Produced in conjunction with:

qbcc queensland building and construction commission

TIMBER QUEENSLAND We build Queensland

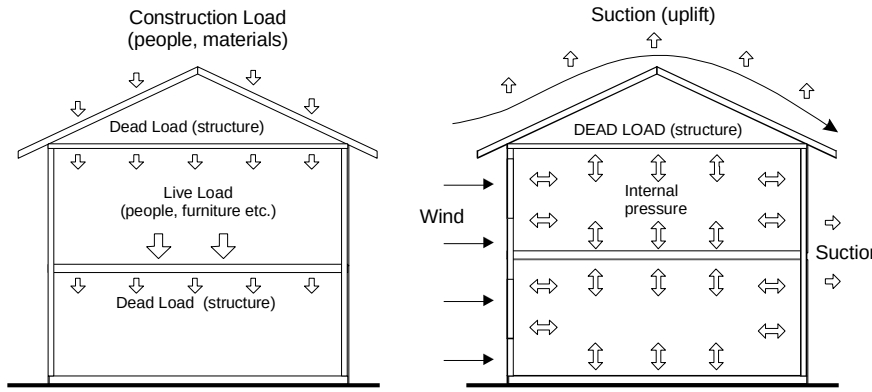
Bracing, tie-down and other issues

A guide to the construction of buildings in cyclonic regions

AS 1684 is:-

- A recipe book of generic solutions designed to cater for most houses, and
- For structural adequacy, based upon generic wind pressure assumptions
- Coupled with known historical satisfactory performance

TIE-DOWN



(a) Gravity loads (b) Uplift wind loads

FIGURE 9.1 LOAD ACTIONS

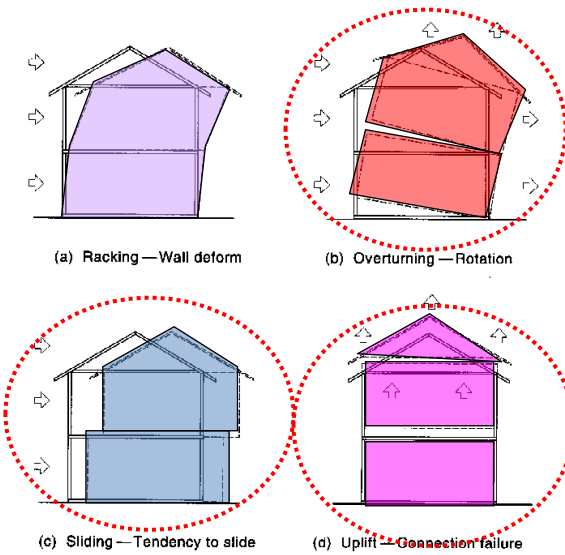
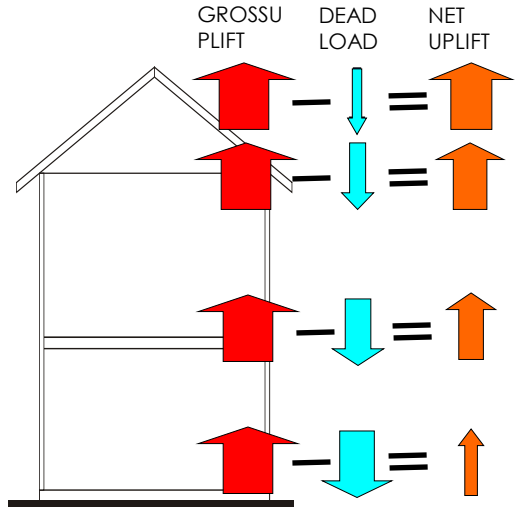


FIGURE 1.3 EFFECTS OF FORCES ON BUILDINGS

Fixings and Tie-down - Top to bottom



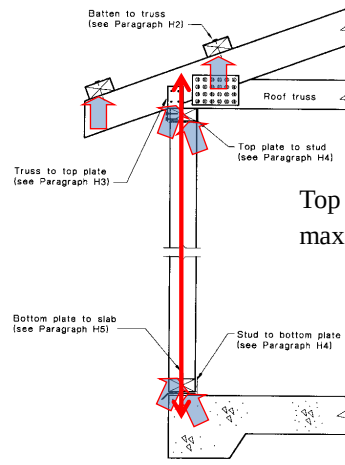
At the roof there is not much dead load to counter-balance the uplift - Nett Uplift is high.

At the top plate there is a bit more dead load to counter-balance the uplift - Nett Uplift is a little smaller.

At the floor there is a lot more dead load to counter-balance the uplift - Nett Uplift is reduced and in lower wind classifications, maybe Nil.

At the lower floor of a two storey, there is considerably more dead load to counter-balance the uplift - Nett Uplift is reduced and in lower wind classifications, maybe Nil.

Fixings and Tie-down - Top to bottom



Top plate down max 1800 crs

1.15 Steel Grade and Corrosion protection

- All metal used in structural timber connections shall be provided with corrosion protection appropriate for the particular conditions of use.
- Where corrosion protection of steel is required it shall be in accordance with AS/NZS 4791, AS/NZS 4534, AS 1397 and AS 1214.
- The level of corrosion protection provided shall take into consideration weather exposure, timber treatment, moisture and presence of salt.
- The minimum corrosion protection that shall be applied to metal straps, framing anchors etc. shall be Z 275.
- The minimum steel grade for metal strap, framing anchors etc. shall be G 300. Other metal in accordance with the relevant Australian Standards.

9.6.1 General

Continuity of tie-down shall be provided from the roof sheeting to the foundations.

Where appropriate, due allowance for the **counterbalancing effects of gravity loads may be considered.**

9.2.3 Steel washers

The size of steel washers shall be determined from Table 9.1.

TABLE 9.1

STEEL WASHERS

Bolt or coach screw diameter (mm)	Washer size (mm)
M10 cup-head	Standard
M12 cup-head	Standard
M16 cup-head	Standard
M10 bolt or coach screw	38 × 38 × 2.0
M12 bolt or coach screw	50 × 50 × 3.0
M16 bolt or coach screw	**65 x 65 x 5.0**

Uplift – Table 9.2

Connection	Wind classification					
	C1		C2		C3	
	Sheet roof	Tile roof	Sheet roof	Tile roof	Sheet roof	Tile roof
Roof battens to rafters/trusses — within 1200 mm of edges — general area	S S	S S	S S	S S	S S	S S
Single or upper storey rafters/trusses or wall frame to floor frame or slab	S	S	S	S	S	S
Single or upper storey floor frame to supports	S	S	S	S	S	S
Lower storey wall frame to floor frame or slab	S	S	S	S	S	S
Lower storey floor frame to supports	S	S	S	S	S	S
S = specific connection may be required for uplift forces (refer to Clause 9.7)						

Nominal Fixings

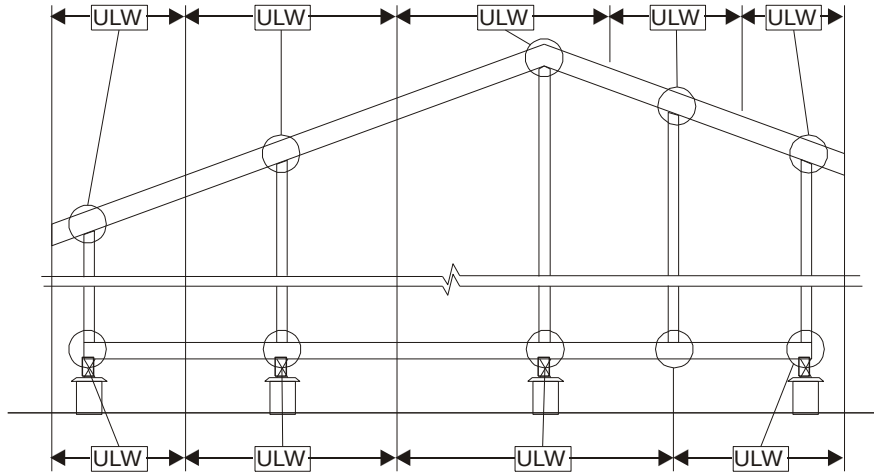
- Required in addition to any specific tie-down fixings

Table 9.13

NET UPLIFT FORCE—ON RAFTERS/TRUSSES, BEAMS OR LINTELS TO WALL FRAME AND WALL PLATE TO STUDS, FLOOR FRAME OR SLAB—SINGLE STOREY OR UPPER STOREY

Wind uplift load width (*ULW*) mm	Fixing spacing (see Note 2) mm	Uplift force, kN					
		Wind classification					
		C1		C2		C3	
		Tile roof	Sheet roof	Tile roof	Sheet roof	Tile roof	Sheet roof
1500	450	1.1	1.4	1.9	2.2	3.1	3.3
	600	1.5	1.9	2.6	2.9	4.1	4.4
	900	2.3	2.8	3.8	4.4	6.1	6.7
	1200	3.0	3.7	5.1	5.9	8.2	8.9
	1350	3.4	4.2	5.8	6.6	9.2	10
	1800	4.5	5.6	7.7	8.8	12	13
	3000	7.6	9.4	13	15	20	22
3000	450	2.3	2.8	3.8	4.4	6.1	6.7
	600	3.0	3.7	5.1	5.9	8.2	8.9
	900	4.5	5.6	7.7	8.8	12	13
	1200	6.0	7.5	10	12	16	18
	1350	6.8	8.4	12	13	18	20
	1800	9.1	11	15	18	25	27
	3000	15	19	26	29	41	44
4500	450	3.4	4.2	5.8	6.6	9.2	10

