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20 October 2023 Ref. HB/11-291.R22

Peet Caboolture Syndicate Ltd
Level 3, 167 Eagle Street
Brisbane Q 4000

Attn: Ms Allie Sharp, Development Manager

Dear Ms Sharp,

Re. Peet Riverbank Stage 21, Caboolture South
Assessment and Control of Rail Noise Intrusion
Guidance for Purchasers of Lots 1482-1487 and 1493-1504
re Acoustical Design Requirements of QDC MP 4.4

Further to your request, we have undertaken an assessment of the extent of rail noise intrusion onto Stage 21 of the Peet Riverbank estate.

Thereafter, we have prepared this letter of guidance to assist purchasers of Lots 1482-1487 and 1493-1504 within Stage 21 with the acoustical design process to be adopted to adequately control rail noise intrusion into their particular residence.

1.0 Background

Queensland Development Code Mandatory Part 4.4 (QDC MP 4.4) *Buildings in a Transport Noise Corridor* was introduced on 1 September 2010. The current version of QDC MP 4.4 commenced on 17 August 2015, replacing the version introduced in 2010. The stated purpose of QDC MP 4.4 is "to ensure habitable rooms of Class 1, 2, 3 and 4 buildings located in a Transport Noise Corridor (TNC) are designed and constructed to reduce transport noise".

On 29 January 2020, under the provisions of Section 246Z and Section 246ZA of *Building Act 1975*, the State Government gazetted new TNC's for the Rail Network of Queensland. This includes North Coast Rail Line (NCRL), ie the section of the Rail Network of Queensland located immediately to the west of the Riverbank estate.

By reference to Queensland Government Gazette - *Extraordinary* No 21 of Vol 383 it is noted that the new mapping presented on the Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) State Planning Policy (SPP) Interactive Mapping System (IMS) supersedes all previous mapping.

Having regard to the mapping presented on the DSDMIP SPP IMS website, it is observed that, from 29 January 2020, land within 250m of NCRL has been designated as lying within the TNC associated with NCRL.

Importantly, the NCRL TNC designation is no longer limited to land lying within only 100m of NCRL, as previously applied between the period from 1 July 2015 to 28 January 2020 (inclusive). That is, the currently gazetted NCRL TNC has been extended by an additional 150m either side of the rail line compared to the prior TNC. The TNC now extends to include Lots 1482-1487 and 1493-1504.

In general, all residential allotments located within a TNC will need to be acoustically designed in accordance with the requirements of QDC MP 4.4 having regard to the relevant noise categories. The QDC MP 4.4 Noise Categories can be determined by reference to the DSDMIP SPP IMS website or in accordance with the alternative site-specific noise level assessment method [1].

An overview of QDC MP 4.4 is presented in Attachment A together with a summary of advice from DTMR regarding the application of AS3671 - 1989 *Acoustics - Road Traffic Noise Intrusion - Building Siting and Construction* to the acoustical design of residential premises within a TNC.

2.0 Determination of Acoustical Upgrade Requirements to Control Rail Noise Intrusion

In July 2020, a detailed site-specific noise level assessment of the extent of rail noise intrusion onto the site was undertaken. From results of this examination, it was determined that the actual level of rail noise intrusion onto Lots 1482-1487 and 1493-1504 of Stage 21 was substantially less than currently shown on the DSDMIP SPP IMS website.

Details of the assessment process and results are presented in Report No 11-291.R21.Rev1, dated 10 October 2022.

Having regard to each of Matters 1-3 presented in Attachment A, and ignoring any beneficial effect generated by future construction of any rail noise barriers, the rail noise model for Stage 21 has been configured to generate the actual QDC MP 4.4 Noise Categories that will apply to Stage 21 after taking account of (i) the existing residences in Stages 18A, 18B, 19A and 19B, as well as (ii) the revised design surface levels over Stage 21 and basin in Stage 22B.

The actual QDC MP 4.4 Noise Categories for rail noise intrusion are presented in Table 1 below.

