

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 Air 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 Air 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 noise levels that may 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**.

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) _{Leq, night}	35 dB(A) _{Leq,night}
Other habitable rooms	35 dB(A) _{Leq, night}	40 dB(A) _{Leq, night}

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 1, 2, 3 and 4 buildings and Class 9c buildings located in *noise attenuation areas* identified in the Noise and Air Emissions Overlay to the Planning and Design Code as being exposed to a *designated sound source* or to higher levels of background noise that can arise in *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**; and
- (b) 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**;
 - (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* within a *noise attenuation area* that is exposed to a *designated sound source* is determined for a *transport corridor* according to its noise category and the *separation distance* between the building and 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 **Mixed land use areas** - The *sound exposure category* for the *building envelope* of a building located within a *noise attenuation area* but which is not exposed to a *designated sound source*, is to be taken as *sound exposure category* 1.
- 4.3.3 **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.
- 4.3.4 **Shielding** – Where a part of a building facade is not exposed to a *designated sound source* but adjoins another part that is exposed, the *required category* to be applied to the part that is not exposed is a *sound exposure category* one category less than that *required* for the exposed part.
- 4.3.5 **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 – Sound exposure category for designated sound sources - Type A and Type B roads

Sound exposure category	Separation distance* between a building and a Type A Road (metres)			Separation distance* between a building and a 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 < 95m	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 for designated sound source – Type R roads

Sound exposure category	Separation distance* between a building and a 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 than 15m	10 < 20m
4	N/A	N/A	less than 10m
5	N/A	N/A	N/A

* The separation distance for Type A, B and R roads is measured from a point 3m inside the road corridor (refer to diagrams in Appendix D), whereas for tram and train lines it is measured from the actual rail line.

Table 4.3 – Sound exposure category for designated sound source – Rail

Sound exposure category	Separation distance* between a building and a tram line	Separation distance* between a building and a train line
1	10 < 20m	25 < 50 m
2	less than 10m (see Note 2)	10 < 25 m
3	Not applicable	less than 10 m (see Note 2)
4	Not applicable	Not applicable
5	Not applicable	Not applicable

Note 1 – 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.

Note 2 - This Standard 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.

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	<i>External walls</i>	$R_w + C_{tr}$ 40 for all <i>habitable rooms</i>
	<i>Windows and external glass doors</i>	See Table 4.5
	Mechanical ventilation systems	R_w 25
2	Ground Floor	$R_w + C_{tr}$ 45 for all <i>habitable rooms</i>
	<i>External walls</i>	$R_w + C_{tr}$ 45 for all <i>habitable rooms</i>
	<i>Windows and external glass doors</i>	See Table 4.5
	<i>External doors other than external glass doors</i>	R_w 27 for all <i>habitable rooms</i>
	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 <i>habitable rooms</i>
	<i>External walls</i>	$R_w + C_{tr}$ 50 for all <i>habitable rooms</i>
	<i>Windows and external glass doors</i>	See Table 4.5
	<i>External doors, other than external glass doors, to all habitable rooms</i>	R_w 30
	Roof and Ceilings	$R_w + C_{tr}$ 40 for bedrooms $R_w + C_{tr}$ 35 all other <i>habitable rooms</i>
	Mechanical ventilation systems	R_w 30

Sound exposure category	Sound insulation requirements	
4	Ground Floor	$R_W + C_{tr}$ 50 for all <i>habitable rooms</i>
	External walls	$R_W + C_{tr}$ 50 for all <i>habitable rooms</i>
	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 <i>habitable rooms</i> other than bedrooms
	Roof and Ceilings	$R_W + C_{tr}$ 45 for bedrooms $R_W + C_{tr}$ 40 for all other <i>habitable rooms</i>
	Mechanical ventilation systems	R_W 35 and complying with 5.7
5	Outside the scope of the <i>Deemed-to-Satisfy Provisions</i> .	Assess against the relevant <i>Performance Requirements</i> 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	Not more than 20%	25	28	31	34	37	
	More than 20% but not more than 40%	28	31	34	37	PS	
	(b) A non-habitable room attached to (a)	More than 40% but not more than 60%	31	34	37	PS	PS
		More than 60% but not more than 80%	34	37	PS	PS	PS
		More than 80%	37	PS	PS	PS	PS
(c) Habitable room, other than a bedroom and an enclosed kitchen	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	PS	
	(d) A non-habitable room attached to (c)	More than 60% but not more than 80%	31	34	37	PS	PS
		More than 80%	34	37	PS	PS	PS

