Code of Practice Inspections

Module 16:

Framing (IFG)

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Contents

Which documents hold technical information?

Detailed technical information and guidance is available in the documents listed below; ensure to always access these electronically (rather than hard copies) to ensure the reading of the most recent version. The inspection tablet will update automatically (when logging on after powering off/on).

- Code of Practice: **NZ Metal Roofing Manufacturers**
- Auckland Council policy note: **AC2234 External and internal membranes.**
- Auckland Council policy note: **AC1116 Reclad and Financial Assistance Package**
- Auckland Council policy note: **AC1187 Modular units or prefabricated buildings**
- **Auckland Council: manufactured modular components guidance**
- NZ Building Code: **Clauses: B1, B2, C1-6, E2, E3, F4, F5, H1.**
- NZ Standard: NZS 3602 (2003) **Timber and Wood-based Products for Use in Building.**
- NZ Standard: NZS 3604 (2011) **Timber framed buildings.**
- DBH publication (Mar 2010): **Simple House Acceptable Solution.**
- National Association of Steel-framed Housing (NASH) (Apr 2012): **House insulation guide.**
- Build 34 (October 2006) **Subfloor ventilation**
- Build 110 (Feb 2009): Thermal breaks and bridges
- Build 128 (February 2012) **Timber treatment**
- Build 143 (August 2014) **Membrane gutters**
- Builders mate 49 (2011) **Bottom plate fixings**
- Builders mate 67 (August 2014) **Uplift connections**
- BRANZ **Guide to passive fire protection in buildings**
- Winstone Wallboards Ltd **Gib Site Guide**
- MiTek **Structural fixings on-site guide**
- Nelson Pine Industries **LVL timber**
- XLam NZ **CLT specifications**
- MSL **Fortress fasteners**
- Korork **Terraced Housing Intertenancy Systems**
- Boral **Intertancy fire rated system**
- Resene Rockcote **Integra intertenancy fire rated system**
- AFS **Logicwall intertenancy fire rated system**
- Winstone Wallboard Ltd **Gib Barrierline intertenancy fire rated system**
- CHH **hyJoist & hySPAN specifications**
- Pryda **Stren-joist specifications**
- Brace-it Ltd **ThruJoist specifications**
- MiTek Lumberlok **Floor joist stiffener specifications**

Purpose of a framing inspection

The purpose of a framing inspection is to ensure that buildings and building elements are able to withstand the combination of loads that they are likely to experience during construction or alteration, or throughout their lives; and that buildings are constructed to provide adequate resistance to penetration by, and the accumulation of moisture, from the outside.

Framing; General Overview

Framing inspections were introduced to ensure the structural load paths and fixings are constructed as per the approved design. This is an important inspection, which requires vigilance on the part of the inspector. This inspection requires the checking of framing and fixings prior to the fixing of wraps and cladding. When undertaking framing inspections there are a number of checks that should be undertaken.

Some Inspectors prefer to start at the top of the building and work their way down i.e. checking truss fixings and roof bracing, etc and then follow the loads down, through the building. Others prefer to do the bracing first, and then complete other items, or check on a room-by-room basis or start on the exterior first.

There is no right or wrong way as to how the inspection should take place. Whichever way is selected, the most important factor is a consistent and methodical approach in checking check all items.

Subfloor

The sub-floor inspection can be undertaken independently, or in conjunction with the framing inspection. The outcome of the inspection is recorded on the framing inspection record.

When conducting a sub-floor inspection, it is important to compare the completed work against the approved plans to confirm framing and bracing requirements.

Subfloors may be checked as a stand-alone inspection or in conjunction with the framing inspection.

The inspector shall check the corrosion zone to identify the grade of fixings that will be required.

Ensure adequate access is provided

- all anchor and braced pile connections must be in place and pile-to-bearer fixings correctly nailed off
- all nogs or dwangs are in place to ensure lateral support
- minimum crawlspace 450mm; polythene required where height <450mm
- subfloor fixings <600mm of ground, and where subfloor ventilation >3500mm2 per m2 floor area, or no ventilation cross flow, must be stainless steel
- subfloor ventilation is generally checked later (unless the foundation has a block perimeter wall), when the base cladding is in place however a check for adequate crossflow should be made now

Figure 1. *Sample of subfloor anchor pile and fixing.*
Note. *Questionable timber grade for the bearer, 12kN plate not stainless steel (less than 600mm above ground), no 12kN joist to bearer fixings, plate nails appear to be in the "no nail zone" 45mm top of pile & 20mm bottom of bearer; [MiTek site guide]).*

Figure 2. *Checklist line item 'Subfloor pile heights and layout'*

Figure 3. *Checklist line item 'Subfloor point loads'*

Figure 4. *Checklist Parent line item 'Subfloor bracing as per plan'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

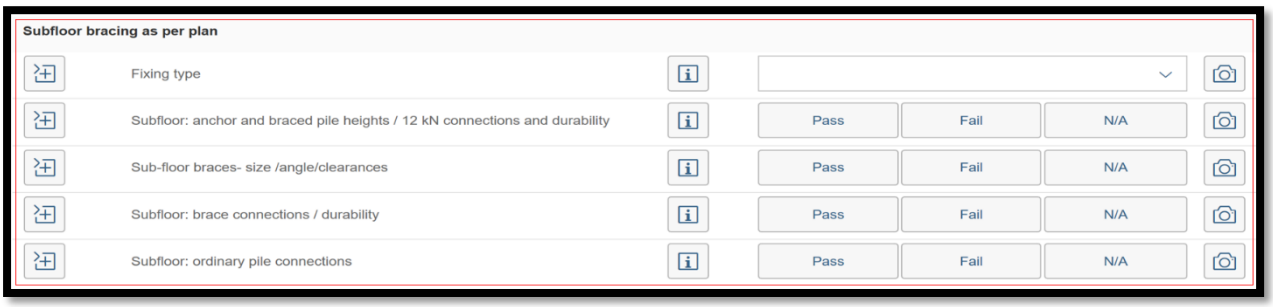


Figure 5. *Checklist Child line items.*

Piles

No pile shall be cut <300mm of the ground; however, this may be reduced to 150mm if a bituminous damp proof course is placed between the pile and the bearer. In this situation adequate crawlspace must still be maintained and the surface area of the ground should be protected by placing polythene over it.

The polythene should be fitted **before** the subfloor framing is erected so that it fits tightly over piles and can be lapped and taped in place to prevent movement. The ground must be graded to prevent indentations where water can accumulate.

Piles must be H5 and if cut, the surface treated with preservative to protect the timber. Any packing timber between a pile and bearer must be H5 and not more than 20mm, note however that packing is **not** permissible on braced or anchor piles

The cross-sectional area of piles maybe 125 square or 140 diameters; the maximum height for piles is:

- 600mm for ordinary piles supporting jack studs
- 600mm for anchor piles
- 3.0m for braced and ordinary piles
- 1.2m for cantilevered piles
- 1.5m for concrete piles

Driven piles

Because of the nature of pile driving it is important to ensure that piles are true and plumb, and that adequate provision has been made for support of bearers. (If the pile has been displaced due to driving, the line and level of bearers, and any subsequent support, maybe affected).

A producer statement construction review must be provided verifying the set of piles at the time of this inspection (if not already provided). Note that the engineer will only be certifying the pile set and does not check the fixings or subfloor framing; this is part of the Building Inspectors role.

Driven timber piles to NZS3604:2011 must not exceed 3.6m in length, otherwise they become specific design. Round piles must be used for pile driving, with a minimum diameter of 140mm, except that this may be reduced to 120mm at the pointed end to facilitate pile driving. If a pile is cut, notched, or drilled it must be surface treated.

The head of the pile should not be damaged during driving. The engineer is responsible for ensuring that the equipment used is in accordance with the design specifications and providing pile driving records on completion of the work. The engineer is required to provide a producer statement construction review (PS4) on completion of the piling verifying the design set has been achieved. The pile driving contractor will provide a PS3 and 'Record of Work' if 'Restricted Building Work'.

Pile tops shall be at a level to support bearers without packing. Piles shall be in straight rows with a tolerance of 10mm between the centre of the pile top and a straight line which is the centre of the bearer. Piles shall be plumb with a tolerance of 15mm/m length of pile.

All driven piles require the set to be confirmed by a registered Geotech engineer who may be required to provide a producer statement construction review (PS4) on completion of the work- Refer Consent

conditions and advice notes. The certificate or site report must be available by the next inspection. The installer of the driven piles will provide a PS3.

It is important to remember that the engineer is only certifying the set and does not check that piles are plumb. Further the engineer does not check the layout, level, or subfloor framing/fixings.

As for pile footings, string lines must be in place so that layout; pile heights, etc can be checked. Engineers typically tend to rely on a PS3 from the Pile Driver and rarely visit site.

The inspector needs to check that the pile heights will achieve the brace design and proactively address this if not; e.g. the plan shows braces, but the pile height will be less than 600mm and the brace angle will be less than 6°, so it is better to get the builder to change to anchor piles now rather than fail the braces later.

Anchor piles

Requirements for an anchor pile

- 12 kN pile to bearer connection
- 6 kN bearer to joist connection
- pile branded with “A” to meet requirements of NZS3605:2001

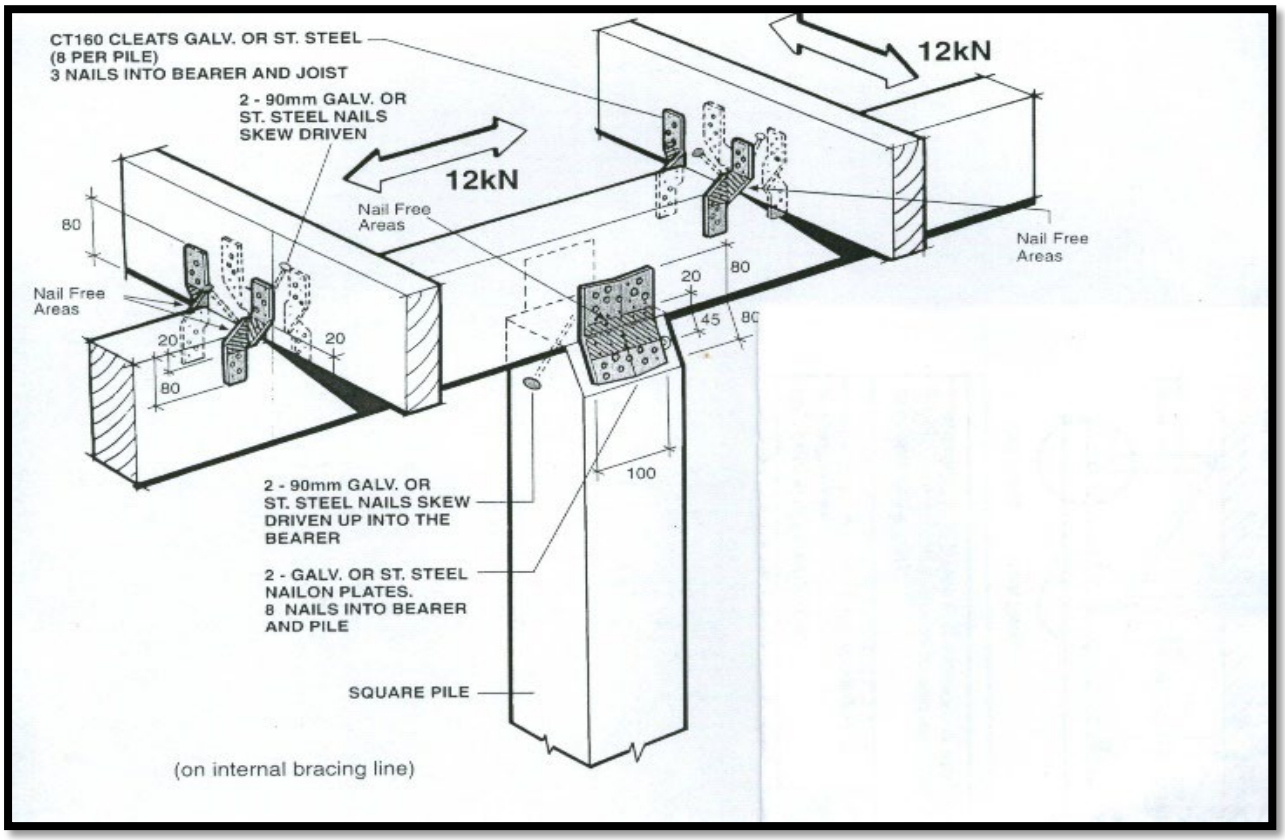


Figure 6. *MiTek detail of anchor pile / bearer / joist connections*

Under no circumstances should the nail plate be bent greater than 30deg. The pile should be cut or scarfed to accommodate the fixing to a maximum angle for a scarf is 30 degrees.

Anchor piles shall be maximum 600mm from ground level to the highest connection point.

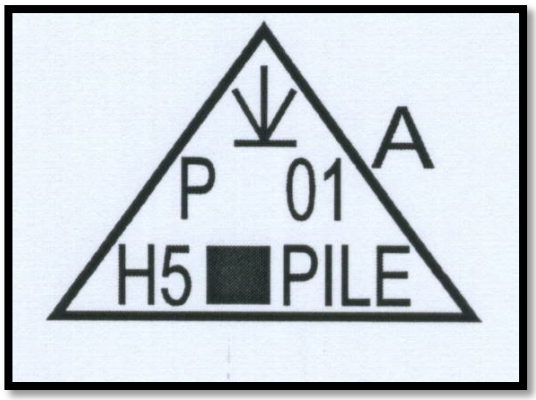


Figure 7. *Sample of anchor pile branding*

Branding: NZS3605:2001 states that all piles must be branded to meet the requirements of NZS3640. Branding must be within the top 1/3 of the length. Braced and Anchor piles must be branded with the letter "**A**". Ordinary piles may still have the H5 triangle stamp without the **A.**

Braced piles

A braced pile consists of 2 piles, between which a diagonal brace is fitted; each end having 12kN connections fitted. Requirements for a braced pile: -

- 12 kN pile to bearer connection
- 6 kN bearer to joist connection
- only 1 brace maybe attached to the top of a pile
- 2 braces maybe attached to the bottom of a pile providing that they are at right angles to each other and not in the same line
- the slope of a timber brace shall range between 10 and 45 degrees
- the lower end of the brace should not be closer than 150mm to the ground, with the bottom bolt fixing between 200mm to 300mm above the ground level.
- There shall be 90mm of timber to the brace past the bolt connection.
- braces may be attached to at the upper end to bearers or joists within 200mm of a pile, where these are used the slope of the brace shall range between 6 and 45 degrees
- the dimensions of a diagonal timber subfloor brace shall be 100mm x 75mm for up to 3m long, 100mm x 100mm for lengths from 3m to maximum 5m long

Sub-floor bracing

A building must not have less than 4 braced piles in each direction, placed symmetrically around the building and spaced at no more than 5.0m centres in each direction and between external walls.

Ordinary piles

Ordinary piles shall be maximum 3m high above cleared ground level. Bearers shall be fixed to piles with 4/100mm x 3.75 nails skew driven into the piles, or 2 x 100mm x 3.75 nails and 2 x 4.9mm wire dogs.

Point load

Point loads shall have the load path transferred over a suitable bearer or pile. Where a loadbearing wall runs parallel to the line of floor joists beneath, it shall be supported by a pair of joists. Where doubled joists support a trimmer stud, itself supporting a roof only, the trimmer stud shall be located within 300mm of the end of the span of the double floor joist. Floor joists supporting trimmer studs outside this limit or supporting trimmer studs which in turn support floor loads, shall be subject to specific engineering design (SED).

Where a loadbearing wall runs perpendicular to the line of joists, such a loadbearing wall shall be located at not more than 200mm centre to centre from a bearer or subfloor loadbearing wall.

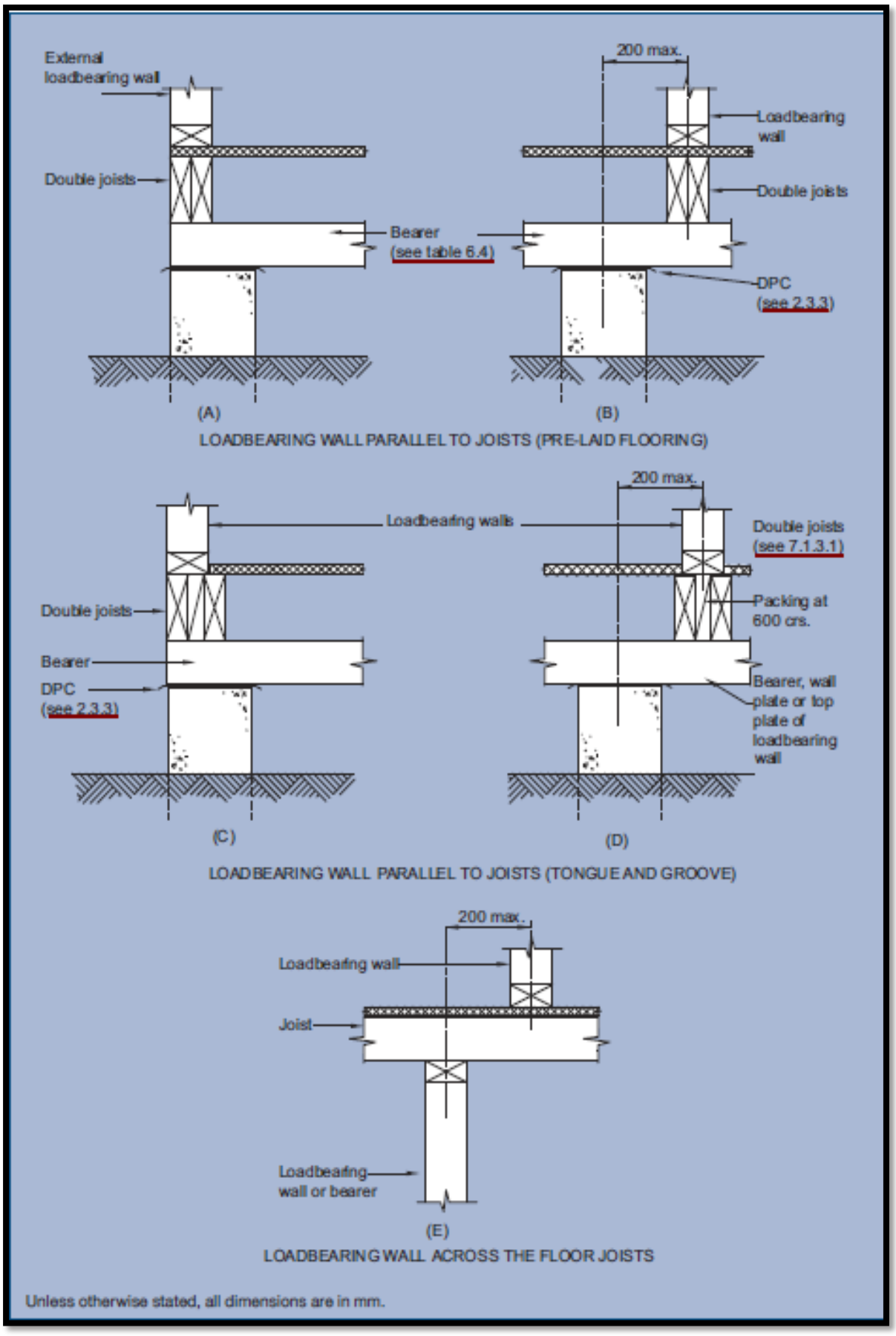


Figure 8. *NZS3604:2011 detail for support to floor joists under loadbearing walls*

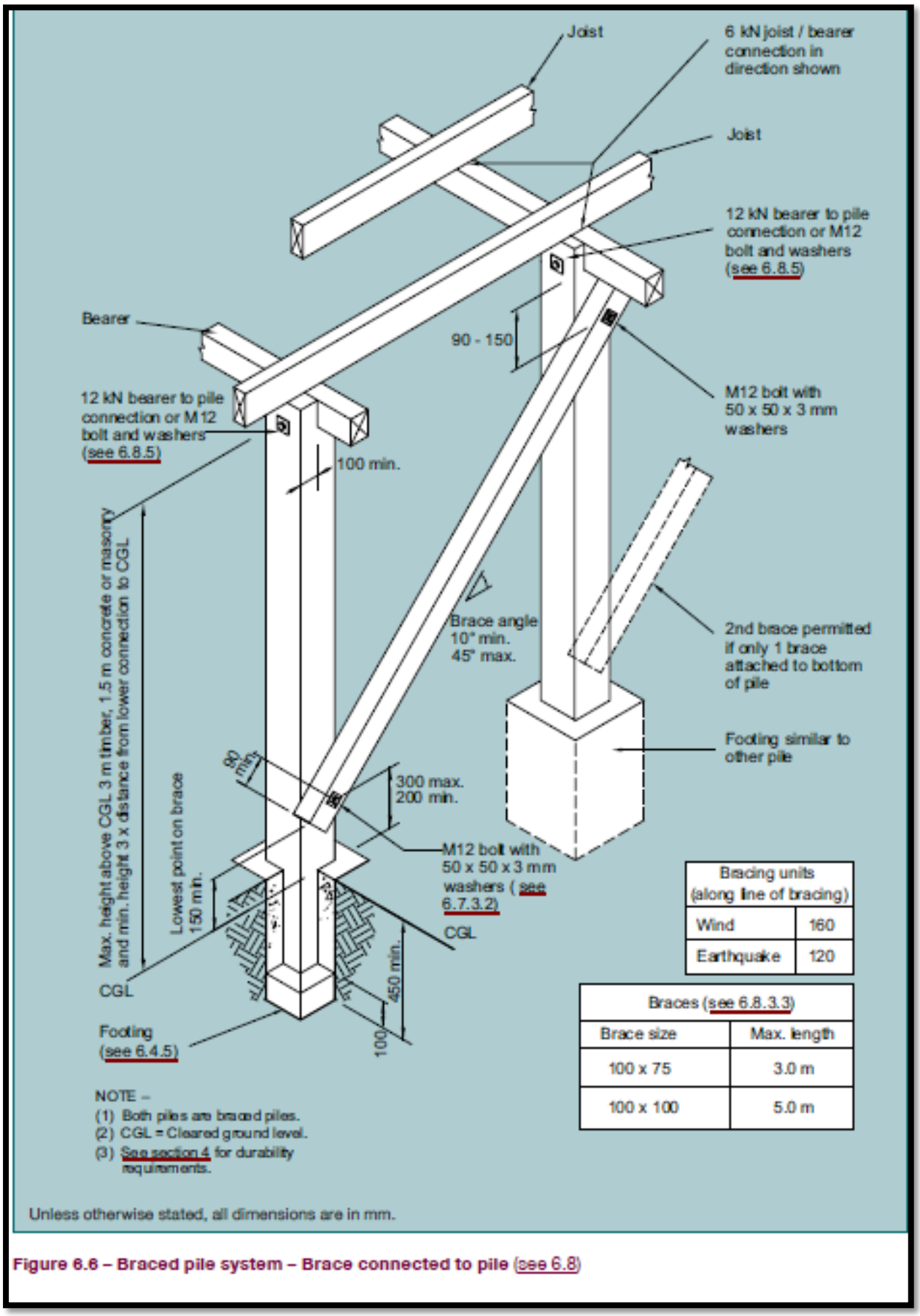


Figure 6.6 – Braced pile system – Brace connected to pile (see 6.8)

Figure 9. *NZS3604:2011 subfloor brace pile detail*

Bearers

Figure 10. *Checklist Parent line item 'Subfloor: Bearers/ stringers as per plan'*
Note: *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 11. *Checklist Child line items.*

Joints in bearers are permissible but must **not** occur over braced or anchor piles; bearers must be continuous over 2 or more spans.

The maximum cantilever of a bearer is

- 200mm for a span exceeding 2.0m, and
- 300mm for a span not exceeding 2.0m

The minimum landing for a bearer over a support is 45mm in all other cases 90mm. If the end of the bearer is exposed to the elements it must be sealed or capped; where a bearer sits over an internal row of piles containing bracing, solid blocking is required at 1.8m centres.

Joints in bearers shall have a connection capacity of:

- Not less than 12kN in tension or compression along the line of the bearer, or 6kN each on both sides, if the bearer is one piece of timber, or
- 6kN on one side of the joint when one laminate is continued over the support.

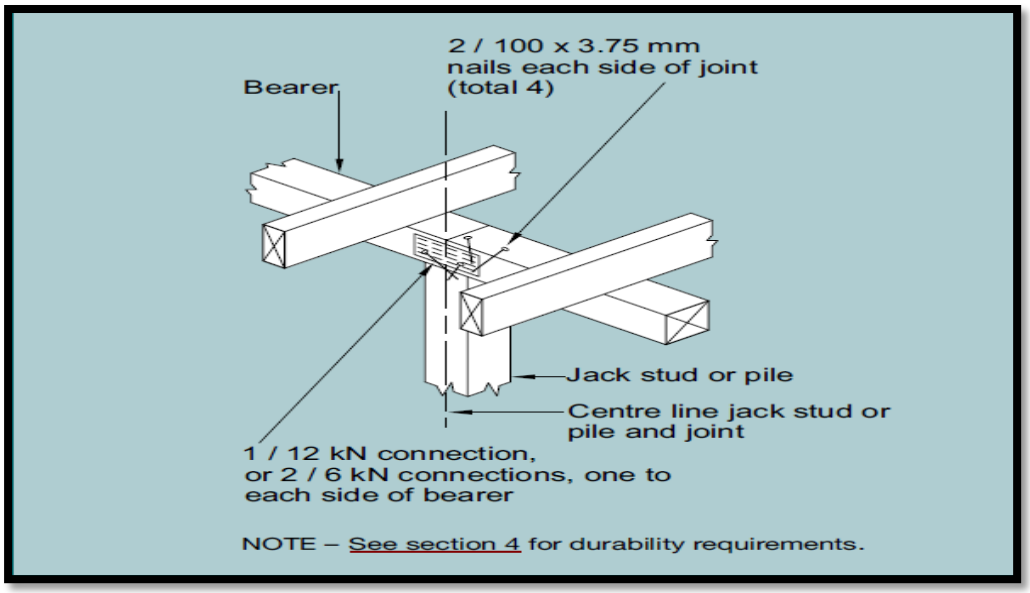


Figure 12. *NZS3604:2011 detail for joints in bearers*

Stringers

Stringers shall be of the dimensions given by the table below, and not support more than one floor and its associated non-loadbearing walls.

Stringers shall be fixed to their supporting foundation walls with M12 bolts set not less than 100mm into the wall at spacings given by the table below.

Stringer nominal size (mm)	**Maximum M12 bolt spacing** (mm) **of:**				
	800	900	1200	1600	2400
	Maximum span of floor joists (m)				
190 x 45	6.0	5.0	4.0	3.0	2.0
140 x 45	6.0	5.0	4.0	3.0	–

Table 1. *NZS3604:2011 table of stringer sizes and fixings*

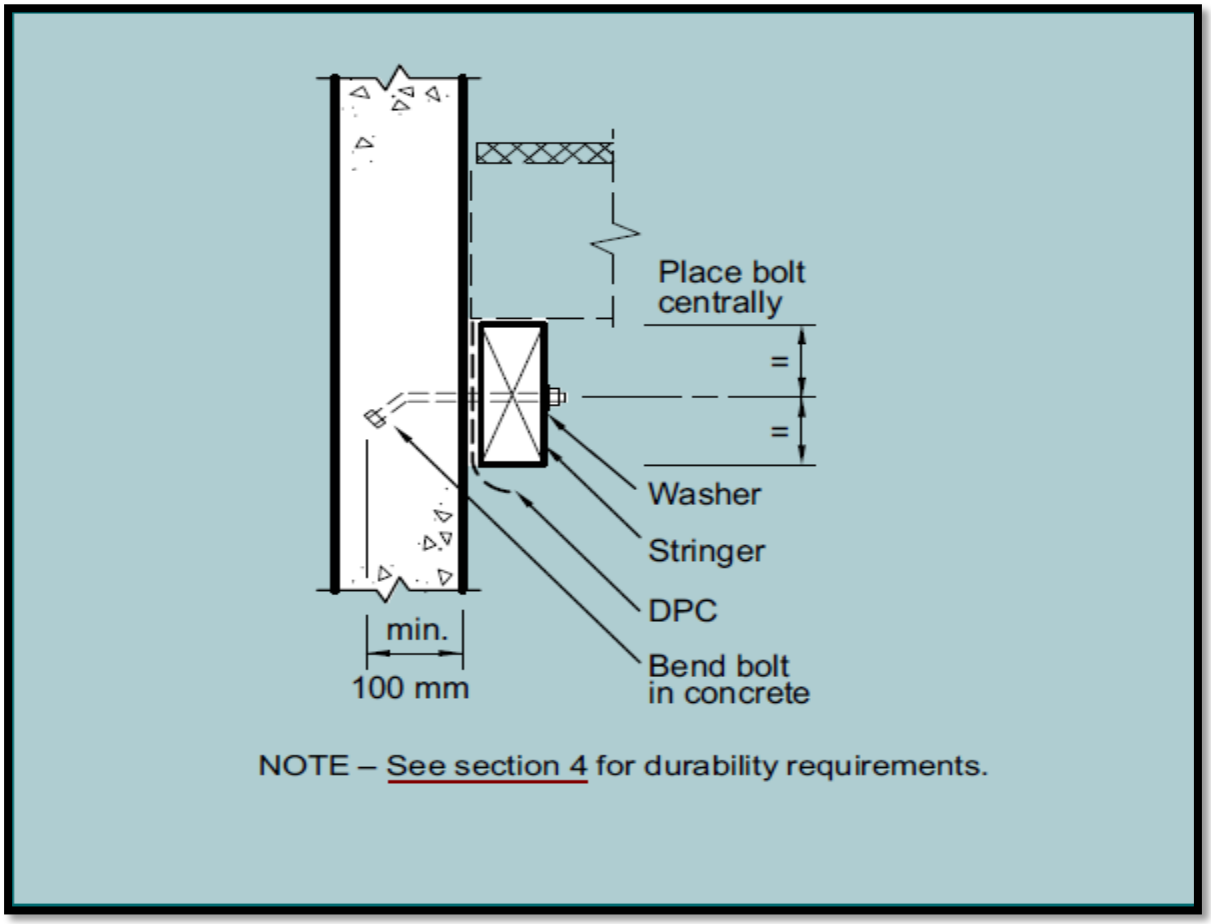


Figure 13. *NZS3604:2011 sample of fixing of stringers to foundation walls.*
Note. *This detail shows a cast in bolt. Proprietary bolts need to provide a minimum capacity of 4.5kN in the vertical direction and 7.3kN in the parallel plane.*

Subfloor Joists

Figure 14. *Checklist Parent line item 'Subfloor: Joists as per plan'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 15. *Checklist child line items*

The inspector shall check:

- floor joists must have a minimum landing of 32mm and be laid in straight lines
- joints in floor joists may only be made over a support
- butt joints are not permitted where the joist has a diagonal brace attached to it
- where the span is >2.5m and the depth of the floor joist is four or more times their thickness (e.g.45mm x 200mm joists), solid blocking mid-span is required (blocking must be same size as the joist)
- joist centres, size, and span, is as per plan

In sub-floor situations, joists must be blocked at 1.8m centres where the wall above contains a bracing element or along lines of horizontal support, e.g. over a foundation wall.

Floor joists having a span of 2.5m or more must also be provided with lateral support, e.g. full depth blocking at 1.8m centres alternatively herringbone strutting maybe used. If the wall above is load bearing and runs in the same direction as the line of joists below, the wall must be supported by double joists.

Holes must be drilled within the middle third of the joist; the hole can be 1/5 the depth or 32mm whichever is less. Anything beyond these dimensions will require specific design.
For example:

- if joist is 150mm (1/5 of 150 = 30mm) OK
- if joist is 200mm (1/5 of 200 = 40mm) Specific design >32mm
- if joist is 250mm(1/5 of 250 = 50mm) Specific design >32mm

The hole should be located not more than 3 x the depth of the joist, from the face of a support.
For example, if the joist is 150mm and the hole is 32mm, then the hole must be located between 96mm and 450mm of the face of a support, e.g. wall or stringer.

Notches are permitted in the **bottom section** of a joist and comprise the same dimensions as for holes. For example, a 200mm joist may have a notch 40mm deep (this requires specific design as it is >32mm). Notches must be located within 450mm of the face of a support.

An alternative solution for accommodating holes in joists is the use of a proprietary product. The critical area of inspection with this product is that the bracket sits tightly against the joist and installed as per the manufacturer's specifications. They are also only suitable for internal use.
Refer to '**Timber types'** in '**Timber wall framing'** and 'Holes in joists' later in this module for more information on LVL and CLT timber.

Cantilevered joists

The inspector shall check

- the maximum height of a wall supported by a cantilevered joist is 2.4m (unless specifically designed)
- joints in floor joists may only be made over a support but not where a joist is cantilevered beyond the support

Note. Under no circumstances are holes or notches permitted in the part of the joist that is cantilevered.

Cantilevered joists must be installed with saddle flashings to protect against moisture penetration.

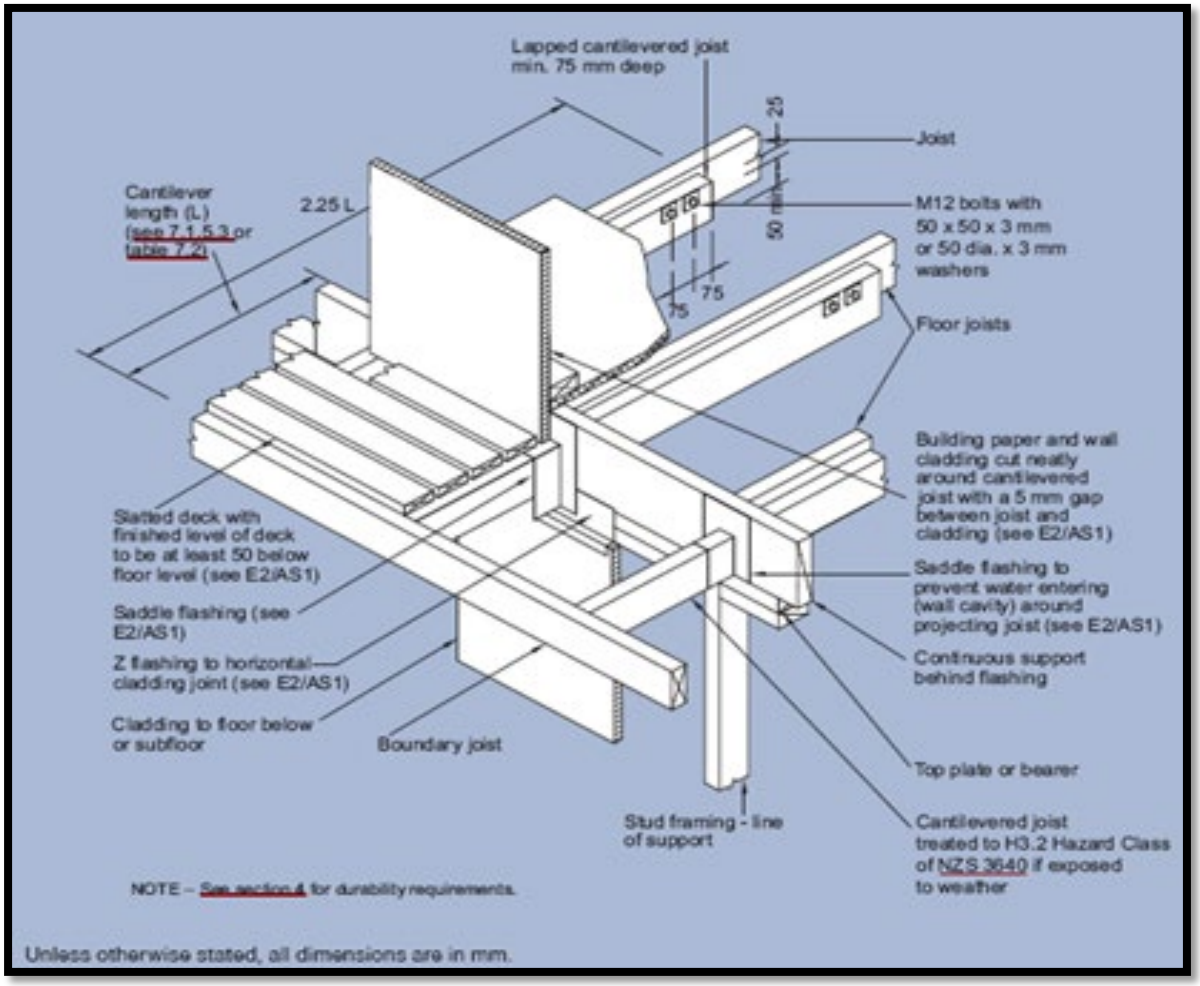


Figure 16. *NZS3604:2011 detail for lapped cantilevered joist installation*

Timber treatment

Figure 17. *Checklist line item 'Subfloor: pile grade treatment as per plan'*

Figure 18. *Checklist line item 'Subfloor: bearer grade treatment as per plan'*

Figure 19. *Checklist line item 'Subfloor: joist grade treatment as per plan'*

Timber in New Zealand is required to be identifiable. Identification may be permanent ink, imprint, incision or burn brand directly to the timber or on a plastic tag affixed to the timber. H3.1 timber must be repetitively marked at 1500 centres maximum along the face or edge.

