11

Wood Solutions™
design and build
woodsolutions.com.au

This guide was revised in Sept 2015
Please check
woodsolutions.com.au/publications
to ensure you have the latest edition

Timber-framed Systems for External Noise

Technical Design Guide issued by Forest and Wood Products Australia

WoodSolutions Technical Design Guides

A growing suite of information, technical and training resources, the Design Guides have been created to support the use of wood in the design and construction of the built environment.

Each title has been written by experts in the field and is the accumulated result of years of experience in working with wood and wood products.

Some of the popular topics covered by the Technical Design Guides include:

- Timber-framed construction
- Building with timber in bushfire-prone areas
- Designing for durability
- Timber finishes
- Stairs, balustrades and handrails
- Timber flooring and decking
- Timber windows and doors
- Fire compliance
- Acoustics
- Thermal performance

More WoodSolutions Resources

The WoodSolutions website provides a comprehensive range of resources for architects, building designers, engineers and other design and construction professionals.

To discover more, please visit
www.woodsolutions.com.au
The website for wood.

Wood Solutions™
design and build
woodsolutions.com.au

WoodSolutions is an industry initiative designed to provide independent, non-proprietary information about timber and wood products to professionals and companies involved in building design and construction.

WoodSolutions is resourced by Forest and Wood Products Australia (FWPA – www.fwpa.com.au). It is a collaborative effort between FWPA members and levy payers, supported by industry bodies and technical associations.

This work is supported by funding provided to FWPA by the Commonwealth Government.

ISBN 978-1-921763-41-0

Prepared by:
Colin MacKenzie
Timber Queensland Limited
www.timberqueensland.com.au

First published: August 2012
Revised: December 2012, September 2015

Table of Contents

Introduction

This guide has been prepared to assist the building industry with the key issues to be considered when assessing alternatives related to external noise using lightweight timber-framed construction. The information contained in this guide should not be considered as standalone, and where appropriate relevant expertise should be obtained. The guide does not cover matters associated with other aspects of building construction or the regulatory requirements associated with these.

Noise – it's everywhere. It impacts on our daily lives, in our homes, work places and during recreational pursuits. Many factors can and will influence the degree of unwanted noise that enters our homes and our response to this, including:

- Owner/occupier expectations
- Daytime or nighttime
- Ambient background noise levels
- Activities being undertaken

One of the most significant sources of unwanted external noise comes from transportation activities – road, rail and aircraft.

In order of priority there are three main strategies for reducing the intrusion of unwanted external noise into residential properties:

- Distance separation between the noise source and the property
- External physical noise attenuation barriers
- Noise attenuation of the building envelope

Where the first two methods cannot be satisfactorily achieved, many regulatory juristictions are now imposing limits on the entry of noise into the habitable areas of dwellings by controlling the design and construction of the building envelope (roofs, walls and floors).

Key Issues

When designing a new or modifying an existing dwelling, all building work must comply with the Building Code of Australia (BCA) and any actions to reduce the ingress of external noise must be designed and constructed to be compatible with all other aspects of the BCA that may apply such as energy efficiency and bushfire construction requirements.

Considerations include:

- Inner cities tend to generate greater levels of external noise than suburban areas with low frequency noise from sources such as trucks, construction sites and waste collection being more problematic.
- In suburban areas, residences close to main road and rail corridors may suffer from unwanted noise and residences close to airports or flight paths may also be exposed to noise sources that need to be addressed.
- The openings in the external building envelope including the number, size, location and selected materials for windows and doors will have a major impact on the control of noise that can enter a building. Careful consideration should be paid to these prior to any upgrading of the exterior walls, floors and the roof-ceiling system.

1 Methods for Reducing Noise into Buildings

In order of priority there are three main options for reducing the intrusion of external noise into residential properties:

- **Adequate distance separation between the noise source and the property (set-backs and separation strips)**
- **Physical barriers including noise attenuation barriers (fences, walls etc and appropriate landscaping and vegetation) and**
- **Building noise attenuation into the building envelope (walls, floors and roofs)**

1.1 Site planning and landscaping

Some of the principles for planning and arranging residential dwellings on a site to help manage and minimise the intrusion of noise from transport sources include:

- using natural features such as contours and slopes in the siting of dwellings to provide shielding from noise sources
- using material excavated on site to form mounds around the building to provide protection
- physical separation by using as much distance as possible between the noise source, such as a road, and the residence
- locating non-sensitive buildings and spaces that are noise tolerant such as landscaped areas, carparks, open space and garages between the noise source and the more sensitive residential development. On a larger scale, open space, recreation areas or commercial facilities could be used to separate noise sources from residential areas
- using structures as a barrier to protect or shield the areas behind such as placing garages, courtyards and similar between the noise source and the dwelling

(Image courtesy of ASK Consulting Engineers)

1.2 Site specific assessment and design

In many instances, developers and builders report that it is far more beneficial and economical to engage acoustic consultants to undertake site specific assessment and design where external noise sources are required to be addressed in residential construction.

This process typically involves the following steps:

- determine the level of existing external noise exposure (either through site measurements or modelling)
- determine external treatments that can be applied to emiliorate external noise (if this option is available)
- determine the facade (openings, walls roofs and floors) treatment that is required
- certification upon completion of work

The Association of Australian Acoustical Consultants (AAAC) have published a guide on levels of acoustic amenity to provide differing levels of building quality. Ratings range from 2 to 6 stars and are based on field testing by an AAAC consultant to verify that they have been achieved. More information about AAAC Star Ratings for dwellings, apartments and townhouses is available at www.aaac.org.au

1.3 Building Envelope Noise Attenuation

Walls including openings, roofs and floors in the external building envelope can be designed and constructed to minimise the intrusion of unwanted external noise.

Many regulatory juristictions are now imposing limits on the entry of noise into the habitable areas of dwellings by controlling the design and construction of the building envelope (roofs, walls and floors).

The following section considers some of the regulatory requirements and provides solutions in lightweight timber construction to meet these requirements.

2

Regulatory Requirements

Across Australia, many levels of Government and their authorities have regulatory or legislative powers to require control of noise entering buildings, in particular residential buildings. These requirements tend to be fairly 'fluid' with regular changes requiring designers and specifiers to keep abreast of new initiatives.

Examples of these requirements include, but are not limited to:-

• noise overlays for aircraft and airport environments

• road noise corridors

• rail noise corridors

Control and application of these requirements may rest with local governments or state authorities such as Departments of Building and Planning, Transport or Main Roads etc, and in some cases (aircraft) at the Federal level.

At the time of publication of this Guide, there were no requirements for the control of external noise entering buildings contained within the BCA, however, these were under consideration by the Australian Building Codes Board with draft changes proposed.

2.1 Local Authority Requirements.

In response to community concerns, many local authorities have been requiring building envelope treatment for residences which are not protected sufficiently by noise barriers. At the same time some councils have been restricting the heights of noise barriers for reasons of visual amenity, limiting the level of noise reduction that can be attained. In conjunction with this height restriction, additional noise insulation requirements have been placed onto residential allotments which are affected by unreasonable levels of noise. These requirements have been enforced by either planning instruments, property notes or covenants to the title.

2.2 State and Territory Requirements

A number of states and territories have legislation that requires developers, designers, certifiers and builders to limit the intrusion of external noise into residential and other types of building occupancy.

Before considering or applying any external noise control options, consult with your relevant state/ territory body to determine the specific requirements that need to be addressed which may vary from significant requirements to none.

Some typical examples for some States and Territories are listed below.

New South Wales

Road Traffic Noise
The NSW State requirements for road traffic noise for residential development are contained within the State Environment Planning Policy (Infrastructure) 2007 Clause 102 – Impact of Road Noise or Vibration on Non-road Development. This clause states that if the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following energy averaged noise levels (LAeq) are not exceeded; (a) in any bedroom in the building - 35 dBA at any time between 10 pm and 7 am, (b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dBA at any time.

Rail Traffic Noise
The NSW rail noise and vibration requirements are found, for example, in Infrastructure SEPP Clause 87 Impact of Rail Noise or Vibration on Non-Rail Development 2007, NSW. Clause 87 states that if the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following energy averaged noise levels (LAeq) are not exceeded; (a) in any bedroom in the building - 35 dBA at any time between 10 pm and 7 am, (b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dBA at any time.

Aircraft Traffic Noise
An acoustical report to comply with the Australian Standard AS 2021 – 2000 "Acoustics – Aircraft Noise Intrusion - Building Siting and Construction" is often required by Council's Development Consent for sound insulation against air traffic noise.

Queensland

Traffic Noise
The Queensland Development Code (QDC) MP 4.4 "Buildings in transport noise corridors" provides for construction standards for minimum traffic noise reduction levels which are to be achieved across four noise categories. These noise categories provide for a weighted sound reduction index (R_w) which determines appropriate building materials for the floor, walls, roof, windows and doors. These building materials are to restrict the amount of external noise entering habitable rooms of a residential building.

Mandatory Part (MP) 4.4 was introduced into the Queensland Development Code (QDC) on 1 September 2010. QDC MP 4.4 is to be used by building certifiers when assessing residential buildings within a transport noise corridor'.

A Transport Noise Corridor is defined by agencies such as the Department of Transport and Main Roads (TMR), Queensland Rail and local authorites. At the time of this study, corridors had only been assigned by TMR for most major roads in Queensland. The Code defines five noise categories based on the noise exposure level. Category 4 is the highest and Category 0 the lowest.

The categories are assigned based only on the distance from the road and the characteristics of the road and do not account for constructed noise barriers and terrain features which may shield properties.

The Code allows a reduction in the noise category using a noise model to predict the noise exposure which can account for screening effects from barriers, terrain and other buildings present between the road and the residence being assessed. This typically results in a reduction in the noise category. For each of the noise categories the following ratings are required by QDC MP 4.4:

Noise Reduction Performance for Various Building Elements

Category	Building Element Sound Reduction Requirement (Rw)				
	Glazing (Area Dependent)	External walls	Roof	Floors	Entry Doors
Category 4	43	52	45	51	35
Category 3	35-38	47	41	45	33
Category 2	32-35	41	38	45	33
Category 1	24-27	35	35	NR	28
Category 0	No additional acoustic treatment required – standard building assessment provisions apply.				

Note: NR = Not required

Victoria

In Victoria there are no specific, statewide regulations for noise, however the special noise control overlay for Melbourne Airport does introduce some requirements, see specific noise control section below.

Australian Capital Territory

In the ACT, the mechanisms available for management of noise levels include:

- regulation of noise emissions at the source (Noise Control Act 1988 administered by the Pollution Control Authority);
- planning control over land use and set-back distances, and design of buildings, necessary to separate noise generating activities from noise sensitive land uses;
- planning and development requirements for provision of noise attenuation measures, including building design, materials used and construction techniques/practices.

Traffic Noise

A draft Noise Management Guidline has been published by the ACT Planning Authority which sets out guidelines for desirable and maximum levels of noise from traffic and land use activity, and advises on methods to prevent or reduce excessive noise levels. The guidelines do not remove the requirement to comply with the Noise Control Act 1988.

The objectives of the noise management guidelines are to ensure that:

- developments with the potential to introduce new noise sources, whether a road or a land use activity, are designed to ensure that noise in adjacent areas is kept within acceptable limits; and
- new noise-sensitive developments are protected from unacceptable noise levels generated by existing sources.

Western Australia

In most cases transportation noise is not subject to the Environmental Protection (Noise) Regulations 1997 because it is regulated by one of several other means.

Vehicle Noise
Traffic noise from roads is exempt from the Environmental Protection (Noise) Regulations 1997. Instead, the Road Traffic (Vehicle Standards) Rules 2002 address community concern about noisy trucks, cars and motorbikes.