ULW for roof and wall frames

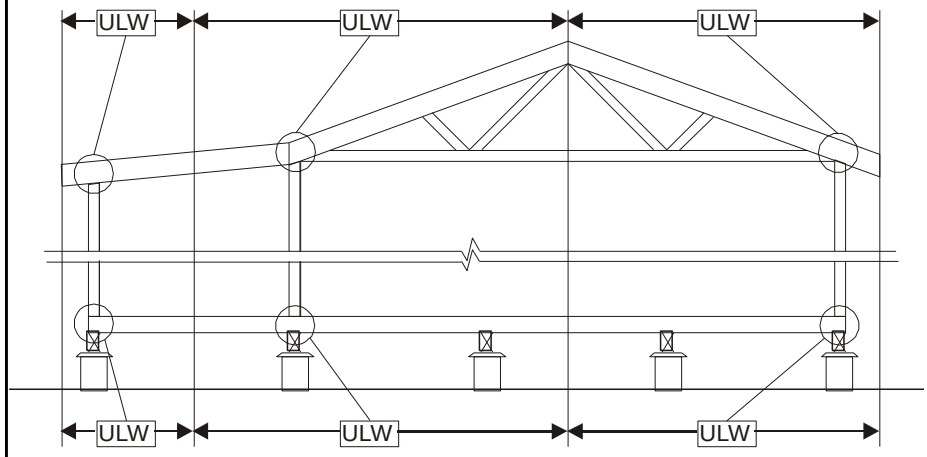


ULW for floor frames

(a) Roof beam construction

FIGURE 9.5 ROOF UPLIFT LOAD WIDTH *ULW*

ULW for roof and wall frames

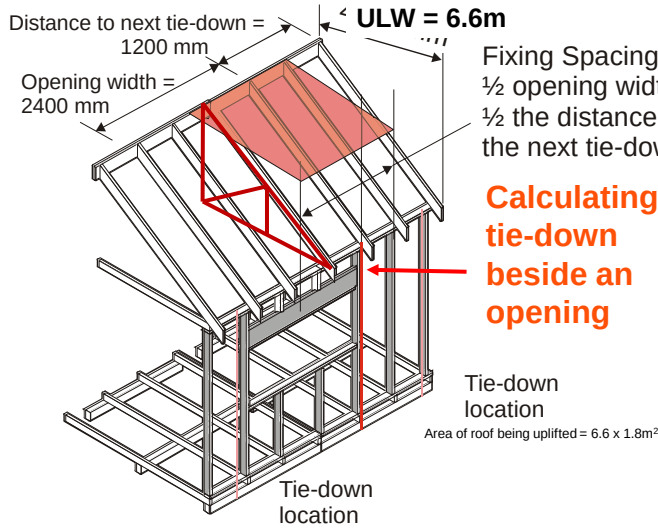


ULW for floor frames

(c) Roof truss construction

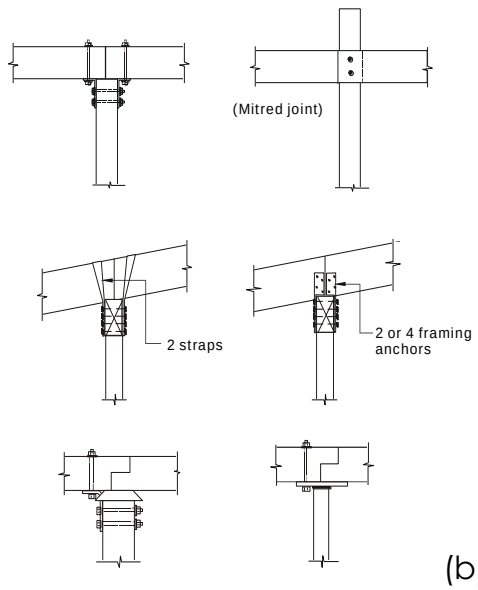
FIGURE 9.5 ROOF UPLIFT LOAD WIDTH *ULW*

Roof area to be tied down (m^2) =ULW x Fixing Spacing
= 6.6m x 1.8m = 11.88m^2



9.2.11 Tie-down of members joined over supports

Where members are joined over supports, such as is shown in Figure 9.3(b), (generally connectors in tension) the uplift capacity shall be equal to the uplift capacity as if there were no join over the support as the full strength of the connection is maintained.



Uplift capacities of these types of joints, where bolts, straps etc are in tension, do NOT need to be reduced.

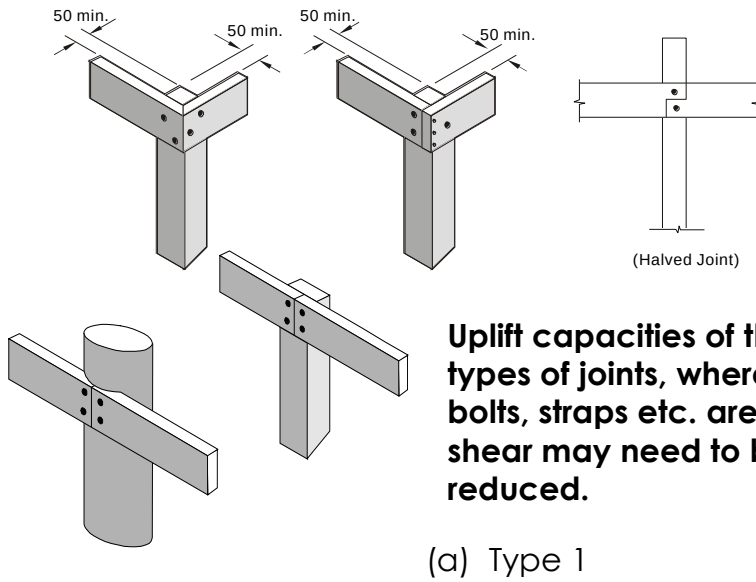
(b) Type 2

FIGURE 9.3 JOINING MEMBERS AT SUPPORTS

9.2.11 Tie-down of members joined over supports

NOTE: As a general guide, where members are joined over supports such as is shown in Figure 9.3(a) (generally connectors in shear) the uplift capacity should be equal to half the uplift for the number of connectors (i.e. bolts) shown as the required end distances are reduced.*

* The uplift capacities in fact should be reduced proportionally to the actual end distance achieved.



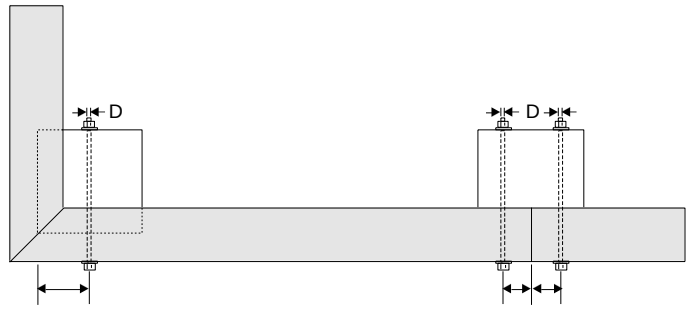
Uplift capacities of these types of joints, where bolts, straps etc. are in shear may need to be reduced.

(a) Type 1

FIGURE 9.3 JOINING MEMBERS AT SUPPORTS

The required end distances are:-

Bolts **5 x bolt diameter**
Screws **10 x screw diameter**
Nails **20 x nail diameter**
(10 x dia. if nails holes are pre-bored)



9.2.6 SPECIFIC TIE-DOWN FIXINGS

9.6.1 General

This Clause provides details for structural connections to resist uplift and shear forces (lateral loads) in floor framing, wall framing and roof framing.

Where specific tie-down fixings provide equal or better resistance to gravity or shear loads, then nominal nailing is not required in addition to the specific tie-down fixing.

Top plate tie-down

- Remember – the **maximum tie-down spacing for top plates is 1800mm crs**
- See the span tables or notes to tie-down table

Table 9.13

NET UPLIFT FORCE—ON RAFTERS/TRUSSES, BEAMS OR LINTELS TO WALL FRAME AND WALL PLATE TO STUDS, FLOOR FRAME OR SLAB—SINGLE STOREY OR UPPER STOREY

Wind uplift load width (*ULW*) mm	Fixing spacing (see Note 2) mm	Uplift force, kN					
		Wind classification					
		C1		C2		C3	
		Tile roof	Sheet roof	Tile roof	Sheet roof	Tile roof	Sheet roof
1500	450	1.1	1.4	1.9	2.2	3.1	3.3
	600	1.5	1.9	2.6	2.9	4.1	4.4
	900	2.3	2.8	3.8	4.4	6.1	6.7
	1200	3.0	3.7	5.1	5.9	8.2	8.9
	1350	3.4	4.2	5.8	6.6	9.2	10
	1800	4.5	5.6	7.7	8.8	12	13
	3000	7.6	9.4	13	15	20	22
3000	450	2.3	2.8	3.8	4.4	6.1	6.7
	600	3.0	3.7	5.1	5.9	8.2	8.9
	900	4.5	5.6	7.7	8.8	12	13
	1200	6.0	7.5	10	12	16	18
	1350	6.8	8.4	12	13	18	20
	1800	9.1	11	15	18	25	27
	3000	15	19	26	29	41	44
4500	450	3.4	4.2	5.8	6.6	9.2	10

