Fire assessment report

Fire resistance of 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel wall system to AS 1530.4:2014

Sponsors: Speedpanel Holdings Pty Ltd and H B Fuller Company Australia Pty Ltd

Revision: R1.0 Reference number: FAS220345

Issued date: 26 October 2022 Expiry date: 31 October 2027

Quality management

Version	Date	Information about the report			
R1.0	Issue: 25/10/2022	Reason for issue	Initial issue		
			Prepared by	Reviewed by	Authorised by
	Expire: 31/010/2027	Name	Mohammed Mutafi	Mahmoud Akl	Omar Saad
		Signature			

Executive summary

This report documents the findings of the assessment undertaken to determine the fire resistance level (FRL) of 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel wall systems in accordance with AS 1530.4:2014. This includes construction details for the base, head, corners and T-junctions of the wall.

The proposed construction is made of 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel as tested in EWFA 2736002.1, EWFA 2848300.2 and BWA 2286900.5, respectively, with consideration given to the following variations:

- Walls can be up to 5 m high for 51 mm, 64 mm and 78 mm thick Speedpanel walls depending on design and the general arrangement as shown in Figure 1.
- Head details fixed to concrete slab can be as shown in Figure 3 to Figure 18.
- Head detail fixed to steel structure can be as shown in Figure 19.
- Wall edge details can be as shown in Figure 20 to Figure 45.
- Wall base details can be as shown in Figure 46 to Figure 53.
- Corner details can be as shown in Figure 54 to Figure 71.
- T-junction details can be as shown in Figure 72 and Figure 73.
- Angled details can be as shown in Figure 74 to Figure 83.
- Multi-angled corner details can be as shown in Figure 84 and Figure 85.
- The sealant product at side and bottom tracks is Fuller Firesound Acrylic sealant.

Additionally for 78 mm wall systems only:

- Inclined wall systems can be constructed as shown in Figure 86.
- For inclined and segmented wall heights between 5 m and 6 m, angled connection and head details must be as shown in Figure 87 – Figure 89, and Figure 91 – Figure 93, respectively.
- Vertical wall curved in plan detail shown in Figure 90.

Based on the discussion presented in this report, it is the opinion of this registered testing authority that the proposed wall construction are expected to achieve the FRLs stated in Table 1 and Table 2 – in accordance with AS 1530.4:2014.

The variations and outcome of this assessment are subject to the limitations and requirements described in sections 2, 3 and 6 of this report. The results of this report are valid until 31 October 2027.

Table 1 Vertical Speedpanel wall systems

<table>
<tr><th rowspan="2">Wall thickness (mm)</th><th rowspan="2">Max. wall height (m)</th><th rowspan="2">Panel-to-panel fixings</th><th colspan="8">Connections</th><th rowspan="2">FRL</th></tr>
<tr><th>Head to concrete slab</th><th>Head to steel structure</th><th>Side/edge</th><th>Base</th><th>Corner</th><th>T-intersection</th><th>Angled</th><th>Multi-Angled</th></tr>
<tr><td>51</td><td>5.0</td><td rowspan="3">Required to be installed to one face of the panels across the wall at 1000 mm centres (Figure 1)</td><td rowspan="4">Figure 3 to Figure 18</td><td rowspan="4">Figure 19</td><td rowspan="4">Figure 20 to Figure 45</td><td rowspan="4">Figure 46 to Figure 53</td><td rowspan="4">Figure 54 to Figure 71</td><td rowspan="4">Figure 72 to Figure 73</td><td rowspan="4">Figure 74 to Figure 83</td><td rowspan="4">Figure 84 to Figure 85</td><td>-/60/60</td></tr>
<tr><td>64</td><td>5.0</td><td>-/90/90</td></tr>
<tr><td>78</td><td>5.0</td><td>-/120/120</td></tr>
<tr><td>78</td><td>6.0</td><td>Required to be installed to one face of the panels at (Figure 2):
• 500 mm centres (1st two joints).
• 750 mm centres (2nd two joints); and then
• 1000 mm centres</td><td>-/120/120</td></tr>
</table>

Table 2 Inclined and curved/segmented Speedpanel wall systems

Wall thickness (mm)	Wall height (H) (m)	Maximum inclined distance (D) (m)	Maximum inclined angle (Θ) (°)	Connections			Minimum radius of curvature view (m)	FRL
				Head	Side/Edge	Base		
78	4.0	1.34	19	Figure 86	Figure 20 to Figure 45	Figure 86	-	-/120/120
	4.2	1.18	16					
	4.5	0.94	12					
	4.7	0.79	10					
	4.8	0.71	8					
	4.9	0.64	7					
	5.0	0.56	6					
	5.2	0.42	5	Figure 91 to Figure 93	Figure 20 to Figure 45	Figure 86		
	5.5	0.19	2					
	5.7	0.04	0					
	5.8	0.00	0					
	6.0	0.00	0					
78	5.0	-	-	Figure 3 to Figure 18	Figure 87 to Figure 89	Figure 46 to Figure 53	-	-/120/120
	5.01 – 6.0	-	-	Figure 91 to Figure 93			-	-/120/120
78	6.0	-	-	Figure 3 to Figure 18	Figure 90	Figure 46 to Figure 53	1.35 (int) / 1.45 (ext)	-/120/120
Note: Situations where two angle sections are used to connect the Speedpanel system, both angle sections may face opposite directions and achieve the relevant FRLs in Table 1 and Table 2.								

Contents

1. Introduction

This report documents the findings of the assessment undertaken to determine the fire resistance level (FRL) of 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel wall systems in accordance with AS 1530.4:2014[1]. This includes construction details for the base, head, corners, T-junctions, angled and multi-angled details of the wall.

This assessment was carried out at the request of Speedpanel Holdings Pty Ltd and H B Fuller Company Australia Pty Ltd.

The sponsor details are included in Table 3.

Table 3 Sponsor details

Sponsor	Address
Speedpanel Holdings Pty Ltd	421 Dorset Road Bayswater VIC 3153 Australia
H B Fuller Australia	16-22 Redgum Drive Dandenong south, 3175 Australia

2. Framework for the assessment

2.1 Assessment approach

An assessment is an opinion about the expected performance of a component or element of structure if it was subject to a standard fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for doing these assessments. We have therefore followed the 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the Passive Fire Protection Forum (PFPF) in the UK in 2021[2].

This guide provides a framework for undertaking assessments in the absence of specific fire test results. Some areas where assessments may be offered are:

- Where a modification is made to a construction which has already been tested
- The interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product.
- Where, for various reasons – eg size or configuration – it is not possible to subject a construction or a product to a fire test.

Assessments will vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated constructions.

This assessment uses established empirical methods and our experience of fire testing similar products to extend the scope of application by determining the limits for the design based on the tested constructions and performances obtained. The assessment is an evaluation of the potential fire resistance performance if the elements were to be tested in accordance with AS 1530.4:2014.

This assessment has been written using appropriate test evidence generated at accredited laboratories to the relevant test standard. The supporting test evidence has been deemed appropriate to support the manufacturer's stated design.

[1] Standards Australia, 2014, Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction, AS 1530.4:2014, Standards Australia, NSW.
[2] Passive Fire Protection Forum (PFPF), 2021, Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence, Passive Fire Protection Forum (PFPF), UK.

2.2 Compliance with the National Construction Code

This assessment report has been prepared to meet the evidence of suitability requirements of the National Construction Code Volumes One and Two – Building Code of Australia (NCC) 2019 Amendment 1[3] under A5.2 (1) (d) and 2016 under specification A2.3, including amendments.

This assessment has been written in accordance with the general principles outlined in EN 15725:2010[4] for extended application reports on the fire performance of construction products and building elements. It also references test evidence for meeting a performance requirement or deemed to satisfy (DTS) provisions of the NCC under A5.4 for fire resistance levels as applicable to the assessed systems.

This assessment report may also be used to demonstrate compliance with the requirements for Evidence of Suitability under NCC 2016, including amendments[5].

2.3 Declaration

The 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposal on 26 November 2021, Speedpanel Holdings Pty Ltd and H B Fuller Company Australia Pty Ltd confirmed that:

- To their knowledge the component or element of structure, which is the subject of this assessment, has not been subjected to a fire test to the standard against which this assessment is being made.
- They agree to withdraw this assessment from circulation if the component or element of structure is the subject of a fire test by a test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment.
- They are not aware of any information that could adversely affect the conclusions of this assessment and – if they subsequently become aware of any such information – they agree to ask the assessing authority to withdraw the assessment.

3. Limitations of this assessment

- The scope of this report is limited to an assessment of the variations to the tested systems described in section 4.3.
- This report details the methods of construction, test conditions and assessed results that are expected if the systems were tested in accordance with AS 1530.4:2014.
- The results of this assessment are applicable to fire exposure from either side for the assessed wall system, but not simultaneously. For multi-angled corner details, the assessment is applicable to fire exposure from either side of one of the connected wall panels, but not simultaneously.
- It is required that the lateral load capacity of the head track and base track be verified by the design engineer for the lateral load capacity under ambient loading conditions.
- It is required the support construction above and below the wall be capable of providing adequate vertical and lateral support for the FRL period.
- It is required the steel structure above the wall shall be protected with vermiculite spray be providing adequate support for the FRL period. The protection of structural steel does not form part of this assessment and required protection thickness must be determined by others by at least considering critical temperature of 550°C. In addition, the design of steel beam

[3] National Construction Code Volume One – Building Code of Australia 2019 Amendment 1, Australian Building Codes Board, Australia.
[4] European Committee for Standardization, 2010, Extended application reports on the fire performance of construction products and building elements, EN 15725:2010, European Committee for Standardization, Brussels, Belgium.
[5] National Construction Code Volumes One and Two - Building Code of Australia 2016 including Amendments, Australian Building Codes Board, Australia

must be conducted in a such manner not to allow the steel beam to deflect more than 20 mm during the fire exposure.

- This report is only valid for the assessed systems and must not be used for any other purpose. Any changes with respect to size, construction details, loads, stresses, edge or end conditions – other than those identified in this report – may invalidate the findings of this assessment. If there are changes to the system, a reassessment will need to be done by an Accredited Testing Laboratory (ATL).
- The documentation that forms the basis for this report is listed in Appendix A.
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.
- This assessment is based on the proposed systems being constructed under comprehensive quality control practices and following appropriate industry regulations and Australian Standards on quality of materials, design of structures, guidance on workmanship and the expert handling, placing and finishing of the products on site. These variables are beyond the control and consideration of this report.

4. Description of the specimen and variations

4.1 System description

This assessment makes reference to test reports BWA 2286900.5, EWFA 2848300.2 and EWFA 2736002.1, which are tests of Speedpanel wall systems tested in accordance with AS 1530.4:2005[6].

BWA 2286900.5 consisted of a test of a vertically orientated 78 mm thick 3 m × 3 m Speedpanel wall system. The wall was loaded to simulate a wall of increased height. The test was conducted by Warringtonfire and sponsored by Speedpanel (Vic.) Pty Ltd.

EWFA 2848300.2 consisted of a test of a vertically orientated 64 mm thick 3 m × 3 m Speedpanel wall system. The test was conducted by Warringtonfire and sponsored by Speedpanel Vic Pty Ltd.

EWFA 2736002.1 consisted of a test of a vertically orientated 51 mm thick 3 m × 3 m Speedpanel wall system. The test was conducted by Warringtonfire and sponsored by Speedpanel Vic Pty Ltd.

This assessment makes reference to test EWFA 2798800.1, 2736000, EWFA 2741700 and FR 3754. The tests were conducted by Warringtonfire and BRANZ and were sponsored by Speedpanel (Vic.) Pty Ltd and Speedwall New Zealand Ltd, respectively.

The assessment makes reference to test EWFA 29942200.1 comprised a test of a vertical orientated 78 mm thick Speedpanel wall system incorporating various services protected with various systems with Fire rated sealant. The test was conducted by Warringtonfire and was sponsored by Sika Australia Pty Ltd.

The assessment also makes reference to test TE 93878. The test was conducted by BRE and was sponsored by Cafco Europe Group SA.

Permission has been granted by Cafco Europe Group SA to reference test report TE 93878.

Permission has been granted by Sika Australia Pty Ltd to reference the test report EWFA 2994200.1.

4.2 Referenced test data

The assessment of the variation to the tested system and the determination of the expected performance is based on the results of the fire tests documented in the reports summarised in

Table 4. Further details of the tested system are included in Appendix A.

[6] Standards Australia, 2005, Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction, AS 1530.4:2005, Standards Australia, NSW.

Table 4 Referenced test data

Report number	Test sponsor	Test date	Testing authority
BWA 2286900.5	Speedpanel VIC Pty Ltd.	18 August 2008	Warringtonfire Australia
EWFA 2736000	Speedpanel VIC Pty Ltd.	22 June 2012	Warringtonfire Australia
EWFA 2736002	Speedpanel VIC Pty Ltd.	13 July 2012	Warringtonfire Australia
EWFA 2741700.1	Speedpanel VIC Pty Ltd.	20 July 2012	Warringtonfire Australia
EWFA 2798800.1	Speedpanel VIC Pty Ltd.	29 January 2013	Warringtonfire Australia
EWFA 2848300.2	Speedpanel VIC Pty Ltd.	29 May 2013	Warringtonfire Australia
EWFA 29942200.1	Speedpanel VIC Pty Ltd.	31 July 2014	Warringtonfire Australia
FR 3754	Speedwall New Zealand Ltd	17 May 2006	BRANZ
FR 4322	Speedpanel VIC Pty Ltd.	22 October 2009	BRANZ
TE 93878	Cafco Europe Group SA (T/A Cafco International)	9 January 2001	BRE laboratories

4.3 Variations to the tested systems

We have assessed the proposed construction using baseline test information for similar systems. The proposed construction is typically made of 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel as tested in BWA 2286900.5, EWFA 2848300.2 and EWFA 2736002.1, respectively, with consideration given to the following variations:

- Walls can be up to 5 m high for 51 mm, 64 mm and 78 mm thick Speedpanel wall depending on design and the general arrangement as shown in Figure 1.
- Head details fixed to concrete slab can be as shown in Figure 3 to Figure 18.
- Head detail fixed to steel structure can be as shown in Figure 19.
- Wall edge details can be as shown in Figure 20 to Figure 45.
- Wall base details can be as shown in Figure 46 to Figure 53.
- Corner details can be as shown in Figure 54 to Figure 71.
- T-junction details can be as shown in Figure 72 and Figure 73.
- Angled details can be as shown in Figure 74 to Figure 83.
- Multi-angled corner details can be as shown in Figure 84 and Figure 85.
- The sealant product at side and bottom tracks is Fuller Firesound acrylic sealant.