Rail Noise
Noise emissions from rail are exempt from the noise regulations.

Aircraft Noise
Whether it is as a result of ground operations or from aircraft whilst in flight, it is covered under federal legislation and managed by an Aircraft Noise Strategy.

Specific Noise Control
In a number of specific situations, special overlays may apply to certain areas. For instance the The Melbourne Airport Environs Overlay is a set of planning rules, or controls, designed to help state and local government plan for the environmental effects of aircraft noise associated with Melbourne Airport.

2.3 National Construction Code Series - Building Code of Australia (BCA)

Currently there is no National code for external noise, however the Australian Building Code Board had drafted amendments proposed to address external noise intrusion for consideration by the BCA. At the time of publication of this guide the BCA had requested further consultation and development of the proposal.

3

Lightweight Timber Solutions

3.1 Introduction

The Weighted Sound Reduction Index (R_w) and Low-frequency Spectrum Adaptation Term ($R_w + C_{tr}$) ratings for various systems given in Sections 3.6 to 3.8 have been derived using information from existing published tests and calculations of performance using the 'Insul' computer software. This information is based on a report provided by acoustic consultants.

3.2 Definitions

Weighted Sound Reduction Index (R_w)

The Weighted Sound Reduction Index (R_w) refers to a single number acoustic rating calculated from the reduction in noise between two rooms. A higher rating indicates less sound transmission and higher performance. Rw is assessed over the frequency range 100-3150Hz using the sum of deviations less than 32 dB method and is calculated using formulae in AS/NZS/ISO 717.1 2004 Acoustics---Rating of sound insulation in buildings and of building elements Part 1: Airborne sound insulation.

Low-frequency Spectrum Adaptation Term ($R_w + C_{tr}$)

The $R_w + C_{tr}$ parameter is also calculated using formulae in AS NZS ISO 717.1 2004

The C_{tr} term refers to a correction factor that adjusts the R_w to take into account low frequency noise. If the noise being transmitted contains a large element of low-frequency noise, then the correction factor will lower the Rw rating to reflect this low-frequency noise intrusion. For nearly all building elements, low frequency transmission is poorer than for speech therefore the Ctr term is usually negative.

STC

STC or Sound Transmission Class is a single number rating for partitions. It is calculated or derived from 1/3 octave band Sound Transmission Loss data by a method described in American Society for Testing Materials standard ASTM E316. The frequency range for assessment of STC is 125-4000 Hz. It also uses the sum of deviations less than 32 dB method and includes a limitation of no octave more than 8 dB below the rating curve.

In general the two ratings (STC and R_w) give either the same number or are only 1-2 points difference, so they can be used fairly interchangeably.

3.3 Calculation of Acoustical Performance

Levels of acoustic performance have been calculated using the industry standard 'Insul' software. (http://www.insul.co.nz/). Allowances have been made for mass of various materials and "ideal" workmanship. Publishers of the 'Insul' software claim that comparisons with "calculated performance" with test data show that it is generally within 3 STC/Rw points for most constructions.

Factors taken into account in calculation of acoustical performance include the surface mass of the material, Young's Modulus, edge damping, the critical frequency and speed of sound in materials, the effect of air cavities and acoustic insulation between members. The R_w values determined and provided in this guide are laboratory values. These estimations of performance can be used for requirements of performance stated in building or planning regulations and other calculation methods, such as AS3671, which also refer to laboratory values.

3.4 Guidance and assumptions for acoustical performance

The performance estimates are based on laboratory quality construction with a high attention to detail. Calculated levels of performance are based on:

- external wall elements being sealed to near-to-air-tight construction which is fully caulked and sealed
- internal plasterboard layers are constructed, caulked, sealed and using details as recommended by the plasterboard manufacturer

Opinions of performance may not be valid where installation details such as stud spacing and fixing centres do not match those used in the nominated systems.

The systems are specifically derived for external noise intrusion and no consideration is given to internal wall construction noise ratings i.e noise travelling between internal rooms. No references are made for the rating of impact noise as impact noise is not an issue for external noise intrusion.

The issue of flanking noise is not considered as estimates are laboratory based and flanking is purposely controlled. For application in the field, flanking should be carefully considered to ensure performance is delivered. If the selection of the acoustical performance of building elements are being made to deliver a result in the field which is not in accordance with a requirement which requires laboratory acoustical performance, an acoustic consultant should be consulted to provide detailed recommendations for construction.

Timber Types

Acoustical opinions were provided for the following wall constructions:

- 70mm studs are 35 or 45 mm thickness
- 90mm studs are 35 or 45 mm thickness
- may consist of softwood, hardwood or engineered timber product
- in standard walls, noggins may be full depth of stud or alternatively lesser depth as per AS 1684
- for the use of staggered studs, where noggings are installed, noggings on the outer studs must not touch the inner studs and vice versa. This may necessitate the use of thin noggings on edge. A typical staggered stud arrangement without noggings is shown in Figure 1
- For pitched roof/ceiling systems, cathedral ceilings and floor construction all timber product types are acceptable including solid timber and engineered timber products such as 'I' joists, LVL, Glulam and trusses.

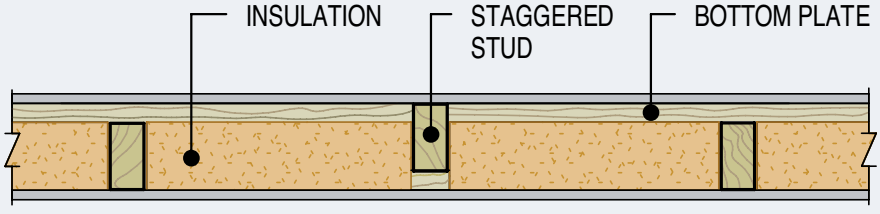


Figure 1: Plan view of Staggered stud wall system

Insulation

(a) Glasswool (GW)

Insulation nominated in this guide is glasswool. Glasswool insulation has been used as there is an Australian Standard for glasswool manufacture and the product remains consistent.

Any glasswool insulation of greater thickness and density to that nominated can be substituted to achieve better acoustic insulation. This additional insulation will improve performance to a value greater than the estimates. In most cases the addition of further insulation either by thickness or density will slightly improve the performance of a system, particularly at low frequency; however the overall improvement may only be 1 dB.

Insulation used should not be thicker than the cavity size as bridging can occur.

Should an upgrade in acoustical performance above and beyond the values provided in this manual be required with the addition of insulation, advice from an acoustic engineer should be sought.

(b) Polyester Insulation

The substitution of polyester insulation is acceptable for the nominated systems on the basis that equivalent or better thickness and density is provided.

Care should be taken when using polyester insulation as there is currently no Australian Standard for its manufacture. Should there be any concern over quality of product used in substitution advice from an acoustic engineer should be sought.

Plasterboard

Where plasterboard is referred to in this manual it is plasterboard constructed in accordance with: AS/NZS 2588:1998 Gypsum Plasterboard.

Minimum permissible masses are as follows:

- 10mm plasterboard (Pbd): 6.5kg/m2
- 13mm plasterboard (Pbd): 8.5kg/m2
- 16mm fire-rated plasterboard (FR Pbd): 12.5kg/m2

Ventilated Eaves

A common feature of timber framed building is the use of ventilated eaves which are connected to the roof cavity. Ventilated eaves result in acoustical weakness unless treated correctly.

It is acknowledged that the use of ventilated eaves are necessary in specific situations. In areas where buildings require acoustical ratings of external elements, detailing is required to preserve acoustical integrity of the building through this path. One method of addressing this is to provide glasswool packed tightly over top plates of walls under the roof sheeting/tiles.

In situations where consideration is given to orientation of the building to a noise source, ventilation of a roof space can be achieved by orientation of the ventilation slots/holes on the leeward side of the building.

Resilient Steel Wall Channels

Where nominated in the details and ratings in Section 3.6, resilient steel wall channels may be fixed vertically to studs or horizontally across studs in accordance with manufacturers requirements.

The channels may also be located on either the inside of the wall or the outside of the wall without affecting the acoustic ratings given.

Where located on the external side of the wall to support cladding, particular attention should be paid to manufacturers recommendations regarding installation to resist relevant wind pressures.

Figure 2 illustrates a typical proprietary side fixed resilient wall channel used to support the internal lining.

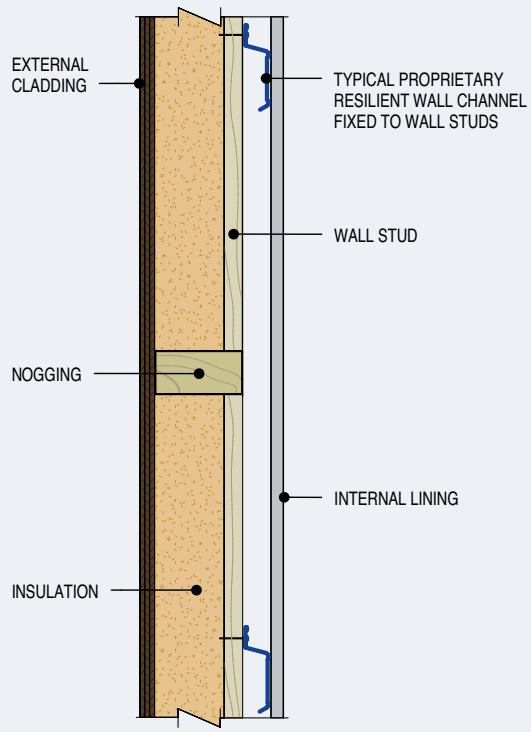


Figure 2: Resilient mounted wall cladding. Vertical section through wall

Resilient Mounted Ceilings

Where ceilings are required to be resiliently mounted, the typical detail given in Figure 3 may be used.

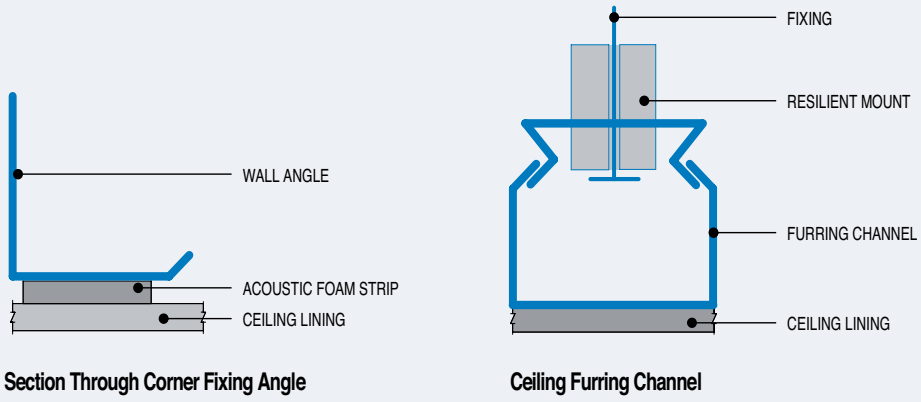


Figure 3: Resilient mounted ceiling lining. Resilient mount and furring channel detail

Floor Zones

Ratings are nominated in this guide for elevated floors which are open to the exterior via an opening. Perimeter sub-floors covered with open mesh, slats or perforated material which allow the air to freely pass do not provide a noise reduction and the ratings in the table should be used without adjustment.

In situations where the underfloor area is built-in around the perimeter of the building with the minimum BCA ventilation opening requirements, an improvement to the noise transmission path through the floor is provided. With the opening requirement of 7500mm^2/m of wall length not being exceeded, using continuous brick, block, or, fibre cement linings, an estimated improvement to the R_w and R_w+C_{tr} rating of the floors is 15 dB. For continuous 0.42mm BMT metal sheeting which is connected to solid elements at the periphery an improvement of 10 dB is expected with the minimum opening requirement.