665	01	H4
Treatment plant number	Preservative code number	Hazard class number

Table 2. *Explanation of timber treatment stamp*

Timber poles and piles must be treated to H5 which is the level required for house and building foundations, as per NZS:3605 and NZS:3640. Other outdoor timber (landscaping) may be treated H4 as appropriate to usage.

The protection is compromised if the treated timber is cut or drilled. If processing after treatment is unavoidable, the affected parts must be protected by brushing on liberal quantities of an approved preservative, e.g. Enseal or Metallex.

Ends cut after treatment must not be put into the ground, or closer than 300mm to the ground and where possible, should be continuously protected from the weather. The top of a timber retaining pole should be cut to a minimum 45-degree angle to ensure water will run off.

Because it can be difficult to identify timber treatment level, Auckland Council requires that the applicant confirm the timber type and treatment levels at the time of the framing inspection. A certificate must be provided by the pre-cut supplier identifying type and location of timber supplied.

Figure 20. *Sample of timber identification tags.*

Take photos of tags and timber branding showing grading or treatment.

Class	Exposure	Service conditions	Biological hazard	Typical uses
H1.1	Protected from the weather, above ground	Protected from the weather, must always dry be kept dry	Borers	Interior finishing timber – refer NZS 3602
H1.2 or H1+	Protected from the weather, above ground, but with a possibility of exposure to moisture	Protected from the weather, but with a risk of moisture content conducive to decay	Borers, decay	Wall framing – refer NZS 3602
H2	Protected from the weather, above ground	Protected from the weather, dry, exposed to ground atmosphere where well-ventilated but not in contact with the ground	Borers, termites	Framing timber in Australia
H3.1	Exposed to the weather, above ground	Periodic wetting, not in contact with the ground	Decay fungi and borers	Cladding, fascia, joinery – refer NZS 3602
H3.2	Exposed to the weather, above ground, or protected from the weather but with a risk of moisture entrapment	Periodic wetting, not in contact with the ground, more critical end uses	Decay fungi and borers	All H3.1 uses, plus, structural and decking – refer NZS 3602
H4	Exposed to the weather, in ground or in fresh water	Ground contact, or conditions of severe or continuous wetting	Decay fungi and borers	Fence posts and landscaping timbers
H5	Exposed to the weather, in ground or in fresh water	Ground contact, or conditions of severe or continuous wetting, where uses are critical and where a higher level of protection than H4 is required	Decay fungi and borers	House piles and poles, crib walling
H6	Sea water or estuarine ground	Immersion in seawater or estuarine ground	Marine wood borers & decay	Marine timber and piles

Table 3. *Timber treatment table*

Table 1: Required treatment levels for different end uses of radiata pine and Douglas fir in timber-framed buildings.

Timber to be used for	Minimum required treatment	Timber to be used for	Minimum required treatment
External timber use			
deck jack-studs supported clear of ground	H3.2	deck piles in ground	H5
exposed subfloor framing	H3.2	piles	H5
veranda posts supported clear of ground	H3.2	poles	H5
		veranda posts in ground	H5
Clear of ground			
exterior plywood unpainted or used as bracing	H3 CCA	balcony barrier exposed	H3.2
exterior plywood painted	H3 LOSP	roof framing weather exposed	H3.2
cladding or exterior trims painted	H3.1	wall framing weather exposed	H3.2
cladding or exterior trims unpainted, clear finished or stained	H3.2	shingles/shakes	H3.2
deck joists/bearers	H3.2	fence rails and palings	H3.2
decking	H3.2	fence posts	H4
Framing timbers [1,2]			
external wall framing direct-fix cladding	H1.2	roof framing – low slope/skillion	H1.2
external wall framing E2/AS1 cavity cladding	H1.2	roof framing – roof space including trusses and ceiling battens	H1.2
balcony wall framing enclosed	H1.2	roof sarking timber	H1.2
parapet framing	H1.2	cavity battens	H3.1
interior wall framing including double top plates	H1.2	roof sarking plywood membrane roof	H3 CCA
enclosed subfloor framing	H1.2	enclosed cantilevered floor joists	H3.2
Interior timbers			
plywood	untreated	joinery (interior)	untreated
furniture	untreated	flooring	H1.2
finishing timbers	untreated	window reveals to aluminium windows	H3.1

Note:

1. Douglas fir may be used untreated on low-risk design buildings as defined in Amendment 7 to B2/AS1.
2. H1.2 boric-treated Douglas fir may be used in all framing applications where H1.2 boric-treated radiata pine is permitted.

(Adapted from NZS 3602:2003 *Timber and wood-based products for use in buildings* with the permission of Standards New Zealand.)

Table 4. *Required timber treatment level for different end uses; sourced from BRANZ Build 128*

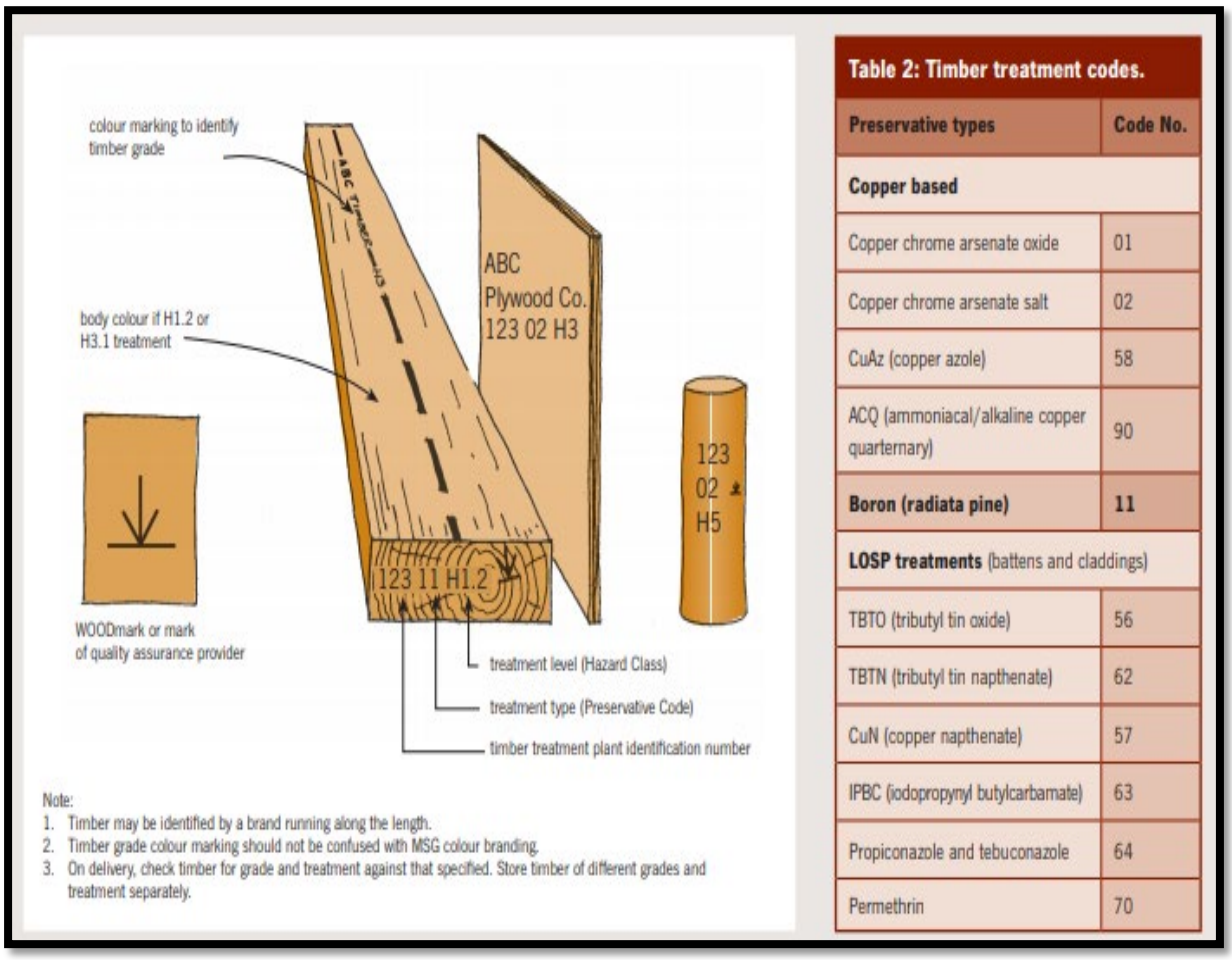


Table 2: Timber treatment codes.

Preservative types	Code No.
Copper based	
Copper chrome arsenate oxide	01
Copper chrome arsenate salt	02
CuAz (copper azole)	58
ACQ (ammoniacal/alkaline copper quarternary)	90
Boron (radiata pine)	**11**
LOSP treatments (battens and claddings)	
TBTO (tributyl tin oxide)	56
TBTN (tributyl tin napthenate)	62
CuN (copper napthenate)	57
IPBC (iodopropynyl butylcarbamate)	63
Propiconazole and tebuconazole	64
Permethrin	70

Figure 21. *Sample of timber treatment identification; sourced from BRANZ Build 128*

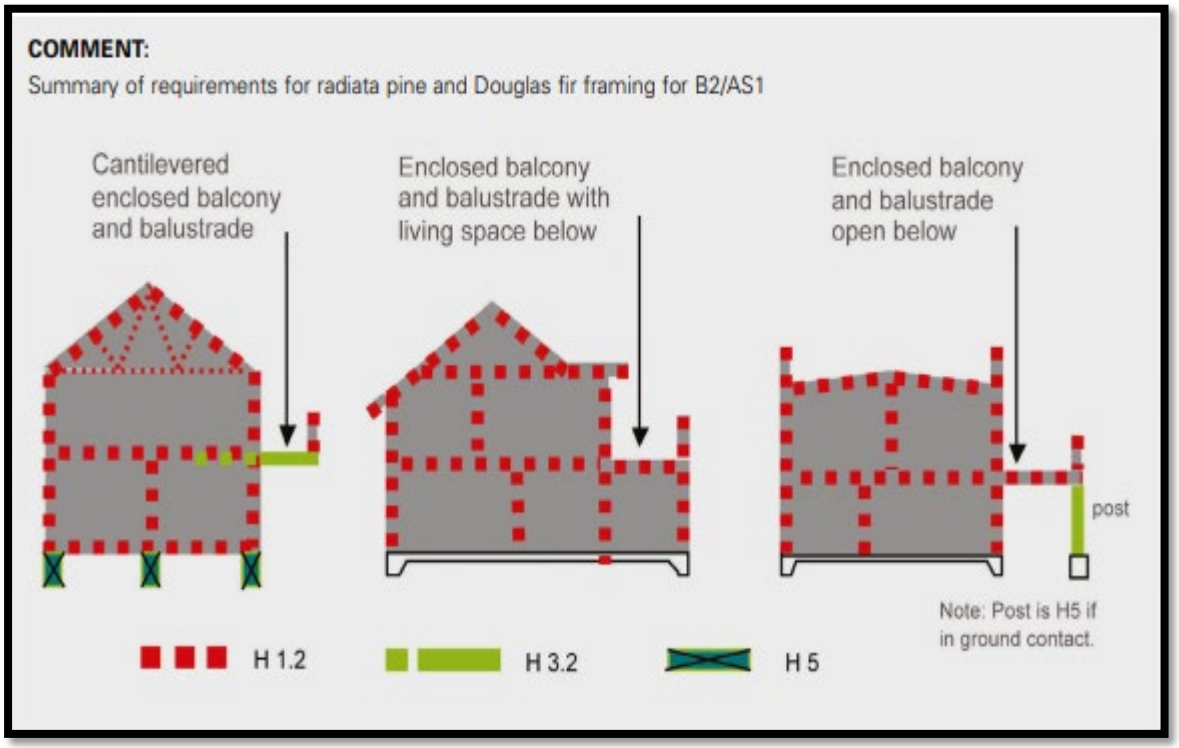


Figure 22. *Timber treatment detail from B2/AS1*

Membrane substrate support

Figure 23. *Checklist line item 'Subfloor: membrane substrate support'*

The substrate must be fit for purpose and screw fixed with appropriate fixings. The membrane must be fully supported and provided with a fillet to relieve stress on all internal corners such as the junction between the floor and any walls.

Ply substrate for membranes to bathrooms require joist spacings at 400mm centres, and support nogs at 400mm centres (dependent on membrane manufacturer specifications). All ply joints must be over solid timber. Fixings to be stainless screw to achieve a 50-year durability.

Particle board flooring (Strand board, Kopine floor, Pyne floor) substrate for membranes to bathrooms require joists at 400mm centres but do not require support nogs. The difference between particle board and ply being the deflection between the joists (framing that deflects when walked over is not rigid enough).

Subfloor ventilation

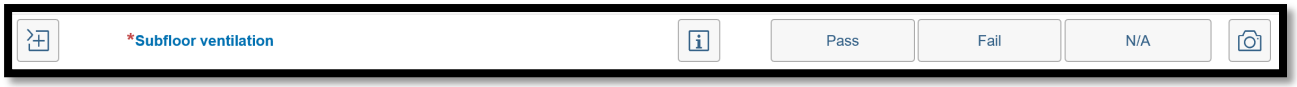


Figure 24. *Checklist Parent line item 'Subfloor ventilation'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

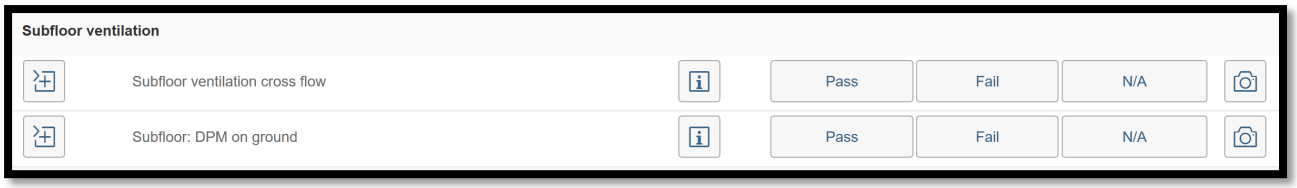


Figure 25. *Checklist Child line items.*

To prevent subfloor dampness, ventilation openings not less than 3500mm2 per m2 of floor area, are required over the whole subfloor area, evenly distributed around the foundation perimeter.

Acceptable ventilation methods include:

- Ventilators spaced regularly, commencing 750mm from the corner and at intervals not exceeding 1.8m;
- Continuous 20mm wide slots between baseboards;
- A 50mm gap between the wall plate and a boundary joist at the ends of cantilevered floor joists and the wall plate and joist, where the bearer is cantilevered;
- Other regularly spaced openings that will provide adequate ventilation.

Where ventilation openings of 3500mm2 per m2 cannot be provided, or the subfloor airflow is obstructed by party walls, attached terraces or similar, or where for larger buildings any part of the subfloor space is more than 7.5m from the nearest ventilation opening, a damp-proof ground cover over the whole subfloor shall be used.

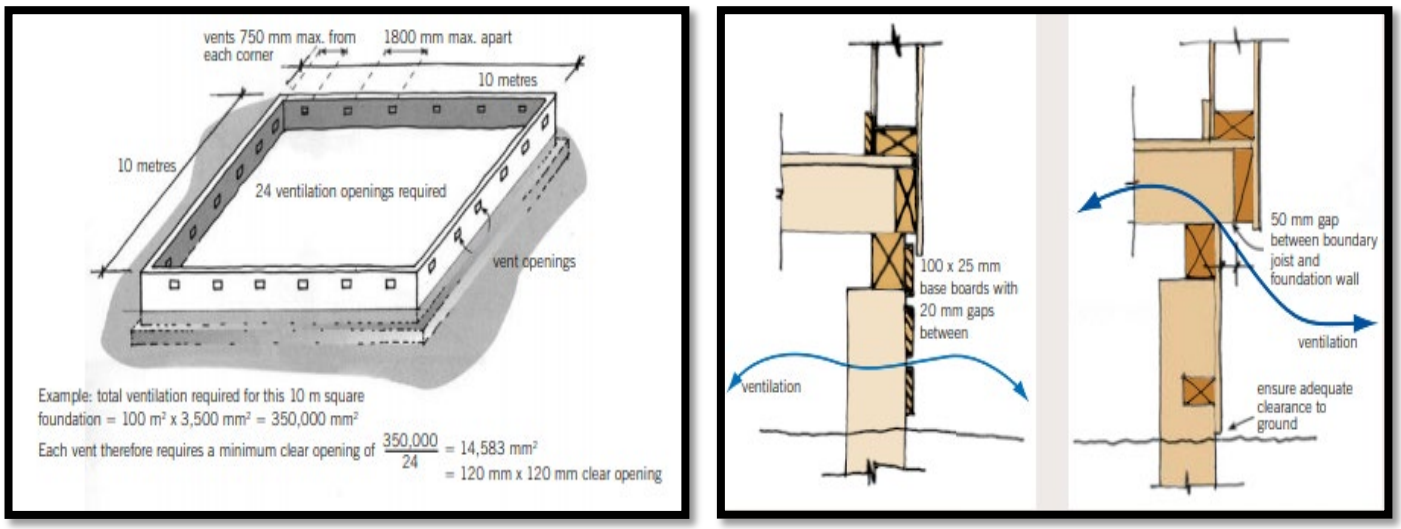


Figure 26. *Samples of subfloor ventilation from 'Build' magazine Oct/Nov 2006*

Ground cover

For damp proof cover to the subfloor, the following conditions shall apply:

- The vapour barrier shall be a ground cover of not less than 50 MNs/g vapour flow resistance held against movement;
- It is held in place with rocks or bricks or similar method;
- Ventilation openings shall have a net open area of no less than 700mm2 for every m2 floor level and be located to provide a crossflow in the subfloor space; and
- The ground is shaped to prevent water accumulation on the vapour barrier and to drain to the exterior.

The polythene should be installed before bearers are laid so that it can be spliced over piles and taped in place.

Subfloor Access

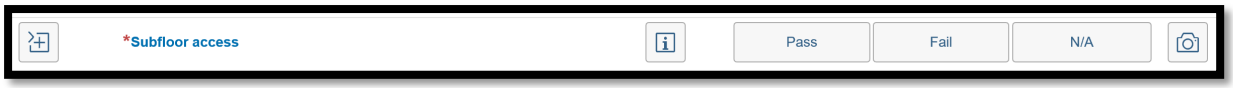


Figure 27. *Checklist Parent line item 'Subfloor access'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

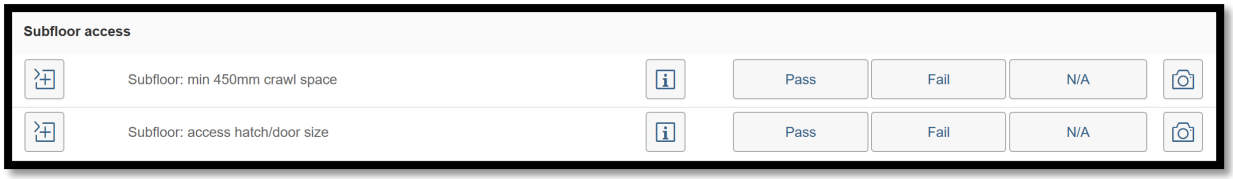


Figure 28. *Checklist Child line items*

Access shall be provided to permit visual inspection of all subfloor framing members. A crawl space for this purpose shall be not less than 450mm high and 600mm wide to the underside of the floor joists.

Subfloor Insulation

Figure 29. *Checklist line item 'Subfloor: Insulation installation/ type'*

Failure of thermal resistance on site is difficult to measure. Therefore, regardless of the ease of access and replacement, thermal insulation is required to have a durability of not less than 50 years. Refer to table 1 of NZBC Clause B2.

For insulation to be effective it must be fitted correctly; the type of insulation installed should be recorded on the inspection record.

NZS4246 Energy Efficiency – Installing Insulation in Residential Buildings requires that the installer fix a label to the joists.

- perforated aluminium foil shall be draped 100mm between joists
- polystyrene or wool insulation shall fit the cavity snugly and be fixed in place firmly to prevent dislodgment

In newly built houses, perforations in aluminium foil are necessary to prevent the accumulation of water or moisture during and after construction of the house.
Perforated aluminium foil is no longer permitted to be retro fitted to the underside of joists to existing buildings.

Because it is unlikely to meet durability requirements, aluminium foil should not be used in

- corrosive zones; and
- very high wind zones

Insulation must not be placed around or over electrical cables.

If using polystyrene special cabling must be used; alternatively cables maybe sleeved in conduit to prevent damage. PVC electrical cables may undergo plasticiser migration when in contact with polystyrene. This causes the polystyrene to shrink away from the cable and cable insulation to become brittle.

Flooring

Figure 30. *Checklist line item 'Subfloor: Flooring installation/ type'*

Floorboards must be laid in straight lines at right angles to the joists. Floorboards must be directly fixed to each joist and have their nails punched to allow for sanding and filling.

Sheet flooring shall wherever possible be laid in complete sheets. Any joints shall be made over supports and fixed along each edge and every intermediate framing member. Nailing should be located not less than 10mm from edge of the sheet.

Most sheet flooring is fixed at 150mm centres to the sheet edges, and 200mm centres to the middle of the sheet.

Floor diaphragm

Figure 31. *Checklist line item 'Subfloor: flooring diaphragm'*

A floor diaphragm has no effect on wall bracing. It does however allow bracing lines to be extended below the floor level. The maximum length of a floor diaphragm is 15m; the length however must not exceed 2.5 x the width for single storey buildings or 2 x the width for 2-storey buildings.

The entire perimeter of the diaphragm must be nailed at 150mm centres and 300mm centres over intermediate supports. Full sheets must be used wherever possible. Screw fixings are not allowed on a floor diaphragm.

It is good practice to record that diaphragm fixings have been checked

Timber wall framing

Figure 32. *Checklist line item 'Timber wall framing as per plan'*

Figure 33. *Checklist Parent line item 'Timber wall framing: stud heights, sizes and centres as per plan'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 34. *Checklist Child line items*

Figure 35. *Checklist line item 'Timber wall framing: point load stud locations/fixings'*

Framing must be erected so that it is straight, true in plane, and plumb. Framing must also be dry and stable, if it is not, then linings will not perform as required, resulting in movement causing cracking.

Timber will move in response to changes in the environment, such as in-service moisture and relative humidity.

Generally, timber will take twice as long to dry in winter than it will in summer. Green or wet timber will dry once installed, but the drying rate depends on factors such as the weather, humidity levels, ventilation, and air-movement around the timber, whether the building is closed in.

Timber types

Framing timber is predominantly **radiata pine H1.2.**

The inspector must check timber treatment and grade at framing inspection, and if unable to verify, written confirmation must be provided by the timber merchant confirming the grade and treatment level for all timber used and confirming compliance with NZS3602.

Laminated Veneer Lumber (LVL) such as J-Frame. LVL is an engineered wood product that provides a consistent, high-performance alternative to solid lumber and steel in structural uses. LVL is manufactured from rotary peeled wood veneers that have been pre-graded for stiffness and to achieve different structural properties. The veneers are glued together using a durable structural adhesive and pressed to form long continuous sections (panels) with the grain running parallel to the main axis.

Figure 36. *Sample of LVL, sourced from Nelson Pine Industries Ltd.*

Macrocarpa has a range of uses including ceiling sarking, exposed beams, flooring, wall panelling, framing, furniture, solid wood bench tops, architraves, and skirtings.

Both the heartwood and sapwood of macrocarpa are naturally borer resistant (Anobium) for interior housing purposes. The heartwood is moderately durable for above-ground purposes, but the sapwood is non-durable. The timber cannot be pressure treated with copper, chromium and arsenic (CCA), but sapwood can be boron diffusion treated to resist insects (but not decay).

Douglas-fir can be used for roof trusses and framing, internal panelling, and glue laminated beams.

As well as being popular for light timber framing, the larger dimensional stock is sought after for exposed interior posts and beams because of its good stability and freedom from twist. Glue lamination to produce beams, arches and scaffold planks is also common.

Douglas-fir heartwood is rated as Class 3 durability and can be used for above-ground purposes, but the sapwood is non-durable. The timber cannot be pressure treated with copper, chromium and arsenic (CCA), but can be boron treated to Hazard Classes H3.1 and H1.2.

Cross Laminated Timber (CLT) Timber planks layered to form a wall or floor panel. Each layer grain direction is laid 90 degrees to the previous layer. CLT buildings need specific engineering design and certified by a chartered structural engineer. Generally, each layer is 40mm thick and built up to create panels 105mm, 175mm, 200mm 240mm thick.

It is important the that fixings of the panels are checked carefully to ensure the correct screws or bolts are used. Fixings in CLTs are designed to provide resilient strength whereby the panels can move, and the fixings will “flex” back to their original position. Changes to screws such as the depth of the threaded shank may have a significant effect on the performance so any substitution of fixings will need to be confirmed by the structural engineer.

The panel erection is required to have engineer oversight and a PS4 cert issued after completion. The construction of the panels themselves will need appropriate certification from the factory. Depending on the risk factor, a PS4 may be required for the manufacture.

Delivery and installation have specific methodology which must be followed including the temporary protection from weather and propping.

Figure 37. *Sample of CLT, sourced from XLam NZ specifications*

Care must be taken when erecting CLT to protect from the weather and moisture damage. It can be prone to creep and deflection and the design must take these factors into consideration.

It is important that any cutting, notching and drilling of panels is covered by appropriate engineering design and oversight. The panel construction must be verified as compliant by ensuring factory quality assurance records are received for the panels. Check specifications regarding treatment of cuts and moisture content limitations at preline stage.

Studs

Framing consists of studs, nogs or dwangs and top and bottom plates. Studs are set out at 400mm, 450mm or 600mm c/s. Where the building has more than one floor level, floor joists may comprise part of the frame. Framing must be erected plumb and square, with a level to be used to check this.

Studs and trimming studs may be built-up by nailing 2 or more pieces of timber together, e.g. a 100mm x 100mm stud may be formed using 2 x 100mm x 50mm studs. All wall junctions must be formed using a minimum of two studs blocked and nailed.

Nogs or dwangs

Nogs where used, must be spaced at no more than 1350mm centres maximum and should be the same size as the stud. Typically, nogs are spaced at 800mm centres. Nogs must be flush with the frame and maybe offset horizontally, if offset they must not exceed 300mm.

Trimming studs

A trimming stud must be fitted beside all openings and must not contain a hole, notch, check or cut in its middle third. A trimming stud will be double thickness where the measured distance from the bottom of the lintel to the bottom of the top plate is more than 400mm.

Jack studs

A jack stud is a short stud fitted below a sill trimmer, or above a lintel, and should be spaced at the same centres as the framing studs. Extra jack studs will be required at load points, above specific design lintels.

Point loads

An established load (force), located at a certain point on a supporting structure; a point where bearing/structural weight is concentrated and transferred to the foundation; e.g. the position of truncated and double girders should be checked to ensure that the point load is occurring in the position identified during processing.

The inspector shall compare the plans to the work on site, ensuring all point loads have been satisfactorily addressed and point loading transferred to the foundation. If the location of the point load is different this may require further investigation.

Top and bottom plates

Figure 38. *Checklist Parent line item 'Timber wall framing; top and bottom plate sizes and fixings'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 39. *Checklist Child line items*

Top plates

Top plates must be continuous and spaced for bracing purposes at 5.0m unless a double top plate is fitted in which case the spacing may be increased to 6.0m

Joints in plates shall be made only over supports being either a stud or blocking.

Additional support must be fitted under the top plate and between studs where a truss lands more than 150mm away from a stud, e.g. 90mm x 45mm timber on edge fixed with 2 x 100 x 3.75mm diameter nails into each stud.

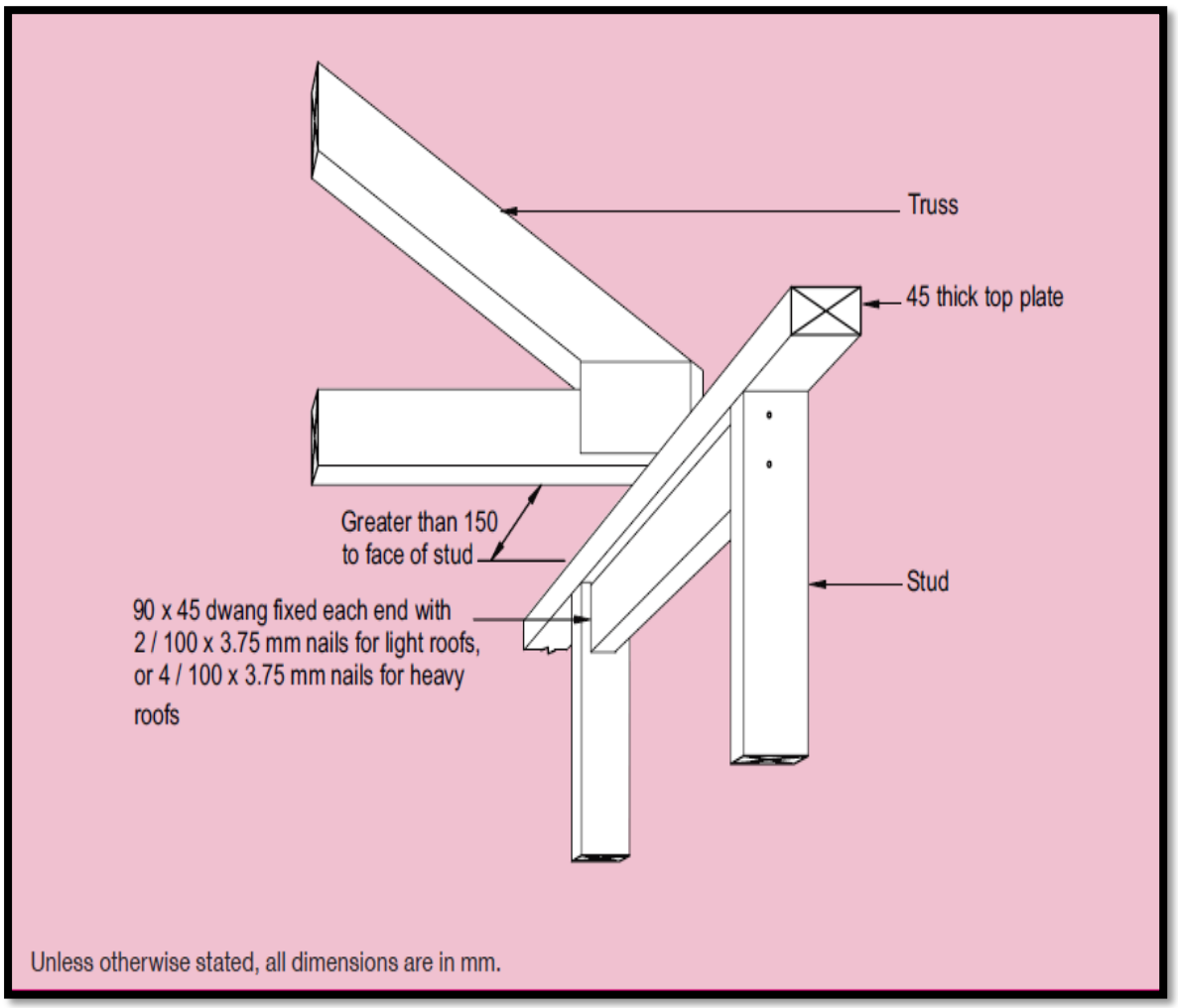


Figure 40. *NZS3604 detail of top plate support for truss landing more than 150mm from a stud*

Joints in top plates

Joints may be either half joints or butt joints and must be made over a stud or solid blocking.

- 3kN = 3 x 30mm x 3.15mm nails each side
- 6kN = 6 x 30mm x 3.15mm nails each side

Where the connection is in the same line as the top plate

Joints on internal non-braced walls

- 3kN connection

Joints in braced walls where bracing value does not exceed 100 BU's

- 3kN connection

Joints in braced walls where bracing exceeds 100 BU's

- 6kN connection

Where the connection of the top plate is at right angles (e.g. the junction of an internal to external wall)

Joints in braced walls where bracing value does not exceed 125 BU's

- connected to at least 1 external wall with 6kN capacity for each connection

Joints in braced walls where bracing value does not exceed 250 BU's

- connected to at least 2 external walls with a 6kN capacity for each connection

Joints in braced walls where bracing value exceeds 250 BU's

- connected to at least 2 external walls each connection having a capacity of 2.4kN per 100 BU's

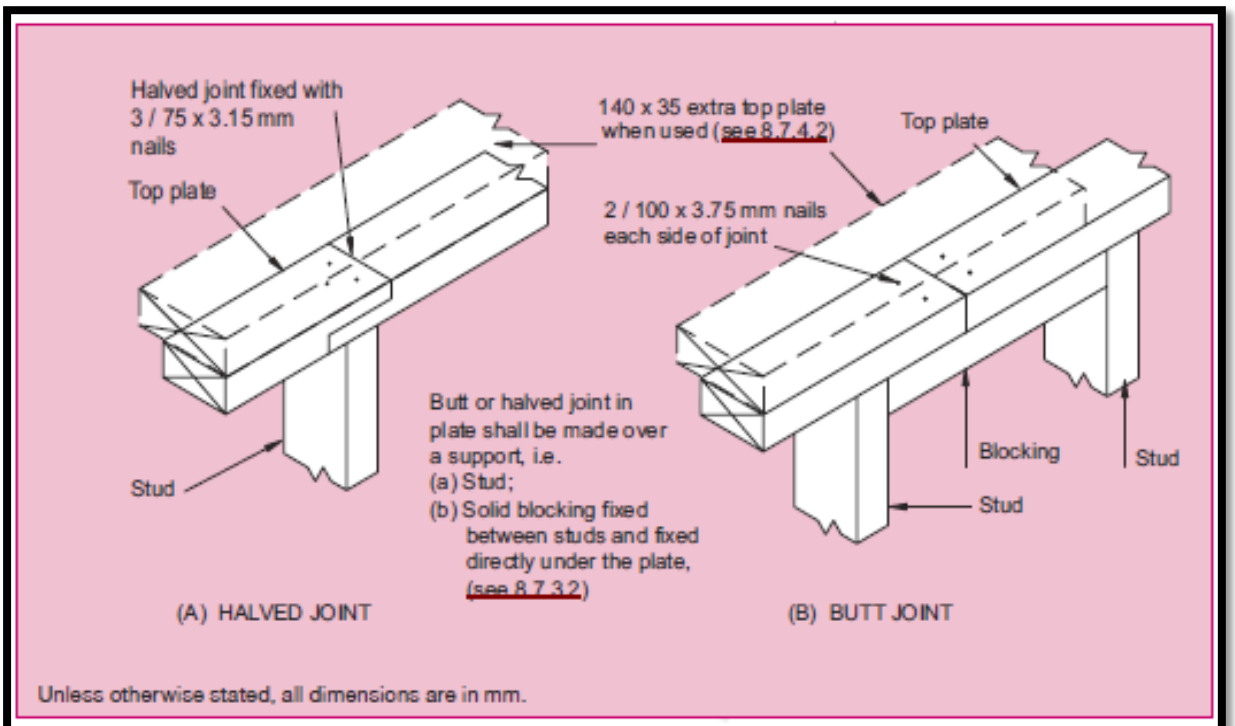
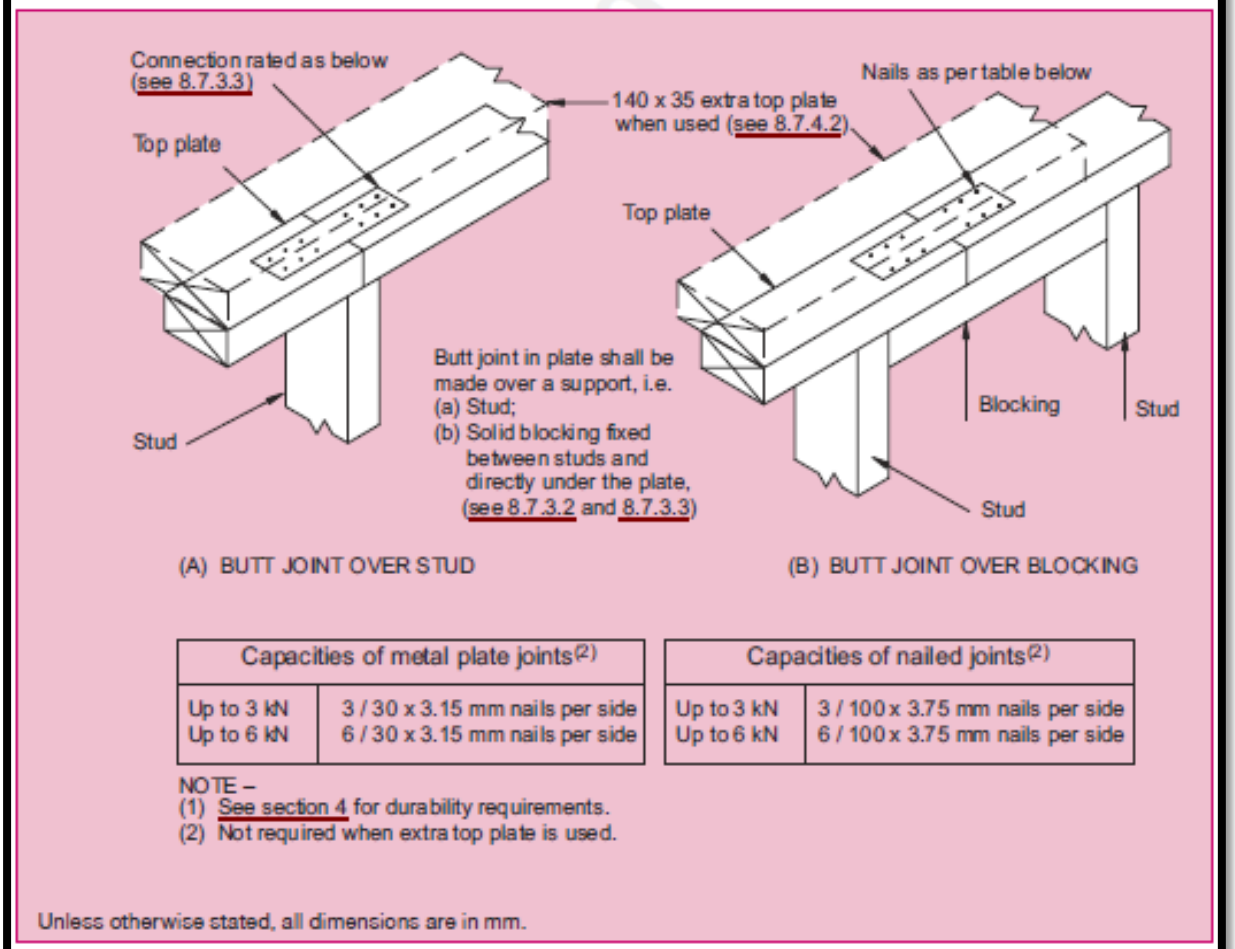


Figure 8.14 – Connecting top plates – Walls not containing bracing (see 8.7.3.2)



Capacities of metal plate joints(2)	
Up to 3 kN	3 / 30 x 3.15 mm nails per side
Up to 6 kN	6 / 30 x 3.15 mm nails per side

Capacities of nailed joints(2)	
Up to 3 kN	3 / 100 x 3.75 mm nails per side
Up to 6 kN	6 / 100 x 3.75 mm nails per side

NOTE –
(1) See section 4 for durability requirements.
(2) Not required when extra top plate is used.