Additionally for 78 mm wall system only:

- Inclined wall systems can be constructed as shown in Figure 86.
- For wall heights between 5 m and 6 m, angled connection and head details must be as shown in Figure 87 – Figure 89, and Figure 91 – Figure 93, respectively.
- Vertical wall curved in plan detail shown in Figure 90.

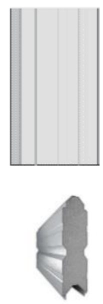
4.4 Purpose of the test

AS 1530.4:2014 sets out procedures for conducting fire resistance tests on building materials, components and structures. Specifically, section 2 of this standard contains general requirements for these tests. Section 3 addresses the fire resistance testing of walls.

4.5 Schedule of components

Table 5 outlines the schedule of components for the assessed systems subject to a fire test, as referenced in Appendix A.

Table 5 Schedule of components of assessed systems

Item	Description		
1	Name	Speedpanel® panel – vertical	
	Material	0.4 mm BMT mild steel sheath with lightweight cementitious infill	
	Size	• 78 mm profile panels as tested in EWFA 2286900.5; or • 64 mm profile panels as tested in EWFA 2848300.2; or • 51 mm profile panels as tested in EWFA 2736002.1	
2	Name	C-track	
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel	
	Size	• 50 mm × 82 mm × 50 mm – 78 mm • 50 mm × 68 mm × 50 mm – 64 mm • 50 mm × 56 mm × 50 mm – 51 mm	
3	Name	Equal angle	
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel	
	Spacing	50 mm × 50 mm	
4	Name	J-track	
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel	
	Spacing	• 50 mm × 82 mm × 90 mm – 78 mm • 50 mm × 68 mm × 90 mm – 64 mm • 50 mm × 56 mm × 90 mm – 51 mm	
5	Name	Fixing – track/angle to panel	
	Material	Minimum 10 g × 30 mm SDS	
	Spacing	Maximum 500 mm centres	
6	Name	Fixing – panel to panel	
	Material	Minimum 10 g × 16 mm SDS	
	Installation	Into every joint at 1000 mm centres	
7	Name	Fixing – masonry	
	Material	Hilti HUS3-P 6 × 40/5 Screw anchor; or 6.5 mm × 50 mm Mushroom head spike – installed in accordance with project engineer's specification and at least 40 mm embedment	
	Installation	Maximum 500 mm centres	
8	Name	Fire rated sealant	
	Material	Fuller Firesound Acrylic sealant	
	Installation	Seal all gaps as shown	
9	Name	Top track protection	
	Option 1	Name	Plasterboard strip
		Material	13 mm thick × 120 mm wide strip of fire rated plasterboard

Item	Description		
		Installation	fixed to min. one face of wall system with: 2 rows of Item 10 at 250 mm centres (top and bottom staggered at 125 mm)
	Option 2	Name	Head track flashing
		Material	Minimum 0.7 mm BMT × 130 mm galvanised steel
		Installation	fixed to min. one face of the wall system with: 2 rows of Item 5 at 500 mm centres (top and bottom staggered at 250 mm)
	Option 3	Name	Promat Promatect 250 Board
		Material	15 mm × 120 mm wide strip
		Installation	fixed to min. one face of wall system with 2 rows of Item 10 at 250 mm centres (top and bottom staggered at 125mm), and all gaps sealed with compatible fire rated acrylic sealant
	Option 4	Name	Promat CAFCO 300 Vermiculite
		Material	Gypsum-based wet mix spray
		Installation	Sprayed over the flange of the top track/angles and the interface of the track/angles and panels on each side (t_1) with a minimum thickness of: 20 mm for 51 mm or 64 mm panels, or 25 mm for 78 mm panels The thickness of vermiculite to protect the structural steel (t_2) is outside the scope of this assessment and additional advice is required from Promat directly.
	Option 5	Name	Trafalgar COREX Board
		Material	15 mm × 120 mm wide strip
		Installation	fixed to min. one face of wall system with 2 rows of Item 10 at 250 mm centres (top and bottom staggered at 125 mm), and all gaps sealed with compatible fire rated acrylic sealant.
10	Name	Fixing – plasterboard strip	
	Material	6 g × 45 mm bugle head screws	
11	Name	Fixing – corners	
	Material	14 g × 115 mm (course thread)	
	Installation	Max. 500 mm centres through joint and protected with corner flashing (Item 13)	
12	Name	Fixing – structural steel	
	Material	Series 500 screws	
	Installation	Equivalent to a minimum 5 mm mild steel bolts – with tension and shear capacities not less than 9 kN at ambient temperature – installed in accordance with project engineer's specification.	
13	Name	Flashing - corner	
	Material	Min. 0.7 mm BMT × 160 mm ×160 mm galvanised mild steel	
	Installation	Fixed along both edges at max. 500 mm centres using Item 5	
14	Name	C-track – 90 mm	
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel	
	Installation	90 mm × 82 mm × 90 mm	
15	Name	Corner protection – plasterboard strip	

Item	Description	
	Material	13 mm fire rated plasterboard
	Installation	Overlapping the Speedpanel system by minimum 100 mm from the edge of the track
16	Name	Fixing – T-intersections
	Material	14 g × 115 mm (coarse thread)
	Installation	Maximum 500 mm centres
17	Name	Custom angled C/J-track
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel
	Installation	Fit to the thickness and height of Speedpanel wall panels - where both flanges are minimum 35 mm onto the face of the panels
18	Name	Custom angles/flat plate
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel
	Installation	Both flanges are minimum 35 mm long
19	Name	Custom corner angle
	Material	1.15 mm BMT (1.2 mm TCT) galvanised mild steel
	Installation	Fixed along both edges at max. 500 mm centres using Item 5
20	Name	Non-Combustible Infill
	Material	• Minimum 120 kg/m³ non-combustible rockwool; or • Non-shrink grout
	Installation	Fill the cavity
21	Name	Speedpanel Head Flashing (to cover plasterboardd)
	Material	Min. 0.7 mm BMT Galv mild steel
	Installation	Fixed along both edges at max. 500 mm centres using Item 5
22	Name	Unequal angle
	Material	1.15 mm BMT (1.2 mm TCT) Galv mild steel
	Size	50 mm × 75 mm (75 mm leg to face of Speedpanel)
23	Name	Protection Lining
	Material	• 13 mm thick fire grade plasterboard; • 15 mm thick Promatect 250; • 15 mm thick Trafalgar COREX; or • Minimum 120 kg/m³ non-combustible rockwool
	Installation	Boards • Fixed to the C-tracks encasing the Speedpanel with 6g × 45 mm plasterboard screws (Item 10) at 500 mm centres; and • Seal all gaps with board manufacturer's sealant (Item 8) Rockwool • Fill cavity between C-tracks

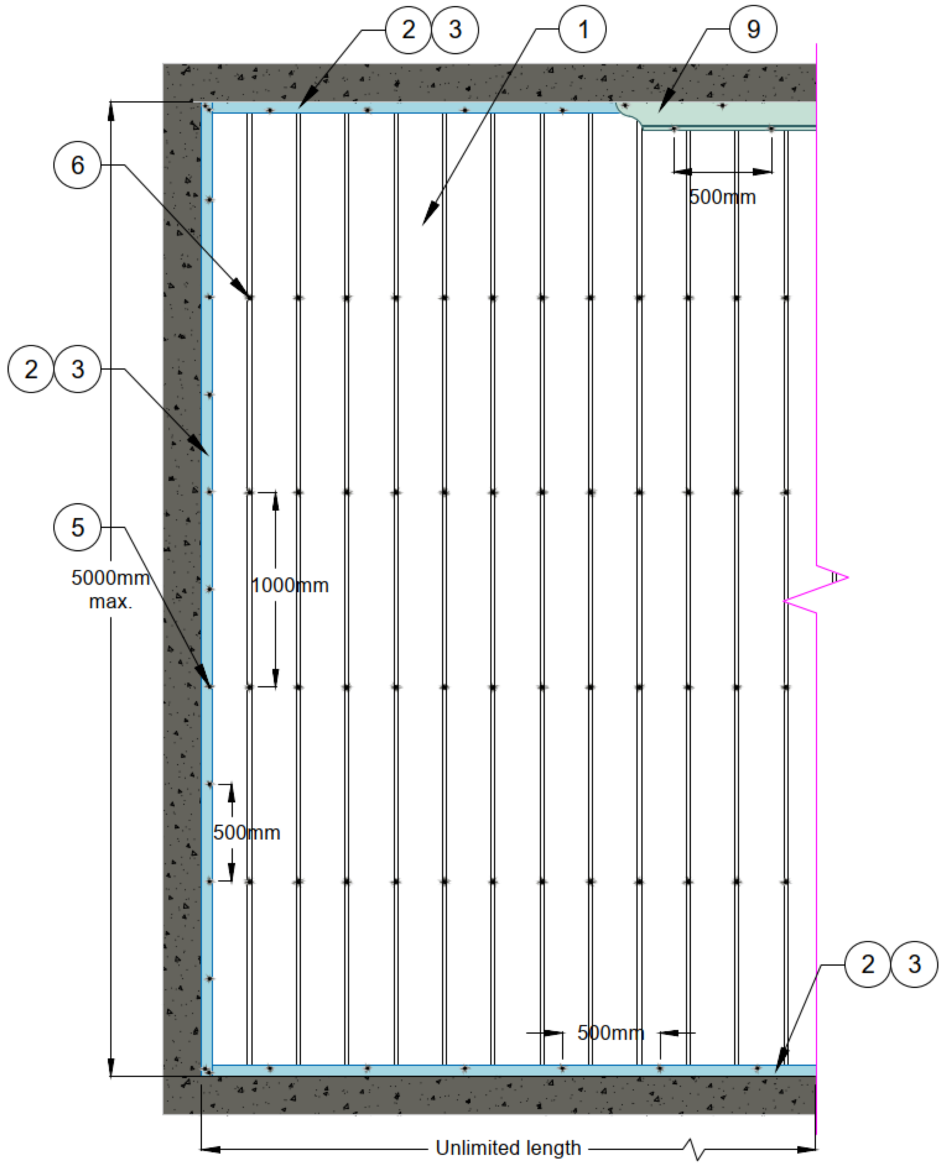


Figure 1 Elevation of vertical Speedpanel wall (up to 5 m high)

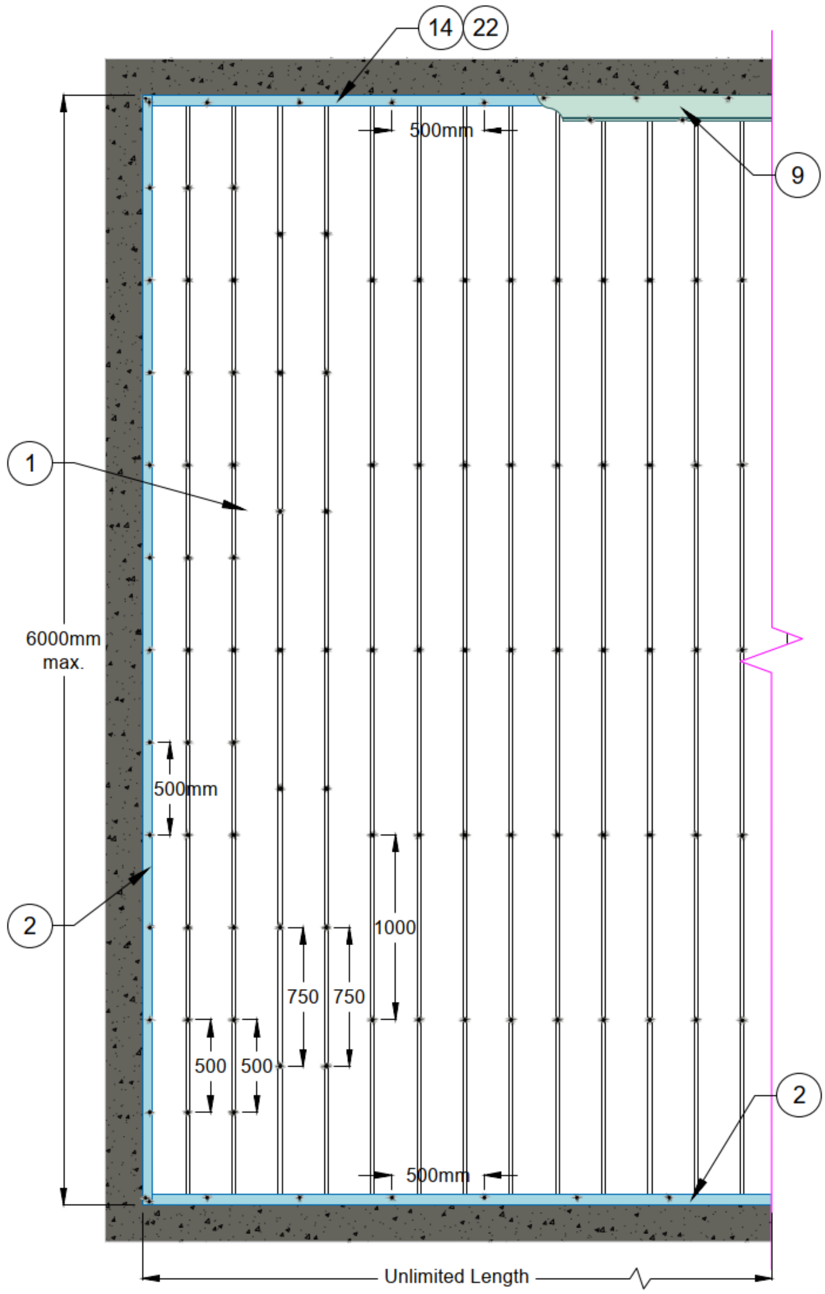


Figure 2 Elevation of vertical Speedpanel wall (up to 6 m high, only for 78 mm wall system)

