INLAND TSUNAMI DESTROYS GRANTHAM

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ABSTRACT

Under the Queensland Development Code Mandatory Part 4.4, Buildings in a Transport Noise Corridor (QDC MP 4.4), the Department of Housing and Public Works (DHPW) requires residents to check their noise category when building near a State-controlled road or railway so that new buildings are designed and constructed to reduce road traffic and railway noise intrusion. In early 2011 an inland tsunami devastated the Grantham area due to intense rainfall in South East Queensland and particularly in the Lockyer Valley. Many houses in the flood plane were swept away. Residents were given the opportunity to rebuild at a new development site on higher ground away from the State-controlled road. Two of the residents elected to rebuild on their properties in the flood plain rather than move to the higher ground. Their original houses were located 30m from the Gatton-Helidon Road, as State-controlled road. These new houses thus become subject to requirements of the QDC MP 4.4. At the request of DHPW, members of the Queensland Department of Transport and Main Roads (TMR) elected to conduct a detailed road traffic noise assessment at no cost to these residents, recognising the hardship they had suffered. TMR staff met with the residences to discuss their road traffic noise concerns, and conducted an acoustical assessment thereby enabling the residents to rebuild their houses at reduced cost due to the findings of the detailed assessment which determined the noise impact on each house façade whereas the prescribed QDC MP 4.4 requirements do not.

INTRODUCTION

Grantham, located approximately 25 kilometres east of Toowoomba in the Lockyer Valley and 114 kilometres south west of Brisbane, was one of the communities devastated in a flash flood that hit on January 10, 2011 (Figure 1). From what was described as a deadly wave of water, the tiny town emerged as the ground zero of the Queensland floods. The population of the village of Grantham was only 350 people at the time (Figure 2).

Buildings were destroyed, cars were crushed and thrown around like corks, and houses were swept from their stumps, with one house being washed more than 2 kilometres from its block, ending up on the plains outside the town (Figure 3).

Some of the residence were rescued from trees by being winched to a helicopter after their houses were washed away.

Figure 1. Locality Plan

Figure 2. Grantham town entrance (Source: The Courier-Mail)

Figure 3. Flood damage (Source: The Courier-Mail)

BACKGROUND

On 1 September 2010, the Queensland Government introduced the new QDC MP4.4 (Department of Local Government and Planning, 2010, now the Department of Housing and Public Works).

The code seeks to reduce the impact of road and rail traffic on the day-to-day activities of occupants in new and renovated residential development within Transport Noise Corridors (TNC). The intention is to ensure that a consistent standard for noise reduction is set across the State to help achieve indoor noise levels that do not impact upon the health and well-being of Queensland residents. Streamlining the development process will reduce costs, uncertainty and timeframes for Government and the community.

The main driver for this shift was to include noise attenuation into the Building Code where it is considered to be most appropriate. Building certification is not a TMR issue.

The QDC MP4.4 sets mandatory building standards for residential development (Building Classes 1, 2, 3 and 4, including houses, townhouses, units, hotels and motels). The Building Class definition can be derived from the website: http://www.bsa.qld.gov.au/SiteCollectionDocuments/Builders_Contractors/Fact%20Sheets/BCA%20Classes%20of%20Building.pdf

Two of the residents whose houses were washed away, elected to rebuild houses on their allotments within the flood plain.

These two allotments access the Gatton-Helidon State-controlled road. Therefore under the QDC MP4.4, these houses have to be constructed in accordance with mandatory building standards.

Transport Noise Corridors

The Building Act 1975 has been amended to provide for the designation of land as a TNC by gazette notice. The Act establishes criteria for State and Local Governments to designate TNC.

Currently only State-controlled roads have been designated. These were designated by gazette on 13 August 2010.

The designated corridors cover land within 100 metres of a State-controlled road with this extended up to 250 metres in situations of high noise levels due to significant volumes of traffic and/or high proportions of heavy vehicles (mainly along motorways and major arterials). Amendments to the designated corridors can be undertaken in the future as circumstances change.

