# Ministerial Building Standard MBS 010

## Construction requirements for the control of external sound

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## 1.0 SCOPE AND APPLICATION

**1.1** This Standard is published as a Ministerial Building Standard under the *Planning, Development and Infrastructure Act 2016* (the *Act*) and must be read in conjunction with the requirements of the *Act* and the Planning, Development and Infrastructure (General) Regulations 2017 *(*the Regulations*)*.

**1.2** This Standard contains provisions for reducing the intrusion of unacceptable levels of sound into habitable rooms of residential buildings.

**1.3** The provisions in this Standard apply to-

(a) a new Class 1, 2 or 3 building, a Class 4 part of a building and a Class 9c aged care building (as defined in the *Building Code*) located within a *noise attenuation area*, identified as such in a Noise and Emissions Overlay to the Planning and Design Code; and

(b) an addition to a Class 1, 2, 3 building, a Class 4 part of a building or a Class 9c aged care building, which contains a *habitable room* located within a *noise attenuation area,* identified as such in a Noise and Emissions Overlay to the Planning and Design Code.

**1.4** The requirements of this Standard are additional to those required by the *Building Code* and do not override any of the *Building Code* provisions.

## 2.0 PERFORMANCE REQUIREMENTS

**2.1** To prevent loss of amenity for the occupants of a residential building located within a *noise attenuation area*, the *building envelope* and any mechanical ventilation system must provide attenuation to reduce the intrusion of external airborne sound from a *designated sound source* or from increased sound levels that arise in mixed land use areas*,* to an acceptable level within *habitable rooms*.

## 3.0 VERIFICATION METHOD

### 3.1 Sound transmission through the *building envelope*

Compliance with performance requirement **2.1** to avoid the transmission of airborne sound through the *building envelope* is verified when the level of attenuation provided by the *building envelope* and its ventilation system is sufficient to provide internal sound levels not exceeding the internal sound criteria values stated in **Table 3.1 or Table 3.2.**

**Table 3.1 - Internal sound criteria for sound intrusion from road and rail**

| **Type of** room | **Internal sound criteria** | |
|---|---|---|
| | **Building design target averaged over the total number of rooms in the building** | **Maximum allowable for individual rooms in the building** |
| Bedrooms | 30 *dB(A)* $L_{eq,\ night}$ | 35 *dB(A)* $L_{eq,night}$ |
| Other habitable rooms | 35 *dB(A)* $L_{eq,\ night}$ | 40 *dB(A)* $L_{eq,\ night}$ |

**Table 3.2** - **Internal sound criteria for sound intrusion from existing entertainment venues**

| Type of room | Internal sound criteria |
|---|---|
| Bedrooms and other habitable rooms | 43 *dB(A)* $L_{eq}$, in any one-third octave band between and including 31.5Hz and 125Hz. |

# 4.0 SOUND TRANSMISSION AND INSULATION

## 4.1 Deemed-to-Satisfy Provisions

Where a *Deemed-to-Satisfy Solution* is proposed, performance requirement **2.1** will be satisfied by complying with the sound insulation requirements of this section and the relevant acceptable construction practices in section **5.0.**

## 4.2 Application

The *Deemed-to-Satisfy Provisions* of this section and section **5.0** apply to Class 2, 3, 4 buildings and Class 9c buildings exposed to noise from road and rail corridors and mixed land use areas.

A part of a *building envelope* or a mechanical ventilation system is exposed to a *designated sound source* if it is-

(a) located within a prescribed *separation distance* from a *designated sound source* as set out in **Tables 4.1, 4.2** or **4.3**; or

(b) located within 65m of an existing *entertainment venue*; and

(c) a straight line can be drawn between a part of the *building envelope* and the *designated sound source* that is not obstructed by-

(i) another part of the building having a minimum ($R_W$+$C_{tr}$) of **40**, or

(ii) another building; or

(iii) a noise barrier.

## 4.3 Sound exposure categories

4.3.1 ***Transport corridors*** - The *sound exposure category of* a *building envelope* exposed to a *designated sound source* is determined for a *transport corridor* according to its noise category and the distance the building is located from the *designated sound source* as set out in Tables **4.1** and **4.2** for road corridors and Table **4.3** for rail corridors.

4.3.2 ***Entertainment venues*** - The *sound exposure category* for the *building envelope* of a building located within 65m of an *entertainment venue* is to be taken as **5.**

4.3.3 **Mixed land use areas** - The *sound exposure category* for the *building envelope* of a building located within a *mixed land use area* is to be taken as 1.

4.3.4 **Multiple *sound exposure categories*** - For a *building envelope* or part of a *building envelope* having multiple *sound exposure categories,* the *required* category to be applied is the most stringent one resulting from the application of Tables **4.1, 4.2** or **4.3** as relevant to the noise category.

4.3.5 **Shielding** – Where a part of a building facade is not exposed to a *designated sound source* but adjoins another part that is exposed, the part that is not exposed must have a *sound exposure category* one category less than that *required* for the exposed part.

4.3.6 **Non-*habitable rooms* adjoining *habitable rooms* -** non-*habitable rooms* adjoining *habitable rooms*, which are bounded by a part of the building façade exposed to a *designated sound source* must either-

(a) be completely separated from the *habitable room* with walls and doors having an $R_w$ of not less than **40** and any doors therein having an $R_w$ of not less than **30**; or

(b) be included in the *habitable room* and the most stringent *sound exposure category* resulting from the application of Tables **4.1**, **4.2** or **4.3** must be used.

**Table 4.1 - *Exposure according to noise category - Type A* and *Type B roads***

| ***Sound exposure category*** | **Separation from *Type A Road* (metres)** | | | **Separation from *Type B Road* (metres)** | | |
|---|---|---|---|---|---|---|
| | **Maximum Road Speed limit [km/h]** | | | **Maximum Road Speed limit [km/h]** | | |
| | **50–60** | **70–90** | **100–110** | **50–60** | **70–90** | **100–110** |
| **1** | 60 < 100m | 95 < 150m | 130 < 200m | 35 < 60m | 55 < 95m | 75 < 130m |
| **2** | 35 < 60m | 45 < 95 m | 60 < 130m | 20 < 35m | 30 < 55m | 35 < 75m |
| **3** | 15 < 35m | 25 < 45m | 35 < 60m | 10 < 20m | 15 < 30m | 20 < 35m |
| **4** | less than 15m | 10 < 25m | 15 < 35m | less than 10m | less than 15m | 10 < 20m |
| **5** | N/A | less than 10m | less than 15m | N/A | N/A | less than 10m |