PS - 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

Forms of construction in 5.3 and 5.4 that are used to achieve the *required* $R_w + C_{tr}$ ratings must be installed in accordance with the requirements for sound insulation in section 2 of Specification F5.2 of Volume One of the *Building Code* or clauses 3.8.6.4 and 3.8.6.5 of Volume Two of the *Building Code* as applicable to the relevant building classification.

5.3 Construction of floors

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

- (a) a floor in direct contact with the ground, such as a concrete slab-on-ground or the like; or
- (b) a suspended floor, other than an intermediate floor in a building with more than one storey and floors with an enclosed perimeter, that is-
 - (i) a minimum 150mm thick concrete slab; or
 - (ii) 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/m²) 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/m³ or minimum 50mm thick polyester insulation with a minimum density of 20kg/m³ in the cavity; or
 - (iii) 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/m²) 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/m³ or minimum 50mm thick polyester insulation with a minimum density of 20kg/m³ 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 for walls, installed in accordance with the relevant general installation requirements for walls in clauses 3.8.6.4 and 3.8.6.5 of Volume Two of the *Building Code*, or the installation methods in section 2 of Specification F5.2 in Volume One of the *Building Code*, are deemed to achieve the following $R_W + C_{tr}$ ratings for walls as *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 70mm 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/m³, or 75mm thick polyester insulation with a density of 14 kg/m³, 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/m³, or 75mm thick polyester insulation with a density of 14 kg/m³, 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/m³, 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/m³, or 75mm thick polyester insulation with a density of 14 kg/m³, 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 one of the following types of insulation installed above the ceiling-
 - (i) a minimum of 165mm thick glass wool or rock wool insulation with a minimum density of 7 kg/m³; or
 - (ii) a minimum of 185mm thick polyester insulation with a minimum density of 11kg/m³.

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 thick, 12 kg/m ³ 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
<p>Explanatory information: Cathedral ceilings are not suitable where the <i>required</i> $R_W + C_{tr}$ rating is more than 40 (bedrooms in exposure category 4) unless the ceiling is supported on separate furring channels.</p>	

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 where practicable exhaust air outlets must be at a point on the building furthest from the *designated sound source*.

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** herein; 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 (eg a solid wall or fence, mounding of soil, dense vegetation etc);
 - (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 is measured from-
 - (A) for roads - from a point 3m inside the *transport corridor* boundary; and
 - (B) for rail - from the centre line of the rail line as shown on the overlay; 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

<i>Sound exposure category</i>	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

<i>Designated sound source</i>	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 - Worked example for a Type A road

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

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 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 Air Emissions Overlay to the Planning and Design Code-

- (a) a road transport corridor that is-
 - (i) a Type A major urban transport corridor;
 - (ii) a Type B urban transport corridor; or
 - (iii) a Type R rural freight route.
- (b) a rail corridor that is-
 - (i) a train line; or
 - (ii) a tram line.

Exposed facade means the elevation or external wall of a building facing the main *sound 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 in decibels (dB_A), averaged over a one hour time period.

$L_{eq,night}$ means the averaged equivalent sound energy level in decibels (dB_A) at night time, which is taken to be between the hours of 10.00pm -7.00am local time.

Mixed land use areas means areas within a *noise attenuation area* where residential buildings require attenuation due to increased noise levels that may arise from non-residential uses permitted in these areas, where 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 require attenuation to reduce the intrusion of unacceptable levels of external airborne sound.

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.

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 or rail line 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 Air Emissions Overlay to the Planning and Design Code.

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

Type R road means a rural road identified as a *designated sound source* in the Noise and Air Emissions Overlay to the Planning and Design Code.

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 Part 2	The use of ventilation and air-conditioning in buildings – Mechanical ventilation in buildings
ISO 717.1 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*).

