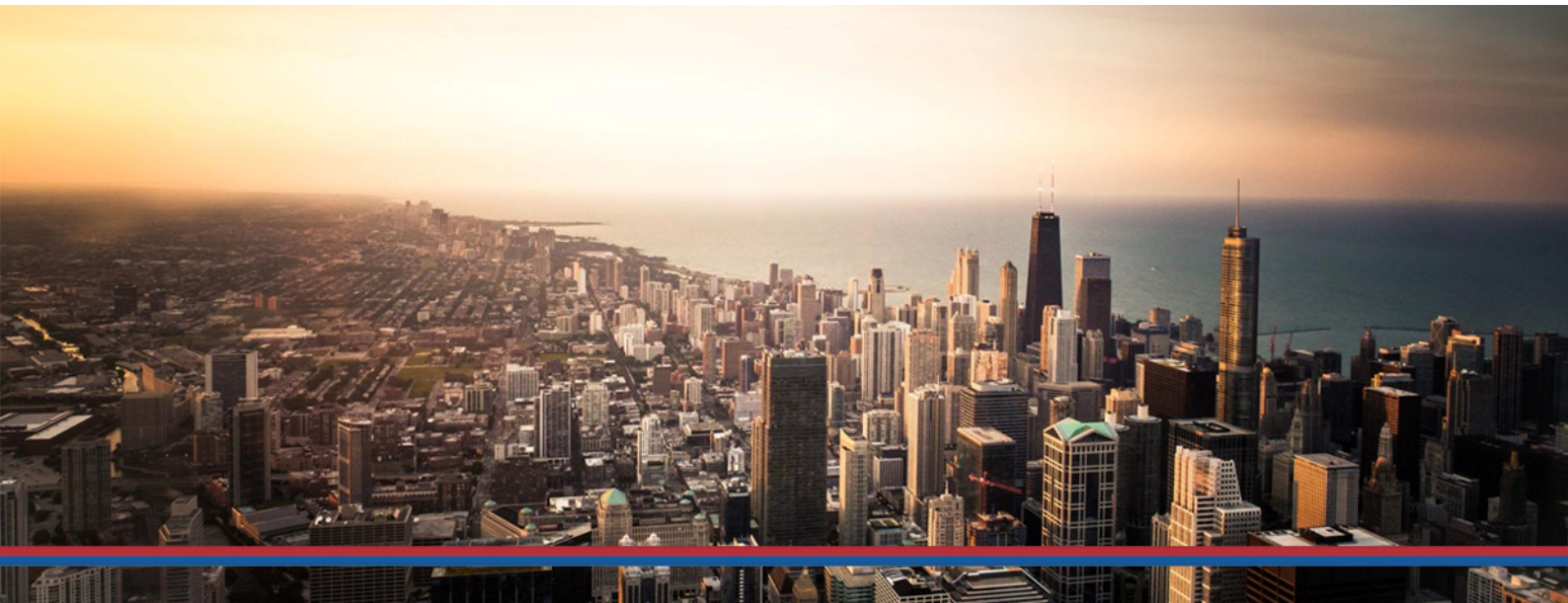
MODEX

MODEX WANHUA GLOBAL PTY LTD

Wanhua SIPS Wall Panel

Technical Guide



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CONTENTS

PREFACE

Modex Wanhua Global Pty Ltd manufacture and supply a structural insulated panel system (SIPS) for constructing internal and external load bearing and non-load bearing walls. The SIPS panel consists of a rigid polyurethane (PU) foam core that is bonded between an oriented strand board (OSB) panels on either face of the panel. The insulation properties of the PU core allow the wall system to achieve a superior thermal insulation and acoustic performance compared to a traditional timber stud or steel stud wall. This document presents technical information, including product specification details, installation information and design guidance for the Wanhua SIPS Wall Panel. The panels, referred to as the "Wanhua SIPS Wall Panel", have been rated for use in non-cyclonic wind regions of Australia for wind classifications up to and including N6. The structural capacity of the system is based on structural testing performed on the product (refer related documents) and the structural assessment report prepared by R. I. Brown Pty Ltd (refer related documents). The wall panels have received CodeMark certification for use in Class 1 buildings in accordance with the National Construction Code (NCC), Volume 2: Building Code of Australia (BCA). The certification allows the wall panels to be used as internal and external walls where no fire rating is required. The wall panels have not been certified for use as fire and/or acoustic rated separating walls.

DISCLAIMER

The Modex Wanhua Technical Guide has been prepared by qualified structural engineers, designers and builders. The use of the Wanhua SIPS wall panels is to be in accordance with the Modex Wanhua Technical Guide and the certified structural engineering drawings for the project. Modex Wanhua Global Pty Ltd does not accept any liability, loss or damage which arise where not used in accordance with this Technical Guide.

CERTIFICATION

Wanhua SIPS Wall Panels are CodeMark Certified. The CodeMark Certification Scheme is a voluntary third-party building product certification scheme that authorises the use of new and innovative products in specified circumstances in order to facilitate compliance with Volumes One and Two of the NCC, also known as the Building Code of Australia or BCA.

CodeMark provides confidence and certainty to regulatory authorities and the market through the issue of a Certificate of Conformity, which is one of several options available for meeting the 'evidence of suitability' requirements of the BCA.

CODEMARK®
Australia
Certificate CM20260

This Technical Guide has been checked by and prepared in accordance with the structural assessment report by:

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RELATED/REFERENCED DOCUMENTS

- AS/NZS 1170.0:2002 Structural Design Actions, Part 0: General Principles
- AS/NZS 1170.1:2002 Structural Design Actions, Part 1: Permanent, Imposed and Other Actions
- AS/NZS 1170.2:2011 Structural Design Actions, Part 2: Wind Actions
- AS 1170.4:2007 Structural Design Actions, Part 4: Earthquake Actions
- AS 1366.1:1992 Rigid Cellular Plastics Sheets for Thermal Insulation, Part 1: Rigi Cellular Polyurethane (RC/PUR)
- AS 1684.2:2010 Residential Timber Framed Construction, Part 2: Non-Cyclonic Areas
- AS 1684.3:2010 Residential Timber Framed Construction, Part 3: Cyclonic Areas
- AS 1720.1:2010 Timber Structures, Part 1: Design Methods
- AS/NZS 3000:2018 Electrical Installations (known as the Australian/New Zealand Wiring Rules)
- AS 4055:2012 Wind loads for Houses
- National Construction Code (NCC) Vol. 2: Building Code of Australia (BCA) Class 1 and 10 Buildings
- Structural Assessment by R. I. Brown Pty Ltd (Report No. 20-130 SAR.1, dated 22-January-2021, revised as Amendment A1, dated 13-October-2021)
- Acoustic Performance Testing by Intertek Testing Services Shenzhen Ltd (Report No. 201010011SHF-003, dated 11-November-2020)
- Thermal Performance Testing by Intertek Testing Services Shenzhen Ltd (Report No. 201010011SHF-002-R1, dated 11-November-2020)
- Thermal Performance Testing by Intertek Testing Services Shenzhen Ltd (Report No. 210607010SHF-001, dated 15-July-2021)
- Thermal Performance Testing by Intertek Testing Services Shenzhen Ltd (Report No. 210607010SHF-002-R1, dated 16-July-2021)
- Structural Testing – Compression Capacity by Intertek Testing Services Shenzhen Ltd (Report No. 201010206GZU-003, dated 7-December-2020)
- Structural Testing – Transverse Out-Of-Plane Capacity by Intertek Testing Services Shenzhen Ltd (Report No. 201010206GZU-001, dated 7-December-2020)
- Structural Testing – In-Plane Racking Capacity by Intertek Testing Services Shenzhen Ltd (Report No. 201010011SHF-001, dated 11-November-2020)
- Structural Testing – Box Lintel Capacity by Intertek Testing Services Shenzhen Ltd (Report No. 201010206GZU-002, dated 7-December-2020)
- Structural Testing – OSB Shear Capacity of Nails by Yantai University (Report titled “Wanhua SIPS Wall Panel 114 and 108 mm Thick Panel Structural Test Report: 50, 100 and 150 mm Nail Space”)
- Thermal assessment and certification by James M Fricker Pty Ltd (letter dated 3-August-2021).

NOTES

SECTION 1: PRODUCTION SPECIFICATION

1.1 Product Description

The Wanhua SIPS wall panel is a load bearing structural insulated panel system (SIPS) element capable of resisting vertical gravity actions, out-of-plane loads and in-plane racking loads. The SIPS panel consists of a rigid polyurethane (PU) foam core that is bonded between an oriented strand board (OSB) panels on either face of the panel, as shown in Figure 1.1. The SIPS panel fits over and is nailed off to a bottom plate attached to the structure and similarly, a top plate at the top of the panel that is nailed off. Timber studs and SIPS spline studs are fixed vertically at each end. The SIPS wall panel relies on the outer two faces of OSB to provide the structural resistance to the system and the inner PU core provides the longitudinal shear connection to allow the outer two faces to act as one composite wall section.

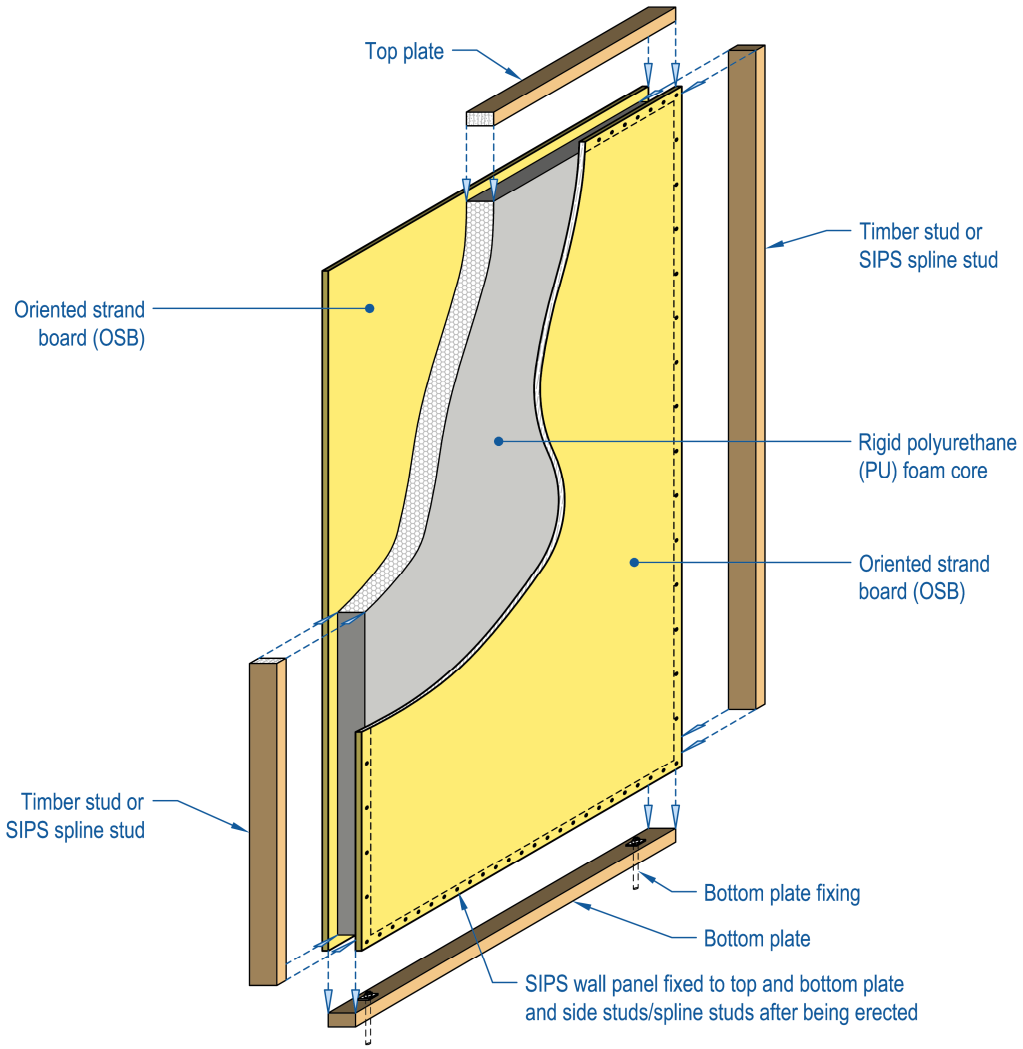

Figure 1.1: Typical SIPS panel.