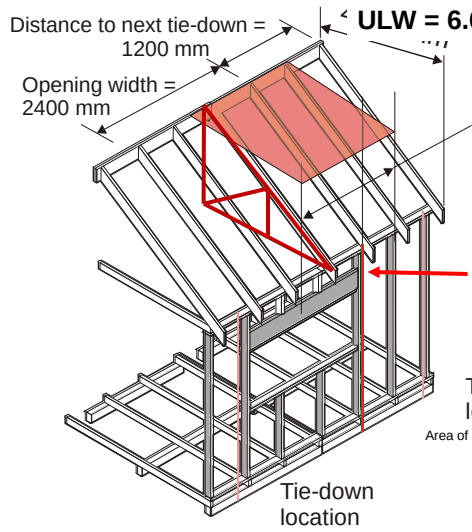
TABLE 9.5

NET UPLIFT PRESSURE

Connection/tie-down position	Nett uplift pressure (kPa)					
	Wind classification					
	C1		C2		C3	
	Sheet roof	Tile roof	Sheet roof	Tile roof	Sheet roof	Tile roof
Roof battens to rafters/trusses — within 1200 of edges — general area	3.27 1.92	3.67 2.32	5.10 3.09	5.50 3.49	7.73 4.78	8.13 5.18
Single or upper storey rafters/trusses to wall frames, floor frame or slab Ridge boards or beams, intermediate beams, verandah beams, underpurlins, strutting beams etc. to wall or post, floor frame or slab	1.68	2.08	2.85	3.25	4.54	4.94
Single or upper storey bottom plates to floor frame or slab	1.36	1.76	2.53	2.93	4.22	4.62
Single or upper storey floor frame to supports	*1.0*	*1.2*	*2.0*	*2.1*	*3.8*	*3.8*
Lower storey wall frame to floor frame or slab	*1.0*	*1.2*	*2.0*	*2.1*	*3.8*	*3.8*
Lower storey floor frame to supports	*0.5*	*0.6*	*1.7*	*1.8*	*3.8*	*3.8*

NOTE: The values in italics make allowance for overturning forces which dictate rather than direct uplift.

Roof area to be tied down (m^2) =ULW x Fixing Spacing
= 6.6m x 1.8m = 11.88m^2

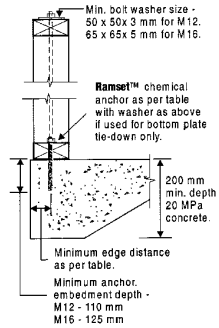


UPLIFT CAPACITY OF WALL FRAME TIE-DOWN USING Ramset™ CONNECTORS

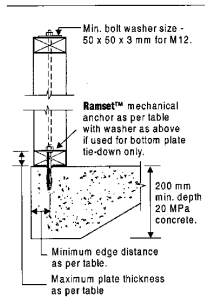
The following tie-down connections have been compiled by TRADAC in conjunction with RAMSET. They are based on typical concrete thickness and strength, anchor size, embedment and washer size. For situations other than those given, refer to the RAMSET technical data.

Position of tie-down connection

Top or Bottom plates to slab

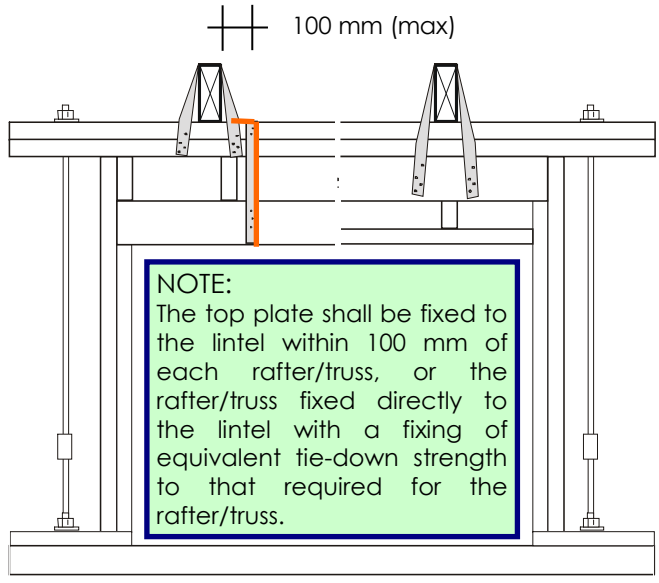


Anchor size	Min.Edge distance	Uplift capacity (kN) Unseasoned timber J2	J3	J4	Seasoned timber JD4	JD5	JD6
		Chemset™ Injection 100 series					
M12	35	10	10	10	10	10	10
	≥48	12	12	12	12	12	12
M16	50	15	15	15	15	15	15
	≥65	18	18	18	18	18	18
Anchor size	Min.Edge distance	**Chemset™ Spin Capsules**					
M12	35	16	16	16	16	16	12
	≥48	20	20	20	20	16	12
M16	50	24	24	24	24	24	21
	≥65	29	29	29	29	28	21
Anchor size	Min.Edge distance	**Chemset™ Injection 800 series**					
M12	35	18	18	18	18	16	12
	≥48	22	22	22	20	16	12
M16	50	26	26	26	26	26	21
	≥65	30	30	30	30	28	21



Max. Plate Thickness	Anchor Type	Min.Edge distance	Dynabolt™ Anchors					
35	DP12100	60	11	11	11	11	11	11
		≥85	14	14	14	14	14	12
35	DP12125	80	12	12	12	12	12	12
		≥125	15	15	15	15	15	12
45	DP12125	65	11	11	11	11	11	11
		≥90	14	14	14	14	14	12
Max. Plate Thickness	Anchor Type	Min.Edge distance	Trubolt™ Anchors					
35	T12140	60	12	12	12	12	12	12
		≥120	18	18	18	18	16	12
35	T12180	60	19	19	19	19	16	12
		≥120	22	22	22	20	16	12

05-02-03



NOTE:
The top plate shall be fixed to the lintel within 100 mm of each rafter/truss, or the rafter/truss fixed directly to the lintel with a fixing of equivalent tie-down strength to that required for the rafter/truss.

Site Issues
Roof Battens

- Steel Thickness & Grade
- Fixings
- Tested and certified?
- Imported material?

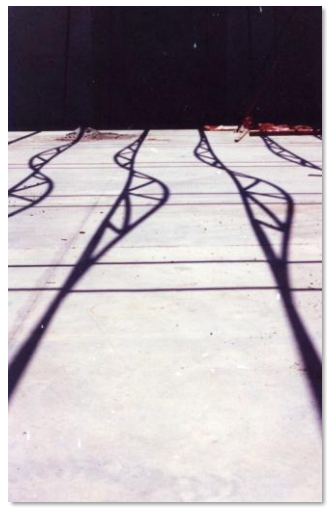
Site Issues - Roof Battens

STRAMIT® 0.75 CYCLONIC ROOF BATTENS MAXIMUM BATTEN SPACINGS (mm)#

AS4055 Load Category	Strength Wind Pressure (kPa)*	Truss spacing (mm), fastening and truss material							
		2 x No14 screws into 1.5 G450, or larger screws and/or thicker or higher strength steel, or 2 x No14 Type 17's into timber or equivalent				2 x No12 screws into 1.5 G450 or 2 x No14 screws into 1.0 G550 or 2 x No12 Type 17's into timber			
		450	600	900	1200	450	600	900	1200
C1	3.71	1950	1460	970	730	1300	980	650	490
C2	5.54	1300	980	650	490	870	650	430	320
C3	8.17	880	660	440	330	590	440	-	-
C4	11.05	650	490	320	-	430	320	-	-

Site Issues
Truss Installation

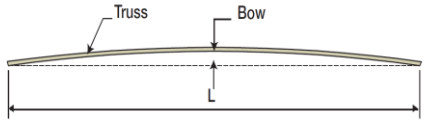
Install Trusses Plumb and Straight



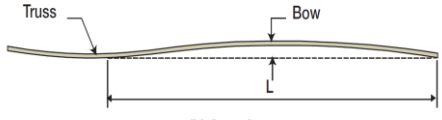
Install Trusses Plumb and Straight

- Haste and carelessness can result in poor installation and trusses that are not plumb and straight
- This is especially so with the installation of **inadequate temporary binders and/or bracing**
- Twisted trusses sag and result in uneven roof and ceiling finishes or in the worst case collapse
- It is the builders responsibility to ensure trusses are properly plumbed, fully braced and restrained before loading the roof.

Bow – trusses shall be installed with bow not exceeding the smaller of span/200 or 50mm.

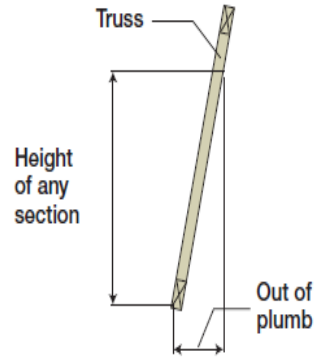


(a) Case 1



(b) Case 2

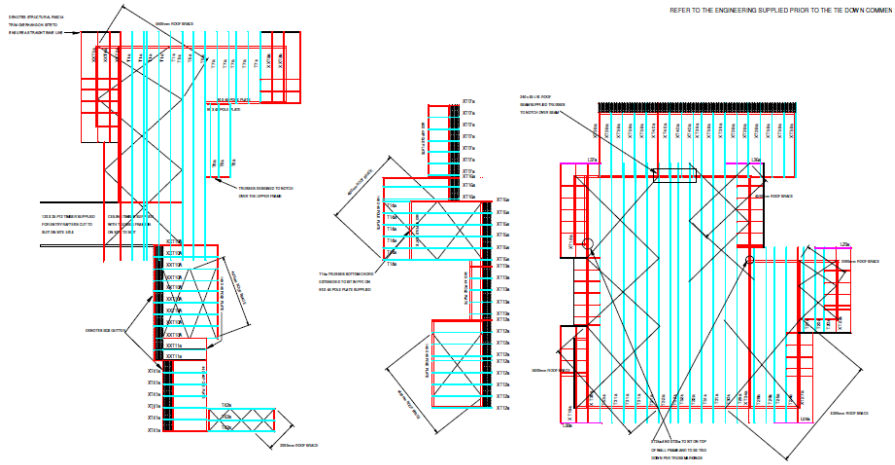
Plumb – trusses shall be installed so that no part of the truss is out of plumb by more than the smaller of rise/50 or 50 mm.



