



Version 5



InsulLiving[®]
Insulated Panel Housing System
by BONDOR[®]

TECHNICAL MANUAL

Single & two storey housing construction

Issue Date: May 2021

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1. ENGINEERING CERTIFICATION

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**BLIGH
TANNER**

19/05/2021
Ref. No. 2019.0738

Bondor - InsulLiving
111 Ingram Road,
Acacia Ridge QLD 4110

Dear Sir/Madam,

Subject: Engineering Certification of "InsulLiving Technical Manual– May 2021"

I hereby confirm that the structural elements included in the Design Manual "InsulLiving Technical Manual" conform with the Building Code of Australia, and the following Australian Standards.

AS 1170.0: 2002 Structural Design Actions Part 0: General Principles
AS 1170.1: 2002 Structural Design Actions Part 1: Permanent, Imposed and Other Actions
AS 1170.2: 2011 Structural Design Actions Part 2: Wind Actions
AS 4055: 2012 Wind Loads for Housing
AS 4600: 2018 Cold Formed Steel Structures

The capacities tabulated have been derived from the following testing undertaken:

- *Static Face Load Testing of Bondor Insulated Panels* - Ref. No. ST0744 - Dated 12 January 2010 by BRANZ
- *Cyclonic Testing of SolarSpan Roofing Panels* - Ref. No. ST0751 - Dated 3 June 2009 by BRANZ
- *Cyclonic Testing of MetecnoPanel and BondorPanel Insulated Wall Panels* - Ref. No. ST0768 - Dated 17 November 2009 by BRANZ
- *Tests of Through Fixings in Bondor Insulated Panels* - Ref. No. ST0750 - Dated 10 June 2009 by BRANZ
- *Indicative Axial Load Tests on Bondor Insulated Panels* - Ref. No. ST0748 - Dated 28 May 2008 by BRANZ
- *Indicative Tests on Bondor Panels* - Ref. No. ST0697 - Dated 17 August 2009 by BRANZ
- *Static Racking and Axial Compression Load Tests on Insulated Sandwich Wall Panels* - Ref. No. TS727 - Dated March 2009 by James Cook University
- *Non-Cyclonic Testing of Bondor FlameGuard Panels* - Ref. No. C100503 - Dated 4 August 2010 by The University of Adelaide

The intent of the manual is to provide building design technical support for the use of Structural Engineers.

Yours faithfully,



Rod Bligh
MIEAust, RPEQ 3514
BLIGH TANNER PTY LTD

2. DESIGN PHILOSOPHY

This manual describes the structural design elements of single and double storey residential house constructions using InsulWall® EPS-FR (expanded polystyrene with fire-retardant) insulated sandwich panel as the primary structural wall elements and SolarSpan® (EPS-FR) roof panel to complete a fully insulated domestic housing application. InsulWall® (Mineral Wool) panels can also be prescribed for specific applications where improved heat and fire rating is required.

The top storey of a double storey house is designed similar to a single storey house using the wall panels to provide bracing and support for the roof. The InsulWall® panels are not to be used to support the suspended first floor. The first floor is supported by a separate steel frame (columns and bearers) hidden in the wall and floor zones. Bracing of the lower storey can be provided by the wall panel or additional vertical bracing elements if required. External wall panels run continuously past and tied to the first floor structure. The ground floor and footings are designed using traditional methods.

2.1. Floor system

A traditional concrete slab or a subfloor framing system may be designed to cater for the anticipated loads from the building.

If a reinforced concrete footing and ground bearing slab solution is to be designed in accordance with AS 2870 - *Residential Slabs and Footings – Construction*, an equivalent construction of Masonry veneer can be utilised provided the building is articulated using expansion joints at 6m maximum centres.

2.2. Wall framing

The InsulWall® panel is an insulated sandwich panel that relies on the bond between the steel skins and the EPS-FR (or Mineral Wool) to act compositely. This composite action enables an effective depth between the steel skins for an increased bending capacity. Typically 140mm thick panels are used for external walls, and 90mm thick panels for internal walls in residential constructions.

The panels can be used as load bearing structural elements to support the roof load and to restrain against wind loading. Refer to the WALL DESIGN section in this manual for load capacities and maximum spans.

Where openings are needed, the stiffened top wall plate member is designed to span across the opening. A heavy duty lintel may be required for larger openings and loads. The stiffened top wall plate and lintel may need to be supported by columns for larger loads or specific applications as explained in the WALL DESIGN section.

2.3. Roof

The InsulLiving domestic house philosophy has been based on incorporating lightweight construction, including SolarSpan® as an insulated roof panel system, spanning to the load bearing elements. However, a traditional trussed roof system can also be specified.

2.4. Stability

Stability of the house is achieved using specific walls as bracing members. Walls that are utilised as bracing require screw fixings and holding down bolts as specified.

The racking capacity of the bracing wall panel increases as a value per metre when there are continuous adjoining panels. Utilising uninterrupted internal wall runs is beneficial in minimising the total length of bracing walls required.

2.5. Cyclonic design considerations

Specific cyclic testing is required to certify suitability of cladding elements in cyclonic wind regions defined in AS 1170.2. The following tests have been completed to allow use in these areas.

2.5.1. Wall testing

The InsulWall® EPS-FR 'BondorPanel' has been tested in accordance with the Lo-Hi-Lo requirements of AS4040 by BRANZ (Test Report ST0768). This testing was completed with a mushroom bolt fixing acting in pull-out on the supporting member. The InsulWall® channel provides the panel with a positive bearing connection that does not rely on tension in the fixings; therefore the testing completed on the wall panel is adequate for specification in cyclonic regions.

2.5.2. Roof testing

The SolarSpan® roofing system has been tested in accordance with the BCA Low-High-Low testing requirements. The roof requires 14g screw fixings at each rib and pan to achieve the specified capacities.

2.5.3. Cyclic racking

Cyclic racking testing has been conducted for the InsulWall® EPS-FR & Mineral Wool panels by James Cook University Cyclone Testing Station (Test Report TS816). A testing regime similar to the Low-High-Low has been utilised and the racking capacities shown to be no less than the non-cyclonic region.

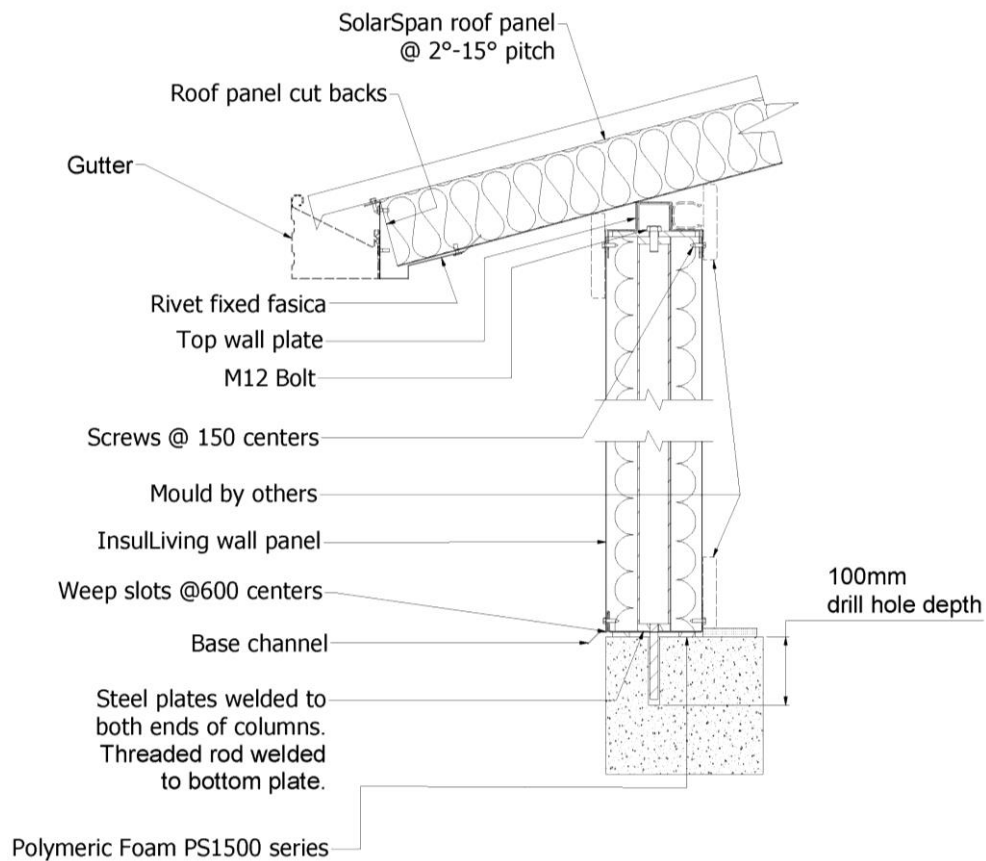
2.6. Bushfire performance

For bushfire zones the structure is to contain additional members or provisions that ensure redundancy of the panels if they are axially loaded or engaged in any other critical structural function.