3.5 Substitutions

In using the nominated opinions in this guide, it is possible that a slightly different system may be sought. If changes to a system are made, the changes will modify the acoustical performance in the following ways:

Cavity, insulation and sarking changes

- Increasing the thickness and density of the insulation will improve the performance slightly. Polyester insulation of equivalent or greater thickness and density may be substituted for the Glass Wool (GW) insulation.
- Increasing the cavity between the inner and outer layer will improve the performance.
- Omission of wall or roof sarking will not effect the acoustic ratings
- When a batten is used on the outer layer of the system, sheeting elements can be grouped together or separated using the batten without affecting the performance.

Stud Changes

- Increasing the thickness of studs and battens will decrease the performance and should be avoided.
- For systems using 70mm studs and batten a 90mm stud without batten may substituted without changing the performance.
- For wall systems other than Brick veneer and staggered studs, the reduction of stud spacing from 600mm centres to 450mm centres reduces the Rw and Rw+Ctr performance by 1 dB due to the additional connections.
- For brick veneer and staggered studs wall systems, there is no reduction in R_w and R_w+C_{tr} performance changing the stud spacing from 600mm to 450mm.
- Bridging staggered studs with noggings will negate the performance improvements back to that of a normal stud wall

Sheeting and lining Changes

- Medium Density Fibreboard (MDF) of equivalent density to plasterboard can be substituted for plasterboard and the same degree of performance obtained if the same arrangements of caulking and sealing are applied as per the plasterboard.
- Fibre cement sheeting (6mm thickness) provides slightly better acoustical performance than standard-core plasterboard and can therefore be substituted for 10 or 13mm plasterboard in any of the systems using 10 or 13 mm plasterboard and the same performance achieved.
- One layer of 10mm plasterboard plus one layer of 16 mm plasterboard may be substituted for two layers of 13 mm plasterboard.
- Hardboard (6.4mm) thickness provides equivalent acoustical performance to standard-core plasterboard and can therefore be substituted for 10mm plasterboard in any of the systems using 10mm plasterboard.

For any other substitutions, or for the application of any other special proprietary systems or cladding, advice from an acoustic engineer should be sought.

3.6 Wall Systems

3.6.1 Timber External Cladding

(i) Weatherboards (Board lap joints to be caulked)

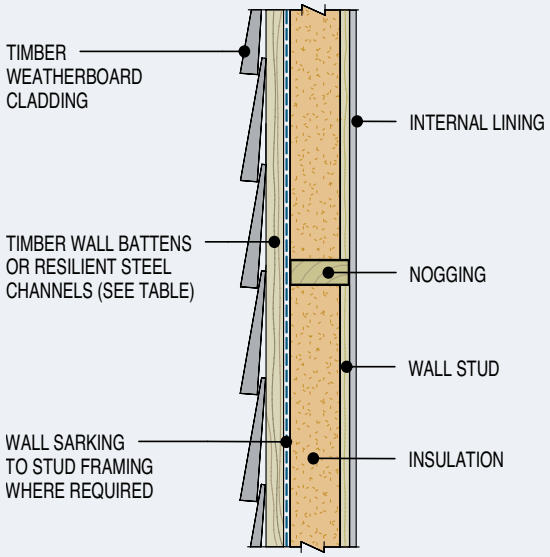


Figure 4: Weatherboard cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	$R_w + C_{tr}$
Weatherboard (25 mm nominal thickness). Board laps caulked with a durable flexible sealant.	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	39	34
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	39	34
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	38
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	41	37
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	41	37
	25	120	300mm staggered	2 x 10mm Pad	75mm 11 kg/m³ GW	47	42
	25	70	600mm	1 x 13mm Pad	75mm 11 kg/m³ GW	38	34
	25	90	600mm	1 x 13mm Pad	75mm 11 kg/m³ GW	39	35
	25	120	300mm staggered	1 x 13mm Pad	75mm 11 kg/m³ GW	45	39
	25	70	600mm	2 x 13mm Pad	75mm 11 kg/m³ GW	41	38
	25	90	600mm	2 x 13mm Pad	75mm 11 kg/m³ GW	41	38
	25	120	300mm staggered	2 x 13mm Pad	75mm 11 kg/m³ GW	48	43
	25	70	600mm	1 x 16mm FR Pad	75mm 11 kg/m³ GW	39	35
	25	90	600mm	1 x 16mm FR Pad	75mm 11 kg/m³ GW	39	36
	25	120	300mm staggered	1 x 16mm FR Pad	75mm 11 kg/m³ GW	45	41
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pad	75mm 11 kg/m³ GW	50	44

Table 1: R_w and $R_w + C_{tr}$ Ratings Weatherboard Clad Walls

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(ii) Chamfer Boards or Shiplap Boards (Hardwood or Softwood) of 19 mm thickness

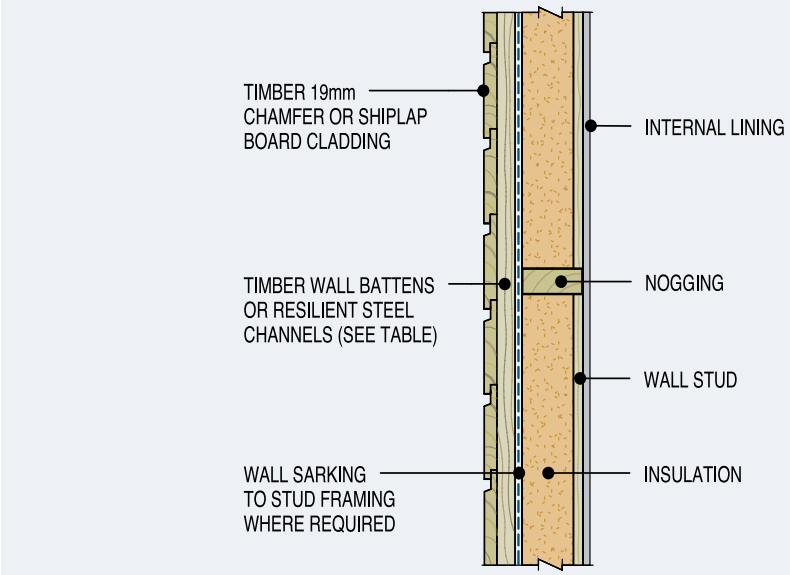


Figure 5: Chamfer Board or Shiplap Board cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
Chamfer Board or Shiplap Boards (19 mm thickness)	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	38	33
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	38	33
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	38
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	41	37
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	41	37
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	42
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	38	33
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	39	34
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	44	39
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	41	38
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	41	38
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	43
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	39	35
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	39	36
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	45	40
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	50	44

Table 2: R_w and R_w+C_{tr} Ratings Chamfer Board or Shiplap Clad Walls

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(iii) Chamfer Boards or Shiplap Boards (Hardwood or Softwood) of 19 mm thickness over 6 mm Fibre Cement

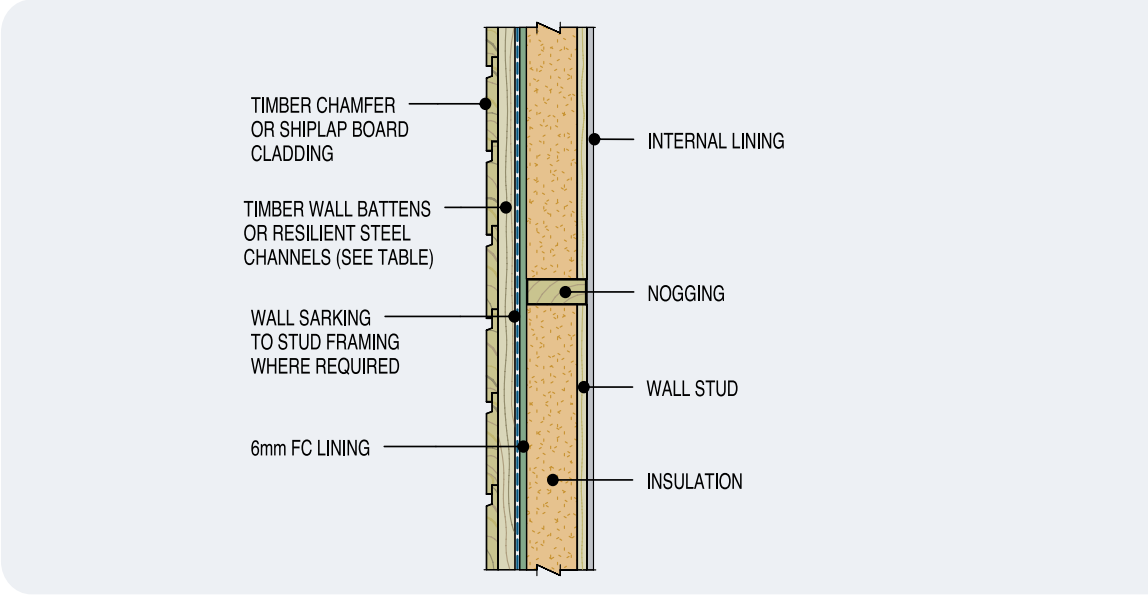


Figure 6: Chamfer Board or Shiplap Board cladding over Fibre Cement. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
Chamfer Board or Shiplap Boards (19 mm thickness) with 6 mm Fibre Cement behind	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	38
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	39
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	49	43
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	46	42
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	46	42
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	52	47
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	43	39
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	43	40
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	49	44
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	46	42
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	46	43
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	52	48
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	43	40
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	43	40
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	49	45
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	54	48

Table 3: R_w and R_w+C_{tr} Ratings Chamfer or Shiplap Board over 6 mm Fibre Cement clad walls

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.
3. The 6 mm fibre cement board may be located on either the inside or the outside of the batten

(iv) 12 mm Plywood

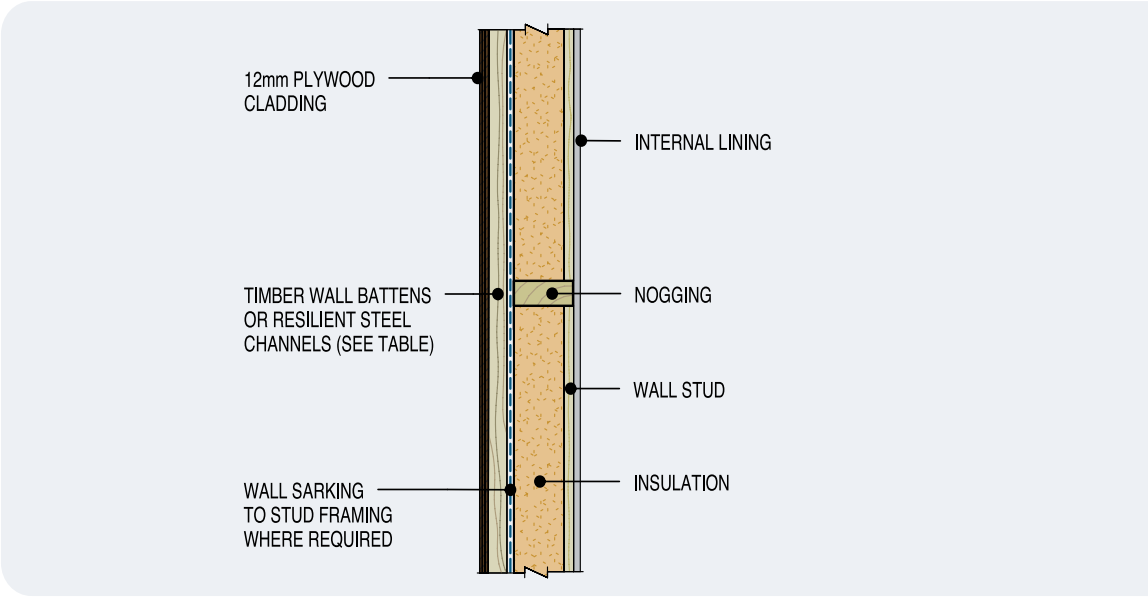


Figure 7: 12 mm Plywood cladding over Fibre Cement. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
12 mm Plywood	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	37	31
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	38	33
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	42	35
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	41	35
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	42	37
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	41
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	38	33
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	38	33
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	43	37
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	42	37
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	42	38
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	42
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	39	34
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	39	35
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	45	40
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	50	42