Unless otherwise stated, all dimensions are in mm.

Figure 8.15 – Connecting top plates in line – Walls containing bracing (see 8.7.3.3)

Figure 41. *NZS3604 detail for top plate connections.*

Fixing top plate to stud

The greater the uplift, the more fixings are required. Lighter roofs place higher strains in terms of uplift on framing and as such will require more fixings.
NZS3604 requires an extra 2 wire dogs for 4.7kN B-type fixings, but there are alternative fixings that can achieve 4.7kN, and these must be installed as per the manufacturer's specifications.

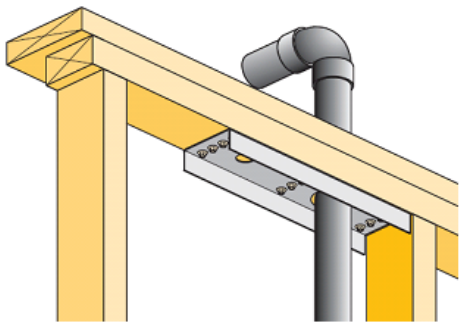
Loaded dimension of wall (m)	Light roof								Heavy roof					
	Roof member spacing (mm)													
	900					1200					900			
	Wind zone					Wind zone					Wind zone			
	L	M	H	VH	EH	L	M	H	VH	EH	L	M	H	VH	EH
	Fixing type (see below)													
2.0	A	A	B	B	B	A	A	B	B	B	A	A	A	B	B
3.0	A	B	B	B	B	A	B	B	B	B	A	A	B	B	B
4.0	A	B	B	B	B	A	B	B	B	B	A	A	B	B	B
5.0	B	B	B	B	B	B	B	B	B	B	A	A	B	B	B
6.0	B	B	B	B	B	B	B	B	B	B	A	A	B	B	B

Fixing type	Fixing to resist uplift	Capacity of alternative fixing (kN)
A	2 / 90 x 3.15 end nails	0.7
B	2 / 90 x 3.15 end nails + 2 wire dogs	4.7

Table 5. *NZS3604:2011 table for top plate uplift connections*

Holes and notches in top plates

- 70mm x 45mm = 19mm diameter or depth (max. 200mm length)
- 90mm x 45mm = 25mm diameter or depth (max. 200mm length)



Where holes or notches exceed these parameters, the top plate must be strengthened, refer to NZS3604, Section 8, and figure 8.19. Alternatively, a proprietary product such as a top plate stiffener, this example manufactured by Mitek Industries, may be used.

Bottom plates

There are many ways a bottom plate can be fixed; the most common methods are described below. The inspector must check the product specifications to ascertain whether suitable for bottom plate fixing standard or bracing.

Cast in anchors M12 Bolts - fixed before the concrete has been poured

- M12 bolt with 50mm x 50mm x 3mm square washer
- embedded 90mm minimum into concrete, 120mm for masonry header blocks
- located 150mm from corner and not more than 1.2m centres around the perimeter

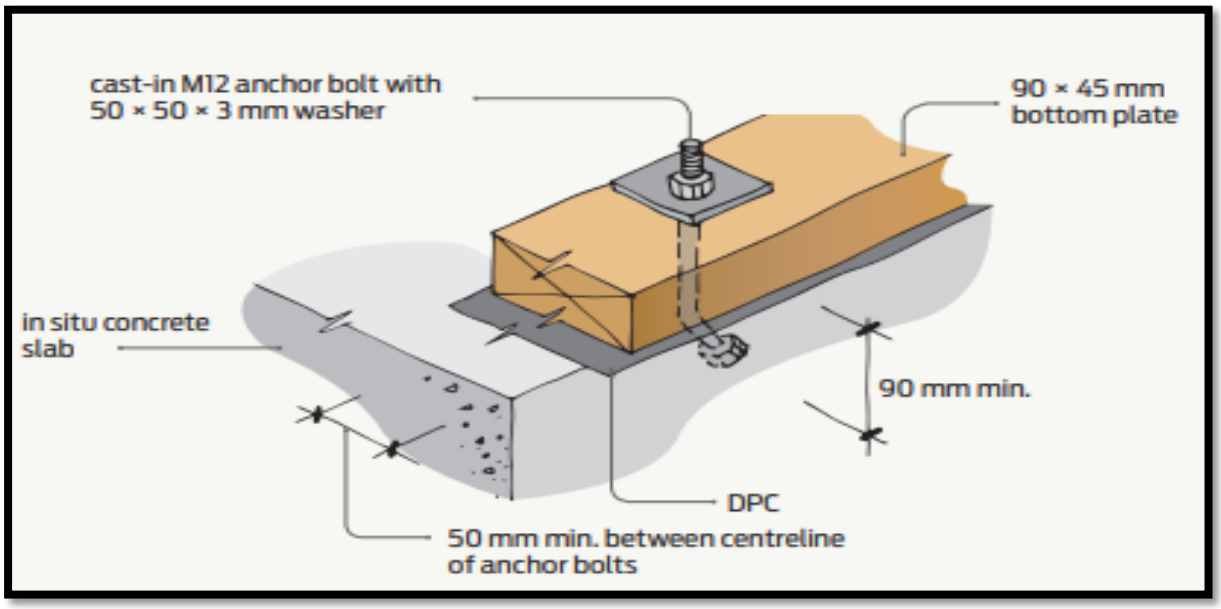


Figure 42. *Cast in M12 anchor bolt, sourced from BRANZ Build magazine.*

R10 dowels - fixed before concrete poured

- R10 dowels bent at least 90 degrees
- embedded 75mm minimum into concrete
- minimum 75mm return, stapled in place over the bottom plate
- located 150mm from corner and not more than 900mm c/s around the perimeter

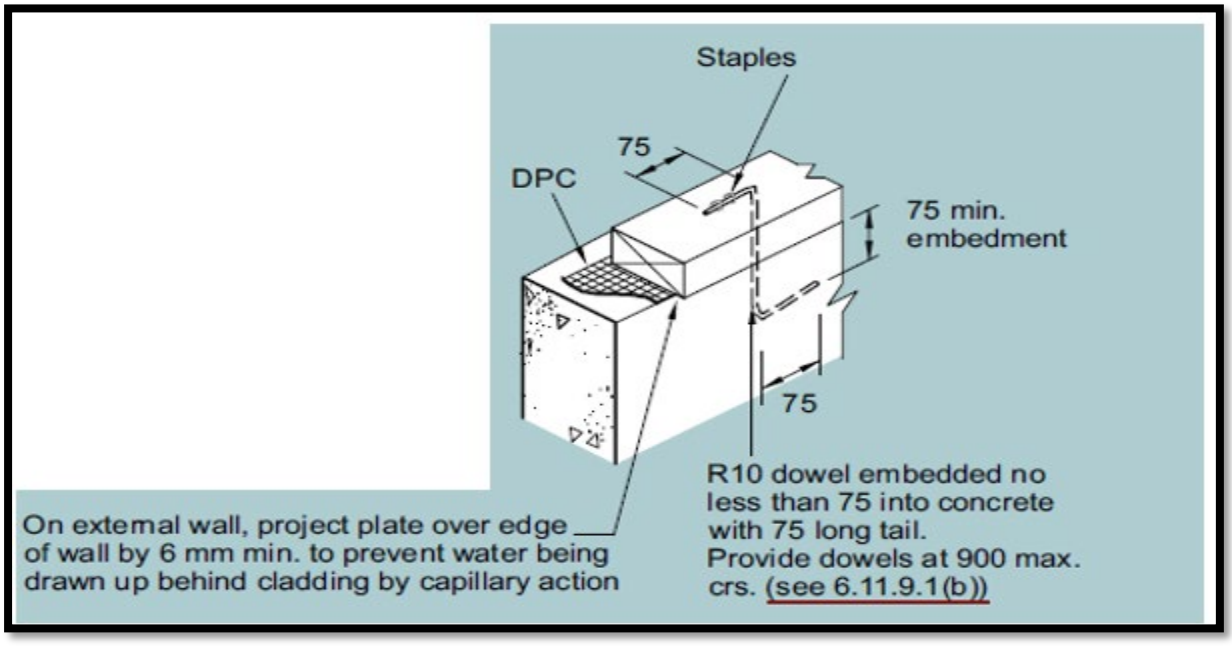


Figure 43. *NZS3604:2011fig 6.16 fixing of wall plates to foundation wall with R10 dowels*

Bottom plate fixing anchors - fixed before concrete poured

- fixed within 150mm of corner and at 900mm c/s
- maybe fixed to stud, bottom plate or both stud and bottom plate
- requires 2 x 30mm x 3.15mm diameter nails into the side or edge of the bottom plate plus 2 x 30mm x 3.15mm diameter nails into the stud or top face of the bottom plate
- requires a 75mm by x 4mm diameter nail within 150mm of anchor

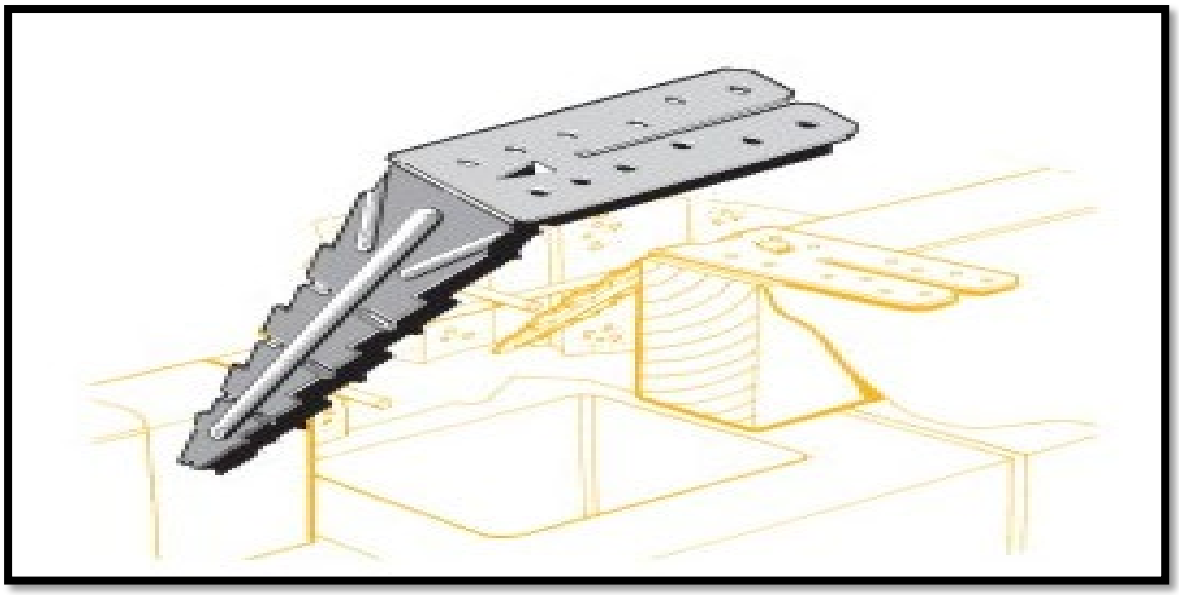


Figure 44. *MiTek Lumberlok bottom plate fixing anchor*

Bottom plate proprietary fixing anchors - fixed after concrete poured

- fixed within 150mm of plate end and at 900mm c/s
- embedded 75mm minimum into concrete at 900mm c/s
- embedded 120mm into concrete with header blocks at 600mm c/s

Bolts need to have a minimum 15kN uplift loading to acceptable for bracing hold-down.

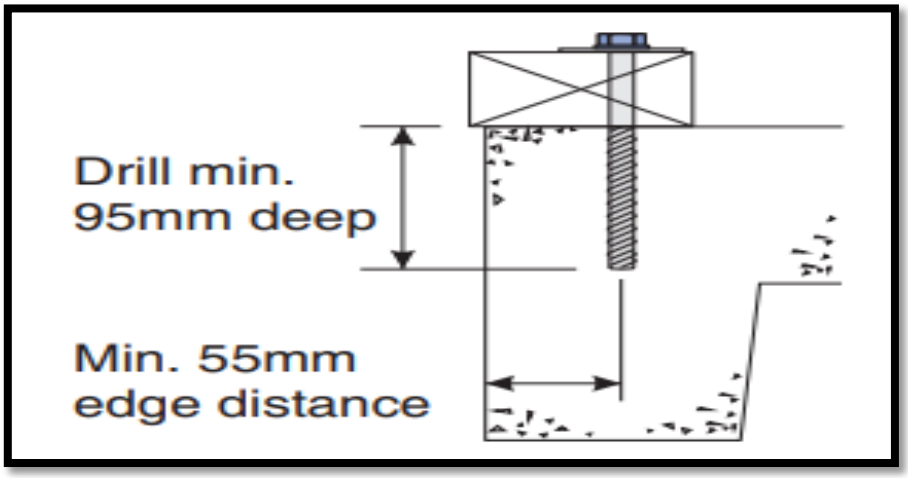


Figure 45. *Bowmac M10x140 Blue Head screw.*

A 10mm diameter masonry bit should be used for drilling into the concrete substrate. Drill a hole into the concrete base to a minimum depth of 95mm and clean out the dust and debris from the hole prior to installation of the BOWMAC SCREW BOLT.
Note what happens on the left photo when there is insufficient edge distance.

Figure 46. *Anchors protruding are signs that the bolt has hit reinforcing and may not have suffient embedment depth.*

Timber foundations - internal or external walls:

- double nailed at 600mm centres for hand driven nails (100mm long)
- triple nailed at 600mm centres for power driven nails
- 150mm long x 12mm diameter coach screw and washer (must be fitted on any brace requiring additional hold down straps)
- Bugle screws; 125mm 14 gauge at 600mm centres

Bottom plate fixings on a timber floor need only achieve a 12kN uplift load for bracing hold-downs.

Concrete slabs - external walls:

- 12mm bolt and washer is required within 100mm of each end of brace and at 900mm centres maximum
- **Note:** For brace hold down bolts (handi bracket or strap) within 80mm end of the brace

Concrete slabs - internal walls:

- 12mm bolt and washer is required within 150mm of each end of brace and at 900mm centres maximum
- GS1a and GS2 **only** maybe fixed with power driven nails fitted with 16mm disc spaced at 150mm and 300mm from end studs and thereafter at 600mm centres

The inspector is to check the bolt manufacturer specifications to ensure the embedment depth and edge distance will achieve the correct kN rating. In most cases, the minimum concrete edge distance to the bolt is 50mm, however in a sea spray zone this is increased to 60mm.
Some bolt manufacturers e.g. ‘Hilti’ require a minimum 60mm concrete to bolt edge distance.

Good practice is to have the washer flush with the inside edge of the bottom plate

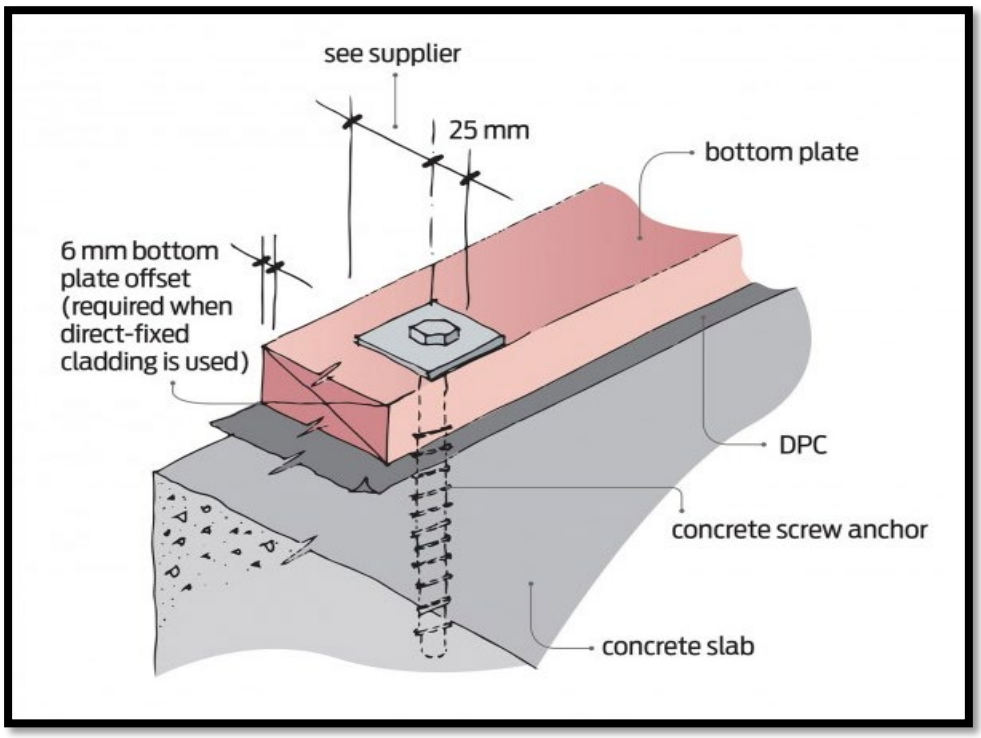


Figure 47. *sample of proprietary screw bolt fixing flush with the inside of the bottom plate; detail sourced from BRANZ Build magazine.*

Holes and notches in bottom plates
Where holes or face notches exceed 50% of the width of the bottom plate, fix the plate against sideways movement on each side of the hole or notch, with one 100mm x 3.75mm nail.

DPC between timber and concrete

Figure 48. *Checklist line item 'Timber wall framing: DPC between timber and concrete'*

All timber to concrete requires a bituminous damp proof course (DPC) or other suitable impervious material overlapping the timber at least 6mm or have a minimum 12mm free draining air space.
Bottom plate to concrete requires DPC with a 6mm overhang each side, or 12mm packer e.g. Hiandri packer.

Sill and head trimmers

Sill and head trimmers to openings shall be of the same width as the studs and of the thickness given by the table below.

Maximum clear width of opening	Minimum thickness of sill and header trimmers
(m)	(mm)
2.0	35
2.4	45
3.0	90 (or 2/45 mm)
3.6	135 (or 3/45 mm)
4.2	SED

Table 6. *NZS3604:2011 table for sill and head trimmer sizes*

Lintel size and fixing

Figure 49. *Checklist line item 'Timber wall framing: lintel size and fixing'*

The inspector is to check the size, support and fixing of lintels. It is also important to check and confirm that any point loads are in the same place as identified by the engineer; if the location of the point load is different this may require further investigation. As a general rule of thumb, if the point load is closer to the end of the lintel it won't be a problem, but if it is further away it should be investigated.

Strapping against uplift is required particularly where the property is subject to higher wind pressures and where lightweight roofing and large spans are involved. The strapping is the same type used in wall bracing; strapping used in roof bracing should **not** be used as this does not provide the required ductile and tensile capacity.

Lintels must be supported at each end by a trimming stud and if supporting rafters and trusses, dependent on wind zone and roof type, secured against uplift.

Uplift requirements are specified in Section 8 of NZS3604, table 8.14 and are for a maximum loaded dimension of 6m; dimensions outside this table are subject to specific design.
When considering uplift, straps must be fitted in 3 locations, at the top and bottom plates and across the lintel. These 3 fixing points ensure the lintel is not only tied to the framing but also to the foundations via the bottom plate and the roof framing via the top plate.

Lintel

- strap fitted on one face of the frame only
- strap fitted to each side of the opening and onto trimming stud
- 6 x 30mm x 2.5mm diameter nails into lintel and 6 x 30mm x 2.5mm diameter nails into the trimming stud

Top plate

- strap taken over top plate and fixed to each side of lintel
- 6 x 30mm x 2.5mm diameter nails into each face
- 'Stud-Lok' screws; refer to manufacturer's installation instructions

Bottom plate - timber floor

- strap must be fitted on bottom of trimming stud and through to blocking or joist below
- 6 x 30mm x 2.5mm diameter nails into trimming stud and 6 x 30mm x 2.5mm diameter nails into floor joist or blocking

Bottom plate - concrete floor

- strap fitted under bottom plate and 150mm up stud
- 6 x 30mm x 2.5mm diameter nails into each side of stud

Sub-floor / mid-floor

In sub-floor or mid-floor situations, straps are fixed from the studs down onto the joists.

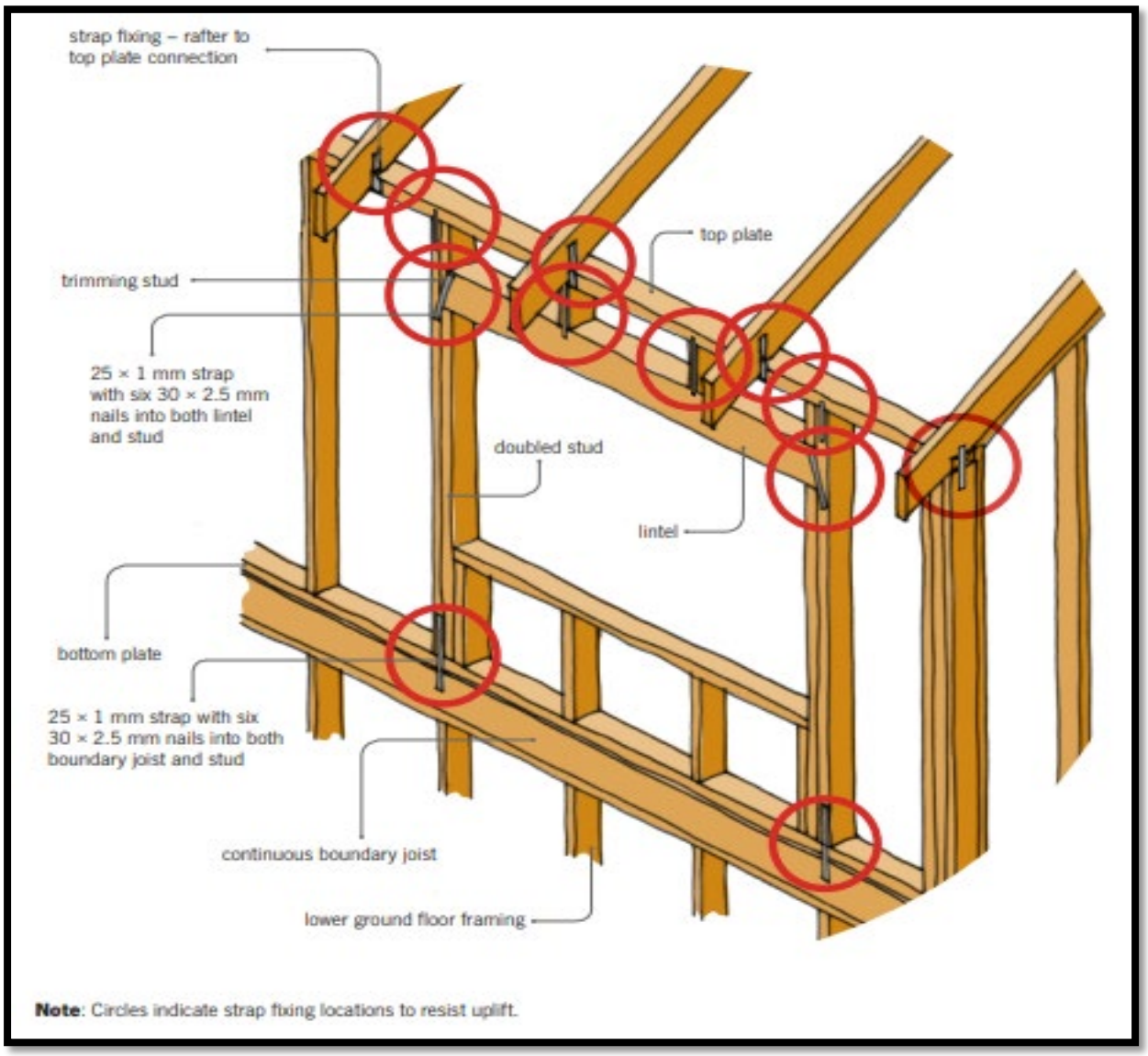


Figure 50. *detail for uplift connections from BRANZ Build magazine*

Beams and fixings

Figure 51. *Checklist Parent line item 'Timber beams and fixings'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 52. *Checklist Child line item*

Figure 53. *Checklist Parent line item 'steel beams and fixings'*

Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 54. *Checklist Child line item*

The inspector will check the plans for all beam connections and load paths. It is also important to check and confirm that any point loads are in the same place as identified by the engineer. If the location of the point load is different this may require further investigation.

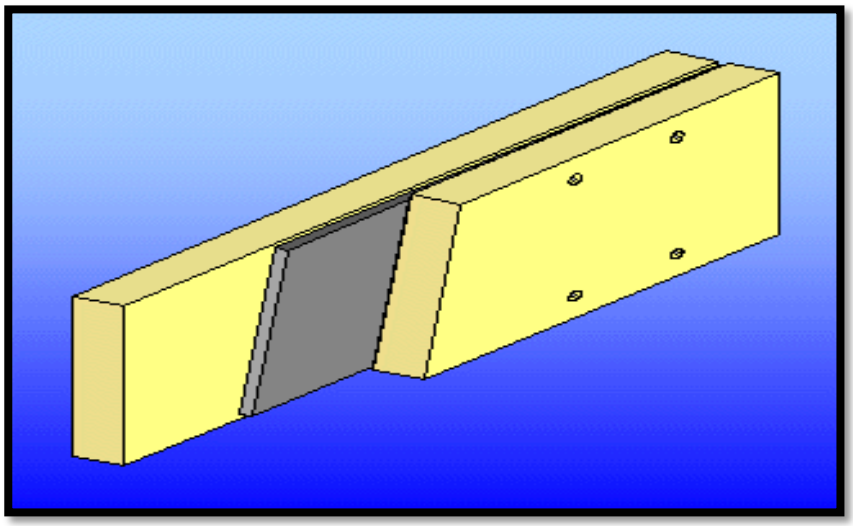
Flitch beams

Flitch beams are manufactured by both Pryda and MiTek Industries; they are proprietary products comprising timber and steel plates bolted together to form a strong unit. These beams are quite common for lintels above garage doors or supporting upper floor loads and can be found supporting most upper floors in residential houses.

Pryda flitch beam (PFB)
These beams are made in the factory by fixing timber to each side of either one or two flat metal plates and bolted together. Flitch beams are for enclosed (internal) use only.

The most common way of specifying a Pryda flitch beam is by its size, e.g. 200PF10

- PF refers to the type
- 200 refers to the depth
- 10 refers to the steel thickness



MiTek flitch beam (MFB)
These beams are factory-made by fixing timber to each side of a flat metal plate. Flitch beams are for enclosed (internal) use only.

The most common way of specifying a MiTek Flitch beam is by its size, e.g. FB25M.

- FB refers to the type
- 25 refers to the depth of the timber plates
- M refers to the steel

LVL beams

Figure 55. *Sample of LVL beam.*
Note: *LVL and CLT beams may have pre-formed cambers.*

Plywood box beam

NZS3604:2011 16.1 allows for the construction of plywood box beam lintels to support roofs that are not subject to snow loading. Tables are provided in NZS3604 for lintel sizes dependent on roof type and pitch, beam span and loaded dimension.

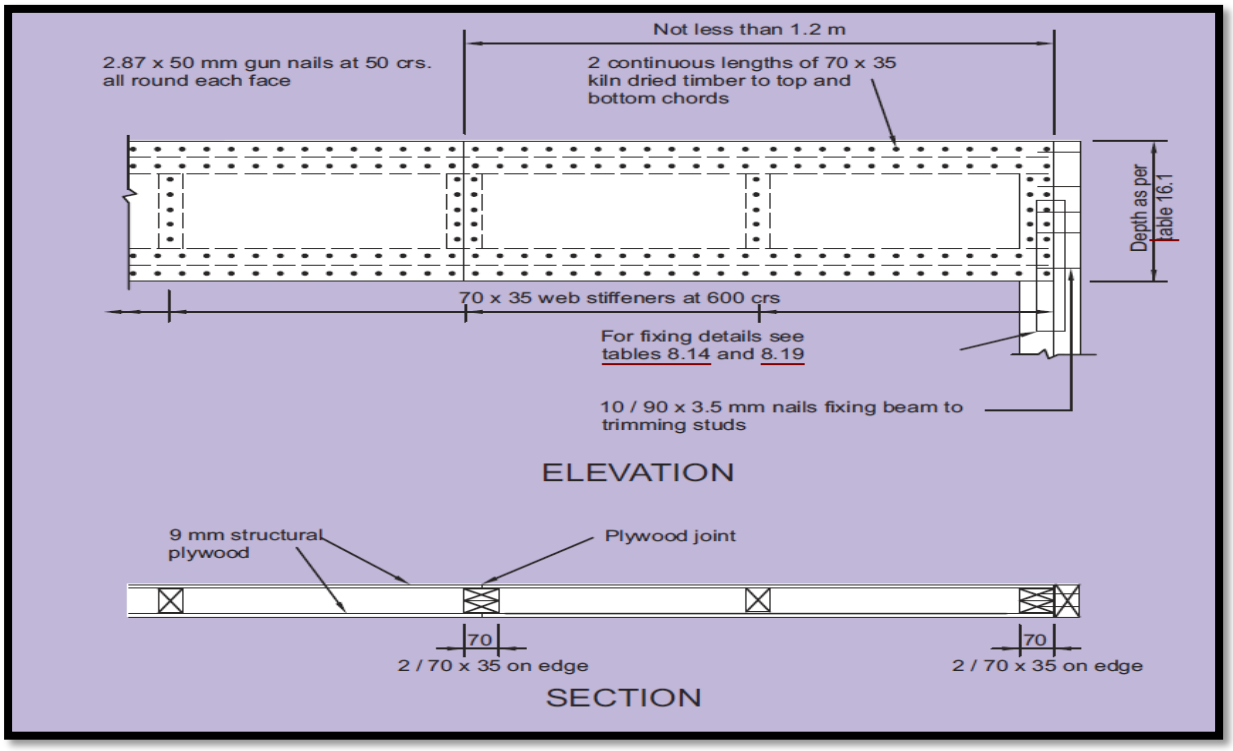


Figure 56. *Sample of plywood box beam construction from NZS3604 fig16.2*

Timber treatment

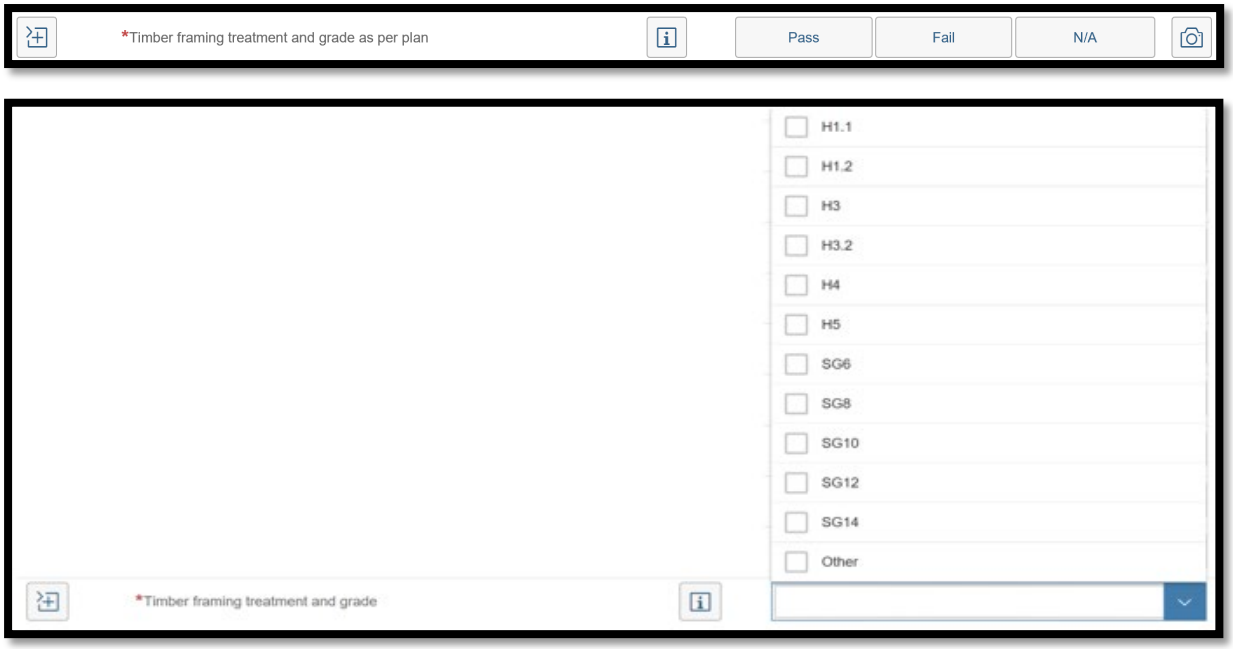


Figure 57. *Checklist line items 'Timber framing treatment and grade as per plan'*

For timber treatment requirements refer to previous section in this module 'Timber treatment'.

Capillary gap

Figure 58. *Checklist line items 'Timber wall framing; Capillary gap 6mm'*

If the cladding is direct fixed, ensure the bottom plate overhangs the slab by 6mm to provide a capillary break and extends at least 50mm below the bottom plate.

In some cases, the concrete protrudes past the edge of the bottom plate. This is not acceptable as it will push out the building wrap and cavity battens, making the cladding out of plumb.

Bracing connections/system

The inspector is to ensure the wall brace system, and bracing elements are as per plan. The bracing calculations are to be checked to ensure the required bracing units have been achieved, and the correct stud height used in the bracing calculations.

Wall braces should be located as close as possible to corners and distributed evenly around the building. A minimum of 15 bracing units (BU's) per meter is required under each external wall (refer NZS3604 section 5) and no less than 100 BU's per wall under a diaphragm or dragon tie.

In addition, some bracing elements require that brackets be fitted to restrict uplift (in addition to bottom plate fixings), depending on the bracing element. It is important to refer to the manufacturer's literature to determine their individual requirements.
In most cases for brace hold down fixings, 80mm is the maximum distance allowed form the bolt position to the edge of the brace.

Tick or highlight the braces on the bracing layout plan as this will save time when returning for the 'Postline' inspection.

Each wall that contains one or more wall bracing elements shall be connected at the top plate level, either directly or through a framing member in the line of the wall, to the external walls at right angles to it. Top plate fixings of the capacity in tension or compression along the line of the wall bracing element shall be:

- for each wall containing wall bracing elements with a total bracing capacity of not more than 125 bracing units: to at least one such external wall by a fixing of 6kN capacity.
- for each wall containing wall bracing elements with a total bracing capacity of not more than 250 bracing units: to at least two such external walls by fixings of 6kN capacity.
- for each wall containing wall bracing elements with a total bracing capacity of more than 250 bracing units: to at least two such external walls by a fixing of not less than 2.4kN per 100 bracing units.