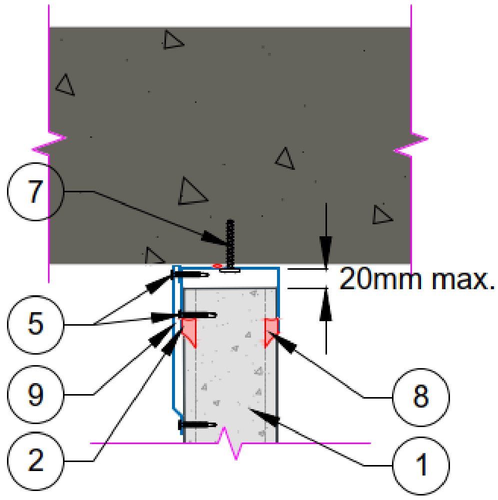


Figure 3 Head detail option 1

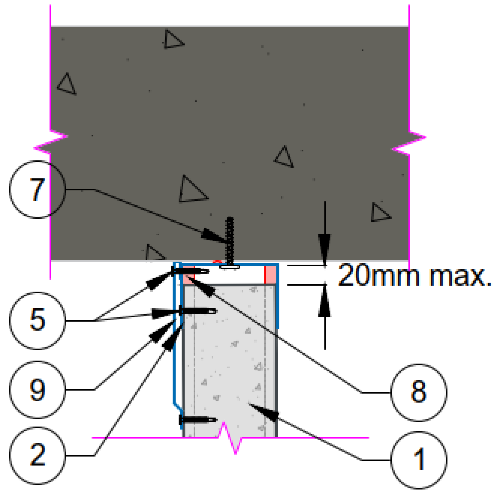


Figure 4 Head detail option 2

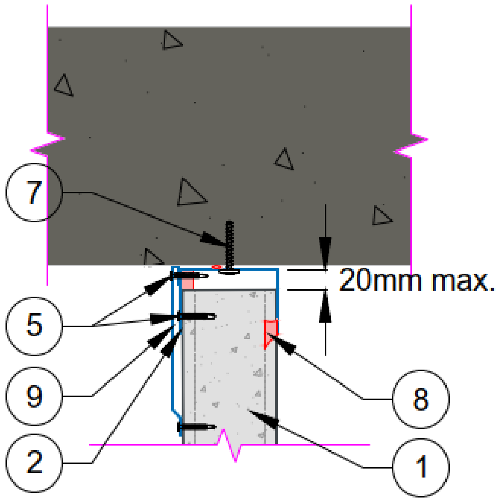


Figure 5 Head detail option 3

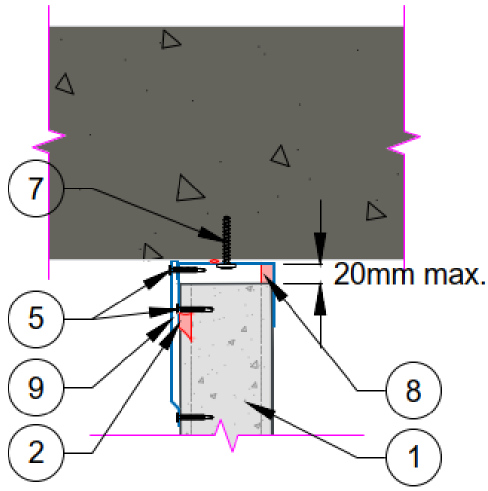


Figure 6 Head detail option 4

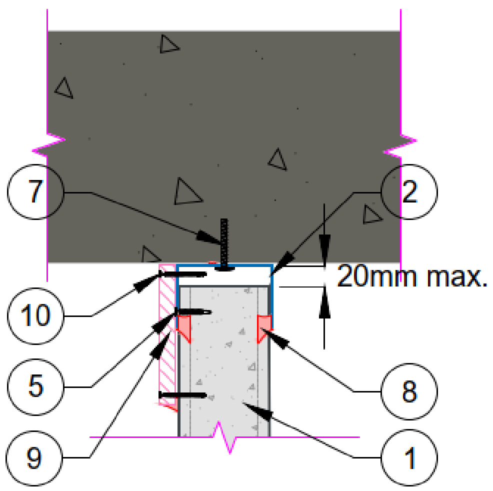


Figure 7 Head detail option 5

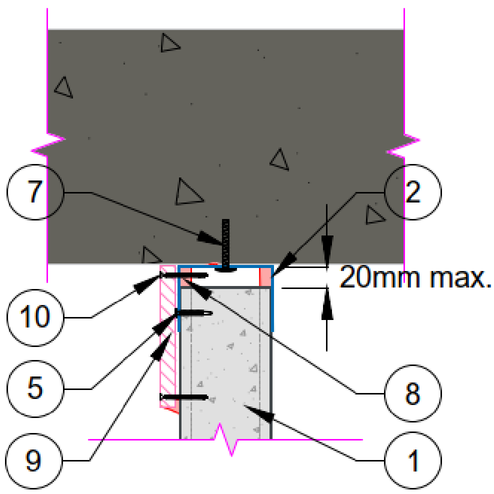


Figure 8 Head detail option 6

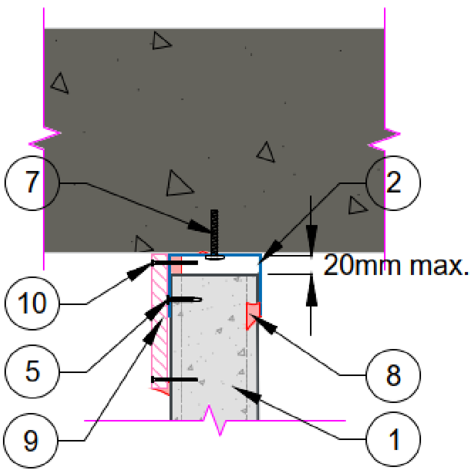


Figure 9 Head detail option 7

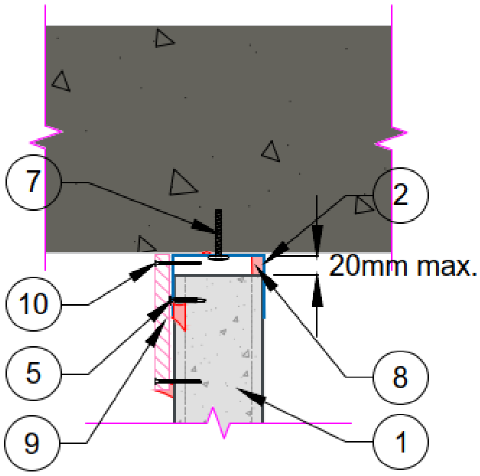


Figure 10 Head detail option 8

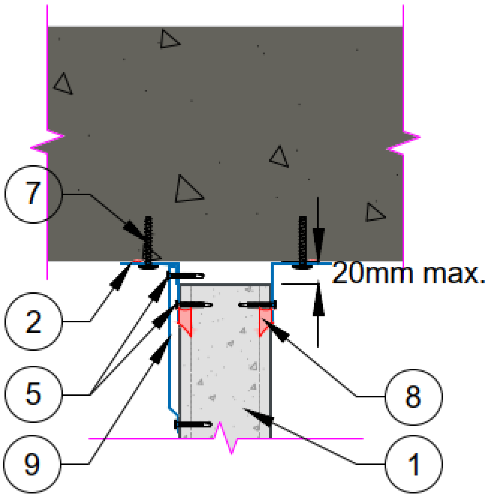


Figure 11 Head detail option 9

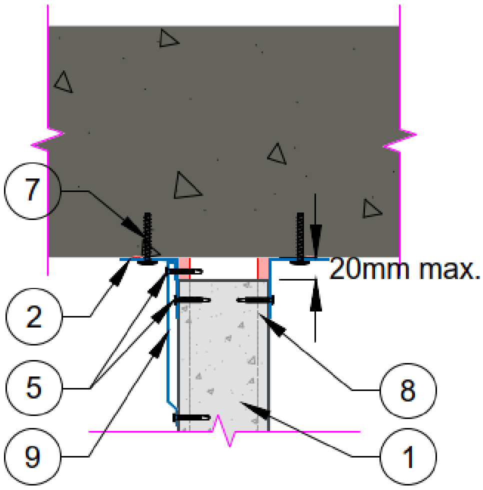


Figure 12 Head detail option 10

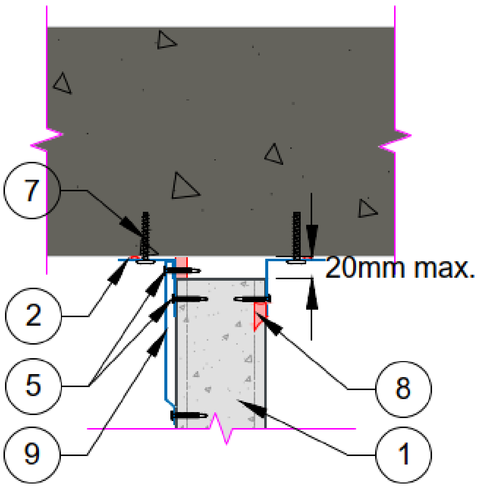


Figure 13 Head detail option 11

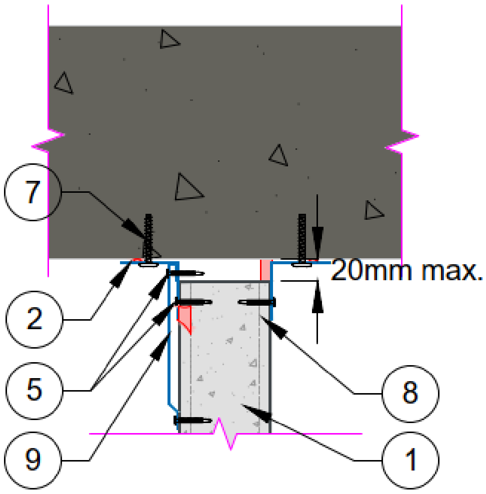


Figure 14 Head detail option 12

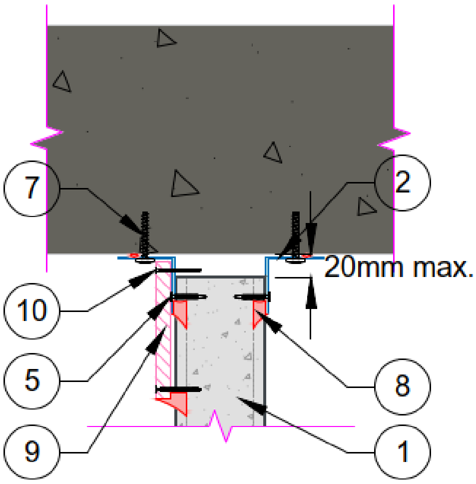


Figure 15 Head detail option 13

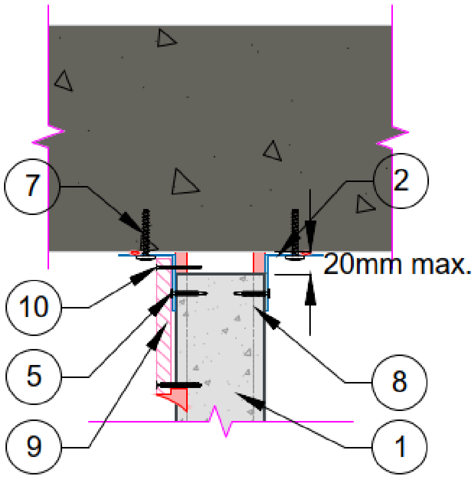


Figure 16 Head detail option 14

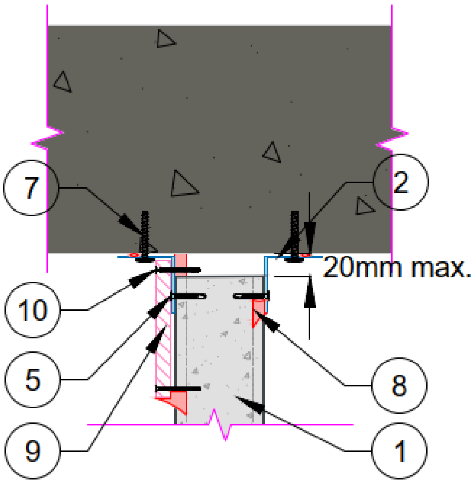


Figure 17 Head detail option 15

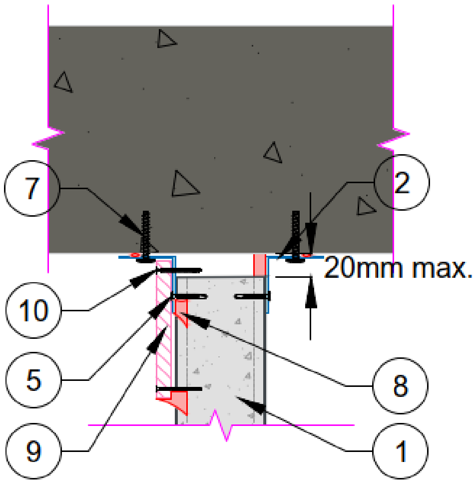


Figure 18 Head detail option 16

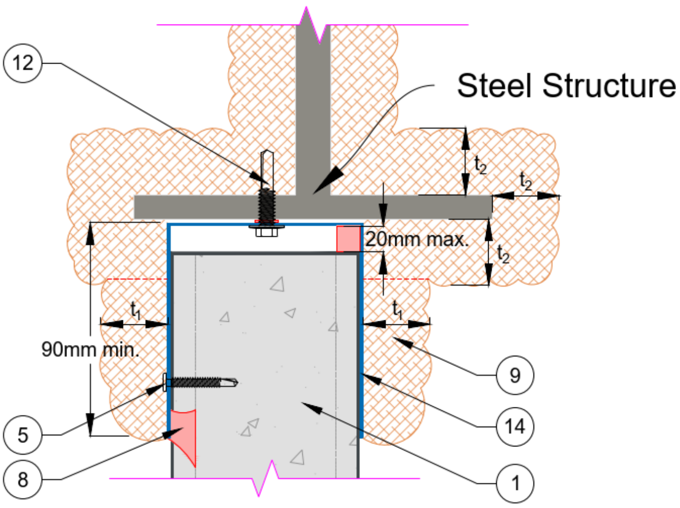


Figure 19 Head connected to structural steel

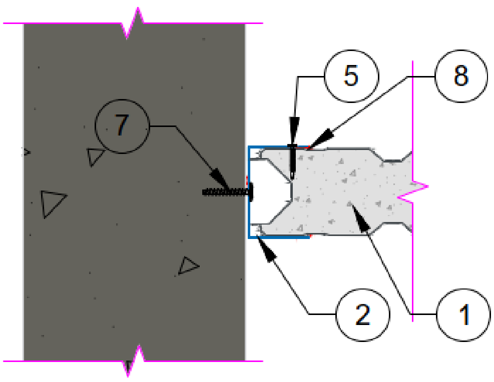


Figure 20 Side detail option 1

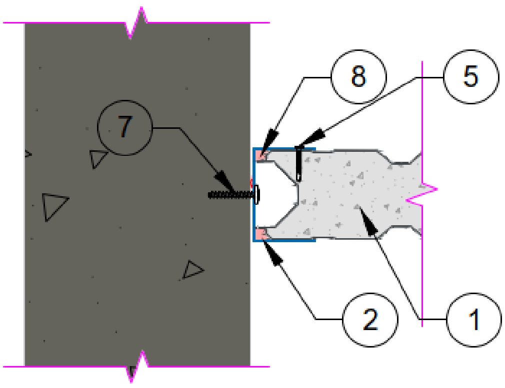