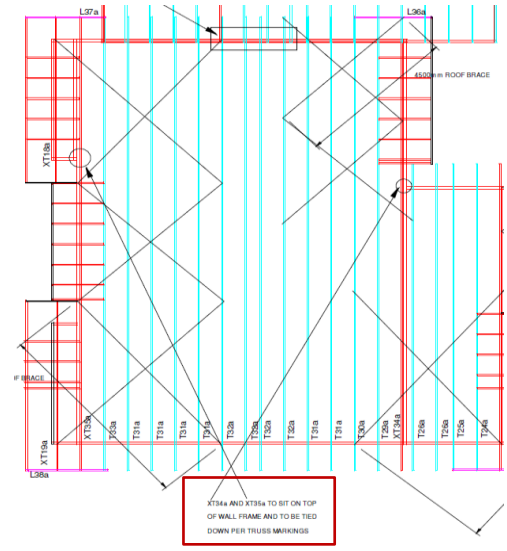
Truss Layout

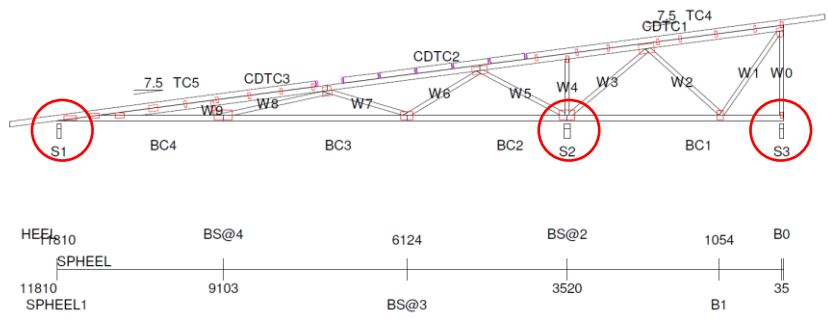
- Make sure installation is strictly in accordance with truss suppliers layout plans and **any specific** details supplied
- If not done, Form 15 is invalid
- Specific details may include:
  - Specific support/tie-down conditions (internal supports)
  - Web bracing
  - Ceiling/bottom chord ties etc

Truss layout



Truss tie-down - girders

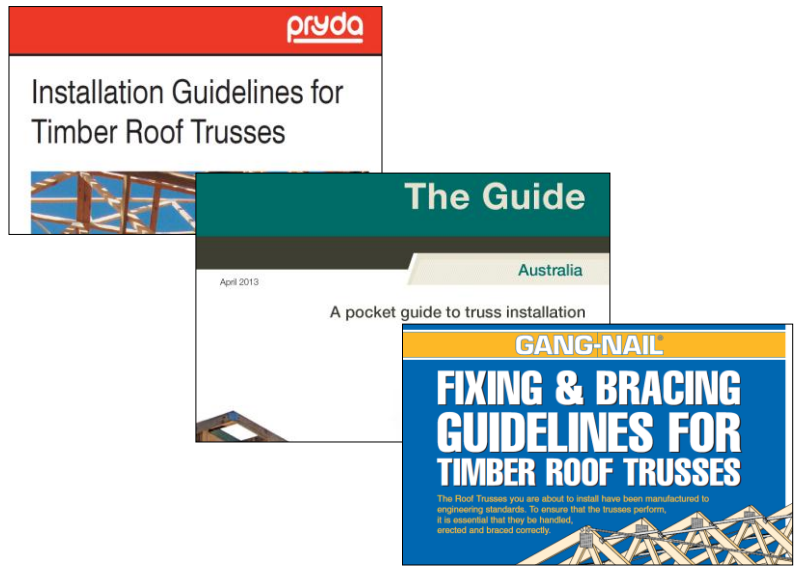




Maximum transport dimensions (mm) Width: 13230 & Height: 1833

ical Reactions at Supports [AS/NZS 1170-2002][AS 1

port	(No.)	S1	S2	S3
DL	(kN)	0.75	2.93	-0.22
L + 1.5MLL	(kN)	2.55	9.52	-0.42
L + 1WL	(kN)	-5.60	-20.30	0.82
Down	Required	2 MGrps	2 Cfles	1 MGrip
ing	Member/Support	Ok/Ok	Ok/Ok	Ok/Ok



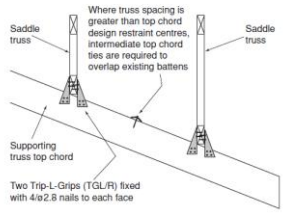
Truss tie-down – girder brackets

Truss tie-down – hips & valleys

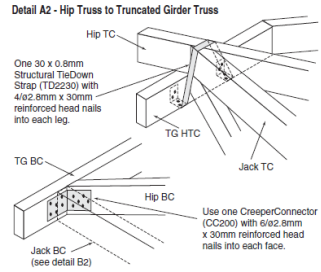
FOR WIND CLASSIFICATION N4, C2 or C3

The following details recommend the connection of saddle trusses for Wind Classification N4, C2 or C3.

Supported trusses without a ceiling



Detail A2 - Hip Truss to Truncated Girder Truss



Detail E2 - Jack Truss to Hip Truss (maximum jack station 2400mm)

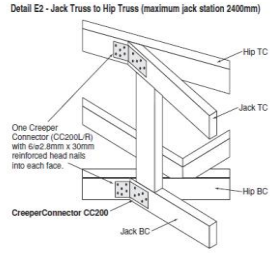
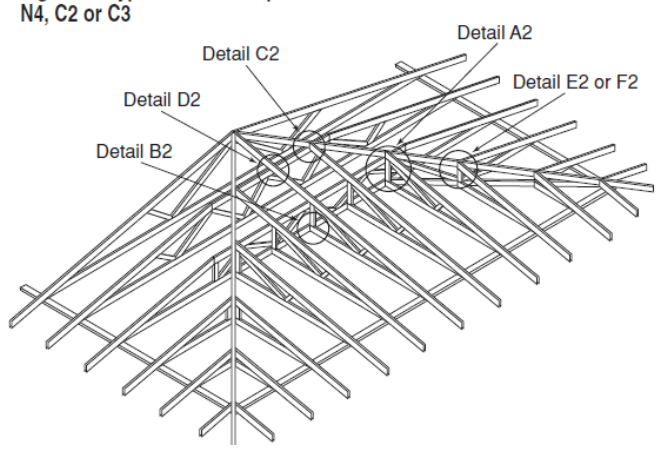


Figure 2. Typical trussed hip end connection for Wind Classification N4, C2 or C3



9.7 SHEAR FORCES ('Sliding')

9.7.1 General

Shear forces (lateral wind forces) shall be resisted by connections at each floor level of the house to prevent 'sliding'.

For masonry veneer construction for wind classifications up to N3 or C1, specific connections to resist shear forces are not required.

Table 9.3 gives the design situations where either nominal (minimum) fixings or specific fixings are required for a range of wind classifications and various connections in the house with respect to **lateral (shear) loads**.

Table 9.3
Shear

Connection	Wind classification		
	C1	C2	C3
Bottom plate to slab	N	N at 600 mm max. centres	N at 600 mm max. centres
Joists to bearers	N	S	S
Bearers to stumps	S	S	S

N = nominal (minimum) connection only (see Clause 9.5)
S = specific connection may be required for shear forces (see Clauses 9.7.5 and 9.7.6)

Site Issues – Ply at sides of openings for tie-down

The Gap Storm Nov 08

Site Issues

Site Issues

Site Issues

Site Issues

Site Issues

Site Issues

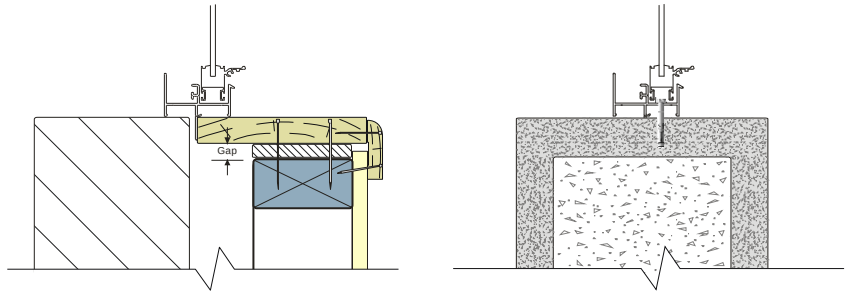
Window & Door fixings

Field studies have identified that many windows are not being properly installed.

This was highlighted in the Brisbane storms, as shown here, Cyclone Larry and also in Cyclone Yasi.

