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## DESIGN GUIDE

Floors in buildings are often required to achieve certain levels of acoustic performance. There are two factors to consider, firstly the reduction of airborne sound transmission (e.g. music, speech, plantroom noise), and secondly the control of impact sound (typically footsteps).

The airborne sound reduction of a floor is determined by its mass, the ceiling below (if any), the acoustic blanket in the ceiling cavity (if any), and the rigidity of the attachment between ceiling and floor structure. In general, the airborne sound reduction of a floor increases by 6 dB per doubling of its mass (the well known mass law), the addition of a plasterboard ceiling can increase performance by 5 – 8 dB, or 13 – 16 dB if an acoustic blanket is placed in the cavity, but will decrease by up to 5 dB if the ceiling is rigidly connected to the floor structure.

Table 1 below gives the STC /$R_w$ for Speedfloor constructions, of various slab thicknesses, with and without ceilings, and with and without a fibreglass or polyester acoustic blanket in the cavity.

Impact sound is determined by similar factors to airborne sound reduction, but in addition the floor covering will have a large influence. In general concrete floors may generate high levels of impact sound, but this is easily controlled by using resilient floor coverings (cushioned vinyl, carpet, tiles on acoustic underlay). Table 2 below gives the IIC /$L_{n,w}$ ratings for Speedfloor constructions of various slab thicknesses, with and without ceilings, and with and without a fibreglass or polyester acoustic blanket in the cavity. The improvements that can be achieved with typical floor coverings are noted below the table.

### Design Criteria

The acoustic performance of floors both for airborne and impact sound, is important in many situations.

National Building Codes (such as the New Zealand Building Code, clause G6 or the Building Code of Australia (BCA)), set minimum acoustic performance for residential buildings that must be met, and these are summarised in the table below. For other non-residential buildings the table below gives guidance on typical recommended values. However, the degree of sound insulation can depend on a number of factors including the loudness of the sound source, the background noise level in the receiving room, and the degree of acoustical privacy that is required. Therefore, for critical applications specialist advice should be sought.

**Table 1: Airborne Sound Reduction**

| Building Type | | Typical Floor Requirement | |
|---|---|---|---|
| | | STC | $R_w$ + Ctr |
| Residential: | | | |
| | NZ Building Code | ≥55 | |
| | Building Code of Australia (Class 2) | | ≥50 |
| Offices | | 45 | 40 |
| Educational: | | | |
| | Lecture theatres | 55 | 50 |
| | Class rooms | 50 | 45 |
| | Tech rooms | 60 | 55 |
| Retail | | 45 | 40 |
| Hospitals/Healthcare | | | |
| | Patient rooms | 45 | 40 |
| | Consulting rooms | 55 | 50 |

More demanding situations such as aerobics, gymnasiums, performing arts venues, HVAC plant rooms, etc require specialist advice.

**Table 2: Impact Sound**

| Building Type | | Typical Floor Requirement | |
|---|---|---|---|
| | | IIC | $Ln_{,w}$ + $C_I$ |
| Residential: | | | |
| | NZ Building Code | ≥ 55 | |
| | Building Code of Australia (Class 2) | | ≤ 62 |
| Educational: | | | |
| | Class rooms | 45 | |
| Hospitals/Healthcare | | | |
| | Patient rooms | 50 | |
| Offices | | 45 | |

## Rating Methods

There are two common rating methods for comparing walls; in New Zealand the ASTM Standards are used and the airborne sound insulation is rated by the STC value. In Australia the ISO Standards are used and the airborne sound insulation is rated either by $R_w$ (laboratory) or $D_{nTw}$ (field) with usually the addition of an adaption terms $C_{tr}$. The STC and $R_w$ values are usually very close, but the $C_{tr}$ term can be -4 to -12 dB depending on the construction.

For impact sound the comparable ratings are IIC, (ASTM), or $L_{n,w}$ (with usually a $C_I$ correction term) (ISO). It is difficult to compare these two rating methods.