Lot No	QDC MP 4.4 Noise Category by Floor Level		Lot No	QDC MP 4.4 Noise Category by Floor Level		Lot No	QDC MP 4.4 Noise Category by Floor Level	
	Ground	First		Ground	First		Ground	First
1482	0	0	1493	0	0	1500	1	1
1483	0	1	1494	0	1	1501	1	1
1484	0	1	1495	0	1	1502	1	1
1485	0	1	1496	0	1	1503	1	2
1486	1	1	1497	0	1	1504	1	2
1487	1	1	1498	1	1			
1492	0	0	1499	1	1			

Table 1 – Actual QDC MP 4.4 Noise Categories for Rail Noise Intrusion onto Stage 21 Without Attenuation Provided by Future Rail Noise Barriers to Stages 22A & 22B

[1] On advice from DTMR (and as noted in DTMR's Transport Noise Management Code of Practice, November 2013) as well as per Schedule 3 of QDC MP 4.4, building upgrade requirements may be determined either (i) by application of noise categories determined from the DSDMIP SPP IMS website, or (ii) from the results of the alternative site-specific noise assessment.

3.0 Guidance Re Acoustical Design and Certification Process

3.1 Rail Noise – Determination of QDC MP 4.4 Noise Categories for a Specific Residence

Having determined the QDC MP 4.4 Noise Categories for each lot from the information presented in Table 1 at Section 2.0 above, the extent of building upgrade that will be required to be implemented into a specific residence can be determined by one of two methods as discussed below:-

1. **Simple Method**: Having regard to Matters 1-3 of Attachment A, simply adopt the applicable QDC MP 4.4 Noise Categories above in Table 1 at Section 2.2. Thereafter, design the residence in accordance with Schedule 1 and Schedule 2 of QDC MP 4.4.

2. **Refined Method**: Having regard to Matters 1-5 of Attachment A, update the existing noise model to include the specific residence to be constructed on the particular lot.

   Then, by having regard to the beneficial shielding provided by (i) other already-constructed "approved" residences on intervening lots and (ii) the residence to be constructed on the particular lot itself, plot rail noise contours at fine gradation around the external facades of each habitable space within the residence being assessed.

   Thereafter for each habitable space, apply the calculation procedures of AS3671-1989 (after validation for rail noise intrusion as discussed in Attachment A) to determine the precise level of building upgrade (ie the R_w rating of each upgraded building element, or the building construction details for each specific building element to be upgraded) that will be required to be implemented into the design of the dwelling to achieve compliance with the relevant internal sound levels derived by QDC MP 4.4.

Note:

For residences located within QDC MP 4.4 Noise Category 1, the deemed-to-comply constructions are generally sufficiently benign that any savings in building costs that may accrue by carrying out a site-specific assessment in accordance with the Refined Method may be commensurate with the cost of conducting the site-specific assessment itself. The Refined Method is usually best suited to residences located in QDC MP 4.4 Noise Categories 2-4.

3.2 Building Design Upgrade Procedure Requirements

3.2.1 Simple Method Building Design Upgrade Procedure Requirements

Once the QDC MP 4.4 Noise Category/ies for a specific residence have been determined by the Simple Method, and having regard to the provisions of QDC MP 4.4, the extent of building upgrade deemed to be required to be applied to each habitable space of a residence may be determined by reference to Schedules 1 and 2 of QDC MP 4.4 as follows below:-

1. Schedule 1 of QDC MP 4.4 provides the R_w performance requirements (ie the acoustical ratings) for each facade element for each specific QDC MP 4.4 Noise Category, and
2. Schedule 2 of QDC MP 4.4 provides the deemed-to-comply building constructions, ie the "acceptable forms of construction", that are deemed to match the R_w performance requirements. As permitted under Acceptable Solution A1(b) of QDC MP 4.4, however, building constructions other than the deemed-to-comply constructions of Schedule 2 may be incorporated into the building design provided that, in each case, the building construction "achieves the minimum R_w value for the relevant building component and applicable noise category [2]".

[2] In instances where alternative building constructions are proposed, it would be prudent to ensure that confirmation is provided that the specific construction achieves the required minimum R_w rating required. This confirmation may be provided either by the supplier of the building element or by an RPEQ-registered acoustical engineer experienced in acoustical design.

To assist in this process, Schedules 1 and 2 of QDC MP 4.4 are reproduced in Appendix C.