Table 4: R_w and R_w+C_{tr} Ratings 12 mm Plywood cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(v) 9.5 mm Hardboard Planks

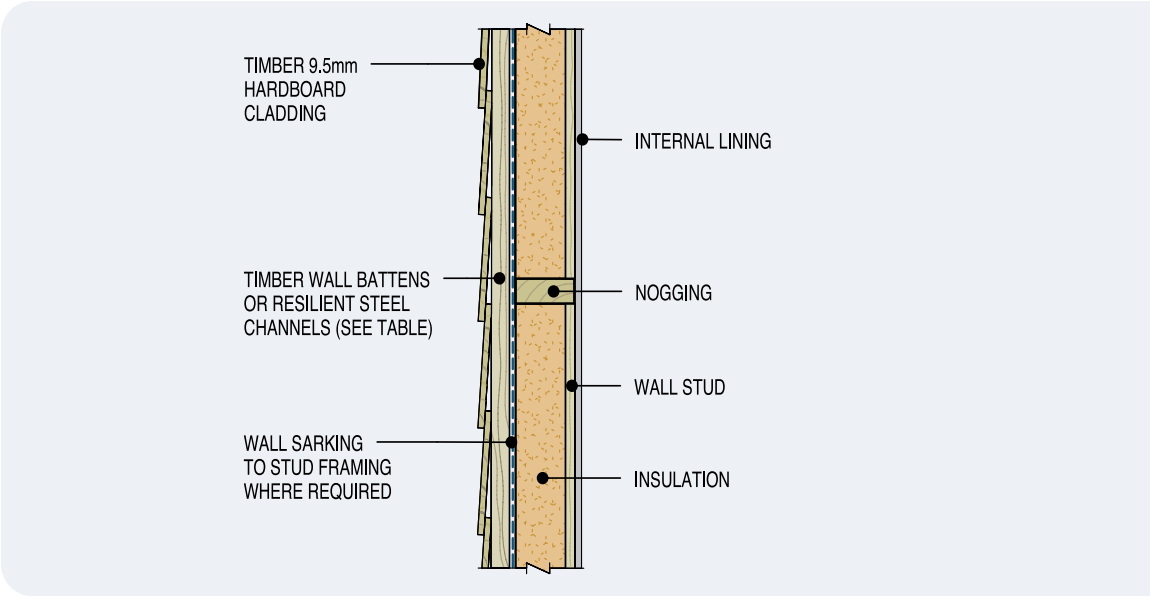


Figure 8: 9.5 mm Hardwood Plank cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
9.5 mm Hardboard	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	43	35
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	43	35
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	47	38
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	39
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	41
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	52	43
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	44	35
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	44	37
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	49	40
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	41
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	42
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	53	45
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	45	38
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	45	40
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	50	43
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	55	45

Table 5: R_w and R_w+C_{tr} Ratings 9.5 mm Hardboard Plank cladding

NOTES

1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.

2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

3.6.2 Fibre Cement External Cladding

(i) 7.5 mm Fibre Cement Board (11 kg/m²)

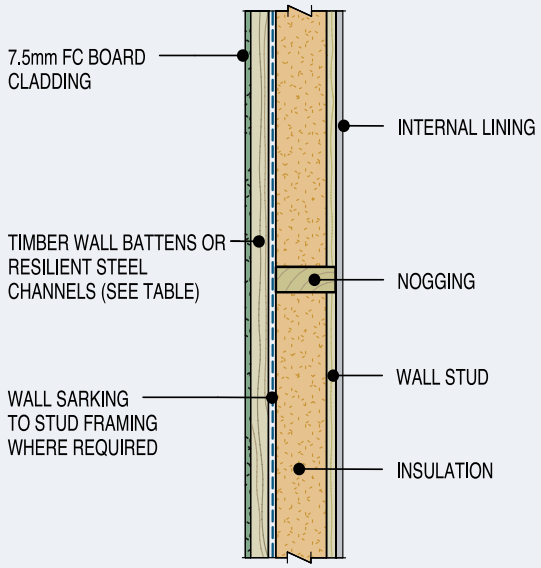


Figure 9: 7.5 mm Fibre Cement Board (11 kg/m2) cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
7.5 mm Fibre cement (12.2 kg/m²) (with acrylic coating	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	37
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	44	37
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	48	40
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	41
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	41
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	52	45
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	44	37
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	44	38
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	49	42
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	42
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	43
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	53	47
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	44	39
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	44	40
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	50	44
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	54	45

Table 6: R_w and R_w+C_{tr} Ratings 7.5 mm Fibre Cement External Cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(ii) 7.5 mm Fibre Cement Board over 6mm Fibre Cement (20 kg/m²)

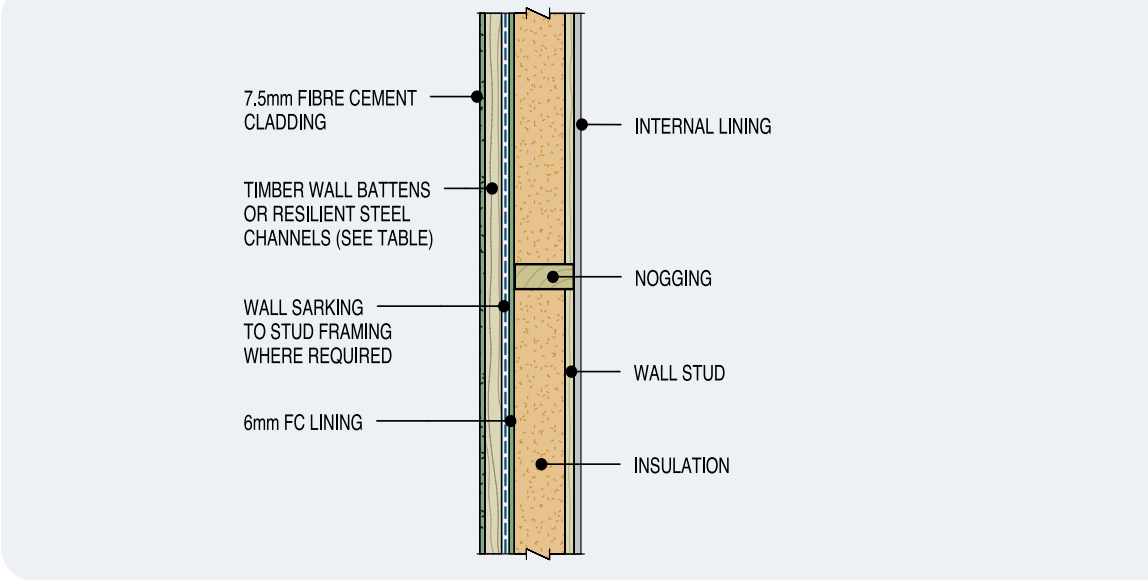


Figure 10: 7.5 mm Fibre Cement Board over 6 mm Fibre Cement cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
7.5 mm Fibre Cement with 6mm Fibre Cement behind (21.2 kg/m²) (with acrylic coating)	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m3 GW	47	40
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m3 GW	47	41
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m3 GW	52	44
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m3 GW	50	44
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m3 GW	50	45
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m3 GW	56	49
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m3 GW	47	41
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m3 GW	47	42
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m3 GW	53	46
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m3 GW	50	45
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m3 GW	50	46
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m3 GW	56	50
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	47	42
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	47	43
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	53	48
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m3 GW	57	49

Table 7: R_w and R_w+C_{tr} Ratings 7.5 mm Fibre Cement Board over 6 mm Fibre Cement cladding.

NOTES
1. A 90mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.
3. The 6 mm fibre cement board may be located on either the inside or the outside of the batten.

(iii) 9 mm Fibre Cement Cladding

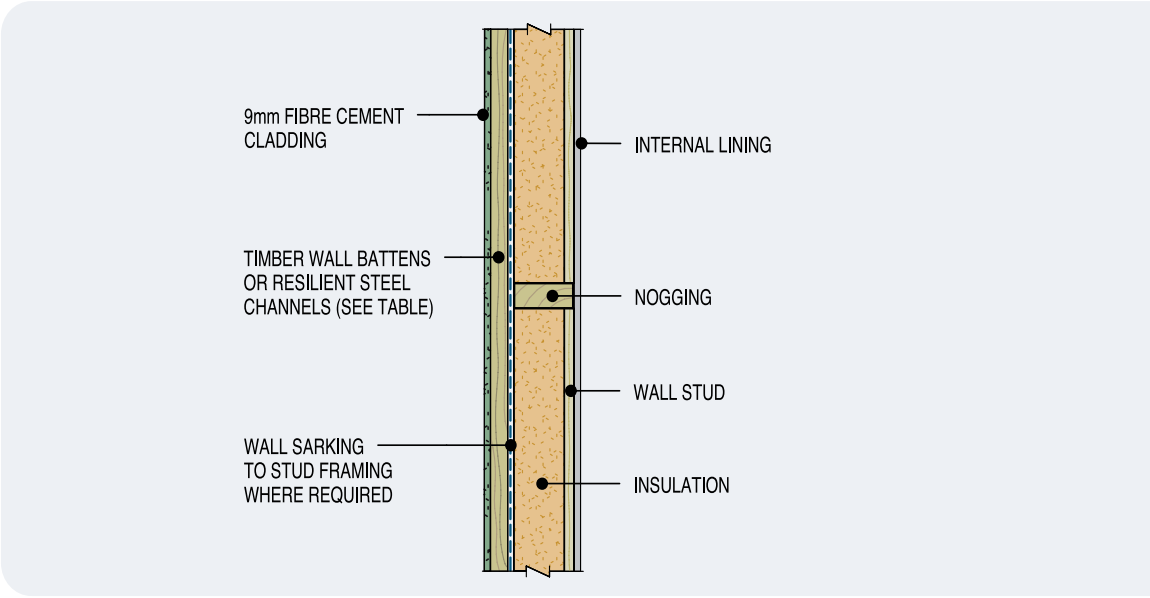


Figure 11: 9 mm Fibre Cement Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
9 mm Fibre Cement Cladding (12.2 kg/m²)	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m3 GW	47	40
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m3 GW	47	41
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m3 GW	52	44
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m3 GW	50	44
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m3 GW	50	45
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m3 GW	56	49
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m3 GW	47	41
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m3 GW	47	42
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m3 GW	53	46
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m3 GW	50	45
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m3 GW	50	46
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m3 GW	56	50
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	47	42
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	47	43
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m3 GW	53	48
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m3 GW	57	49

Table 8: R_w and R_w+C_{tr} Ratings 9 mm Fibre Cement Cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(iv) 11 mm Fibre Cement Weatherboards