**Table 4.2 – *Sound exposure category – Type R roads***

| ***Sound exposure category*** | **Separation from *Type R Road* (metres)** | | |
|---|---|---|---|
| | **Maximum Road Speed limit [km/h]** | | |
| | **50–60** | **70–90** | **100–110** |
| **1** | 25 < 35m | 35 < 55m | 40 < 75m |
| **2** | 10 < 25m | 15 < 35m | 20 < 40m |
| **3** | less than 10m | less than15m | 10 < 20m |
| **4** | N/A | N/A | less than 10m |
| **5** | N/A | N/A | N/A |

*Note – For the purposes of **Tables 4.1** and **4.2**, the speed limit applicable to the building is the speed limit at the point on the transport corridor at which the separation distance is measured and assessed.*

**Table 4.3 – *Sound exposure category* – Rail**

| ***Sound exposure category*** | **Separation from *Tram line* (metres)** | **Separation from *Train line* (metres)** |
|---|---|---|
| **1** | 10 < 20m | 25 < 50 m |
| **2** | less than 10m* | 10 < 25 m |
| **3** | N/A | less than 10 m* |
| **4** | N/A | N/A |
| **5** | N/A | N/A |

**Note - This Specification does not consider ground-borne vibration from road or rail sound sources. Buildings closer than 10m to a road or 20m to a rail line, may be exposed to perceptible ground vibration. Advice on ways to reduce the effects of unacceptable ground vibration should be sought from a professional acoustic engineer.*

*N/A – Not applicable*

## 4.4 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must-

(a) have the *required* value for weighted sound reduction index ($R_w$) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) not less than the relevant rating set out in Tables **4.4** and **4.5** for the relevant *sound exposure category* of the particular *designated sound* source, determined in accordance with AS/NZS ISO 717.1 using results from laboratory measurements; or

(b) comply with the acceptable construction practices in section **5.0** that will achieve the *required* value for weighted sound reduction index ($R_w$) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) set out in Table **4.4** for the relevant *sound exposure category*.

## 4.5 Sound insulation requirements

Table **4.4** sets out the *required* value for weighted sound reduction index ($R_w$) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) for sound insulation of building elements that are deemed to provide the required attenuation to meet the internal sound criteria levels required by Table **3.1.**

**Table 4.4 – Acoustic requirements for building elements**

| ***Sound exposure category*** | **Sound insulation requirements** | |
|---|---|---|
| **1** | *External walls* | $R_W + C_{tr}$ **40** for all *habitable rooms* |
| | *Windows* and *external glass doors* | See **Table 4.5** |
| | Mechanical ventilation systems | $R_W$ **25** |
| **2** | Ground Floor | $R_W + C_{tr}$ **45** for all *habitable rooms* |
| | *External walls* | $R_W + C_{tr}$ **45** for all *habitable rooms* |
| | *Windows* and *external glass doors* | See **Table 4.5** |
| | *External doors* other than *external glass doors* | $R_W$ **27** for all *habitable rooms* |

| ***Sound exposure category*** | **Sound insulation requirements** | |
|---|---|---|
| | Roof and ceilings of bedrooms | $R_W + C_{tr}$ **35** |
| | Mechanical ventilation systems | $R_W$ **25** |
| **3** | Ground Floor | $R_W + C_{tr}$ **50** for all *habitable rooms* |
| | *External walls* | $R_W + C_{tr}$ **50** for all *habitable rooms* |
| | *Windows* and *external glass doors* | See **Table 4.5** |
| | *External doors,* other than *external glass doors,* to all *habitable rooms* | $R_W$ **30** |
| | Roof and Ceilings | $R_W + C_{tr}$ 40 for bedrooms<br>$R_W + C_{tr}$ **35** all other *habitable rooms* |
| | Mechanical ventilation systems | $R_W$ **30** |
| **4** | Ground Floor | $R_W + C_{tr}$ **50** for all *habitable rooms* |
| | *External walls* | $R_W + C_{tr}$ **50** for all *habitable rooms* |
| | *Windows* and *external glass doors* | External glass doors are not permitted in bedrooms. For elsewhere see **Table 4.5** |
| | *External doors* other than *external glass doors* | $R_W$ **30** to all *habitable rooms* other than bedrooms |
| | Roof and Ceilings | $R_W + C_{tr}$ **45** for bedrooms<br>$R_W + C_{tr}$ **40** for all other *habitable rooms* |
| | Mechanical ventilation systems | $R_W$ **35** and complying with **5.7** |
| **5** | Outside the scope of the *Deemed-to-Satisfy Provisions*. | Buildings are *required* to be assessed as a *Performance Solution* against the relevant *Performance Requirements* in section **2.0** |

**Table 4.5- Minimum sound insulation requirements for closed *windows* and *external glass doors* to *habitable rooms* - values airborne ($R_W$+C $_{tr}$)**

| **Room** | **Area of *window and external glass doors* as a percentage of the *floor area* of the room** | **Designated *sound exposure category*** | | | | |
|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** |
| (a) Bedroom<br>(b) A non-*habitable room* attached to (a) | Not more than 20% | 25 | 28 | 31 | 34 | 37 |
| | More than 20% but not more than 40% | 28 | 31 | 34 | 37 | Note 1. |
| | More than 40% but not more than 60% | 31 | 34 | 37 | Note 1. | Note 1. |
| | More than 60% but not more than 80% | 34 | 37 | Note 1. | Note 1. | Note 1. |
| | More than 80% | 37 | Note 1. | Note 1. | Note 1. | Note 1. |

| Room | Area of *window and external glass doors* as a percentage of the *floor area* of the room | Designated *sound exposure category* | | | | |
|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** |
| (c) *Habitable room*, other than a bedroom and an enclosed kitchen<br>(d) A non-*habitable room* attached to (c) | Not more than 20% | 22 | 25 | 28 | 31 | 34 |
| | More than 20% but not more than 40% | 25 | 28 | 31 | 34 | 37 |
| | More than 40% but not more than 60% | 28 | 31 | 34 | 37 | Note 1. |
| | More than 60% but not more than 80% | 31 | 34 | 37 | Note 1. | Note 1. |
| | More than 80% | 34 | 37 | Note 1. | Note 1. | Note 1. |

Note 1. *Windows* and *external glass doors* are outside the scope of the *Deemed-to-Satisfy Provisions* and will need to be considered as part of a *Performance Solution.*

## 5.0 ACCEPTABLE CONSTRUCTION PRACTICE

### 5.1 Application

The acceptable construction practices in this section are deemed to achieve the levels of sound insulation *required* by Tables **4.4** and **4.5**.