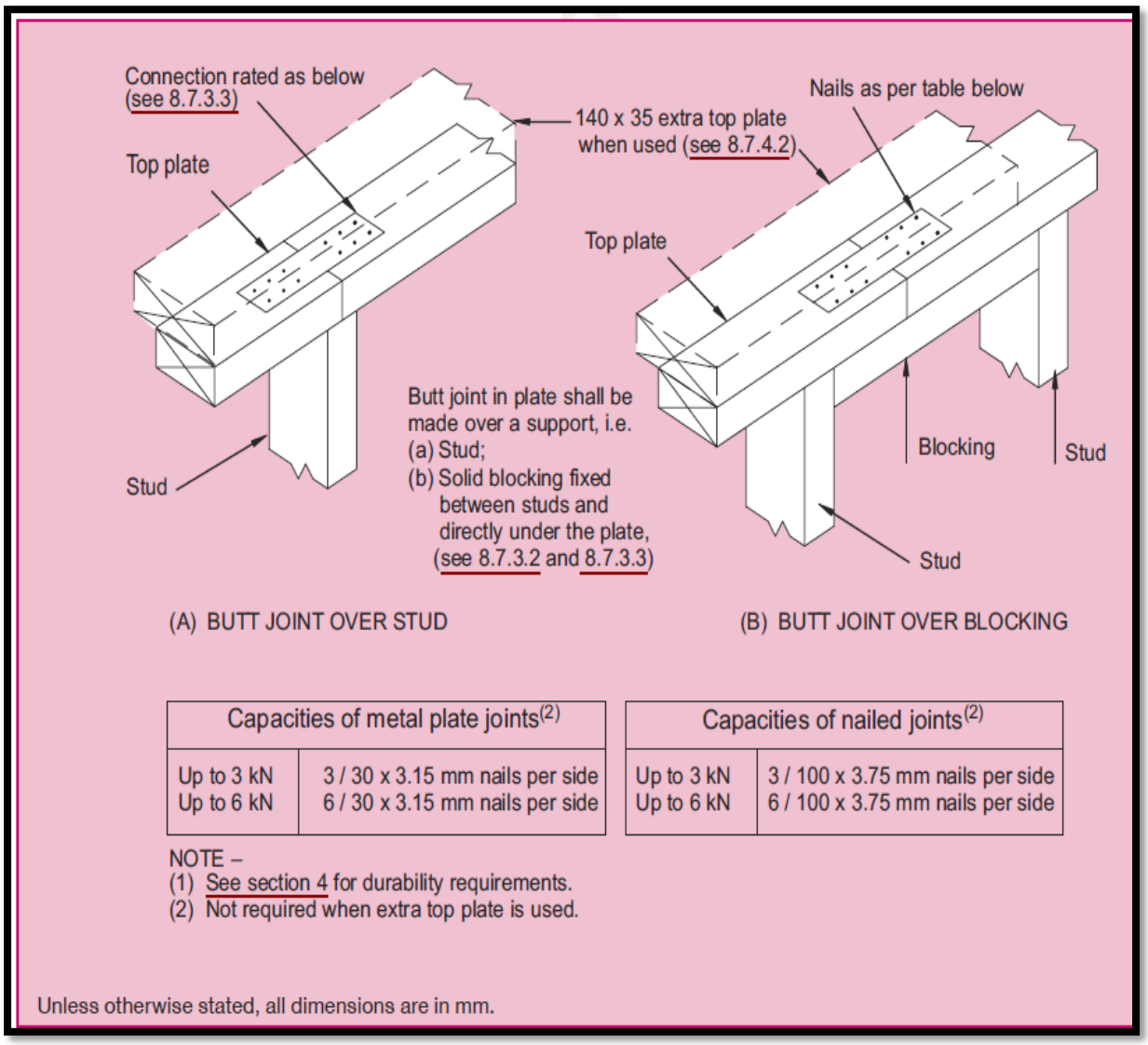
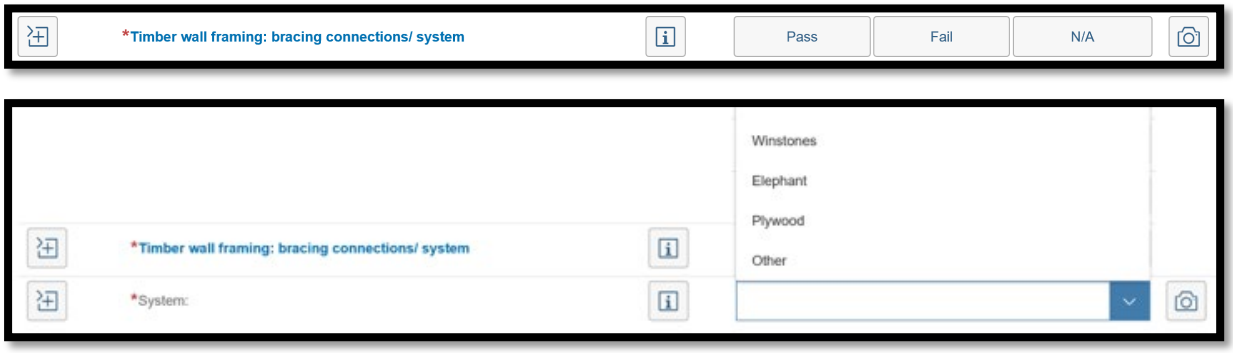


Figure 59. *NZS3604:2011 fig 8.15 connecting top plates in line-walls containing bracing*



Figures 60. *Checklist Parent line item 'Timber wall framing: bracing connections/system'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 61. *Checklist Child line items*

Fire wall structural stability

Figure 62. *Checklist line item 'Timber wall framing: fire wall structural stability'*

Passive fire protection refers to the use of construction elements within a building that are designed to prevent or delay the spread of fire and/or smoke to different parts of the building. The purpose of passive fire protection is to limit the effects of fire within a building by acting as a barrier to fire and smoke or protecting structural components from fire that may cause early collapse. This is achieved by installing fire resistance rated elements of construction and controlling the flammability of construction materials.

Passive fire protection systems must be installed in strict accordance with the consented plans, and the manufacturer's specifications. Any variations should be referred to the designer or manufacturer and submitted to the BCA for approval as an amendment to the consent before the changes are constructed.

Buildings may be subdivided into firecells designed to contain the fire and prevent its spread for a specified period. Firecells are separated using construction elements that are fire resistance rated for at least the specified period of time required for the firecell. Fire-resistant construction must be located to separate the intended firecell from the rest of the building. Where the fire separation meets unrated construction, such as a suspended ceiling, it should be continued and extend to reach another fire separation or the main boundaries of the building envelope (such as floors, external walls and ceiling/roof). All penetrations in fire separations, doors, dampers and services must be sealed to maintain the performance of the fire-rated construction.

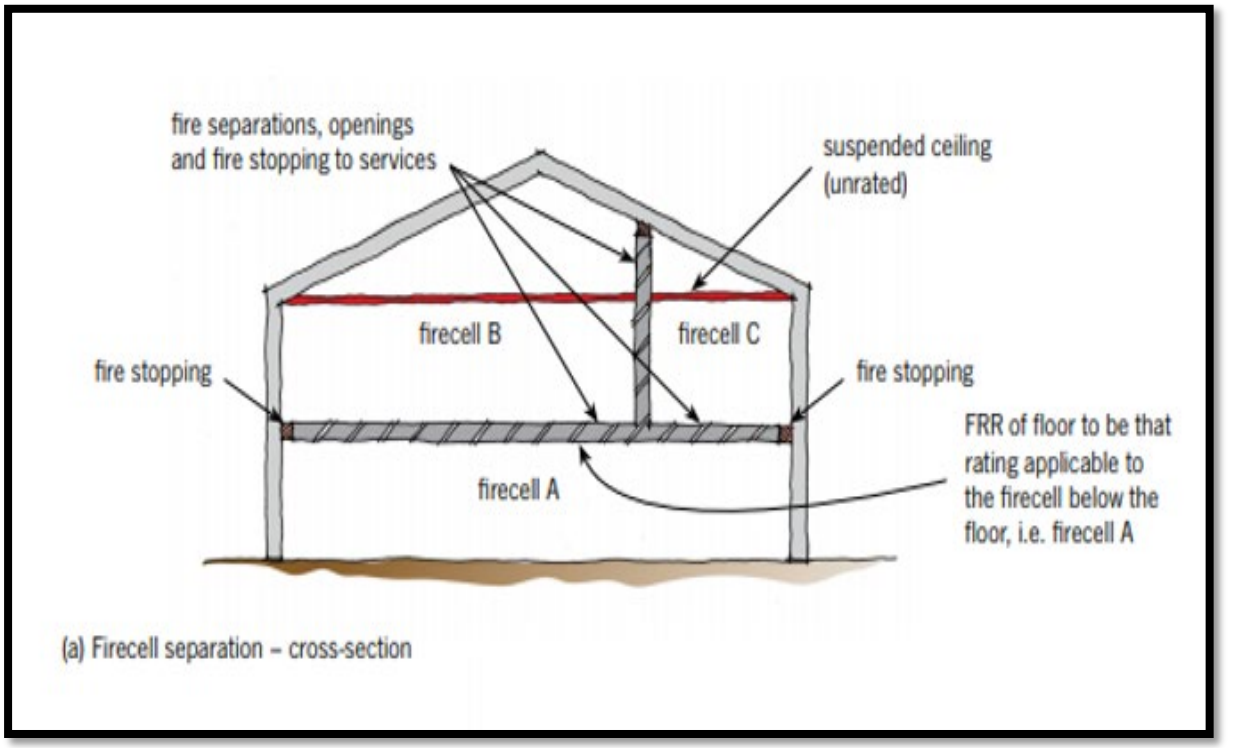


Figure 63. *From BRANZ 'Guide to Passive Fire Protection in Buildings'*

Examples of fire rated inter-tenancy walls

The following products are subject to change at any time and not to be used as support documents for inspections. In all cases manufacturer specifications are to be used in the building consent.

Precast panels

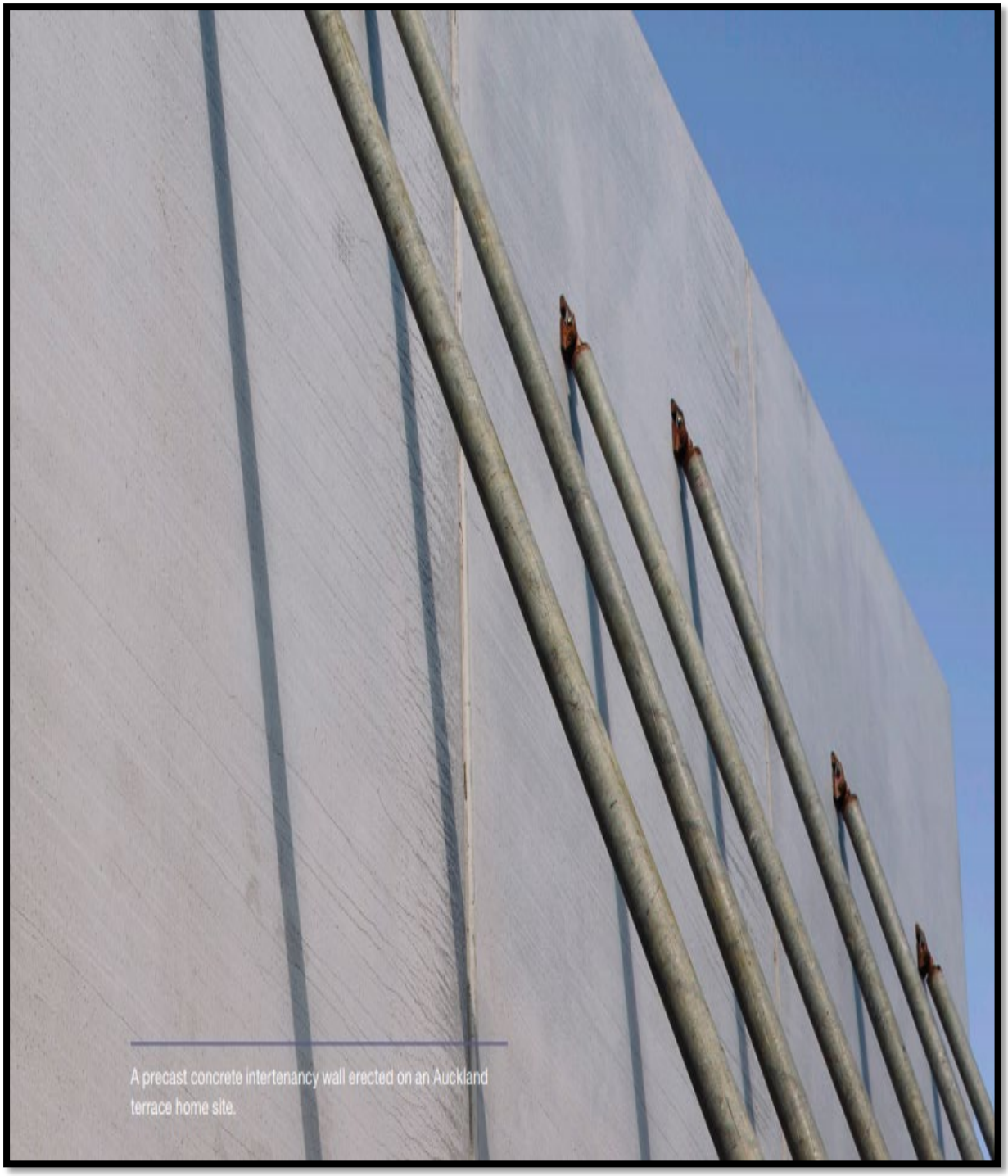


Figure 64. *Sample of precast concrete intertenancy fire rated wall, sourced from 'Gib Terrace home guide'*

Joints to precast panels should have a pef rod or fire foam backing. PEF Rod with a diameter of 25 - 30% greater than the width of the joint is pushed into joint gaps to form a uniform and firm base to ensure that it remains firmly in place during installation of the intumescent sealant. The rod must be positioned to achieve a uniform and even, predetermined depth without any twists, bumps or gaps and avoid excessive

longitudinal stretching of the rod. If using foam as a backing this must not pass through the whole joint but create an even base to install the intumescent sealant to both sides of the panel joint.
The intumescent sealant must be installed as per the sealant manufacturer specifications, with the specifications onsite at the inspection.

Korok

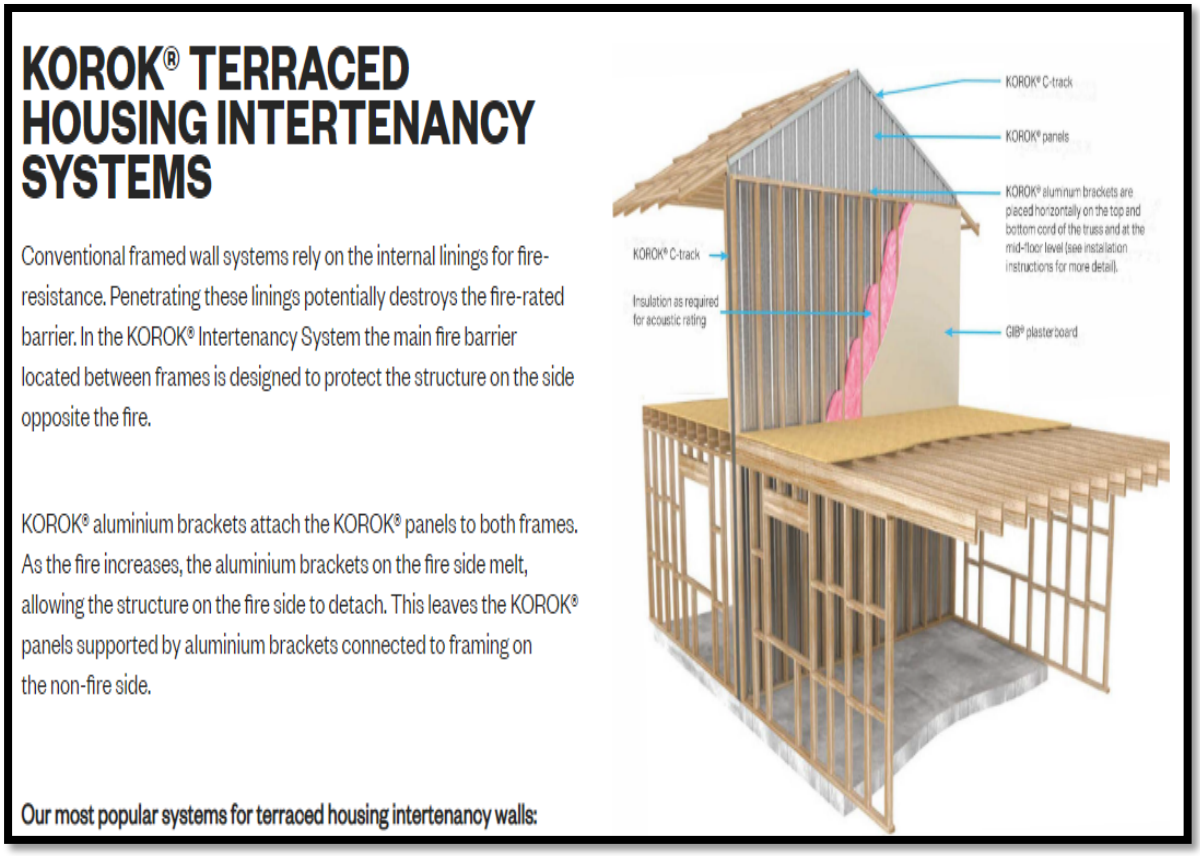


Figure 65. *Sample of Korok brand intertenancy fire rated system (formerly Speedwall)*

Boral

Based on a panelised construction principle, the IntRwall system utilises 25mm Shaftliner plasterboard panels fitted between steel H-studs. Services are easily incorporated in wall cavities on one or both sides of the wall. As the fire lining is sandwiched in the middle of the system — rather than on the outer face, penetrations of the wall do not need to be fire rated.

Figure 66. *Sample of Boral brand intertenancy fire rated system*

Winstones Gib Barrierline

Figure 67. *Sample of Gib 'Barrierline' system*

GIB® Intertenancy Barrier Systems for Terrace Homes are designed to provide a NZBC compliant separating wall between attached dwellings. The system consists of a double timber frame wall with a 25mm thick plasterboard barrier between the frames. The primary fire resistance is provided by the plasterboard barrier, with the wall linings contributing to some extent. This allows the wall linings to be used for structural bracing and to incorporate penetrations.

The basis of the acoustic performance is a double cavity system. This provides isolation from airborne sound. Insulation in both cavities is used to meet various performance levels and allows certain services to penetrate the wall linings.

Resene Construction Integra

The INTEGRA Lightweight Concrete Intertenancy System is a proprietary high-performance wall system that provides horizontal fire and acoustic separation between adjacent tenancies in the same building. The core component of the INTEGRA system is a high-tech lightweight concrete panel and intertenancy bracket

that is installed between traditional timber framing that has insulation and plasterboard lining on the outer face.

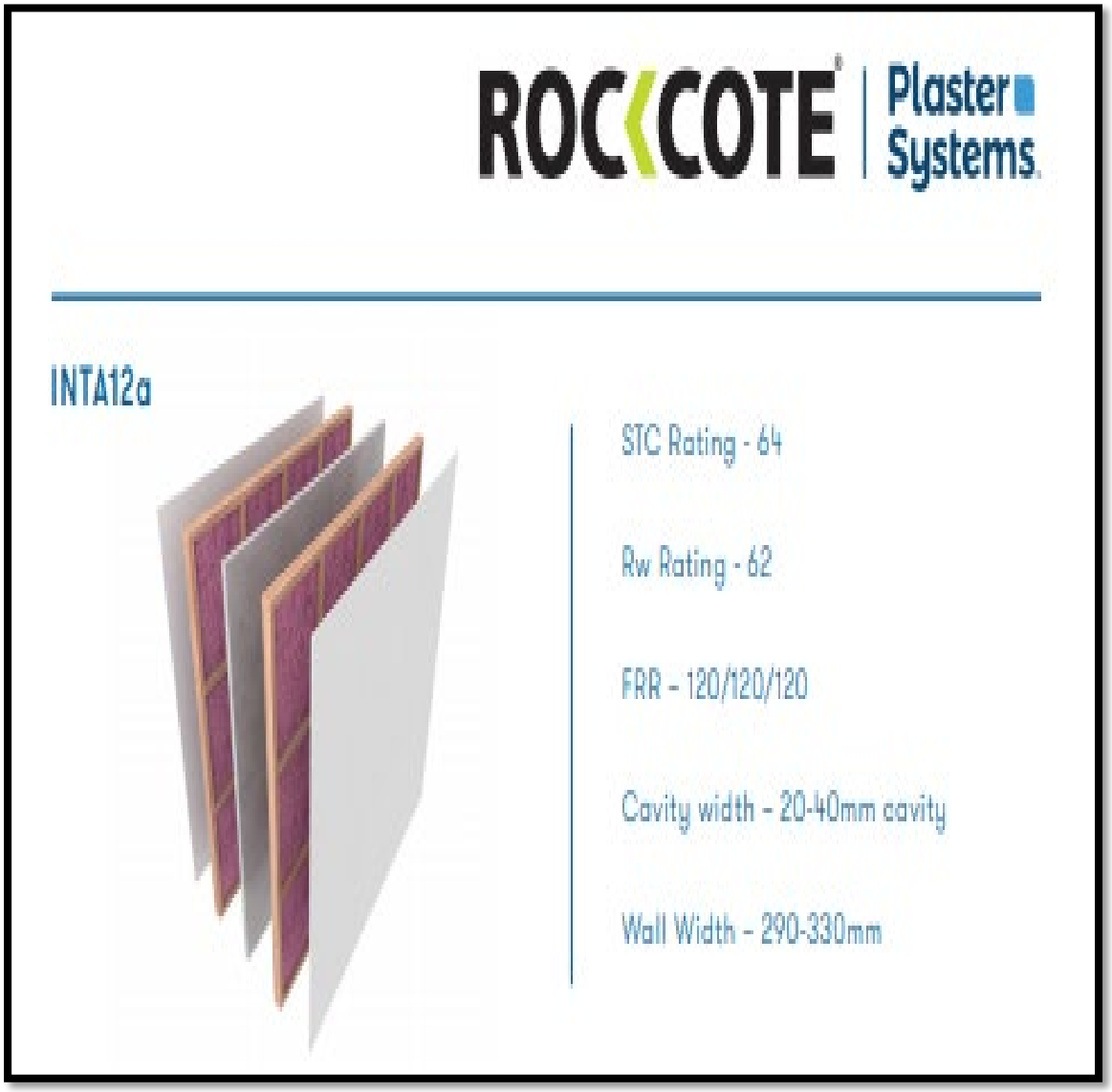


Figure 68. *sample of Integra brand intertenancy fire rated system*

AFS Logicwall

AFS Logicwall is a permanent formwork system for concrete walling for external and internal walls. It consists of lightweight sandwich panels created by bonding hard-wearing fibre cement sheets to galvanised steel stud frames.

The panels are quickly and simply hand-erected on site and then core-filled with concrete to achieve loadbearing walls that are fire and sound rated. The fibre cement sheeting remains in place as sacrificial formwork and provides an excellent substrate for applied finishes such as skim coating, acrylic render and paint.

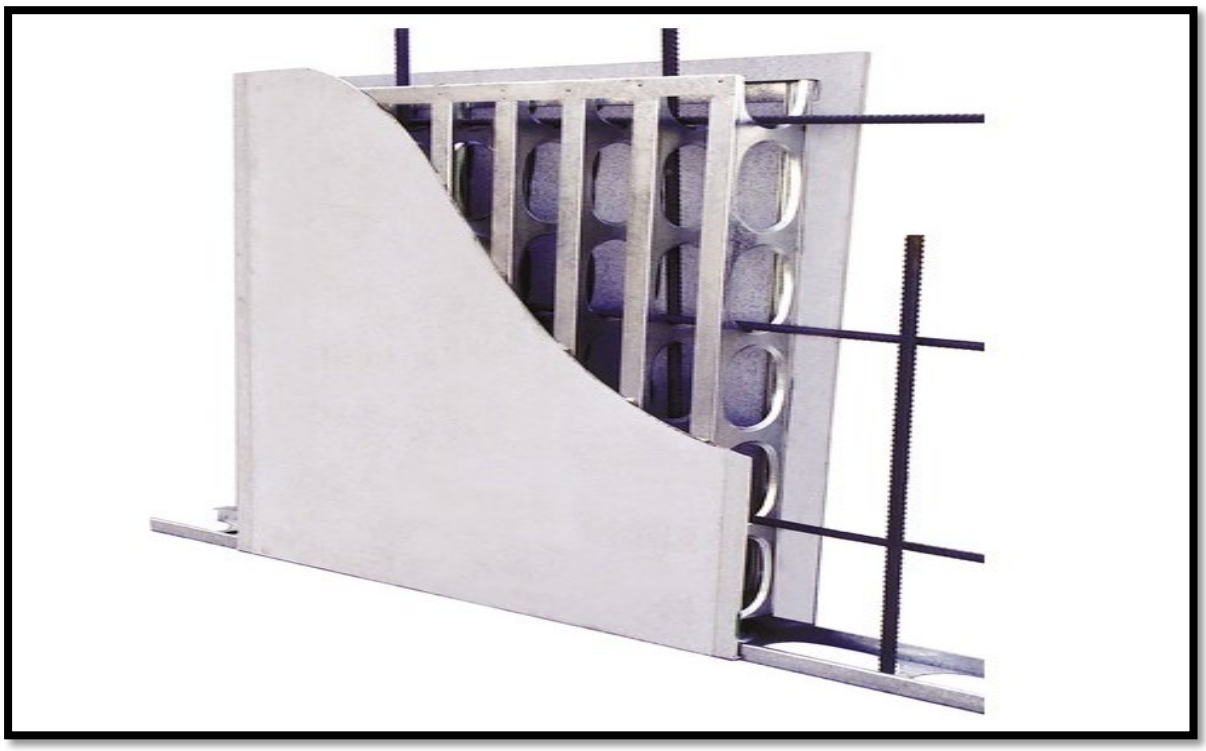
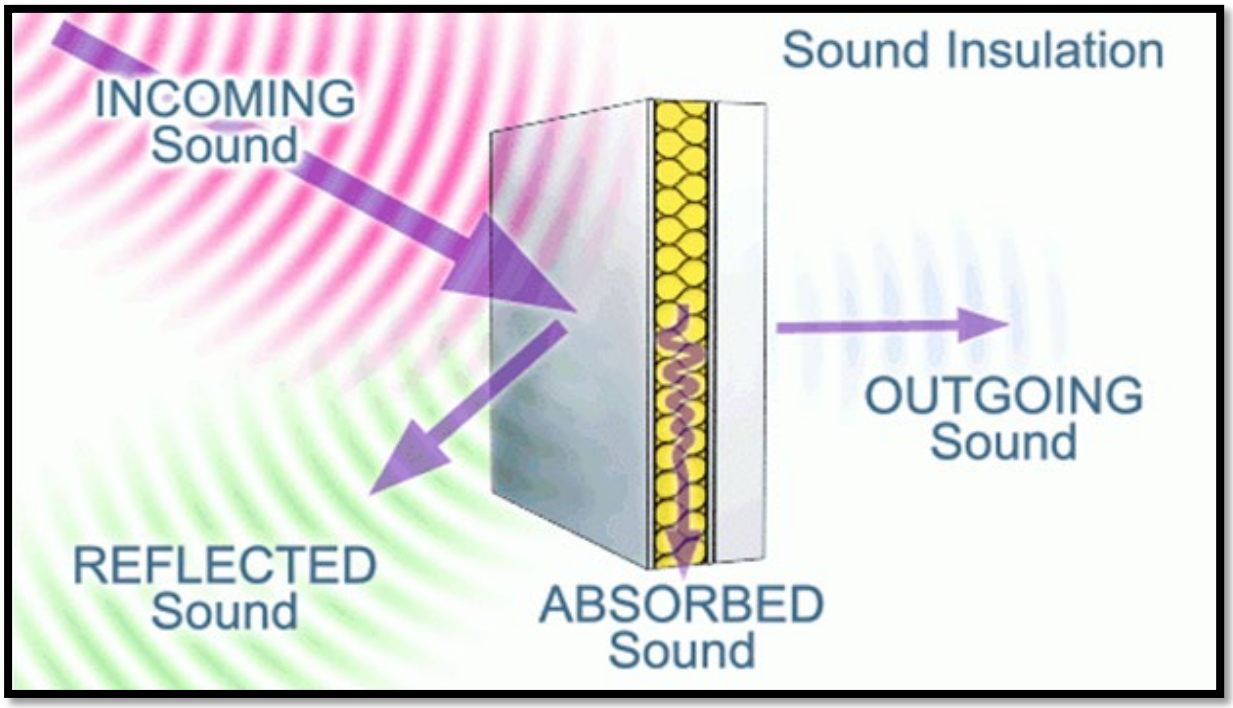


Figure 69. *Sample of AFS Logicwall brand intertenancy fire rated system*

Intertenancy wall acoustic system

The purpose of this inspection is to prevent undue noise transmission in building elements between occupancies or common spaces in household units.



Inspection requirements

Type	Minimum requirements
Framing	Check construction details for acoustic framing between walls, floors and ceilings in habitable spaces. • Check system • Check framing • Check resilient clips / channels • Linings • Sealants • Insulation • Penetrations
Lining	Check acoustic linings between walls, floors and ceilings in habitable spaces. • Lining materials • Sealants
Testing	On site acoustic testing is required to demonstrate that the required Sound Transmission Class (STC) and Impact Insulation Class (IIC) ratings as required by G6 have been achieved. Acoustics are tested at the final inspection, only for units with both vertical and horizontal separation. To avoid failure at the inspection, owners are encouraged to engage their own experts to conduct testing during construction.

Table 7. *Minimum inspection requirements*

General requirements

Clause G6 requires that habitable spaces are protected from other occupancies using wall and floor and ceiling elements with a laboratory tested performance of STC 55 (walls and floors) and IIC 55 (floors only). Sound transmission class (STC) means a single number rating derived from measured values of transmission loss. It provides an estimate of the performance of a partition in certain common sound insulation situations.

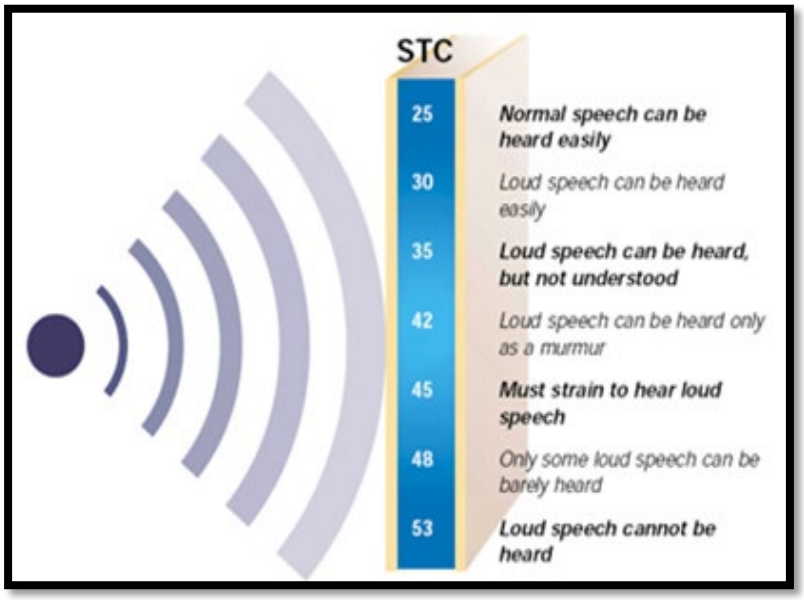
Impact insulation class (IIC) means a single number rating derived from measured values of normal impact sound pressure levels. This method uses a tapping machine to gauge the impact of sound through floor-ceiling assemblies.

The ability of building materials to resist the transmission of sound is dependent on their density, thickness and stiffness. Light and stiff materials have poor sound insulation properties because they allow sound at certain frequencies to transmit easily. Materials of similar thickness and weight can have different sound reduction performance if they have different critical frequencies. For example, laminated glass has a better sound reduction because it reduces the effect of the critical frequency by damping vibration and reducing the stiffness of the window.

There is no optimum window to wall ratio. From an acoustic point of view, the smaller the window the better it is. This is because glazing is the weakest path and thicker glazing, or double-glazing is more expensive in comparison to other building systems. The newer types of laminated glazing using a PMM interlayer (e.g. Pilkington HUSH Glass) provides about a 3-dBA improvement over similar thickness float glass. A 3-dBA reduction would otherwise require an increase from say 6mm to 10mm float glass.

The performance of pre-cast concrete walls more than 150mm thick and solid filled masonry 200mm thick is very sensitive to construction practices, detailing and concrete density. Although these walls can achieve STC 55, the sound attenuation is greatly enhanced when resilient mounts and/or battens are installed on at least one side. These additions can be counterproductive unless a minimum cavity of 45mm is created and filled with sound control infill prior to lining. Note that polystyrene is not a suitable infill.

Where separate tenancies adjoin each other, noise is a fundamental consideration. NZBC Clause G6 requires that habitable spaces in household units are protected from other occupancies using wall and floor/ceiling elements with a laboratory tested performance of STC 55 (walls and floors) and IIC 55 (floors only).



STC sound transmission class: How well a building assembly attenuates (reduces) airborne sound.

A larger number means more attenuation (reduction).

STC 55 is the minimum to meet performance criteria of NZBC G6

There are four elements to sound attenuation, they are: -

- Decoupling (separating walls / ceilings so noise won't travel though the space)
- Damping (stopping the dry wall from vibrating by using sealant on dry wall or using materials that won't vibrate)
- Mass (making the walls as heavy as possible)
- Absorption (filling the void with insulation to absorb the sound, sealants, underlays etc)

Timber framed walls

Framing generally consists of two frames with a 25-65mm gap, which varies depending on the stud size (70-90mm) used. Studs are generally at 600 c/s maximum and nogs 1350mm c/s. In timber-framed walls, stud heights are restricted to NZS3604.

Figure 70. *sample of resilient clip on rubber grommets to reduce vibration. The clips are designed to carry a channel, which the dry wall is attached to.*

Gib quiet ties

Quiet tie connections between frames may be required for seismic reasons to control independent lateral movement of adjacent floors. Connections are also often required to ensure that the stability of double frame walls is maintained in the case of a fire on one side of the wall. Check with the building designer for required spacing of the Gib® Quiet Tie

For inter-storey heights between 3 and 4 metres, and a stud spacing of 600mm, the recommended maximum spacing is one Gib® Quiet Tie every 3rd stud (1.8 metres) along the wall bottom plate and at roof level (if required by the engineer)

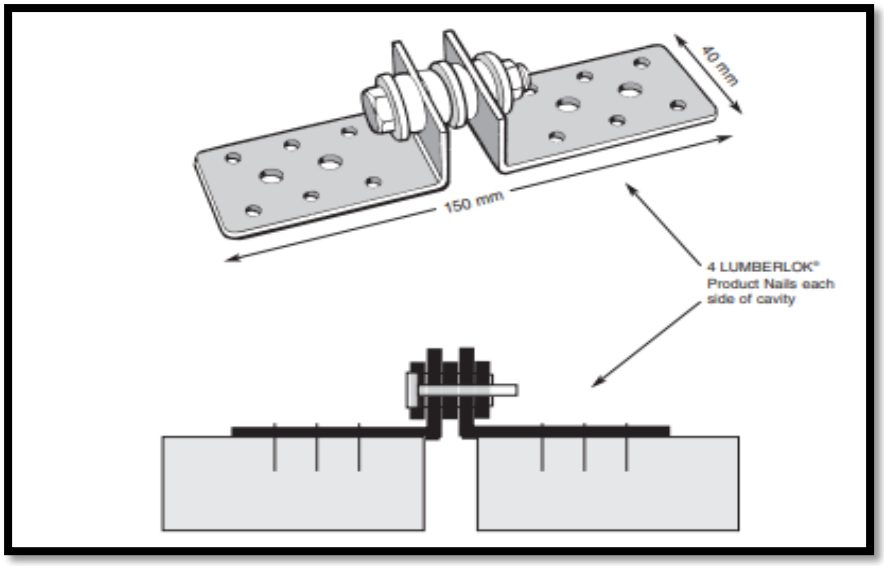


Figure 71. *Sample of Winstone Gib Quiet tie*

Concrete and concrete masonry

The performance of pre-cast concrete walls more than 150mm thick and solid filled masonry 200mm thick is very sensitive to construction practices, detailing and concrete density. Although these walls can achieve STC 55, the sound attenuation is greatly enhanced when resilient mounts and battens are installed on at least one side. These additions can be counter intuitive unless a minimum cavity of 45mm is created and filled with sound control infill prior to lining. Note that polystyrene is not a suitable infill to achieve sound attenuation.

On floors, carpet and underlay will also reduce noise whereas tiles will increase and transmit noise.