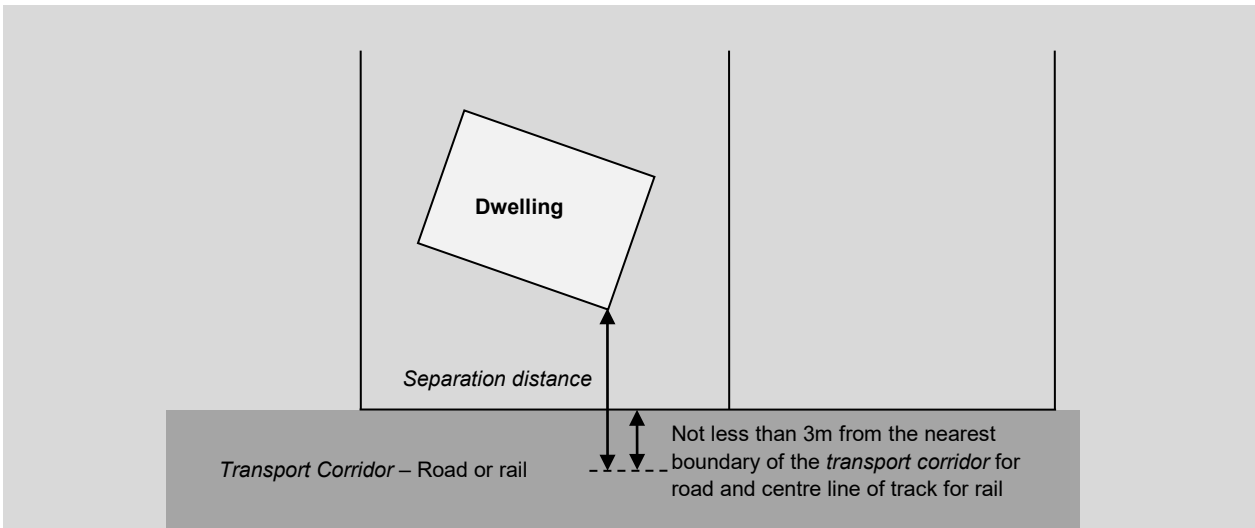


Figure D1.1 – Measuring the *separation distance* for dwelling adjacent a road or rail line