### 5.2 General

Where sheeting materials, such as plasterboard or the like, are used to comply with this Standard, they must–

(a) be installed so that if two layers are *required*, the second layer must be fastened over the first layer so that the joints do not coincide with those of the first layer; and

(b) have all joints between sheets or between sheets and any adjoining construction, taped and filled solid.

### 5.3 Construction of floors

The following forms of construction are deemed to achieve the *required* $R_W + C_{tr}$ ratings for floors-

(a) be in direct contact with the ground, such as a concrete slab-on-ground or the like; or

(b) for a suspended floor, other than an intermediate floor in a building with more than one storey and floors with an enclosed perimeter, comply with one of the following:

(i) be a minimum 150mm thick concrete slab; or

(ii) be a lightweight floor consisting of–

(A) 2 layers of minimum 25mm thick structural grade particleboard flooring (or other solid flooring with surface mass not less than 35 kg/m$^2$) installed on minimum 150mm high floor joists; and

(B) 1 layer of minimum 6mm thick fibre cement sheeting resiliently mounted to the underside of the floor joists with rubber isolation clips; and

(C) minimum 50mm thick glass wool or rock wool insulation with a minimum density of 11kg/m$^3$ or minimum 50mm thick polyester insulation with a minimum density of 20kg/m$^3$ in the cavity; or

(iii) be a lightweight floor consisting of–

(A) 1 layer of minimum 25mm thick structural grade particleboard flooring (or other solid flooring with surface mass not less than 17.5 kg/m$^2$) installed on minimum 150mm high floor joists; and

(B) 2 layers of minimum 6mm thick fibre cement sheeting resiliently mounted to the underside of the floor joists with rubber isolation clips; and

(C) minimum 50mm thick glass wool or rock wool insulation with a minimum density of 11kg/m$^3$ or minimum 50mm thick polyester insulation with a minimum density of 20kg/m$^3$ in the cavity.

**Explanatory Information**

1. An enclosed perimeter means that the area beneath the floor is enclosed by a ground-to-floor wall complying with **5.4.** Air movement between the area beneath the floor and any wall cavities should also be stopped by the use of flashings or the like.
2. The ground-to-floor wall section can incorporate *required* sub-floor vents and still be considered to be enclosed.

## 5.4 Construction of external walls

The following forms of construction are deemed to achieve the following $R_W + C_{tr}$ ratings for walls *required* by Table **4.4**-

(a) ***$R_W + C_{tr}$*** of **50** – An *external wall* must comply with--

(i) a construction technique set out in the *Building Code* that is suitable for use in external applications and achieves an $R_W + C_{tr}$ of **50**; or

(ii) one or a combination of the following-

(A) two leaves of 110 clay masonry with-

(aa) a 50mm cavity between the masonry leaves; and

(bb) 50mm thick glass wool insulation with a density of 11kg/m³ or 50mm thick polyester insulation with a density of 20 kg/m³ in the cavity; or

(B) two leaves of 110 clay masonry with-

(aa) a 50mm cavity between the masonry leaves; and

(bb) 50mm thick glass or mineral wool insulation with a density of 11kg/m³ or 75mm thick polyester insulation with a density of 20 kg/m³ in the cavity; and

(cc) One layer of 13mm plasterboard battened 50mm from the inside face; or

(C) one leaf of 90mm thick brick masonry with-

(aa) a row of 7mm x 35mm timber studs or 64mm steel studs at 600mm centres; and

(bb) a 25mm cavity between the studs and the masonry; and

(cc) 75mm thick glass or mineral wool insulation with a density of 11kg/m³ or 50mm thick polyester insulation with a density of 14 kg/m³ positioned between the studs; and

(dd) one layer of 10mm plasterboard fixed to the inside face.

(D) single leaf of 220mm clay brick with-

(aa) 13mm render on the outside face; and

(bb) one layer of 13mm plasterboard fixed to the inside face.

(b) ***$R_W$ + $C_{tr}$* of 45** – An *external wall* must comply with--

(i) a construction technique set out in the *Building Code* or (a) that is suitable for use in external applications and achieves an $R_W + C_{tr}$ of **45** or **50**; or

(ii) one or a combination of the following-

(A) one row of 90mm studs at 600 centres with-

(aa) resilient steel channels fixed to the outside of the studs; and

(bb) 9.5mm hardboard, 9mm fibre cement sheeting or 11mm fibre cement weatherboard cladding fixed to the outside of the channels; and

(cc) not less than 75mm thick glass or mineral wool insulation, having a minimum density of 11 kg/m$^3$, or 75mm thick polyester insulation with a density of 14 kg/m$^3$, positioned between the studs; and

(dd) two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs; or

(B) one row of 90mm studs at 600 centres with-

(aa) resilient steel channels fixed to the outside of the studs; and

(bb) one layer of 19mm board cladding fixed to the outside of the channels and 6mm fibre cement sheets fixed to the inside of the channels; and

(cc) not less than 75mm thick glass or mineral wool insulation, having a minimum density of 11 kg/m$^3$, or 75mm thick polyester insulation with a density of 14 kg/m$^3$, positioned between the studs; and

(dd) two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs.

(b) ***$R_W$ + $C_{tr}$* of 40** – An *external wall* must comply with--

(i) a construction technique set out in the *Building Code* or (a) that is suitable for use in external applications and achieves an $R_W + C_{tr}$ of **40, 45** or **50**; or

(ii) one or a combination of the following-

(B) one row of 90mm studs at 600 centres with-

(aa) 9.5mm hardboard, 9mm fibre cement sheeting or 11mm fibre cement weatherboard cladding fixed to the outside of studs; and

(bb) not less than 75mm thick glass or mineral wool insulation, having a minimum density of 11 kg/m3, or 75mm thick polyester insulation with a density of 14 kg/m$^3$, positioned between the studs; and

(cc) two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs; or

(B) one row of 90mm studs at 600 centres with-

(aa) steel channels fixed to the outside of the studs; and

(cc) one layer of 19mm board cladding fixed to the outside of the channels and 6mm fibre cement sheets fixed to the inside of the channels; and

(dd) not less than 75mm thick glass or mineral wool insulation, having a minimum density of 11 kg/m$^3$, or 75mm thick polyester insulation with a density of 14 kg/m$^3$, positioned between the studs; and

(ee) one layer of 16mm fire-protective grade plasterboard fixed to the inside face of the studs.