1.2 Standard Panel Sizes

The wall panels are offered in three thicknesses of 114, 94 and 88 mm. The 114 and 94 mm panels have 12 mm OSB boards on each face with a 90 and 70 mm PU core, respectively. The 88 mm panels have 9 mm OSB boards on each face a 70 mm PU core. All the panels have standard widths of 610 and 1220 mm and standard nominal heights of 2,400, 2,700 and 3,000 mm. The standard panel sizes are summarised in Table 1.1 and illustrated in Figure 1.2.

The standard panels are manufactured with case in horizontal conduits and a vertical chase at each end for services, as shown in Figure 1.2. The horizontal conduits are located 300, 450 and 1200 mm from the bottom of the panel. The vertical chase at each end of the panel is 30x30 mm. The services conduits and chases can be used for running electrical cabling and internet wiring. Services and wiring in the SIPS is discussed further in Section 2.

Table 1.1: Standard panel sizes.

Ref.	Mark	Panel thickness (mm)	OSB thickness (mm)	PU thickness (mm)	Panel width (mm)	Nominal height (mm)	Actual height (mm)	Top and bottom plate	Self-weight* (kg)
1	1220x114x3000	114	12	90	1,220	3,000	2,990	Top plate: 35x90 Bottom plate: 45x90	71.7
2	1220x114x2700					2,700	2,690		64.5
3	1220x114x2400					2,400	2,390		57.3
4	610x114x3000				610	3,000	2,990		35.8
5	610x114x2700					2,700	2,690		32.2
6	610x114x2400					2,400	2,390		28.6
7	1220x94x3000	94	12	70	1,220	3,000	2,990	Top plate: 35x70 Bottom plate: 45x70	68.4
8	1220x94x2700					2,700	2,690		61.5
9	1220x94x2400					2,400	2,390		54.7
10	610x94x3000				610	3,000	2,990		34.2
11	610x94x2700					2,700	2,690		30.8
12	610x94x2400					2,400	2,390		27.3
13	1220x88x3000	88	9	70	1,220	3,000	2,990	Top plate: 35x70 Bottom plate: 45x70	54.2
14	1220x88x2700					2,700	2,690		48.7
15	1220x88x2400					2,400	2,390		43.3
16	610x88x3000				610	3,000	2,990		27.1
17	610x88x2700					2,700	2,690		24.4
18	610x88x2400					2,400	2,390		21.6

* Approximate self-weight values only.
Note: all standard panel sizes come with the typical cast in services conduits as shown in Figure 1.2.

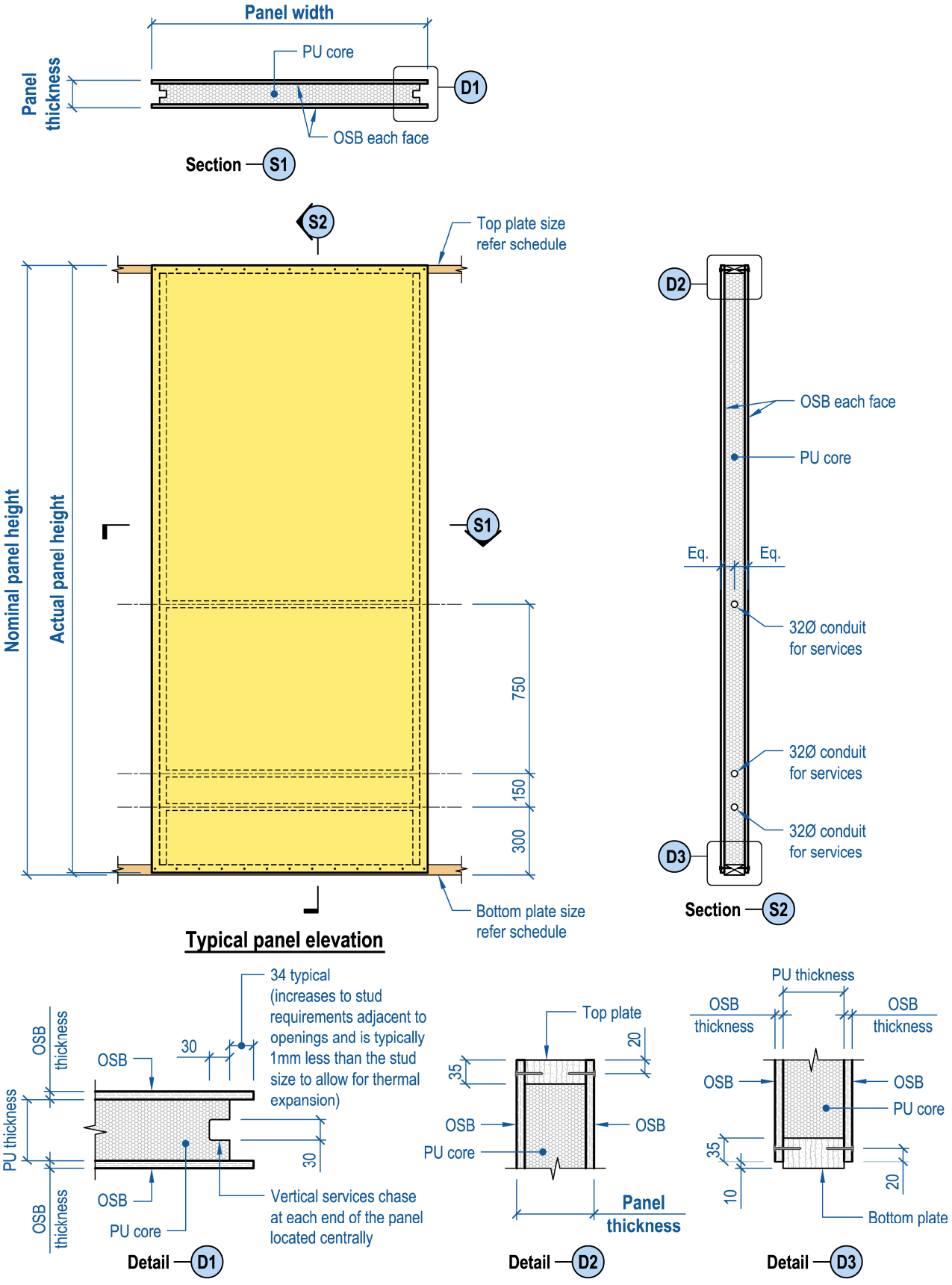

Figure 1.2: Standard wall panel dimensions and set out.

1.3 Material Specifications

1.3.1 Oriented Strand Board Specification

The oriented strand board (OSB) used in the Wanhua SIPS wall panels is manufactured to achieve a grade of OSB/3 or higher in accordance with European Standard EN 300:2006 and Chinese Standard CH-LT/T 1580-2010. The European Standard and Chinese Standard have the same material property requirements for OSB/3, which are summarised in Table 1.2.

Table 1.2: European Standard EN 300:2006 OSB/3 requirements.

Property/requirement	Unit	Board thickness (mm)				
		$6 \leq t \leq 10$	$10 < t < 18$	$18 \leq t \leq 25$	$25 < t \leq 32$	$32 < t \leq 40$
Bending strength (major axis)	MPa	22	20	18	16	14
Bending strength (minor axis)	MPa	11	10	9	8	7
Modulus of elasticity (major axis bending)	MPa	3,500	3,500	3,500	3,500	3,500
Modulus of elasticity (minor axis bending)	MPa	1,400	1,400	1,400	1,400	1,400
Internal bond	MPa	0.34	0.32	0.30	0.29	0.26
Swelling in thickness (24 hr immersion)	%	15	15	15	15	15

Note: Chinese Standard CH-LT/T 1580-2010 has the same OSB/3 requirements to EN 300:2006.

1.3.2 Rigid Polyurethane Core Specification

The rigid polyurethane (PU) core is a rigid polyurethane insulation material manufactured in accordance with the Chinese National Standard GB 50404-2017 *Technical Specification for Rigid Foam Polyurethane Insulation and Waterproof Engineering*.

1.4 Acoustic Rating

The acoustic performance was assessed by Intertek Testing Services Shenzhen Ltd. The acoustic rating was assessed for a 114 mm thick panel (i.e. 12 mm OSB each face with a 90 mm PU core). The values are shown in Table 1.3.

Table 1.3: Acoustic Performance.

R_w	C	C_{tr}
27 dB	−1 dB	−3 dB

1.5 Thermal Performance

The thermal performance was assessed by Intertek Testing Services Shenzhen Ltd and reviewed by James M Fricker Pty Ltd. The thermal resistance levels for the 88 and 94 thick panels are presented in Table 1.4 for base temperatures of 15, 23 and 30 degrees Celsius. The thermal performance of the 114 mm panel has not been tested; however, this thickness panel is scheduled for testing at a future date.

Table 1.4: Thermal resistance.

Panel thickness (mm)	OSB thickness (mm)	PU thickness (mm)	Thermal Resistance, R (m^2K/W)		
			15℃	23℃	30℃
88	9	70	3.30	3.15	2.91
94	12	70	3.34	3.20	2.95

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SECTION 2: INSTALLATION PROCESS

2.1 Installation Procedure and Site Activities

The installation process for the SIPS wall panels is as follows:

1. Clean concrete slab (or equivalent sub-structure) and ensure it is free from dust and debris.
2. Mark out bottom plate locations in accordance with the SIPS shop drawings. Ensure the corner overlaps for the bottom plates are as per the shop drawings and are set back from the slab/floor edge an equal distance to the OSB thickness (refer Figure 2.1).
3. Provide damp proof membrane (DPM) between bottom plate and concrete slab (note: this is not applicable for timber framed floor connection).
4. Fix bottom plates as per the structural drawings (refer Figure 2.3).
5. Erect the SIPS wall panels and **provide temporary bracing**. Temporary bracing must remain until the floor/roof diaphragm over has been constructed and the building is adequately bracing for racking forces.
6. Fix the SIPS panels to the bottom plate. Ensure nail grade, size and spacing is strictly in accordance with the structural documentation for the building.
7. Fix adjacent panels together (refer Figure 2.5).
8. Fix the top plate to the SIPS panels. Ensure nail grade, size and spacing is strictly in accordance with the structural documentation for the building.

Do not cut the SIPS panels or provide penetrations in any location unless it is shown on the structural drawings and/or the shop drawings.

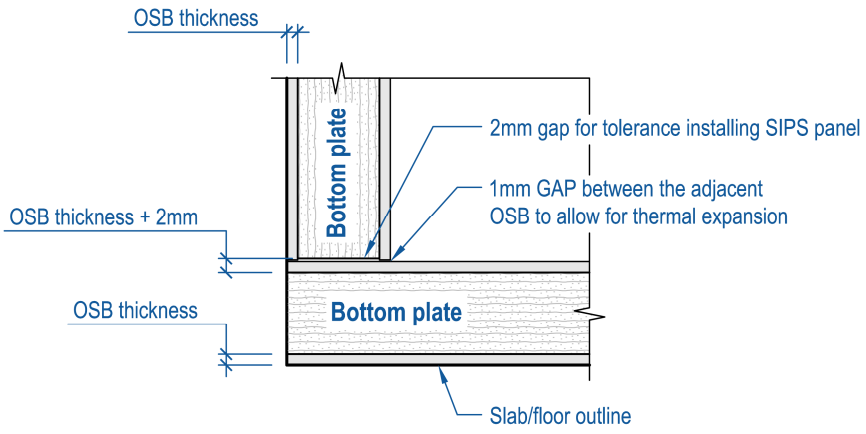


Figure 2.1: Bottom plate set out.