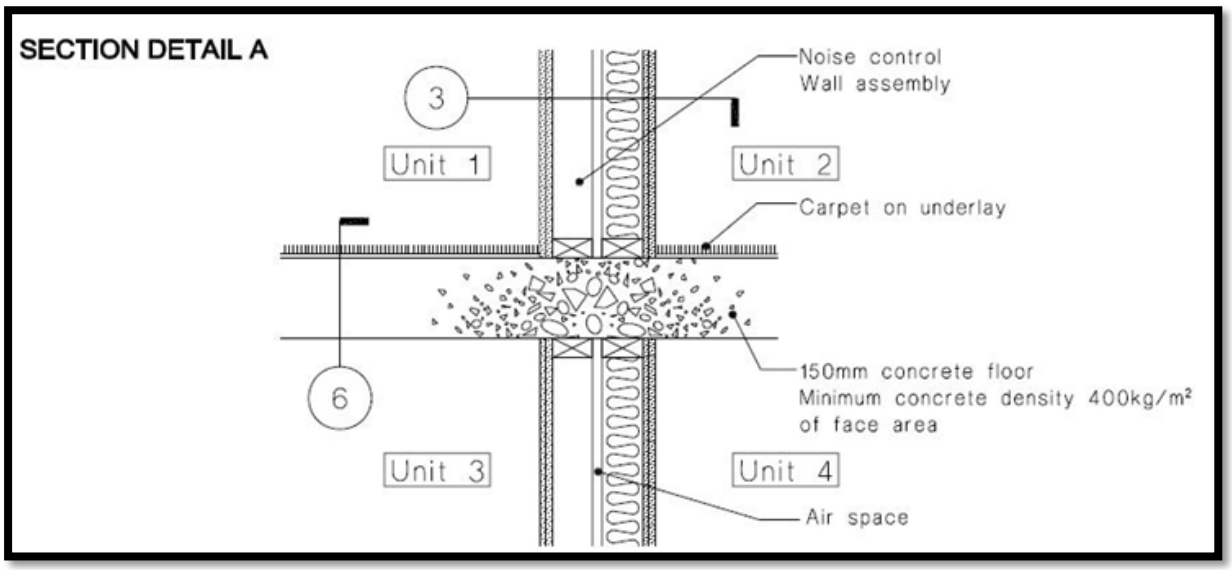


Figure 72. *Sample of vertical and horizontal fire/acoustic separation.*

Figure 73. *Checklist Parent line item 'Mid-floor joist size and spacings as per plan'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 74. *Checklist Child line item*

Joists

The inspector is to ensure the floor joists have not sagged and are of appropriate treatment, particularly if cantilevered outside the building. Floor joists must have a minimum landing of 32mm and be laid in straight lines, with any joints in floor joists must be made over a support.

- where the span is >2.5m and the depth of the floor joist is >200mm, solid blocking is required at mid-span (blocking must be same size as the joist), alternatively herringbone strutting maybe used

If a joist is joined by lapping, the lap must be 150mm (300mm total) beyond the centreline of the support, e.g. wall. If the joint is butted and flitched, the flitch plate must be the same dimension as the joist. Note that only every third joist needs to be flitched, unless the sheet flooring extends minimum 600mm past the joint, then no flitching is required.

Floors joists landing onto a wall containing a wall bracing element, require solid nogs at 1.8m centres within 300mm of the wall, for lateral support.

Although the moisture content of timber is not checked until pre-line building it is important to realise that timber will shrink quite a bit when wet. A wet 200mm joist will shrink up to 8mm as it dries to equilibrium and is likely to sag, particularly where spans are long. If the joist is spanning 3.0m or more meters and exceeds 20% moisture content it must be propped to prevent deflection.
If the wall above is load bearing and runs in the same direction as the line of joists below, the wall must be supported by double joists.

Hole and notch position without proprietary support differs for different joist types: e.g. holes to I-beams are further away from the joist support compared to standard timber joists which must be close to their support.

For standard timber joists holes must be drilled within the middle third of the joist, where the hole can be 1/5 the depth or 32mm whichever is less, e.g.

- 150mm x 50 (1/5 of depth of joist = 30mm)
- 200mm x 50 (1/5 of depth of joist = 40mm however 32mm maximum allowed)

The hole should be located not more than three x the depth of the joist, from the face of a support. For example: If joist is 150mm and the hole is 32mm, then the hole must be located 96mm (3 x 32mm) from the face of a support, e.g. wall. Alternatively, a proprietary product such as Thru-Joist maybe used (refer subfloor section for details of this).

Notches are permitted in the bottom section of a joist and comprise the same dimensions as holes. Notches must be located within 450mm from the face of a support, e.g. wall.

It is important for the inspector to check the manufacturer specifications for any holes to I-beam joists, and LVL joists, as each brand and type have different values.

The inspector shall check all joist centres, layout, sizes, spans, cantilevers, are as per plan. Solid block nogging, holes and notches also need to be inspected.

Holes to I-beam joists

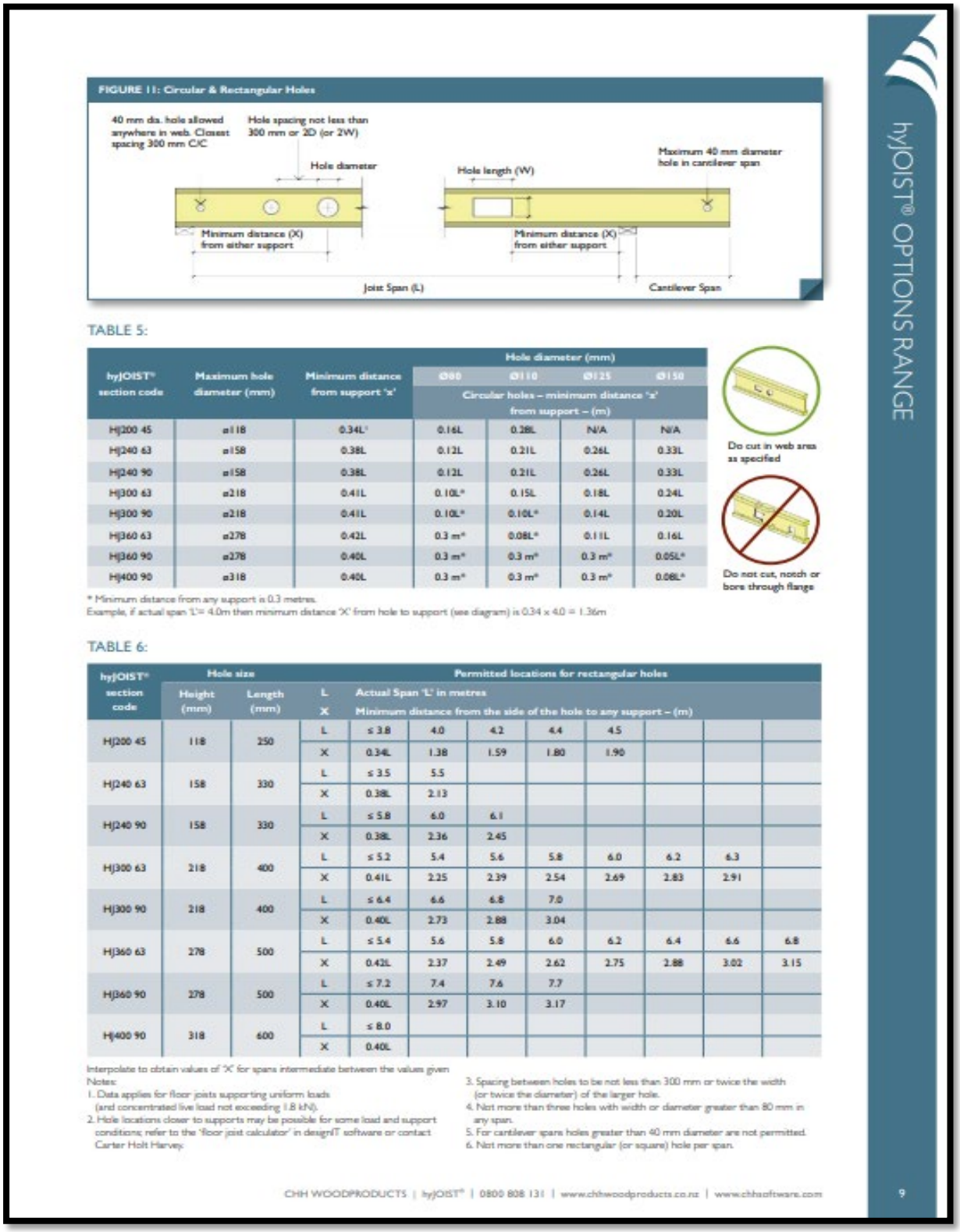


FIGURE 11: Circular & Rectangular Holes

TABLE 5:

hyJOIST® section code	Maximum hole diameter (mm)	Minimum distance from support 'x'	Hole diameter (mm) Ø80	Ø110	Ø125	Ø150
			Circular holes – minimum distance 'x' from support – (m)			
HJ200 45	ø118	0.34L*	0.16L	0.28L	N/A	N/A
HJ240 63	ø158	0.38L	0.12L	0.21L	0.26L	0.33L
HJ240 90	ø158	0.38L	0.12L	0.21L	0.26L	0.33L
HJ300 63	ø218	0.41L	0.10L*	0.15L	0.18L	0.24L
HJ300 90	ø218	0.41L	0.10L*	0.10L*	0.14L	0.20L
HJ360 63	ø278	0.42L	0.3 m*	0.08L*	0.11L	0.16L
HJ360 90	ø278	0.40L	0.3 m*	0.3 m*	0.3 m*	0.05L*
HJ400 90	ø318	0.40L	0.3 m*	0.3 m*	0.3 m*	0.08L*

Do cut in web area as specified

Do not cut, notch or bore through flange

* Minimum distance from any support is 0.3 metres.
Example, if actual span 'L'= 4.0m then minimum distance 'X' from hole to support (see diagram) is 0.34 x 4.0 = 1.36m

TABLE 6:

hyJOIST® section code	Hole size Height (mm)	Length (mm)		Permitted locations for rectangular holes Actual Span 'L' in metres							
			X	Minimum distance from the side of the hole to any support – (m)							
HJ200 45	118	250	L	≤ 3.8	4.0	4.2	4.4	4.5			
			X	0.34L	1.38	1.59	1.80	1.90			
HJ240 63	158	330	L	≤ 3.5	5.5						
			X	0.38L	2.13						
HJ240 90	158	330	L	≤ 5.8	6.0	6.1					
			X	0.38L	2.36	2.45					
HJ300 63	218	400	L	≤ 5.2	5.4	5.6	5.8	6.0	6.2	6.3	
			X	0.41L	2.25	2.39	2.54	2.69	2.83	2.91	
HJ300 90	218	400	L	≤ 6.4	6.6	6.8	7.0				
			X	0.40L	2.73	2.88	3.04				
HJ360 63	278	500	L	≤ 5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8
			X	0.42L	2.37	2.49	2.62	2.75	2.88	3.02	3.15
HJ360 90	278	500	L	≤ 7.2	7.4	7.6	7.7				
			X	0.40L	2.97	3.10	3.17				
HJ400 90	318	600	L	≤ 8.0							
			X	0.40L							

Interpolate to obtain values of 'X' for spans intermediate between the values given

Notes:
1. Data applies for floor joists supporting uniform loads (and concentrated live load not exceeding 1.8 kN).
2. Hole locations closer to supports may be possible for some load and support conditions; refer to the 'floor joist calculator' in designIT software or contact Carter Holt Harvey.
3. Spacing between holes to be not less than 300 mm or twice the width (or twice the diameter) of the larger hole.
4. Not more than three holes with width or diameter greater than 80 mm in any span.
5. For cantilever spans holes greater than 40 mm diameter are not permitted.
6. Not more than one rectangular (or square) hole per span.

CHH WOODPRODUCTS | hyJOIST® | 0800 808 131 | www.chhwoodproducts.co.nz | www.chhsoftware.com

hyJOIST® OPTIONS RANGE

9

Table 8. *Table for hole positions for 'hyJOIST" sourced form 'CHH hyJOIST" specifications*

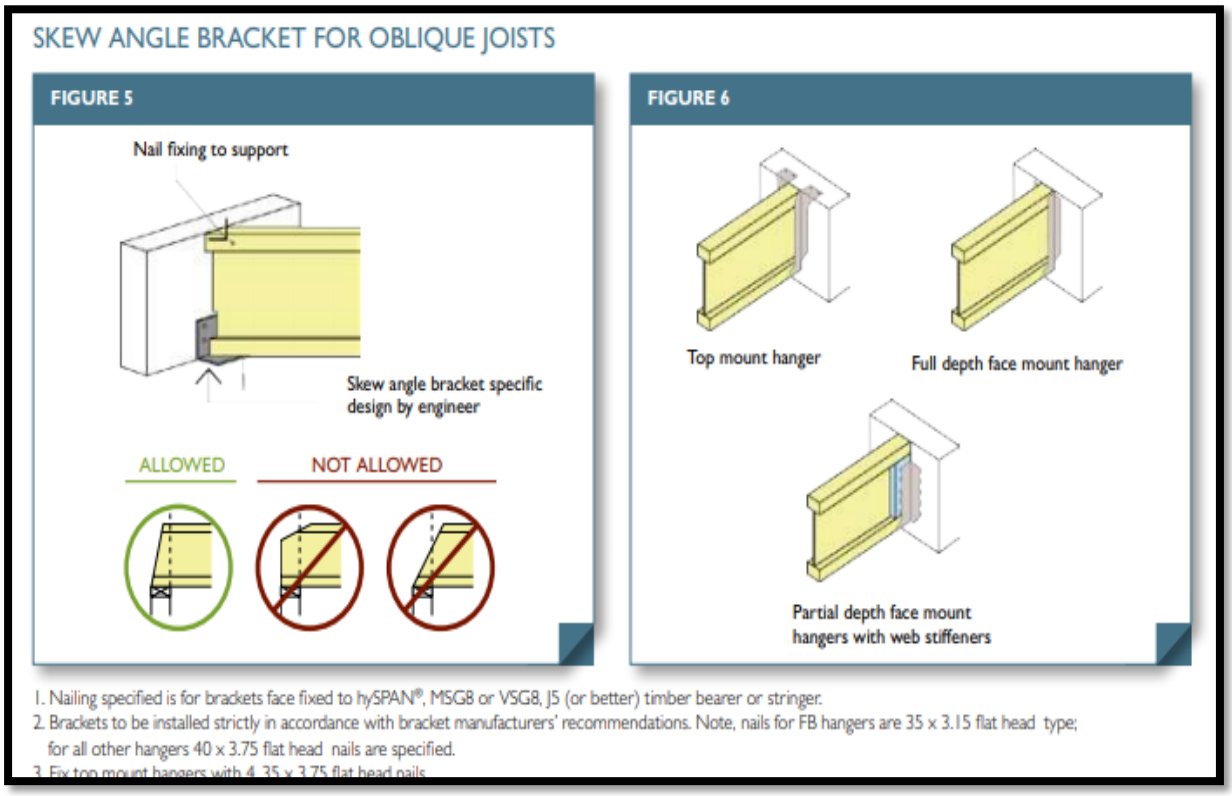


Figure 75. *'hyJOIST' fixing details sourced form 'CHH hyJOIST' specifications*

Holes to LVL joists

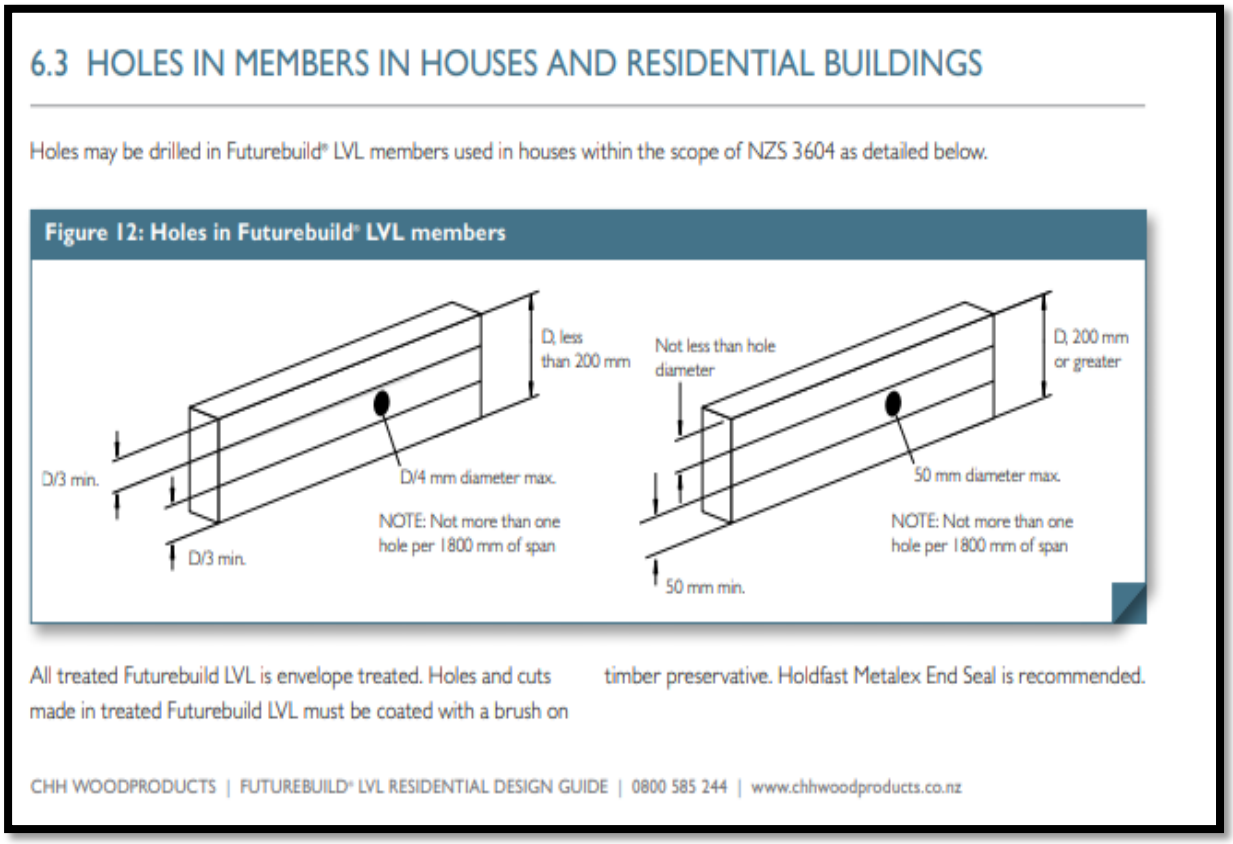


Figure 76. *'hySPAN' fixing details sourced form 'CHH hySPAN' specifications*

Floor joist stiffeners

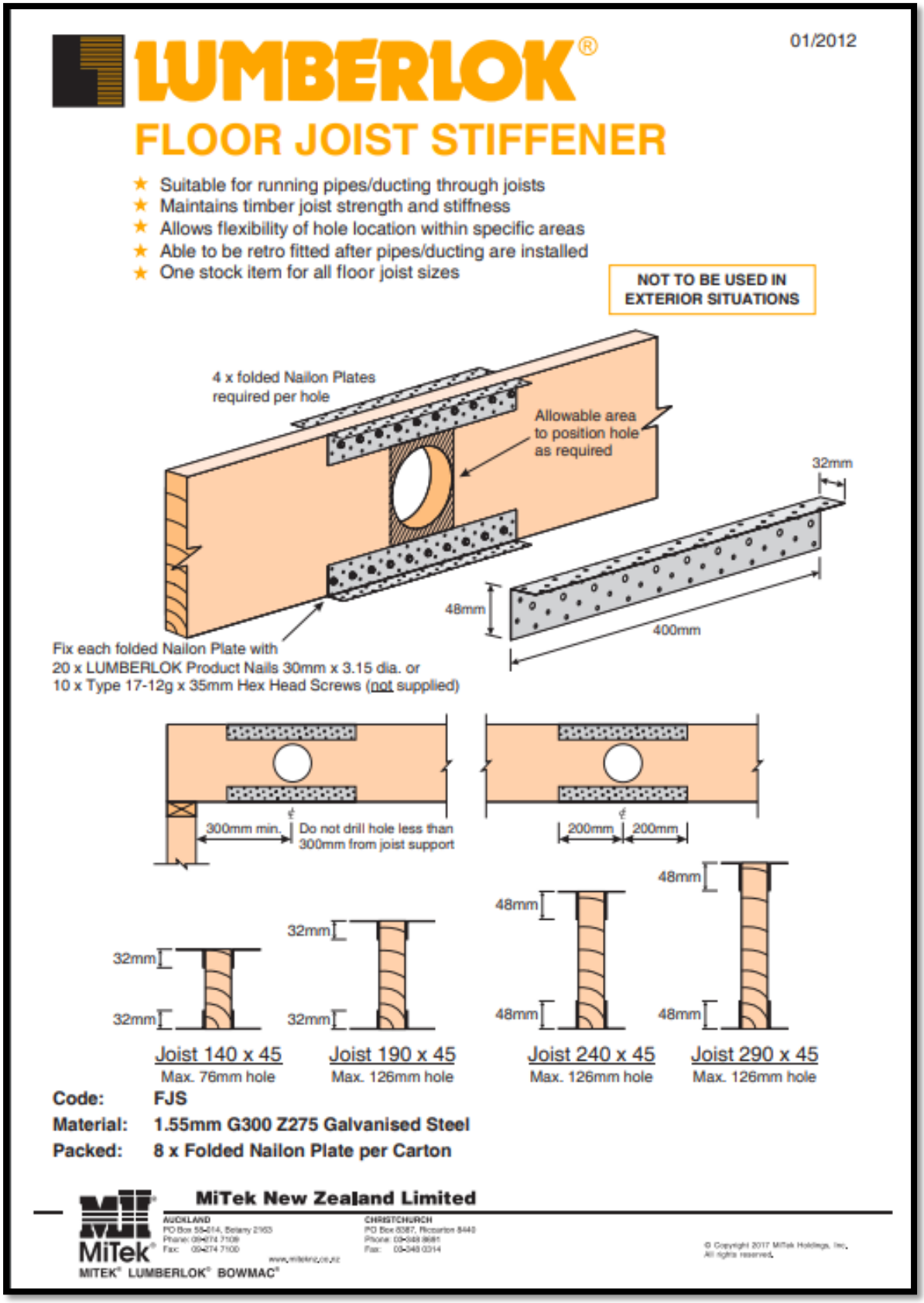


Figure 77. *Sample of 'Lumberlok' joist stiffener from 'MiTek' specifications*

Product Update

pryda

February 2011

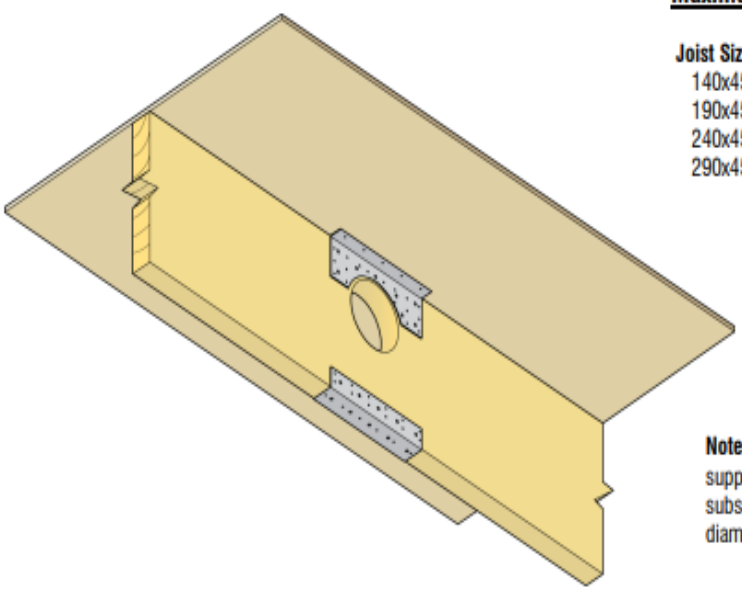
Pryda Stren-Joist

The Pryda Stren-Joist has been designed to allow holes to be cut in floor joists to enable pipes, wiring or other services to be passed through the joist. The fitting of a Pryda Stren-Joist re-instates the integrity of the penetrated joist.

Advantages:

- Quick and easy to install
- Fixing option of either nailing or screwing. Note—Fixing to the flooring must be done with screws provided. All other holes can use either nails or screws
- Can be retro-fitted. There is no requirement to remove services to fit the Stren-Joist
- Comes in one size, designed to fit 140—290mm joists
- Allows an easy solution to fix penetrations in floor joists made by other trades
- Timber grade can be MSG8 or better
- The edge of the penetration shall be at least the joist depth from the end of the joist
- All components are available in a single kit - **Pryda Code NPSJ**

Each kit contains: 1 x 'U' channel, 2 x arched angles, 1 x 500gm of Pryda Product Nails and 10 /8g x 20mm screws. (If the hex screw fixing option is used then 30 /12g x 35mm hex head type #17 galvanised screws are required. Not supplied)



Maximum Joist Penetration (mm)

Joist Size	Max Hole size
140x45	72
190x45	122
240x45	125
290x45	125

Note: Pryda Product nails (30x3.15mm) supplied with the kit are not to be substituted with nails of a lesser diameter such as standard clouts.

Figure 78. *Sample of 'Pryda Stren-Joist' joist stiffener from 'Pryda' specifications*

Figure 79. *Sample of 'Thru-joist' stiffener from 'BRACE iT Ltd' specifications*

Cantilevered joists

Inspectors shall check

- the maximum height of a wall supported by a cantilevered joist is 2.4m (unless specifically designed)
- joints in floor joists may only be made over a support but not where a joist is cantilevered beyond the support

Note. under no circumstances are holes or notches permitted in the part of the joist that is cantilevered.

For slatted open decking, cantilevered joists must be installed with saddle flashings to protect against moisture penetration.

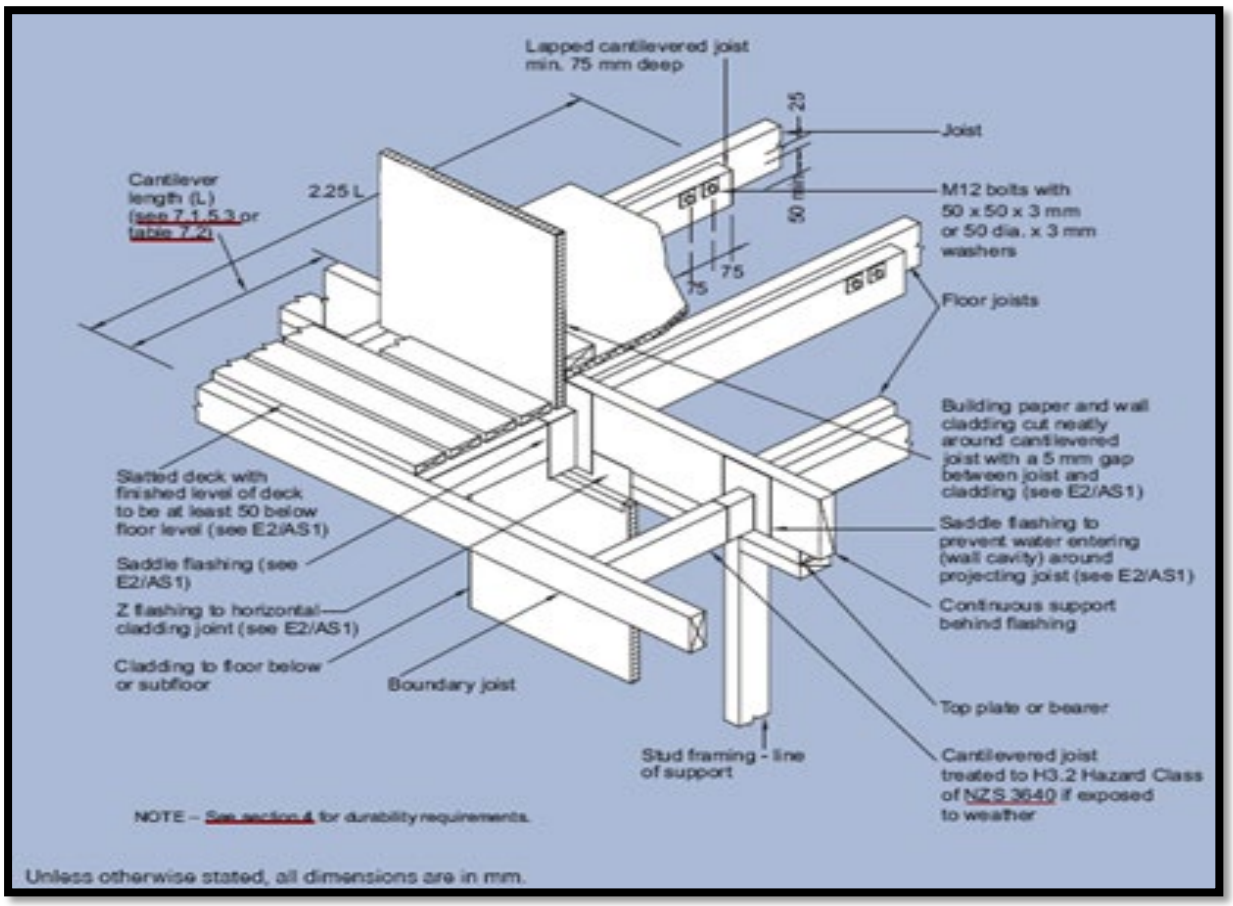


Figure 80. *NZS3604:2011 detail for lapped cantilevered joist installation*

Joist treatment

Figure 81. *Checklist Parent line item 'Mid-floor joists treatment and grade'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

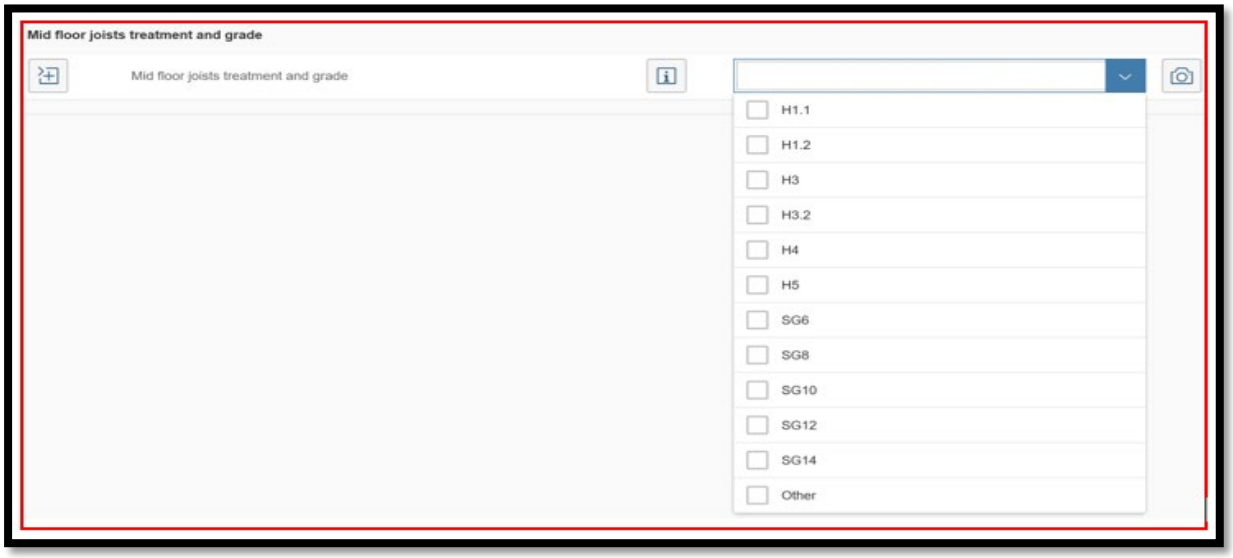


Figure 82. *Checklist Child line item: treatment and grade to be ticked by the inspector*

Written confirmation must be provided by the timber merchant confirming the grade and treatment level for all timber used and confirming compliance with NZS3602. Because it can be difficult to identify timber treatment level, Auckland Council requires that the applicant confirm the timber type and treatment levels at the time of the framing inspection. A certificate must be provided by the pre-cut supplier identifying type and location of timber supplied.

Refer to the '**Timber treatment'** section previously covered in this module.

Flooring

Figure 83. *Checklist Parent line item 'Mid-floor: flooring as per plan.'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 84. *Checklist line item 'Mid-floor: flooring as per plan'*

Figure 85. *Checklist Child line item*

Floorboards must be laid in straight lines at right angles to the joists. Floorboards must be directly fixed to each joist and have their nails punched to allow for sanding and filling.

Sheet flooring shall wherever possible be laid in complete sheets. Any joints shall be made over supports and fixed along each edge and every intermediate framing member. Nailing should be located not less than 10mm from edge of the sheet.

Diaphragms

A floor diaphragm has no effect on wall bracing. It does however allow bracing lines to be extended below the floor level. The maximum length of a floor diaphragm is 15m; the length however must not exceed 2.5 x the width for single storey buildings or 2 x the width for 2-storey buildings.

The entire perimeter of the diaphragm must be nailed at 150mm centres and 200mm centres over intermediate supports. Full sheets must be used wherever possible. Refer to flooring manufacturer's specifications.

It is good practice to record that the fixings on a floor diaphragm have been checked.

Wet areas

When carrying out the pre-line inspection it is important to thoroughly check wet areas. The fundamental requirement of E3 Internal Moisture, New Zealand Building Code is that the surface (walls, floors and ceilings) are impervious and do not allow the passage of moisture.

Always ask what lining material and finishes are going to be put into wet areas. Particleboard flooring for example is not suitable in water splash areas. H3.1 plywood or compressed fibre cement sheeting should be used as this is more suitable for the environment.

If the walls behind showers and baths are to be tiled, studs should be at 400mm centres to provide a more rigid and stable substrate for the lining material. The internal corner must also be reinforced with a metal angle.

Note that under no circumstances should bracing be installed behind baths or showers. Membranes must be installed before fitting baths and showers.

Tell the builder **now** if a membrane inspection is required and inquire what product is being used.

Membrane substrate

Figure 86. *Checklist line item 'Mid-floor: substrate fixings/nogs/slope'*

Ply substrate for membranes to bathrooms require joist spacings at 400mm centres, and support nogs at 400mm centres (dependent on membrane manufacturer specifications). All ply joints must be over solid timber. Fixings to be stainless screw to achieve a 50-year durability.

Particle board flooring (Strand board, Kopine floor, Pyne floor) substrate for membranes to bathrooms require joists at 400mm centres but do not require support nogs. The difference between particle board and ply being the deflection between the joists (framing that deflects when walked over is not rigid enough).

Mid-floor Insulation

Figure 87. *Checklist line item 'Mid-floor: Insulation-installation/type'*

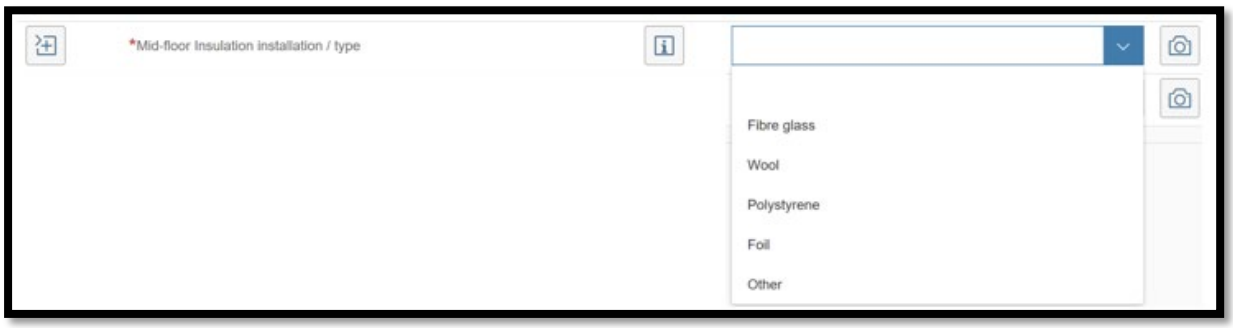


Figure 88. *Checklist line item 'Mid-floor: Insulation-installation/type'*

Insulation is an important part of creating a dry and healthy home. Failure to install insulation correctly can cause problems with heat loss and energy efficiency. The goal of insulation is to slow down heat transfer.

The best insulation material can be ineffective if installed poorly. How well insulation is fitted is important, because heat can escape through small gaps or by thermal bridging. Thermal bridging occurs, when a material with lower thermal resistance allows the heat to by-pass the insulation. One example is stud framing, which has a lower thermal resistance than insulation. Heat passes through the framing at a faster rate than it does through the insulation in the spaces between.

Insulation works by trapping air in cavities. The smaller the cavities of trapped air, the better the insulation material will work. We can insulate our homes by providing cavities of still air, such as in wall insulation or double-glazing. This reduces heat transfer because air is a poor conductor of heat.

Insulation is designed in varying sizes, which enables it to be friction fitted between joists, trusses or wall studs. Insulation should always be cut slightly oversize to ensure a friction fit but not too large causing it to bulge.