Thereafter, to ensure that the residence is constructed in accordance with the required building upgrades, the building design drawings should be annotated to include the following:-

(i) Reference to the R_w ratings for specific building facade elements (eg windows) which are then to be used as a specification for supply of these facade elements, and

(ii) The specific deemed-to-comply constructions presented in Schedule 2 for the particular building facade element (eg external walls), or

(iii) In the case of other building elements where none of the specific deemed-to-comply constructions is to be incorporated into the building design (eg in the case of lightweight external wall constructions), an alternative building construction that "achieves the minimum R_w value for the relevant building component and applicable noise category".

3.2.2 Refined Method Building Design Upgrade Procedure Requirements

Once the schedules of (i) R_w ratings for each upgraded building element and/or (ii) the building construction details for each specific building element to be upgraded are prepared, as outlined above at Section 3.2, annotate the building design drawings to include these specific R_w ratings and/or the building construction details.

3.3 Documentation for Building Acoustical Design Certification

Certification of the adequacy of the acoustical design of the residence is a matter for sole determination by the Building Certifier.

To assist the Building Certifier in making this determination, it is to be expected that various documents will need to be supplied to the building certifier. The documentary requirements of the Building Certifier should be determined by making a request of the Building Certifier directly.

While the requirements of individual Building Certifiers will vary from one to another, it is likely that the following information will need to be provided in any event:-

- **Simple Method**:
  - (i) A copy of this letter of guidance
  - (ii) Building design drawings annotated to include:
    - a. the actual QDC MP 4.4 Noise Category applying to each level of the dwelling (extracted from Table 1), and
    - b. reference to the R_w ratings, specific deemed-to-comply constructions, and
    - c. where necessary, alternative building construction/s (plus supporting confirmation that the alternative construction/s comply with the R_w rating required) as discussed above at Section 3.2.1.
- **Refined Method**:
  - (i) A copy of this letter of guidance
  - (ii) A site-specific acoustical design review report for the specific residence listing:
    - a. the R_w ratings for each upgraded building element, and/or
    - b. the building construction details for each specific building element.
  - (iii) A completed Form 15 *Compliance Certificate for Building Design or Specification* to accompany the acoustic design review report.
  - (iv) Building design drawings annotated to include:

a. R_w ratings for each upgraded building element, and/or
b. the building construction details for each specific building element to be upgraded as discussed above at Section 3.2.2.

We trust that this information is adequate for your purposes at this stage, but should you require any further information, please do not hesitate to contact us.

Regards,
Acoustics RB Pty Ltd

Hugh Brown,
Senior Project Engineer
BEng(Mech)

Reviewed and approved by:

Russell Brown,
Director
RPEQ 2799

Attachment A

Overview of QDC MP 4.4 and Advice from DTMR

Under the provisions of Section 246Z and Section 246ZA of *Building Act 1975*, a Transport Noise Corridor (TNC) applies along both sides of North Coast Rail Line (NCRL).

In general, all residential allotments located within a TNC will need to be acoustically designed in accordance with the requirements of QDC MP 4.4 having regard to the relevant noise categories. The QDC MP 4.4 Noise Categories can be determined at BA by reference to the DSDMIP SPP IMS website or in accordance with the alternative site-specific noise level assessment method.

On advice from DTMR and as noted in DTMR's *Transport Noise Management Code of Practice*, November 2013, building upgrade requirements can be determined at BA either (i) by application of QDC MP 4.4 Noise Categories determined from the DSDMIP SPP IMS website, or (ii) from the results of the alternative site-specific noise assessment.

The alternative site-specific noise assessment allows the actual building upgrades that need to be incorporated into the design of the dwelling to be optimised. In most commonly encountered situations, and especially for residences located in QDC MP 4.4 Noise Categories 2, 3 and 4, the optimisation of building upgrades results in lower overall building costs relative to those that would be incurred using the deemed-to-comply constructions of QDC MP 4.4.

When applying the alternative site-specific noise assessment method to the determination of either the QDC MP 4.4 Noise Categories or the building upgrade requirements that apply to any specific residence located within a TNC, due consideration may be given to the following five (5) matters:-

1. Site topography.
2. Beneficial shielding provided by any barriers – either existing or required to be constructed as a condition of the approval of the Development Application over the subject site.
3. Acoustical shielding provided by existing and approved buildings, where "approved buildings" refers to (i) buildings for which formal building approval has been granted, or (ii) in the case of the specific building/s being assessed, where building approval is being sought.
4. Determination of the relevant QDC MP 4.4 Noise Categories may be made on a facade-specific basis, but where the total area of the facade of a habitable space is exposed to two or more QDC MP 4.4 Noise Categories, the higher QDC MP 4.4 Noise Category would apply to the whole facade of the particular habitable space.