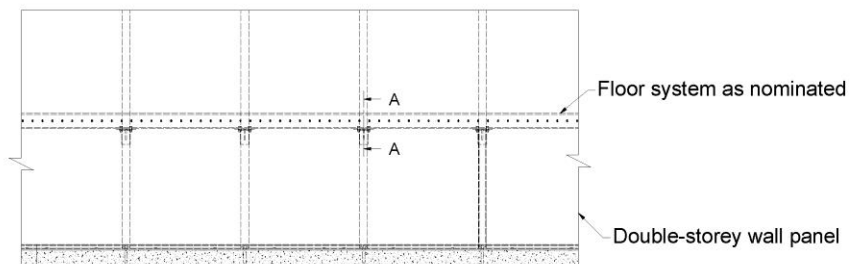
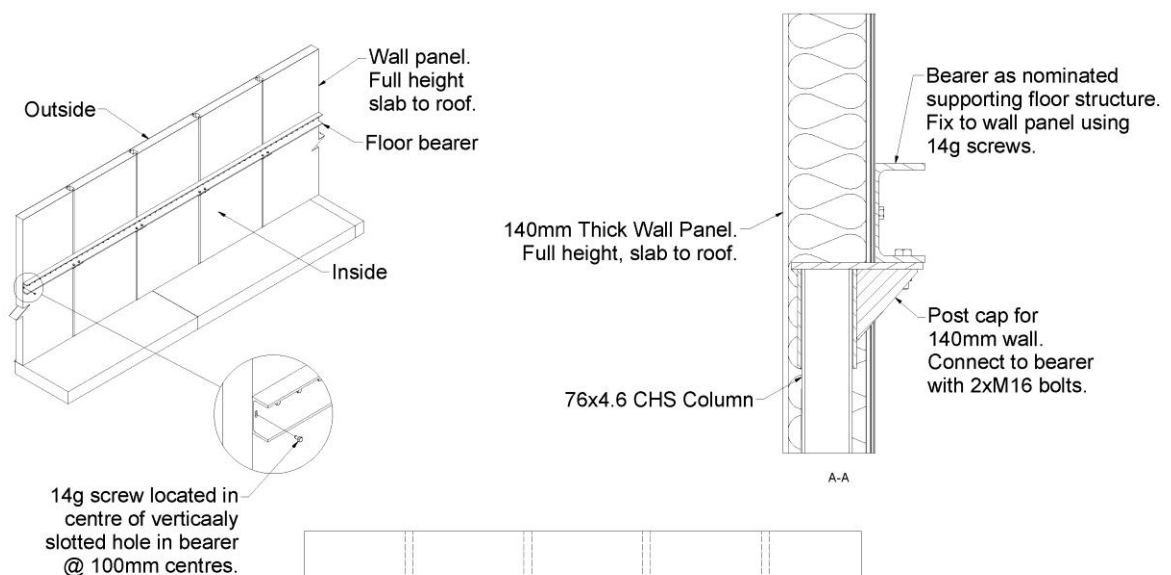
To satisfy this condition a steel frame structure should be incorporated into the wall panel to support the roof. This structure comprises of a cold formed steel wall plate which runs continuously around the external perimeter. This member is supported by 48 CHS 3.2 columns at max 3.6m centres - refer section 3.6.6 for column capacities.

For further information please refer to "Building Code of Australia Deemed to Satisfy Assessment" reports by CHGroup, titled: Construction in Designated Bushfire Prone Areas up to BAL40 (for SolarSpan® roofing panel & rendered InsulWall® panel).

2.7. Typical sections



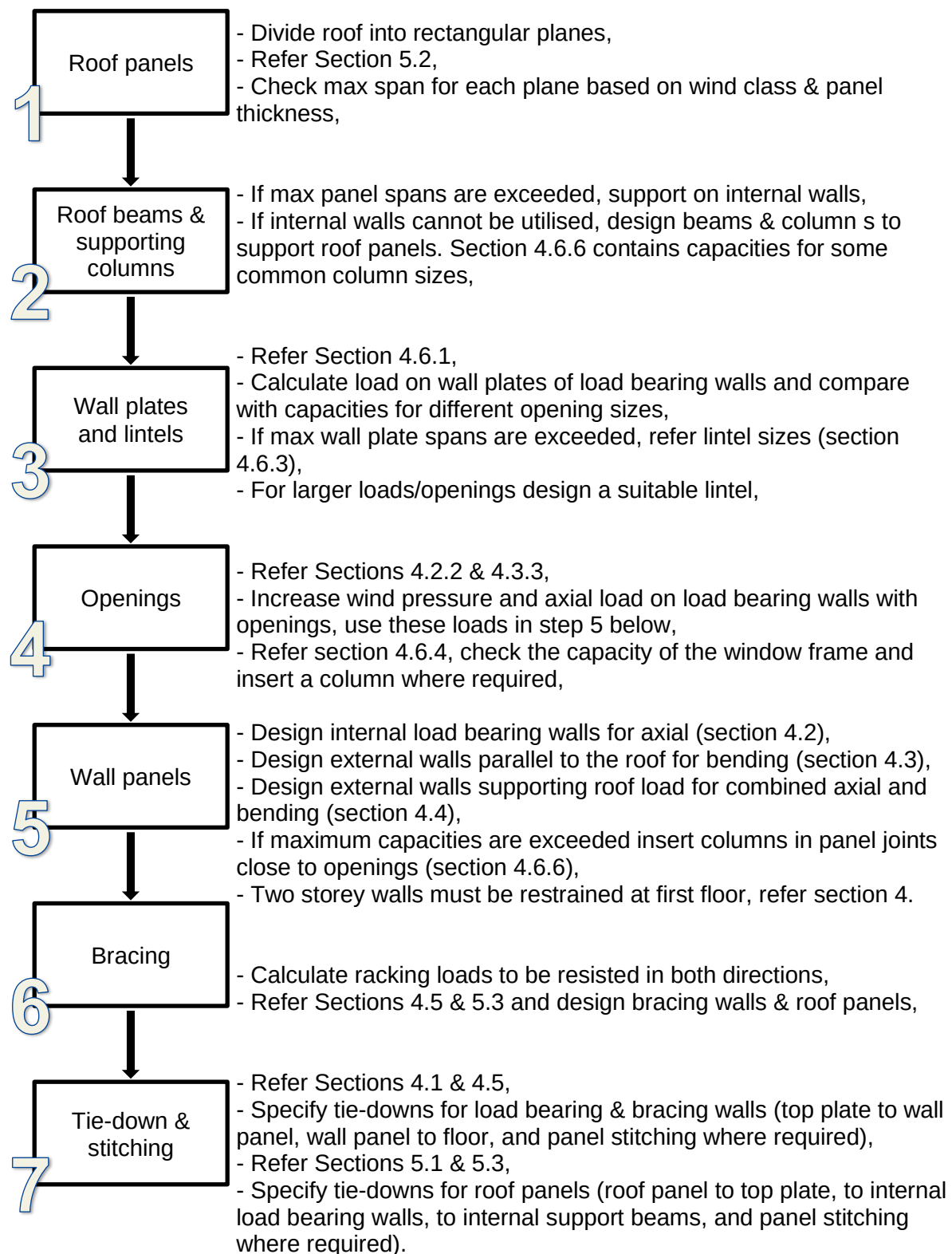
Single storey application



Two storey application

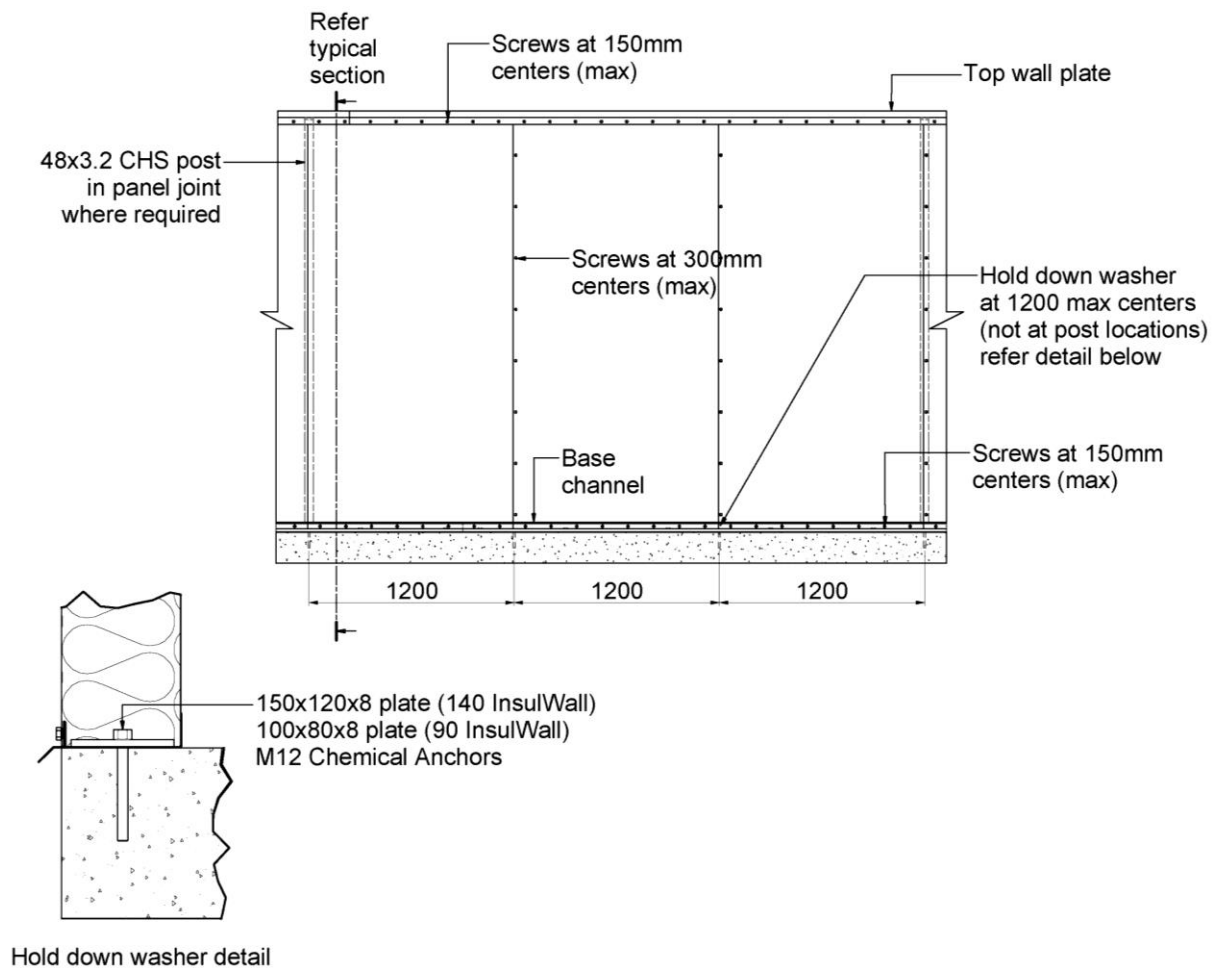
3. DESIGN PROCEDURE

The following flowchart summarises the main steps in the engineering design of InsulLiving®.



4. WALL DESIGN

4.1. Main components & fixing recommendations



Typical wall elevation (non-bracing)

Note:

- Load Bearing Walls: chemical anchors and base plate hold down washers at 1200mm max centres.
- Bracing Walls: chemical anchors and base plate hold down washers at 600mm max centres.
- Non-Load Bearing Walls: masonry mechanical anchors at 1200mm max centres, no base channel washers required.

4.2. Axial tension and compression

4.2.1. Axial capacities

The axial capacities of InsulWall® (EPS-FR and Mineral Wool) panel are similar in compression & tension for all panel widths.

Screw Centres	Axial Capacity (Compression & Tension) ³
150 mm	8.5 kN/m

Notes:

1. Screws are fixed to the base and top channels each side of the wall.
2. Base plate holding down washers and bolts are provided at 1200 mm maximum centres for non-bracing walls and at 600 mm maximum centres for bracing walls.
3. In double storey applications, compression capacity relies on horizontal restraints at 4.2m maximum vertical centres to prevent buckling (e.g. floor or roof effectively tied to the wall).