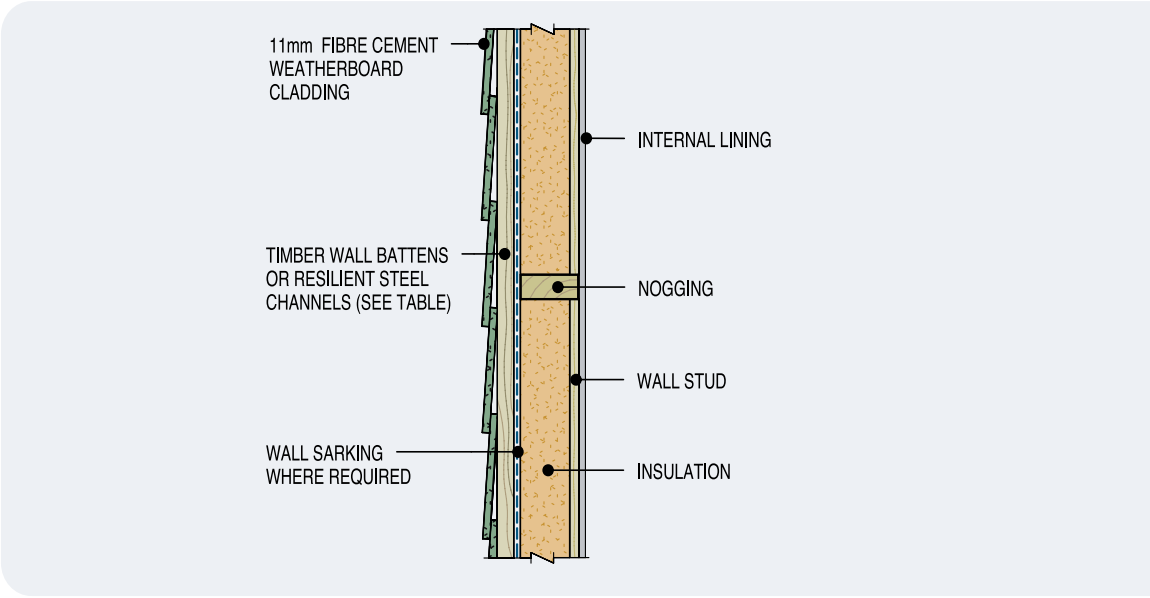


Figure 12: 11 mm Fibre Cement Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
11 mm Fibre Cement Weatherboards (17.3 kg/m²)	25	70	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	43	35
	25	90	600mm	1 x 10mm Pbd	75mm 11 kg/m³ GW	43	35
	25	120	300mm staggered	1 x 10mm Pbd	75mm 11 kg/m³ GW	47	39
	25	70	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	46	39
	25	90	600mm	2 x 10mm Pbd	75mm 11 kg/m³ GW	47	41
	25	120	300mm staggered	2 x 10mm Pbd	75mm 11 kg/m³ GW	52	44
	25	70	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	43	35
	25	90	600mm	1 x 13mm Pbd	75mm 11 kg/m³ GW	43	37
	25	120	300mm staggered	1 x 13mm Pbd	75mm 11 kg/m³ GW	48	40
	25	70	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	47	41
	25	90	600mm	2 x 13mm Pbd	75mm 11 kg/m³ GW	48	42
	25	120	300mm staggered	2 x 13mm Pbd	75mm 11 kg/m³ GW	53	46
	25	70	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	44	38
	25	90	600mm	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	44	39
	25	120	300mm staggered	1 x 16mm FR Pbd	75mm 11 kg/m³ GW	49	43
	Resilient Steel Channel	90	600mm	2 x 16mm FR Pbd	75mm 11 kg/m³ GW	55	48

Table 9: R_w and R_w+C_{tr} Ratings 11 mm Fibre Cement Cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(v) 11 mm Fibre Cement Weatherboards over 6 mm Fibre Cement

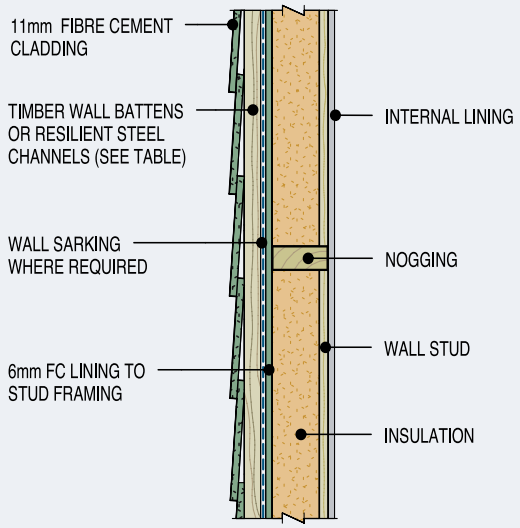


Figure 13: 11 mm Fibre Cement over 6 mm Fibre Cement Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
11 mm Fibre Cement Weatherboards with 6 mm Fibre Cement behind (17.3 kg/m²)	25	70	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	39
	25	90	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	41
	25	120	300 mm staggered	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	52	44
	25	70	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	50	44
	25	90	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	50	45
	25	120	300 mm staggered	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	56	49
	25	70	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	41
	25	90	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	42
	25	120	300 mm staggered	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	53	45
	25	70	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	50	45
	25	90	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	50	46
	25	120	300 mm staggered	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	56	50
	25	70	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	47	42
	25	90	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	47	43
	25	120	300 mm staggered	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	53	47
	Resilient Steel Channel	90	600mm	2 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	57	51

***Table 10: R_w and R_w+C_{tr} Ratings 11 mm Fibre Cement Cladding* over 6 mm Fibre Cement**

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.
3. The 6 mm fibre cement board may be located on either the inside or the outside of the batten.
.

(vi) 16mm Fibre Cement Weatherboards

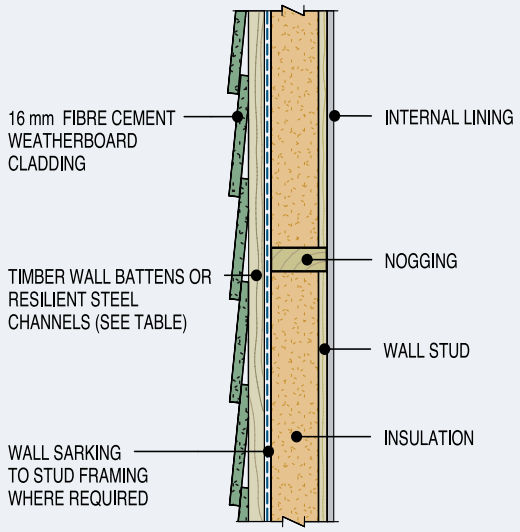


Figure 14: 16 mm Fibre Cement Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
16 mm Fibre Cement Weatherboards (18.4 kg/m²)	25	70	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	39
	25	90	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	45	40
	25	120	300 mm staggered	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	50	43
	25	70	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	42
	25	90	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	43
	25	120	300 mm staggered	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	53	48
	25	70	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	44	40
	25	90	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	44	40
	25	120	300 mm staggered	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	50	45
	25	70	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	43
	25	90	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	44
	25	120	300 mm staggered	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	53	49
	25	70	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	44	40
	25	90	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	44	41
	25	120	300 mm staggered	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	50	46
	Resilient Steel Channel	90	600 mm	2 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	55	49

Table 11: R_w and R_w+C_{tr} Ratings 16 mm Fibre Cement Cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

3.6.3 Metal External Cladding

(i) Corrugated (regular) horizontal or vertical metal cladding on battens

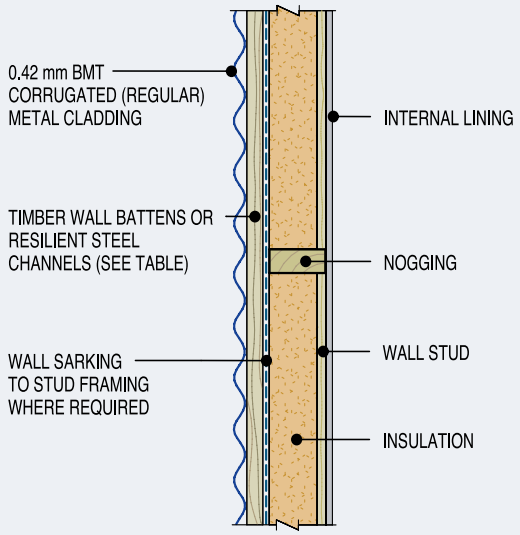


Figure 15: Metal External Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
Corrugated (regular) metal cladding on battens with sarking (0.42mm BMT)	25	70	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	38	29
	25	90	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	39	30
	25	120	300 mm staggered	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	41	31
	25	70	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	43	34
	25	90	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	35
	25	120	300 mm staggered	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	38
	25	70	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	40	30
	25	90	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	41	31
	25	120	300 mm staggered	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	43	34
	25	70	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	45	35
	25	90	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	37
	25	120	300 mm staggered	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	40
	25	70	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	33
	25	90	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	34
	25	120	300 mm staggered	1 x 16 mm FR Pbd	75 mm 11 kg/mv GW	45	37
	Resilient Steel Channel	90	600 mm	2 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	50	41

Table 12: R_w and R_w+C_{tr} Ratings Metal External Cladding

NOTES
1.A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

(i) Corrugated (mini) horizontal or vertical metal cladding on battens

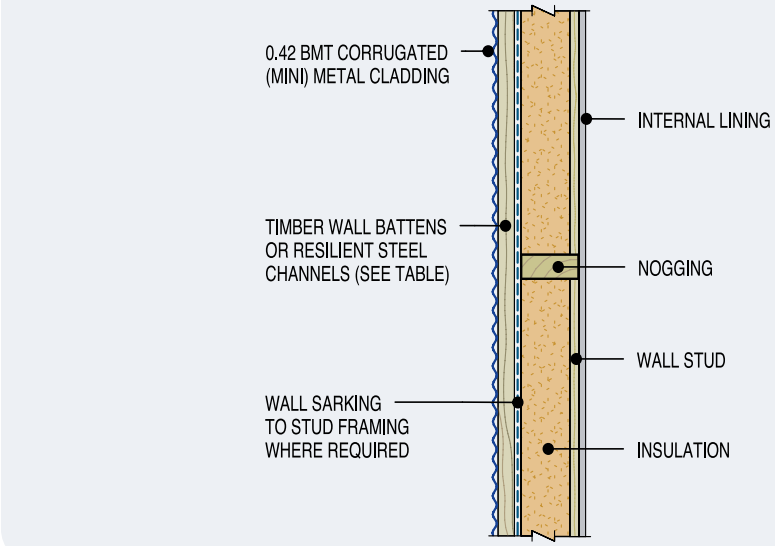


Figure 16: Metal External Cladding. Vertical section through wall

External Cladding	Batten	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	R_w+C_{tr}
Corrugated (mini) metal cladding on battens with sarking (0.42 mm BMT)	25	70	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	38	29
	25	90	600 mm	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	39	30
	25	120	300 mm staggered	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	41	31
	25	70	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	34
	25	90	600 mm	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	45	35
	25	120	300 mm staggered	2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	38
	25	70	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	40	30
	25	90	600 mm	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	41	31
	25	120	300 mm staggered	1 x 13 mm Pbd	75 mm 11 kg/m³ GW	43	34
	25	70	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	45	35
	25	90	600 mm	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	37
	25	120	300 mm staggered	2 x 13 mm Pbd	75 mm 11 kg/m³ GW	49	40
	25	70	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	33
	25	90	600 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	34
	25	120	300 mm staggered	1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	46	37
	Resilient Steel Channel	90	600 mm	2 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	50	41

Table 13: R_w and R_w+C_{tr} Ratings, Corrugated (mini) horizontal or vertical metal cladding

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. For staggered stud wall frames with 120 mm plates, either 70 or 90 mm studs may be used. See also Section 3.4.