This window has not failed but because of inadequate fixing, the whole window has been blown in as a unit, thereby pressurising the building and leading to further damage.

Window & Door Fixing



Window & Door fixings

Inadequate connections to supports/frame

Cyclone Larry

Cyclone Yasi

Cyclone Yasi

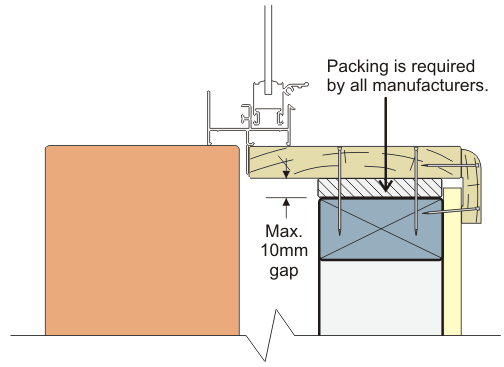
Window & Door fixings

Cyclone Larry, Yasi and the Brisbane storm were severe events, but the gust wind speeds were estimated to be less than the design wind speed.

Therefore the window & door fixings should not have failed.

Window & Door fixings

One of the biggest problems is the lack of packing between the window frame (reveal) and the supporting jamb studs etc.



Window & Door fixings

The window industry considers that packing is mandatory to any gaps between the window/door frame and its support, yet windows are often installed with large gaps and no packing.

There are also problems with the incorrect number and size of nails & screws.

The AWA 'Guide to the Correct Fixing of Windows and Doors' gives the correct number of nails/screws to be used and this Guide is available on their website.

NOTE: Fixings must go through the packing.

Window & Door fixings

Window & Door fixings

Nail Capacity - C2

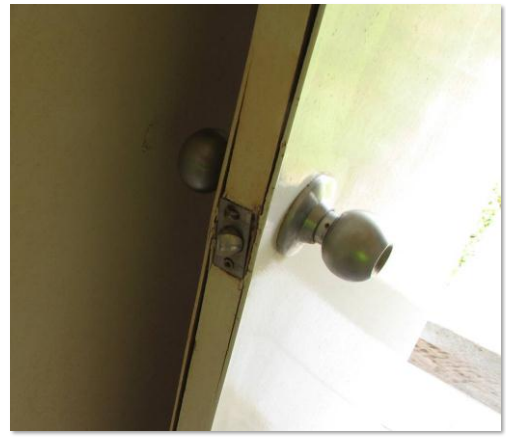
ULS Wind Pressure: 3000 Pa, Nail Diameter: 2.5 mm

Window Width

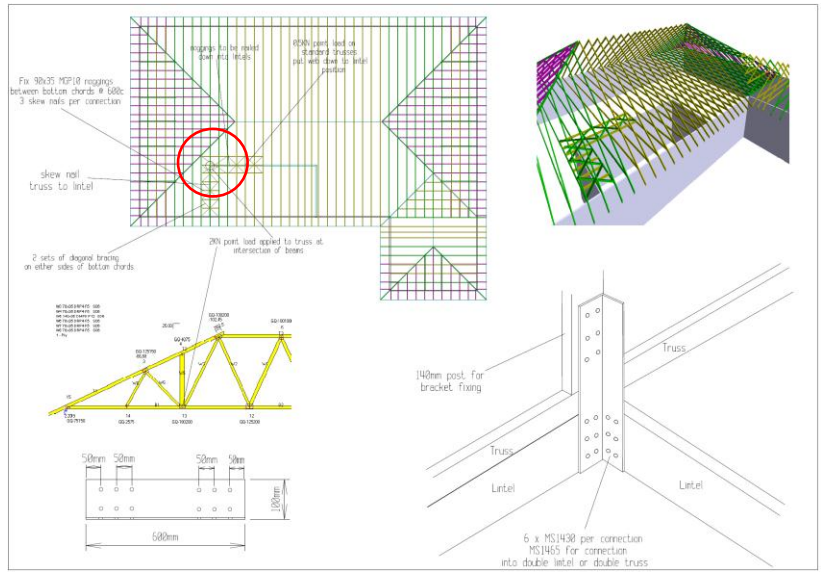
Window Height	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600
600	4	4	6	6	8	8	10	10	12	12	14
900	4	6	8	8	10	12	14	14	16	18	20
1200	6	8	10	12	14	16	18	20	22	24	26
1500	6	8	12	14	16	18	22	24	26	30	32
1800	8	10	14	16	20	22	26	28	32	34	38
2100	8	12	16	18	22	26	30	34	36	40	44
2400	10	14	18	22	26	30	34	38	42	46	50
2700	10	14	20	24	28	34	38	42	48	52	56

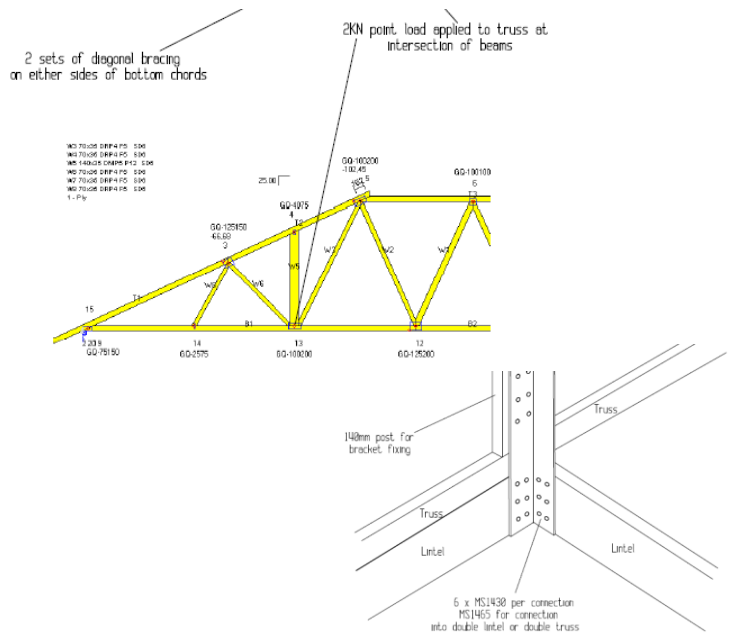
Window & Door fixings

An issue that was highlighted in the Cyclone Yasi damage investigation was external door / door furniture failure.



Stacker Doors (Corner Stackers in Particular)

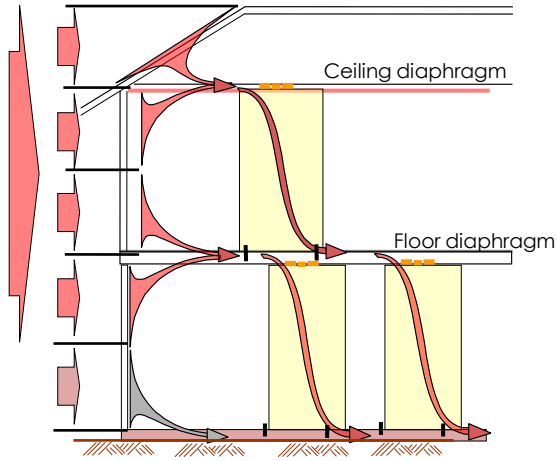

Fix 90x35 MGP10 noggings between bottom chords @ 600c 3 skew nails per connection
skew nail truss to lintel
2 sets of diagonal bracing on either sides of bottom chords
2KN point load applied to truss at intersection of beams
50mm 50mm 50mm 50mm
100mm
600mm
140mm post for bracket fixing
Truss
Truss
Lintel
Lintel
6 x MS1430 per connection MS1465 for connection into double lintel or double truss


2 sets of diagonal bracing on either sides of bottom chords
2KN point load applied to truss at intersection of beams
140mm post for bracket fixing
Truss
Truss
Lintel
Lintel
6 x MS1430 per connection MS1465 for connection into double lintel or double truss

Questions

Bracing

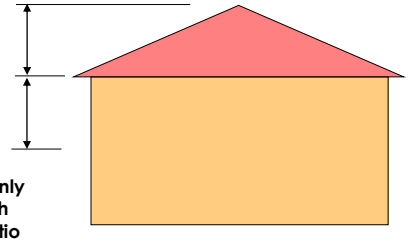
Bracing



When wind flows over a building it applies different pressures (forces) on a flat vertical wall to that on the sloping roof surface.