All SIPS panels should be stacked and stored horizontal on site prior to being erected. The panels should be stacked in separate piles a maximum of 12 panels high (as shown in Figure 2.2). All care should be taken to sure the panels, the OSB outer faces and PU core are not damaged while the panels are being stored and subsequently erected on site. The panels should be elevated and not directly sitting on ground and covered with a tarp to ensure they are weather protected while being stored on site.

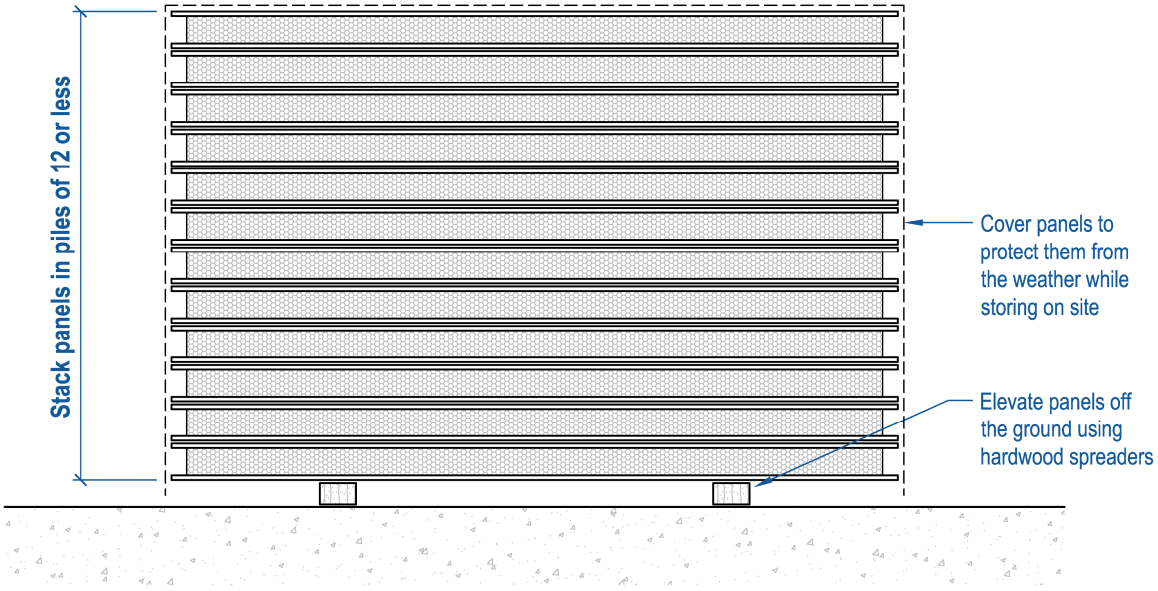


Figure 2.2: Storage of SIPS wall panels on site.

2.2 Vertical Panel Connections

Two typical vertical panel connections for the SIPS panels are shown in Figure 2.3. The first connection is a typical ground floor base connection to a reinforced concrete slab/footing beam and the second connection is a suspended timber floor connection. Typical cladding details are show in Figure 2.4.

2.3 Horizontal Panel Connections

Four typical horizontal panel connections for the SIPS panels are shown in Figure 2.5. The first connection uses two laminated timber studs between adjacent panels and the second connection uses a SIPS spline stud between adjacent panels. The SIPS spline stud has a 12 mm OSB panel on each face with a PU core, as shown in Figure 2.6. The spline stud has a PU core of 66 mm for the 114 mm thick panels and a 46 mm core for the 94 and 88 mm thick panels. The SIPS spline studs have matching horizontal conduits cast in to align with the standard panel conduits shown in Figure 1.2. If the timber post or laminated timber stud detail in Figure 2.5 is adopted, the contractor may need to drill horizontal 25 mm diameter holes in the centre of the timber elements to align with conduits in the SIPS panel (refer Section 2.6.1).

In addition, typical corner and cross-wall connections are shown in Figure 2.7 and a typical detail showing how a steel column can be built into the wall is shown in Figure 2.8.

These figures are intended to show different available connection options for the SIPS wall panels. The actual detail adopted is to be as per the structural drawings for the respective project.

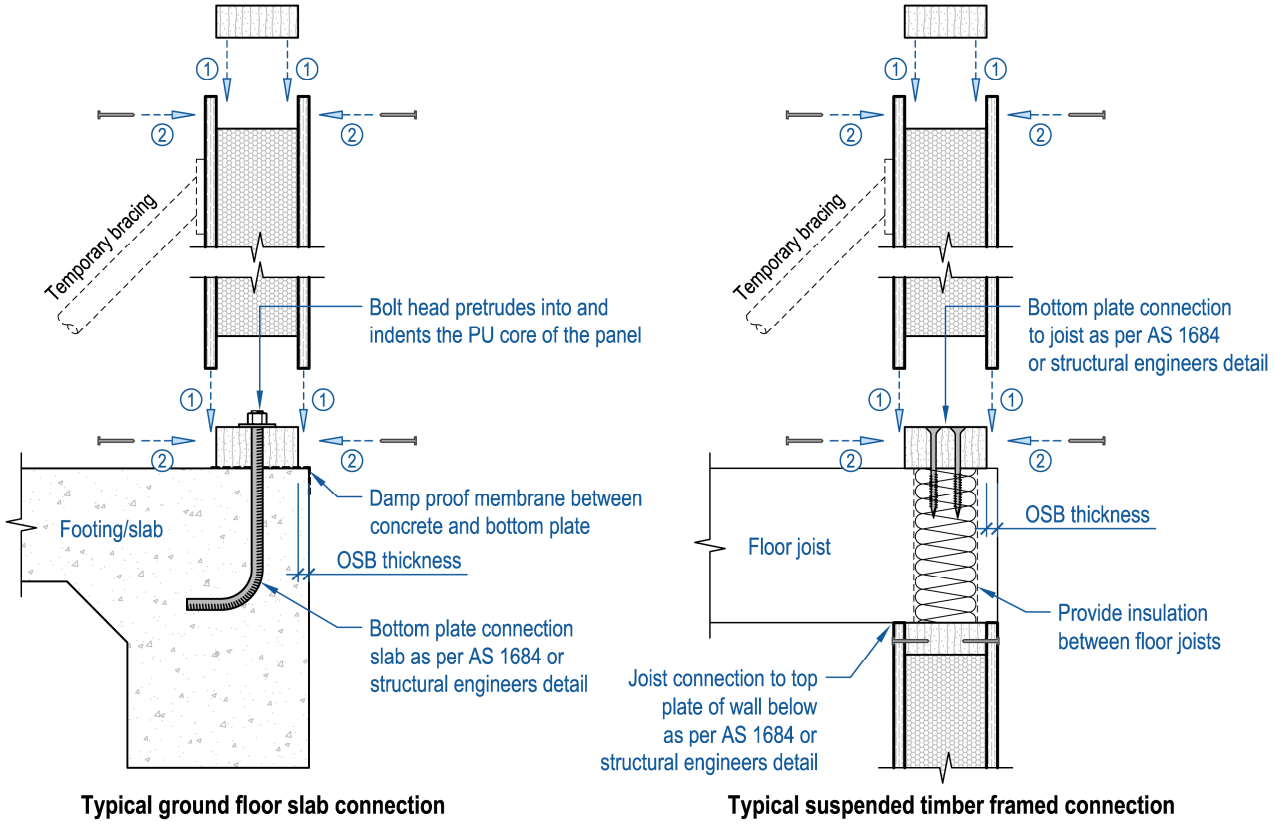


Figure 2.3: Vertical panel connections.

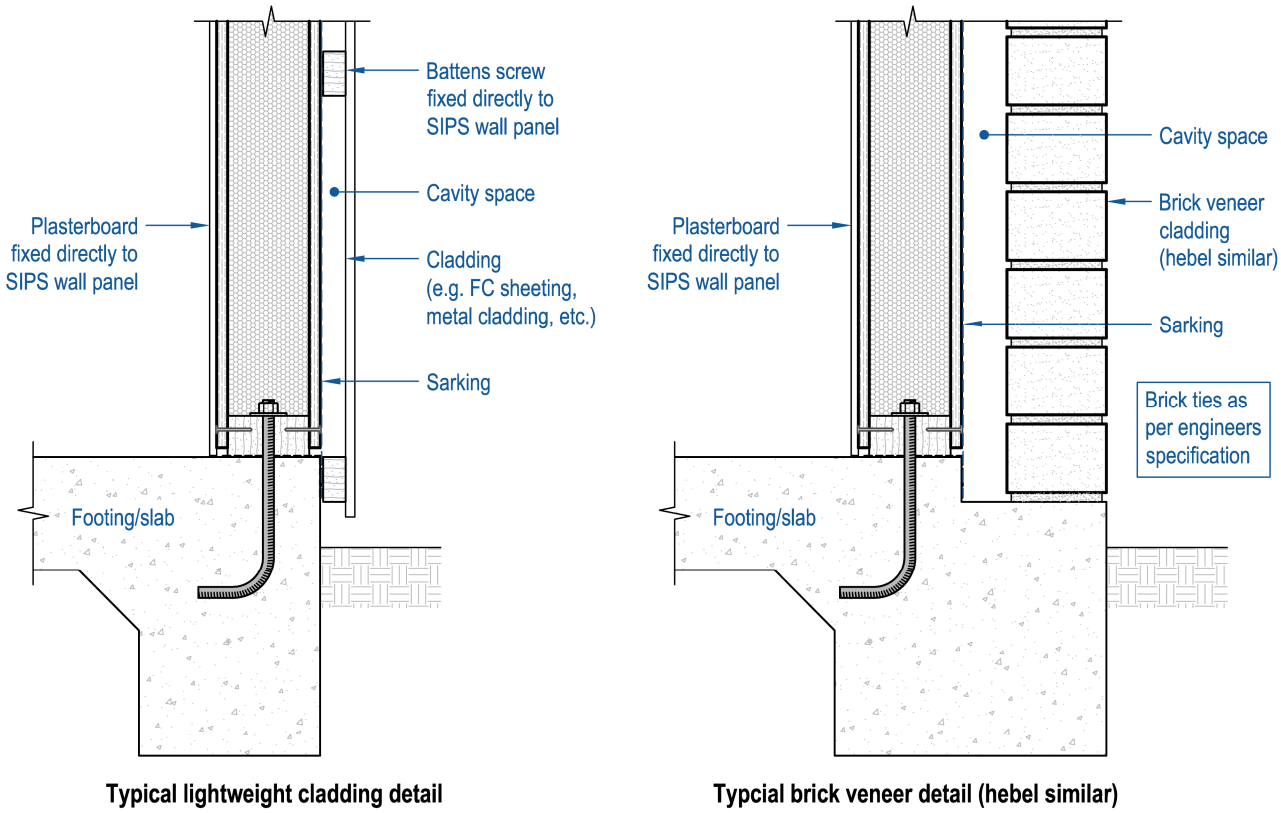


Figure 2.4: Typical cladding details.