## Speed Floor Constructions

**Table 3A: Airborne Sound Ratings (STC/$R_w$)**

| Floor Slab Thickness | No Ceiling | Ceiling (1 layer of 10 or 13mm plasterboard) | |
|---|---|---|---|
| | | No Acoustic Blanket | 75 mm minimum Acoustic Blanket |
| 75 | 45 | 56 | 64 |
| 90 | 48 | 57 | 67 |
| 100 | 49 | 57 | 68 |
| 125 | 52 | 59 | 70 |
| 150 | 55 | 61 | 72 |
| 175 | 57 | 64 | 74 |

It is assumed the ceiling lining is fixed to a light steel grid (for instance USG FC35 or FC50 steel furring channels) hung beneath the floor, forming a minimum 200mm deep ceiling cavity. If the ceiling is rigidly fixed to the bottom of the Speedfloor trusses these ratings may be reduced by 1 – 5 dB. In practice flanking sound transmission may limit performance in real situations.

Acoustic blanket should be fibreglass, polyester or mineral wool, a minimum of 75mm thick, and of minimum 10kg/$m^3$.

**Table 3B: Airborne Sound Ratings ($R_w + C_{tr}$)**

| Floor Slab Thickness | No Ceiling | Ceiling (1 layer of 10 or 13mm plasterboard) | |
|---|---|---|---|
| | | No Acoustic Blanket | 75 mm minimum Acoustic Blanket |
| 75 | 43 | 51 | 60 |
| 90 | 45 | 52 | 62 |
| 100 | 46 | 51 | 62 |
| 125 | 48 | 52 | 64 |
| 150 | 50 | 53 | 64 |
| 175 | 52 | 55 | 66 |

It is assumed the ceiling lining is fixed to a light steel grid (for instance USG FC35 or FC50 steel furring channels) hung beneath the floor, forming a minimum 200mm deep ceiling cavity. If the ceiling is rigidly fixed to the bottom of the Speedfloor trusses these ratings may be reduced by 1 – 5 dB. In practice flanking sound transmission may limit performance in real situations.

Acoustic blanket should be fibreglass, polyester or mineral wool, a minimum of 75mm thick, and of minimum 10kg/$m^3$.

**Table 4A: Impact Sound Ratings (IIC)**

| Floor Slab Thickness | No Ceiling | Ceiling (1 layer of 10 or 13mm plasterboard) | |
|---|---|---|---|
| | | No Acoustic Blanket | 75 mm minimum Acoustic Blanket |
| 75 | 16 | 32 | 33 |
| 90 | 19 | 36 | 36 |
| 100 | 22 | 38 | 39 |
| 125 | 26 | 42 | 43 |
| 150 | 29 | 44 | 45 |
| 175 | 30 | 46 | 47 |

Notes: 1. Floor coverings improve the IIC rating by approximately the following amount:

| | |
|---|---|
| Carpet tiles | + 22 dB |
| Carpet on underlay | + 35 dB |
| Cushioned vinyl | + 16 dB |
| Timber floors on foam underlay | + 15 dB |
| Ceramic tiles on acoustic cork underlay | + 15 dB |

**Table 4B: Impact Sound Ratings ($L_{n,w}$ + $C_I$)**

| Floor Slab Thickness | No Ceiling | Ceiling (1 – 2 layers of 10 or 13mm plasterboard) | |
|---|---|---|---|
| | | No Acoustic Blanket | 75 mm minimum Acoustic Blanket |
| 75 | 80 | 66 | 59 |
| 90 | 78 | 64 | 57 |
| 100 | 75 | 62 | 54 |
| 125 | 72 | 59 | 51 |
| 150 | 70 | 57 | 50 |
| 175 | 68 | 55 | 46 |

Notes: 1. Floor coverings reduce the Ln,w rating by approximately the following amount:

| | |
|---|---|
| Carpet tiles | + 22 dB |
| Carpet on underlay | + 35 dB |
| Cushioned vinyl | + 16 dB |
| Timber floors on foam underlay | + 15 dB |
| Ceramic tiles on acoustic cork underlay | + 15 dB |

## Flanking Sound Transmission

Sound can travel by several paths between rooms.

As well as sound being transmitted directly through the floor/ceiling to the room below, sound can travel along the floor slab, under a wall, and into an adjacent room. This is known as a flanking path and should always be considered for high performance constructions or critical situations.

Generally when there is a requirement for STC/$R_w$ 50 or greater between rooms, floor slabs should be at least 125 mm thick to reduce sideways flanking transmission. In practice to achieve ratings of greater than STC/$R_w$ 55 will require careful attention to suppressing flanking transmission.