## 5.5 Windows and external doors

(a) *Windows* - to achieve the $R_W + C_{tr}$ ratings *required* by Table **4.5,** *windows* must be-

(i) one of the *window* types listed in Table **5.1** that meets the $R_W + C_{tr}$ level *required* by Table **4.5,** with seals fitted to each edge of the openable *window* to restrict air infiltration; or

(ii) a window type that has been verified by the manufacturer as having the $R_W + C_{tr}$ level *required* by Table **4.5.**

(b) External glazed doors - to achieve the *required* $R_W + C_{tr}$ ratings in Table **4.5,** *external glazed doors* must be-

(i) one of the door types listed in Table **5.1** that meets the $R_W + C_{tr}$ level *required* by Table **4.5**, with seals fitted to each edge of the door to restrict air infiltration and glazing set and sealed in an airtight, non-hardening sealant or a soft elastomer gasket or glazing tape; or

(ii) a window type that has been verified by the manufacturer as having the $R_W + C_{tr}$ level *required* by Table **4.5.**

(c) External doors (other than glazed doors) - to achieve the *required* $R_W + C_{tr}$ ratings in Table **4.4,** external doors must be-

(i) one of the door types listed in Table **5.1** which meets the $R_W + C_{tr}$ level *required* by Table **4.4**, with seals fitted as follows-

(A) external side hinged doors must have compressible seals positioned around the door perimeter and a drop seal across the bottom of the door (brush seals do not comply) to provide an air tight system when closed; and

(B) external sliding doors must incorporate a seal to restrict air infiltration fitted to each edge of the door.

(d) A seal required to meet (a), (b) may be a foam or rubber compressible strip or a fibrous seal with vinyl fin interleaf or the like (brush type seals do not comply).

## 5.6 Roof and ceiling construction

The following form of construction is deemed to achieve the $R_W + C_{tr}$ ratings for roofs and ceilings *required* by Table **4.4**-

(a) the roof has metal sheet roof cladding or a tiled roof system that complies with the *Building Code*; and

(b) the ceiling is a plasterboard ceiling selected from Table **5.2** that meets the $R_W + C_{tr}$ level *required* by Table **4.4**, fixed to the underside of the joists or roof trusses ;and

(c) the roof space has-

(i) a minimum of 165mm thick glass wool or rock wool insulation with a minimum density of 7 kg/m$^3$; or

(ii) a minimum of 185mm thick polyester insulation with a minimum density of 11kg/m$^3$

installed above the ceiling.

**Table 5.1 - Acceptable forms of construction for *windows* and *external doors***

| ***Window* construction type: Single glass pane** | $R_W + C_{tr}$ |
|---|---|
| Aluminium or timber frame, employing fixed or operable sash, with either: | |
| (a) 3mm thick monolithic or laminated glass with sliding or double hung type opening | 22 |
| (b) 3mm thick monolithic or laminated glass with awning type opening | 25 |
| (c) 6mm thick monolithic or laminated glass with sliding or double hung type opening | 28 |
| (d) 6mm thick monolithic or laminated glass with awning type opening | 31 |
| (e) 10mm thick monolithic or laminated glass with awning type opening | 34 |
| (f) 6mm thick monolithic or laminated glass, 100mm airgap, 5mm monolithic or laminated glass for both with awning and sliding type openings | 37 |
| **Door construction type: Glazed, single glass pane** | $R_W + C_{tr}$ |
| Aluminium or timber frame, employing fixed or operable sash, with either: | |
| (a) 6mm thick monolithic or laminated glass sliding door | 28 |
| (b) 6mm thick monolithic or laminated glass side-hung door | 31 |
| (c) 10mm thick monolithic or laminated glass sliding door | 31 |
| (d) 10mm thick monolithic or laminated glass side-hung door | 34 |
| (e) 12mm thick laminated glass, minimum 10mm airgap, 10mm thick laminated glass for sliding type openings | 37 |
| **Door construction type: Timber solid core** | $R_W$ |
| 40mm thick solid core door, side hinged | 30 |
| **Door construction type: Timber solid core with glass inserts** | $R_W$ |
| 40mm thick solid core door, side hinged, with: | |
| (a) Not less than 6mm glass inserts (monolithic or laminated glass acceptable) | 30 |

**Table 5.2 - Acceptable forms of construction for ceiling systems**

| Description | $R_W+C_{tr}$ |
|---|---|
| (a) one layer of 10mm plasterboard | 35 |
| (b) two layers of 10mm plasterboard | 40 |
| (c) one layer of 10mm plasterboard plus 50mm 12 kg/m³ glass fibre blanket between ceiling joists | 40 |
| (d) one layer of 16mm fire rated plasterboard | 40 |
| (e) two layers of 13mm fire rated plasterboard fixed to furring channels to the underside of the joists or trusses | 45 |
| **Explanatory information:** Cathedral ceilings are not suitable where the *required* $R_W + C_{tr}$ rating is more than 40 (bedrooms in exposure category 4) unless the ceiling is supported on separate furring channels. | |

## 5.7 Ventilation systems

Where natural ventilation is provided through windows and doors, the windows and doors must comply with the insulation requirements for windows and doors in sections **4.5** and **5.5.**

Where the *sound exposure category* is 4, a mechanical ventilation system complying with Australian Standard *AS 1668.2 - The use of mechanical ventilation and air-conditioning in buildings* must be provided; and

(a) relief air paths (or evaporative air conditioning) must be fully ducted to allow for the operation of the system with *windows* and external doors closed; and

(b) the fresh air (or make up air) inlets and exhaust air outlets shall be at a point on the building furthest from the *designated sound source* where practicable.

## 5.8 Penetrations

Penetrations through the building envelope by pipes, ducts, conduits or the like must have the space between the *building envelope* and the pipes, ducts, conduits or the like sealed air tight with flexible caulking compound or filled with mortar.