Figure 21 Side detail option 2

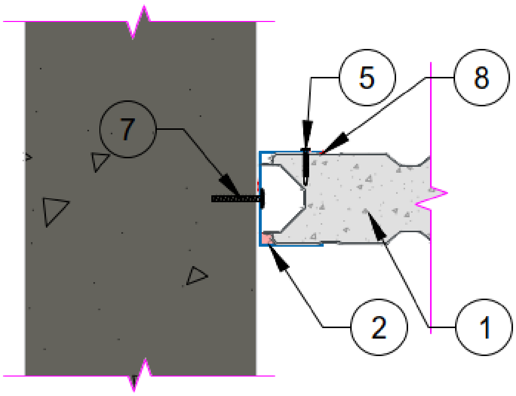


Figure 22 Side detail option 3

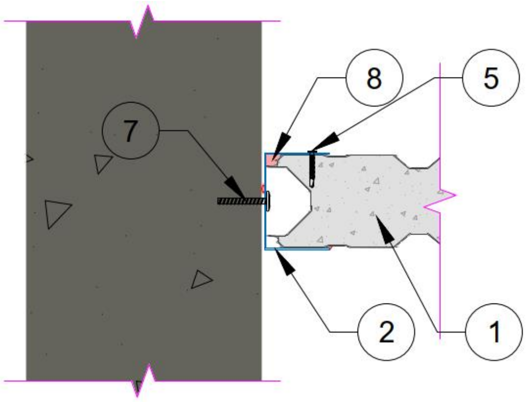


Figure 23 Side detail option 4

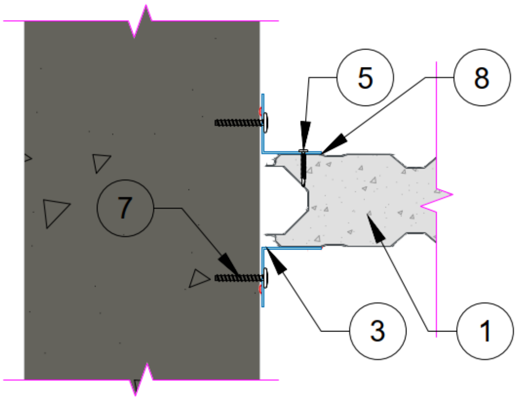


Figure 24 Side detail option 5

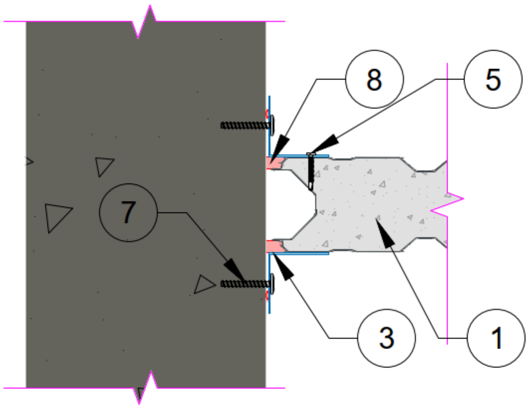


Figure 25 Side detail option 6

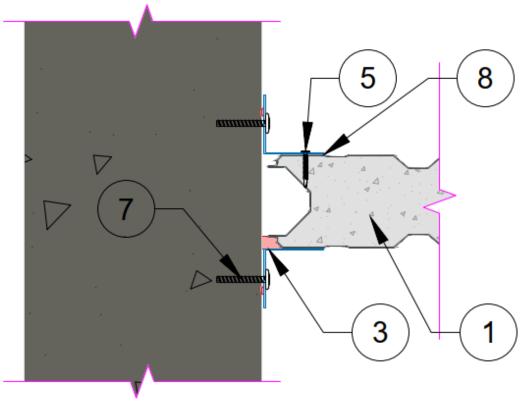


Figure 26 Side detail option 7

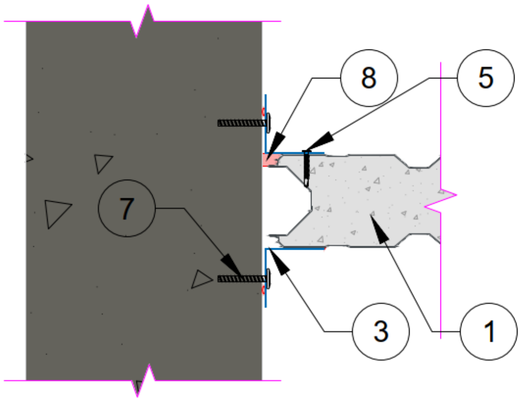


Figure 27 Side detail option 8

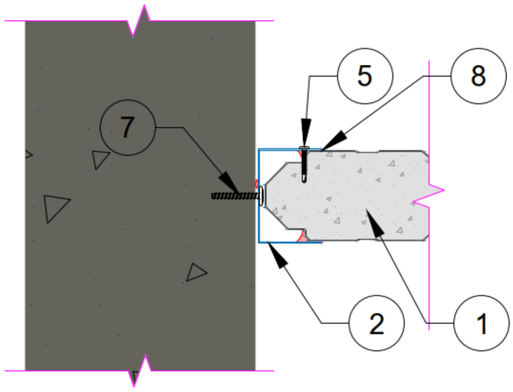


Figure 28 Side detail option 9

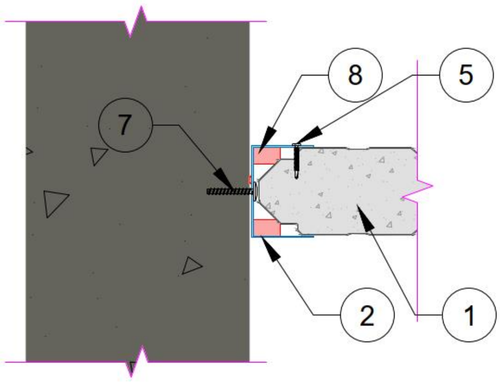


Figure 29 Side detail option 10

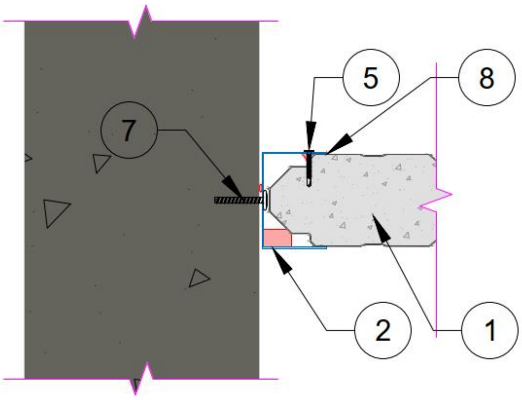


Figure 30 Side detail option 11

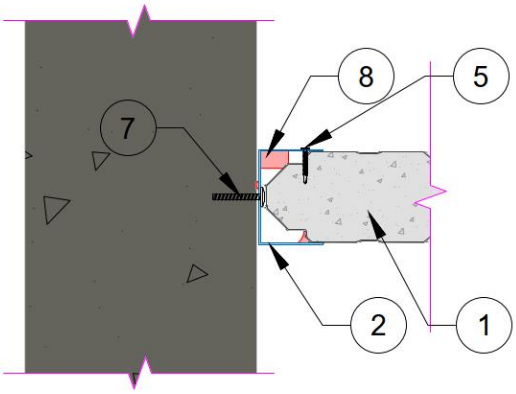


Figure 31 Side detail option 12

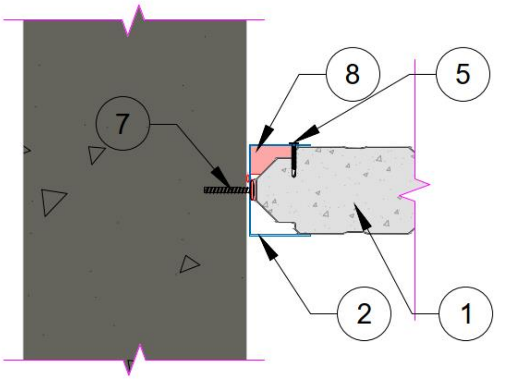


Figure 32 Side detail option 13

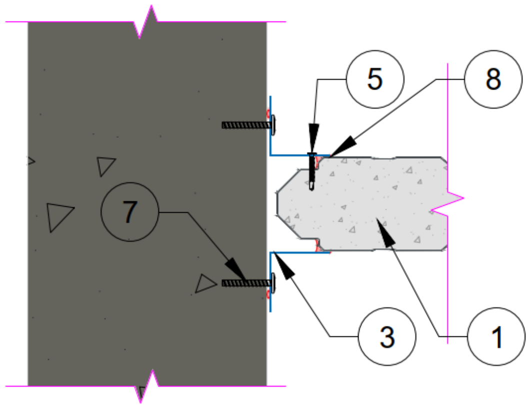


Figure 33 Side detail option 14

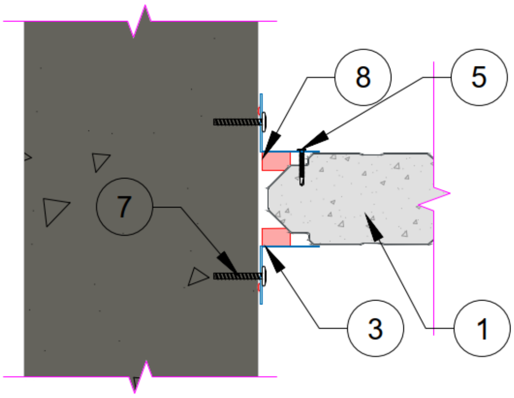


Figure 34 Side detail option 15

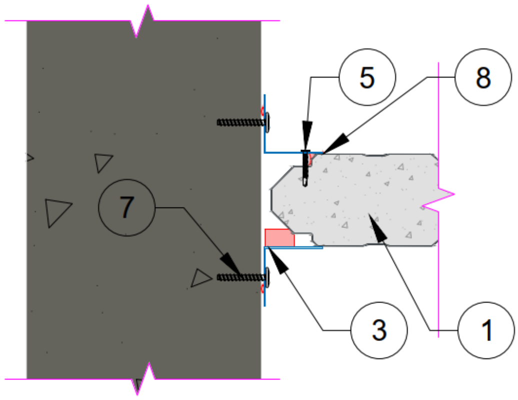


Figure 35 Side detail option 16

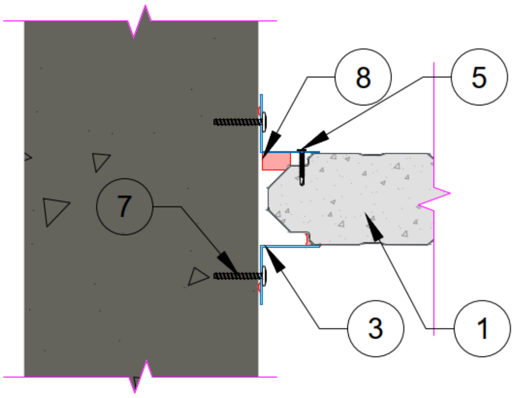


Figure 36 Side detail option 17

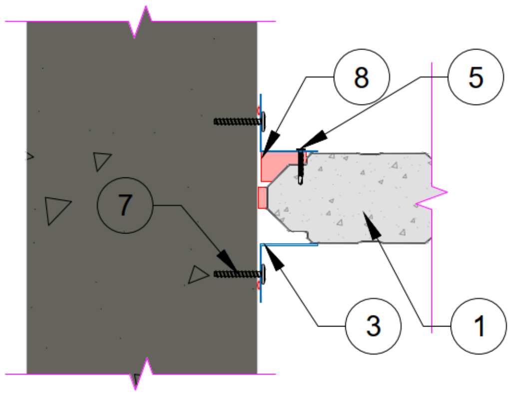


Figure 37 Side detail option 18

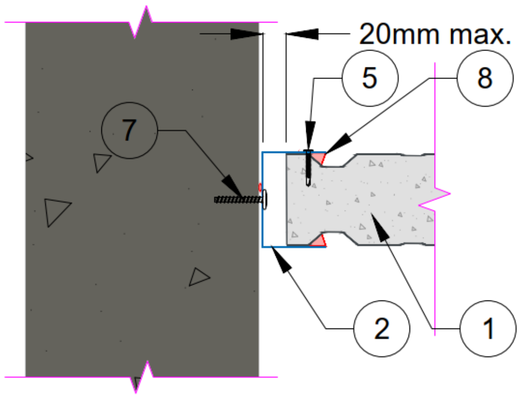


Figure 38 Side detail option 19

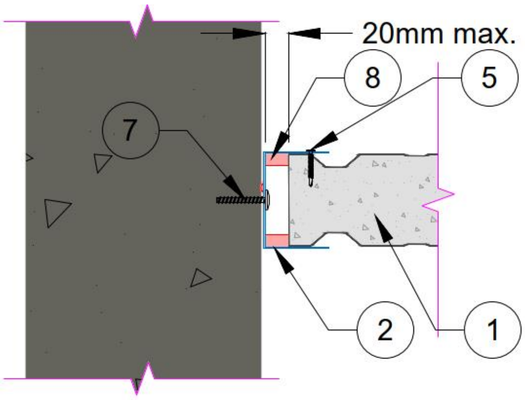