In addition, and as a result of advice provided by DTMR, the following refinements to the site-specific noise assessment may also be applicable (refer also constraint detailed following):-

5. In April 2012, updated advice from DTMR resulted in further refinement of the acoustical design procedures. This updated advice contends that in situations where noise contours can be plotted at fine gradation around the external facades of the building being assessed, such that noise levels can be determined with precision at individual building facade elements, the calculation procedures of AS3671 - 1989 *Acoustics - Road Traffic Noise Intrusion - Building Siting and Construction* may be adopted in lieu of the QDC MP 4.4 Noise Categories and the minimum R_w values presented in Schedule 1 of QDC MP 4.4 to determine the precise level of building upgrade required to be implemented to achieve compliance with the internal sound level of AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* [3] that is applicable to the specific space.

Notes:

Each of these items of advice has been endorsed in DTMR's *Transport Noise Management Code of Practice*, November 2013.

AS3671 – 1989, as its name suggests, provides guidance on dealing with road traffic noise intrusion. There is currently no equivalent standard to deal adequately with rail noise intrusion. Notwithstanding, even though AS3671 – 1989 is not directly applicable to the control of rail noise intrusion, it can be demonstrated that it is a relatively simple matter to apply standard acoustical theory and calculation techniques to the processes of AS3671 to yield validated outcomes.

It has been well-established that when considering the degree of noise intrusion from electric train passbys, the application of the calculation procedures of AS3671 – 1989 (after validation) would result in the same internal noise levels (ie generally within ±1dBA) as would be obtained by application of the applicable deemed-to-comply constructions set by QDC MP 4.4 and, correspondingly, would result in compliance with the 45-50dBA target range set by QDC MP 4.4.

By contrast, when considering the degree of noise intrusion from diesel passbys, the direct application of AS3671 – 1989 results in internal noise levels which are significantly higher than those which result from a direct application of applicable deemed-to-comply constructions set by QDC MP 4.4 for the same external noise level [4]. This results in noise levels which very frequently may be above the 45-50dBA target range set by QDC MP 4.4. Exceedances of 5-8dBA may be encountered.

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[3] The minimum R_w values presented in Schedule 1 of QDC MP 4.4 were determined for a generic building design by applying the calculation techniques of AS3671 – 1989 to achieve compliance with the satisfactory internal sound levels of AS/NZS 2107:2016. Refer tabulation of Referenced Documents of QDC MP 4.4. Because it was necessary to cover a moderately wide range of functional variances for each particular space (ie number of exposed facades, floor areas, areas of glazing, ceiling height, presence of roof/ceiling construction, presence of entry door, etc) in doing so, as well as deal with (i) a 5dBA spread of noise levels within each noise category and (ii) generalised (and usually conservative) offsets between (a) $L_{10(18hour)}$ and $L_{Aeq,1hrnight}$ values and (b) $L_{10(18hour)}$ and $L_{Aeq,1hrday}$ values, a significant degree of conservatism was built into the minimum R_w values of Schedule 1.

In addition, the minimum R_w values of Schedule 1 have been determined on the basis that equal levels of acoustic energy are transmitted via each of the specific building elements. In practice, the acoustical performance of wall and roof/ceiling constructions, even under "standard construction" conditions, often exceeds the minimum R_w values of Schedule 1. As a result of this, a re-balancing of the R_w performance requirement for glazing can be undertaken without increasing the level of noise intrusion and without jeopardising compliance with the relevant internal sound levels of AS/NZS 2107:2016.

When due consideration is also given to the actual level of noise exposure at the facade, rather than adoption of the applicable 5dBA noise category band, a further refinement of the R_w performance requirement for glazing can be conducted, again without jeopardising compliance with the relevant internal sound level requirement. As a result, when these refinements are adopted, it has been determined that, in almost all instances, the glazing to habitable spaces will not need to be upgraded to the degree stated in Schedule 1. Furthermore and in particular, for spaces with relatively low areas of glazing and exposed to noise levels at or around 63dBA $L_{10(18hour)}$ for road traffic noise intrusion, it has been determined routinely that full compliance with the relevant internal sound levels of AS/NZS 2107:2016 can be achieved without requiring any upgrade beyond standard construction be made to the acoustical performance of the glazing.