## APPENDIX A – PERFORMANCE SOLUTIONS

**A1.1** A *Performance Solution* can be achieved by demonstrating compliance with performance requirement 2.1 in accordance with the methods outlined in Parts A2 and A5 of the *Building Code.*

**A1.2** In a *Performance Solution*, internal sound levels for a proposed building can be calculated-

(a) using the highest applicable *sound spectrum level* identified by adding the applicable *sound source level* for a *designated sound source* given in Tables **A1.2** and **A1.3** to the applicable spectral adjustment levels given in Table **A1.4**; and

(b) using a recognised acoustic prediction method that takes into account-

(i) the distance the *building envelope* is from the *designated sound source*, which for this purpose is to be taken as the acoustic centre of the *transport corridor.* For wide roads with a central median strip separating lanes (or similar), the equivalent energy of the *designated sound source* may be split across two line sound sources on either side of the road in accordance with standard modelling practice;

(ii) any shielding provided by adjacent permanent structures or topography;

(iii) the *façade sound reduction* properties of the proposed *building envelope* on the basis of verifiable test data for elements of the *building envelope*;

(iv) windows and doors being closed; and

(v) ventilation being provided with outside air to maintain air quality in *habitable rooms*.

**A1.3** For buildings adjacent to *transport corridors*, the *sound source levels* set out in Tables **A1.2** and **A1.3** and the spectral adjustment levels set out in Table **A1.4** must be used to determine the applicable sound spectrum levels to be used in developing a *Performance Solution.*

**A1.4** Alternatively, external *sound exposure categories* for a proposed building adjacent to *transport corridors* can be calculated-

(a) using the highest applicable *sound source level* for a *designated sound source* given in Tables **A1.2** and **A1.3**;

(b) using a recognised acoustic prediction method that takes into account-

(i) the distance the *building envelope* is from the *designated sound source,* which for this purpose is taken to be at a point 3m inside the boundary of the *transport corridor*; and

(ii) any shielding provided by adjacent permanent structures or topography.

(c) comparing the predicted sound levels to the *sound exposure category* levels provided in Table **A1.1**.

**Table A1.1 – Sound exposure category levels**

| ***Sound exposure category*** **[km/hr]** | **Sound exposure level at the facade [*dB(A)*]** |
|---|---|
| 1 | 59 |
| 2 | 63 |
| 3 | 67 |
| 4 | 71 |
| 5 | 75 |

**Table A1.2 - *Sound source levels* for roads**

| Road Source | Maximum Road Speed limit [km/h] | $L_{eq\ night}$ at 10m [*dB(A)*] |
|---|---|---|
| **Type A** | 60 | 71 |
| | 90 | 73 |
| | 110 | 75 |
| **Type B** | 60 | 68 |
| | 90 | 70 |
| | 110 | 72 |
| **Type R** | 60 | 65 |
| | 90 | 67 |
| | 110 | 69 |

**Table A1.3 - *Sound source levels* for rail**

| Rail Source | $L_{eq\ night}$ at 10m [*dB(A)]* |
|---|---|
| **Train** | 62 |
| **Tram** | 58 |

**Table A1.4 *Spectral adjustment levels* for *designated sound sources***

| *Designated sound source* | Octave band centre frequency (Hz) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **63** | **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **Road** | -18 *dB(A)* | -14 *dB(A)* | -10 *dB(A)* | -7 *dB(A)* | -4 *dB(A)* | -6 *dB(A)* | -11 *dB(A)* |
| **Train** | -21 *dB(A)* | -10 *dB(A)* | -11 *dB(A)* | -6 *dB(A)* | -4 *dB(A)* | -8 *dB(A)* | -14 *dB(A)* |
| **Tram** | -22 *dB(A)* | -15 *dB(A)* | -8 *dB(A)* | -7 *dB(A)* | -8 *dB(A)* | -5 *dB(A)* | -9 *dB(A)* |

Note – The sound source levels in Tables **A1.2** and **A1.3** have been determined based on the following assumptions-
(a) the sound source originates at a height of 0.5m above finished ground level; and
(b) the sound is received at the façade at a height of 1.5m above finished ground level.

**Explanatory information:**

A *Type A road* with a posted speed limit of 60km/h would have the following sound spectrum at 10m.

| **Sound Source** | **Octave band centre frequency (Hz)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **63** | **125** | **250** | **500** | **1000** | **2000** | **4000** |
| **Type A, 60 km/h** | 71 | 71 | 71 | 71 | 71 | 71 | 71 |
| **Road spectral levels** | -18 | -14 | -10 | -7 | -4 | -6 | -11 |
| **Sound spectrum** ***dB(A)*** $L_{eq, night}$ | **53** | **57** | **61** | **64** | **67** | **65** | **60** |

**A1.5** For buildings adjacent to an *entertainment venue,* the *sound source levels* can be obtained by measuring the music sound levels at the nearest future envisaged point on the *building envelope* (or at an equivalent distance from the sound source) during a period when the entertainment venue is operating under its entertainment licence.

## APPENDIX B – INTERPRETATION

**Acoustic centre** means the centre of the existing or future envisaged *transport corridor* line sound source.

**Aged care building** has the same meaning as defined in the *Building Code.*

**Building Code** means Volume One and Volume Two of the National Construction Code published by the Australian Building Codes Board as amended from time to time.

**Building envelope** means those parts of a building's fabric that separate an internal *habitable room* from the exterior of the building. Reference to the *building envelope* includes parts of a *building envelope.*

**dB(A)** means 'A' weighted overall sound pressure levels expressed in units of decibels.

**Deemed-to-Satisfy Provisions** has the same meaning as defined in the *Building Code.*

**Designated sound source** means a Type A, B or R road or a train or tram rail corridor or an existing *entertainment venue* identified as such on a Noise and Air Emissions Overlay to the Planning and Design Code.

A *designated sound source* may be one or more of the following noise sources identified as such in a Noise and Emissions Overlay to the Planning and Design Code-

(a) a road corridor that is-

  (i) a Type A major urban corridor;

  (ii) a Type B urban corridor; and

  (iii) a Type R rural freight route; or

(b) a ***rail corridor*** that is-

  (i) a train line;

  (ii) a tram line; or

(c) an existing *entertainment venue.*

**Entertainment venue** means an existing Class 9b assembly building (as defined in the *Building Code*), that provides live entertainment utilising amplified music and has a licence under the *Liquor Licensing Act 1997* (SA) to operate beyond 2.00am and has been identified as a *designated sound source* in a Noise and Air Emission Overlay to the Planning and Design Code due to the level of noise generated from the premises.

**Exposed façade** means the elevation or external wall of a building facing the main noise source.

**External glass door** means an external door with more than 40% of the area of the door being glass.

**External wall** has the same meaning as defined in the *Building Code.*

**Facade sound reduction** means the reduction in external to internal sound level provided by the façade of the *building envelope* exposed to the *designated sound source*.

**Floor area** means, in relation to a room, the area of the room measured within the finished surfaces of the walls, and includes the area occupied by any cupboard or other built-in furniture, fixture or fitting.