The 'R value' measures how good the insulation material is at containing heat. The higher the R-value, the better the insulation value will be. The insulation needs to be properly installed to reach the R value. The inspector is to ensure the insulation is

- friction fitted
- clear of electrical cables where polystyrene used
- labelling is fitted
- same product used as specified or minor variation completed

Stairwell construction

Figure 89. *Checklist line item 'Mid-floor: stairwell construction'*

Stairwells may or may not be installed at this inspection. Check to ensure there is sufficient headroom (2.0m) along the stair pitch line.

Landings are required at the top and bottom of every flight of stairs except where there is a fall of less than 600mm in which case a landing can be omitted. If a landing is provided the minimum length is 900mm.

Stair	Maximum pitch	Maximum riser height	Minimum tread width
Service or minor private	47	220	220
Secondary private	41	200	250
Common and main private	37	190	280
Accessible	32	180	310

Riser height and tread depth for all steps in one flight and must be uniform although a tolerance of ± 5 mm is permitted. Studs along the back of the stairwell must be continuous; also, if stairs are installed consider whether sheet linings can be installed effectively, particularly if the sheet behind is to be braced.

If the walls of the stairwell are to be framed and lined on both sides, check to ensure provision has been made for support blocks to secure the handrail.

Roof/Ceiling

Figure 90. *Checklist line item 'Roof framing type'*

Roof framing – trussed roof

A roof truss layout must be provided at the time of the framing inspection in order that truss types and fixings can be confirmed. When checking the design certificate, which should be provided with the truss layout, check and confirm the wind zone is appropriate for the site, as well as truss top and bottom chord restraint spacings (purlins and ceiling battens).

It is a condition of consent that the truss layout is provided at the framing inspection, failure to provide this information must result in a failed inspection.

Unless the manufacturer specifies otherwise, trusses require a minimum of 2 nails and 2 wire dogs per truss to plate connection. Check that the trusses are at the specified centres and that there are no cuts, notches or holes drilled in them. Builders often cut the top chord to accommodate valleys. If a truss has been cut or damaged in any manner an engineer must verify in writing that the integrity of the truss has not been affected.

The position of truncated and double girders should be checked to ensure that the point load is occurring in the position identified during processing. If the position has altered (even if it is only 100mm), an engineer's check is required to confirm that the lintel can carry the load. Whilst this might seem pedantic, the point where the load occurs can have a significant impact on the ability of the lintel to carry the load.

The closer the load is to the edge or support of the lintel, the better it is. All loads must be directly supported, whether this is via nogs over a lintel or a stud in framing. In 2-storey situations follow the load down through the building to ensure it is adequately supported.

All trusses, supporting ceiling lining must be housed in either joist hangers or supported by multi-grips, it is a common misconception that half truss do not require support. Always check the truss layout and verify connections have been installed as required by the truss supplier.

The inspector will check wind zone and ensure that purlins or tile battens have been secured against uplift. High and very high wind zones require additional fixings for purlins to trusses.

Roof framing – pitched roof

A roof framing plan should be included in the plans, the inspector will check rafter sizes and centres, ridge beams and point loads. Ridge beams will generally need strapping and nailing, and the load must be transferred to the foundations.

All rafters shall have a minimum 32mm bearing on the wall top plate whilst maintaining 80% of the actual depth of the rafter, not less than minimum 65mm

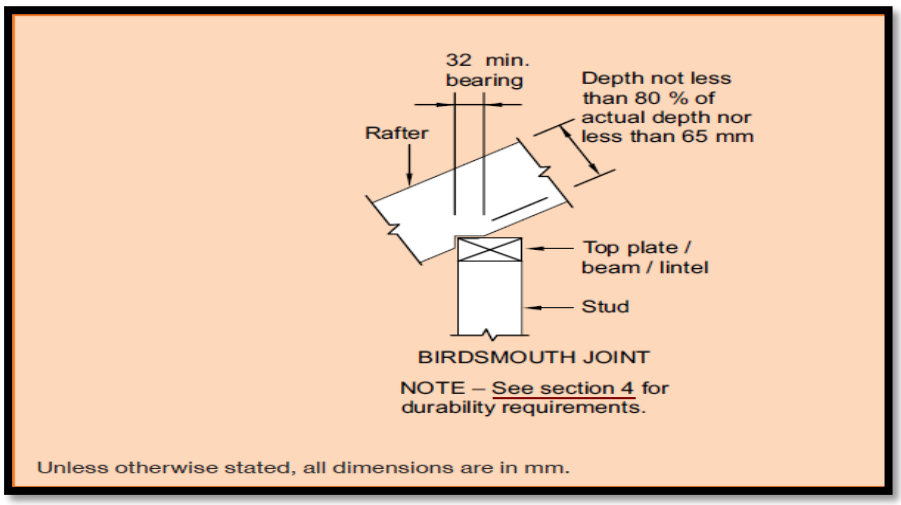


Figure 91. *NZS3604:2011 detail for seating of rafters.*

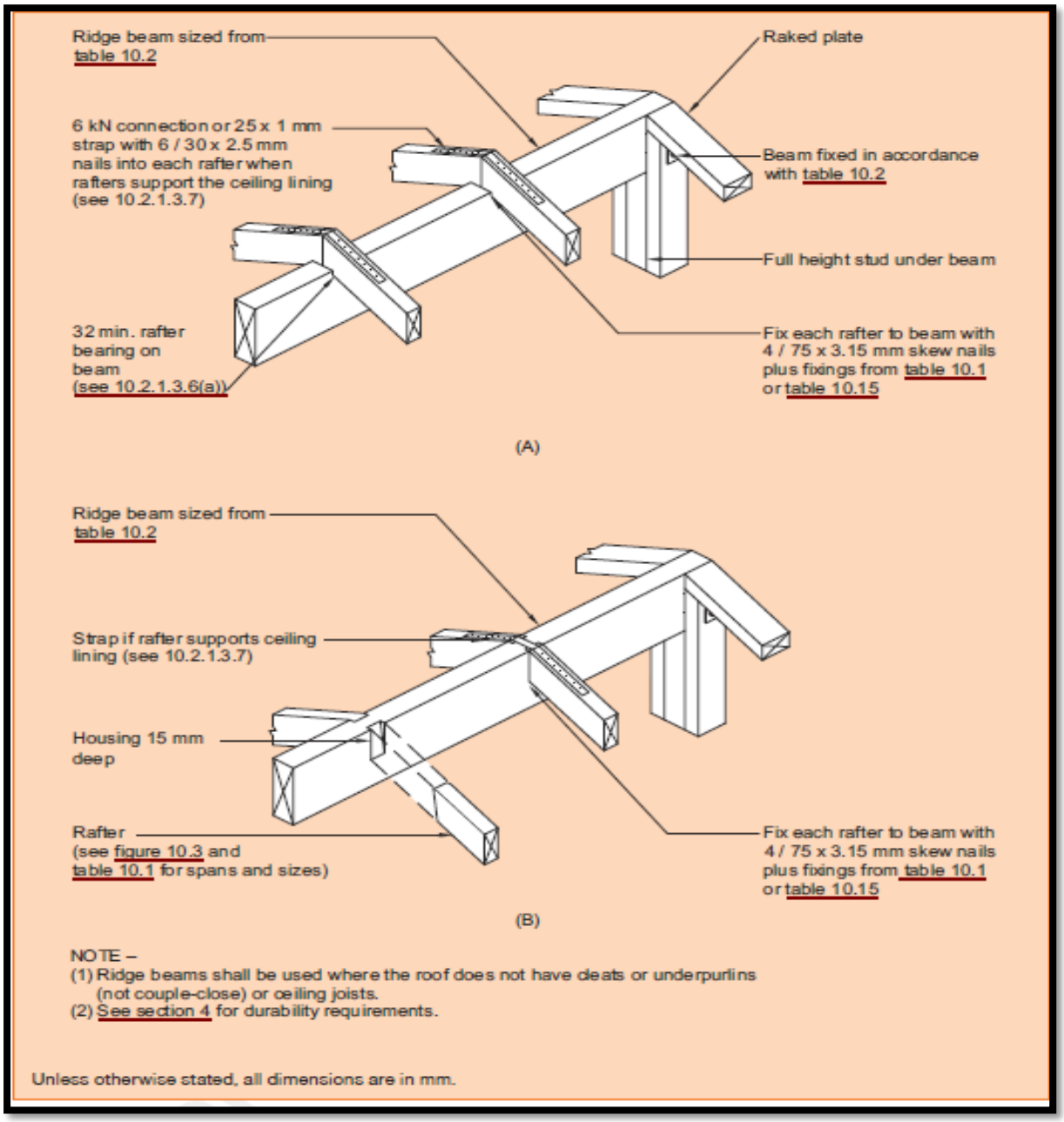


Figure 92. *NZS3604:2011 detail for ridge beam connections for rafters.*

Ridge beams may be used to support the upper ends of paired rafters whose lower ends are not tied with ceiling joists or other framing. Collar ties do not provide this tie. The ridge beam shall be secured to the wall with a fixing as specified in NZS3604:2011 table 10.2. The built-up studs under the beam shall have point load fixings down to the foundations.

Ridge boards in couple-close roofs shall be a minimum of 19mm thick and provide full bearing for the whole depth of the rafters.

Collar ties and cleats in couple close roofs steeper than 10° to the horizontal, pairs of rafters shall be connected as follows:

- Where underpurlins are used: collar ties (140mm x 19mm or 90mm x 45mm timber) at 1.8m centres or every third pair of rafters, whichever is the closer, fixed to the sides of the rafters immediately above each underpurlin.
- Where underpurlins are not used; cleats (90mm x 19mm timber) at 1.8m centres or every third pair of rafters, whichever is the closer, fixed to the sides of the rafters immediately below the ridge board.

Underpurlins are a horizontal timber member laid underneath rafters, supporting the rafters at intermediate points along their length.

Underpurlin struts are used to transfer load from an underpurlin to a loadbearing wall or strutting beam. Underpurlin struts and beams shall be as per approved plan and in accordance with NZS3604:2011 section 10. Underpurlin struts shall land directly over:

- a stud, or the top plate doubled between the studs on each side of the underpurlin strut,
- a lintel or strutting beam
- a 90mm x 45mm timber plate laid on it's flat on top of the ceiling joists within 300mm of a loadbearing wall. The plate shall be fixed to at least 2 joists each side of the underpurlin strut.

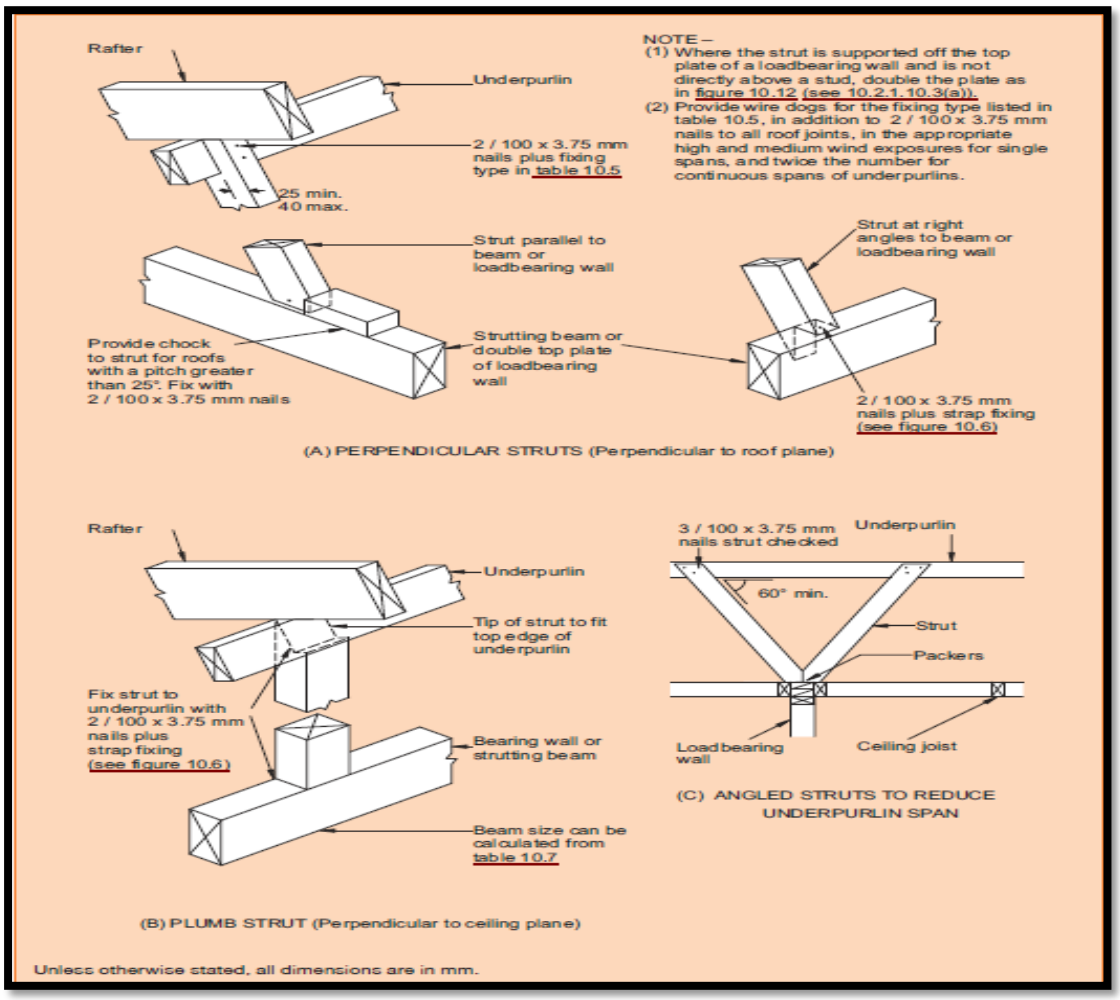


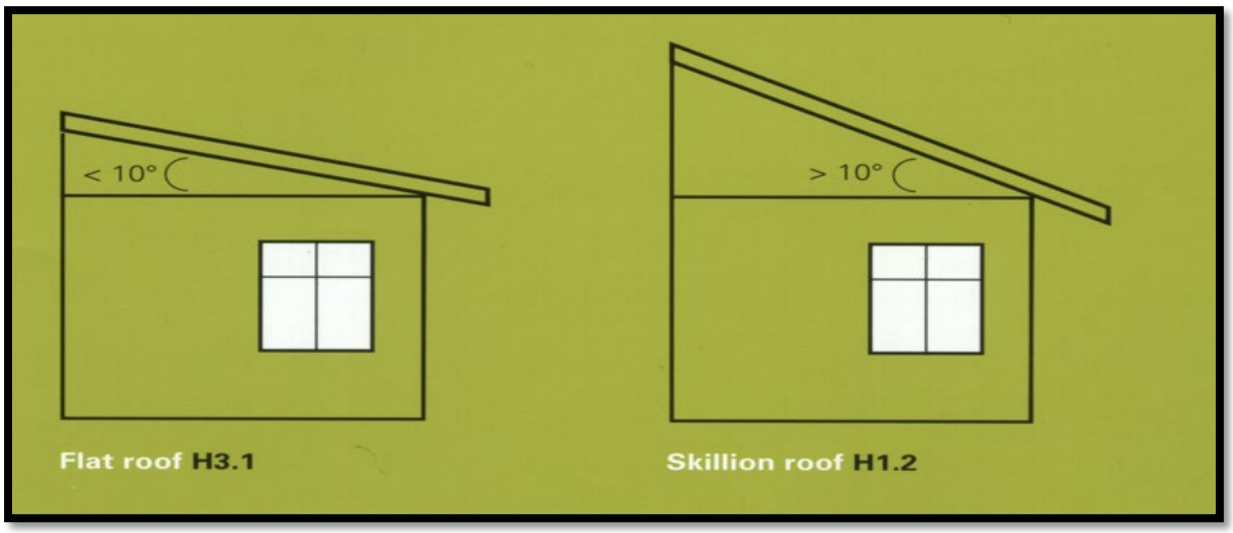
Figure 93. *NZS3604:2011 detail for underpurlin struts.*

Skillion roofing

A skillion roof is a pitched roof where the ceiling lining is parallel and close to the roof cladding. The roof may consist of more than one roof plane. The rafters may or may not be exposed below the ceiling.

Beneath a skillion or low slope roof, it is important to allow for lofting of the insulation after installation. To ensure that the minimum cavity height of at least 25mm is retained between the top of the insulation and the underside of the roof (and underlay) the insulation must be physically restrained.

The difference between a skillion and flat roof is a skillion roof is greater than 10^0 to the horizontal whereas a flat roof is less than 10^0 to the horizontal.



Parapet roof

A parapet is a wall-like structure at the edge of a roof. It can be a safety feature in that it is designed to stop falls from the edge of the roof, but it can also be a defensive, constructional or stylistic feature. Parapets can be used to give a roof the appearance of a flat roof.

Figure 94. *Sample of detail for a parapet roof*

Parapets require a drained cavity for claddings except for vertical corrugated steel.
Parapet roofs will require multiple inspections.

1st inspection/framing

Before the waterproof membrane is in place, the membrane substrate moisture content 18% maximum.

- substrate is suitable, dry and primed if required
- substrate is screwed with appropriate fixings
- fillets are fitted on all internal corners
- provision for stormwater (waste and overflow)
- minimum clearances achieved between abutting claddings
- flashings and penetrations catered for
- slope formed on horizontal surfaces – parapets 5°

- 2 degrees minimum fall across roof
- roof ventilation required if >40m^2 (specific design)

2nd inspection/membrane tanking
Roof gutter outlet and secondary overflows required, installed after membrane fitted

- no claddings in place, up-stand to be checked
- protection of membrane provided for balance of construction

Applicator must provide workmanship certificates and written confirmation of the type of system used.

Under no circumstances should water spill over the edge of a membrane roof. Roofs should be formed so that a plinth, parapet or upstand contains the water within the body of the roof which in turn directs water to the drainage outlet.

Roof framing

Figure 95. *Checklist Parent line item 'Roof framing as per plan-pitch, overhang and truss/rafter sizes & spacings'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

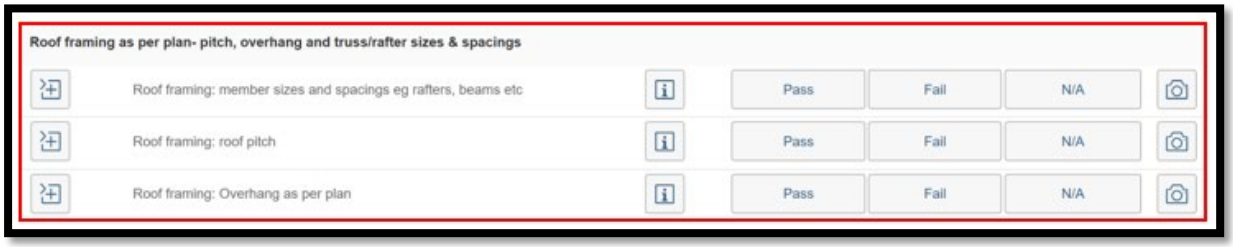


Figure 96. *Checklist Child line items*

The inspector will check the roof layout for beam position and connections, rafter/truss sizes and spacings, roof pitch, and roof overhang.

All roof framing members require minimum 4.7kn fixings, which increases dependent on roof type, loading, and wind zone.

All truss roofs must have a manufacturer's design statement, which will identify the bottom and top chord restraint spacings. It will also show if there is bracing to a gable end and if there is a requirement for a strongback.

Any stringers used to support roof framing, must be coach screwed to the studs and not reliant on just nails, as this does not provide enough axial loading resistance.

Roof overhang

Purlins provided they have a back span of at least 3 rafters, can extend as cantilevers beyond their support for a distance not exceeding:

Laid on their flat:

- Light and heavy roofs at no more than 900mm spacing
- 70mmx45mm purlins: 300mm
- 90mmx45mm purlins: 400mm

Laid on their edge: as per NZS3604:2011 table 10.9 below

Outrigger size and orientation (mm)	Maximum outrigger spacing for a maximum cantilever of: (mm)		Boundary / Fly rafter size (mm)
	600	750	
70 x 45	900	600	70 x 45 (on edge)
90 x 45	1200	900	90 x 45 (on edge)
45 x 90	600	400	90 x 45 (on edge)
NOTE – All joints fixed using a minimum of 2 / 90 x 3.15 mm nails.			

Table 9. *NZS3604:2011 table 10.9*

Purlins

Figure 97. *Checklist line item 'Roof framing: purlin/batten sizes, centres and fixings'*

The inspector is to check the wind zone and ensure that purlins or tile battens have been secured against uplift. High and very high wind zones require additional fixings for purlins to trusses.

Table 10.11 – Purlins on their edge in all wind zones – SG 8 (see 10.2.1.16.1)

Purlin size (depth x thickness)	Purlin spacing (mm)							
	600		900		1200		1800	
	Span	Fixing	Span	Fixing	Span	Fixing	Span	Fixing
(mm x mm)	(m)	(type)	(m)	(type)	(m)	(type)	(m)	(type)
140 x 45	2.6	E	2.2	E	2.0	F	1.7	E
190 x 45	3.5	E	3.1	F	2.8	F	2.4	F
240 x 45	4.4	F	3.9	F	3.5	F	3.0	SED
290 x 45	5.4	E	4.7	F	4.1	SED	3.4	SED

Fixing type	Description	Alternative fixing capacity (kN)
E	2 / 90 x 3.15 skew nails + 2 wire dogs	4.7
F	2 / 90 x 3.15 skew nails + strap fixing (see figure 10.6)	7.0

NOTE – All fixing types are determined as required for the higher uplift loads at the periphery of the roof (based on local pressure factors in AS/NZS 1170.2).

Table 10. *NZS3604:2011 table for purlin fixings*

Purlins laid on edge shall be laterally supported by solid blocking a minimum 2/3 the depth of the purlin.

Table 10.10 – Purlins on their flat in all wind zones – SG 8 (see 10.2.1.16.1)

Purlin size	Max. span	Maximum spacing and fixing in the following wind zones									
		Low		Medium		High		Very high		Extra high	
		Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing
	(mm)	(mm)	(type)	(mm)	(type)	(mm)	(type)	(mm)	(type)	(mm)	(type)
70 x 45	900	900	S	900	T	900	T	900	T	900	U
70 x 45	900	1200	T	1200	T	1200	T	1050	U	900	U
70 x 45	900	1800	T	1800	U	1400	U	1050	U	900	U
70 x 45	1200	1200	T	1150	T	800	T	600	T	500	T
70 x 45	1200	1300	T	1150	T	800	T	600	T	500	T
90 x 45	1200	1700	T	1450	U	1000	U	750	U	650	U

Fixing type	Description	Alternative fixing capacity (kN)
S	2 / 90 x 3.15 gun nails	0.8
T	1 / 10g self-drilling screw, 80 mm long	2.4
U	1 / 14g self-drilling type 17 screw, 100 mm long	5.5

NOTE – All fixing types are determined as required for the higher uplift loads at the periphery of the roof (based on local pressure factors in AS/NZS 1170.2).

Table 11. *NZS3604:2011 table for purlin fixings*

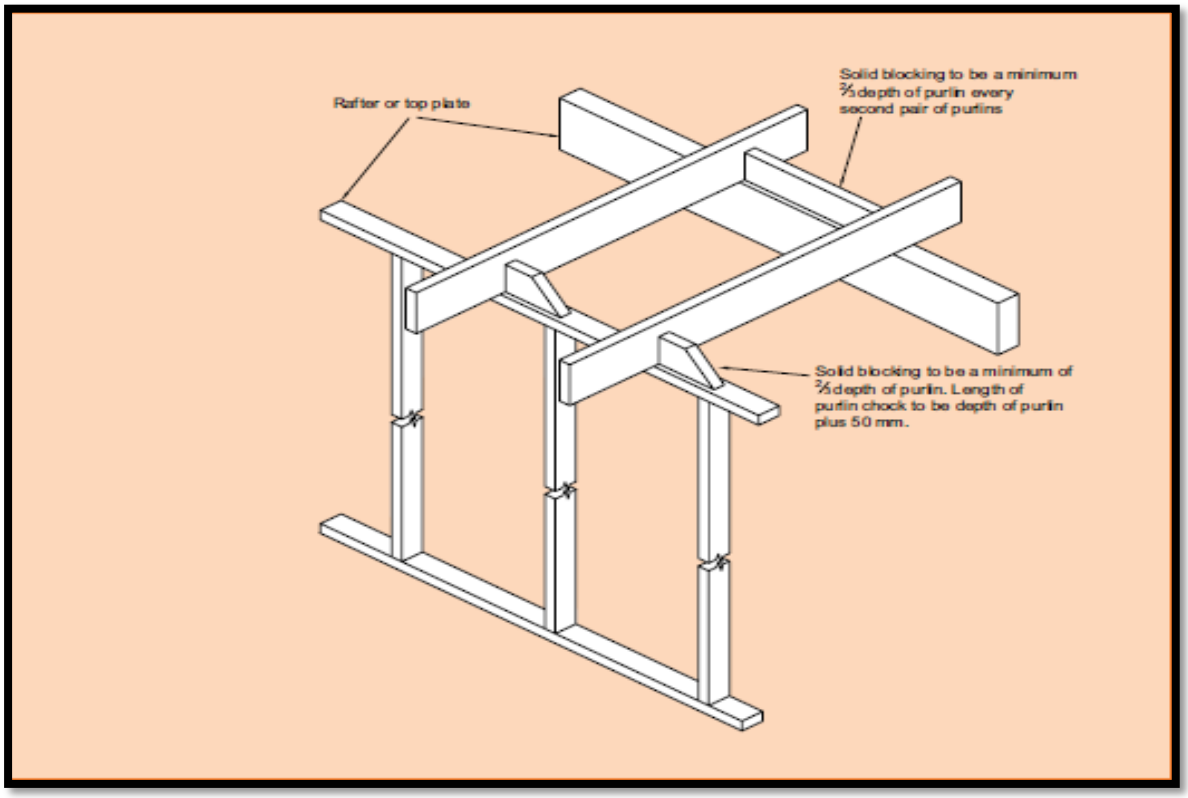


Figure 98. *NZS3604:2011 solid blocking for purlins*

Battens

Tile battens shall be selected to be free from visual defects, or alternatively be able to resist a load of 100kg gradually applied at mid-span without failure.

Tile batten size	Max. span	Maximum spacing and fixing in the following wind zones									
		Low		Medium		High		Very high		Extra high	
		Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing	Spacing	Fixing
(mm)		(mm)		(mm)		(mm)		(mm)		(mm)	
Light roof cladding											
50 x 40	900	370	R	370	R	370	S	370	S	370	T
50 x 50	1200	370	R	370	S	370	T	370	T	370	T
Heavy roof cladding											
50 x 25	480	370	R	370	R	370	R	370	R	370	R
50 x 40	600	370	R	370	R	370	R	370	R	370	R
50 x 50	900	370	R	370	R	370	R	370	R	370	R

Fixing type	Description	Alternative fixing capacity (kN)
R	1 / 90 x 3.15 gun nail	0.55
S	2 / 90 x 3.15 gun nails	0.8
T	1 / 10g self-drilling screw, 80 mm long	2.4

Table 12. *NZS3604:2011 tables for batten fixings*

Roof bracing

Figure 99. *Checklist Parent line item 'Roof framing; bracing as per plan'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 100. *Checklist Child line items*

Roofs are subject to both vertical and horizontal loads. Roof framing and trusses resist vertical loads whilst horizontal loads are resisted by bracing. Timber or metal straps are used for this purpose although sheet material may also be used

Figure 101. *Sample of metal strap roof plane bracing sans tensioners*

Roof plane bracing

- 100mm x 25mm timber members – these members should be continuous wherever possible but if joined the lap should extend one full truss width or rafter spacing or
- flat strap bracing should be fixed in pairs and fitted with tensioners. Check fixings at ends to ensure it meets the correct 4.0 kN rating.
- run at 45^0 to ridge

Roof plane braces can be omitted where ceiling is sarked or forms a structural ceiling diaphragm. Sarking must cover the entire surface in order to omit bracing requirements.

Roof space bracing

Roof space braces should be evenly distributed over the length of the roof and run in opposite directions, no steeper than 45^0 to the horizontal.

- 90 x 45 continuous length up to 2m long, then 2x 90mm x 45mm lengths fixed together with blocks at 1m centres for braces over 2m long.
- the top end must be fixed to the ridge board or blocking between top chords or rafters with (3) 100mm x 3.75mm nails to each side

- the bottom end must be fixed within 300mm of a braced wall onto angled blocking fitted between rafters with 4x 75mm x 3.15mm nails, or alternatively over a ceiling diaphragm.

Figure 102. *Sample of a roof space brace*

Roof membrane substrate and gutter

Figure 103. *Checklist Parent line item 'Roof framing: Gutter construction as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 104. *Checklist Child line items*

Figure 105. *Checklist line item 'Record gradient (in degrees)'*

Membrane roofs must have a fall of no less than 2 degrees. The substrate must be flush with no rough edges. If the substrate is timber it should have a moisture content of 20% or less and if concrete 75% or less. This will ensure good adhesion and prevent problems as a result of any trapped moisture. If there is excessive moisture in the substrate bubbles may occur in the surface due to inadequate bonding.

The substrate must be fit for purpose and screw fixed with appropriate fixings. The membrane must be fully supported with H3.2 ply on framing timber at 400mm centres each way and provided with a fillet to relieve stress on all internal corners such as the junction between the floor and any walls. Ply shall be fixed with 10g x 50mm stainless steel countersunk head screws 150mm centres to sheet edges and 200mm centres for the rest of the ply. There shall be a 3mm gap between all sheets.

One of the biggest problems with membrane roofs is the lack of care taken by other contractors on the job who tend to drop their tools and materials on the membrane once it is completed. The membrane should be protected during construction with a sheet of ply or similar to prevent any damage.
Internal gutters require a minimum fall of 1:100 and outlets at not more than 12m centres. The minimum size of a gutter is 300mm wide x 70mm deep.

All gutters must be fitted with at least 1x 75mm outlet and an overflow, or an extra outlet with both outlets sized to take the full required capacity. Outlets must be protected from infiltration of debris by fitting a grate over the top of them. Overflows must be installed at least 50mm below flood level and located in a visible position to warn of potential problems.

If the discharge point is through a parapet or balustrade then the scupper must be 200mm wide and 75mm high and formed with a lip to shed water away from the cladding.

All internal junctions must be supported using a 45^0 – timber fillet to relieve stress to the membrane and be extended a minimum of 150mm up the face of the wall.

Where the roof is > than $40m^2$ ventilation will be required to prevent heat build-up in the void below.

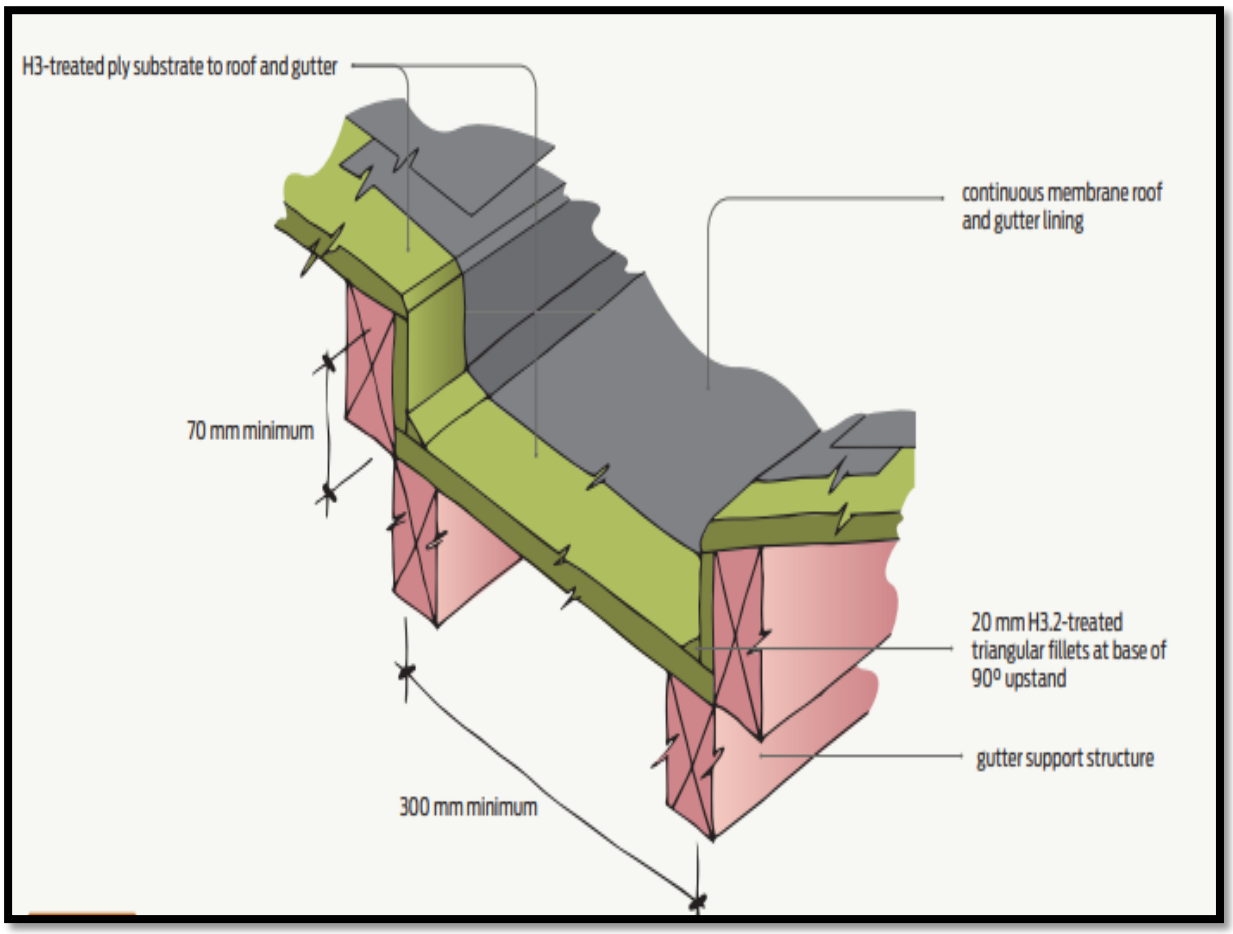


Figure 106. *Sample of membrane gutter, sourced from BRANZ Build 143*

Roof framing treatment

Figure 107. *Checklist Parent line item 'Roof framing treatment and grade as per plan'.* ***Note:*** *When completing this parent line item, consideration must be given to cover all relevant child line items.*

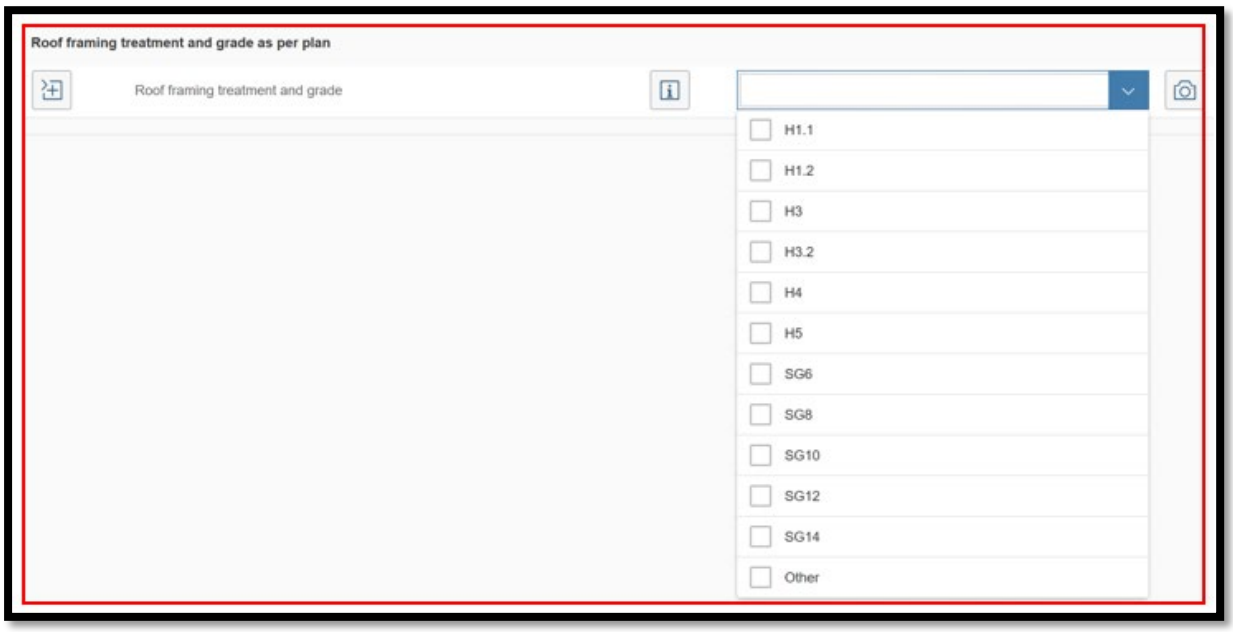


Figure 108. *Checklist Child line item*

Truss plan and timber treatment certificates are required.
Written confirmation must be provided by the timber merchant confirming the grade and treatment level for all timber used and confirming compliance with NZS3602.

Ceiling diaphragm

If a ceiling diaphragm is to be installed, the inspector shall check and make sure, any openings (such as manholes) are located within the middle third of the space.