Figure 39 Side detail option 20

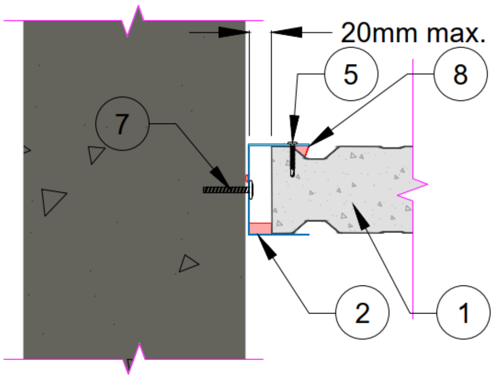


Figure 40 Side detail option 21

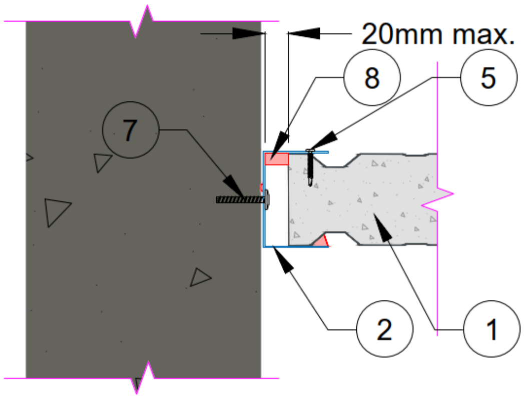


Figure 41 Side detail option 22

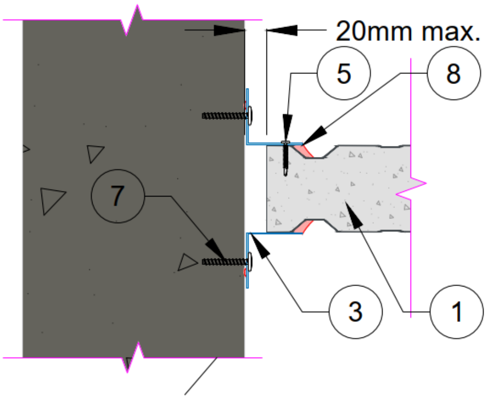


Figure 42 Side detail option 23

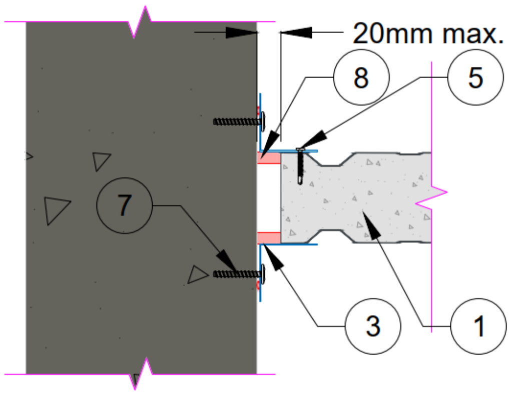


Figure 43 Side detail option 24

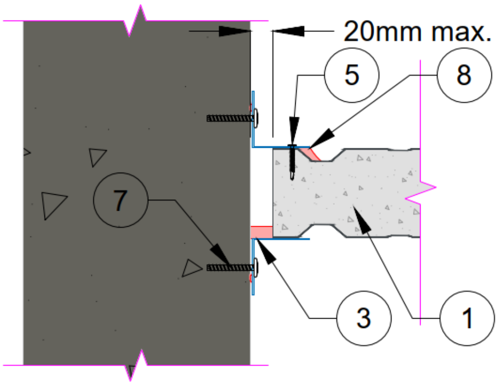


Figure 44 Side detail option 25

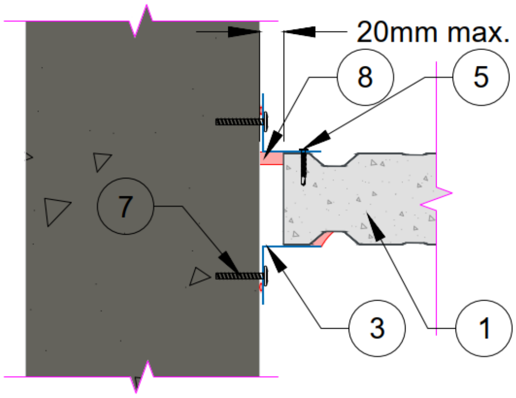


Figure 45 Side detail option 26

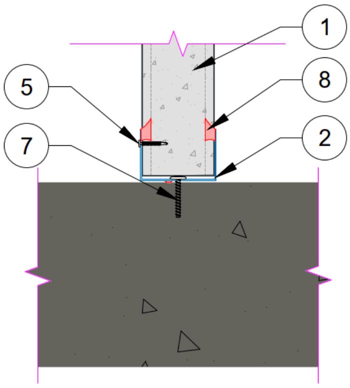


Figure 46 Base detail option 1

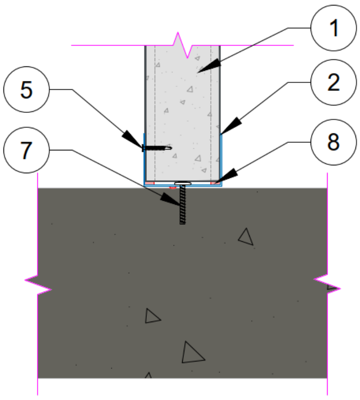


Figure 47 Base detail option 2

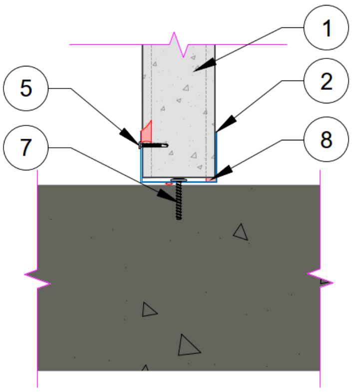


Figure 48 Base detail option 3

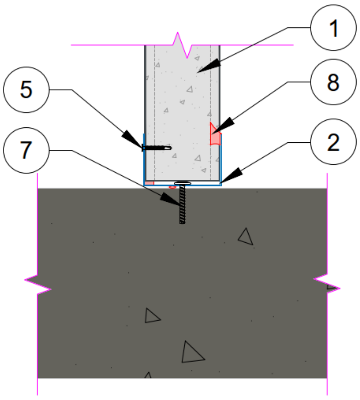


Figure 49 Base detail option 4

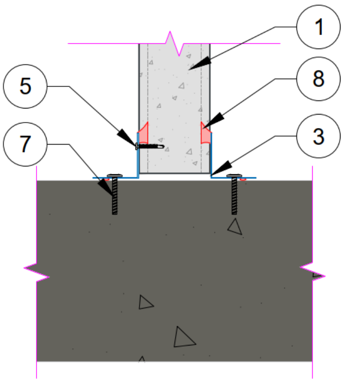


Figure 50 Base detail option 5

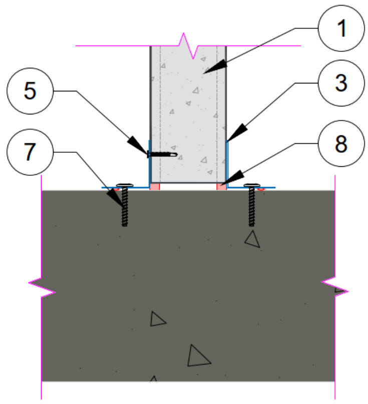


Figure 51 Base detail option 6

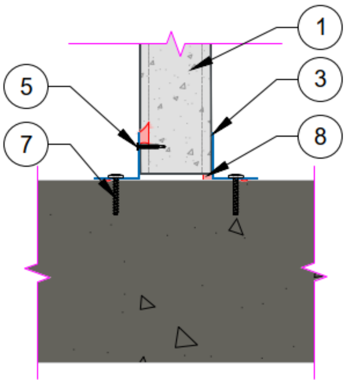


Figure 52 Base detail option 7

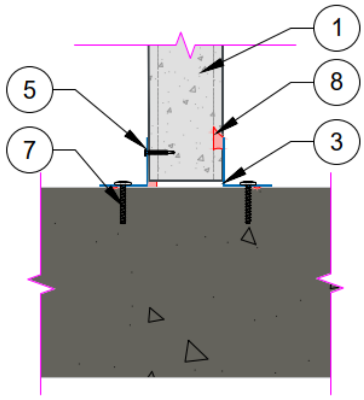


Figure 53 Base detail option 8

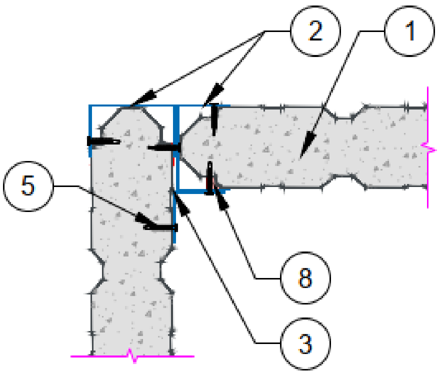


Figure 54 Corner detail option 1

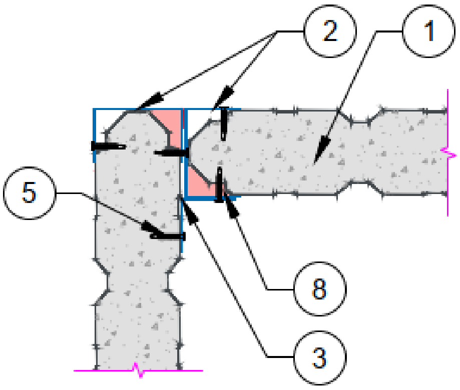


Figure 55 Corner detail option 2

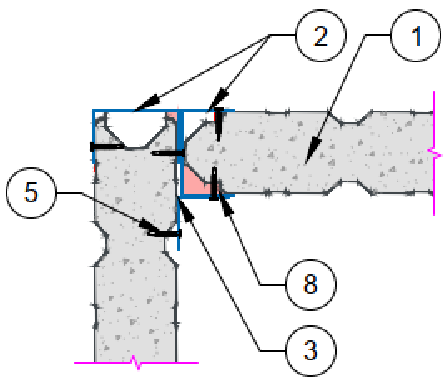


Figure 56 Corner detail option 3

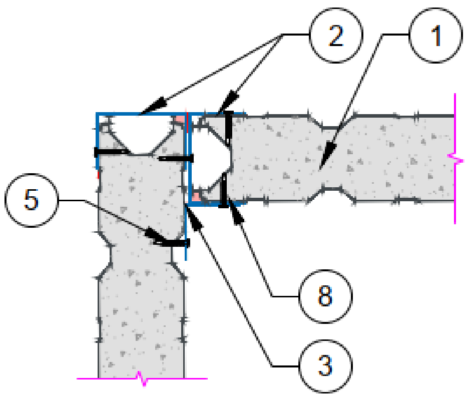


Figure 57 Corner detail option 4