**Habitable room** has the same meaning as defined in the *Building Code,* other than an enclosed kitchen.

$L_{eq,1hr}$ means the averaged equivalent sound energy level, averaged over a one hour time period.

**Mixed land use area** means an area identified in a Noise and Air Emission Overlay to the Planning and Design Code as a *noise attenuation area*, within which residential buildings may require attenuation from increased noise levels arising from mixed uses. For areas identified as mixed land use areas in a Noise and Emissions Overlay to the Planning and Design Code, the sound is non-directional and not specific to a particular location.

**Noise attenuation area –** an area identified in a Noise and Air Emission Overlay to the Planning and Design Code, within which residential buildings may require attenuation from a *designated sound source*.

**Performance Requirement** has the same meaning as defined in the *Building Code.*

**Performance Solution** has the same meaning as defined in the *Building Code.*

**Professional acoustic engineer** means a person who is –

(a) a member of the Australian Acoustical Society (AAS) and the Institute of Engineers Australia (IEAust), or

(b) eligible to become a member of the Australian Acoustical Society (AAS) and the Institute of Engineers Australia (IEAust).

**$R_W$** (Weighted Sound Reduction Index) means a measure of the sound attenuation performance of a building element, measured in controlled conditions in a laboratory.

**$R_W+C_{tr}$** means a weighted sound reduction index with spectrum adaptation placing greater emphasis on low frequency performance.

**Required** means required to satisfy a *Performance Requirement* or a *Deemed-to-Satisfy Provision* as appropriate.

**Separation distance** means the shortest distance (to the nearest metre), from an existing or future *designated sound source* to the nearest point of the *building envelope* bounding a *habitable room* exposed to the *designated sound source.*

The *separation distance* is determined by-

(a) For roads and rail lines – measuring the shortest distance between the *building envelope* and the *designated sound source,* which for this purpose is taken to be at a point 3m inside the boundary of the *transport corridor* at a point closest to the building.

(b) For existing *entertainment venues* – measuring the shortest distance between the *building envelope* and the *designated sound source,* which for this purpose is taken to be the *entertainment venue's* allotment boundary.

**Sound exposure category** means the degree to which a *habitable room* within a building is likely to be affected by external sound received by the *building envelope*.

**Sound source** means a road, rail line or *entertainment venue* subject to this Standard.

**Sound source level** means a prescribed sound level for a *designated sound source* to be used in proposing a *Performance Solution*.

**Spectral adjustment levels** means a prescribed sound level adjustment to be made to the *designated sound source level* for the purpose of calculating the *facade noise reduction* across the *building envelope*.

**Train line** means a railway identified as a *designated sound source* in a Noise and Air Emissions Overlay to the Planning and Design Code.

**Tram line** means a tramway identified as a *designated sound source* in a Noise and Air Emissions Overlay to the Planning and Design Code.

**Transport corridor:** means an area of land identified in the Noise and Air Emissions Overlay to Planning and Design Code for an existing or future *train* or *tram line* or an existing or future *Type A, Type B* or *Type R road*.

**Type A road** means a metropolitan road identified as a *designated sound source* in a Noise and Emissions Overlay to the Planning and Design Code because it-

- is designed to have more than 50,000 vehicles per day; or
- is a primary freight route (not rural).

**Type B road** means a metropolitan road identified as a *designated sound source* in a Noise and Emissions Overlay to the Planning and Design Code because it–

- is designed to have between 25,000 – 49,999 vehicles per day (vpd);
- is a freight route;
- is a DPTI major traffic route; or
- is the basis for a growth corridor.

**Type R road** means a rural road identified as a *designated sound source* in the Noise and Emissions Overlay to the Planning and Design Code because it is a primary freight route.

**Window** has the same meaning as defined in the *Building Code.*

## APPENDIX C – REFERENCED DOCUMENTS

A reference to an Australian Standard in this Standard is to the edition that is current for the purposes of the *Building Code* at the time of application.

**Table C1.1 – Schedule of referenced standards and documents**

| No | Title |
|---|---|
| AS 1668.2<br>Part 2 | The use of ventilation and air-conditioning in buildings –<br>Mechanical ventilation in buildings |
| ISO 717.1<br>Part 1 | Acoustics – Rating of sound insulation in buildings and of building elements – Airborne sound insulation |

## APPENDIX D – GUIDE

### D1.0 - Measurement of *separation distance*

Figures **D1.1** to **D1.3** illustrate how *separation distances* for roads and rail lines are determined.

The *separation distance* between the *building envelope* and the *sound source* is measured in a straight line from any point measured from 3m inside the *transport corridor* (ie 3m from the boundary of the *transport corridor*) to any point on the building façade that faces the *transport corridor* (ie an external wall or part thereof that is exposed to the *sound source*)**.**

