because of the ease and speed of construction and the elimination of wet trades on site. Typically, light steel separating walls comprise twin frames of studs separated by mineral wool insulation. The outer faces of the studs are lined with two layers of gypsum-based board giving an overall thickness of around 250–300mm. Alternative, single frame stud wall solutions are available. These usually include the use of resilient bars or specially designed acoustic studs. The overall thickness of single stud wall solutions is around 150–220mm. Specialist manufacturers have produced a number of proprietary wall and detail solutions.

6.4.1 Detailing of joints

Junctions between walls and floors must be detailed appropriately to limit the amount of flanking sound that is transmitted. *Figures 6.8 to 6.11* show detailing that is required between Slimdek separating floors and walls. Specific points to note are:

- Floor treatments should not be continuous underneath separating walls.
- Floor treatments should be isolated from the walls with a resilient flanking strip.
- In some situations it is necessary to install additional mineral wool insulation in the wall in the zone of the junction.
- Primary steelwork should not be in direct contact with wall or ceiling lining boards.
- Wall linings should be stopped about 5mm above the floor slab. The gap should be filled with acoustic sealant.
- A deflection head is provided at the top of the light steel separating wall to allow for relative movement between the Slimdek floor and the wall.

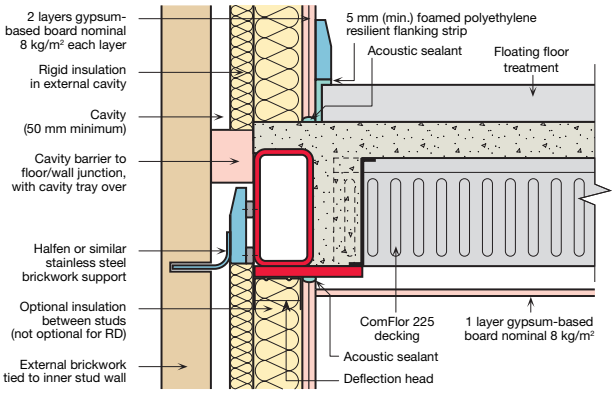

Figure 6.8 Acoustic detailing at junction between floor and external wall with RHSFB

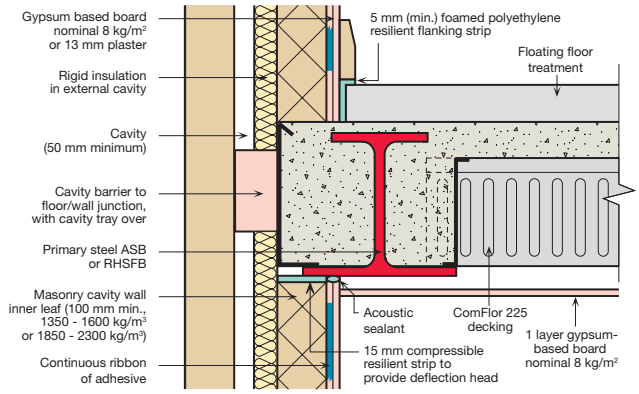

Figure 6.9 Acoustic detailing at junction between floor and external wall with ASB edge

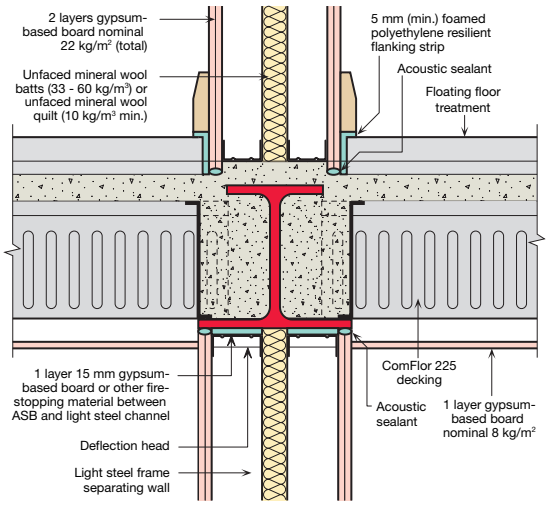

Figure 6.10 Acoustic detailing at junction between floor and separating wall with ASB

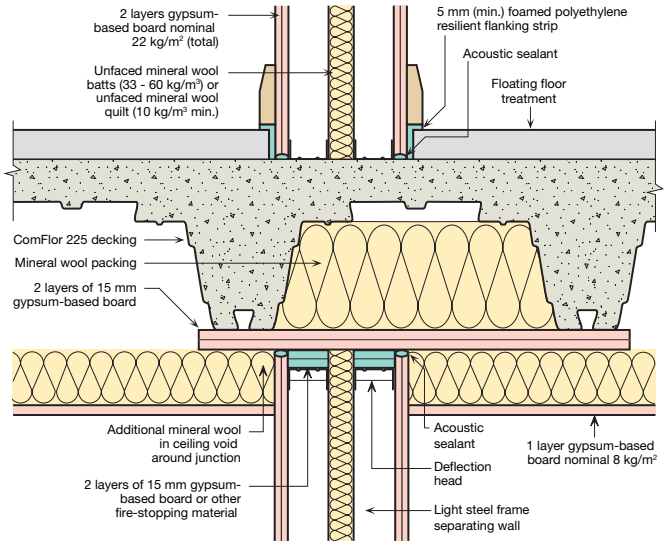

Figure 6.11 Acoustic detailing at junction between floor and separating wall without ASB