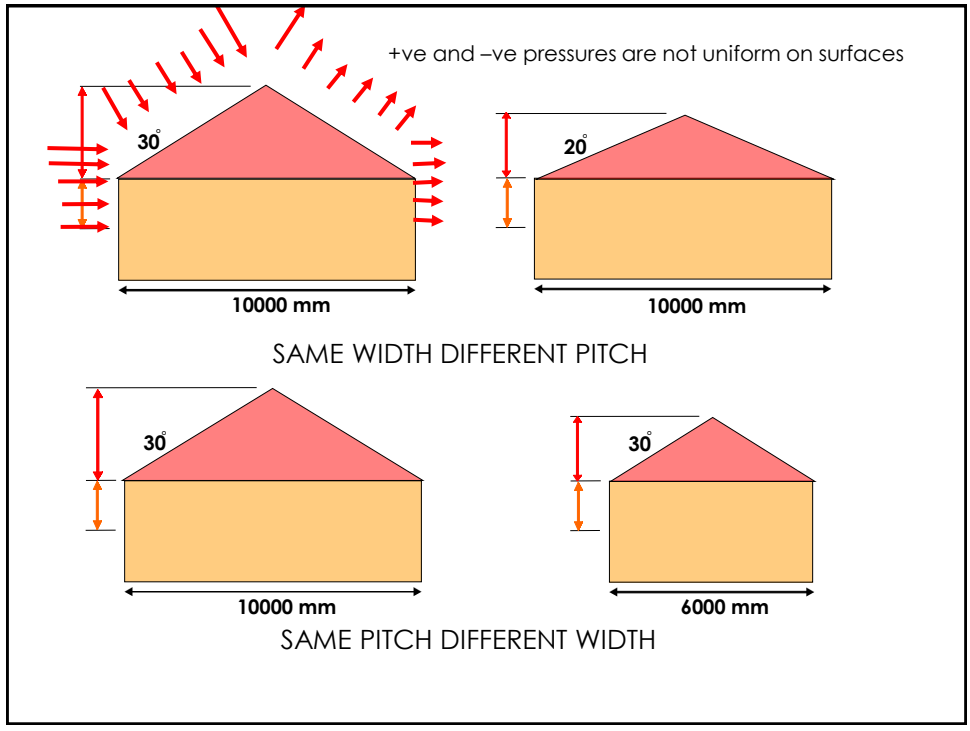
Pressure on roof 1.4 kPa*

Pressure on wall 2.0 kPa*



*** These values are indicative only (C2) and will vary with roof pitch and building height to depth ratio etc.**

The tables need to know the ratio between how much roof area the wind 'sees' as opposed to how much wall area the wind 'sees'. The building width and roof pitch establish this ratio.



8.3.3 Area of elevation

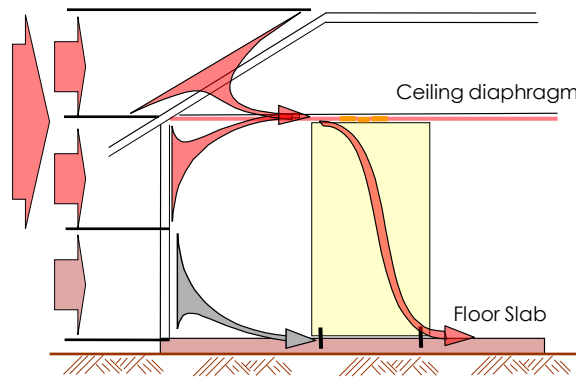
Except for very simple L, H or U shapes where each 'part' of the building has an identical width and pitch and/or contains no vertical surface in the roof area such as a gable or skillion, each of the 'parts' **MUST** be considered individually and **NOT** added together.

8.3.3 Area of elevation

bracing....., shall be distributed throughout the house approximately in proportion to the forces (or areas) relevant to each shape
(see Clause 8.3.6.6 Location and distribution of bracing walls).

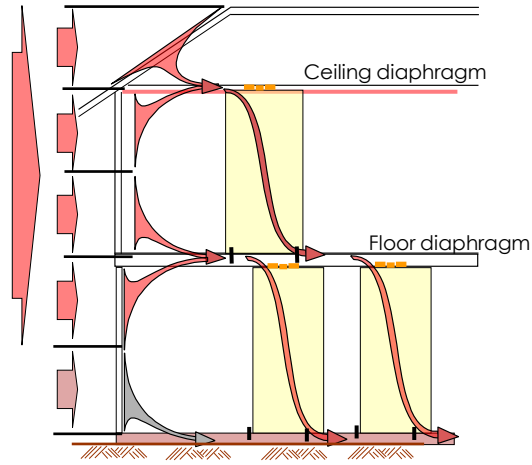
As indicated by Figures 8.2 (A) and Note 1, the area of an elevation includes only the top half of the wall.

This is the area used to calculate single or upper storey bracing



For lower storey of two storey

This is the area used to calculate lower storey bracing



8.3.1 Area of elevation

If a verandah or the like is present and is to be enclosed, it shall be included in the 'area of elevation' calculations.

A verandah should be considered enclosed if :- (a) any part of the main building projects out into the verandah, or
(b) an end(s) is filled in with lattice or similar.

8.3.4 Racking force

The total racking force, in kN, shall be calculated as follows:

Projected area of elevation (m^2)

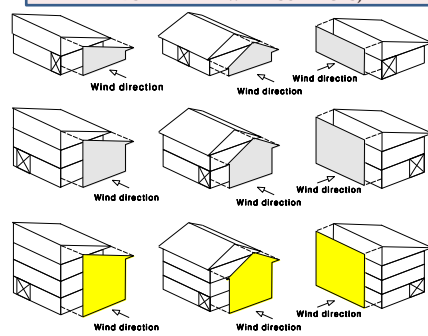
x

Lateral wind pressure (kPa)

= Total racking force

Table 8.1

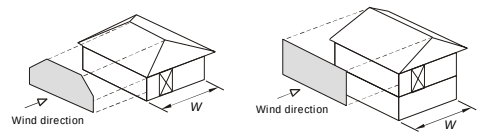
PRESSURE (kPa) ON AREA OF ELEVATION (m^2)—SINGLE STOREY, UPPER OF TWO STOREYS, LOWER STOREY OR SUBFLOOR OF SINGLE STOREY OR TWO STOREYS—ALL VERTICAL SURFACE ELEVATIONS (GABLE ENDS, SKILLION ENDS AND FLAT WALL SURFACES)



Wind classification	Pressure, kPa
C1	1.4
C2	2.1
C3	3.2

TABLE 8.2

PRESSURE (kPa) ON PROJECTED AREA—SINGLE STOREY OR UPPER OF TWO STOREY-Wind 90° to Ridge continued –HIP OR GABLE ENDS

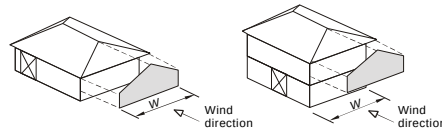


C2

W (m)	Roof pitch (degrees)							
	0	5	10	15	20	25	30	35
C2								
4.0	2.0	1.7	1.6	1.4	1.4	1.7	1.8	1.8
5.0	2.0	1.7	1.5	1.3	1.3	1.6	1.8	1.7
6.0	2.0	1.6	1.4	1.3	1.4	1.6	1.7	1.7
7.0	2.0	1.6	1.4	1.2	1.4	1.6	1.7	1.7
8.0	2.0	1.5	1.3	1.2	1.4	1.6	1.7	1.7
9.0	2.0	1.5	1.3	1.1	1.4	1.7	1.7	1.7
10.0	2.0	1.4	1.2	1.1	1.4	1.7	1.6	1.7
11.0	2.0	1.4	1.2	1.1	1.4	1.7	1.6	1.8
12.0	2.0	1.4	1.1	1.1	1.5	1.7	1.7	1.8
13.0	2.0	1.3	1.1	1.1	1.5	1.7	1.7	1.8
14.0	2.0	1.3	1.0	1.2	1.5	1.7	1.7	1.8
15.0	2.0	1.3	0.97	1.2	1.5	1.7	1.7	1.8
16.0	2.0	1.2	0.93	1.2	1.5	1.7	1.7	1.8

TABLE 8.4

PRESSURE (kPa) ON PROJECTED AREA—SINGLE STOREY OR UPPER OF TWO-STOREY–Wind parallel to Ridge –HIP ENDS



C2

W (m)	Roof pitch (degrees)							
	0	5	10	15	20	25	30	35
C2								
4.0	2.1	2.0	1.9	1.8	1.8	1.8	1.9	1.9
5.0	2.1	2.0	1.8	1.7	1.7	1.8	1.9	1.8
6.0	2.1	1.9	1.8	1.7	1.7	1.8	1.8	1.8
7.0	2.1	1.9	1.7	1.6	1.7	1.8	1.8	1.8
8.0	2.1	1.9	1.7	1.6	1.7	1.8	1.8	1.8
9.0	2.1	1.8	1.7	1.5	1.7	1.8	1.8	1.8
10.0	2.1	1.8	1.6	1.5	1.7	1.8	1.8	1.8
11.0	2.1	1.8	1.6	1.5	1.7	1.8	1.8	1.8
12.0	2.1	1.8	1.5	1.5	1.7	1.8	1.8	1.8
13.0	2.1	1.7	1.5	1.5	1.7	1.8	1.8	1.8
14.0	2.1	1.7	1.4	1.5	1.7	1.8	1.8	1.8
15.0	2.1	1.7	1.4	1.5	1.7	1.8	1.8	1.9
16.0	2.1	1.7	1.4	1.5	1.7	1.8	1.8	1.9

8.3.6 Wall bracing

8.3.6.1 *General*

Walls shall be permanently braced to resist horizontal racking forces applied to the building. Wall bracing shall be designed to resist racking forces equal to or greater than the forces calculated from Clause 8.3.4.

The total capacity of bracing walls shall be the sum of the bracing capacities of individual walls. See Table 8.18 for the capacity of structural bracing walls.

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Temporary Bracing 2

AS 1684 only requires temporary bracing to be 60% of the permanent bracing and this reflects the lower probability of a building being subjected to its long term maximum design gust wind speed event, during the relatively short period of construction.




8.3.6.2 *Nominal wall bracing*

The minimum length of nominal bracing walls shall be 450 mm. The maximum amount that can be resisted by nominal wall bracing is 50% of the total racking forces

TABLE 8.17

NOMINAL SHEET BRACING WALLS

Method	Bracing capacity (kN/m)
Sheeted one side only	0.45 kN/m
Sheeted two sides	0.75 kN/m

8.3.6.3 *Structural wall bracing*

The capacity of sheet bracing given in bracing types (g) to (m) in Table 8.18 is based on fixing the sheeting to framing having a minimum joint strength group of J4 or JD4.