In early 2011, following proposed amendments to the Building Act 1975, TNC have been designated for franchised roads. A franchised road means a road to which a road franchise agreement applies, which is usually a toll road in this instance.

These corridors can also be designated along rail corridors or Local Government roads. The proposed designated corridors for rail cover the land within 150 metres for a passenger line and up to 250 metres for a freight line. TNC relating to rail are expected to be designated in late 2012.

Effectively, this means that most transport corridors which are the responsibility of the State, will have designated TNC under the Building Act 1975. It is anticipated that Local Governments will also designate TNC within their jurisdiction in the future. Only one Local Government has undertaken this process to date.

The QDC MP4.4 and how it applies

The new QDC MP4.4 is a mandatory component of the Queensland Development Code (QDC), applying only to residential buildings in designated TNC. This information can be derived from the website: http://dlgp.qld.gov.au/resources/laws/queensland-development-code/current-parts/mp-4-4-buildings-in-transport-noise-corridors.pdf

The QDC MP4.4 sets mandatory building standards comprising various building material specifications to reduce internal noise levels. It details noise reduction requirements for habitable rooms across five noise categories and contains information on acceptable building materials for floors, walls, roofs, windows and doors to achieve appropriate noise reductions. The actual level of noise reduction required in each instance will depend on the property's noise category.

The noise category applicable to a building or site within a designated TNC is based on the amount of noise modelled for the location. The applicable category can be derived from the website:

http://www.dlgp.qld.gov.au/building/transport-noise-corridor-search-tool.html

Alternatively, the noise category can be determined by a noise assessment prepared by a suitably qualified person pursuant to Schedule 3 of the new QDC MP4.4.

Each noise category (refer to Table 1) is based on the predicted external noise level and hence reflects a required noise reduction level (Transport Noise Reduction or TNR). Each category has an associated list of indicative building material specifications to achieve the specified weighted sound reduction index (R_w), resulting in a reduction in transport noise from the external side of a habitable room to the internal living space.

Table 1. Determination of noise categories

Noise Category	Road Traffic Noise Level* (State-controlled roads and designated local government roads) L_{A10} (18h) dB(A)	Railway Noise Level* Single event maximum noise L_{Amax} dB(A)
Category 4	≥ 73	≥ 85
Category 3	68 - 72	80 - 84
Category 2	63 - 67	75 – 79
Category 1	58 - 62	70 - 74
Category 0	≤ 57	≤ 69

* measured at 1m from the most exposed façade of the proposed or existing building and rounded to the nearest whole number. For example, 57.4 is 57 and 57.5 is 58 for roads, and 69.4 is 69 and 69.5 is 70 for railways.

Checking compliance with the QDC MP4.4 is the responsibility of building certifiers. The QDC MP4.4 lists acceptable building materials to achieve the required TNR values, and will enable certifiers to approve the listed building materials when undertaking building assessment and certification.

It should be noted that a single property can be partially within a noise category or lie across multiple noise categories. In these cases, the requirements will depend on where the actual building is located. If the building sits wholly within a single noise category area on the property, then that noise category's requirements will apply, even though other parts of the property may be in a higher or lower noise category. Where a building sits across multiple noise category areas, the requirements of each noise category will apply to the respective parts of the building.

The QDC MP4.4 applies consistently across the State to all new and renovated residential buildings within TNC. A Guideline for Buildings in a Transport Noise Corridor is being developed (Department of Housing and Public Works, 2012).

Alternative Solutions

Under section 14(4)(b) of the Building Act 1975, alternative solutions to the prescribed acceptable solutions contained in the Schedule 2 of QDC MP4.4 can be used if the alternative solution is determined to comply with, or at least be equivalent to the relevant performance criteria of the materials. Building certifiers are responsible for assessing whether an alternative solution complies with the QDC MP4.4 performance criteria and they may rely on a competent person to assist with the assessment. It is recommended that, in cases where a noise assessment forms part of an alternative solution, that the assessment be conducted by a suitably qualified person and meets the requirements for noise reports as outlined in Schedule 3 of the QDC MP4.4. A suitably qualified person is defined as being a Registered Professional Engineer of Queensland. It is recommended that the property owner discuss alternative solutions and possible requirements involved with a building certifier early in the design stage.