3.6.4 Brick Veneer

(i) Brick Veneer (90 mm or thicker bricks)

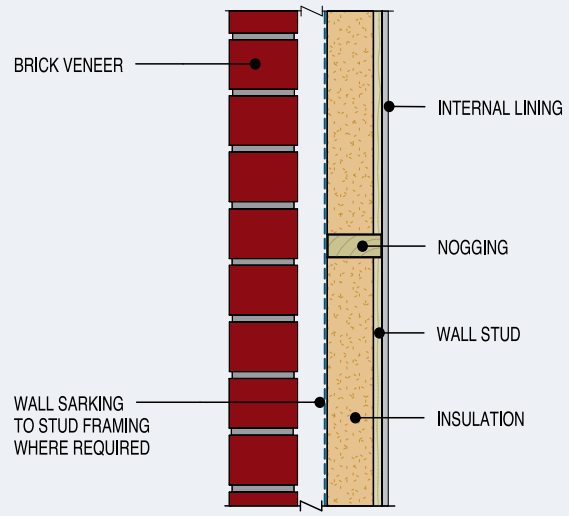


Figure 17: Brick Veneer. Vertical section through wall

External Cladding	Frame	Stud Centres (max)	Internal Lining	Insulation	R_w	$R_w + C_{tr}$
Brick Veneer (hollow or solid) with 90 mm+ Bricks	70	≥450 mm	1 x 10 mm Pbd	75 mm 11 kg/m3 GW	55	51
	90	≥450 mm	1 x 10 mm Pbd	75 mm 11 kg/m3 GW	55	51
	70	≥450 mm	2 x 10 mm Pbd	75 mm 11 kg/m3 GW	56	52
	90	≥450 mm	2 x 10 mm Pbd	75 mm 11 kg/m3 GW	56	52
	70	≥450 mm	1 x 13 mm Pbd	75 mm 11 kg/m3 GW	55	50
	90	≥450 mm	1 x 13 mm Pbd	75 mm 11 kg/m3 GW	55	51
	70	≥450 mm	2 x 13 mm Pbd	75 mm 11 kg/m3 GW	55	51
	90	≥450 mm	2 x 13 mm Pbd	75 mm 11 kg/m3 GW	55	51
	70	≥450 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m3 GW	53	50
	90	≥450 mm	1 x 16 mm FR Pbd	75 mm 11 kg/m3 GW	55	52

Table 14: R_w and $R_w + C_{tr}$ Ratings Brick Veneer

NOTES
1. A 90 mm stud without batten may be used in lieu of and at the same rating as a 70 mm stud with a 25 mm batten.
2. The minimum cavity gap shall be 20 mm

3.7 Roof Systems

3.7.1 Trussed or Pitched Roofs

(i) Trussed or Pitched Roof with R 3.0 Insulation

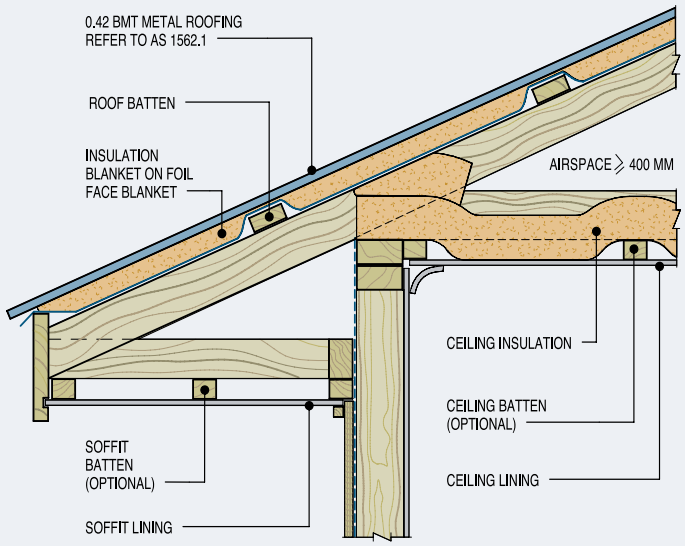


Figure 18: Pitched 0.42mm BMT Corrugated roof with R 3.0 Insulation. Section through roof

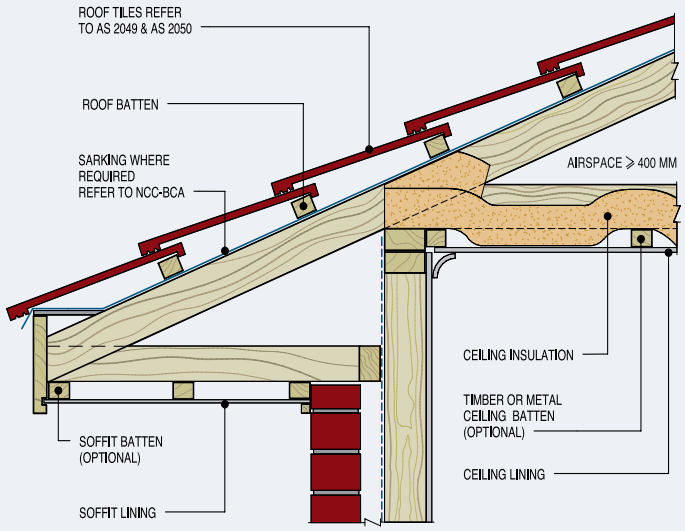
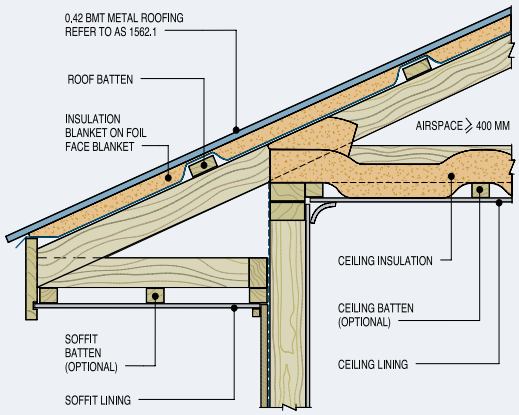


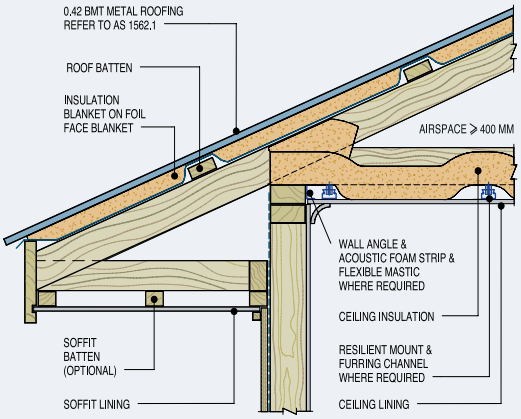
Figure 19: Pitched tiled roof with R 3.0 Insulation. Section through roof

Roof Material	Frame	Truss/rafter Spacing	Ceiling Lining	Insulation	R_w	$R_w + C_{tr}$
Pitched 0.42 mm BMT Corrugated roof sheeting with 50 mm glasswool insulation bonded to foil	Timber Truss/ rafter with average airspace ≥400 mm	600 mm or greater centres	1 x 10 mm Pbd (ceiling grade)	R 3.0 - 7 kg/m³ GW	42	36
			2 x 10 mm Pbd (ceiling grade)	R 3.0 - 7 kg/m³ GW	48	42
			1 x 13 mm Pbd	R 3.0 - 7 kg/m³ GW	44	38
			2 x 13 mm Pbd	R 3.0 - 7 kg/m³ GW	50	43
			1 x 16 mm FR Pbd	R 3.0 - 7 kg/m³ GW	46	40
Pitched tiled roof with or without sarking			1 x 10 mm Pbd (ceiling grade)	R 3.0 - 7 kg/m³ GW	40	35
			2 x 10 mm Pbd (ceiling grade)	R 3.0 - 7 kg/m³ GW	50	45
			1 x 13 mm Pbd	R 3.0 - 7 kg/m³ GW	43	38
			2 x 13 mm Pbd	R 3.0 - 7 kg/m³ GW	49	43
			1 x FR Pbd	R 3.0 - 7 kg/m³ GW	46	41

Table 15: R_w and $R_w + C_{tr}$ Ratings, Trussed or Pitched Roofs with R 3.0 Insulation

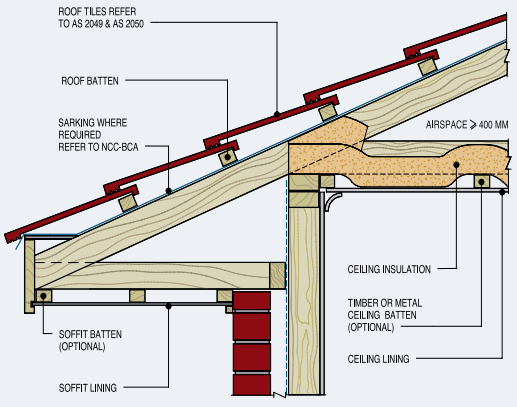
(ii) Trussed or Pitched Roof with R 4.0 Insulation

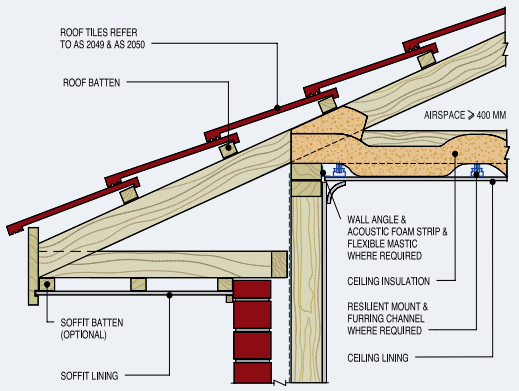




Left: Figure 20: Pitched 0.42mm BMT Corrugated roof with R 4.0 Insulation. Section through roof

RIght: Figure 21: As per FIgure 20 but with resilient mounts and furring channels. Section through roof





Left: Figure 22: Pitched tiled roof with R 4.0 Insulation. Section through roof

Right: Figure 23: As per FIgure 22 but with resilient mounts and furring channels. Section through roof

Roof Material	Frame	Stud Layout	Ceiling Lining	Insulation	R_w	$R_w + C_{tr}$
Pitched 0.42 mm BMT Corrugated roof sheeting with 50 mm glasswool insulation bonded to foil	Timber Truss/ rafter with average airspace ≥400 mm	600 mm or greater centres	1 x 10 mm Pbd (ceiling grade)	R 4.0 - 7 kg/m³ GW	43	37
			2 x 10 mm Pbd (ceiling grade)	R 4.0 - 7 kg/m³ GW	49	43
			1 x 13 mm Pbd	R 4.0 - 7 kg/m³ GW	45	39
			2 x 13 mm Pbd	R 4.0 - 7 kg/m³ GW	51	44
			1 x 16 mm FR Pbd	R 4.0 - 7 kg/m³ GW	47	41
			2 x 13mm Pbd on resilient mounts & furring channels	R 4.0 - 7 kg/m³ GW	52	45
Pitched tiled roof with or without sarking			1 x 10 mm Pbd (ceiling grade)	R 4.0 - 7 kg/m³ GW	40	36
			2 x 10 mm Pbd (ceiling grade)	R 4.0 - 7 kg/m³ GW	50	46
			1 x 13 mm Pbd	R 4.0 - 7 kg/m³ GW	43	39
			2 x 13 mm Pbd	R 4.0 - 7 kg/m³ GW	49	44
			1 x FR Pbd	R 4.0 - 7 kg/m³ GW	46	42
			2 x 13mm Pbd on resilient mounts & furring channels	R 4.0 - 7 kg/m³ GW	51	45

Table 16: R_w and $R_w + C_{tr}$ Ratings, Trussed or Pitched Roofs with R 4.0 Insulation