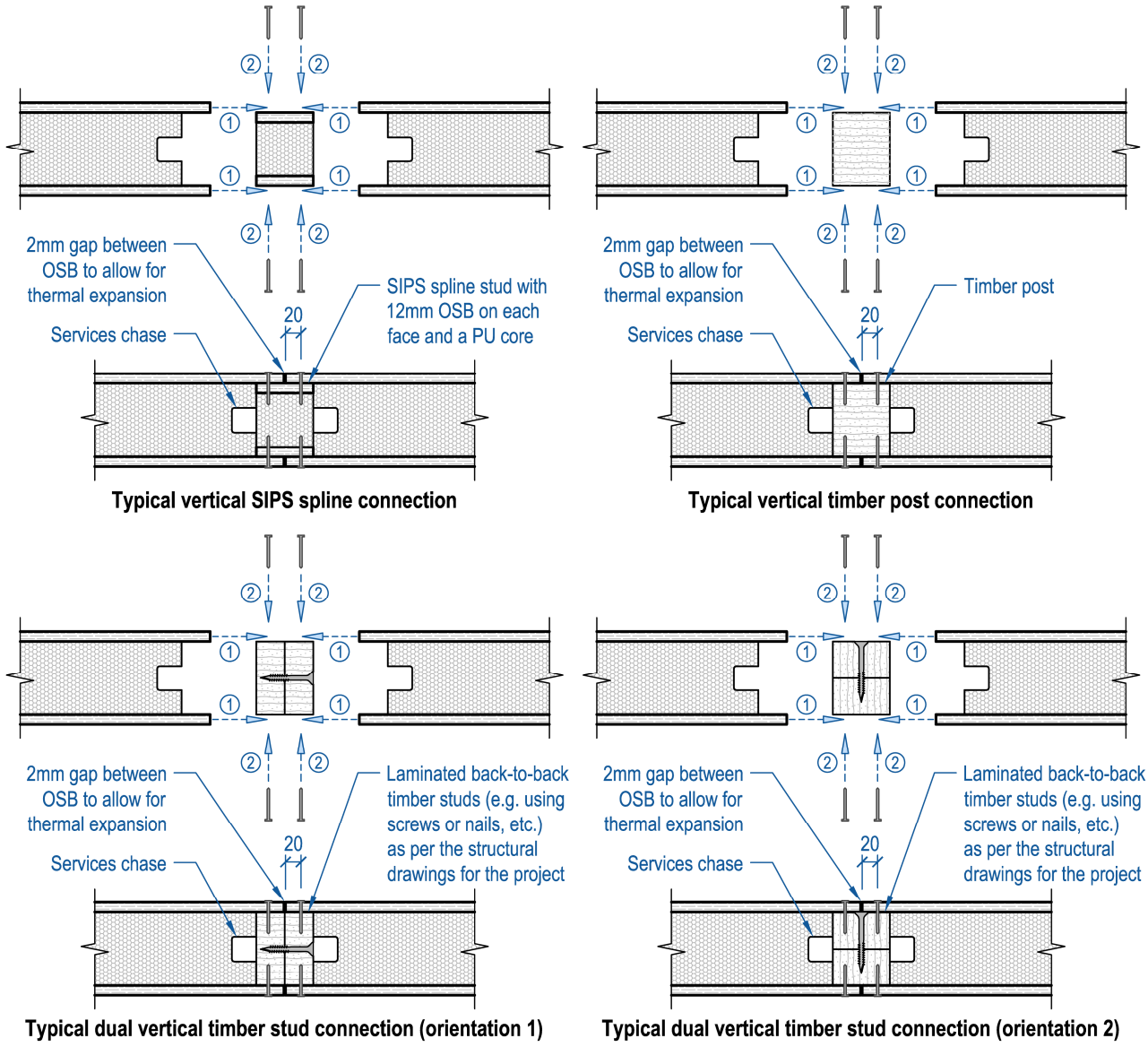


Figure 2.5: Horizontal panel connections (plan view cross-sections).

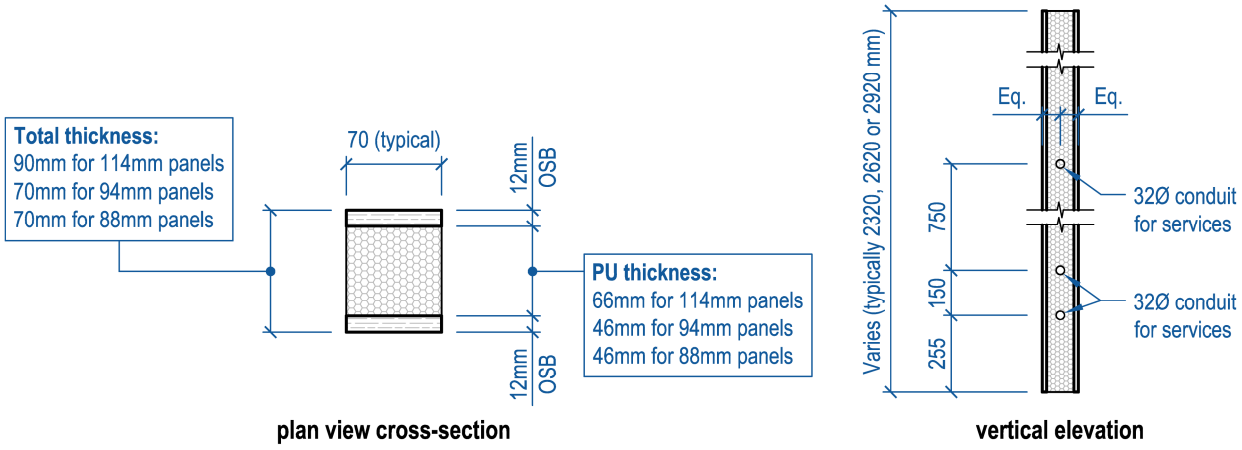


Figure 2.6: SIPS spline stud.

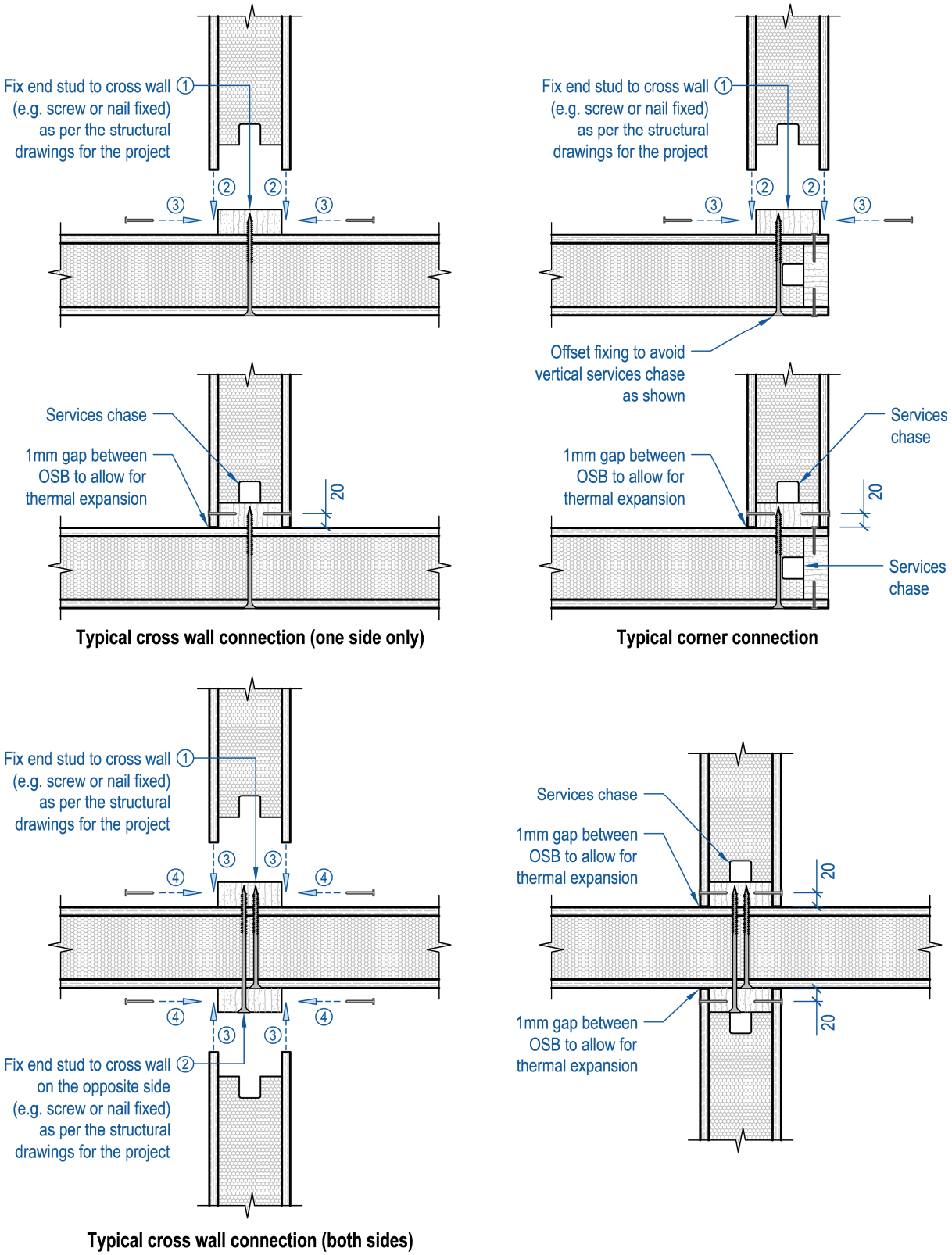


Figure 2.7: Horizontal panel connections (plan view cross-sections).

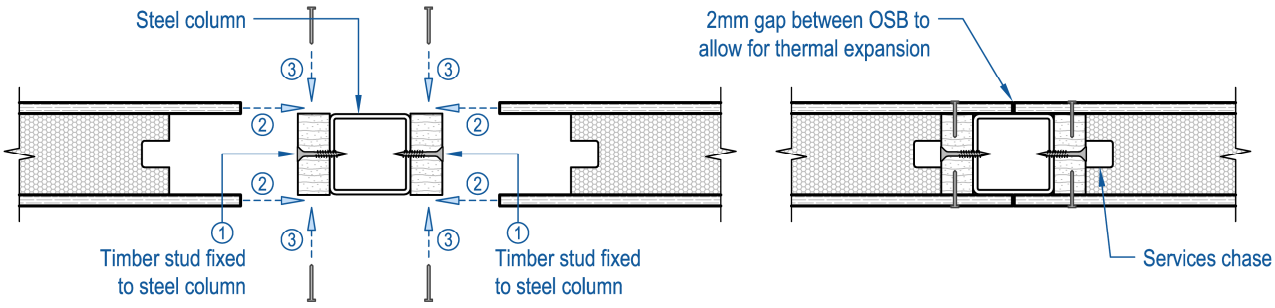


Figure 2.8: Steel column built into SIPS wall panel (plan view cross-section).

2.4 Separating Wall Connections

Typical details showing how the SIPS wall panels connect to concrete or masonry separating walls are shown in Figure 2.9.

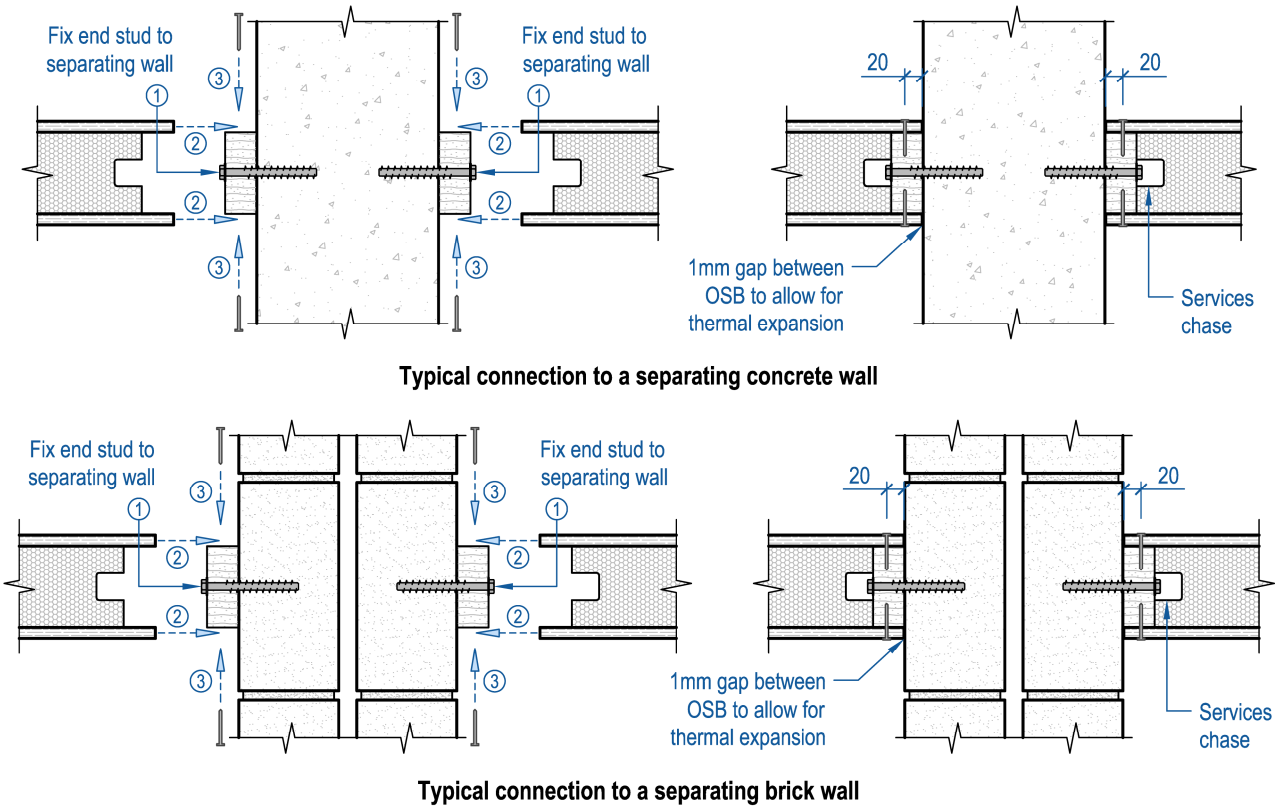


Figure 2.9: Horizontal panel connections to separating walls (plan view cross-sections).