Acceptable Solutions defined in the QDC MP4.4 are as follows:

- The external envelope of habitable rooms in a residential building located in a transport noise corridor complies with the minimum R_w for each building component specified in Schedule 1 of the QDC MP4.4 to achieve a minimum transport noise reduction level for the relevant noise category by:

(b) using materials specified in Schedule 2 of the QDC MP4.4; 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.

As well, as an alternative solution, it is considered that the use of Australian Standard AS3671: Acoustics – Road traffic noise intrusion – Building siting and construction, may be used to determine the minimum R_w for each building component on all sides of a building. Providing the building certifier gives approval, the alternative solution scenario may permit the applicant to redefine the noise category locations by taking into account the effect of a noise barrier and terrain on the noise levels for instance. The whole building shall be designed in accordance with the intent of QDC MP4.4. However, legislation does allow that where buildings have had a detailed noise assessment carried out, each part of the building can be designed with regard to its specific noise exposure level. The required noise reduction levels relating to L_{10} (18h) levels for roads and to the L_{max} levels for rail (in single whole number increments) are specified in Schedule 1 of the QDC MP4.4.

It is highly likely that an alternative solution will result in a reduced noise category requirement and hence reduced cost to the house builder as is the situation in the Grantham case.

APPLICATION OF THE QDC MP4.4 FOR GRANTHAM

Prescribed QDC MP4.4 Requirements

The new homes (Buildings A and B) are proposed to be constructed in the same locations as the homes that were washed away, as indicated in Figure 4.

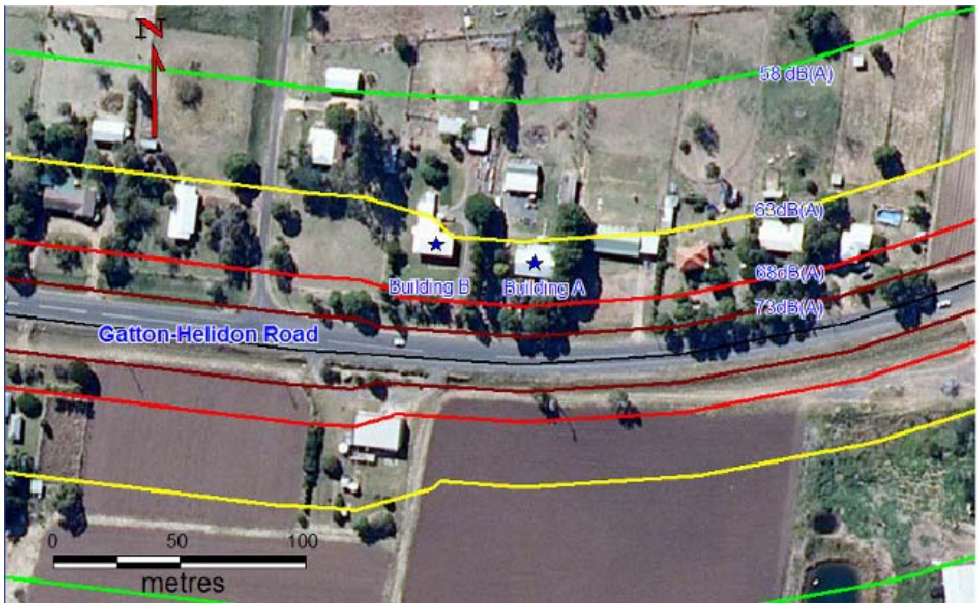

Figure 4. TNC noise contours

The prescribed QDC requirements are indicated in Table 2 and the TNC noise contours are also shown on Figure 4.