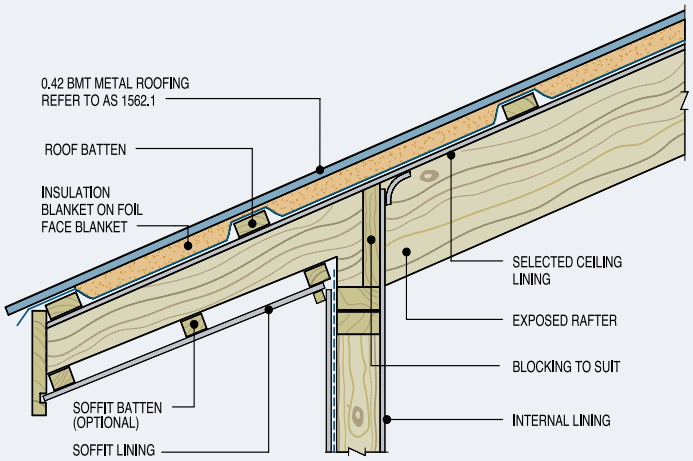


Figure 24: Cathedral Roof/Ceiling Construction. Section through roof

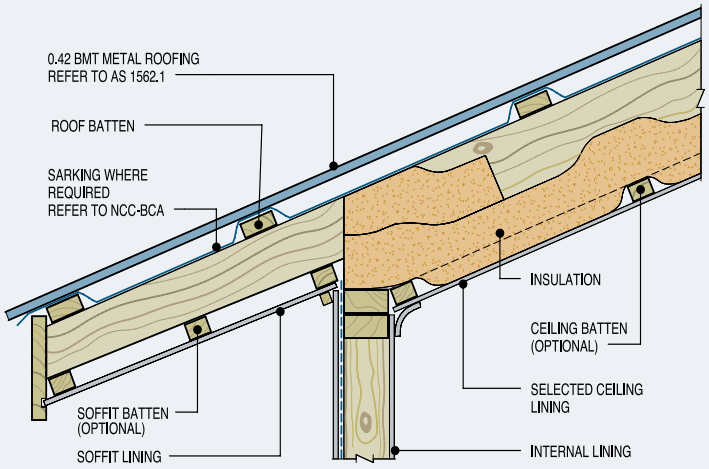


Figure 25: Cathedral Roof/Ceiling Construction. Section through roof

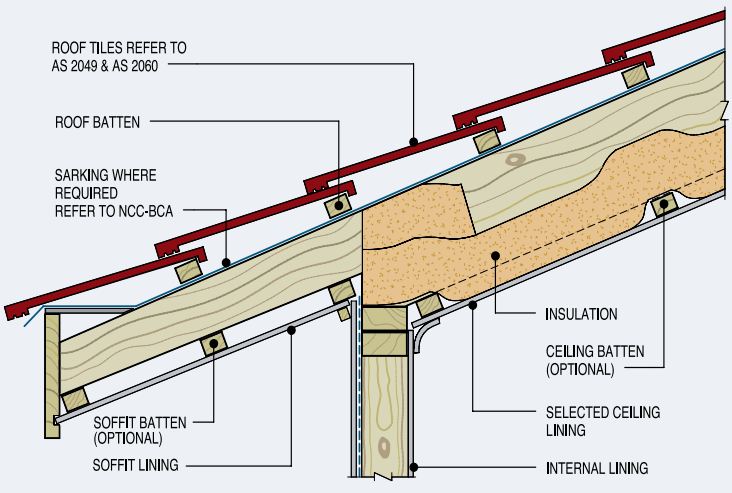


Figure 26: Cathedral Roof/Ceiling Construction. Section through roof

Roof Material	Cavity	Rafter Layout	Ceiling Lining	Insulation	R_w	$R_w + C_{tr}$
Pitched 0.42 mm BMT corrugated roof sheeting with 50mm glasswool insulation bonded to foil or Pitched tiled roof with sarking	**35 mm roof battens with exposed rafters.**	**400 mm Centres**	1 x 10 mm Pbd	Insulation/foil over battens only	32	25
			2 x 10 mm Pbd	Insulation/foil over battens only	38	30
			1 x 13 mm Pbd	Insulation/foil over battens only	34	27
			2 x 13 mm Pbd	Insulation/foil over battens only	40	32
			1 x 16 mm FR Pbd	Insulation/foil over battens only	37	29
		600 mm or greater Centres	1 x 10 mm Pbd	Insulation/foil over battens only	33	25
			2 x 10 mm Pbd	Insulation/foil over battens only	38	30
			1 x 13 mm Pbd	Insulation/foil over battens only	34	27
			2 x 13 mm Pbd	Insulation/foil over battens only	40	32
			1 x 16 mm FR Pbd	Insulation/foil over battens only	37	29
	90 mm	**400 mm Centres**	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	36	27
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	41	32
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	38	28
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	44	34
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	39	31
		600 mm or greater Centres	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	36	27
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	41	32
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	38	29
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	44	34
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	40	31
	140 mm	**400 mm Centres**	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	38	30
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	36
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	40	32
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	39
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	35
		600mm or greater Centres	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	39	30
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	37
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	41	33
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	39
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	43	36

Table 17: R_w and $R_w + C_{tr}$ Ratings, Cathedral Roof/Ceiling Construction

Roof Material	Cavity	Rafter Layout	Ceiling Lining	Insulation	R_w	$R_w + C_{tr}$
Pitched 0.42 mm BMT corrugated roof sheeting with 50mm glasswool insulation bonded to foil **or** **Pitched tiled roof with sarking**	**190 mm**	**400 mm Centres**	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	39	31
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	44	37
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	41	33
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	39
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	42	36
		600 mm or greater Centres	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	40	31
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	45	37
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	42	33
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	40
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	43	36
	240 mm	**400 mm Centres**	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	40	33
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	45	39
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	42	35
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	41
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	43	38
		600 mm or greater Centres	1 x 10 mm Pbd	75 mm 11 kg/m³ GW	40	33
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	46	39
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	42	35
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	41
			1 x 16 mm FR Pbd	75 mm 11 kg/m³ GW	44	38

Table 17 (continued): R_w and $R_w + C_{tr}$ Ratings, Cathedral Roof/Ceiling Construction

(i) 19 mm T&G Hardwood flooring or particleboard to top of joists

For improved ratings, of up to 15 dB, for enclosed sub-floors, refer to Section 3.4.

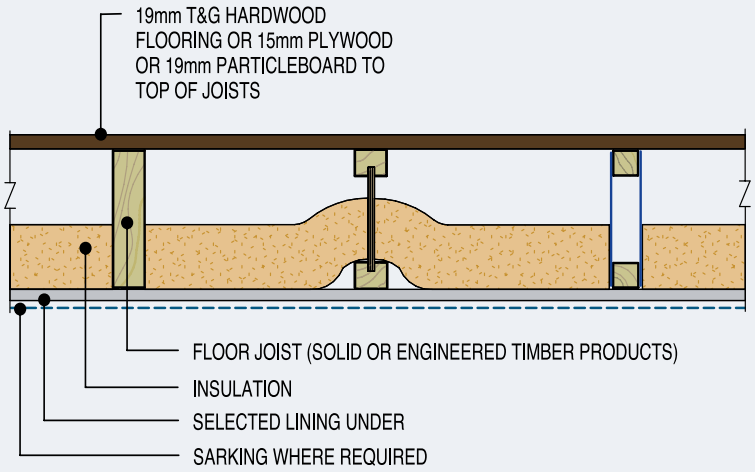


Figure 27: 19 mm T&G Hardwood flooring or particleboard to top of joists

Floor Material	Joist depth (mm)	Joist Layout	Lining to Underside	Insulation	R_w	$R_w + C_{tr}$
19mm solid T&G Hardwood or Particleboard to top of joists	90 mm	400/450 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	33	29
			1 x 10mm Pbd	75mm 11 kg/m3 GW	40	35
			2 x 10mm Pbd	75mm 11 kg/m3 GW	43	39
			1 x 13mm Pbd	75mm 11 kg/m3 GW	40	36
			2 x 13mm Pbd	75mm 11 kg/m3 GW	43	39
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	40	37
		600 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	33	29
			1 x 10mm Pbd	75mm 11 kg/m3 GW	42	36
			2 x 10mm Pbd	75mm 11 kg/m3 GW	44	40
			1 x 13mm Pbd	75mm 11 kg/m3 GW	42	37
			2 x 13mm Pbd	75mm 11 kg/m3 GW	44	41
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	43	39
	190 mm	400/450 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	34	29
			1 x 10mm Pbd	75mm 11 kg/m3 GW	41	37
			2 x 10mm Pbd	75mm 11 kg/m3 GW	43	40
			1 x 13mm Pbd	75mm 11 kg/m3 GW	40	37
			2 x 13mm Pbd	75mm 11 kg/m3 GW	43	40
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	40	37
		600 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	34	29
			1 x 10mm Pbd	75mm 11 kg/m3 GW	42	39
			2 x 10mm Pbd	75mm 11 kg/m3 GW	44	41
			1 x 13mm Pbd	75mm 11 kg/m3 GW	42	39
			2 x 13mm Pbd	75mm 11 kg/m3 GW	45	42
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	42	39
	290 mm	400/450 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	36	30
			1 x 10mm Pbd	75mm 11 kg/m3 GW	41	38
			2 x 10mm Pbd	75mm 11 kg/m3 GW	43	40
			1 x 13mm Pbd	75mm 11 kg/m3 GW	40	38
			2 x 13mm Pbd	75mm 11 kg/m3 GW	43	40
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	40	37
		600 mm Centres	Nil	Nil	30	27
			Nil	75mm 11 kg/m3 GW	36	30
			1 x 10mm Pbd	75mm 11 kg/m3 GW	42	39
			2 x 10mm Pbd	75mm 11 kg/m3 GW	44	42
			1 x 13mm Pbd	75mm 11 kg/m3 GW	42	39
			2 x 13mm Pbd	75mm 11 kg/m3 GW	44	42
			1 x 16mm Fyrcheck Pbd	75mm 11 kg/m3 GW	42	39

Table 18: R_w and $R_w + C_{tr}$ Ratings, 19 mm T&G Hardwood flooring or particleboard to top of joists

(ii) 19mm T&G Hardwood flooring over 15mm plywood or 19mm particleboard to top of joists

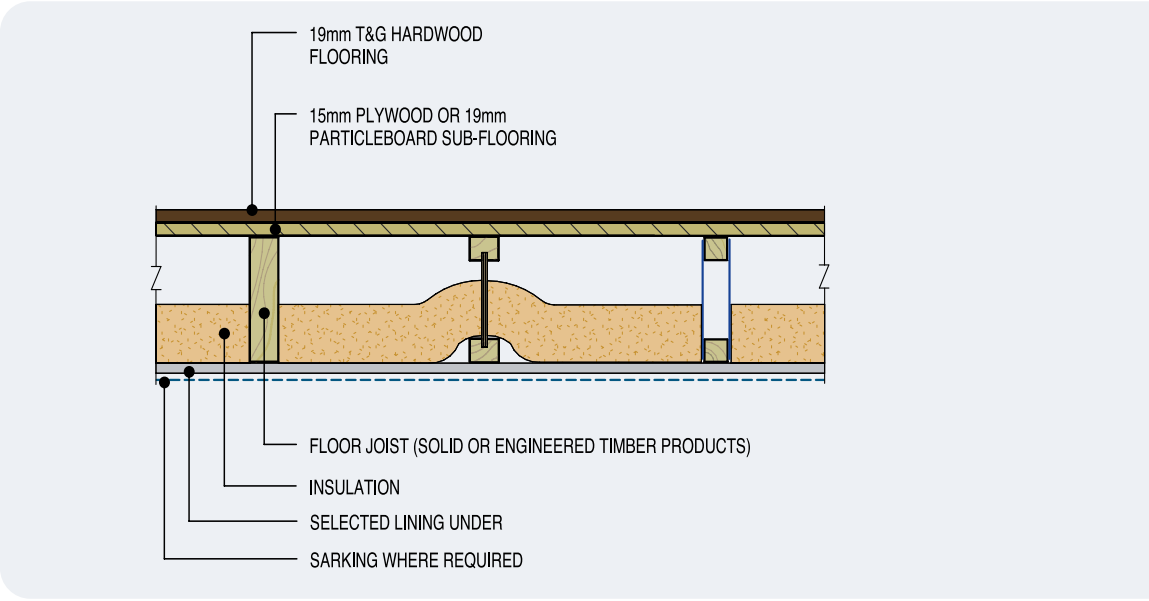


Figure 28: 19mm T&G Hardwood flooring over 15mm plywood or 19mm particleboard to top of joists