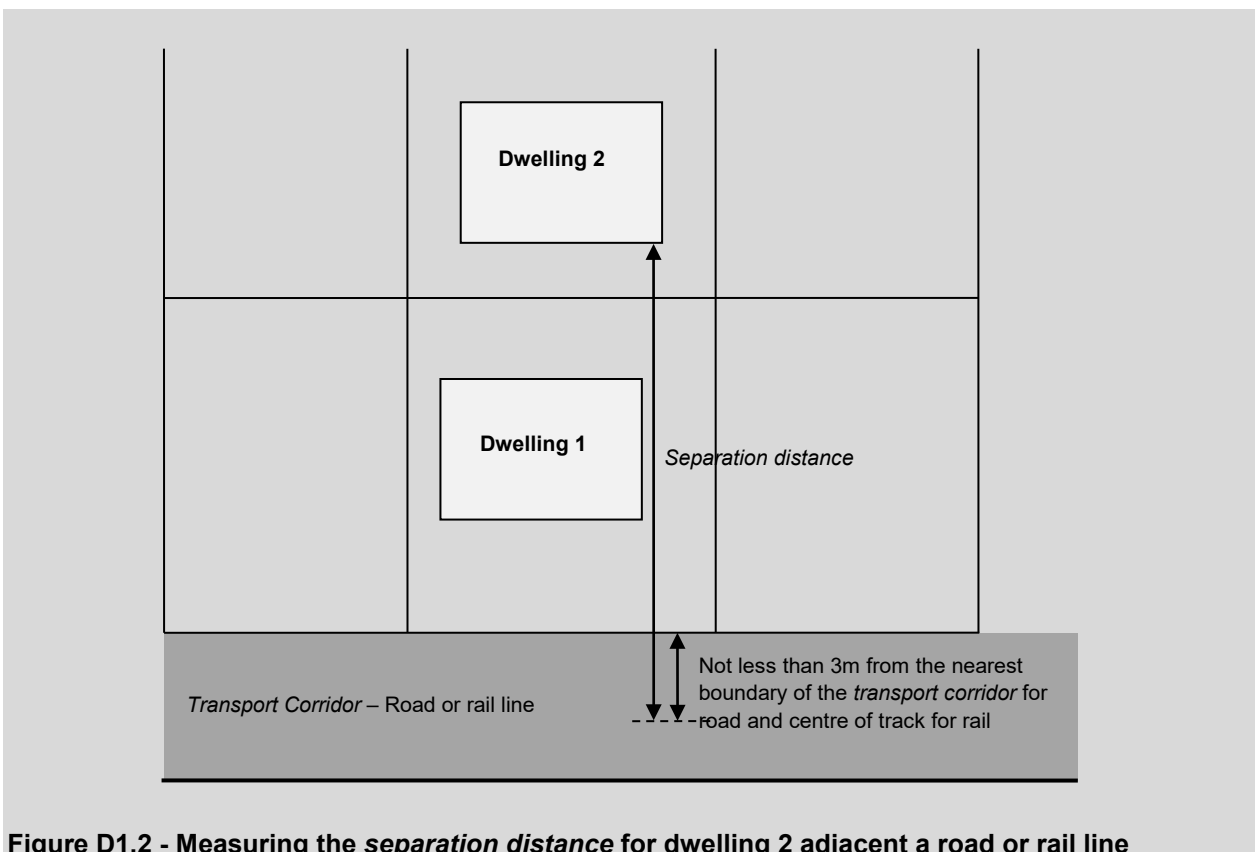


Figure D1.2 - Measuring the *separation distance* for dwelling 2 adjacent a road or rail line

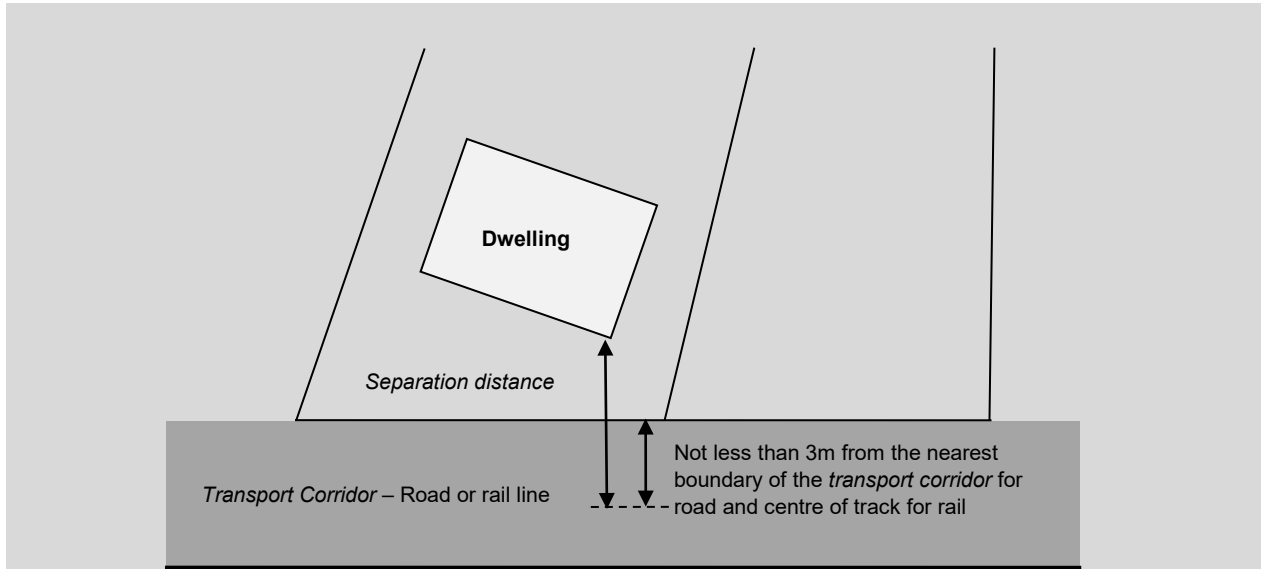


Figure D1.3 – Road or rail *separation distance* definition

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 20dB(A) for standard construction, increasing by 4dB 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 façade 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 façade will be the doors and *windows*, 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 façade (for providing sound insulation) is progressively compromised to the point where the *window* is the whole of the façade.