Table 2. Prescribed QDC requirements

Building	TNC Levels	TNC Category
A	63-67	2
B	63-67	2

Alternative Solution Application

The Gatton-Helidon Road, Grantham road traffic noise assessment project was initiated by the Department of Housing and Public Works (DHPW) and TMR. Activities including the site-selection, noise monitoring and noise assessment were completed by personnel from the TMR Noise & Air Quality team in accordance with the TMR Road Traffic Noise Management: Code of Practice (Department of Transport and Main Roads, 2007)

The Grantham noise assessment includes comparing calculated noise levels from traffic on the Gatton-Helidon Road with measured noise levels in December 2011 in order to verify the noise calculation/predication model. This includes determining the calculated noise levels in 2011 and the predicted noise levels for the 10 year planning horizon, 2022.

This assessment described the background to the alternative solution investigation assessment. It included the following:

- Measurements conducted by TMR within the assessment area;
- A summary of results produced by the SoundPLAN (v7.1) software used to calculate the road traffic noise within the study site;
- DHPW noise category levels; and
- The revised Queensland Development Code Mandatory Part (MP) 4.4 (QDC) Noise Category Levels for each façade on the proposed buildings.

Assessment Area Description

Gatton-Helidon Road is an existing State-controlled road, and the houses which are the subject of this assessment, are new building applications.

The assessment area extends 200 metres to the west and east of the properties and approximately 100 metres each side of the Gatton-Helidon Road (Figure 5).

Gatton-Helidon Road has a flat grade along the length of the assessment area. There is an intersection with a local road, Nicholls Street, which is about 70 metres to the west of the monitoring location. Nicholls Street is not included in the assessment due to its having less than 50 vehicles per day. The Rosewood to Helidon railway line runs approximately 250 metres to the north of the property and was not included in this assessment as the combined road/rail measured levels would not affect the QDC Noise Category outcome with only one train passby during the attended monitoring.

The assessment area features medium density living with mostly single levels of accommodation. Building A is to be a highset house which will be relocated from a house removalist's yard. Building B is to be a new lowset house constructed onsite.

Figure 5. Assessment area. Gatton-Helidon Road

ROAD TRAFFIC NOISE CRITERIA

The location where the road traffic noise level is to be assessed, is at the nearest or most road traffic noise exposed façade of the proposed dwellings. The QDC requires assessment against road traffic noise criteria based upon road traffic noise levels for a 10 year planning horizon. The criteria are shown in Table 1.

NOISE MODELLING

Road Traffic Noise Model

The 'Calculation of Road Traffic Noise' methodology within the SoundPLAN 7.1 road traffic noise modelling software has been used to generate noise model scenarios for the existing and future road traffic data. The noise models for the different scenarios calculate road traffic noise levels for 2011, which are verified against the measured noise levels, and the predicted levels for 2022, 10 years after the proposed completion of the building construction. The survey data, traffic count data and road information used in the noise model have been sourced from within TMR. Measurements were undertaken at Building B.

Model Development

Using 0.2 metres contour data from TMR Geospatial Technologies, a digital ground model was created to represent the relevant terrain for the road, buildings and other noise related data.

Digital Video Road (DVR) was used to determine the source-receptor geometry and the road profile, and the TMR traffic data was sourced from the Traffic Analysis and Reporting System (TARS).

Model Input Data

Table 3 summarises the traffic and pavement surface data that was input into the model

Table 3. Traffic data, measured and predicted for the Gatton-Helidon Road :

	24 hour AADT	*18 hour	24 hour AADT	*18 hour
Year	2011	2011	2022	**2022
Vehicles	4115	3907	4589	4316

* The 18 hour traffic data is calculated by multiplying the Annual Average Daily Traffic (AADT) x 0.94.

** The assumed growth rate was 1.0% pa (compound)

The pavement surface type is a bituminous seal requiring a +2dB (A) correction factor.

Noise Levels-Measured and Calculated

Once the road traffic noise model was generated, the calculations indicated that the noise model was verified within the assessment area.

Table 4. Measured and calculated free-field levels (Building B)

Dates	Measured level 2011 dB (A), L_{10} (18h)	Calculated level 2011 dB (A), L_{10} (18h)	Predicted level 2022 dB(A), L_{10} (18h)
Thursday 01/11/11	58.2	60	62
Friday 02/11/11	60.2		

From Table 4 the difference between the average measured and calculated noise levels is 1dB which is within the acceptable range of ± 2*dB*(A) for verification purposes.