If JD5 is used, the bracing capacity given in bracing types (g) to (m) in Table 8.18 shall be reduced by 12.5%. due to the reduced shear capacity of fixings in JD5 material.

WALL HEIGHT ADJUSTMENT - EXAMPLE:

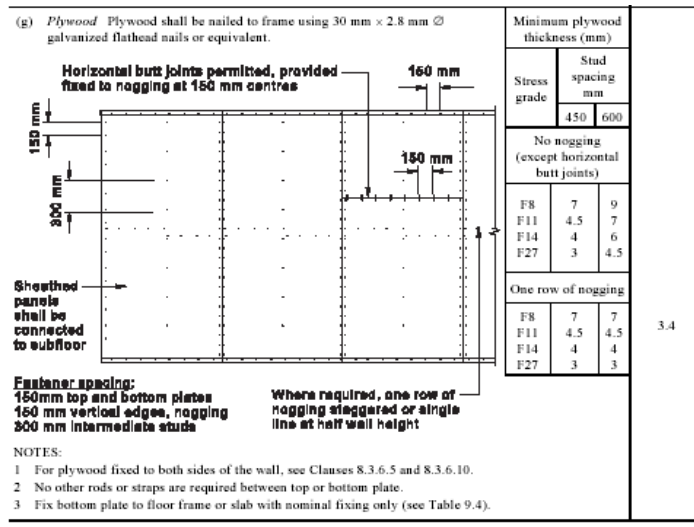
For a brace rated at 6.4kN/m @ 2700 mm high - @ 3600 mm high will be rated at 6.4 x 2700/3600(0.75) = 4.8kN/m.

TABLE 8.19

BRACING WALL CAPACITY/HEIGHT MULTIPLIER

Wall height (mm)	Multiplier
3000	0.9
3300	0.8
3600	0.75
3900	0.7
4200	0.64

Walls rated up to 3.4kN/m nominally fixed at bottom – why – because!



8.3.6.5 *Length and capacity for short plywood bracing walls*

The capacity of plywood systems (g) and (h) Method A in Table 8.18, for panel lengths between 600 and 900 mm wide, may be determined by multiplying the respective capacities by 0.5 for 600 mm wide varying linearly to 1.0 for 900 mm.

8.3.6.9 Fixing of top of bracing walls

All internal bracing walls shall be fixed to —
(a) the floor for lower storey bracing walls;
(b) the ceiling or roof frame; and/or
(c) the external wall frame,
with structural connections of equivalent shear capacity to the bracing capacity of that particular bracing wall.
Nominal and other bracing walls with bracing capacity up to 1.5 kN/m require nominal fixing only, i.e. no additional fixing requirements.

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Fixing of Top of Bracing Walls 5

Internal bracing walls can be connected to the floor/ceiling/roof diaphragm either directly (a connection at the actual position of the bracing wall) or at some other position in the same wall but away from the actual brace.

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GUIDE TO THE USE OF AS 1684

Fixing of Top of Bracing Walls

5

For this latter case, the top plate in the wall will need to provide a continuous tie from the braced section of wall to where the top plate is connected such as at an external wall.

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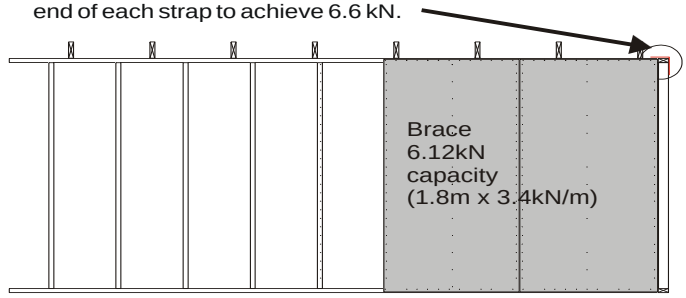
Fixing of Top of Bracing Walls

5

Example 1 - Strapping to external walls

Connect braced wall to external wall using 2 straps as per Table 8.22 (k). For JD4 pine, 4/2.8 dia nails required each end of each strap to achieve 6.6 kN.



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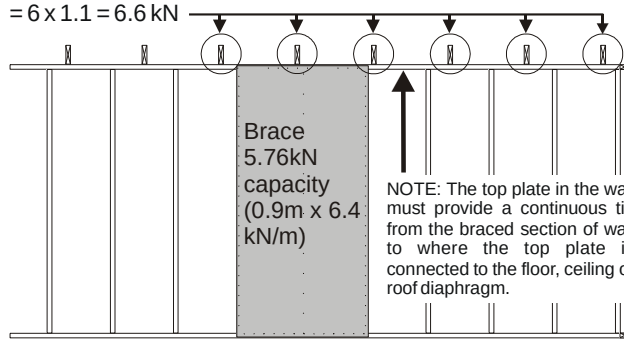
Fixing of Top of Bracing Walls 5

Example 2 - Nailing floor or ceiling joists to walls

Connect braced wall to 6 ceiling joists using 2/3.05 dia skew nails per joist as per Table 8.22 (i). For JD4 pine, capacity = 6 x 1.1 = 6.6 kN



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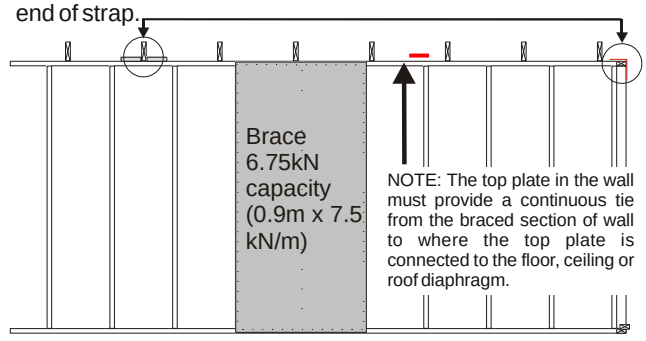
Fixing of Top of Bracing Walls 5

Example 3 - Combinations

Connect braced wall to ceiling joists or truss bottom chords with blocking as per Table 8.22 (j) 4/3.05 dia nails to each block + one strap to the external wall with 4/2.8 dia nails each end of strap.



8.3.6.10 *Fixing of bottom of bracing walls*

Details included in Table 9.18 may also be used to fix bottom plates to timber-framed floors where their uplift capacities are appropriate.

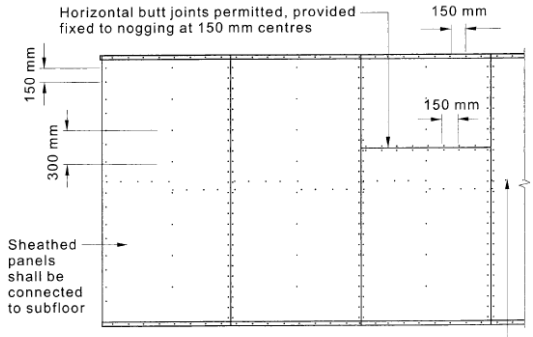
Table 8.24

Uplift force at end of bracing walls

Wall height (mm)	Uplift force at ends of bracing walls (kN) For bracing walls rated at (kN/m) capacity												
	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	8	10
2400	2.4	3.6	4.8	6.0	7.2	8.4	10	11	12	13	14	19	24
2700	2.7	4.1	5.4	6.8	8.1	9.5	11	12	14	15	16	22	27
3000	3.0	4.5	6.0	7.5	9.0	11	12	14	15	17	18	24	30

1.Some bracing wall systems require fixings to be full-length anchor rods, that is from the top plate to the floor frame or concrete slab.
2.The maximum tension load of 8.5 kN given in the Notes to Span Tables for studs in the Supplements is not applicable when considering the uplift force at the ends of bracing walls.
3.Where provided, the bottom plate tie-down details given in Table 8.18 may be used in lieu of the details determined from Tables 8.24 and 8.25.

(g) *Plywood* Plywood shall be nailed to frame using 30 mm × 2.8 mm Ø galvanized flat-head nails or equivalent.



Minimum plywood thickness (mm)		
Stress grade	Stud spacing mm	
	450	600
No nogging (except horizontal butt joints)		
F8	7	9
F11	4.5	7
F14	4	6
F27	3	4.5
One row of nogging		
F8	7	7
F11	4.5	4.5
F14	4	4
F27	3	3

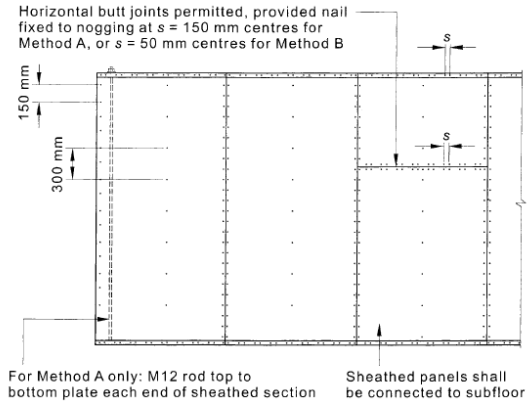
3.4

NOTES:

1 For plywood fixed to both sides of the wall, see Clauses 8.3.6.5 and 8.3.6.10.
2 No other rods or straps are required between top or bottom plate.
3 Fix bottom plate to floor frame or slab with nominal fixing only (see Table 9.4).