4.2.2. Increased axial load due to openings

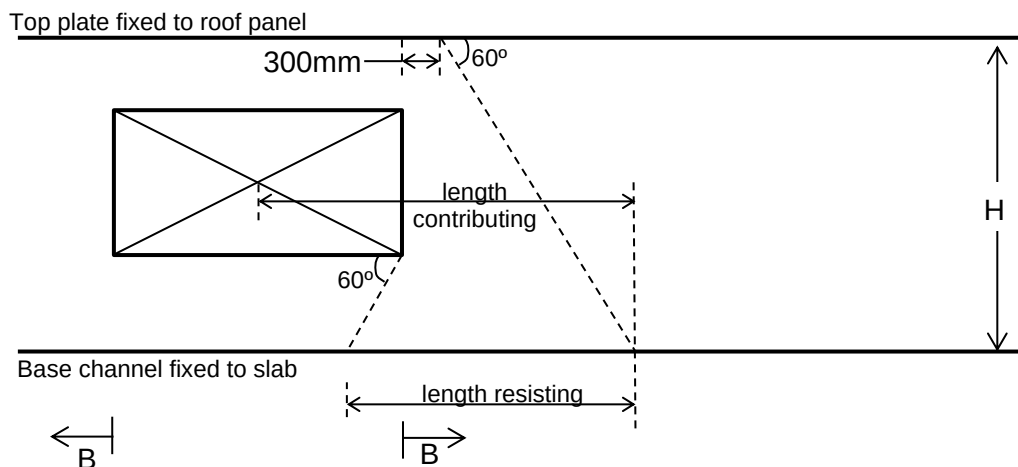
Arrangement 1

Continuous wall panel with single opening:

$$\text{Increased axial load} = \text{ULS axial load} \times \frac{\text{Wall length contributing}}{\text{Wall length resisting}}$$

Notes:

1. Increased axial load must be greater than or equal to ULS axial load
2. Distance to adjacent opening, $B \geq 1.15H + 600$ from adjacent opening



B = Distance to adjacent opening

Arrangement 2

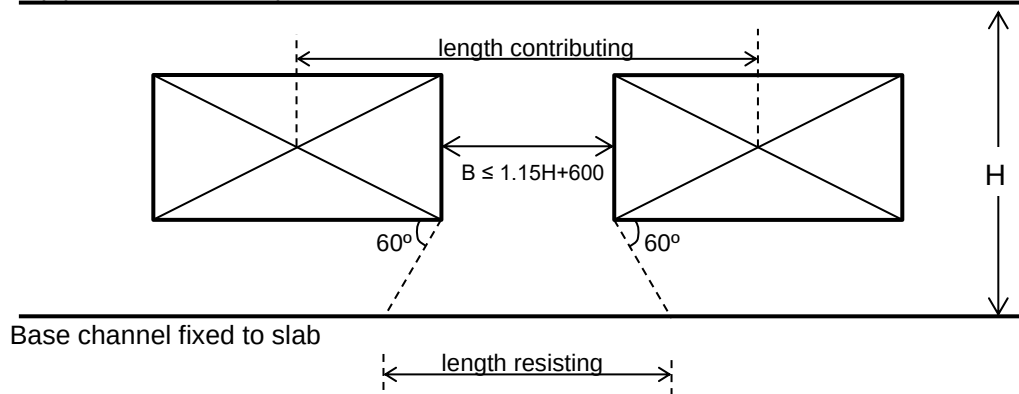
Continuous wall panel with two openings within a distance (B) less than or equal to 1.15H+600:

$$\text{Increased axial load} = \text{ULS axial load} \times \frac{\text{Wall length contributing}}{\text{Wall length resisting}}$$

Notes:

1. Increased axial load must be greater than or equal to ULS axial load
2. Assume windows are of similar size
3. For B greater than 1.15H+600 refer arrangement 1

Top plate fixed to roof panel



Arrangement 3

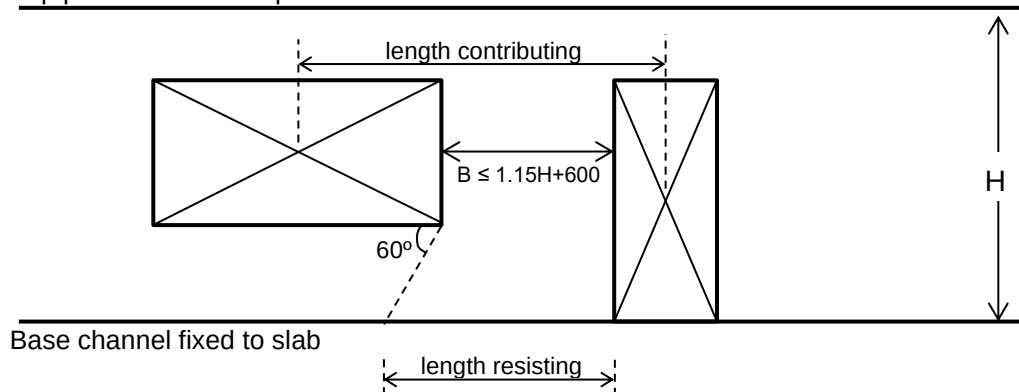
Wall panel with window & door (or full height window) openings:

$$\text{Increased axial load} = \text{ULS axial load} \times \frac{\text{Wall length contributing}}{\text{Wall length resisting}}$$

Notes:

1. Increased axial load must be greater than or equal to ULS axial load
2. For B greater than 1.15H+600 refer arrangement 1

Top plate fixed to roof panel



4.3. Lateral wind load

4.3.1. InsulWall® (EPS-FR) panel

Cyclonic & non-cyclonic wind capacities

Please note maximum deflection of span / 150 has been allowed for Serviceability Limit State.

Single storey

InsulWall® EPS-FR - Maximum ULS wind pressure (kPa)							
Panel Thickness (mm)	Wall height (mm)						
	2400	2700	3000	3300	3600	3900	4200
90	3.8	3.4	3.0	2.6	2.2	1.9	1.6
140	5.9	5.3	4.7	4.1	3.4	2.9	2.5

Double storey

140 InsulWall® EPS-FR - Maximum ULS wind pressure (kPa)							
Horizontal restraint spacing (mm)	Wall height to horizontal restraint (mm)						
	2400	2700	3000	3300	3600	3900	4200
Screws @ 100c/c	1.83	1.63	1.47	1.33	1.22	1.13	1.05
Screws @ 50c/c	3.67	3.26	2.93	2.67	2.44	2.26	2.10

Notes:

1. Double storey walls are restrained horizontally at the first floor by face fixing the bearer using 14g screws to the internal skin of the wall at spacing specified.

Maximum spans

These spans are specific to 140mm external EPS-FR wall panels in domestic applications, subject only to lateral wind load.

Single storey

140mm InsulWall® EPS-FR - Maximum heights (mm)				
Wind Class	ULS Wind Pressure (kPa)		Maximum height (mm)	
	Within 1200mm of a corner	Away from corners	Within 1200mm of a corner	Away from corners
N2	-1.44	0.96	5400	6600
N3	-2.25	1.5	4200	5400
N4	-3.35	2.23	3600	4200
C1	-3.00	-2.03	3600	4500
C2	-4.47	-3.01	3000	3600
C3	-6.57	-4.44	2100	3000
C4	-8.88	-5.99	1500	2100

Notes:

1. Wind speeds and coefficients based on AS 4055 - Wind Loads for Housing.
2. Wall pressure coefficients:

- 1.2m from corners - $C_{pe}.K_l = -1.3$, $C_{pi} = +0.2$ (Non-cyclonic), $+0.7$ (Cyclonic)
 Away from corners - $C_{pe}.K_l = +0.7$, $C_{pi} = -0.3$ (Non-cyclonic), -0.65 (Cyclonic)
 3. Serviceability deflection limit of span/150 has been allowed for.

Double storey

140mm InsulWall® EPS-FR - Maximum heights (mm)					
Wind Class	ULS Wind Pressure (kPa)		Horizontal restraint spacing (mm)	Maximum wall height to horizontal restraint (mm)	
	Within 1200mm of a corner	Away from corners		Within 1200mm of a corner	Away from corners
N2	-1.44	0.96	100	3000	4200
			50	4200	4200
N3	-2.25	1.5	100	-	2700
			50	3900	4200
N4	-3.35	2.23	100	-	-
			50	2400	3900

Notes:

1. Wind speeds and coefficients based on AS 4055 - Wind Loads for Housing.
 2. Wall pressure coefficients:
 1.2m from corners - $C_{pe}.K_l = -1.3$, $C_{pi} = +0.2$ (Non-cyclonic), $+0.7$ (Cyclonic)
 Away from corners - $C_{pe}.K_l = +0.7$, $C_{pi} = -0.3$ (Non-cyclonic), -0.65 (Cyclonic)
 3. Serviceability deflection limit of span/150 has been allowed for.

4.3.2. InsulWall® (Mineral Wool) panel

Cyclonic & non-cyclonic wind capacities

Please note maximum deflection of span / 150 has been allowed for Serviceability Limit State.

Single storey

150 InsulWall® Mineral Wool - Maximum ULS wind pressure (kPa)							
Panel Thickness (mm)	Wall height (mm)						
	2400	2700	3000	3300	3600	3900	4200
100	2.3	2.1	1.9	1.7	1.6	1.5	1.3
150	3.5	3.1	2.8	2.6	2.3	2.2	2.0

Double storey

150 InsulWall® Mineral Wool - Maximum ULS wind pressure (kPa)							
Horizontal restraint spacing (mm)	Wall height to horizontal restraint (mm)						
	2400	2700	3000	3300	3600	3900	4200
Screws @ 100c/c	1.83	1.63	1.47	1.33	1.22	1.13	1.05
Screws @ 100c/c	2.81	2.5	2.25	2.05	1.88	1.73	1.61

Notes:

1. Double storey walls are restrained horizontally at the first floor by face fixing the bearer using 14g screws to the internal skin of the wall at spacing specified.

Maximum spans

These spans are specific to 150mm external Mineral Wool wall panels in domestic applications subject only to lateral wind load.