2.5 Box Lintel Installation

The SIPS box lintels are constructed using two OSB panels and a PU core with matching thicknesses to the adjacent SIPS wall panels being adopted. The box lintel has a bottom stud that extends over the jamb studs in each adjacent wall panel. The top plate extends continuously across the box lintel from one side to the other. Single, double or triple jamb studs can be adopted depending on the loading requirements. The double and triple jamb studs should be laminated together. The typical installation method of the SIPS box lintels is shown in Figures 2.10 and 2.11.

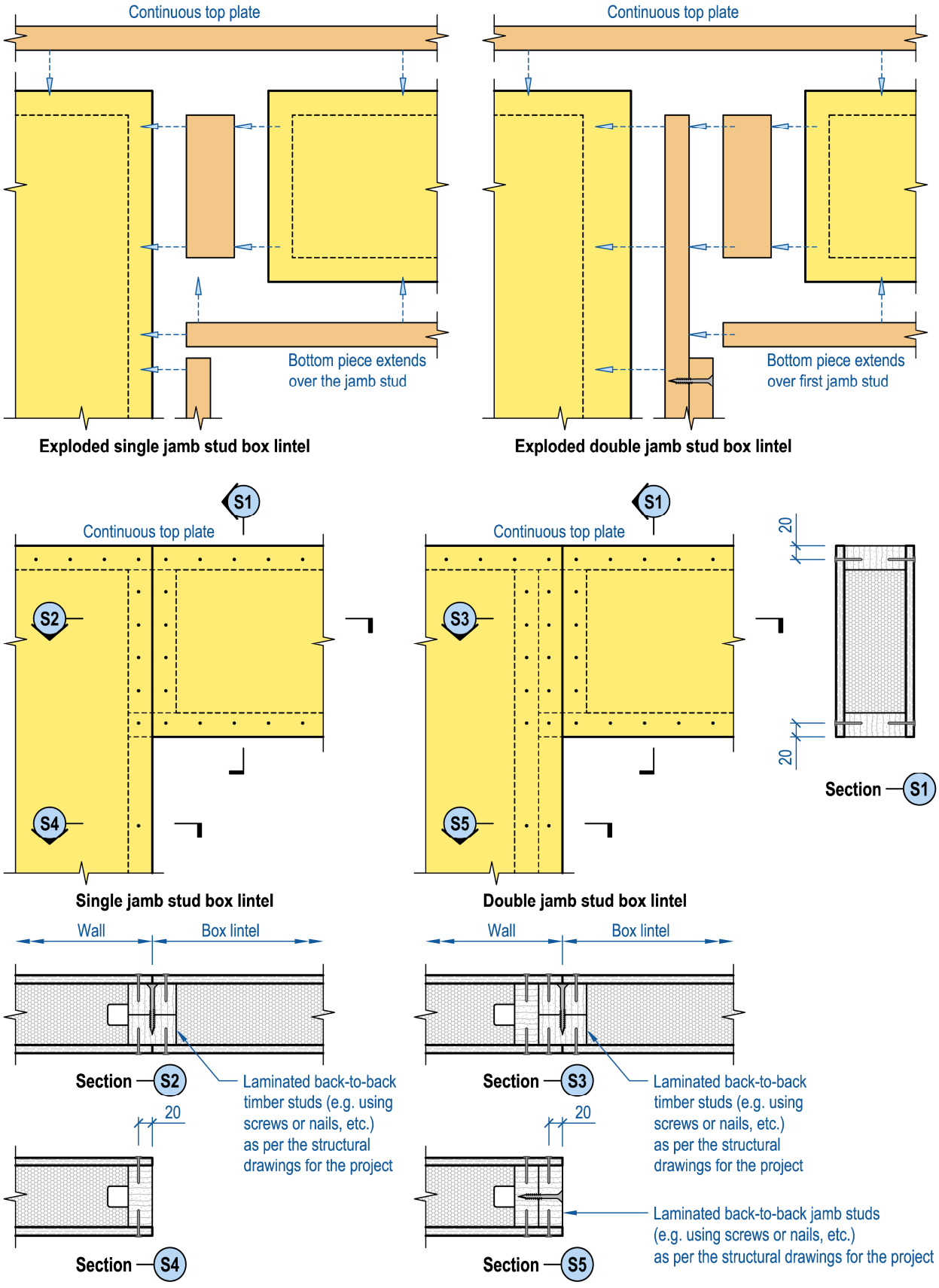
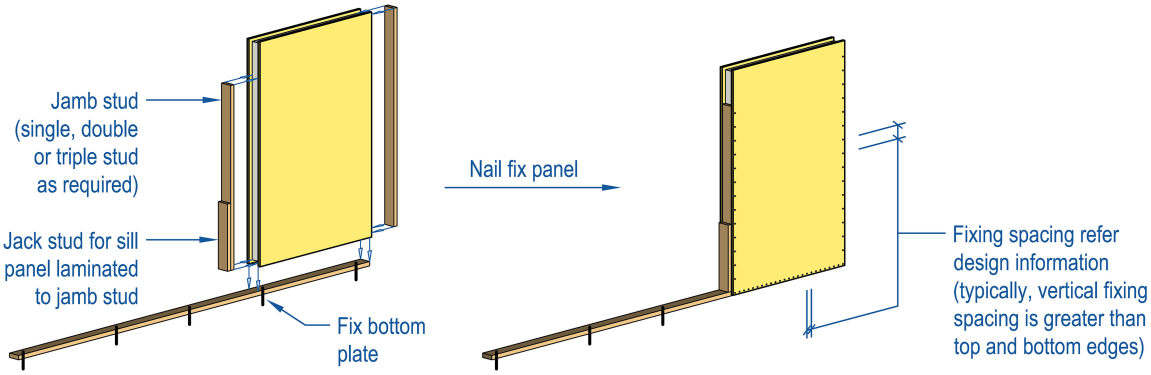
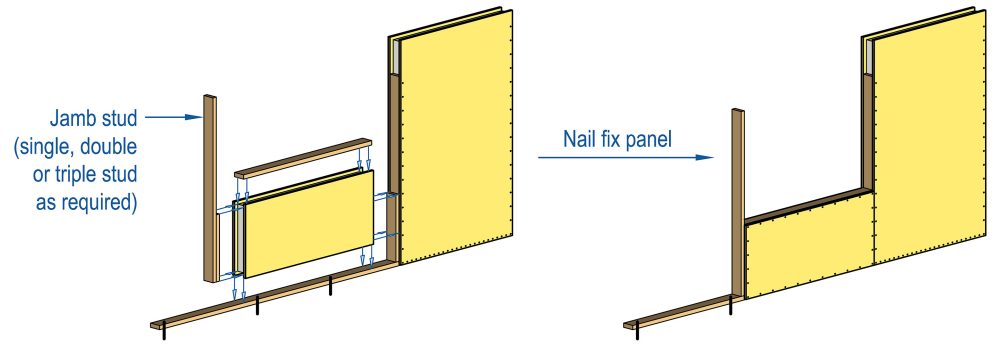


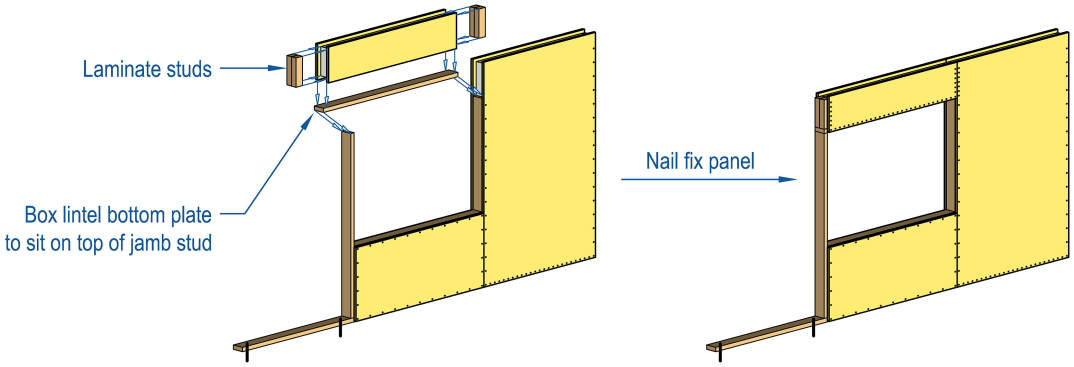
Figure 2.10: SIPS box lintel configuration.



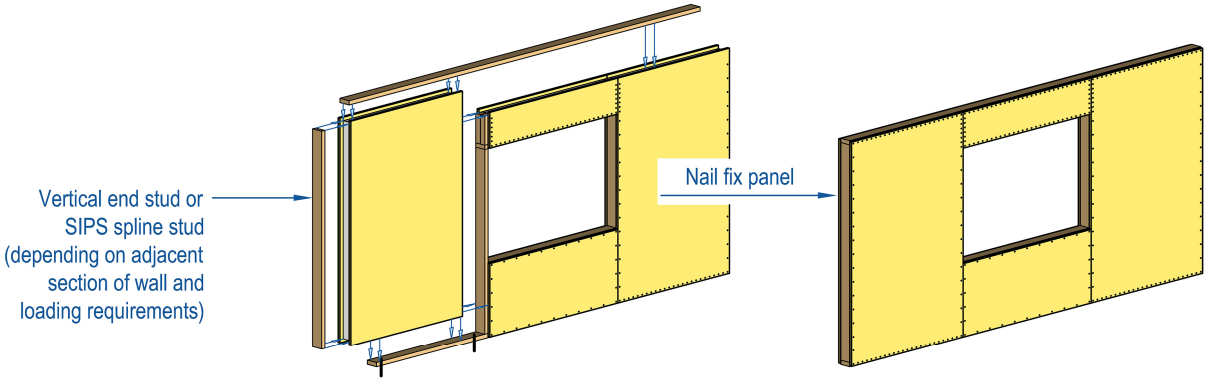
Step 1: fix bottom plate and install SIPS panel on one side of opening



Step 2: install the sill SIPS panel underneath the opening



Step 3: install the SIPS lintel box beam above the opening



Step 4: install SIPS panel on other side of opening and fix top plate

Figure 2.11: SIPS box lintel installation process.

2.6 Services

2.6.1 Electrical and Telecommunications Wiring

The SIPS wall panels are supplied with cast in horizontal conduits and vertical chases at each end (both located centrally in the panel, as shown in Figure 1.2), for electrical and telecommunications wiring. Various examples of how electrical and telecommunications wiring can be run through the panels is shown in Figure 2.12. A maximum of one light switch and two general power outlets (GPO) or telecommunication outlets are allowed per panel.

It is strongly recommended that the wiring be distributed through the ceiling space to the required locations and run from the top of the wall down to the outlet/GPO.