(g) *Plywood* Plywood shall be nailed to frame using 30 × 2.8 Ø galvanized flat-head nails or equivalent.

For Method A, M12 rods shall be used at each end of sheathed section top plate to bottom plate/floor frame. Method B has no rods but sheathing shall be nailed to top and bottom plates and any horizontal joints at 50 mm centres.



Minimum plywood thickness (mm)		
Stress grade	Stud spacing (mm)	
	450	600
F8	7	9
F11	6	7
F14	4	6
F27	4	4.5
Fastener spacing, *s* (mm)		
Top and bottom plate:		
— Method A	150	
— Method B	50	
Vertical edges	150	
Intermediate studs	300	
Fixing of bottom plate to floor frame or slab		
Method A: M12 rods as shown plus a 13 kN capacity connection at max. 1200 mm centres		
Method B: A 13 kN capacity connection at each end and intermediately at max. 1200 mm centres		

Method A 6.4
Method B 6.0

NOTE: For plywood fixed to both sides of the wall, see Clauses 8.3.6.5 and 8.3.6.10.

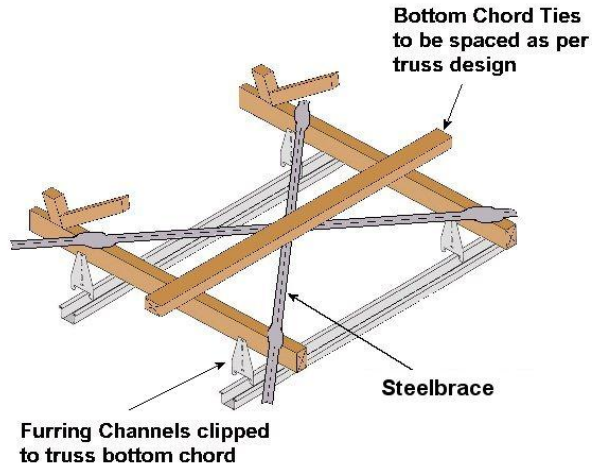
What about double sided bracing walls?

- AS 1684 is fairly 'silent' on what is required, but,
- Everything doubles!!
  - Shear connections at top
  - Tie-down connections
  - Member sizes?
- See EWPAA bracing manual

TABLE 8.21
MAXIMUM SPACING OF BRACING WALLS—WIND CLASSIFICATION
C2

Ceiling depth m	Maximum bracing wall spacing, m								
	Roof pitch, degrees								
	0	5	10	15	17.5	20	25	30	35
≤4	3.9	4.3	4.9	5	4.6	4.2	3.4	2.9	2.8
5	4.9	5.4	6.1	6.2	5.7	5.2	4	3.3	3.1
6	5.9	6.6	7.3	7.4	6.5	5.8	4.4	3.7	3.4
7	6.9	7.9	8.6	8.3	7.2	6.3	4.7	4	3.7
8	7.9	9	9	9	7.7	6.7	5	4.4	3.8
9	8.8	9	9	9	8.4	7.1	5.2	4.8	3.9
10	9	9	9	9	8.9	7.4	5.5	5.2	4.1
11	9	9	9	9	9	7.7	5.8	5.2	4.2
12	9	9	9	9	9	7.9	5.9	5.2	4.3
13	9	9	9	9	9	8.1	6.1	5.3	4.3
14	9	9	9	9	9	8.2	6.1	5.5	4.4
15	9	9	9	9	9	8.5	6.3	5.5	4.5
16	9	9	9	9	9	8.6	6.5	5.7	4.6

Suspended Ceiling Systems



Suspended Ceiling Systems

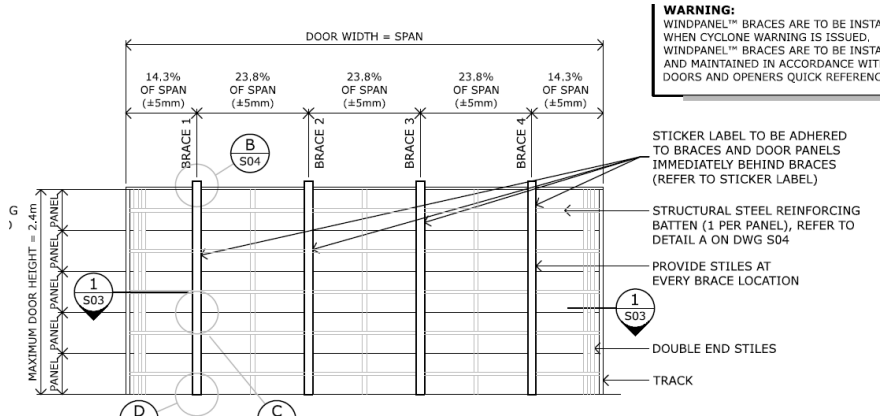
- Suspended ceilings **do not** provide a structural ceiling diaphragm required for building stability.
- Plasterboard ceilings not directly attached to trusses and ceiling battens not directly fixed to bottom chords constitute suspended ceilings (e.g. hung grid systems and clipped in place furring channel systems).
- It is the responsibility of the building designer or builder to provide a suitable engineered ceiling bracing system.
- Do not assume that the truss fabricator has included this even if some bottom chord bracing such as binders and cross bracing has been provided.

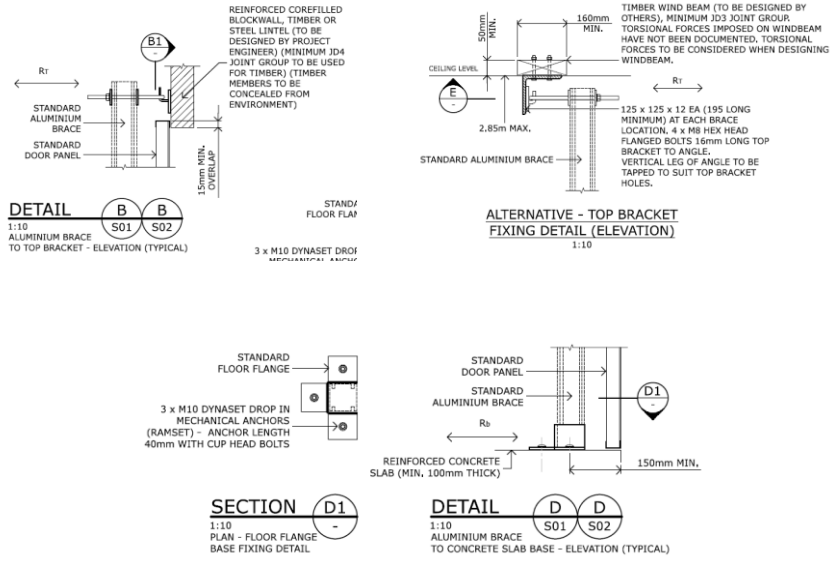
Site issues!

Site issues!

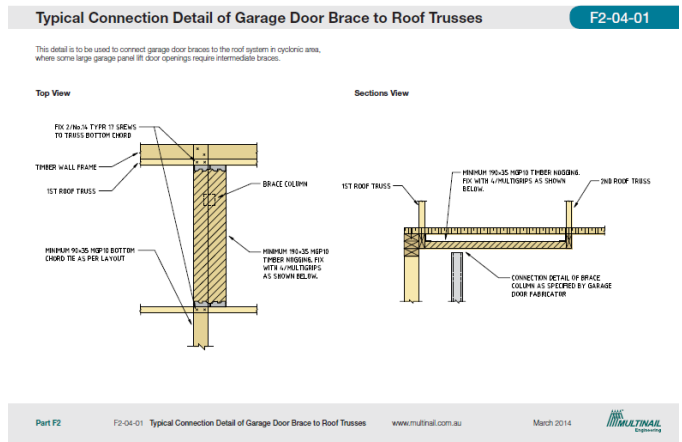
Installation of Garage Doors AS/NZS 4505 - 2012

Installation of Garage Doors

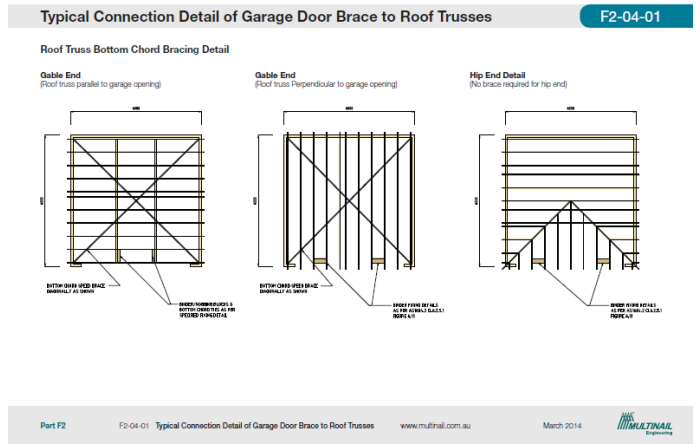




Installation of Garage Doors



Installation of Garage Doors



Typical Connection Detail of Garage Door Brace to Roof Trusses F2-04-01

Roof Truss Bottom Chord Bracing Detail

Gable End
(Roof truss parallel to garage opening)

Gable End
(Roof truss Perpendicular to garage opening)

Hip End Detail
(No brace required for hip end)

Part F2 F2-04-01 Typical Connection Detail of Garage Door Brace to Roof Trusses www.multinail.com.au March 2014

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- MiTek, Pryda and MultiNail
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- QBCC