150mm InsulWall® Mineral Wool - Maximum heights (mm)				
Wind Class	ULS Wind Pressure (kPa)		Maximum height (mm)	
	Within 1200mm of a corner	Away from corners	Within 1200mm of a corner	Away from corners
N2	-1.44	0.96	5100	6300
N3	-2.25	1.5	3600	5100
N4	-3.35	2.2	2400	3600
C1	-3.00	-2.03	2700	3900
C2	-4.47	-3.01	1800	2700
C3	-6.57	-4.44	-	1800
C4	-8.88	-5.99	-	-

Notes:

1. Wind speeds and coefficients based on AS 4055 - Wind Loads for Housing.
2. Wall pressure coefficients:
 - 1.2m from corners - $C_{pe}.K_l = -1.3$, $C_{pi} = +0.2$ (Non-colonic), $+0.7$ (Cyclonic)
 - Away from corners - $C_{pe}.K_l = +0.7$, $C_{pi} = -0.3$ (Non-cyclonic), -0.65 (Cyclonic)
3. Serviceability deflection limit of span/150 has been allowed for.

Double storey

150mm InsulWall® Mineral Wool - Maximum heights (mm)					
Wind Class	ULS Wind Pressure (kPa)		Horizontal restraint spacing (mm)	Maximum wall height to horizontal restraint (mm)	
	Within 1200mm of a corner	Away from corners		Within 1200mm of a corner	Away from corners
N2	-1.44	0.96	100	3000	4200
			50	4200	4200
N3	-2.25	1.5	100	-	2700
			50	3000	4200
N4	-3.35	2.23	100	-	-
			50	-	3000

Notes:

1. Wind speeds and coefficients based on AS 4055 - Wind Loads for Housing.
2. Wall pressure coefficients:
 - 1.2m from corners - $C_{pe}.K_l = -1.3$, $C_{pi} = +0.2$ (Non-colonic), $+0.7$ (Cyclonic)
 - Away from corners - $C_{pe}.K_l = +0.7$, $C_{pi} = -0.3$ (Non-cyclonic), -0.65 (Cyclonic)
3. Serviceability deflection limit of span/150 has been allowed for.

4.3.3. Increased lateral wind load due to openings

Wall wind pressure is increased when large window or door openings are added. The increase in pressure is calculated as shown here based on opening positions. The width of the opening is the critical element; hence the height of the opening is not included in these calculations.

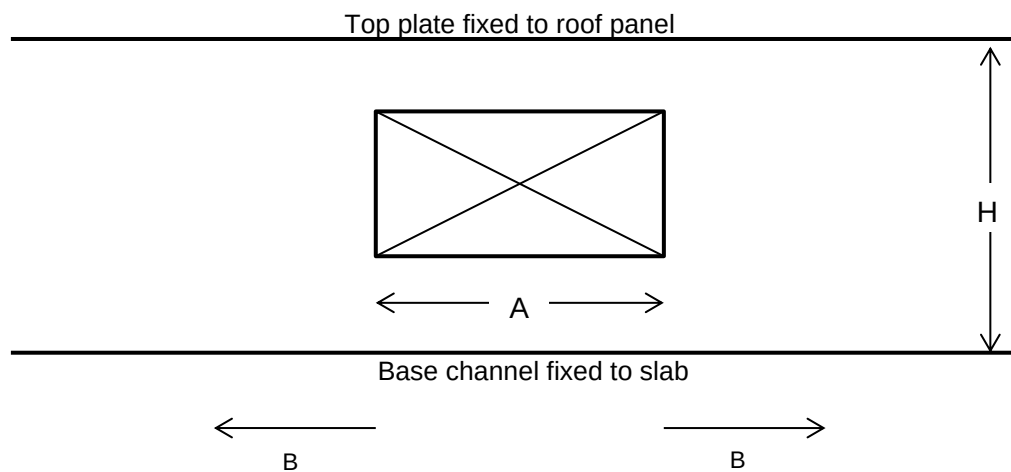
Arrangement 1

Continuous wall panel with single opening:

$$\text{Increased wind load} = \text{ULS wind pressure} \times \frac{\left(\frac{A}{2} + 0.25H\right)}{0.25H}$$

Notes:

1. $B \geq 0.5H$ from adjacent opening
2. $B \geq 0.25H$ from buttress/return wall



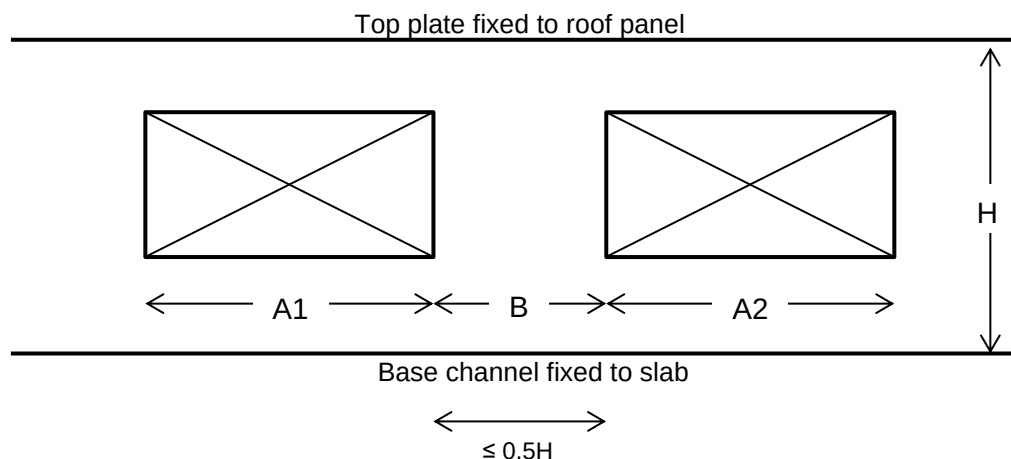
Arrangement 2

Continuous wall panel with two openings within a distance (B) less than or equal to half the height of the wall:

$$\text{Increased wind load} = \text{ULS wind pressure} \times \frac{\left(\frac{A_1 + A_2}{2} + B\right)}{B}$$

Notes:

1. $B \leq 0.5H$
2. For B greater than $0.5H$ refer arrangement 1
3. Assume A_1 & A_2 are of similar size



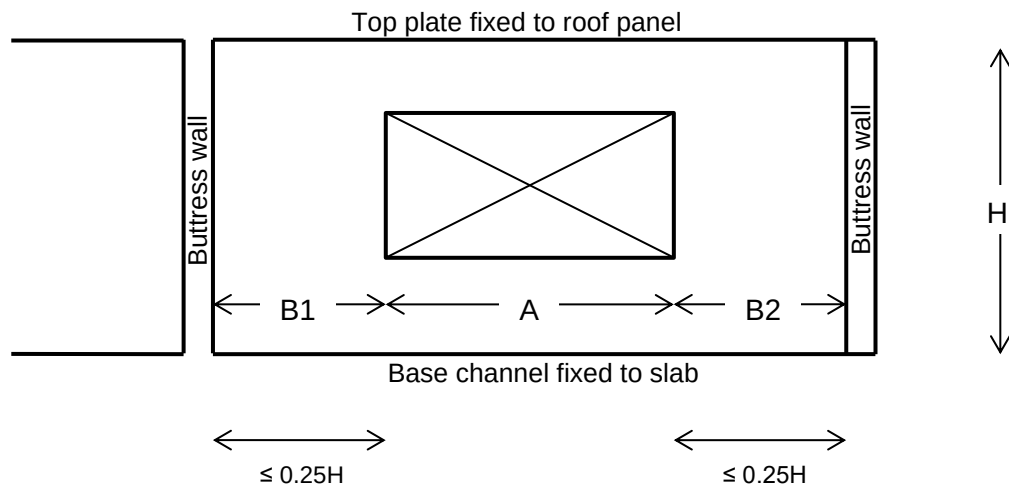
Arrangement 3

Short wall segment in between return walls with one opening:

$$\text{Increased wind load} = \text{ULS wind pressure} \times \left(1 - \frac{B}{0.25H \left(1 + \frac{0.5H}{A} \right)} \right)^{-1}$$