[4] This outcome as a direct result of there being a higher level of low frequency sound energy within the noise levels generated by diesel passbys compared to that generated by electric passbys. The acoustical performance of all building elements is frequency-dependent. This is exemplified by the fact that as the sound frequency increases, so does the performance of the building element. As a result, any particular building element (eg a window) will better control noise intrusion from electric passbys than it will for diesel passbys. Correspondingly, to achieve the same internal noise levels from diesel passbys electric passbys, higher R_w rated building elements will be required for diesel passbys than will be required for electric passbys, or for that matter, required by the deemed-to-comply constructions under QDC MP 4.4.

When this situation has arisen previously on other occasions, the advice from the relevant Building Certifier/s has been that the assessment of the extent of building upgrade is to be conducted by reference to the deemed-to-apply acoustical performance ratings set by Schedule 1 of QDC MP 4.4, rather than by application of the validated calculation procedures of AS3671 – 1989.

This is notwithstanding the fact that by application of the deemed-to-apply ratings set by QDC MP 4.4, the level of noise transmitted by diesel passbys into habitable spaces will generally be above than the upper end of the 45-50dBA target range set by QDC MP 4.4 and sometimes substantially above.

Rather, the advice is based on (i) an acceptance that the deemed-to-apply ratings set by QDC MP 4.4 provide an acceptable level of control of rail noise intrusion from both trains drawn by diesel locomotives and electric trains and (ii) the acknowledgement that the determination of the specific deemed-to-comply constructions can be best made by reference to the actual site-specific QDC MP 4.4 Noise Categories applicable to the particular residence which are determined by reference to Matters 1-4.

Consequently, given that the North Coast Rail Line is regularly trafficked by trains drawn by diesel locomotives, the objective of any site-specific acoustical design assessment should be to determine the deemed-to-apply minimum R_w ratings for each component of the external envelope of the particular residence by reference directly to (i) the results presented in Table 1 and (ii) the details in Schedule 1 of QDC MP 4.4 notwithstanding the fact that noise levels exceeding the upper end of the 45-50dBA target range set by QDC MP 4.4 will result from diesel train passbys.

Attachment B

Refinement of QDC MP 4.4 Noise Categories

Table 1 of QDC MP 4.4 sets Noise Categories depending upon the external noise level to which the dwellings subjected when measured 1m from the facade of the proposed or existing building [5]. The QDC MP 4.4 Noise Category levels of Table I are reproduced in Table B1 below.

Noise Category	State-Controlled Roads and Designated Local Government Roads, $L_{10(18hour)}$ (dBA)	Railway Land Single Event Maximum Noise Level, $L_{Amax\ passby}$ (dBA)
Category 4	≥ 73 dBA	≥ 85 dBA
Category 3	68 - 72 dBA	80 - 84 dBA
Category 2	63 - 67 dBA	75 - 79 dBA
Category 1	58 - 62 dBA	70 - 74 dBA
Category 0	≤ 57 dBA	≤ 69 dBA

Table B1 – Noise Category Levels Reproduced from QDC MP 4.4

Note: Recognising the discontinuities and resultant practical uncertainties evident in the noise level class intervals ascribed by Table B1 [6], DTMR has issued a directive requiring that, in the case of State-controlled roads, the class intervals be adjusted. The new class intervals for road traffic noise are presented in Table B2 below together with, for consistency, the class intervals for rail noise reconciled in the same manner.

These adjustments are also reconciled in the mapping presented on the DSDMIP SPP IMS website.

The Single Event Maximum Noise Levels presented in Table B2 for each Noise Category have been adopted and applied accordingly.