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 facade which is directly exposed to the *designated sound source*.

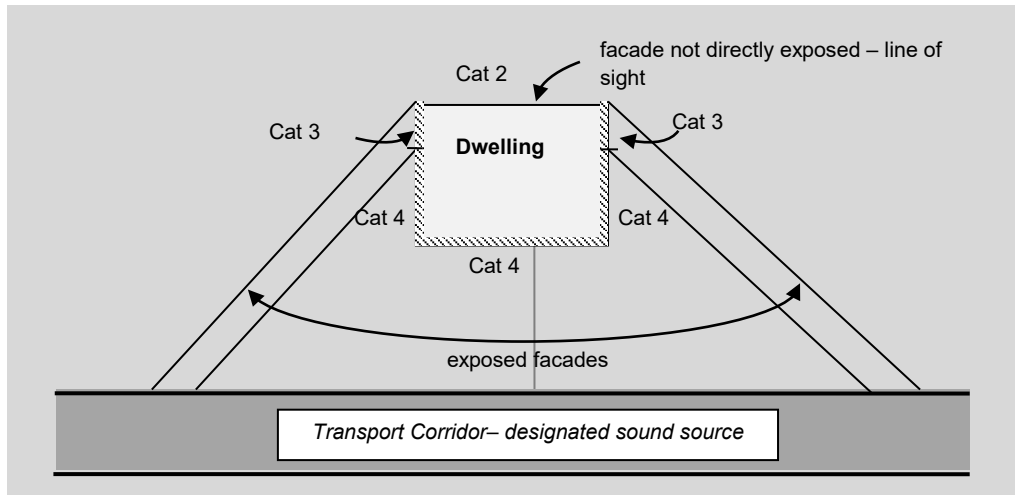


Figure D4.1 – A plan example of sound exposure categories for facades

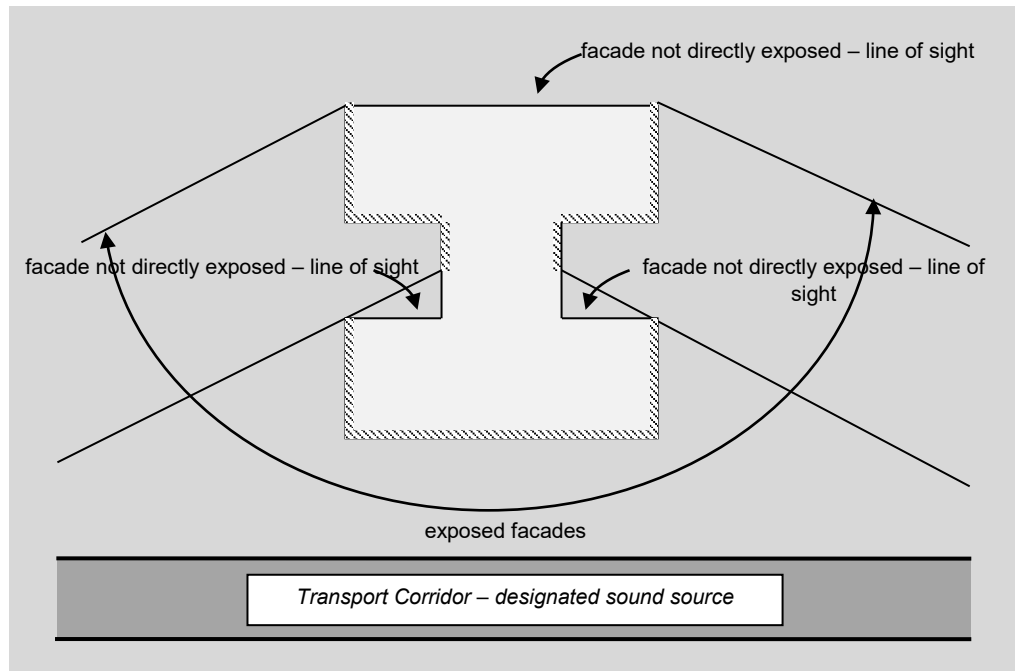


Figure D4.2 - Exposed facades and facade categories example