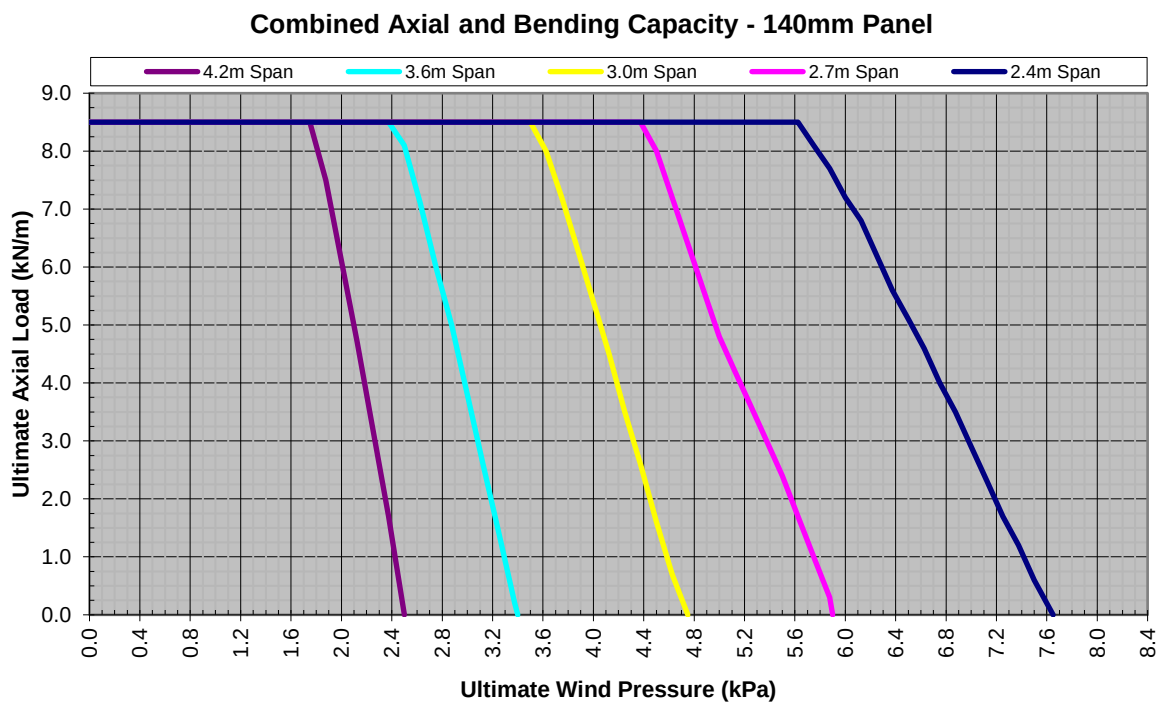
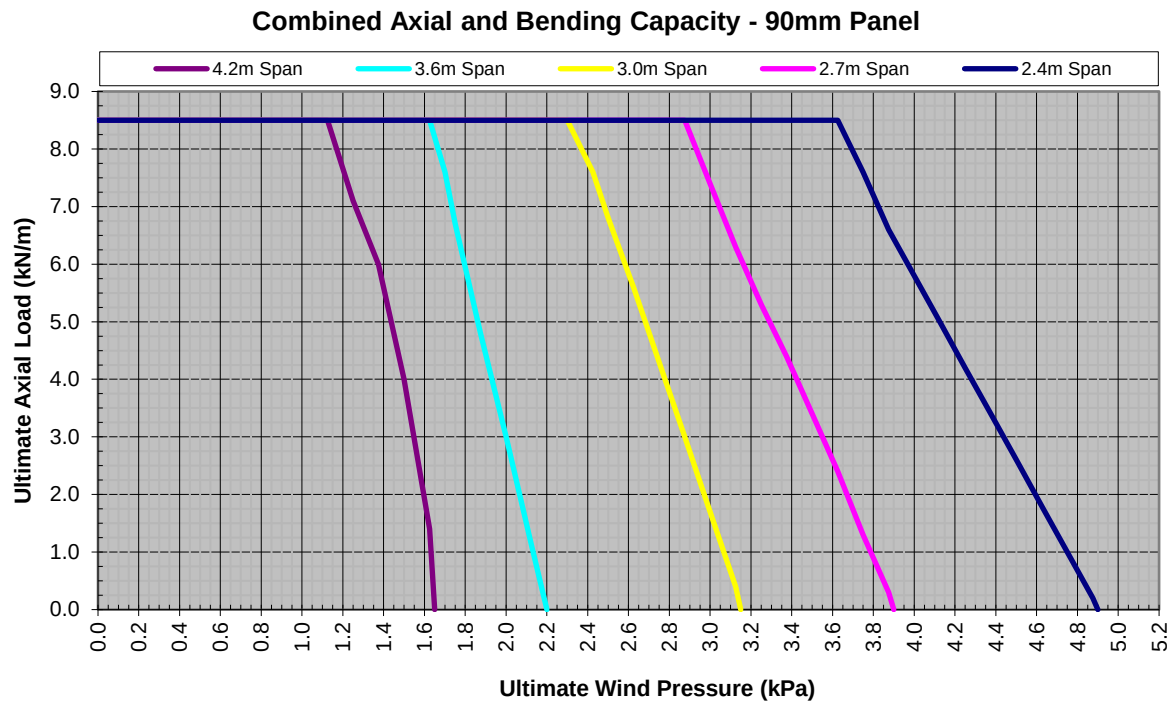
Notes:

1. $B1 \& B2 \leq 0.25H$
2. For B greater than $0.25H$ refer arrangement 1
3. Check for worst case B



4.4. Combined axial and bending

External wall panels supporting the roof are subject to combined axial and bending. These loads are increased to allow for window openings as described in the previous sections. The following graphs can be used to determine the maximum wall heights based on the axial load and wind pressure. In two storey applications the maximum wall height is taken as the wall height to horizontal restraint.

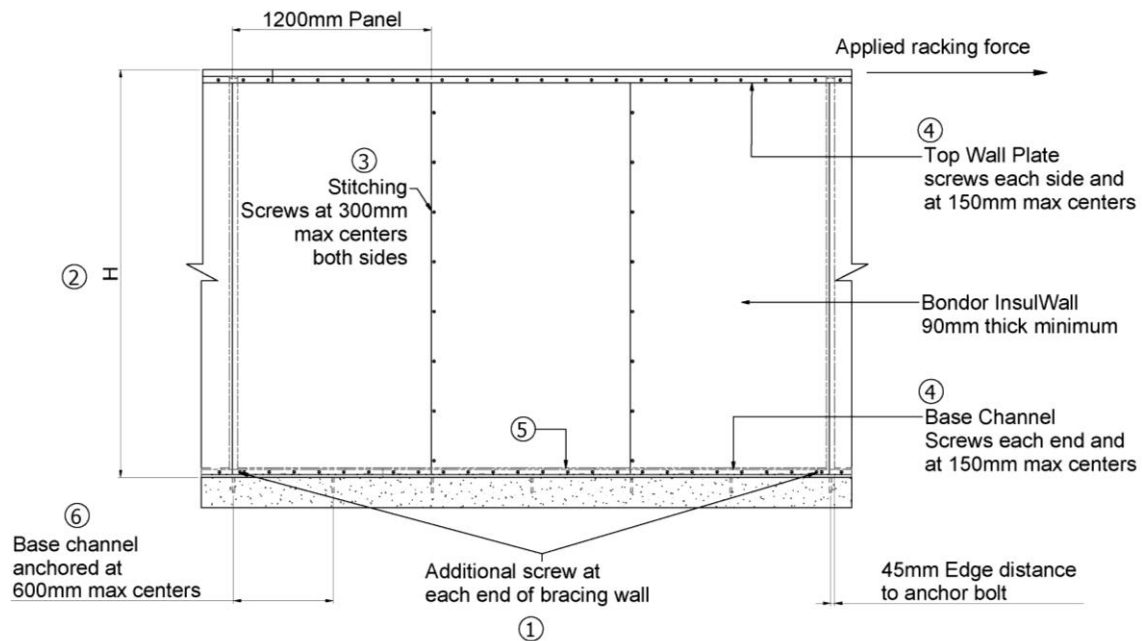


Notes:

1. Span is vertical span of wall from base channel to top restraint at roof level.
2. 90mm & 140mm graphs assume 15mm and 25mm eccentricity of load respectively.

4.5. Bracing capacity

Bracing capacities of EPS-FR and Mineral Wool InsulWall® in cyclonic and non-cyclonic applications is provided in the following table.



Bracing Resistance	
Panel width $\geq 90\text{mm}$, height=2700mm	
Number of continuous stitched panels	Ultimate bracing capacity (kN/m)
1	2.8
2	4.4
3 or more	5.7

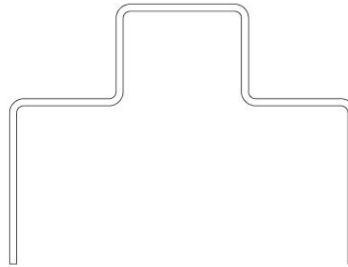
Notes:

1. All bracing panel walls must have an additional No.10 screw at each end of the bracing wall, both sides.
2. For panel heights other than 2700mm, capacity to be reduced/increased by multiplier = $2700/H$.
3. Stitching: 10g 16x16 self-drilling flat head screws each side at 300mm cts.
4. Top wall plate and base channel: Refer to InsulLiving's approved manufacturing drawings for dimensions, material specifications and tolerances.
5. All screws to be 10g 16x16 self-drilling screws, at 150mm cts (for non-cyclonic regions), 100mm cts (for cyclonic regions) top wall and base channel; 30mm minimum edge distances.
6. Bondor® bracing walls to be tied down at ends and 600mm maximum cts. Tie down using M12 (min) chemical injection anchors (N25 concrete, min 45mm edge distance, 90mm embedment) to concrete slabs or M12 tie rods to floor framing.
7. Base channel anchor bolts to incorporate special bearing plates: Refer to InsulLiving's approved manufacturing drawings for dimensions, material specifications and tolerances.
8. Tabulated values do not accommodate for any additional uplift forces. For uplift forces applied concurrently with racking, additional screws and anchors may be required.

4.6. Wall plates, Lintels and support columns

4.6.1. Stiffened top wall plate

The stiffened top wall plate comes in two widths to suit the 90mm and 140mm InsulWall® panels. Please refer to InsulLiving's approved manufacturing drawings for dimensions, material specifications and tolerances. This member may need to be supported by columns at the nearest wall panel joint depending on the roof load and size of the opening as shown below.



Maximum UDL (kN/m)								
Wall plate type	D (mm)	T (mm)	Wall plate span (mm)					
			1200		2400		3600	
			ULS	SLS	ULS	SLS	ULS	SLS
WP1	40	1.5	7.3	7.3	1.8	1.0	0.8	0.3
WP2	70	2.0	15.4	15.4	3.9	3.0	1.7	0.9
WP3	70	3.0	22.9	22.9	5.7	4.4	2.5	1.3

Notes:

1. Point loadings on member to be considered separately.
2. Serviceability limit state allowance of span/250 allowed for.
3. Member elements are assumed to be fully restrained for the full length of the section by InsulWall® panel.

4.6.2. Joiner plate

A joiner plate is used to connect two stiffened top wall plates. 4x 10g-16x16 stitching screws are required on each side of the wall plates.

4.6.3. Lintels

Typical steel lintel sizes for use where wall plate is insufficient.

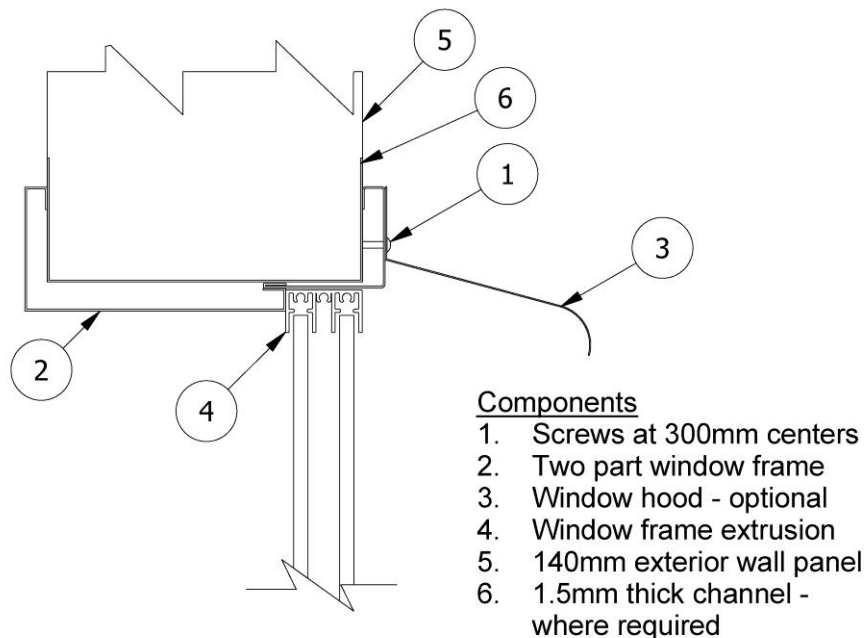
Simply Supported member bending about major axis X-X Maximum UDL (kN/m)						
Member Size	Member span (mm)					
	2000		3000		4000	
	ULS	SLS	ULS	SLS	ULS	SLS
100x50x4.0 RHS Grade C350	21.0	10.0	9.3	2.9	5.2	1.2
125x75x4.0 RHS Grade C350	37.9	23.4	16.8	6.9	9.5	2.9
150x100x4.0 RHS Grade C350	59.0	45.0	26.5	13.3	14.9	5.6

Notes:

1. Table assumes full lateral restraint of simply supported member, bending about major axis. Further analysis required for bending about the minor axis.
2. Serviceability limit state figure assumes a deflection limit of Span/250.