Diaphragms should be square or rectangular in shape and the length must not exceed twice the width. Openings are only permitted within the middle third of the diaphragm and fixed to opening trimmers at 150mm centres.

Full width sheets must be used wherever possible; if a sheet needs to be cut it must not be less than 900mm wide and 1.8m long. Minimum sheet size of 600mm x 1800mm provided all adjacent sheets are back blocked. Sheets on the edge of the diaphragm must be nailed at 150mm centres with fixings 12mm from the edge of the sheet. The screw spacing changes to 100mm centres where the ceiling pitch is greater than 15° and no longer than 12m, or not steeper than 45° and no longer than 7.5m.

If the ceiling is installed on steel battens with a clip system, then a solid timber block must be fixed to the framing member. The inspector shall check sheet the manufacturer specifications for fixing details.

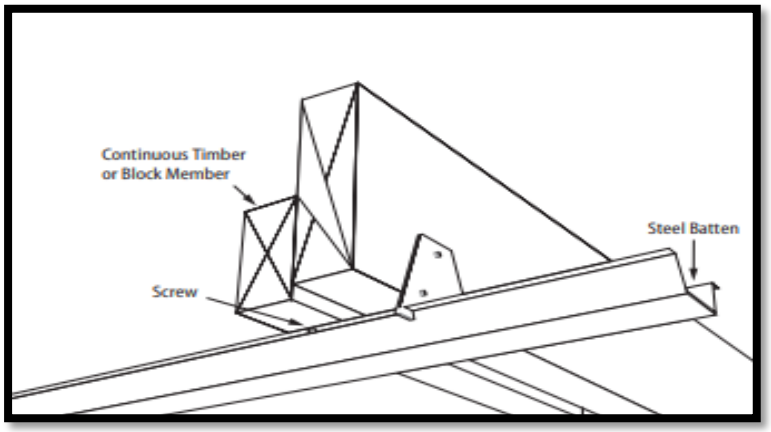


Figure 109. *Sample of timber block requirement when using steel ceiling battens on a ceiling diaphragm.*

Ceiling plane braces/dragon ties

Ceiling plane bracing

- 100 x 50 framing continuous length
- must be connected to upper side of every truss chord or ceiling joist it intersects
- connected at no more than 2.5m centres to wall bracing lines parallel to the ridge line

Ceiling plane braces can be omitted where the top plate is a boundary member of a ceiling diaphragm.

Dragon tie

Dragon ties, minimum size 90mm x 35mm, are fixed at an angle between 40 and 50° to both external walls (each having a minimum bracing capacity of at least 100 bracing units), not more than 2.5m from the corner.

Note that dragon ties do not contribute to roof bracing but are used to extend wall bracing lines from 6.0m to 7.5m

Figure 110. *Sample of dragon tie*

Ceiling battens

Figure 111. *Checklist line item 'Ceiling batten fixings/centres and type'*

Ceiling battens should be installed at right angles to the truss or ceiling joists. Depending on the thickness of the sheet material, they should be fixed at 400mm to 600mm centres.

Timber battens should be double nailed into the bottom chord of the truss or joist.

These days, it is more common to use steel battens for ceiling linings to eliminate movement resulting in peaking and popping of the lining.

Care needs to be taken for steel battens fixed with a clip system for diaphragm ceilings and to the underside of trusses, where timber blocks must be used to fix the steel batten into, preventing lateral movement of the steel battens to the ceiling joists or trusses.

Ceiling access

Figure 112. *Checklist line item 'Ceiling access planned'*

Ceiling access must be provided for each floor level, these are often overlooked in split-levels. Ceiling access allows for visual inspection of the ceiling space and provides a port for access and maintenance. The minimum size of an access port is 600mm x 500mm, with 600mm minimum clearance into the roof space above the opening.

Deck open slatted

Figure 113. *Checklist line item 'Deck-open slatted type'*

Figure 114. *Checklist line item 'Deck location'*

All framing should be H3.2 minimum and all horizontal surfaces (parapet tops, barriers, etc) should be formed with a minimum slope of 5°.

A 12mm airgap must always be maintained between the floor of the deck and any cladding on non-cantilevered decks, this provides for air flow and prevents moisture being trapped in this space.

Always check the finished floor level (on upper floors or roofs). Is the finished floor level appropriate?

- 35mm minimum clearance from the bottom edge of the wall cladding to roof cladding or finished deck level
- cantilevered deck - 50mm from inside floor to the finished deck surface if deck surface is timber-slatted

Can the cladding be fixed without compromising the flashing or finished floor levels?

- minimum up stand of 110mm
- 75mm overlap cover of cladding to flashing up-stand

Deck piles and fixings

Figure 115. *Checklist Parent line item 'Deck piles/fixings as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 116. *Checklist Child line items*

Figure 117. *Checklist Parent line item 'Deck Beams/Bearers/stringers as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

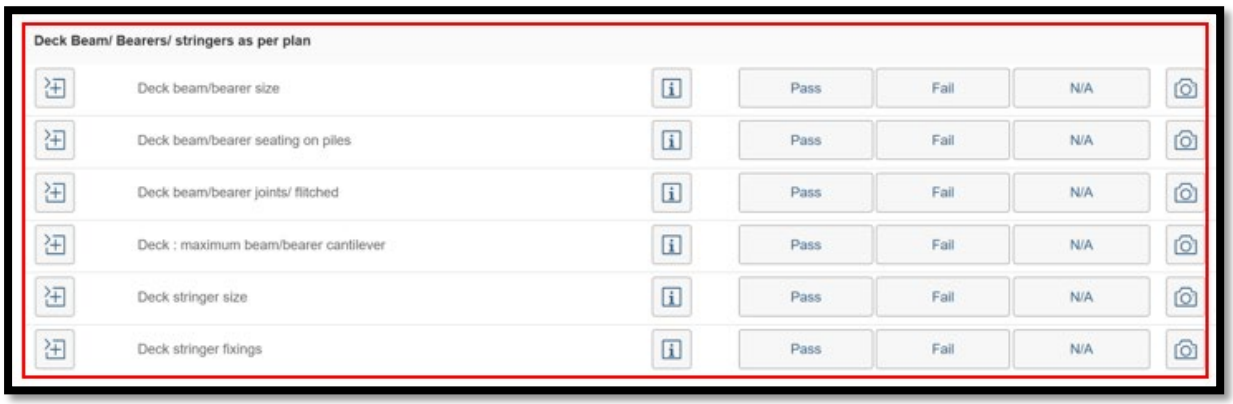


Figure 118. *Checklist Child line items*

Figure 119. *Checklist Parent line item 'Deck joists as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 120. *Checklist Child line items.*

Note. *Cantilevered deck joist floor load is calculated with a 2kPa loading.*

A slatted deck is classed as exposed and therefore all timber treatment shall be H3.2.

When the deck is constructed in a sea spray zone, the framing timber fixings must be stainless steel.

Deck piles, bearers, joists, stringers, and fixings shall be treated the same as for building subfloor. Refer to the 'Subfloor' section at the beginning of this module for all the above line items.

Cladding clearance

Figure 121. *Checklist line item 'Deck- cladding clearance 12mm (slatted decks)'*

A 12mm airgap must always be maintained between the floor of the deck and any cladding on non-cantilevered decks, as this provides for air flow and prevents moisture being trapped in this space.

Deck step down

Figure 122. *Checklist line item 'Deck: minimum 50mm step down at cantilevered deck threshold'*

The inspector shall check the finished floor level (on upper floors or roofs). Is the finished floor level appropriate?

- cantilevered deck - 50mm from inside floor to the finished deck surface if deck surface is timber-slatted

Can the cladding be fixed without compromising the flashing or finished floor levels?

- minimum up stand of 110mm
- 75mm overlap cover of cladding to flashing up-stand

Deck saddle flashings

All cantilevered joists **must** be fitted with saddle flashings where they extend outside the building envelope

- the maximum height of a wall supported by a cantilevered joist is 2.4m (unless it is subject to specific design)
- joints in cantilevered floor joists are not permitted beyond the support

Note. Under no circumstances are holes or notches permitted in the part of the joist that is cantilevered.

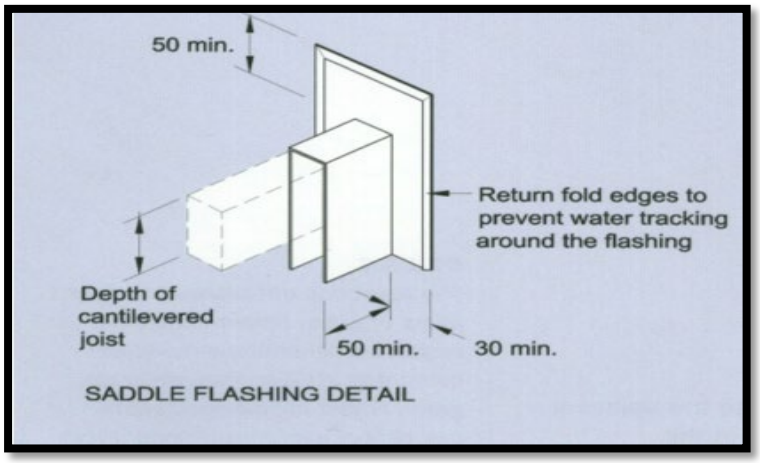


Figure *123.* *Sample of cantilevered deck joist saddle flashing; sourced from E2/AS1*

Deck fixings/connections durability

Figures 124. *Checklist line items 'Deck fixings/connections durability'*

Figure 125. *Checklist Parent line item 'Deck structure timber treatment and grade'.* ***Note:*** *When completing this parent line item, consideration must be given to cover all relevant child line items.*

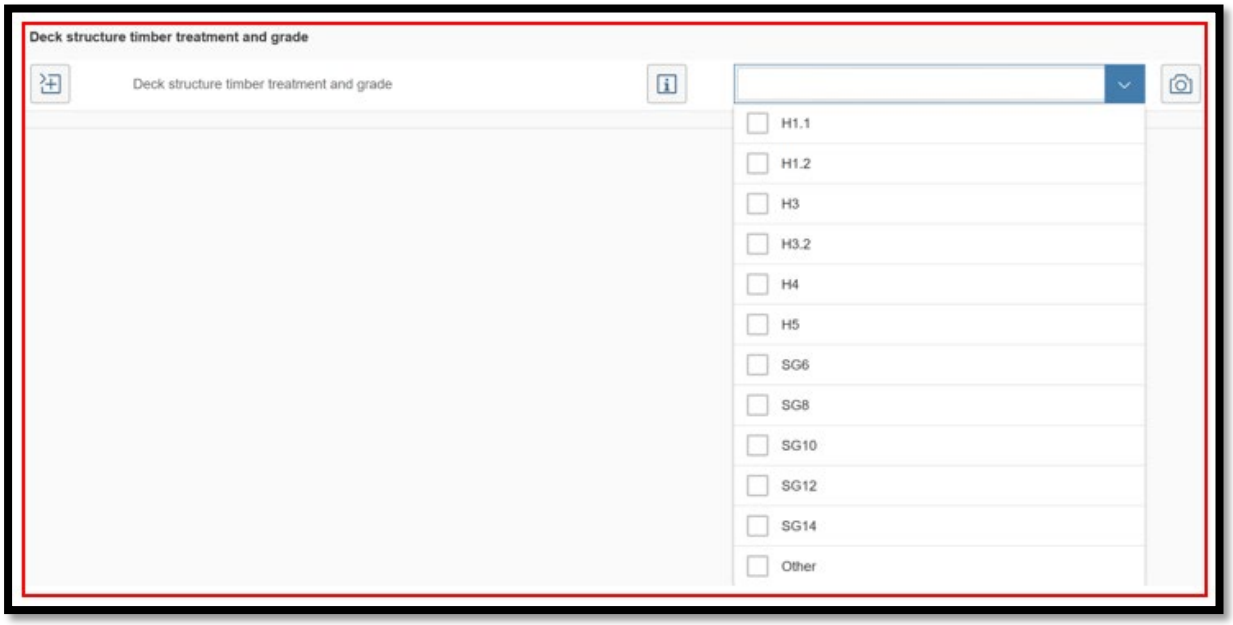


Figure 126. *Checklist Child line item*

An open slatted deck is classed as exposed and therefore all timber shall be minimum treatment H3.2, and fixings shall be stainless steel.

Balcony

Figure 127. *Checklist line item 'Balcony type'.*

Figure 128. *Checklist Parent line item 'Balcony joists as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 129. *Checklist Child line items*

Balconies and parapets are probably one of the most at risk weathertightness features and must be thoroughly inspected. If the barrier or parapet has been formed with a solid barrier the horizontal surface must be fitted with a 15° slope and capped with a metal capping.

Under no circumstances can handrails or balusters be mounted directly on top of the horizontal surface of a barrier or floor as it places too much stress at the point of attachment and will result in damage to the membrane. All such fixings must be on a vertical face. The height of a barrier is measured vertically from finished floor level and must be a minimum of 1000m high.

All gutters must be a minimum of 300mm wide and 70mm deep and fitted with at least 1 outlet and an overflow, or two outlets with both outlets sized to take the full required capacity. Outlets must be protected from infiltration of debris by fitting a grate over the top of them. Overflows must be installed at least 50mm below flood level and located in a visible position to warn of potential problems. Overflows to a rainwater head must be 1.5 times the size of the outlet.

The inspector is to ensure the floor joists are as per plan, correct size, centres and span, and are of appropriate treatment, particularly if cantilevered outside the building.
Floor joists must have a minimum landing of 32mm and be laid in straight lines, with any joints in floor joists must be made over a support.

- where the span is >2.5m and the depth of the floor joist is >200mm, solid blocking is required at mid-span (blocking must be same size as the joist), alternatively herringbone strutting maybe used

All cantilevered joists **must** be fitted with saddle flashings where they extend outside the building envelope

- the maximum height of a wall supported by a cantilevered joist is 2.4m (unless it is subject to specific design)
- joints in cantilevered floor joists are not permitted beyond the support.

Note. Under no circumstances are holes or notches permitted in the part of the joist that is cantilevered.

Balcony threshold

Figure 130. *Checklist line item 'Balcony threshold step down minimum 100mm'*

Figure 131. *Checklist line item 'Balcony deck: cladding clearance from deck level'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Finished floor level must be maintained to prevent flooding and damage to claddings:

- enclosed deck - 100mm step down from **inside floor** to the **finished deck** surface
- 35mm minimum clearance from the bottom edge of the **wall** cladding to finished deck level.

Note. Inspector is to check cladding product specifications for cladding clearances: e.g. ‘Hardies’ products require 50mm clearance, ‘Shadowclad’ requires 100mm cladding clearance.

Balcony membrane substrate

Figure 132. *Checklist line item ‘Balcony membrane substrate fixings/nogs/slope’*

Figure 133. *Checklist line item ‘Balcony: slope of substrate’ use smart level to check gradient and ensure sufficient readings are taken to confirm compliance across the entire area.*

The substrate must be flush with no rough edges. The substrate should have a moisture content of 18% or less. This will ensure good adhesion and prevent problems as a result of any trapped moisture. If there is excessive moisture in the substrate bubbles may occur in the surface due to inadequate bonding.

The substrate must be fit for purpose and screw fixed with appropriate fixings. The membrane must be fully supported with minimum 17mm H3.2 ply and joist framing at 400mm centres in both directions, and fillets to relieve stress on all internal corners such as the junction between the floor and any walls. The upstand must be checked prior to the fixing of claddings. The minimum slope for a butyl or EPDM membrane deck is 1.5°, maximum area 40msq, as per E2/AS1.

One of the biggest problems with membrane decks and roofs is the lack of care taken by contractors on the job who tend to drop their tools and materials on the membrane once it is completed. If damage is sighted, request a flood test to ensure no damage has occurred. The membrane should be protected during construction with a sheet of ply or similar to prevent any damage.

The membrane must extend 150mm up the wall. This will usually require that a double bottom plate (or nogs between studs), is fitted to provide support for this purpose.

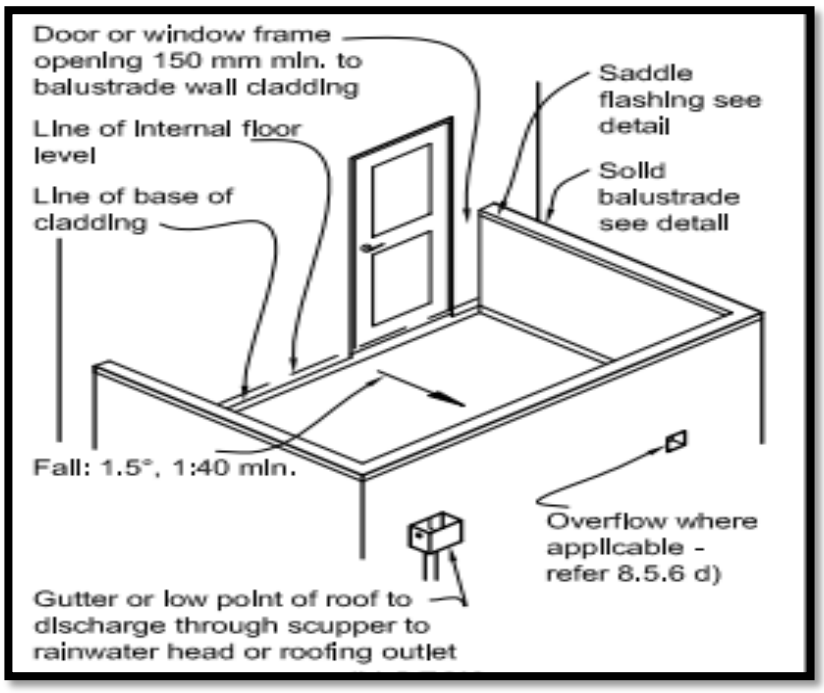


Figure 134. *Membrane deck detail from E2/AS1 fig 56*

Balcony/deck: barrier construction as per plan

Figure 135. *Checklist Parent line item 'Balcony/deck; barrier construction as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 136. *Checklist Child line items*

Enclosed balustrades require a drained cavity for claddings, except for vertical corrugated steel. Top of the barrier must have a minimum 5° slope.

Reports on leaky buildings show these junctions have been prone to leakage and care must be taken to detail and build them correctly.

Junctions of parapets to walls shall be flashed to direct water clear of the outside face of the cladding system, using a saddle flashing.

Deck trimmer joists and barrier supports

Building code B1/AS1has modifications to the Standards, necessary for compliance with the New Zealand Building Code, are given against the relevant clause number of each Standard.

B1/AS1 3.1.2B NZS 3604 Figure 7.10(b)
On the plan view replace the text “2/M12 x 250mm coach screws at 140mm centres” with “2/M12 x 240mm coach screws at 140 centres vertically.”
On the plan view replace “2/M12 at 400 centres” twice with “2 M12 bolts at 140mm centres vertically to capture end joist laminations and blocking, and boundary joist laminations and blocking, at post centrelines.”
Add to Note 3: “All coach screws to have 50mm x 50mm washers.”

B1/AS1 3.1.2C NZS 3604 Figure 7.10(c)
On the plan view insert the text “At each strap location (at joist ends and nogging), 2/M12 x 240mm long coach screws are required.”
On the plan view, replace the text “2/M12 x 250mm coach screws at 140 centres vertically” with “2/M12 x 200mm coach screws at 140mm centres vertically.”
On the section view, replace the text “M12 x 200mm coach screws at 400mm centres vertically” with M12 x 240mm coach screws at 140mm centres vertically.
Delete “2/M12 bolts at 400mm centres” which tie laminations together along edge joists and along boundary joists.

Deck framing shall be as per NZS3604:2011 with the above B1/AS1 modifications. Where the decks support a cantilever, the balustrade itself, must be specifically engineer designed.
Figures 7.10 (a-c) below provide solutions for the support of a cantilevered balustrade depending on how it is fixed. It is important to ensure that durability requirements are met; **Note;** details below do not show the B1/AS1 modifications.

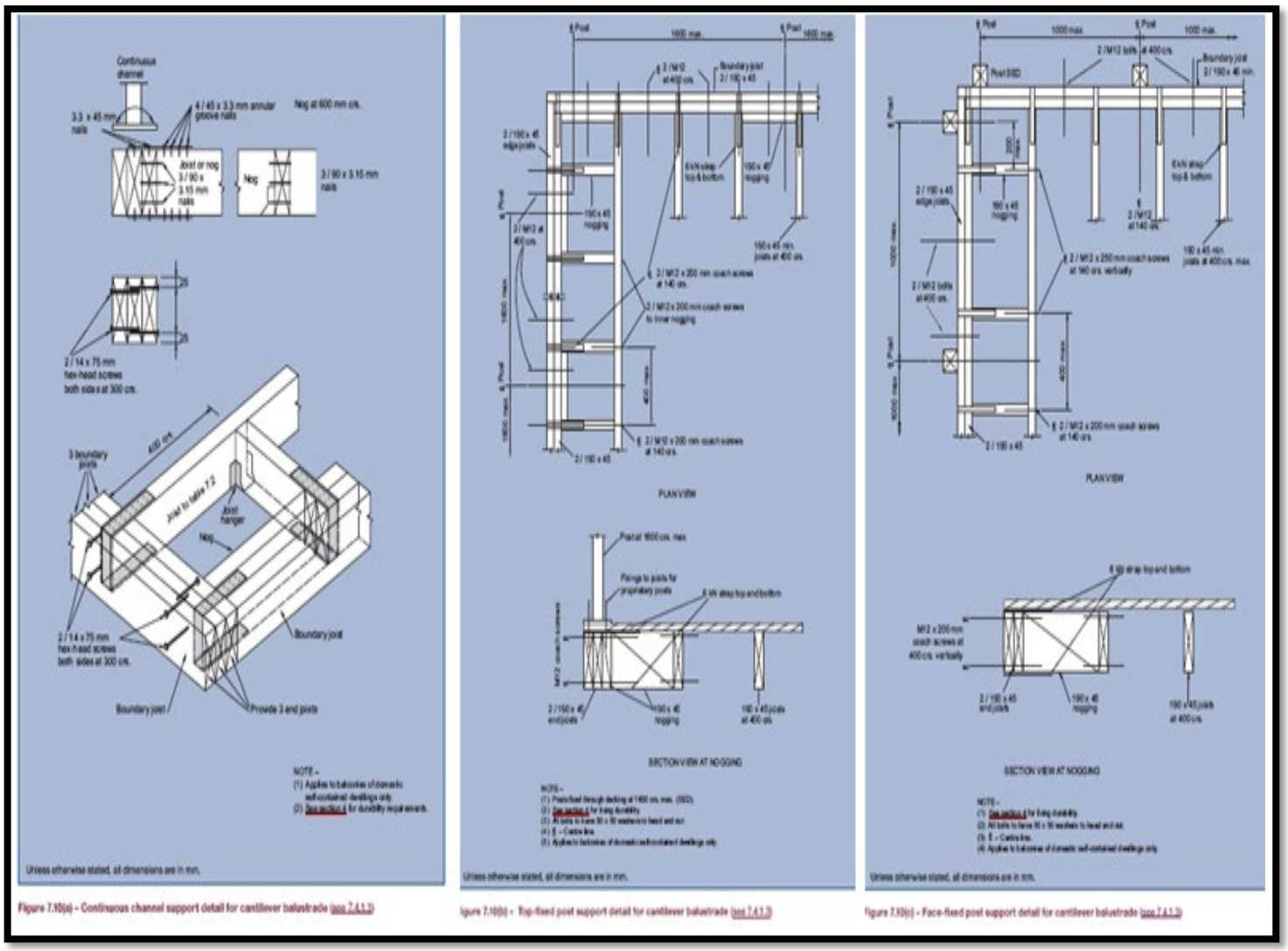


Figure 7.10(a) – Continuous channel support detail for cantilever balustrade (see 7.4.1.3)

Figure 7.10(b) – Top-fixed post support detail for cantilever balustrade (see 7.4.1.3)

Figure 7.10(c) – Face-fixed post support detail for cantilever balustrade (see 7.4.1.3)

Figure 137. *NZS3604:2011 7.10 deck balustrade connections*

Balcony framing treatment and grade

	*Balcony framing treatment and grade- joists, beams, barrier, substrate etc as per plan		Pass	Fail	N/A	

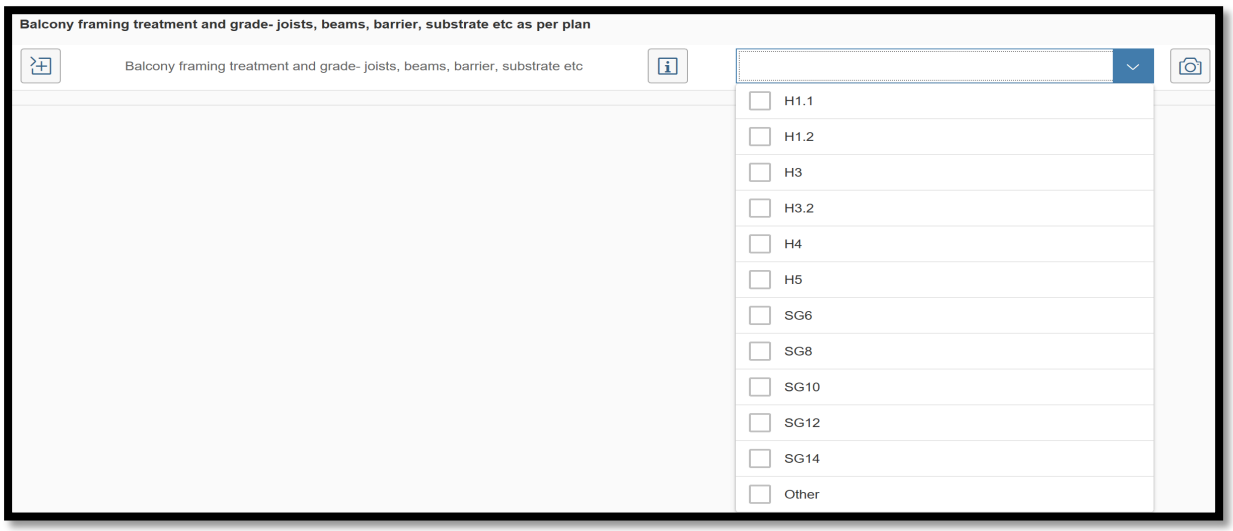


Figure 138. *Checklist line items 'Balcony framing treatment and grade- joists, beams, barrier, substrate etc as per plan'*

An enclosed balcony framing is to have minimum H1.2 timber treatment, although the timber 'metal capping' support is to be 9mm H3 ply. The inspector is to check and record the treatment and grade of the balcony timber framing.

Balcony drainage

Figure 139. *Checklist line item 'Balcony Stormwater outlet/overflow*

Balconies shall have a minimum fall of 1.5° (1:40), a maximum area of 40 m2, no steps in level within deck area except into gutters, no integral roof gardens, and no downpipe direct discharge onto a deck. Internal gutters shall have a minimum fall of 1 in 100.

A membrane upstand against all wall, parapet, or enclosed balustrades shall extend a minimum 150 mm above deck level.

Surface water shall discharge either:

- into a gutter outlet with a minimum diameter of 75 mm with either:
  - an overflow or
  - an extra outlet, with both outlets sized to take the full required capacity. or,
- via a scupper, into a gutter, or rainwater head compliant with E2/AS1 detail below

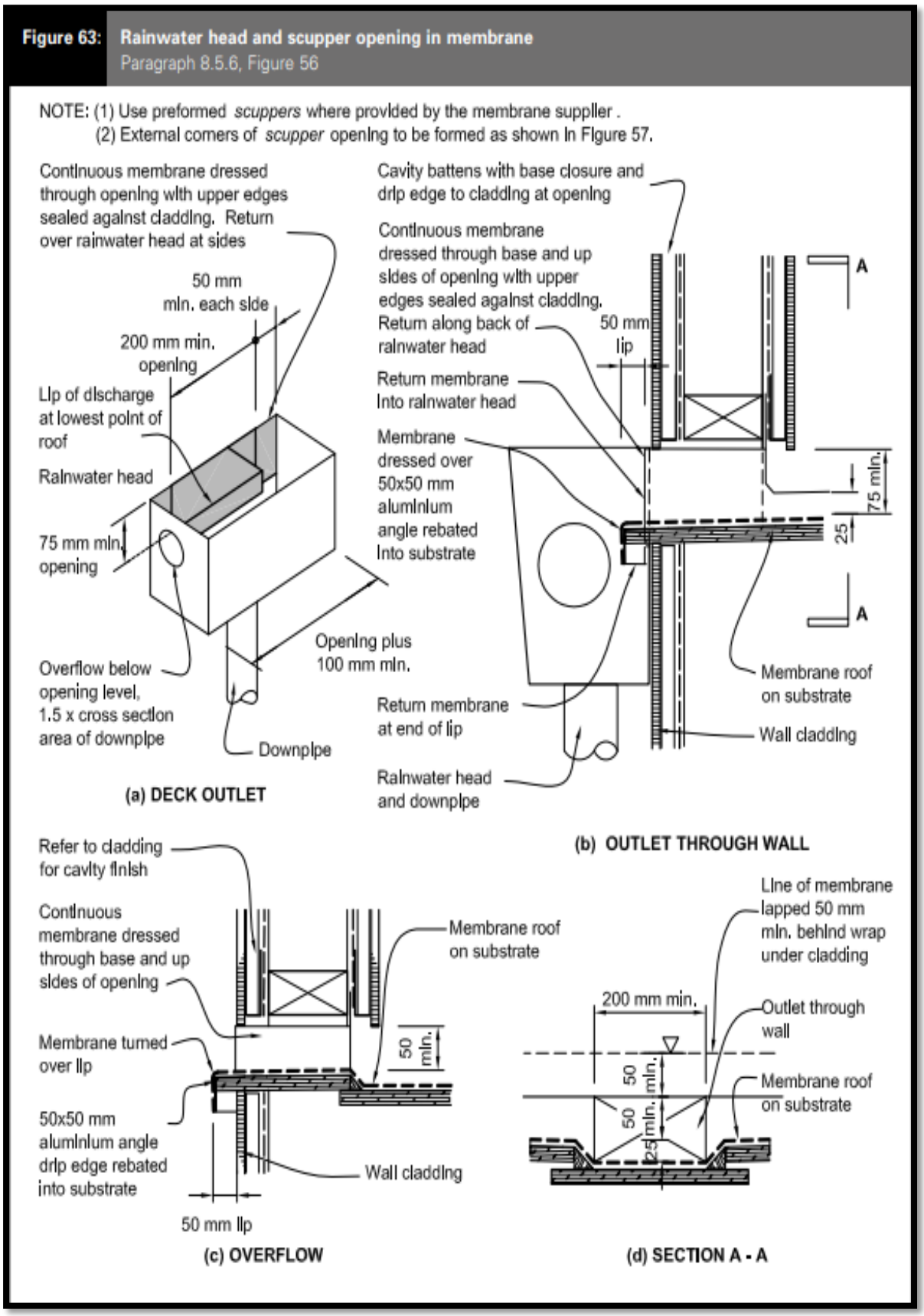


Figure 140. *Detail for rainwater head and scupper detail from E2/AS1*

Deck gutters and internal outlets shall be constructed with a clampable grate as per the below detail. Gutters formed with continuous butyl or EPDM strip shall have no cross-joints.

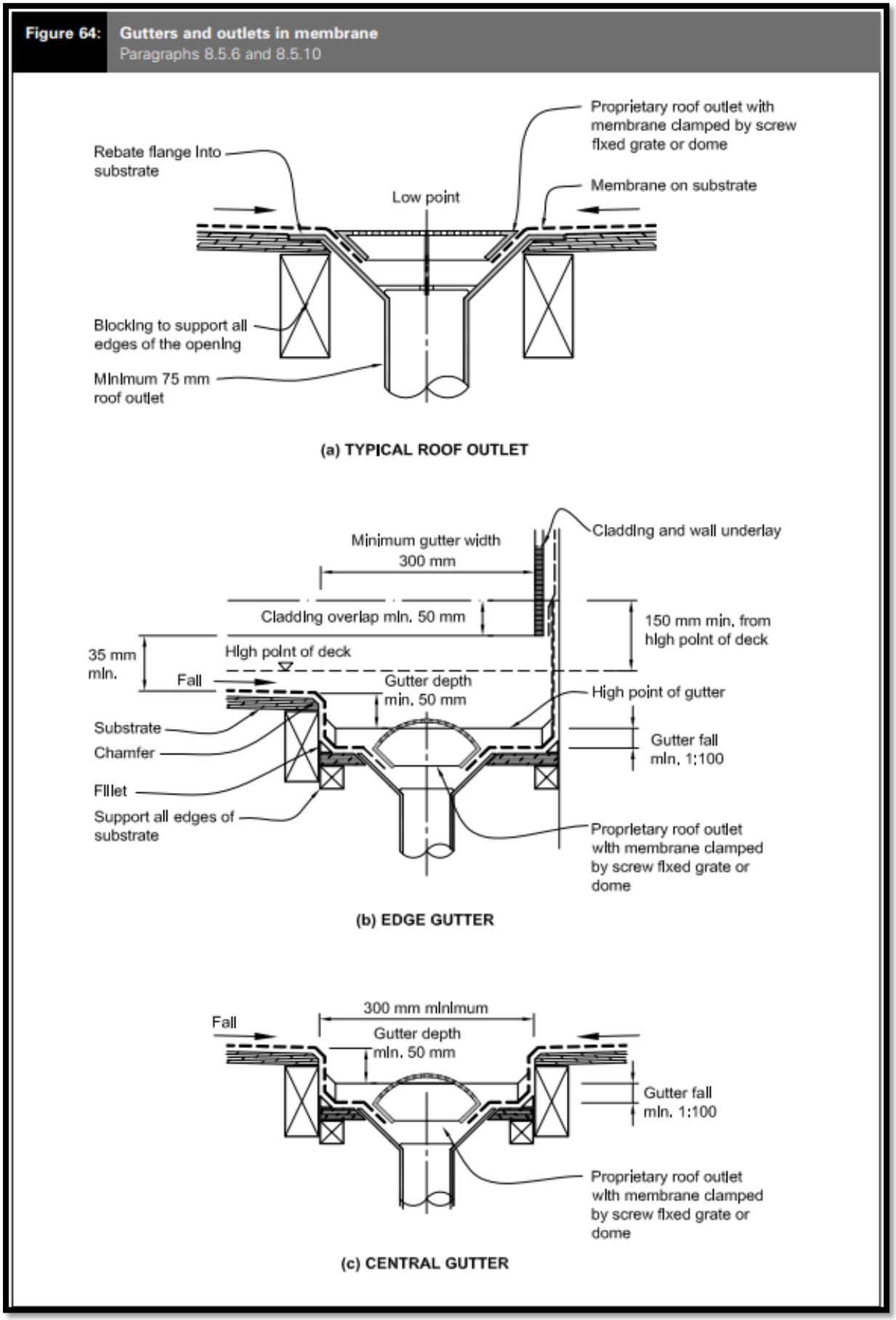


Figure 141. *Detail for gutters and outlets in membrane; sourced from E2/AS1*

Steel framing

Figure 142. *Checklist line item 'Steel framing construction as per plan'*

Figure 143. *Checklist Parent line item 'Steel framing: stud heights, sizes and centres as per plan'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 144. *Checklist Child line items*

Figure 145. *Checklist line item 'Steel framing: point load stud location/fixings'*

The inspector is to check the size, centres and fixing of the steel framing. It is important to check and confirm that any point loads are in the same place as identified by the engineer; if the location of the point load is different this may require further investigation.

Steel framing is more common in commercial situations but is becoming increasingly popular in domestic situations; particularly in ceilings where strapping is used because it provides a more stable support system.

Steel framing provides a rigid system and is lightweight and easy to install. Other advantages are the fact that there is no problem when lining, as there is no moisture present and holes for services are generally predrilled in the factory making it much easier to install cabling, etc.

Steel framing requires a thermal break to prevent cold bridging and condensation as well as meeting requirements for thermal bridging. The bottom plate must be fitted with DPC on all concrete floors (internal and external) and where studs meet walls.

Although 'no moisture' problems are touted as an advantage of steel framing, it is important that the bottom channels are spotlessly clean as dust, sawdust and rubbish has the potential to cause corrosion issues. Compatibility of material and fastenings is critical.

Metallic plumbing pipes or electrical cabling should not come in direct contact with the steel frame and should be threaded through either plastic or rubber grommets.

Every component of the frame requires earthing.

For steel framing, the stud height is restricted to 2.7m in height unless specific design has been provided. If a gib Rhondo resilient steel stud is used the wall height can be increased to 3.6m.

Studs must be friction fitted with a 15mm expansion gap at the top of the frame with no fixings to the top channel. R1.8 (75mm) pink batts glass-wool insulation installed between the studs and nogs on one side of the double frame.

It is important to realise that the testing of the system is based on all components being installed exactly as per plan; e.g. R1.8 pink batts are specified therefore if a different brand of insulation has been used, verification must be sort from the manufacturer that the system will still meet the performance requirements specified. Variations may significantly compromise performance.