Noise Category	State-Controlled Roads and Designated Local Government Roads, $L_{10(18hour)}$ (dBA)	Railway Land Single Event Maximum Noise Level, $L_{Amax\ passby}$ (dBA)
Category 4	≥ 73 dBA	≥ 85 dBA
Category 3	68 dBA ≤ noise level < 73 dBA	80 dBA ≤ noise level < 85 dBA
Category 2	63 dBA ≤ noise level < 68 dBA	75 dBA ≤ noise level < 80 dBA
Category 1	58 dBA ≤ noise level < 63 dBA	70 dBA ≤ noise level < 75 dBA
Category 0	< 58 dBA	< 70 dBA

Table B2 – Corrected Noise Category - QDC MP 4.4

[5] In contrast to other Codes and Guidelines, QDC MP 4.4 permits assessment of extent of road and rail noise intrusion onto the site to take account of shielding provided by existing and approved buildings, only where "approved buildings" refers to (i) existing residences, (ii) buildings for which formal building approval has been granted, or (iii) in the case of the specific building being assessed, where building approval is being sought. It does not allow the shielding of other future residences to be taken into account when determining the extent of noise intrusion to lots located one or two rows of lots distant from transport noise source.

[6] The discontinuities are the gaps between the upper bound of one Noise Category and the lower bound of the next higher Noise Category. Discontinuities give rise to resultant practical uncertainties. For example, should the residence subjected to an external noise level of 62.5dBA $L_{10(18hour)}$ be ascribed a Noise Category 1 designation or a Noise Category 2 designation? To resolve this uncertainty, the upper bound of one Noise Category must be equivalent to the lower bound of the next higher Noise Category. The corrected Noise Categories are presented in Table B2.

Attachment C

Performance Requirements, Acceptable Solutions and Schedules 1 and 2 from QDC MP 4.4

Note: Refer to full text of QDC MP 4.4 for complete details.
https://www.business.qld.gov.au/industries/building-property-development/building-construction/laws-codes-standards/queensland-development-code/building-transport-noise

	PERFORMANCE REQUIREMENTS		*ACCEPTABLE SOLUTIONS*
	Relevant residential buildings		
P1	*Habitable rooms* in a *relevant residential building* are adequately protected from *transport noise* to safeguard occupants' health and amenity.	**A1**	The *external envelope* of each *habitable room* in a *relevant residential building* must comply with the minimum R_W for each building component specified in Schedule 1 to achieve a minimum *transport noise reduction* level for the relevant *noise category* by: (a) using materials specified in Schedule 2; or (b) using materials with *manufacturer's specifications* that, in combination, achieve the minimum R_w value for the relevant building component and applicable *noise category*.

Schedule 1

Noise category	Minimum *transport noise reduction* (*dB (A)*) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 4	40	Glazing	43
		External walls	52
		Roof	45
		Floors	51
		Entry doors	35
Category 3	35	Glazing	38 (where total area of glazing for a *habitable room* is greater than 1.8m^2)
			35 (where total area of glazing for a *habitable room* is less than or equal to 1.8m^2)
		External walls	47
		Roof	41
		Floors	45
		Entry doors	33

Noise category	Minimum *transport noise reduction* (*dB (A)*) required for *habitable rooms*	Component of building's *external envelope*	Minimum R_w required for each component
Category 2	30	Glazing	35 (where total area of glazing for a *habitable room* is greater than 1.8m^2)
			32 (where total area of glazing for a *habitable room* is less than or equal to 1.8m^2)
		External walls	41
		Roof	38
		Floors	45
		Entry doors	33
Category 1	25	Glazing	27 (where total area of glazing for a *habitable room* is greater than 1.8m^2)
			24 (where total area of glazing for a *habitable room* is less than or equal to 1.8m^2)
		External walls	35
		Roof	35
		Entry Doors	28
Category 0	No additional acoustic treatment required – standard building assessment provisions apply.		

Schedule 2

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
Glazing	43	Double glazing consisting of two panes of minimum 5mm thick glass with at least 100mm air gap and full perimeter *acoustically rated seals*.
	38	Minimum 14.38mm thick laminated glass, with full perimeter *acoustically rated seals*; OR Double glazing consisting of one pane of minimum 5mm thick glass and one pane of minimum 6mm thick glass with at least 44mm air gap, and full perimeter *acoustically rated seals*
	35	Minimum 10.38mm thick laminated glass, with full perimeter *acoustically rated seals*.
	32	Minimum 6.38mm thick laminated glass with full perimeter *acoustically rated seals*.
	27	Minimum 4mm thick glass with full perimeter *acoustically rated seals*
	24	Minimum 4mm thick glass with standard weather seals