4.6.4. Window frame

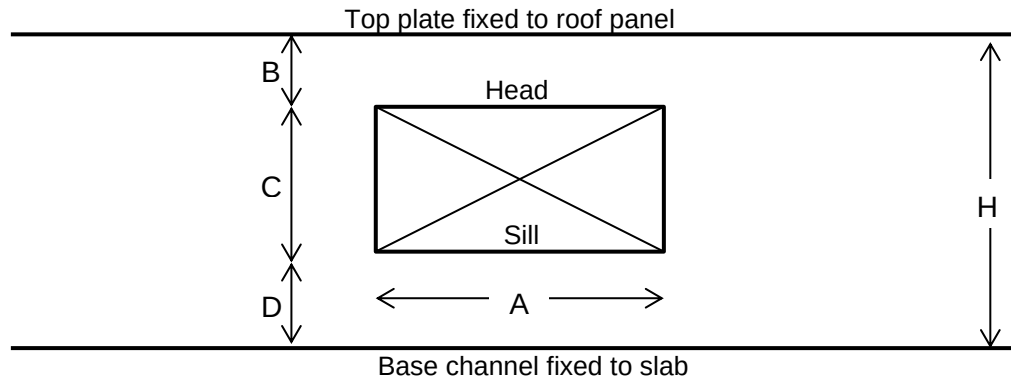
InsulLiving window frame is a two piece flashing screw fixed to the InsulWall® panels. For increased capacity an additional channel can be used as shown here.



The following formulae can be used to calculate the ultimate wind load on the window head and window sill.

$$\text{Ultimate Wind Load on window head} = \text{ULS wind pressure} \times \left(B + \frac{C}{2} \right)$$

$$\text{Ultimate Wind Load on window sill} = \text{ULS wind pressure} \times \left(D + \frac{C}{2} \right)$$



The following table shows the maximum capacity of the window frame:

Opening width A (mm)	Ultimate Wind UDL (kN/m)	
	Standard window frame	Window frame plus additional channel
< 900	12.3	-
900 – 1200	6.9	-
1200 – 1800	3.1	8.7
1800 – 2400	-	4.9
2400 – 2700	-	3.8

4.6.5. Base channel and receiver channel

There are three base channel options for the 140mm thick external walls as shown here. This member spans between holding down bolt fixing support points. Please refer to InsulLiving's approved manufacturing drawings for dimensions, material specifications and tolerances.



OPTION 1



OPTION 2



OPTION 3

The receiver channel is used to vertically fix wall panels together at wall junctions. Please refer to InsulLiving's approved manufacturing drawings for dimensions, material specifications and tolerances.



4.6.6. Support column

To cater for the increased axial load and wind pressure due to openings, and to support the stiffened top wall plate where required – such as bushfire applications - a 48x3.2CHS column can be utilised to fit inside the panel joint.

The structural steel columns must be located at the panel joints. Therefore it is essential to consider the panel joint locations to ensure they are as close as possible to wall openings. The following table displays the axial capacities of 48x3.2CHS & 65x3.0SHS columns at different heights. Alternative columns may be designed if these capacities are exceeded.

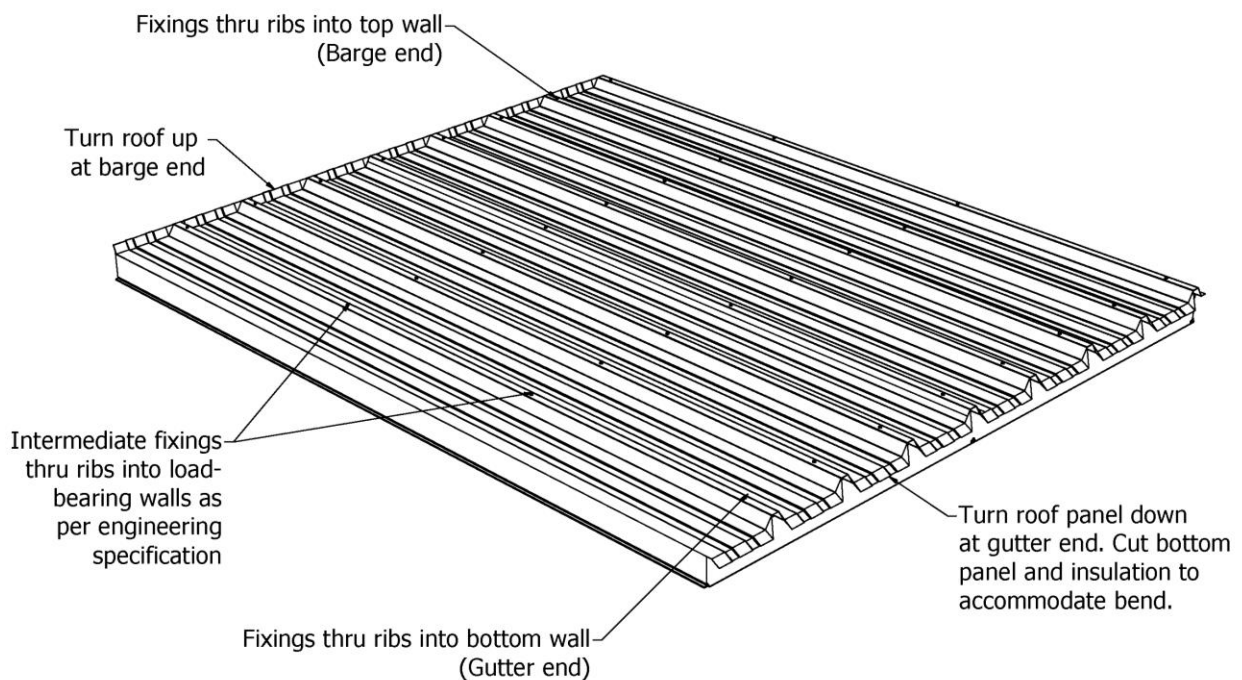
Ultimate Axial Load Capacity (kN)					
Section Size	Member Effective Length (mm)				
	2500	3000	3500	4000	5000
48x3.2 CHS Grade C250	29.9	21.2	15.8	12.2	7.9
65x3.0 SHS Grade C350	108	79.7	60.3	46.9	30.6

Notes:

1. Table indicates load capacity columns acting in compression only. No effects of moment due to eccentric loading or horizontal load along the length have been taken account.
2. Where additional moments are acting on the member further engineering design must be undertaken.

5. ROOF

5.1. Main components and fixing recommendations



Notes:

1. Non Cyclonic applications- fixing at each rib:

Use 14-10x225 screws for fixing to timber structural member

Use 14-14x225 screws for fixing to steel structural members up to 3mm thick

Use 14-20x225 screws for fixing to steel structural members thicker than 3mm

2. Cyclonic applications – fixings with Cyclone & Neo washers at each rib and pan

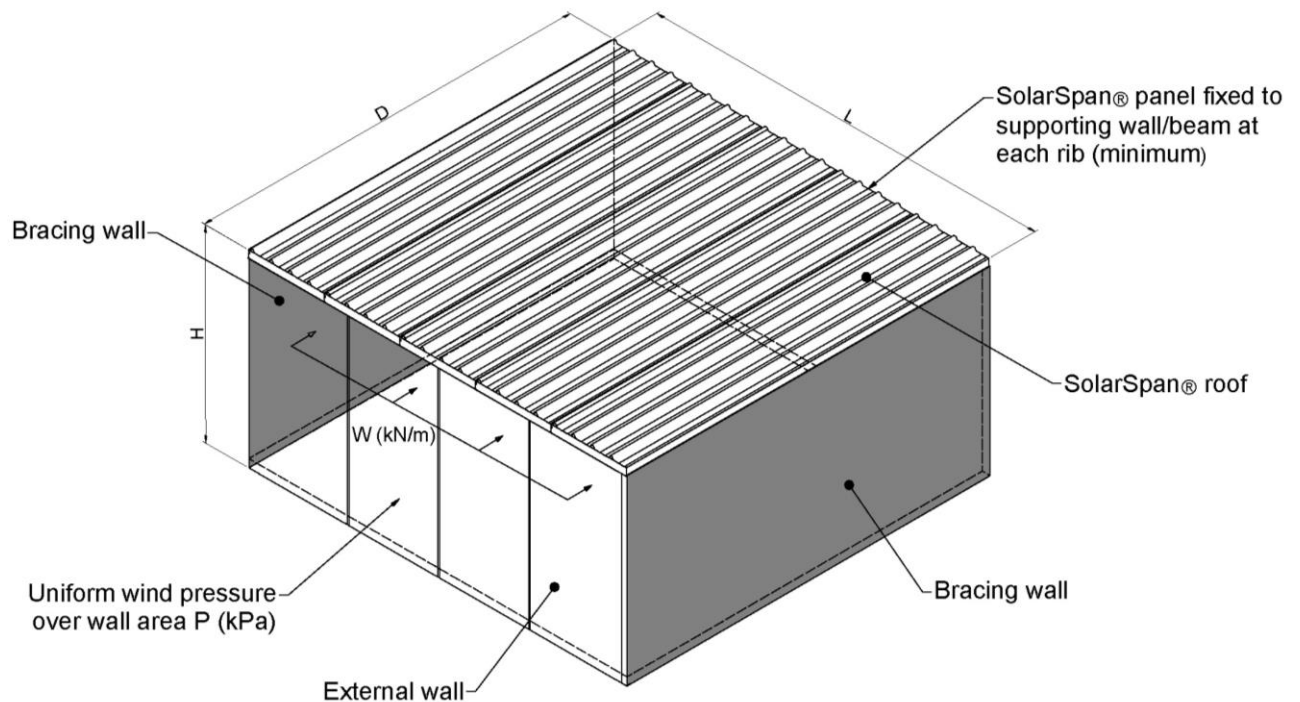
5.2. SolarSpan® wind loading

Maximum span (mm)										
Wind Class	ULS Design Wind Pressure (kPa)	Panel thickness (mm)								
		100			125			150		
		Single Span	Multi-Span	Cantilever ⁸	Single Span	Multi-Span	Cantilever ⁸	Single Span	Multi-Span	Cantilever ⁸
N1	-0.97	6500	6600	1200	7200	7500	1600	7900	8100	2400
N2	-1.34	5400	5600	1200	6000	6400	1600	6600	7400	2400
N3	-2.10	4300	4200	1200	4700	4900	1600	5200	5600	2400
N4	-3.13	3500	3200	1200	3800	3700	1600	4100	3700	1600
N5	-4.60	2700	2400	1100	3100	2500	1100	3400	2500	1100
C1	-2.78	3700	3500	1200	4000	4700	1600	4500	4700	1800
C2	-4.13	3000	2300	1200	3300	3100	1200	3600	3100	1600
C3	-6.08	2400	1600	800	2700	2100	1100	3000	2100	1100
C4	-8.21	1800	-	-	2300	1500	800	2600	1500	800