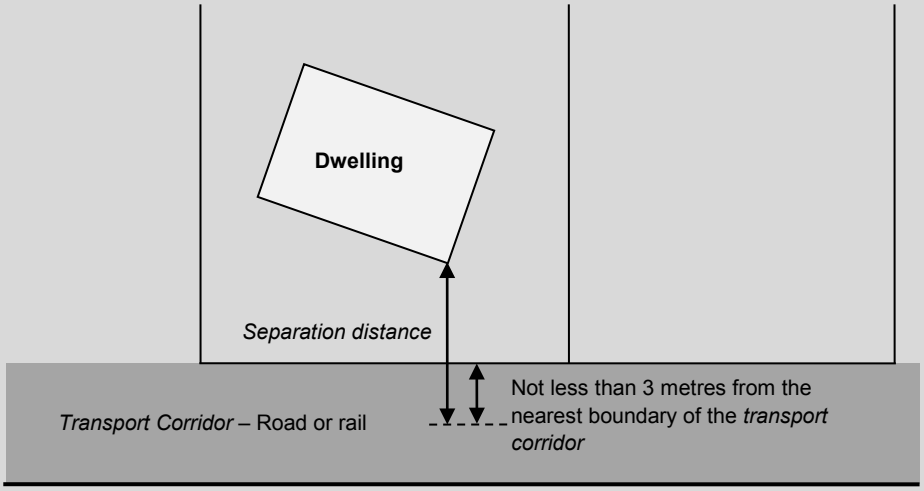


**Figure D1.1 – Measuring the *separation distance* for dwelling adjacent a road or rail line**

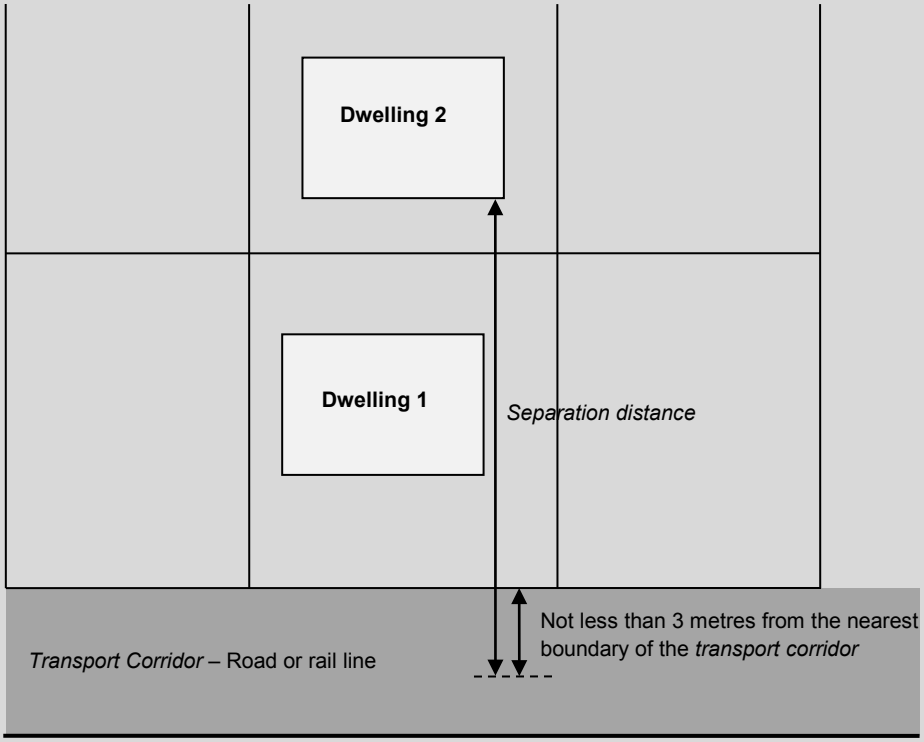


**Figure D1.2 - Measuring the *separation distance* for dwelling 2 adjacent a road or rail line**

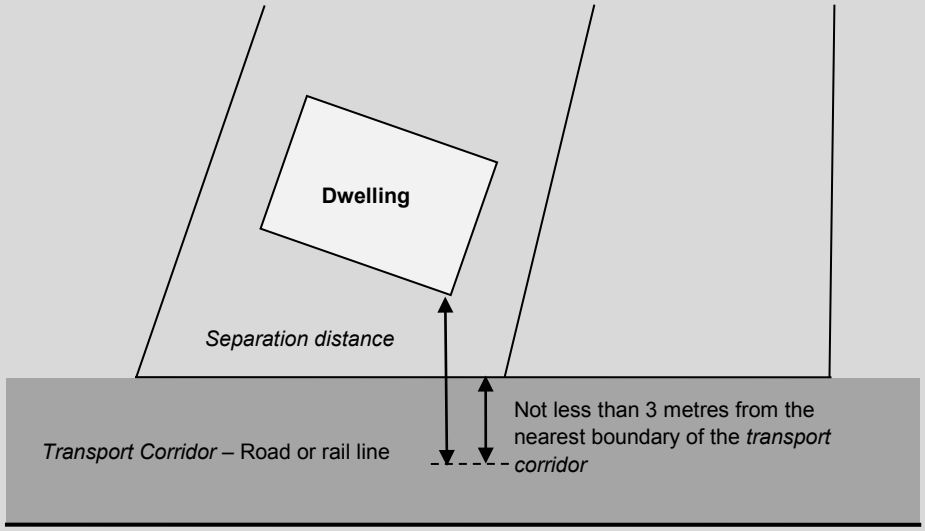


**Figure D1.3 – Road or rail *separation distance* definition**

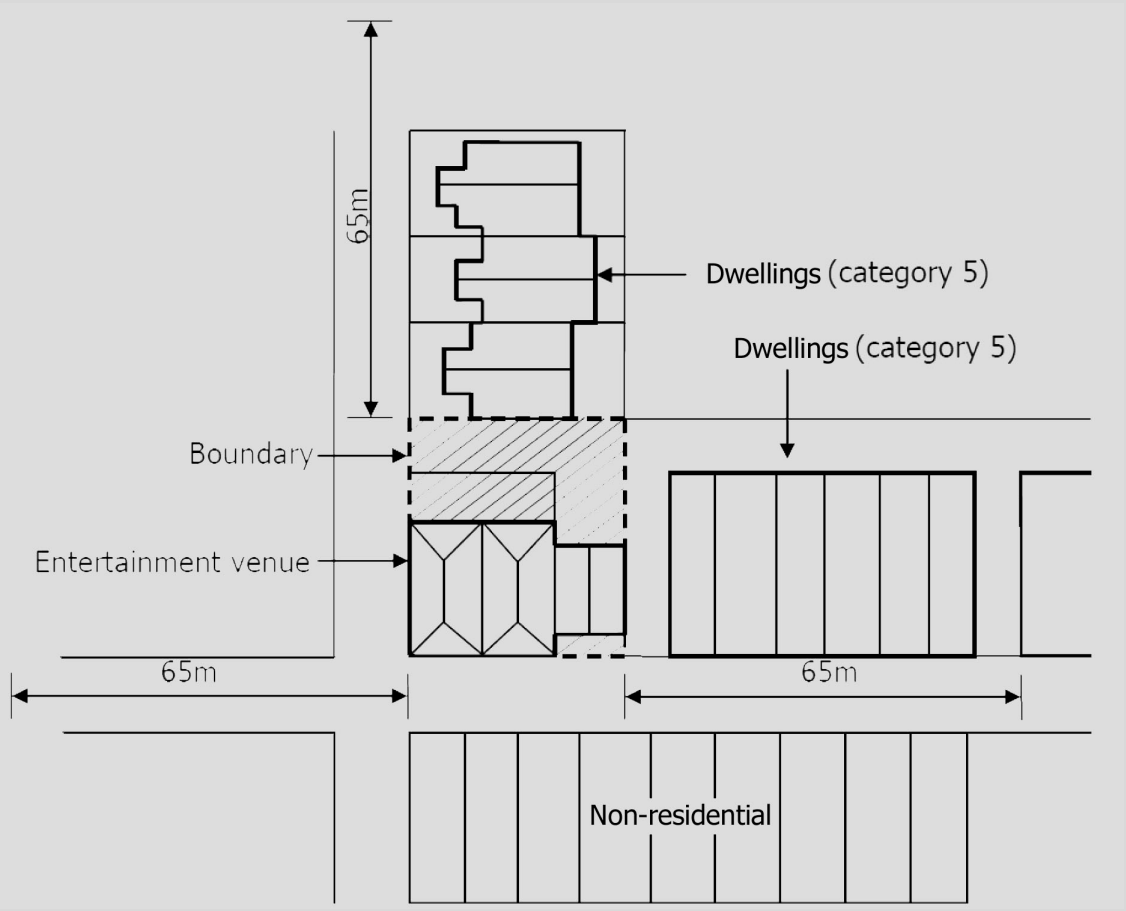


**Figure D1.4 – A plan showing the applicable *separation distance* for an *entertainment venue***

The separation distance for an *entertainment venue* is taken from the allotment boundary of the *entertainment venue.*