Figure 146. *Checklist Parent line item 'Steel framing: top and bottom plate sizes and fixings.'*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 147. *Checklist Child line items*

Figure 148. *Checklist line item 'Steel framing: Framing connections as per the manufacture specs'*

All top plate, studs, nogs, lintels must have fixings in accordance with the manufacturer specifications.

Figure 149. *Checklist line item 'Steel framing: DPC between steel and concrete'*

All steel framing against concrete must have DPC separation.

Figure 150. *Checklist line item 'Steel framing: lintel size and fixing'*

Figure 151. *Checklist Parent line item 'Steel framing: steel beams and fixings.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 152. *Checklist Child line item*

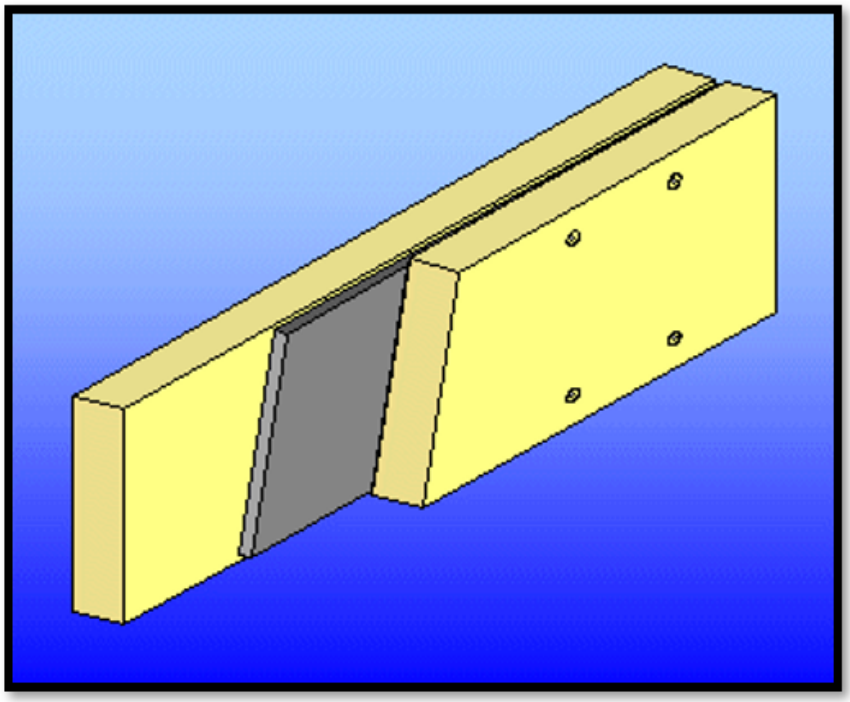
Flitch beams

Flitch beams are manufactured by both Pryda and Mitek Industries; they are proprietary products comprising timber and steel plates bolted together to form a strong unit. These beams are quite common for lintels above garage doors or supporting upper floor loads and can be found supporting most upper floors in residential houses.

Pryda flitch beam (PFB)
These beams are made in the factory by fixing timber to each side of either one or two flat metal plates and bolted together. Flitch beams are for enclosed (internal) use only.

The most common way of specifying a Pryda flitch beam is by its size, e.g.: 200PF10

- PF refers to the type
- 200 refers to the depth
- 10 refers to the steel thickness



Mitek flitch beam(MFB)
These beams are factory-made by fixing timber to each side of a flat metal plate. Flitch beams are for enclosed (internal) use only.

The most common way of specifying a Mitek Flitch beam is by its size, e.g. FB25M.

- FB refers to the type
- 25 refers to the depth of the timber plates
- M refers to the steel thickness

Structural steel posts and beams

Structural steel beams and posts must be installed as per the engineer's specifications and treated with appropriate protection. All site welds must be verified in writing by a certified welder or registered engineer.

Any bolts passing through timber should be fitted with a 50mm x 50mm x 3mm square washer; alternatively, a 55mm diameter x 3mm washer can be used. Placing a washer spreads the load and prevents the timber from fracturing (splitting). Bolting requires the bolt to protrude one full thread past the nut after tightening to ensure full thread engagement. Steel washers should still be used even when bolting directly to steel. The washer eliminates the risk of the nut gouging or steel galling.

Figure 153. *Inspectors should see one full thread past the nut and washers installed.*

Figure 154. *Where bolt holes are oversized, a heavy washer may be used but this should be specified by an engineer. Note: Check the 8.8 bolt on the right is the correct bolt to use by looking at engineers' specifications.*

Figure 155. *When a bolted joint is specified and welding is used instead, this must be approved by the structural engineer and registered as a variation on the consent.*

Typically, steel is specified by its

- mass per metre e.g. kg/m, and
- its size

The inspector should always familiarise themselves with what has been specified and check to confirm the correct steel has been used. All engineering details should be described and depicted in the plans, but if for some reason, it is not the specifications / calculations must be checked.

The inspector should always compare the plans to the work on site, ensuring all point loads have been satisfactorily addressed and that all bolted connections have been completed. If any on-site welding has been undertaken, this must be verified by an engineer in writing. If any part of the structural design has been altered, an amendment must be provided and approved before work can continue.

Inspectors must request documentation to confirm the grade of steel, e.g. mill certificates- heat treatment records / heat number traced from the mill to the site, welding records, non-destructive testing records, dimensional and tolerance records, painting and coating records, statutory or third party approval requirements and approval documentation. This is particularly important for larger commercial sites. These documents will be required prior to issue of Code Compliance Certificate (CCC) and must show compliance with NZS5131At the completion of the job, a report must be provided to cover the following:

1) List of contents
2) Inspection & test plan
3) Inspection release note
4) Material certificate summary: Material certificates: Test reports and mill certificates
5) Certificates of conformity
6) Welding records
7) Non-destructive testing records
8) Heat treatment records
9) Dimensional & tolerance records
10) Painting & coating records
11) Drawings: Data sheets
12) Miscellaneous certification, test reports & records
13) List statutory or 3rd party approval requirements
14) Statutory or 3rd party approval documentation

In some situations, the small amount of structural steel involved in residential houses, a simplified version of the report can be provided by the supplier to confirm the steel is fit for purpose.

Onsite Welding

Onsite welding needs to be visually inspected regardless of any forthcoming producer statements and the contractor should be advised when issues are seen. All welders must produce (when asked) their welding ticket to prove they are competent to undertake the welding. There are two factors which should be checked on the license: Position qualified for e.g. vertical or horizontal welding and the weld process they are competent to use. Inspectors should be looking for Manual Metal Arc Welding (MMAW).

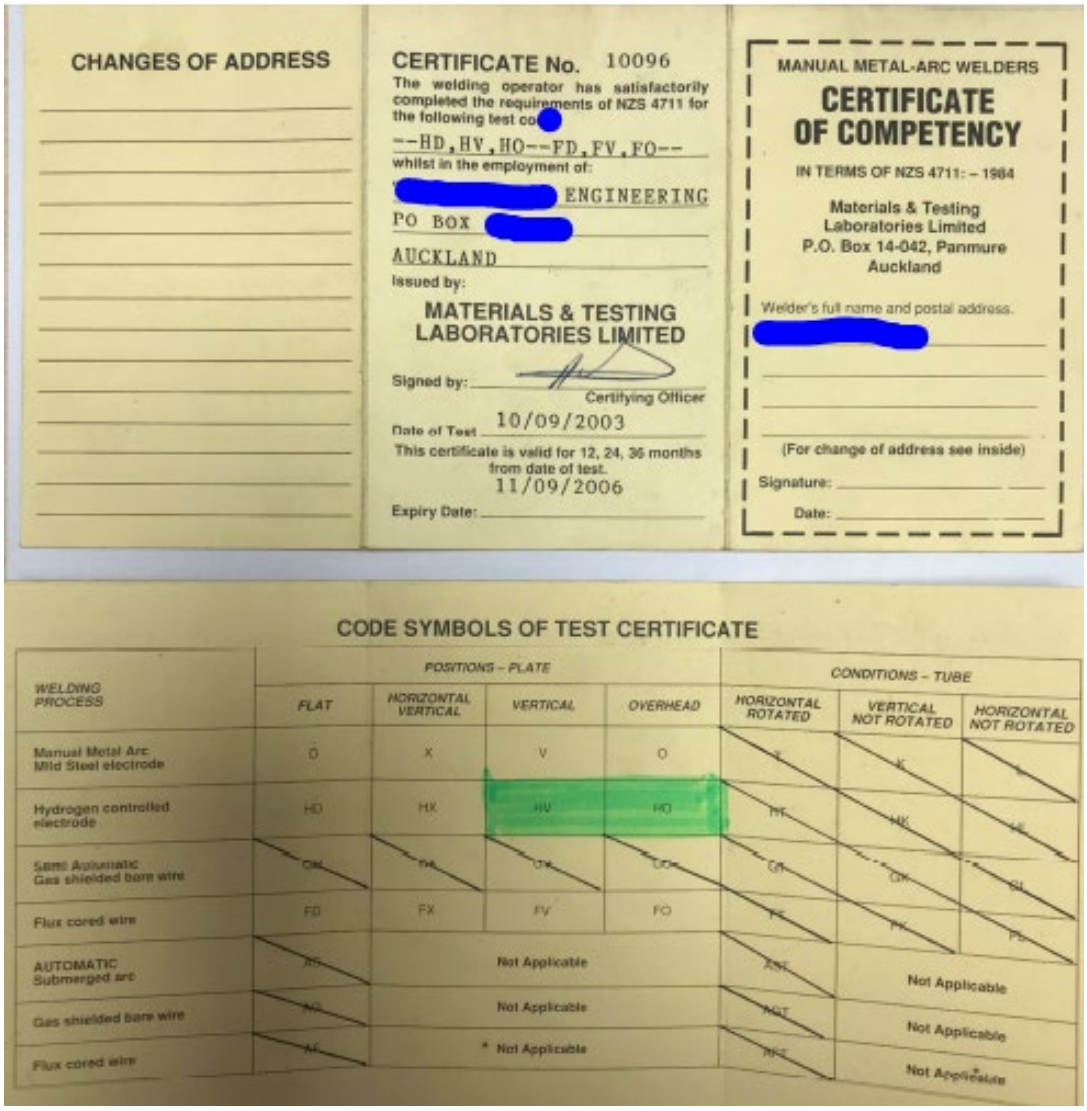
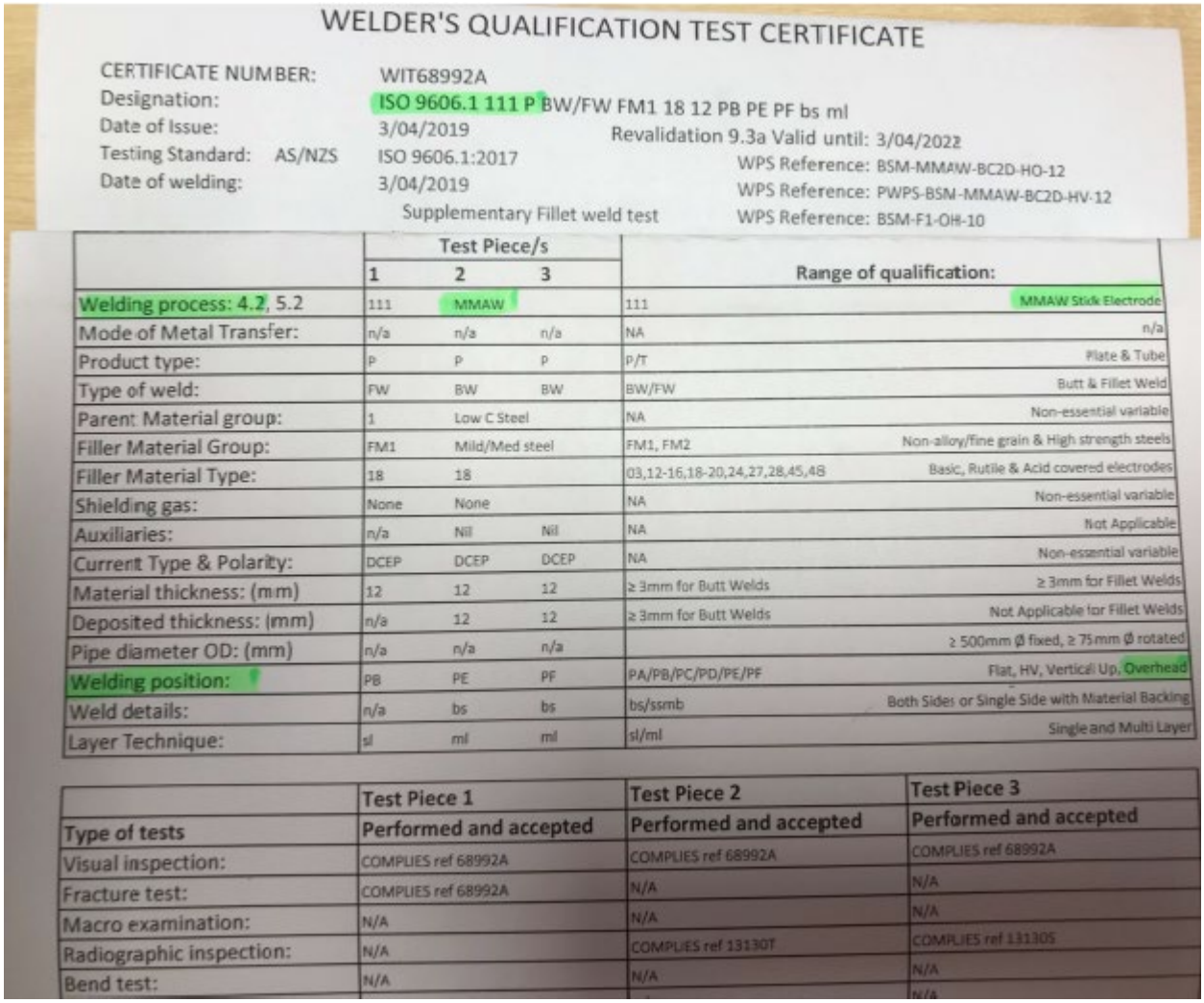


Figure 156. *An older style license. These are generally held by very experineced welders.*



WELDER'S QUALIFICATION TEST CERTIFICATE

CERTIFICATE NUMBER: WIT68992A
Designation: ISO 9606.1 111 P BW/FW FM1 18 12 PB PE PF bs ml
Date of Issue: 3/04/2019 Revalidation 9.3a Valid until: 3/04/2022
Testing Standard: AS/NZS ISO 9606.1:2017 WPS Reference: BSM-MMAW-BC2D-HO-12
Date of welding: 3/04/2019 WPS Reference: PWPS-BSM-MMAW-BC2D-HV-12
Supplementary Fillet weld test WPS Reference: BSM-F1-OH-10

	Test Piece/s			Range of qualification:	
	1	2	3		
Welding process: 4.2, 5.2	111	MMAW		111	MMAW Stick Electrode
Mode of Metal Transfer:	n/a	n/a	n/a	NA	n/a
Product type:	P	P	P	P/T	Plate & Tube
Type of weld:	FW	BW	BW	BW/FW	Butt & Fillet Weld
Parent Material group:	1	Low C Steel		NA	Non-essential variable
Filler Material Group:	FM1	Mild/Med steel		FM1, FM2	Non-alloy/fine grain & High strength steels
Filler Material Type:	18	18		03,12-16,18-20,24,27,28,45,48	Basic, Rutile & Acid covered electrodes
Shielding gas:	None	None		NA	Non-essential variable
Auxiliaries:	n/a	Nil	Nil	NA	Not Applicable
Current Type & Polarity:	DCEP	DCEP	DCEP	NA	Non-essential variable
Material thickness: (mm)	12	12	12	≥ 3mm for Butt Welds	≥ 3mm for Fillet Welds
Deposited thickness: (mm)	n/a	12	12	≥ 3mm for Butt Welds	Not Applicable for Fillet Welds
Pipe diameter OD: (mm)	n/a	n/a	n/a		≥ 500mm Ø fixed, ≥ 75 mm Ø rotated
Welding position:	PB	PE	PF	PA/PB/PC/PD/PE/PF	Flat, HV, Vertical Up, Overhead
Weld details:	n/a	bs	bs	bs/ssmb	Both Sides or Single Side with Material Backing
Layer Technique:	sl	ml	ml	sl/ml	Single and Multi Layer

	Test Piece 1	Test Piece 2	Test Piece 3
Type of tests	Performed and accepted	Performed and accepted	Performed and accepted
Visual inspection:	COMPLIES ref 68992A	COMPLIES ref 68992A	COMPLIES ref 68992A
Fracture test:	COMPLIES ref 68992A	N/A	N/A
Macro examination:	N/A	N/A	N/A
Radiographic inspection:	N/A	COMPLIES ref 13130T	COMPLIES ref 13130S
Bend test:	N/A	N/A	N/A

Figure 157. *Copy of a current weld license version. Highighted are the weld position and processes this welder is qualified to weld.*

Figure 158. *Good clean even welding is easy to identify visually. Note: this visual inspection does not take the place of the ITP.*

Issues to look for:

1. Most structural purpose welds for residential work should have a minimum size of 6mm.exposed. Anything less should be checked by engineer.

Figure 159. *Example of a simple tool available from most engineering tool suppliers to check weld size. The photo on the right shows a weld which is too small.*

2. Heavy spatter is a visual indicator to look closer at the welding. Generally, inexperienced welder or rushed work produce this and there may be more likely other issues present. Note, spatter itself does not fail the inspection, it is more a warning to look closer. It is common to see undercuts or inclusions- see later photos.

Figure 160. *Shows heavy spatter from arc blow resulting in a small weld.*

3. Undercut welds or lack of fill creates hollowed out areas in the weld and may lead to structural weakness. Using the 6mm weld producing rule will help spot these.

Figure 161. *Sometimes, spatter leads your eye to other issues. In these cases, the welds are "undercut" or lacking fill. There is insufficient weld to provide structural adequacy.*

4. Slag inclusions are nonmetallic particles trapped in the weld metal or at the weld interface. Slag inclusions result from faulty welding technique, improper access to the joint, or both. Sharp notches in joint boundaries or between weld passes promote slag entrapment. With proper technique, slag inclusions rise to the surface of the molten weld metal. Tungsten inclusions are tungsten particles trapped in weld metal deposited with the gas tungsten arc welding process. Dipping the tungsten electrode in the molten weld metal or using too high current that melts the tungsten can cause inclusions.

Figure 162. *Inclusions can build a weld up to look thick enough but in reality it would have the ffect of having no or little weld in place.*

5. No or insufficient welds. Area where no weld is present must be addressed before continuing.

Figure 163. *Look out for welds on one side only. All welds should be both sides of fillet.*

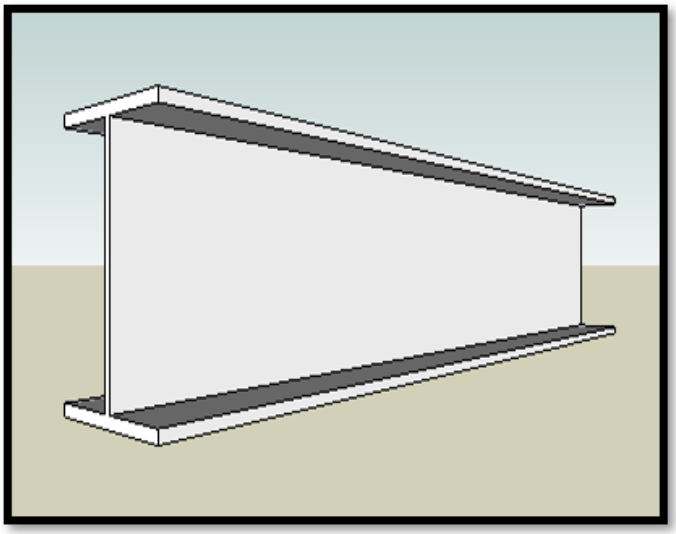
6. Flux should be removed by chipping off after the weld is done. If the flux remains on the weld, it may mask the actual size of the weld. It's identified by it's puffy appearance and is soft and easily removed with a hammer. Real weld is not easily chipped off.

Figure 164. *Flux build up not removed masks the true weld size. Once removed, these welds were shown to be too small.*

7. Misalignments of joints. Where there is a misalignment of more than 5mm, the engineer should be requested to have a look at it. Misalignments can have a negative effect on load paths and the performance of the structure.

Figure 165. *Misalignments need to be refered to an engineer to inspect and approve or provide remedial instructions. Note the misalignment was rectified above by welding extra steel plate to strengthen the joint.*

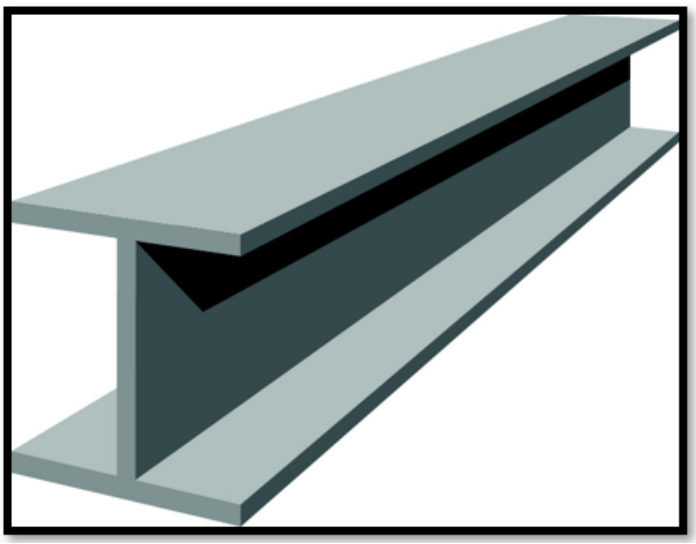
Steel sections usually seen on residential sites



Universal beams (UB)
Universal beams are probably the most common beam that is used for supporting a two-storey house where a large area is required below an upper floor. These are sometimes called 'I' beams and are roughly rectangular in plan view. A 'U' beam is made up of 2 webs and a flange.

The most common way of specifying a UB is by its size and weight, e.g. 200UB30

- UB refers to the beam type
- 200 refers to the depth of the beam
- 30 refers to the weight (kg) per metre

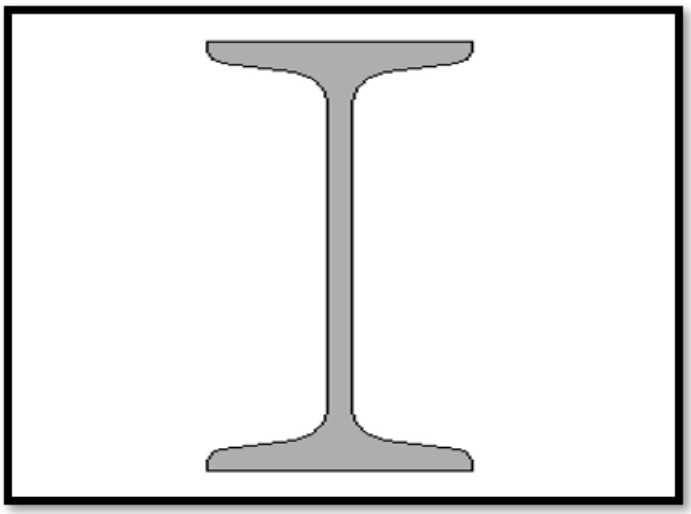


Universal columns (UC)
Universal columns are used for vertical support of commercial building but may also be used in the residential or multi-unit developments. Universal columns are roughly square in plan view.

Just like a universal beam, a universal column is specified by its size and weight, e.g.: 200UC50.

- UC refers to the beam type
- 200 refers to the depth of the beam

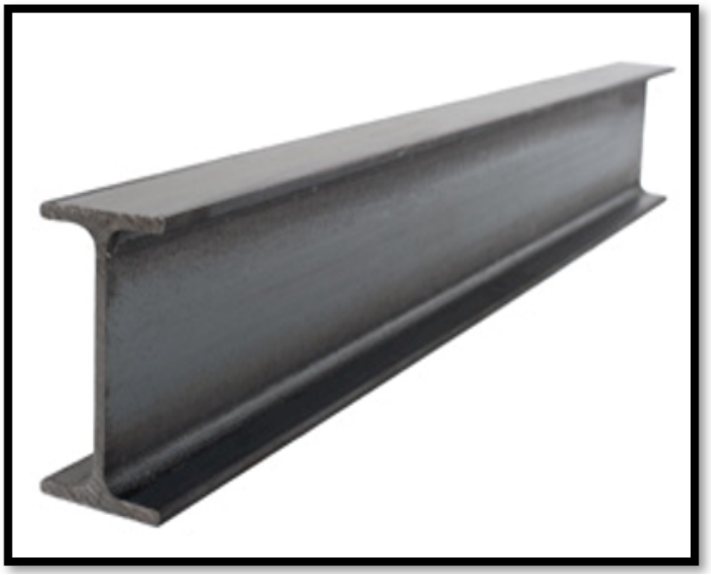
50 refers to the weight (kg) per metre



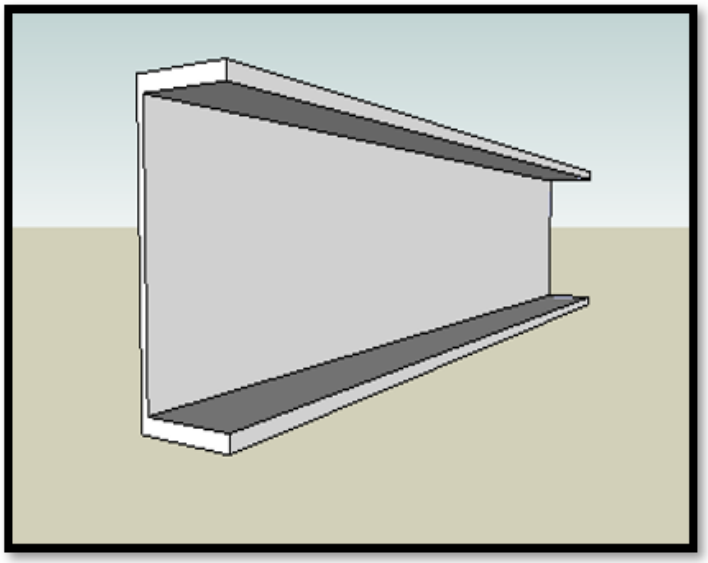
Tapered flange beams (TFB)
Tapered flange beams are similar in shape to universal beams. The most obvious difference is that the flange is tapered. These are typically used for supporting concrete floors.

The most common way of specifying a TFB is by its size, e.g.: TFB100

- TFB refers to the beam type
- 100 refers to the depth of the beam

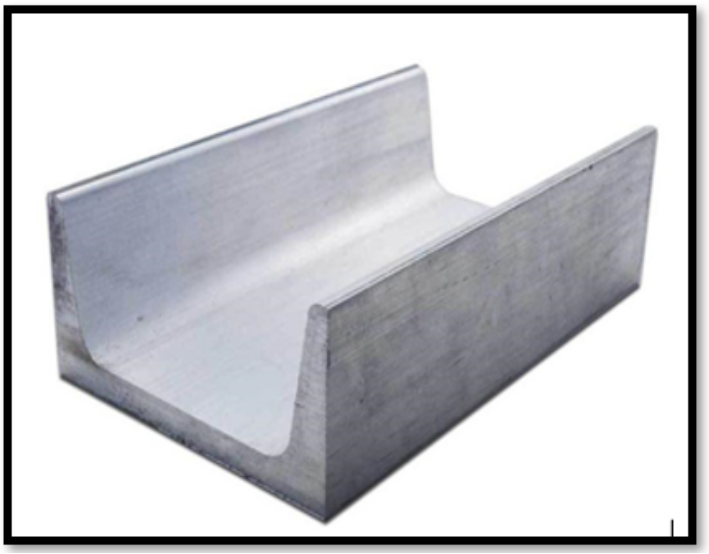


Rolled steel joists (RSJ)
Rolled steel joists are not very common but do turn up from time to time. The web is tapered rather than being of the same thickness, thus providing more strength.



Parallel flange channels (PFC)
Parallel flange channels are commonly used as lintels where headroom is limited or where the span is such that specific design is required.

Flanges are parallel and symmetrical in size. The most common way of specifying a PFC is by its size, e.g.: PFC180
- PFC refers to the channel type
- 180 refers to the depth of the beam



Tapered flange channels (TFC)
Taper flange channels are commonly used as lintels where headroom is limited but may also be used for bearer support when removing piles.

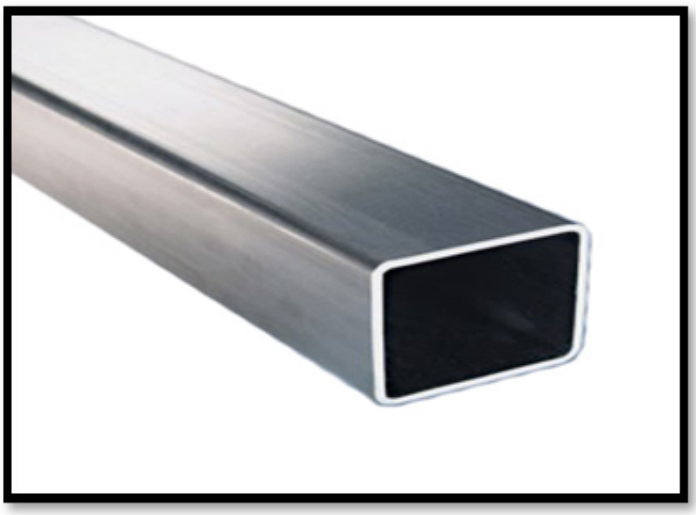
The most common way of specifying a TFC is by its size, e.g.: TFC100
- TFC refers to the Channel type
- 100 refers to the depth of the beam

Rectangular hollow section (RHS)

Rectangular hollow sections are commonly used as beams or columns. As the name suggests, the profile is rectangular.

The most common way of specifying a RHS is by its size, e.g.: RHS150 x 100 x 9

- RHS refers to the section type
- 150 refers to the widest side
- 100 refers to the narrowest side
- 9 refers to the thickness



Square hollow section (SHS)

Square hollow sections are commonly used as posts. As the name suggests, the profile is square.

The most common way of specifying a SHS is by its size, e.g.: SHS 89 x 89 x 6

- SHS refers to the section type
- 89 refers to the size of the sides
- 6 refers to the thickness

Figure 166. *Checklist line item 'Steel framing: Capillary gap 6mm'*

If the cladding is face-fixed the inspector is to ensure the bottom plate overhangs the slab by 6mm to provide a capillary break and extends at least 50mm below the bottom plate.

Bracing

Figure 167. *Checklist Parent line item 'Steel framing: bracing connections/ system'.*
Note. *When completing this parent line item, consideration must be given to cover all relevant child line items.*

Figure 168. *Checklist Child line items*.

Figure 169. *Checklist line item 'System'*

There are currently many steel framing companies operating in NZ e.g. Axxis, Ezisteel, Frametek, Steelhaus, Zog, to name a few.

Most steel frame companies use their own brace systems including fabricated brace hold down brackets. The inspector shall check that all brace systems and bottom plate fixings are as per the plans and manufacturer specifications. Plans may specify one type of brace connection or add "or equivalent" to the description to allow a different type but with the same kN rating.

The use of a different bracket may be accepted as an alternative solution and covered under a minor variation with the approval of the steel frame company.

Figure 170. *Sample of steel framing*

Figure 171. *Checklist line item 'Steel framing: 'fire wall structural integrity'*

Figure 172. *Checklist line item 'Steel framing: intertenancy walls-acoustic system'*

The inspector is to check plan construction details for fire structural integrity and acoustic framing to walls, floors, and ceilings in habitable spaces.

- Check framing
- Check resilient clips / channels
- Insulation

Studs must be friction fitted with a 15mm expansion gap at the top of the frame with no fixings to the top channel.

Figure 173. *Checklist line item 'Steel framing: all plumbing and electrical service holes in framing pre-punched and grommets installed'*

Metallic plumbing pipes or electrical cabling should not come in direct contact with the steel frame and should be threaded through either plastic or rubber grommets.

Figure 174. *Checklist line item 'No copper in contact with steel framing'*

Compatibility of material and fastenings is critical. Copper is non compatible with steel framing and must therefore be isolated from the framing.

Figure 175. *Checklist line item 'Steel framing permanently earthed'*

Electrical cabling should not come in direct contact with the steel frame and should be threaded through either plastic or rubber grommets. Every component of the steel frame requires earthing.

Figure 176. *Checklist line item 'Steel framing: insulation in channels as required'*

Insulation specified on the plans shall be installed between the studs and nogs.

It is important to realise that the testing of the fire rated/acoustic system is based on all components being installed exactly as specified; e.g. if R1.8 pink batts are specified and a different brand of insulation has been used, verification must be sort from the manufacturer (e.g. Winstone Wallboards) that the system will still meet the performance requirements specified. Variations may significantly compromise performance.

Reclad Inspection.

Mark-up

Figure 177. *Checklist line item 'Framing mark-up- Financial assistance package (FAP)'*

Figures 178. *Checklist line item 'Framing mark-up completed and by who'*

Figure 179. *Checklist line item 'FAP: Quantities record left onsite'*

Framing mark up

A suitably qualified building surveyor is required to carry out the assessment of the existing structure, their role is to confirm that the existing structure will continue to meet the durability performance requirements and mark up the timber that is to be replaced, and this should be done with a visual mark such as dazzle and recorded as photos in the checklist. The building surveyor will also provide a report that needs to remain on site to be used as a reference, to ensure that marked timber has been remediated. The report is also required to be submitted at CCC stage to record the condition of the existing structure.

Framing mark-up completed and by who

The mark up of the framing is generally carried out by a timber consultant (building surveyor), in some case where Council and MBIE are contributing to a claim, MBIE will assign a consultant to carry out the framing assessment or Council will be engaged to carry out the mark up. Where council have been engaged to carry out the mark up, the Reclad team carry out this role.

Quantities record left on site

A record of the quantities measured is only required when Council are contributing to a claim. This role is carried out by the Reclad team

Remediation

Figures 180. *Checklist line item 'Framing remediation: - Brush on timber treatment as per MBIE guidelines'*

A part of the remediation process is to ensure that the building will continue to meet the performance requirements of the Building Code. It is the responsibility of the building surveyor engaged to assess the existing framing condition and verify the treatment levels of the existing framing. This may require the application of an in-situ treatment, such as PROTIM FrameSaver which will provide a protection from insect attack and fungal decay.

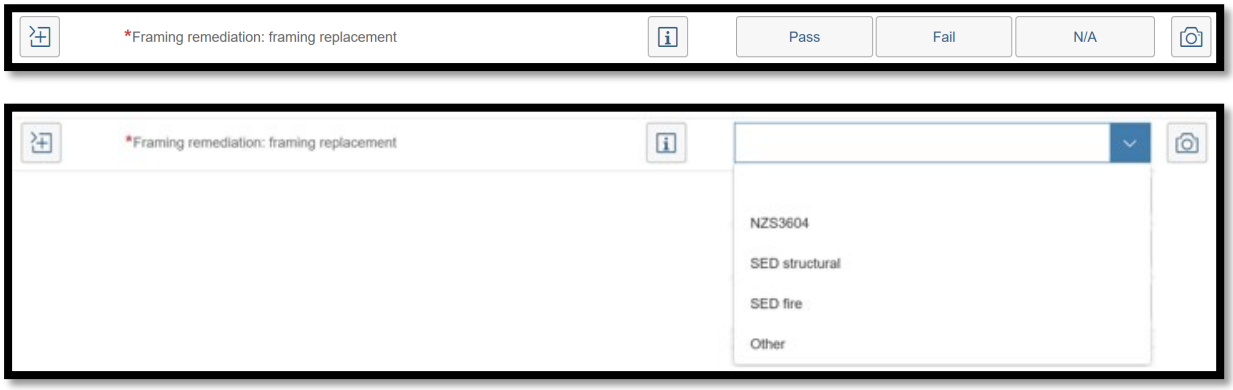


Figure 181. *Checklist line item 'Framing remediation: - framing replacement'*

Figure 182. *Checklist line item 'Framing remediation: - bracing hold downs'*

Figure 183. *Checklist line item 'Framing remediation: - bracing stud/bottom plate fixings'*

Figure 184. *Checklist line item 'Framing remediation: - insulation reinstated'*

The remediation of framing may be required when the external cladding has failed to prevent the ingress of moisture. Although these types of failures are often associated with direct fix monolithic cladding, other types of cladding systems are known to have failed. Often the cause of this, is poor construction detailing. Framing remediation is generally associated with existing buildings that the cladding is being fully replaced or a targeted repair. Alterations and additions that include changes to the cladding need the framing to be assessed before the new cladding is applied, as it needs to be fit for purpose. Depending on the age of the building, framing remediation may be required due to borer infestation. In accordance with AC1116, where moisture ingress issues are identified, the inspection must be failed, and the application directed to the Reclad team

Modular or prefabricated buildings

Modular building must be managed in accordance with the specific inspection regime advised in the building consent. Refer Council's Modular guidance for further details on the quality assurance process for the factory build.

Inspections of areas where modules are assembled onsite can consist of a hybrid of framing, wrap cavity and preline inspections. Careful attention must be paid to the structural connections and in some cases, engineers will need to certify fixings.

Where modules are stitched together, there may also be fire and acoustic requirements which should be inspected as per the preline code of practice module.