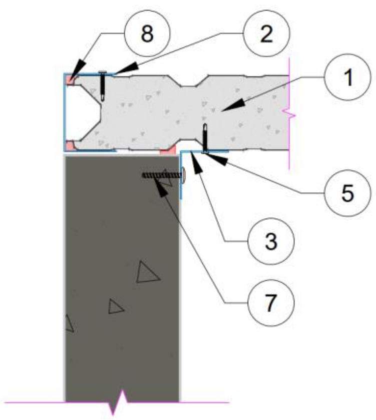


Figure 58 Corner detail option 5

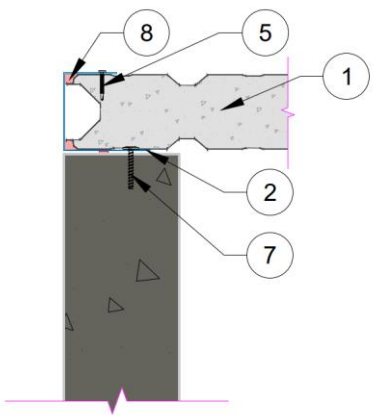


Figure 59 Corner detail option 6

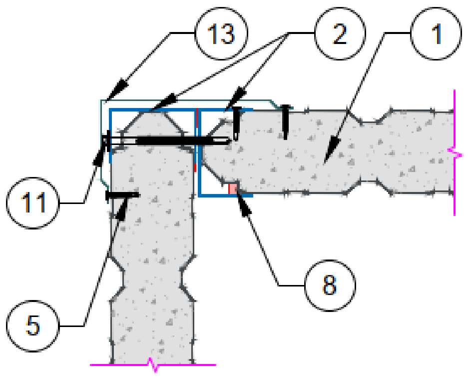


Figure 60 Corner detail option 7

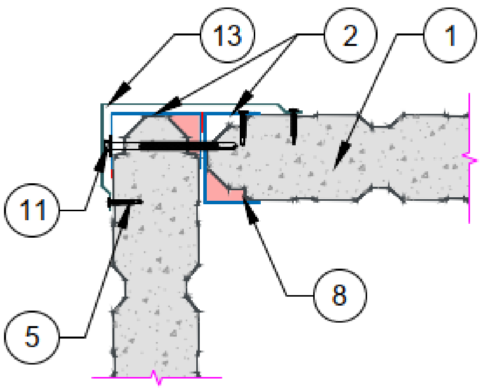


Figure 61 Corner detail option 8

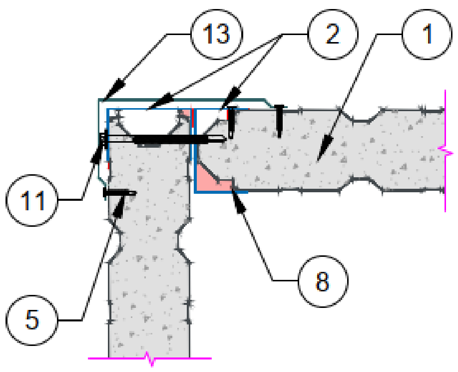


Figure 62 Corner detail option 9

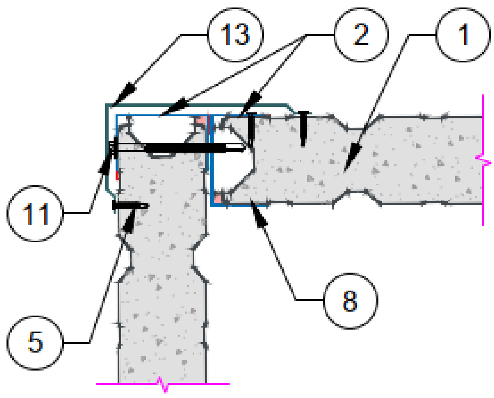


Figure 63 Corner detail option 10

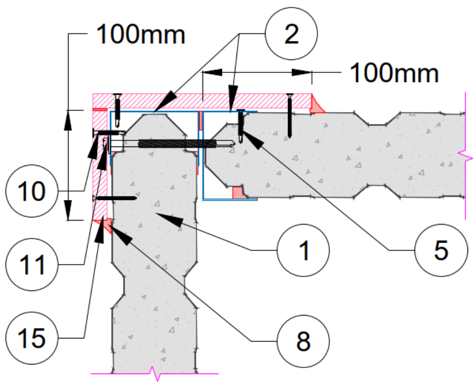


Figure 64 Corner detail option 11

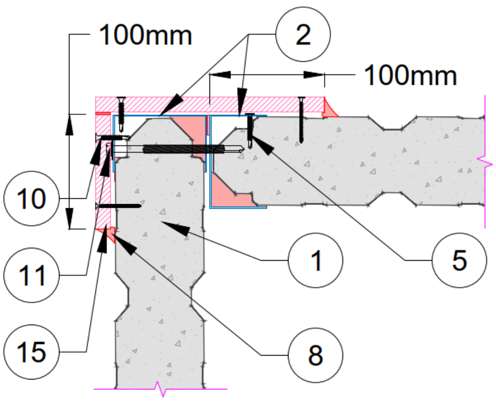


Figure 65 Corner detail option 12

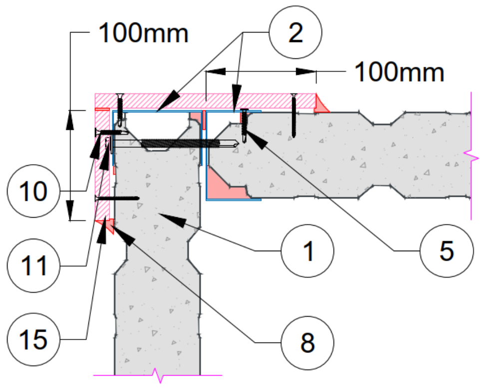


Figure 66 Corner detail option 13

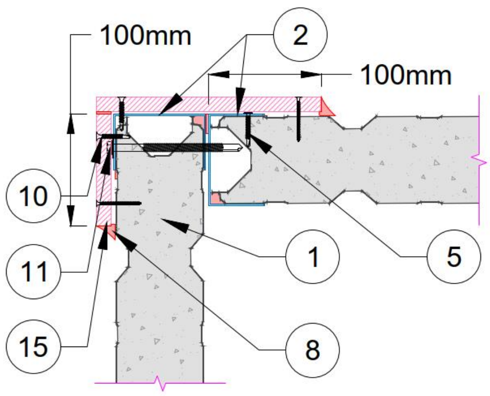


Figure 67 Corner detail option 14

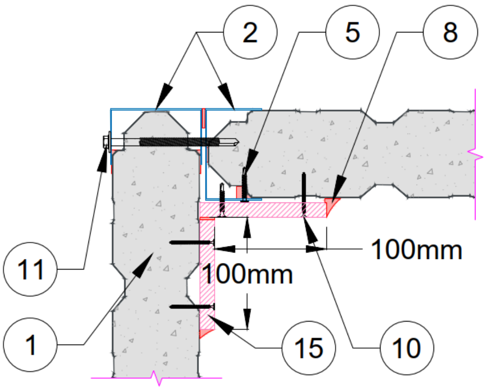


Figure 68 Corner detail option 15

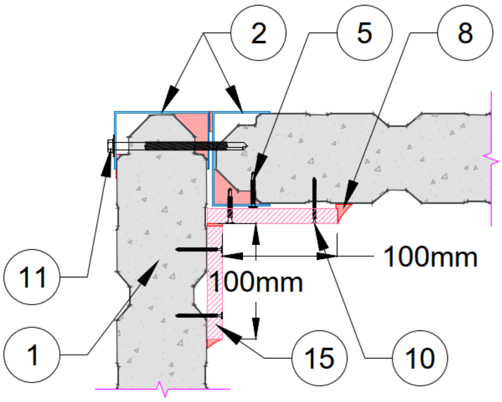


Figure 69 Corner detail option 16

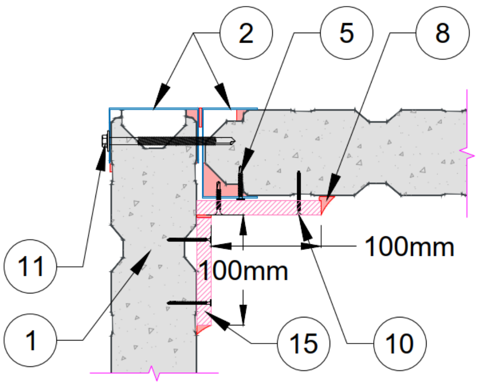


Figure 70 Corner detail option 17

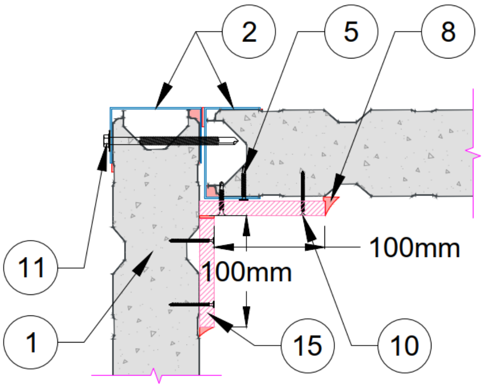


Figure 71 Corner detail option 18

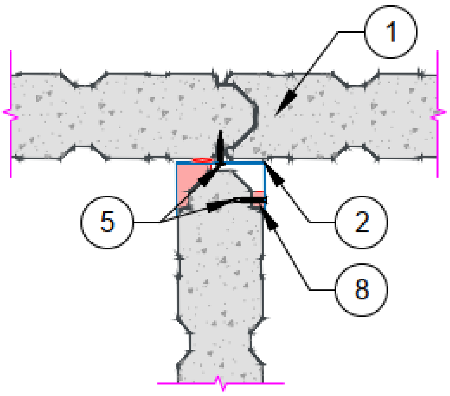


Figure 72 T-intersection option 1

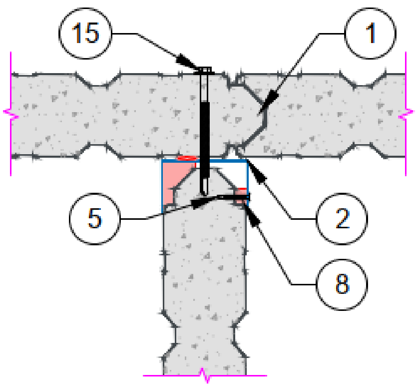


Figure 73 T-intersection option 2

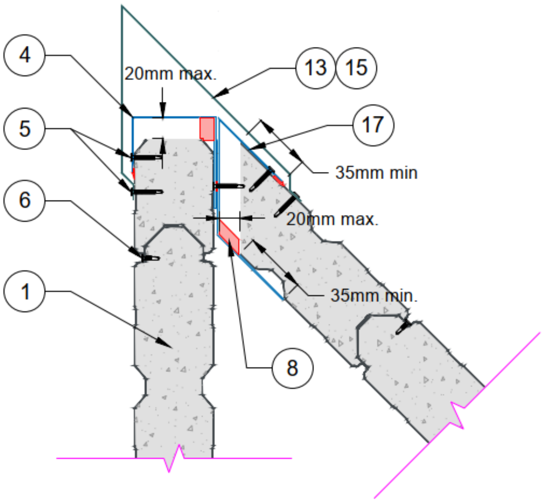


Figure 74 Acute angled corner detail option 1

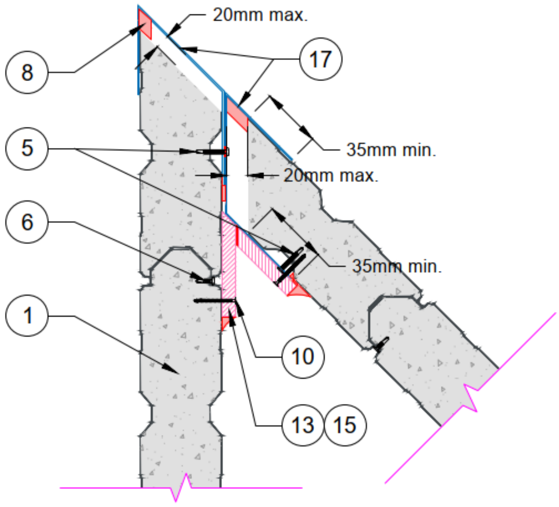