Notes:

- Wind speeds and coefficients based on AS 4055 - Wind Loads for Housing.
- Roof pressure coefficients based on the following worst case assumptions:
 - External Pressure - Ratio of building height to least horizontal dimension on plan, $h/d < 0.5$.
 $C_{pe} = -0.9$.
 - Internal Pressure -
Non-Cyclonic - Building has no dominate openings & more than one permeable wall or is effectively sealed. $C_{pi} = +0.2$
Cyclonic - Based on dominate opening pressure. $C_{pi} = +0.7$
 - Local Pressure - Least Horizontal Dimension on Plan $< 20m$ ($a = 4m$). $K_I = 1.5$
 - Combination Factor - $K_c = 0.9$
 - Non-cyclonic - $C_{fig} = -1.4$, Cyclonic - $C_{fig} = -1.85$
- Serviceability deflection limit of span/150 has been allowed for.
- Self-weight of the panel has been allowed for, plus an allowance of up to $25kg/m^2$ ($0.25kPa$ dead load) for light duty fittings (lights, etc.).
- Non-trafficable maintenance access (concentrated load) of $140kg$ on any span has been allowed for, in roof pans only. Avoid stepping on the ribs.
- Distributed live load of $0.25kPa$ (as per AS/NZS 1170.1) has been allowed for.
- Fixing at each rib for non-cyclonic regions and each rib and pan for cyclonic regions with $14g$ tek screws (or equivalent) into 1.5 BMT G450 steel are required.
- Overhangs:
 - Max. Overhang is min. of cantilever value stated above or 40% of back-span.
 - Overhangs include an allowance for a $1.1kN$ concentrated load based on strength limit state as a separate load case.

5.3. Diaphragm action



$$\text{Load applied to roof diaphragm} - W \text{ (kN/m)} = P \text{ (kPa)} \times H/2 \text{ (m)}$$

Ultimate Capacity - Non-Cyclonic (kN/m)							
Fixing Arrangement		Diaphragm Span - L (mm)					
Type	Details	4000	5000	6000	7000	8000	9000
1	Fixed to supports using screws at each rib	3.0	2.4	2.0	1.7	1.5	1.3
2	As per type 1, plus silicone sealant to underside of joint	4.2	3.3	2.8	2.4	2.1	1.8
3	As per type 1, plus screws to underside at panel joints, 1 each end & central	3.8	3.0	2.5	2.1	1.9	1.7
4	As per type 1, plus screws to underside at panel joints at 250max centres	9.9	7.9	6.6	5.7	5.0	4.4

Note:

1. SolarSpan® roof is fixed to top plate or supporting member at each rib.
2. Additional screws to underside of panels at joint as specified for arrangement 2, 3 & 4.
3. Roof diaphragm depth - $D > 3\text{m}$.

6. CUPBOARDS, BRACKETS AND ANCILIARY FIXINGS

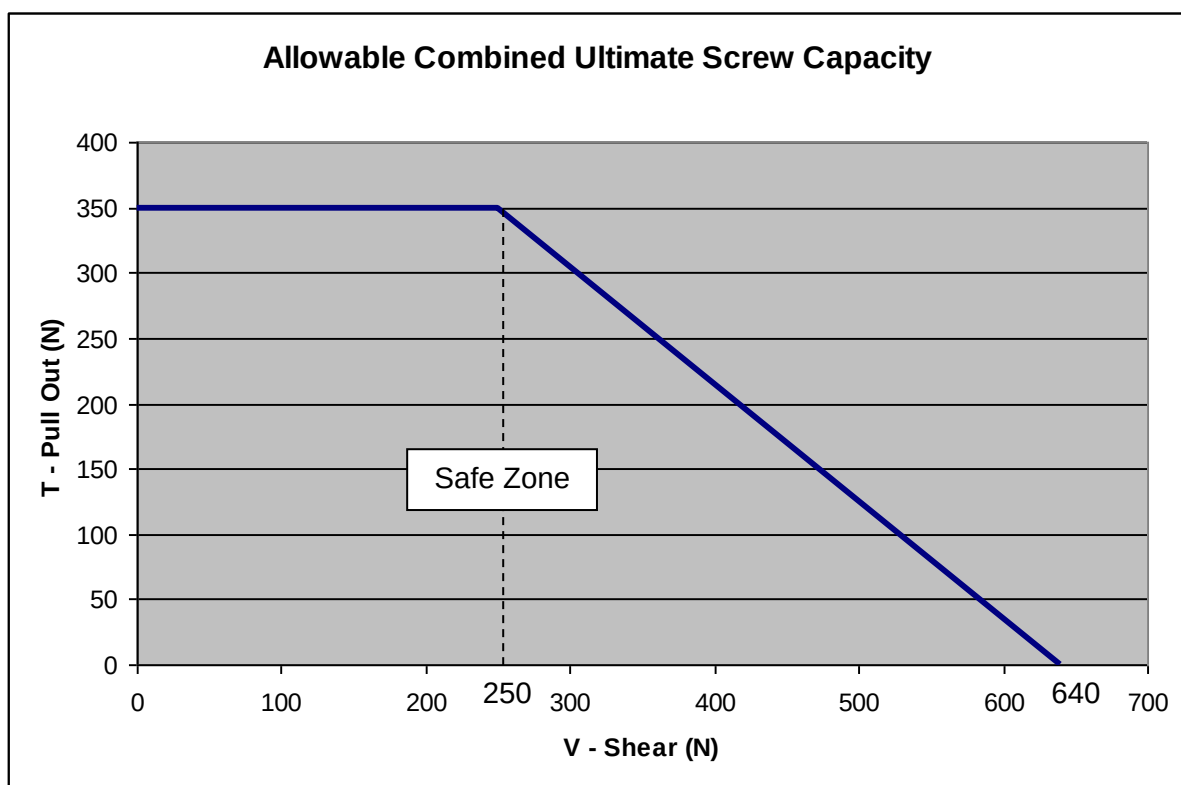
6.1. Cupboards

InsulWall® panels have been tested in accordance to, and comply with the requirements of Australian Standard AS 4387.15:1996, *Domestic Kitchen Assemblies – Method 15: Determination of the Strength of Support Frames*.

Typical 900mm x 720mm x 300mm kitchen cupboards can be attached to InsulWall® (EPS-FR) and InsulWall® (Mineral Wool) panels using 4 fasteners per cupboard.

6.2. Face fixed screw capacity

The combined ultimate shear and pull-out forces on a screw fixed to the face of the panel (single skin) are shown below.



Combined Ultimate Screw Capacity for Bracket Fixings

Notes:

1. All fixings to be 10g 16x32 self-drilling screws.
2. Loads are for screw fixing only. Bracket and shelf design by others.
3. Fixings to be effectively sealed to prevent moisture entering panel.
4. Screw fixings to be installed ensuring no damage to threads and panel.

6.3. Fixing to underside skin

From the bracket fixing test, it was determined that a 35 kg ultimate pull out load could be specified for a single 10g screw fixed to the face of a 0.6 mm thick panel skin. To accommodate for permanent long term dead load for fixings attached to the underside of the roof panel the following capacity and notes need apply:

- 5kg/screw (10g) design capacity should be allowed for.
- Maximum dead load of 10 kg/m² applies to both external and internal side of SolarSpan® roof, including garage door weights, light duty fittings and ancillary. (Roof spans need to be reviewed for loads exceeding 10 kg/m²).
- Loads should be spread over large area to reduce the effect of concentrated load.

Larger loads (including garage door weight) may require through fixings. Further testing is in progress to look at the long term effects of tension fixings on the single skin.

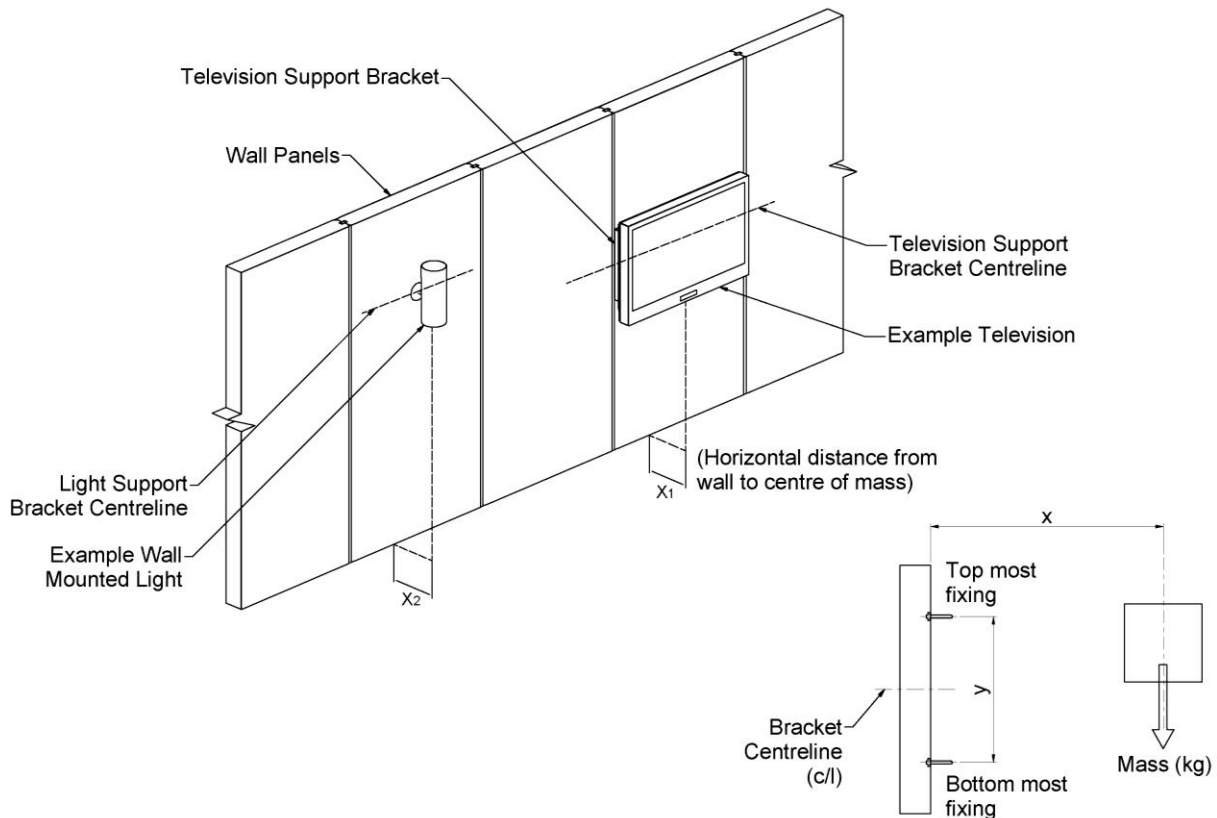
6.3.1. Fan Fixing

The ceiling fan can be attached to the underside of SolarSpan® with the same conditions as the garage door fixing above.