The noise contour outputs from SoundPlan 7.1 are shown on Figure 6 for the 2022 design horizon and a 4.6m receptor height.

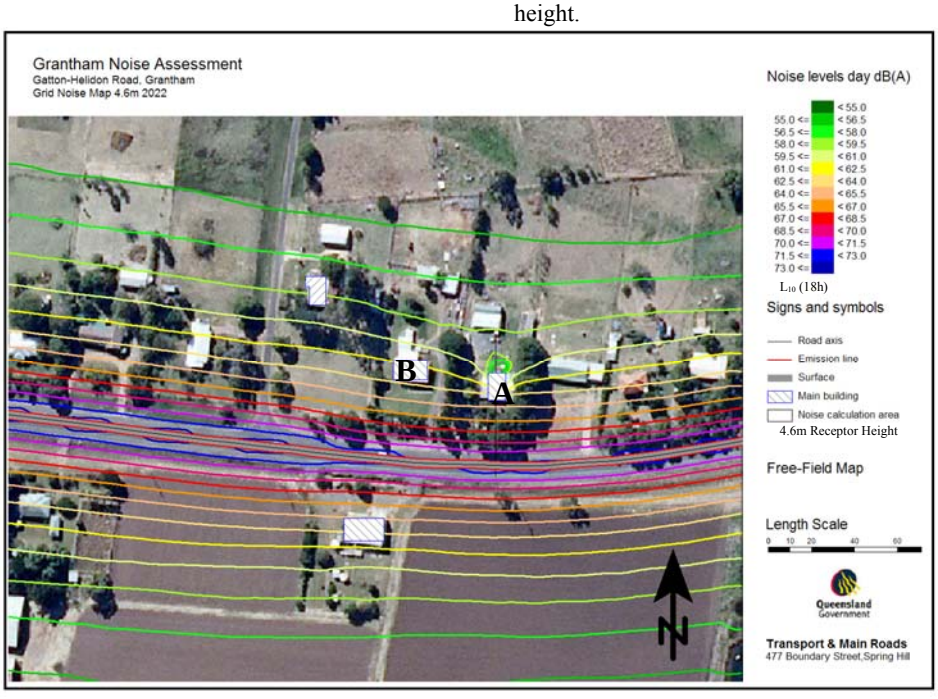

Figure 6. Grid noise map

The noise contours are generated from a large number of single point calculations. These single points are distributed in a grid with a 10m spacing from which the contours are then interpolated. Caution must be used when viewing these plots as they provide an estimate of the predicted road traffic noise levels. For more accurate predicted noise levels, reference should be made to the single point calculation results at individual receptors as indicated in Table 5.

Results

As a result of the detailed road traffic noise assessment, noise levels were predicted at the proposed dwellings on all four facades. These levels have been applied to the QDC noise category levels to determine the applicable noise categories pertaining to the façades of the proposed dwellings as shown in Table 5. The Façade Noise Map is shown in Figure 7

Table 5. Façade Noise Levels (2022)

Building	Facade	Prediction Level dB(A) L_{10} (18h)	Noise Category
A (4.6m) *	North	56	0
	South	65	2
	East	61	1
	West	62	1
B (1.8m) *	North	53	0
	South	62	1
	East	57	0
	West	59	1

* Note: Receptor height in brackets

The comparison between the prescribed QDC MP4.4 requirements and alternative solutions is shown in Table 6.

Table 6. Comparison between prescribed QDC MP4.4 requirements and alternative solutions

Building	Facade	Prescribed TNC	Alternative Solution TNC
A	North	2	0
	South	2	2
	East	2	1
	West	2	1
B	North	2	0
	South	2	1
	East	2	0
	West	2	1

CONCLUSION

The QDC MP4.4 states that:

"The external envelope of habitable rooms in a residential building located in a transport noise corridor complies 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."

Refer to Tables 7 and 8 for the applicable extracts from Schedules 1 and 2 respectively.