Figure 75 Acute angled corner detail option 2

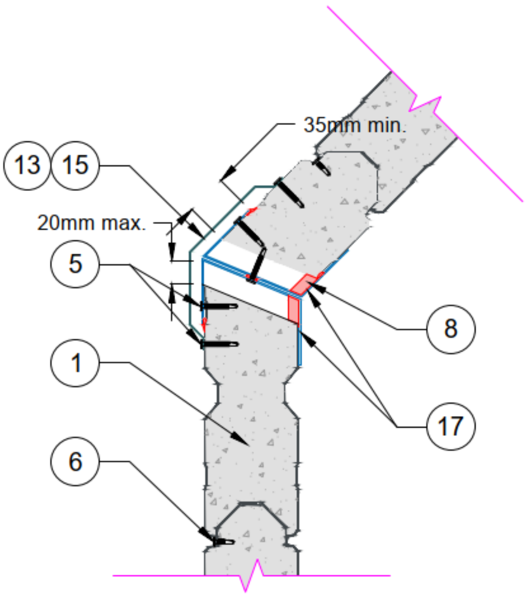


Figure 76 Obtuse angled corner detail option 1

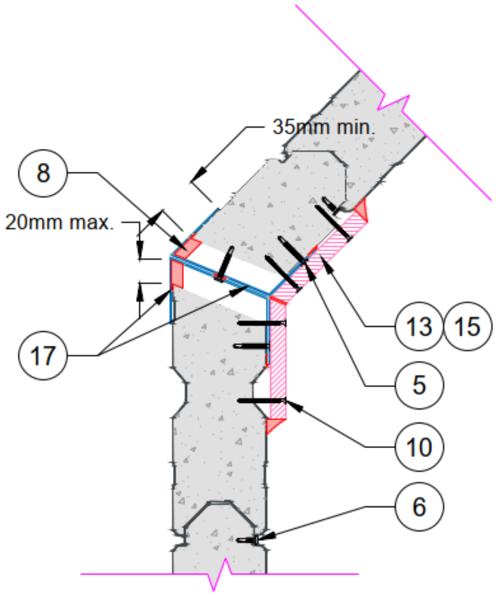


Figure 77 Obtuse angled corner detail option 2

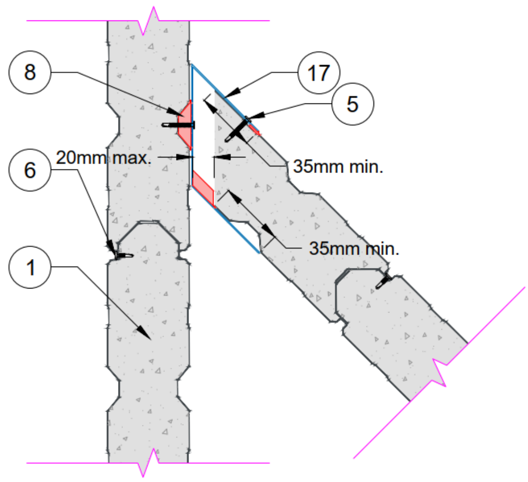


Figure 78 Angled T-junction detail option 1

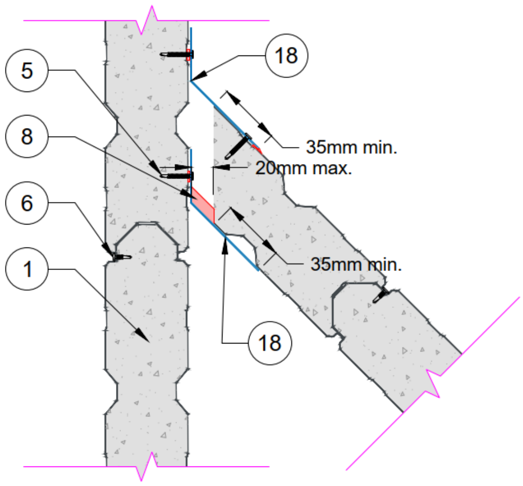


Figure 79 Angled T-junction detail option 2

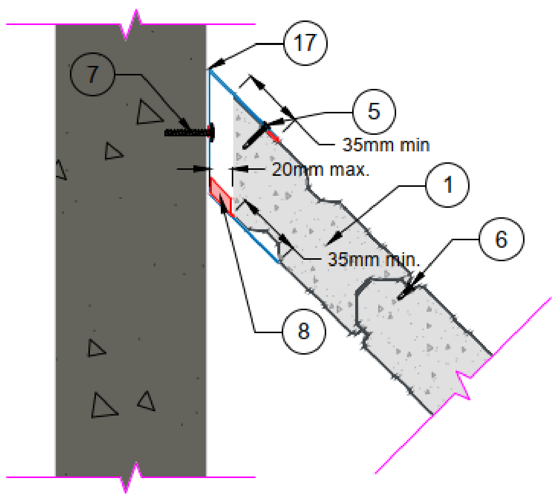


Figure 80 Angled wall detail option 1

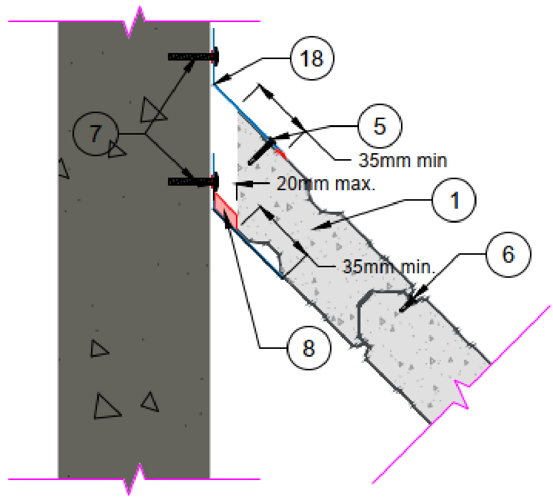


Figure 81 Angled wall detail option 2

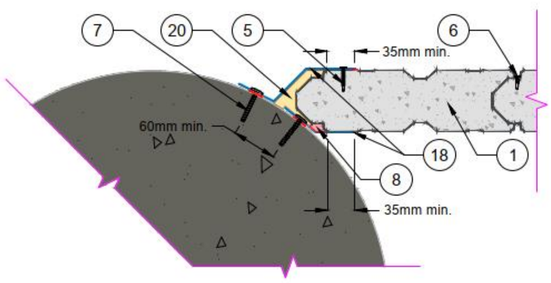


Figure 82 Circular column detail option 1

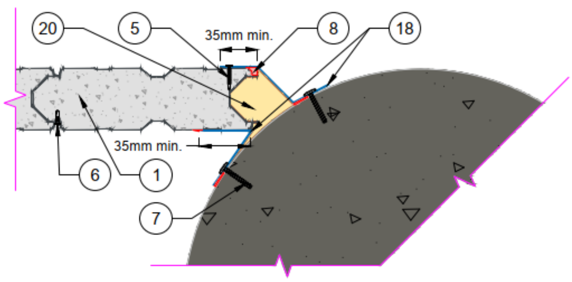


Figure 83 Circular column detail option 2

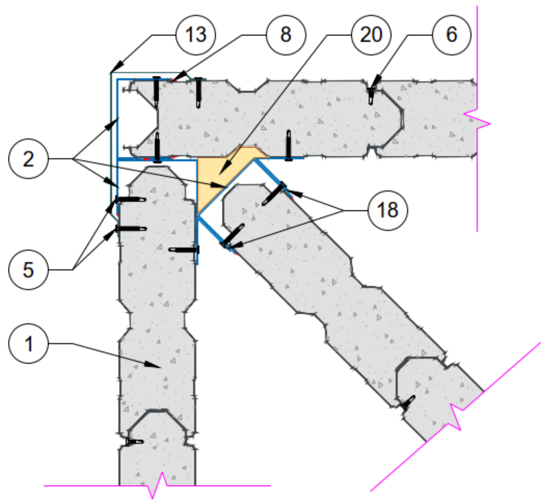


Figure 84 Multi-angled corner detail option 1

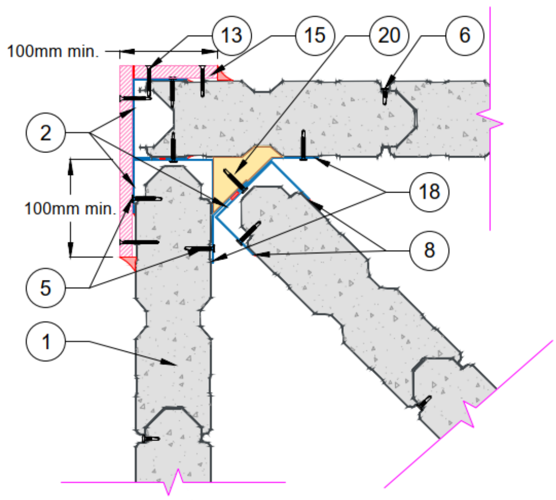


Figure 85 Multi-angled corner detail option 2

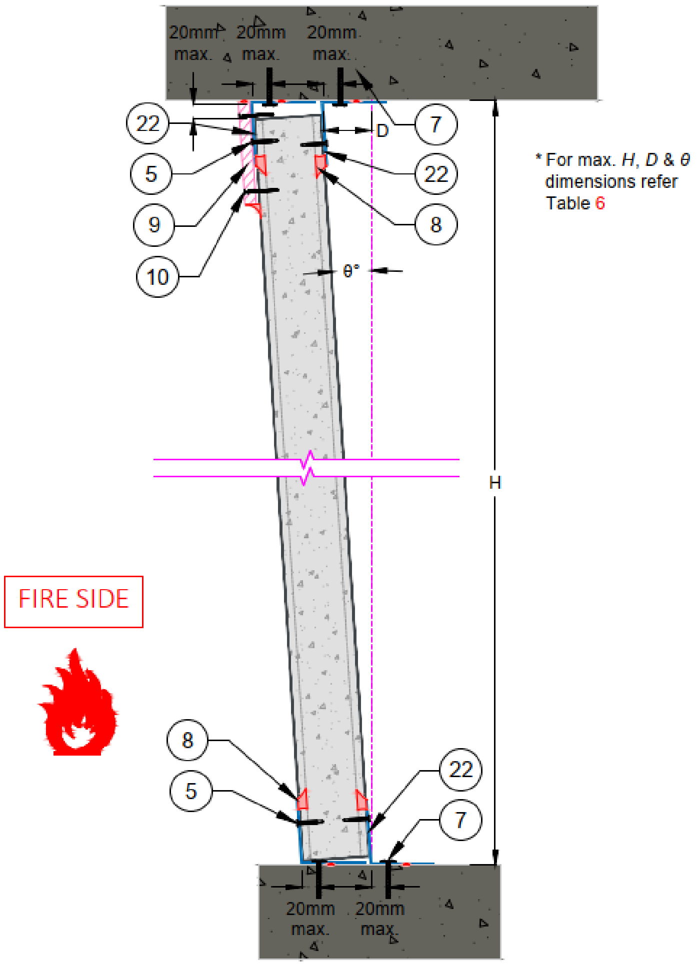


Figure 86 Inclined vertical Speedpanel wall – 78 mm system only

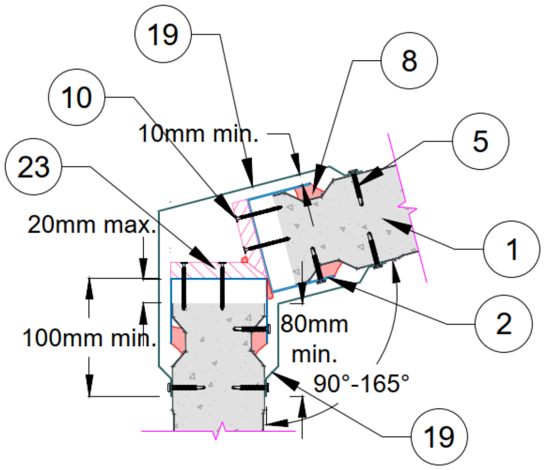


Figure 87 Angled connection (segmented) option 1

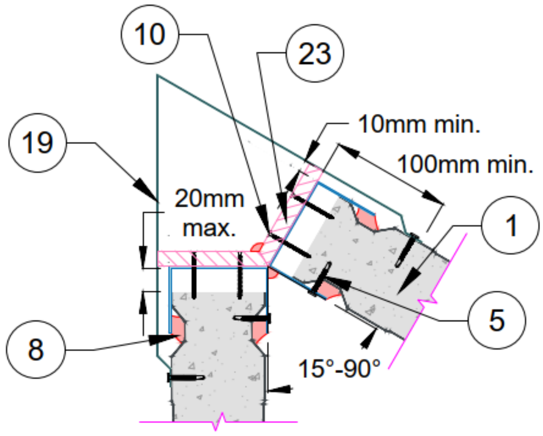


Figure 88 Angled connection (segmented) option 2

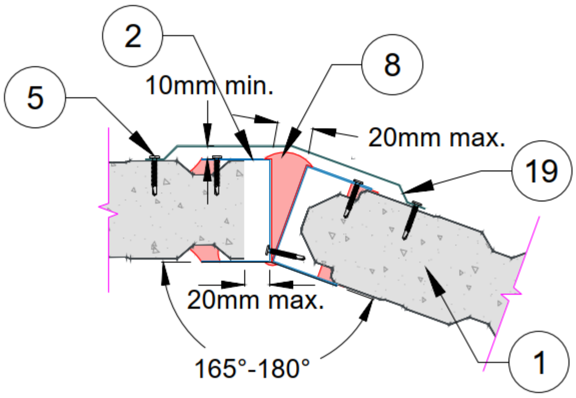


Figure 89 Angled connection (segmented) option 3

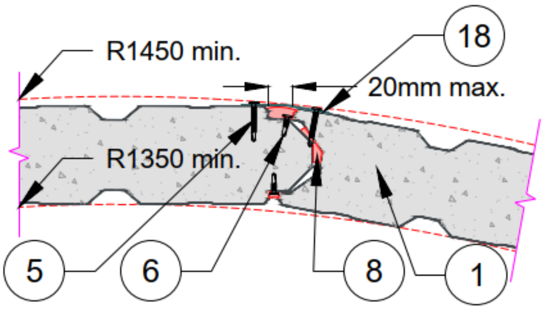


Figure 90 Vertical wall with radius (plan)