AS 3000 requires a minimum cover of 50 mm between the outside face of the wall and any electrical wiring running in fixed conduits. This distance is achieved by providing 1 layer of 9 mm plasterboard for the 114 mm thick SIPS wall panels and 2 layers of 12 mm plasterboard for the 94 and 88 mm thick SIPS wall panels.

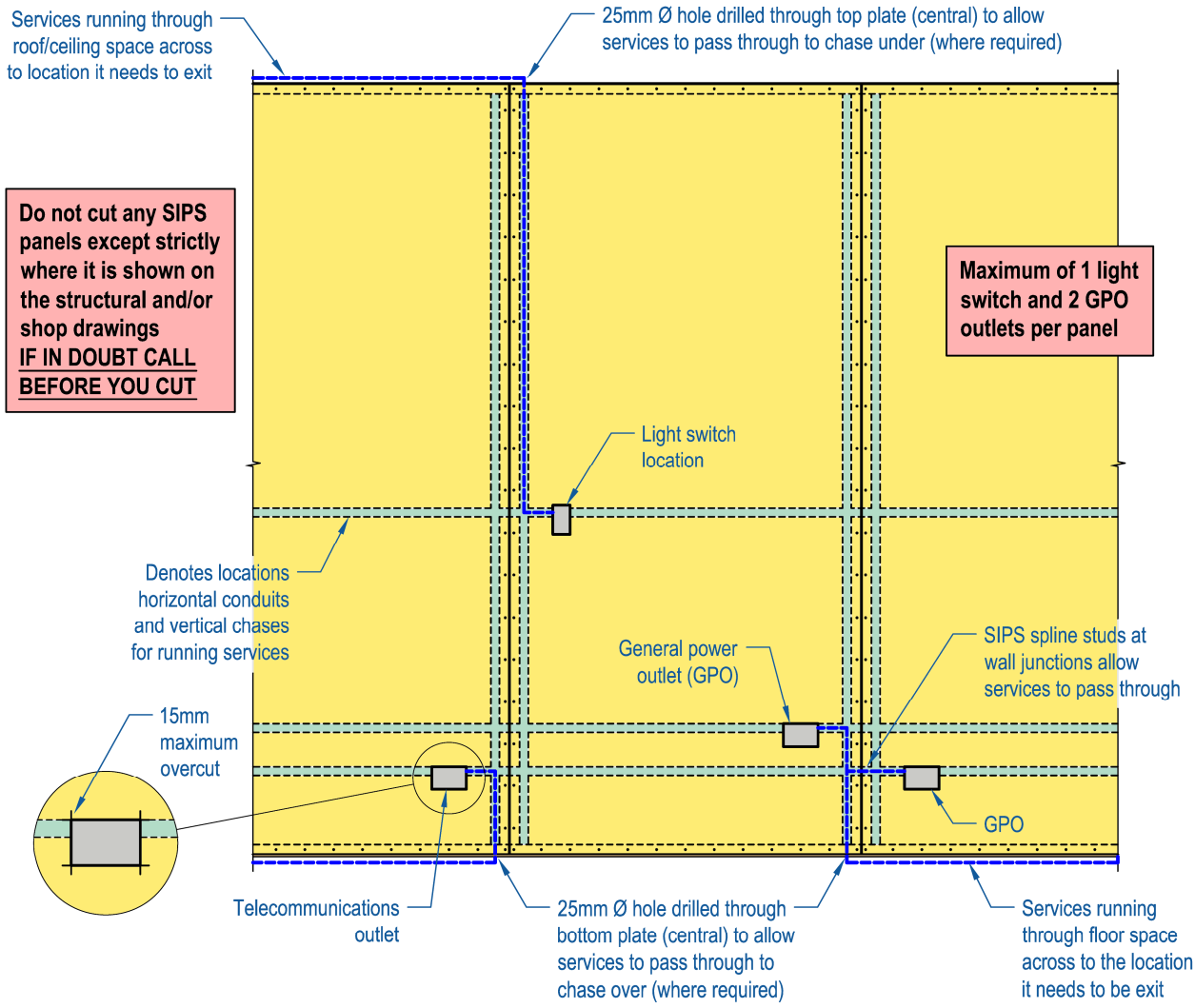


Figure 2.12: Electrical and telecommunication wiring.

2.6.2 Water and Waste Penetrations

A maximum of one 130 mm diameter straight through penetration is allowed for wastewater or sewage pipes. The region in which the penetration can be taken on the panel is shown in Figure 2.13.

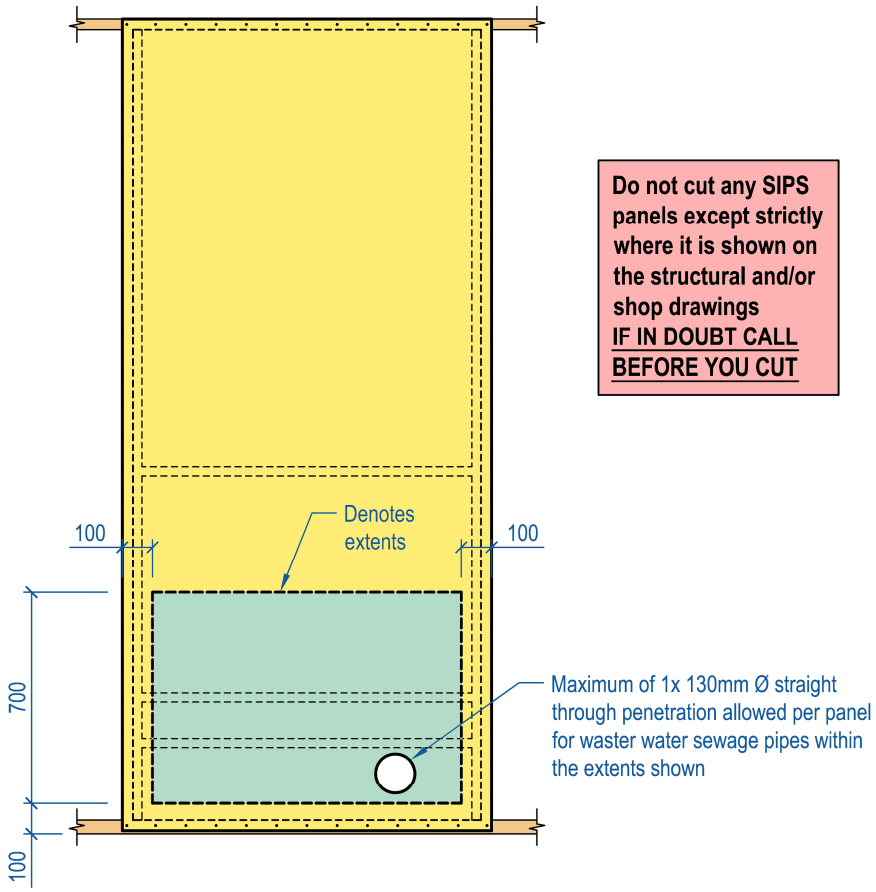


Figure 2.13: Electrical and telecommunication wiring.

SECTION 3: WALL CAPACITY

3.1 Axial Load Capacity

The ultimate axial load capacity of the SIPS wall panels are presented in Table 3.1. The ultimate capacity is based on the top plate being flush with the OSB (as shown in Figure 1.2) and 30 mm long x 2.8 diameter galvanised flat nails (or approved equivalent) at 100 mm centres between the top/bottom plates (timber grade MGP10) and the OSB, each face (as shown in Figure 3.1). Studs should be provided directly under concentrated loads. The capacity of these studs can be determined using AS 1684 and/or AS 1720.1.

Table 3.1: Axial load capacity.

Ultimate axial load capacity, $\emptyset N_{d,c}$ (kN/m)					
Panel thickness (mm)	**OSB thickness (mm)**	**PU thickness (mm)**	**Panel height**		
			2,400 mm	**2,700 mm**	**3,000 mm**
88	9	70	28.3	28.3	25.5
94	12	70	37.8	37.8	34.0
114	12	90	40.1	40.1	36.0

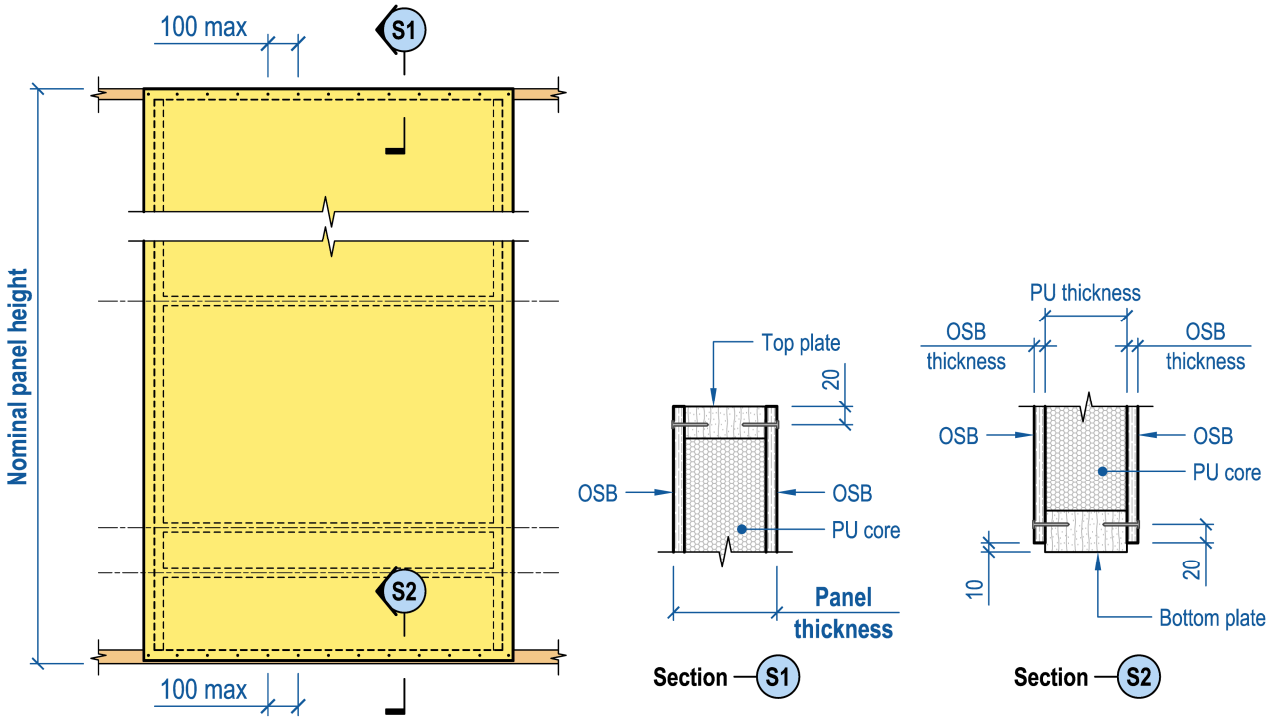


Figure 3.1: Axial load capacity.

3.2 Out-Of-Plane Flexural Capacity

The out-of-plane flexural capacity of the panels are presented in Tables 3.2 and 3.3 for a serviceability deflection limit of height/240 and height/300, respectively. The maximum wind speeds are based on a C_{fig} value (i.e. aerodynamic shape factor) 0.56.

Table 3.2: Permissible transverse loading for deflection limit of height/240.

Panel thickness (mm)	OSB thickness (mm)	PU thickness (mm)	Panel height		
			2,400 mm	2,700 mm	3,000 mm
			Pressure (kPa)		
88	9	70	0.87	0.61	0.44
94	12	70	1.72	1.20	0.86
114	12	90	2.02	1.42	1.02
			Wind speed, V (m/s)		
88	9	70	57.4	42.7	36.5
94	12	70	71.5	60.0	50.7
114	12	90	78.0	65.2	54.9
			Serviceability classification for Wind Speed (V)		
88	9	70	N5	N4	N3
94	12	70	N6	N6	N5
114	12	90	N6	N6	N5

Table 3.3: Permissible transverse loading for deflection limit of height/300.