Also, under the Building Act 1975, alternative solutions to the prescribed acceptable solutions can be used if the alternative solution is determined to comply with, or at least be equivalent to the relevant performance criteria of the materials. A site specific alternative solution approach has determined that lesser noise control requirements can be utilised than the prescribed approach required for these two houses in Grantham.

Therefore the costs of the building components associated with the requirements of the QDC MP4.4 will be reduced as a result of the outcomes of the alternative solution approach.

REFERENCES

Department of Housing and Public Works 2012, *Guidelines for Building in a Transport Noise Corridor*, Queensland, Australia.

Department of Local Government and Planning 2010, *Queensland Development Code: MP4.4 – Buildings in a Transport Noise Corridor,* Queensland, Australia.

Department of Transport and Main Roads 2007, *Road Traffic Noise Management: Code of Practice*, Queensland, Australia.

ACKNOWLEDGMENTS

The work reported in the present paper was conducted under instruction from and commission by TMR as part of the Department's ongoing commitment to implementing the obligations under the Sustainable Planning Act 2009 where appropriate. The authors acknowledge these arrangements and express their appreciation to the Director-General of TMR for permission to publish the present paper. Any opinions expressed are those of the authors.

DISCLAIMER

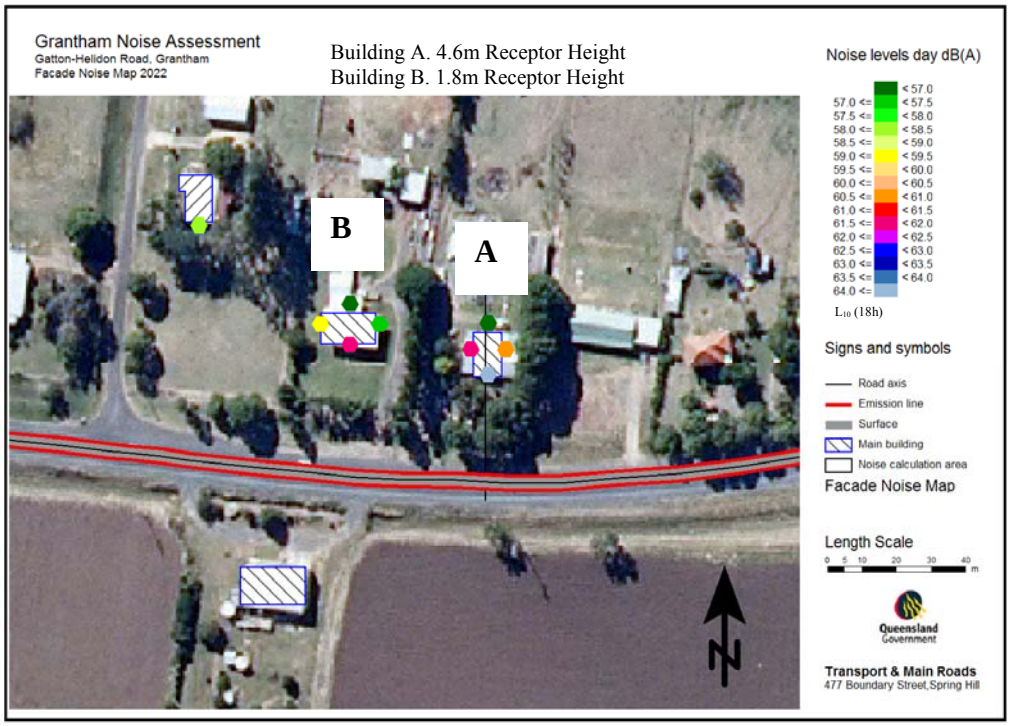

Figure 7. Façade noise map

Table 7. Applicable Extract from Schedule 1 of QDC MP 4.4

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.		

Table 7. Applicable Extract from Schedule 2 of the QDC MP4.4

Component of building's external envelope	Minimum R_w	Acceptable forms of construction
Glazing	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 seats
External walls	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 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 11kg/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
	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	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.
	35	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10mm thick fixed to ceiling cavity.
Floors	45	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 75m 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 insulation at least 25mm thick with a density of at least 11kg/m^3 laid over entire floor, including tops of joists before flooding 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	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.