**D2.0 - *Façade sound reduction***

The *façade sound reduction* to be provided by the *building envelope* for each *sound exposure category* is based on a base reduction of 20 *dB(A)* for standard construction, increasing by 4 dB increments for Category 1 and for each subsequent *sound exposure category* as shown below.

| ***Sound exposure category*** | **Sound attenuation *dB(A)*** |
|---|---|
| 1 | 24 |
| 2 | 28 |
| 3 | 32 |
| 4 | 36 |
| 5 | 40 |

Knowing the external sound level at the facade and the desired internal sound level then determines the *façade sound reduction required* as expressed in the *sound exposure category*.

**D3.0 - Windows and doors**

The weak point for noise transmission in any facade will be the doors and *window*s, particularly-

(a) the ability of the glazing to provide the necessary sound attenuation; and

(b) the quality of the sealing around the whole of the frame and round any openable sections.

As the area of *windows* increases, the benefits of the rest of the facade (for providing sound insulation) is progressively compromised to the point where the *window* is the whole of the facade.

**D4.0 - Sound exposure categories for different facades of the *building envelope***

Where the *designated sound source* is a *transport corridor* the most exposed facades are those that have a direct line of sight to the *transport corridor*.

Facades that are not directly exposed to the *designated sound source* (generally the facade opposite the most affected facade) are deemed to have a *sound exposure category* one less than that applying to an adjoining façade which is directly exposed to the *designated sound source*.

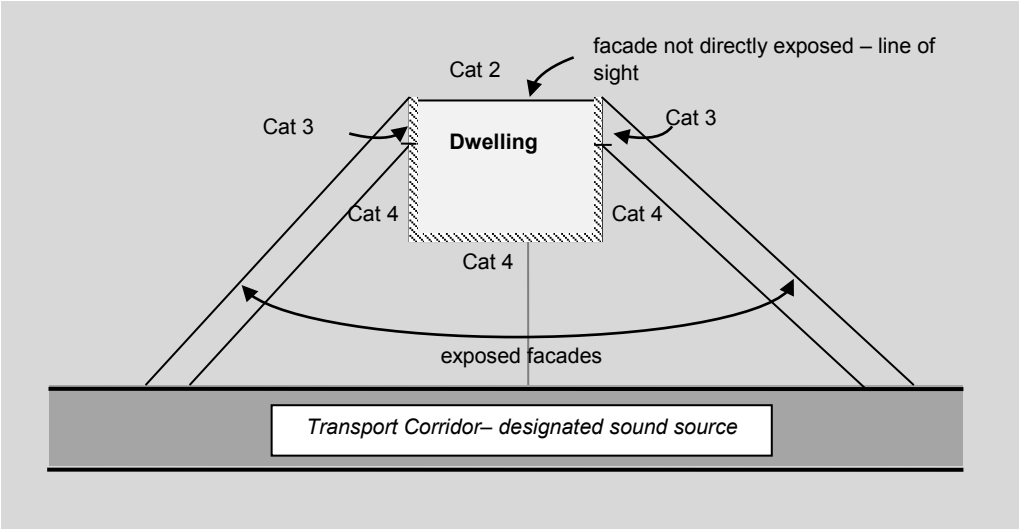


**Figure D4.1 – A plan example of sound exposure categories for facades**

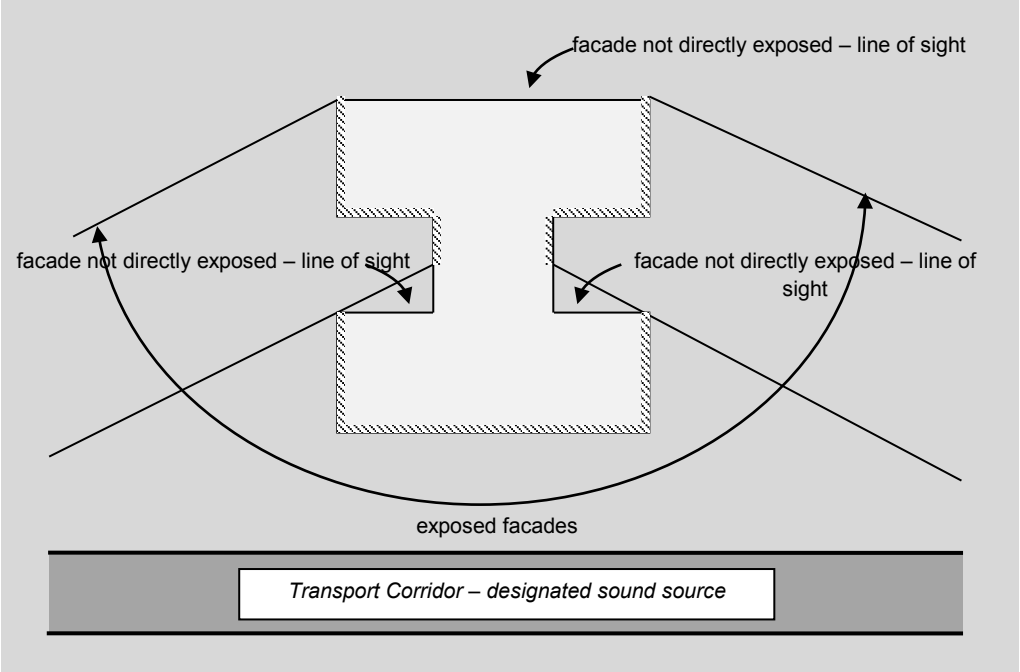


**Figure D4.2 - Exposed facades and facade categories example**