Panel thickness (mm)	OSB thickness (mm)	PU thickness (mm)	Panel height		
			2,400 mm	2,700 mm	3,000 mm
			Pressure (kPa)		
88	9	70	0.69	0.49	0.35
94	12	70	1.29	0.90	0.64
114	12	90	1.61	1.12	0.80
			Wind speed, V (m/s)		
88	9	70	45.6	38.5	32.6
94	12	70	62.1	52.0	43.9
114	12	90	69.2	57.9	48.9
			Serviceability classification for Wind Speed (V)		
88	9	70	N4	N3	N3
94	12	70	N6	N5	N4
114	12	90	N6	N6	N5

3.3 Box Lintel Capacity

The SIPS wall panels can be constructed using SIPS box lintels or traditional hardwood timber lintels. The capacity of a typical 400 mm deep SIPS box lintel is provided in Table 3.4(a). The capacity of the hardwood timber lintel option can be calculated using AS 1684 and/or AS 1720.1.

Table 3.4: SIPS box lintel capacity.

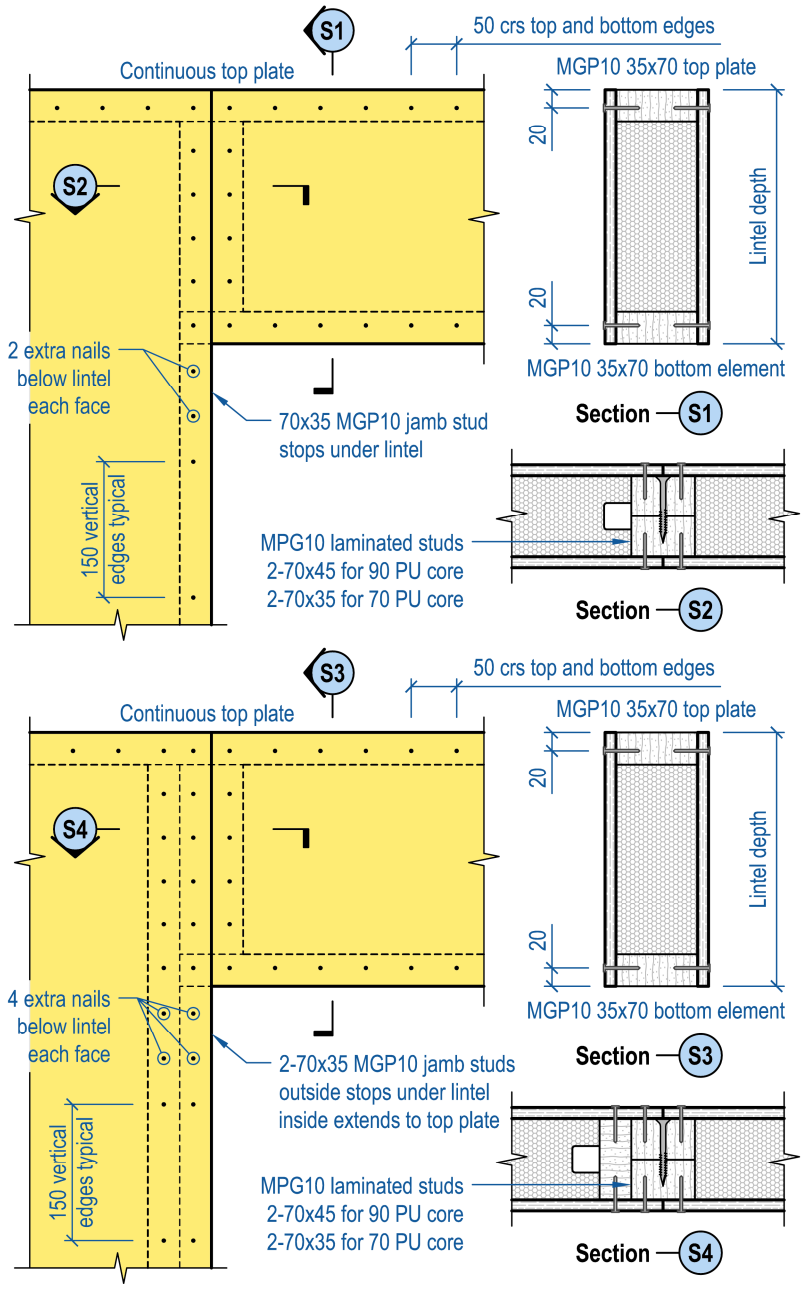
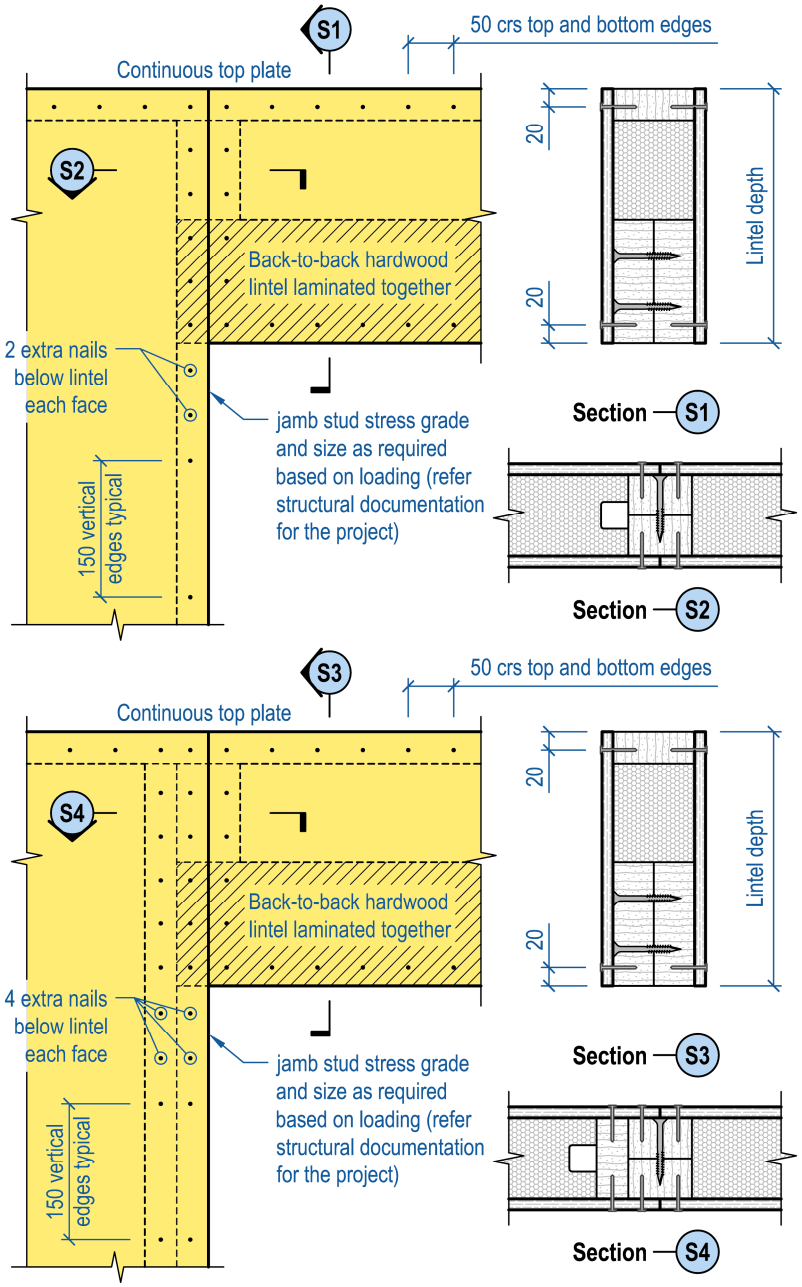
Box lintel size	Box lintel span length (mm)		
	3,000		
(a) Composite box lintel beam **400 mm deep** with **12 mm OSB boards**	**Ultimate uniformly distributed load (kN/m)**		
	10.4		
	Permissible uniformly distributed load (kN/m)		
	Span/300	**Span/360**	**Span/500**
	4.67	3.90	2.61
	Notes: 1. All nails to be 30 mm long x 2.8 diameter galvanised flat nails. 2. All timber studs are MGP10 unless noted otherwise. 3. PU core either 90 or 70 mm thick to suit thickness of adjacent wall panels.		

Table 3.4 (cont.): SIPS box lintel capacity.

Box lintel size	Box lintel span length (mm)
	NA
(b) Box lintel beam with **hardwood beam** 	Capacity based on strength of hardwood beam using AS 1684 and/or calculated using AS 1720.1 (composite action with OSB boards ignored)

3.4 Typical Wall Details

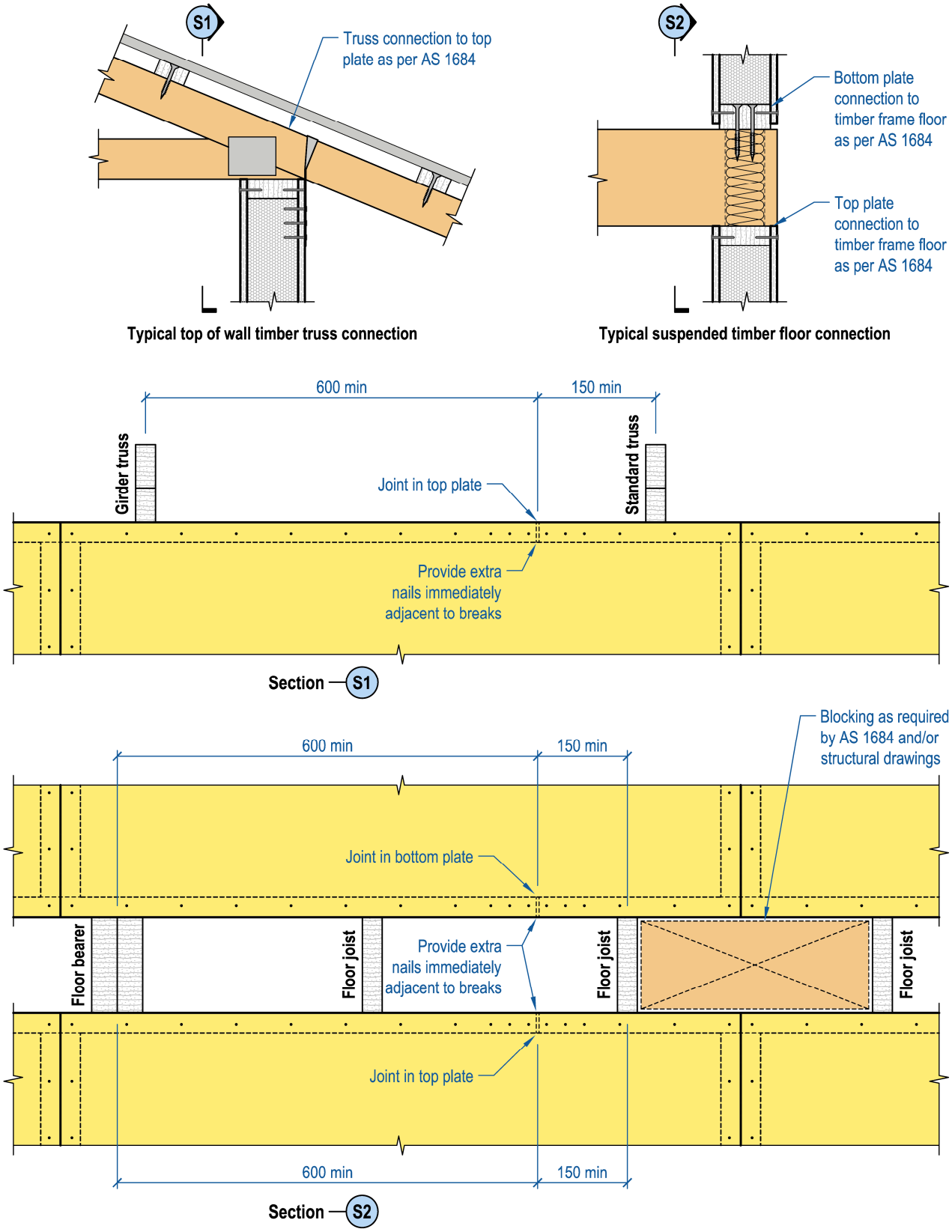


Figure 3.2: Top and bottom plate splices.