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
External walls	52	Two leaves of clay brick masonry, at least 270mm in total, with subfloor vents fitted with noise attenuators.
	47	Two leaves of clay brick masonry at least 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) 50mm thick mineral insulation or 50mm thick glass wool insulation with a density of 11kg/m^3 or 50mm thick polyester insulation with a density of 20kg/m^3 in the cavity. OR Two leaves of clay brick masonry at last 110mm thick with: (i) cavity not less than 50mm between leaves; and (ii) at least 13mm thick cement render on each face OR Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) Mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m^3 positioned between studs; and (iii) One layer of plasterboard at least 13mm thick fixed to outside face of studs. OR Single leaf of minimum 150mm thick masonry of hollow, dense concrete blocks, with mortar joints laid to prevent moisture bridging.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	41	Two leaves of clay brick masonry at least 110mm thick with cavity not less than 50mm between leaves OR Single leaf of clay brick masonry at last 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m^3 positioned between studs; and (iii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Single leaf of brick masonry at least 110mm thick with at least 13mm thick render on each face OR Concrete brickwork at least 110mm thick OR In-situ concrete at least 100mm thick OR Precast concrete at least 100mm thick and without joints.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Single leaf of clay brick masonry at least 110mm thick with: (i) a row of at least 70mm x 35mm timber studs or 64mm steel studs at 600mm centres, spaced at least 20mm from the masonry wall; and (ii) One layer of plasterboard at least 10mm thick fixed to outside face of studs OR Minimum 6mm thick fibre cement sheeting or weatherboards or plank cladding externally, minimum 90mm deep timber stud or 92mm metal stud, standard plasterboard at least 13mm thick internally.
Roof	45	Concrete or terracotta tile or sheet metal roof with sarking, *acoustically rated plasterboard* ceiling at least 13mm thick fixed to ceiling joists, cellulose fibre insulation at least 100mm thick with a density of at least 45kg/m^3 in the cavity. OR Concrete or terracotta tile or sheet metal roof with sarking, 2 layers of *acoustically rated plasterboard* at least 16mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m^3 or polyester insulation at least 50mm thick with a density of at least 20kg/m^3 in the cavity.
	41	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling joists, glass wool insulation at least 50mm thick with a density of at least 11kg/m^3 or polyester insulation at least 50mm thick with a density of at least 20kg/m^3 in the cavity. OR Concrete suspended slab at least 100mm thick.
	38	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity, mineral insulation or glass wool insulation at least 50mm thick with a density of at least 11 kg/m^3.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	35	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity.
Floors	51	Concrete slab at least 150mm thick.
	45	Concrete slab at least 100mm thick OR Tongued and grooved boards at least 19mm thick with: (i) timber joists not less than 175mm x 50mm; and (ii) mineral insulation or glass wool insulation at least 75mm thick with a density of at least 11kg/m^3 positioned between joists and laid on plasterboard at least 10mm thick fixed to underside of joists; and (iii) mineral insulation or glass wool insulation at least 25mm thick with a density of at least 11kg/m^3 laid over entire floor, including tops of joists before flooring is laid; and (iv) secured to battens at least 75mm x 50mm; and (v) the assembled flooring laid over the joists, but not fixed to them, with battens lying between the joists.
Entry Doors	35	Solid core timber not less than 45mm thick, fixed so as to overlap the frame or rebate of the frame by not less than 10mm, with full perimeter *acoustically rated seals*.
	33	Fixed so as to overlap the frame or rebate of the frame by not less than 10mm, fitted with full perimeter *acoustically rated seals* and constructed of - (i) solid core, wood, particleboard or blockboard not less than 45mm thick; and/or (ii) acoustically laminated glass not less than 10.38mm thick.

Component of building's *external envelope*	Minimum R_w	Acceptable forms of construction
	28	Fixed so as to overlap the frame or rebate of the frame, constructed of - (i) Wood, particleboard or blockboard not less than 33mm thick; or (ii) Compressed fibre reinforced sheeting not less than 9mm thick; or (iii) Other suitable material with a mass per unit area not less than 24.4kg/m^2; or (iv) Solid core timber door not less than 35mm thick fitted with full perimeter *acoustically rated seals*.