Floor Material	Joist depth (mm)	Joist Layout	Lining to Underside	Insulation	R_w	$R_w + C_{tr}$
19 mm T&G flooring[1] over 15 mm plywood or 19 mm particleboard	90 mm	400/450 mm Centres	Nil	Nil	36	33
			Nil	75 mm 11 kg/m³ GW	38	34
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	45	41
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	43
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	45	41
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	43
			1 x 16mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	44	41
		600 mm Centres	Nil	Nil	36	33
			Nil	75 mm 11 kg/m³ GW	38	34
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	41
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	44
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	42
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	45
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	42
	190 mm	400/450 mm Centres	Nil	Nil	36	33
			Nil	75 mm 11 kg/m³ GW	40	35
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	46	42
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	44
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	45	42
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	44
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	44	41
		600 mm Centres	Nil	Nil	36	33
			Nil	75 mm 11 kg/m³ GW	40	35
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	43
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	45
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	43
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	45
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	43
	290 mm	400/450 mm Centres	Nil	Nil	41	35
			Nil	75 mm 11 kg/m³ GW	36	33
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	46	42
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	44
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	45	42
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	46	44
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	44	41
		600 mm Centres	Nil	Nil	41	35
			Nil	75 mm 11 kg/m³ GW	36	33
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	47	44
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	46
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	44
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	45
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	43

Table 19: R_w and $R_w + C_{tr}$ Ratings, 19 mm T&G Hardwood flooring or particleboard to top of joists

Notes:

1 With the substitution of 12 mm overlay flooring for 19mm, the performance is reduced by -1 R_w point.

(iii) Tiles on 6mm Tile underlay over 15mm plywood or 19mm particleboard to top of joists

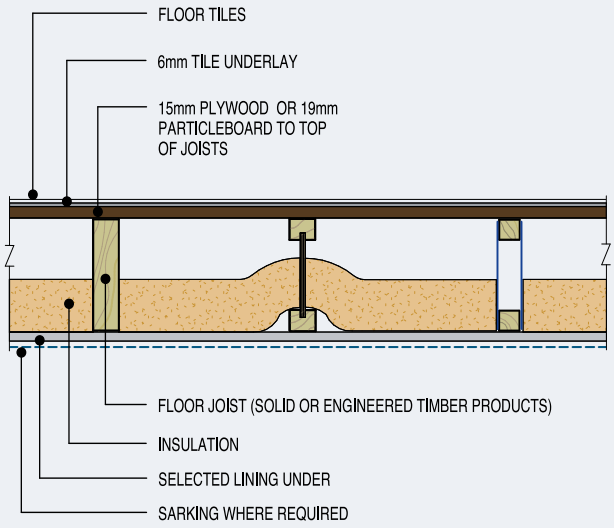


Figure 29: Tiles on 6mm Tile underlay over 15mm plywood or 19mm particleboard to top of joists

Floor Material	Joist depth (mm)	Joist Layout	Lining to Underside	Insulation	R_w	$R_w + C_{tr}$
Tiles on 6 mm Tile underlay over 15mm or 19mm particleboard	90 mm	400/450 mm Centres	Nil	Nil	38	35
			Nil	75 mm 11 kg/m³ GW	41	36
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	48	43
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	45
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	43
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	45
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	43
		600 mm Centres	Nil	Nil	38	35
			Nil	75 mm 11 kg/m³ GW	41	36
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	47
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	51	47
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	49	44
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	50	47
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	48	44
	190 mm	400/450 mm Centres	Nil	Nil	38	35
			Nil	75 mm 11 kg/m³ GW	42	36
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	48	44
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	46
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	46
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	46
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	43
		600 mm Centres	Nil	Nil	38	35
			Nil	75mm 11 kg/m3 GW	42	36
			1 x 10 mm Pbd	75mm 11 kg/m3 GW	49	46
			2 x 10 mm Pbd	75mm 11 kg/m3 GW	51	48
			1 x 13 mm Pbd	75mm 11 kg/m3 GW	49	46
			2 x 13 mm Pbd	75mm 11 kg/m3 GW	50	47
			1 x 16 mm Fyrcheck Pbd	75mm 11 kg/m3 GW	48	45
	290 mm	400/450 mm Centres	Nil	Nil	38	35
			Nil	75 mm 11 kg/m³ GW	42	36
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	48	45
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	46
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	47	44
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	48	46
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	46	43
		600 mm Centres	Nil	Nil	38	35
			Nil	75 mm 11 kg/m³ GW	42	36
			1 x 10 mm Pbd	75 mm 11 kg/m³ GW	49	46
			2 x 10 mm Pbd	75 mm 11 kg/m³ GW	51	48
			1 x 13 mm Pbd	75 mm 11 kg/m³ GW	49	46
			2 x 13 mm Pbd	75 mm 11 kg/m³ GW	50	48
			1 x 16 mm Fyrcheck Pbd	75 mm 11 kg/m³ GW	48	45

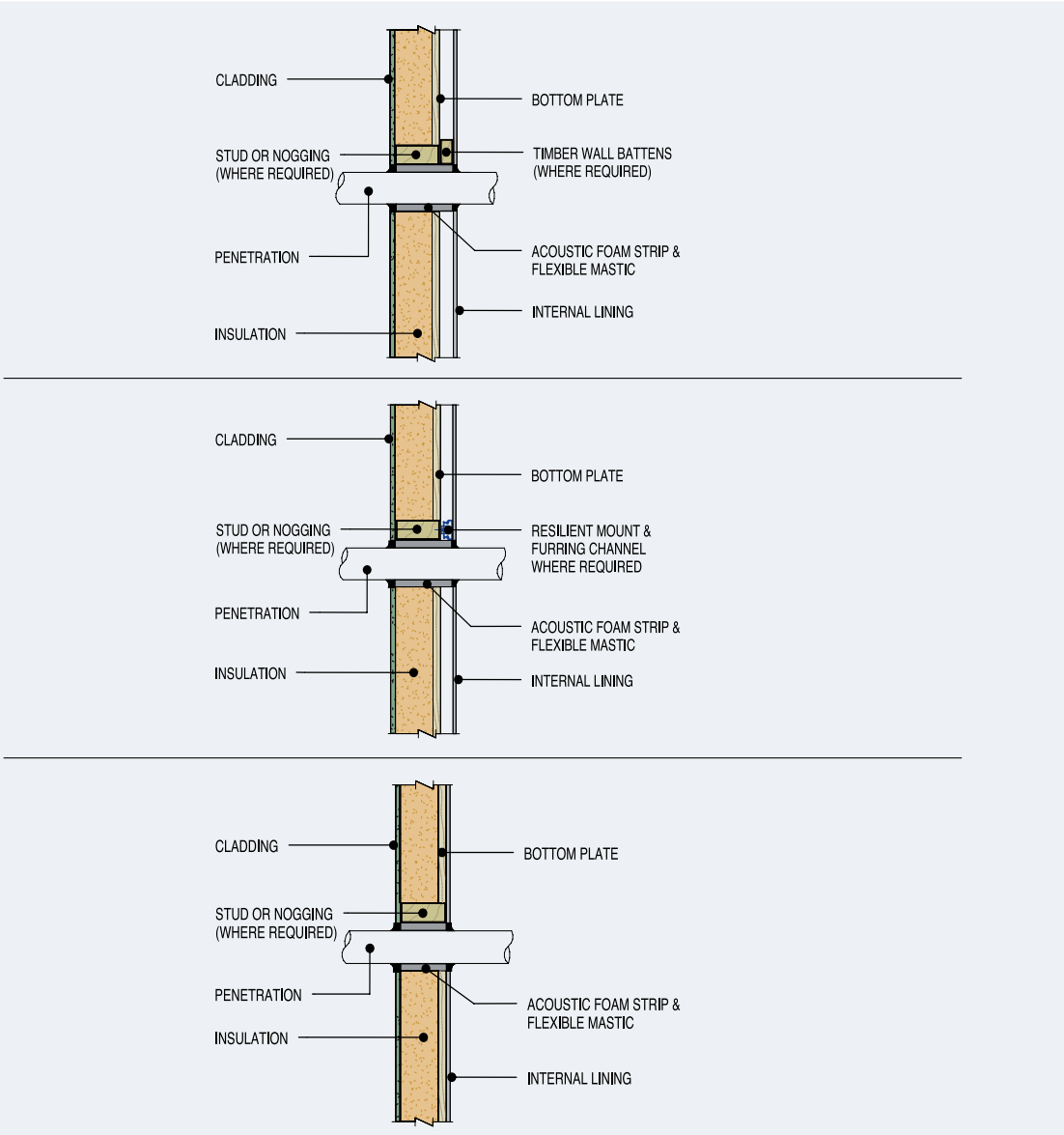
Table 20: R_w and $R_w + C_{tr}$ Ratings, Tiles on 6mm Tile underlay over 15mm plywood or 19mm particleboard to top of joists

4

Gaps, Services and Penetrations

Design of a wall or roof/ceiling system should consider services and penetrations from other building elements. Penetrations in a system can compromise its acoustic performance and will require extra consideration. For external walls it is also important not to chase services into masonry or concrete walls.

- All penetrations in sound-rated building elements should be neatly cut or drilled. Avoid excessively sized penetrations.
- The wall around any large penetration should be rebuilt with the same material. Small residual gaps at penetrations can be sealed with suitable mastic.
- The normal tolerance in building construction should be considered when installing penetrations, and at wall/floor junctions. Revised detailing is needed where residual gaps are too large to allow effective sealing with mastic.
- Gaps around all penetrations in sound-rated walls or ceilings should be treated and sealed to maintain acoustic ratings.
- Sealing should be effective, resilient, resistant to the surrounding environment, and designed to last for the life of the building.



Figures 30, 31, 32: Examples of penetration through wall of building elements

5 Further Information

5.1 Opinions and Assessment Report

The acoustic advice, assessments and opinions contained in this Guide have been based on a report, prepared by acoustic engineers, ASK Consulting Engineers Pty Ltd, South Brisbane. QLD. 4101, February 2012.

Qualified consultants can be found through the professional body, the Association of Australian Acoustical Consultants (AAAC) www.aaac.org.au

Discover more ways to build your knowledge of wood

If you need technical information or inspiration on designing and building with wood, you'll find WoodSolutions has the answers. From technical design and engineering advice to inspiring projects and CPD linked activities, WoodSolutions has a wide range of resources and professional seminars.

www.woodsolutions.com.au

Your central resource for news about all WoodSolutions activities and access to more than three thousand pages of online information and downloadable publications.

Technical Publications

A suite of informative, technical and training guides and handbooks that support the use of wood in residential and commercial buildings.

WoodSolutions Tutorials

A range of practical and inspirational topics to educate and inform design and construction professionals. These free, CPD related, presentations can be delivered at your workplace at a time that suits you.

Seminars and Events

From one day seminars featuring presentations from leading international and Australian speakers to international tours of landmark wood projects, WoodSolutions offer a range of professional development activities.

What is WoodSolutions?

Developed by the Australian forest and wood products industry for design and building professionals, WoodSolutions is a non-proprietary source of information from industry bodies, manufacturers and suppliers.

Wood Solutions™
design and build
woodsolutions.com.au