Proprietary disc were fixed with 4x 10g screws before fixing the fan bracket. Proprietary disc is made from Aluminium, with 148mm diameter and thickness of 3mm.

6.4. Fixing on the Wall

For ancillary fixing on the InsulWall®, such as LCD TV, the following table can be used as a guide when determining fixing requirements. It is best to place the centre of the mass as close to the mounting wall as possible.



Number of fixings required					
Mass (kg)	Mass distance from wall, x (mm)				
	50	100	200	300	500
5	1 above c/l 0 below c/l	1 above c/l 0 below c/l	1 above c/l 0 below c/l	1 above c/l 0 below c/l	1 above c/l 0 below c/l
10	1 above c/l 0 below c/l	1 above c/l 0 below c/l	1 above c/l 1 below c/l	2 above c/l 1 below c/l	2 above c/l 1 below c/l
15	1 above c/l 1 below c/l	1 above c/l 1 below c/l	2 above c/l 1 below c/l	2 above c/l 1 below c/l	3 above c/l 1 below c/l
20	1 above c/l 1 below c/l	2 above c/l 1 below c/l	2 above c/l 1 below c/l	3 above c/l 1 below c/l	4 above c/l 2 below c/l
25	2 above c/l 1 below c/l	2 above c/l 1 below c/l	3 above c/l 1 below c/l	3 above c/l 1 below c/l	5 above c/l 2 below c/l
30	2 above c/l 1 below c/l	2 above c/l 1 below c/l	3 above c/l 2 below c/l	4 above c/l 2 below c/l	6 above c/l 2 below c/l

Notes:

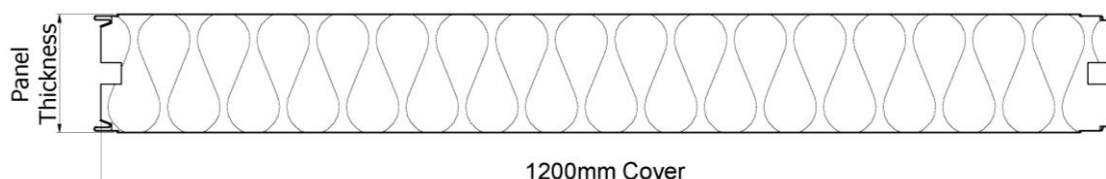
1. Safety factor = 4.
2. All fixings to be 10g 16x32 self-drilling screws.
3. Min. distance between top & bottom screws, y = 300mm.
4. Min. horizontal distance between screws = 250mm.
5. Min. 2 screws are recommended wherever possible.

Refer Bondor® for larger load fixing on the wall.

7. PANEL PHYSICAL PROPERTIES



7.1. InsulWall® (EPS-FR)



InsulWall® (EPS-FR) is a lightweight, non-ozone-depleting structural panel made with an insulating EPS-FR core and strong COLORBOND® facings.

Panel Specifications

Width	1200mm
Length	Cut to order, minimum 1200mm
Panel thickness	90 and 140 mm
Steel thickness	0.6mm (standard)
Panel External Coating	External coating strictly to the guidelines as per DuSpec Specification Sheet (Exterior- issue 2 dated 19/01/2010) using Dulux AcraTex Coventry Coarse for InsulWall® by Bondor®.
Panel Internal Coating	Internal coating strictly to the guidelines as per DuSpec Specification Sheet (Interior- issue 3 dated 08/09/2011) Dulux Wash and Wear 101 Advanced L/G for broad wall and Dulux Wash and Wear Kitchen and Bathroom L/G for wet areas to InsulWall® by Bondor®.
Core material	SL Grade FR Polystyrene 13.5 kg/m ³
Thermal conductivity at 23°C	0.042 W/mK
Adhesive	Thermosetting two-part adhesive (CFC free)

Technical Data

Technical property	Panel Thickness (mm)	
	90	140
Mass (kg/m ²)	11.8	12.5
Total R-value (m ² K/W) at 15°C (Winter)	2.41	3.66
Total R-value (m ² K/W) at 30°C (Summer)	2.29	3.48

Early Fire Hazard Properties (AS 1530.3 Indices)

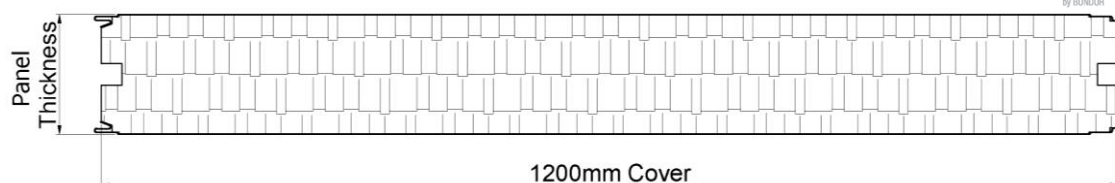
Ignitability	0
Spread of Flame	0
Heat Evolved	0
Smoke	2-3

BCA Group Number specifications are also available. Refer Bondor®.

Acoustic Properties

Rw value for BondorPanel® is 24 – 25. Refer Bondor® for your specific application.

7.2. InsulWall® (Mineral Wool)



InsulWall® (Mineral Wool) is non-ozone-depleting, non-combustible sandwich panel manufactured with a core of Mineral Wool fibre. The core is manufactured with the fibres oriented across the thickness of the panel to maximise its structural strength.

Panel Specifications

Width	1200mm
Length	Cut to order, minimum 1200mm
Panel thickness	100 and 150 mm
Steel thickness	0.6mm (standard)
Panel internal/external coating	COLORBOND® finish (assorted colours)
	Under development: Dulux system
Core material	Mineral Wool fibre
Thermal conductivity at 23°C	0.037 W/mK
Adhesive	Thermosetting two-part adhesive (CFC free)

Fire performance & Insurance

InsulWall® (Mineral Wool) panels may be used where non-combustible material is required by the BCA. These panels in various system configurations can achieve Fire Resistance Levels (FRL) including -/60/60, 60/60/60, -/90/90 and -/180/180 to AS1530.4, as appropriate to the application. Factory Mutual (FM) Approval and BCA Group Number specifications are also available. Refer Bondor® for Flameguard® installation specifications and updates.

Technical Data

Technical Property	Panel Thickness (mm)	
	100	150
Mass (kg/m ²)	20.6	25.6
Total R-value (m ² K/W) at 15°C (Winter)	3.00	4.41
Total R-value (m ² K/W) at 30°C (Summer)	2.79	4.11

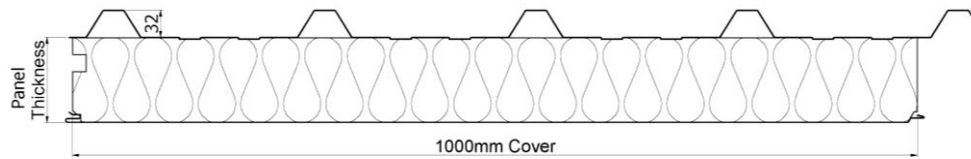
Early Fire Hazard Properties (AS 1530.3 Indices)

Ignitibility	0
Spread of Flame	0
Heat Evolved	0
Smoke	3

Acoustic Properties

Rw value for InsulWall® (Mineral Wool) ranges from 27 – 28 depending on thickness. Refer Bondor® for your specific application.

7.3. SolarSpan®



SolarSpan® combines roofing, insulation & ceiling in one durable, functional and attractive panel. This all-in-one roofing solution offers the potential to create the ideal indoor/outdoor living environment in any climate. SolarSpan® features a high tensile COLORBOND® steel exterior, a polystyrene core for insulation in all seasons and a pre-painted COLORBOND® steel underside.

Panel Specifications

Width	1000mm cover
Length	Cut to order, minimum 1800mm
Panel thickness	50, 75, 100, 125, 150
Steel thickness	0.42 upper skin, 0.6 lower skin
Underside finish	Smooth or VJ
Core material	(Standard) SL Grade FR Polystyrene 13.5 kg/m ³
Thermal conductivity at 23°C	0.042 W/mK
Max skin temperature permitted	80°C
Adhesive	Thermosetting two-part adhesive (CFC free)

Panel Skin Details

Steel face	Thickness, BMT (mm)	Substrate	Gloss Level	Colour
Upper Skin	0.42	G550 steel COLORBOND® steel	25%	Surfmist®, Paperbark®, Classic Cream®, Pale Eucalypt®, Dune®, Headland®, Shale Grey®
Lower Skin	0.6	Metallic coated G300 steel	25%	Surfmist®

Technical Data

Technical property	Panel Thickness (mm)				
	50	75	100	125	150
Weight (kg/m ²)	10.6	10.9	11.3	11.6	12.0
Total R-value (m ² K/W) at 15°C (Winter)	1.40	2.03	2.65	3.27	3.90
Total R-value (m ² K/W) at 30°C (Summer)	1.38	1.98	2.57	3.17	3.76

Early Fire Hazard Properties (AS 1530.3)

Ignitability	0
Spread of Flame	0
Heat Evolved	0
Smoke	2-3