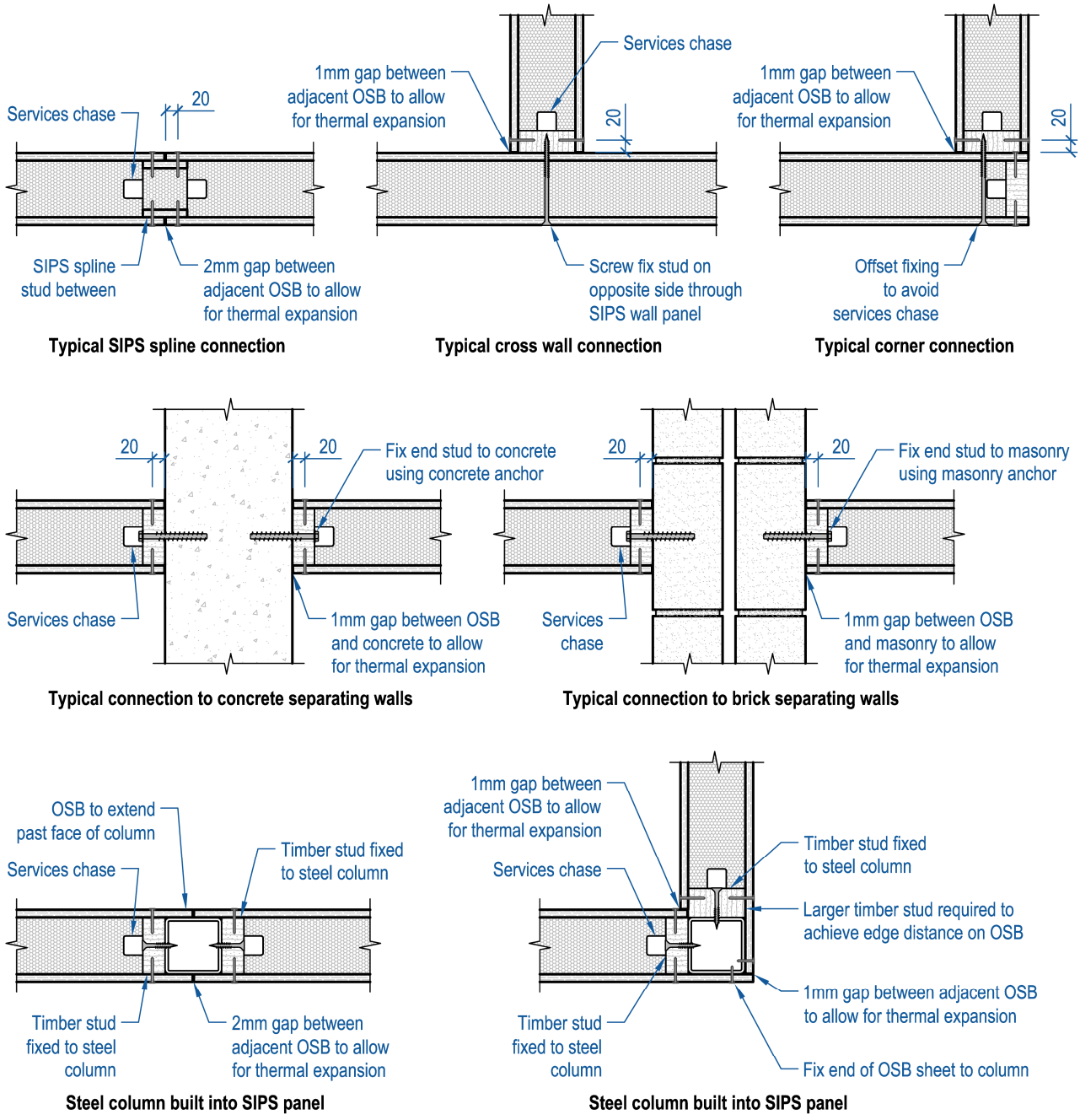


Figure 3.3: Wall intersection details.

SECTION 4: RACKING CAPACITY

4.1 Wall Bracing Capacity

Table 4.1: Bracing capacity of SIPS wall panels.

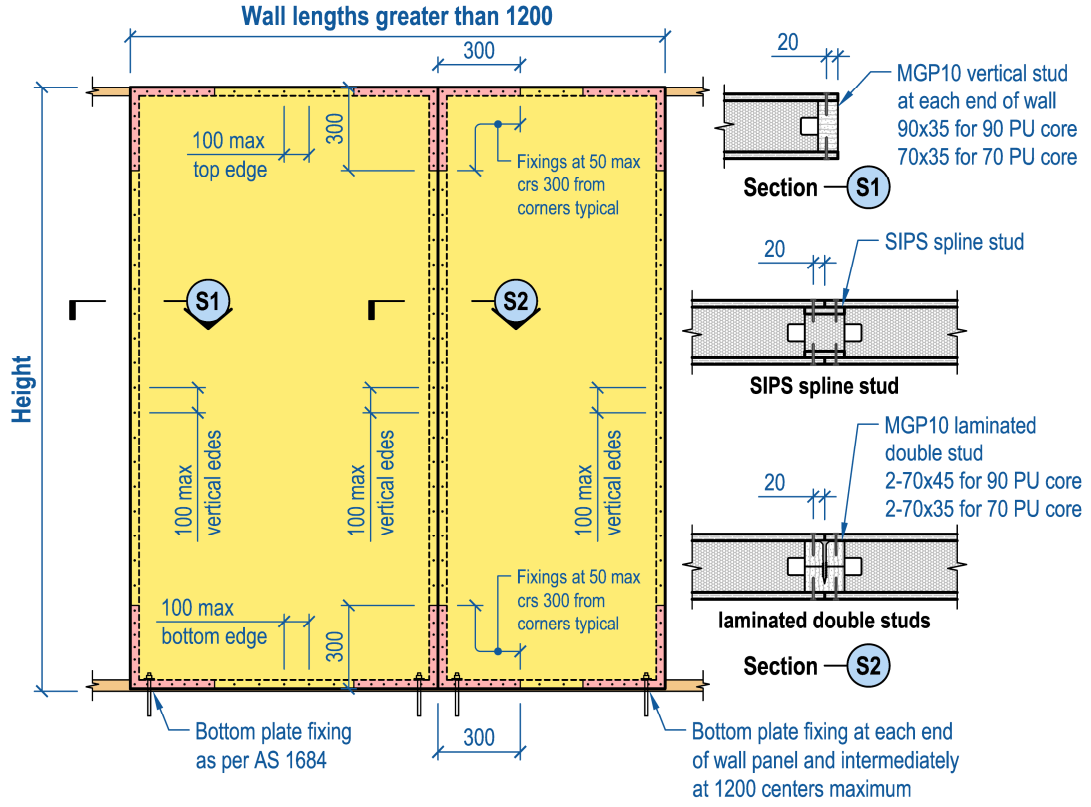
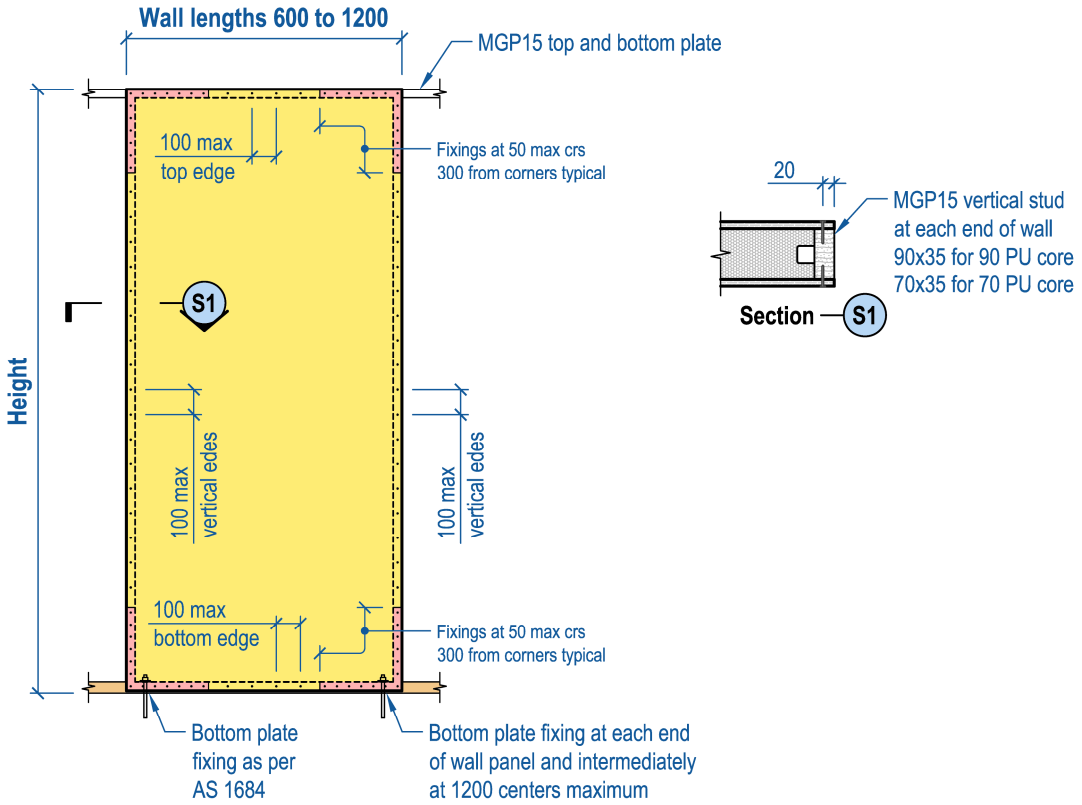
Type of bracing	Bracing capacity (kN/m)
(a) Minimum wall length of 1,200 mm or longer: **MGP10 top and bottom plate** required.  **Notes:** 1. All panels to be fixed using 30 mm long x 2.8 mm diameter galvanised flat nails or equivalent. 2. Top and bottom plates fixings to be at 100 mm centres (generally) each face. 3. Vertical edge fixings to be at 100 mm centres (generally) each face. 4. Additional fixings (horizontal and vertical) to be provide at 50 mm centres within 300 mm of each corner. 5. Bracing capacity is for 2,400 mm high panels. Bracing capacity to be multiplied by 0.9 for 2,700 mm and 0.8 for 3,000 high wall panels. 6. Bottom plate to be fixed to the slab/floor under for the associated uplift force in Table 4.2.	5.7

Table 4.1 (cont.): Bracing capacity of SIPS wall panels.

Type of bracing	Bracing capacity (kN/m)
(b) Wall length less than 1,200 mm (600 mm minimum): **MGP15 top and bottom plate** required. 	**Length = 600 mm** 2.5 **Length = 900 mm** 5.0 **Length = 1,200 mm** 5.7 Note: linear interpolate for wall lengths in between.

Notes:

1. All panels to be fixed using 30 mm long x 2.8 mm diameter galvanised flat nails or equivalent.
2. Top and bottom plates fixings to be at 100 mm centres (generally) each face.
3. Vertical edge fixings to be at 100 mm centres (generally) each face.
4. Additional fixings (horizontal and vertical) to be provide at 50 mm centres within 300 mm of each corner.
5. Bracing capacity is for 2,400 mm high panels. Bracing capacity to be multiplied by 0.9 for 2,700 mm and 0.8 for 3,000 high wall panels.
6. Bottom plate to be fixed to the slab/floor under for the associated uplift force in Table 4.2.

Table 4.2: Uplift force at ends of bracing walls.

Wall height (mm)	Panel width (mm)		
	600	900	≥ 1,200
2,400	23 kN	14 kN	11 kN
2,700	26 kN	17 kN	13 kN
3,000	28 kN	19 kN	15 kN