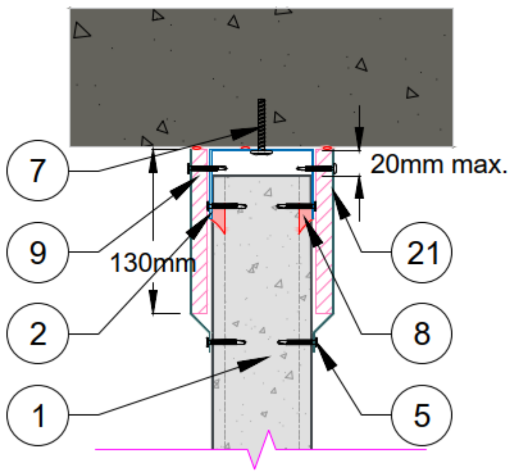


Figure 91 Head detail (segmented) option 1

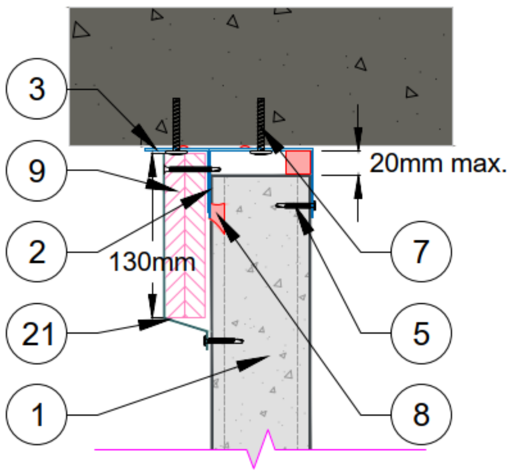


Figure 92 Head detail (segmented) option 2

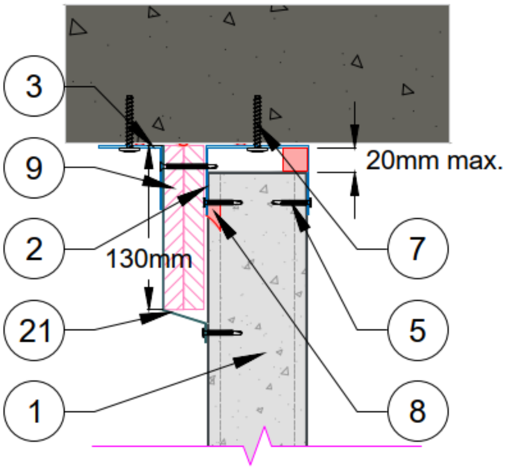


Figure 93 Head detail (segmented) option 3

5. Assessment of the proposed variations

5.1 Description of variation

The proposed construction is made 51 mm, 64 mm and 78 mm thick vertically orientated Speedpanel as tested in EWFA 2736002.1, EWFA 2848300.2 and BWA 2286900.5, respectively with consideration given to the variations summarised in section 4.3.

5.2 Methodology

The method of assessment used is summarised in Table 6.

Table 6 Method of assessment

Assessment method	
Level of complexity	Complex assessment
Type of assessment	Qualitative and quantitative

5.3 51 mm thick vertically oriented Speedpanel wall systems

5.3.1 Increased wall height

The proposed construction is a vertically oriented Speedpanel wall system similar to the tested wall system in EWFA 2736002.1, but with an increased height of 5 m. As Speedpanel walls are non-load bearing systems, it is assumed that only the integrity performance will be compromised as a result of increased wall height.

Reference test report EWFA 2736002.1 consisted of a load-bearing test on a 51 mm thick vertically oriented Speedpanel wall. The panels incorporated a tongue and groove detail on their vertical edges. The uniformly distributed axial load applied on the wall at the start of the test (including prior to the conditioning period) was 2.876 kN (or 0.959 kN/m).

After 60 minutes, the uniformly distributed load was gradually increased in several steps, where the applied load was approximately 3.94 kN/m at 82 minutes. The wall maintained its integrity performance at this time and showed a maximum lateral deflection of 241 mm.

The test report states that the integrity failure was observed at 87 minutes. Accordingly, it can be concluded that the 51mm thick Speedpanel wall displayed significant axial compression and bending strengths up to 86 minutes of fire exposure under an axial load of 3.94 kN/m.

It should be noted that the Speedpanel walls are not designed to act as load bearing walls and the load applied on EWFA 2736002.1 test was to determine the impact of increased wall height (self-weight). Based on these test results, the maximum allowable axial compression and bending moment capacities of a 51 mm thick Speedpanel wall was calculated.

Then the obtained maximum strength limits were used to demonstrate that the Speedpanel wall systems up to 5 m high walls will maintain integrity performance the same as the tested system in EWFA 2736002.1 for at least 60 minutes.

It is proposed that the criteria to demonstrate the adequacy of the proposed Speedpanel wall systems up to 5 m high depend on the predicted bending moment and axial compression load. It is considered that the design is safe,

- if the maximum predicted bending moment is less than the maximum bending moment capacity obtained from the test.
- if the maximum predicted axial compression load is less than the maximum axial compression capacity obtained from the test.

The calculation is based on the following assumptions:

- The deflection is based on the deflection measured at 60 minutes in fire test report EWFA 2736002.1.
- The lateral deflections measured at the mid-point of the wall were used directly in determining the bending moment capacity of the proposed construction.
- The radius of curvature of the expected deflection behaviour of the proposed constructions would be similar to that of the tested system.

Table 7 Structural performance of 51 mm thick vertically oriented 5 m high wall

Description		Value
Tested system	Weight of the panel	30.12 kg/m^2
	Height of the wall	3 m
	Width of the wall	3 m
	Wall thickness	51 mm
	Applied load	3.94 kN/m
	Self-weight at mid height (1.5m from the base)	0.44 kN/m
	Load at wall mid height in the test	4.38 kN/m
	Deflection before the integrity failure	241 mm
	Maximum bending moment capacity (calculated)	**1.056 kNm/m**
	Maximum axial compression capacity (calculated)	**4.83 kN/m**
Proposed system	Measured weight of the panel	30.12 kg/m^2
	Height of the wall	5.0 m
	Wall thickness	51 mm
	Self-weight at mid height (2.5m from the base)	0.74 kN/m
	Total self-weight	1.48 kN/m
	Predicted maximum deflection at 60 minutes	456.9 mm
	Determined bending moment capacity at integrity failure	0.34 kNm/m
	Ratio of safety with respect to bending moment	**0.32 < 1.0**
	Ratio of safety with respect to axial compression	**0.31 < 1.0**

As shown in Table 7, the induced maximum bending moment and the axial load of the proposed 5 m high, 51 mm thick vertically oriented Speedpanel wall is less than the allowable limits obtained from the test. Therefore, it is considered that the proposed wall system is expected to achieve an FRL of - /60/60 in accordance with AS 1530.4:2014.

5.3.2 Head details

Test evidence

It is proposed that the head details of the Speedpanel wall systems can be as shown in Figure 3 to Figure 19. The proposed head details are expected to be used in Speedpanel wall systems exposed to fire from both sides, but not simultaneously.

Referenced test EWFA 2736002 consisted of a vertically oriented 51 mm thick Speedpanel wall with intumescent C-track at the head of the wall. When tested, the head detail failed the insulation criteria at 27 minutes and recorded a maximum temperature of 467°C at 60 minutes. The insulation weakness at the top of the panel was considered to be associated with either the gap at the top of the panel or heat conduction through the top track.

The tested assembly in test EWFA 2741700 consisted of a 78 mm thick vertically oriented Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm head C-track of Speedpanel wall was protected by a flashing cap or 13 mm thick × 120 mm deep fire grade plasterboard strip protected at either fire exposed side or unexposed side. When tested, all four head details performed well and achieved integrity and insulation performances of 132 minutes.

Based on the test results of EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side for flashing cap fixed on either side of the wall was 112°C at 60 minutes. Similarly, it was observed that the maximum temperature recorded on the unexposed side for 13 mm fire grade plasterboard strip fixed on either side of the wall was 101°C at 60 minutes.

Even though the Speedpanel wall thickness (51 mm) is less than the tested 78 mm thick Speedpanel wall in EWFA 2741700, the wall thickness is not expected to significantly affect the performance of the head detail as the primary mode of heat transfer is via conduction (through C-track) and convection at the head. Provided that the measured temperatures of the unexposed side of the wall in EWFA 2741700 are less with a significant margin of safety with respect to insulation failure temperature rise limit, it is expected that a 51 mm thick Speedpanel wall with similar head details (as of those in EWFA 2741700) is expected to achieve an FRL of -/60/60 in accordance with AS 1530.4:2014.

Head details shown in Figure 3 to Figure 10

A 56 mm deep standard C-track is proposed to be used instead of the tested intumescent C-track in EWFA 2736002.1. There are two kinds of proposed head track protection options. The first option is a flashing cap installed on one side of the head track, which refers to Figure 3 to Figure 6. The second option is one layer of 13 mm thick fire grade plasterboard fixed on one side of the head track, which is shown in Figure 7 to Figure 10.

It was observed the temperature recorded on the unexposed side of head C-track at 60 minutes was 467°C recorded by a thermocouple located 15 mm from the head on east side head track.

The insulation weakness at the top of the panel is associated with either the gap at the top of the panel or conduction through the top track.

The tested assembly in test EWFA 2741700 comprised a 78 mm thick vertically orientated Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm BMT head C-track of Speedpanel wall was protected by five different ways, which are: flashing cap protected on either the fire exposed side or the unexposed side, one layer of 13 mm thick CSR Fyrchek fixed on either fire exposed side or unexposed side and one layer of 13 mm thick CSR Fyrchek fixed on both sides of head C-track. Fire rated sealant was applied in the 20 mm gap between the top C-track and wall panels.

With reference to the test results of EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 60 minutes for flashing fixed on the fire side of head C-track was 112°C. The temperature recorded on the unexposed side at 60 minutes for flashing fixed on the non-fire side of head track was less hot (105°C).

With reference to the test results of EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 60 minutes for 13mm fire grade plasterboard fixed on the fire side of the head track was 101°C. The temperature recorded on the unexposed side at 60 minutes for plasterboard fixed on the non-fire side of head track was less hot (95°C).

The proposed head C–track is similar to that tested in EWFA 2741700 except the size is 56 mm deep instead of tested at 82 mm deep and no fire rated sealant is filled in the gap between the head track and wall panels.

With reference to test EWFA 2736002, the test results indicated the cementitious core of the Speedpanel wall panel was still releasing steam at 60 minutes, and the steam significantly affected the heat transfer, namely caused the temperature rise to dwell around 100°C. It is therefore expected that in this particular case, the heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case, the 20 mm gap between panels and head track) was much weaker.

In light of the above, it is considered the C-track made of the same material and thickness but in a smaller size will not significantly raise the temperature on the unexposed side at 60 minutes.

In addition, with reference to test EWFA 2741700, it was observed fire rated sealant was applied in the 20 mm gap between the top C-track and panels. The applied sealant was considered to reduce the gap size and hence resist heat transfer to the unexposed side.

With reference to EWFA 2736200, the proposed 20 mm gap between head track and panels is expected to be filled with steam from the panels, interrupting radiant heat transfer across this cavity and dominating the surface temperatures in the vicinity of the head. It is therefore considered that the temperature recorded on the unexposed side will not significantly differ when the partially filled gap at the top is removed.

Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed head details is expected to achieve an FRL of at least - /60/60 in accordance with AS 1530.4:2014.

Head details shown in Figure 11 to Figure 18

In the proposed head details shown in Figure 11 to Figure 18, the head Speedpanel wall is connected to masonry or concrete by using equal angle sections on both sides of the wall panel. Similar to the head details with C-track, there are two kinds of proposed head track protection options. The first option is a flashing cap installed on one side of the head track, which refers to Figure 11 to Figure 14. The second option is one layer of 13 mm thick fire rated plasterboard fixed on one side of the head track that refers to Figure 15 to Figure 18.

With reference to EWFA 2736002.1, the maximum temperature measured on the unexposed side of the head C-track of a 51 mm thick Speedpanel wall was around 467°C.

The proposed unexposed side steel angle is not directly exposed to the heat source and the 20 mm gap between the concrete lintel and Speedpanel panel is sealed with fire resistant sealant at one side. Steel flashing or 13 mm thick fire grade plasterboard is protected on one side.

It is therefore considered the temperature on the unexposed side steel angle would be much less than the cold side flange of C-tracks tested.

As discussed previously, it is confirmed that if the head details are protected with either a steel flashing or a layer of 13 mm thick fire grade plasterboard on either fire side or non-fire side, the maximum temperature of the cold flange of the C-track would remain below 180°C.

It is therefore considered the proposed steel angle head detail will maintain the structural capacity of the steel angle head connection for up to 120 minutes based on designs, thereby allowing it to some provide vertical support at the top of the wall. In addition, it is expected the temperature on the unexposed side steel angle would be less than 180°C for up to 60 minutes based on designs.

Based on the above discussion, it is considered that the proposed construction will achieve an insulation and integrity performance of up to 60 minutes in accordance with AS 1530.4:2014.

Alternative sealant locations

The proposed head details incorporate various sealant location options as shown in Figure 3 to Figure 18.

The presence of the sealant between the C-track/angle section flange and the wall panel is expected to prevent hot gases from the exposed side from freely passing through to the cavity within the C-track or between the two angle sections, at least until the sealants fall away.

The presence of the sealant within the cavity between the head track and panel is expected to significantly interrupt the steam from the panel core and the hot gases from exposed side to heat up the flange of C-track or the angle section on the unexposed side.

With reference to tests EWFA 2736002.1, test results indicate the cementitious core of 51 mm thick Speedpanel wall panel started dehydrating around 60 minutes.

With reference to test BWA 2286900, test results indicate the cementitious core of 78 mm Speedpanel wall panel started dehydrating around 120 minutes, the proposed 20 mm gap between head track and panel is still expected to be filled with steam from the panel interrupting radiant heat transfer across this cavity and dominating the surface temperature in the vicinity of the head. The heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case the 20 mm gap between panels and head track) was much weaker.

It is therefore considered the proposed alternative sealant location options will not introduce any foreseeable weakness to the performance of 51 mm thick Speedpanel wall systems up to 60 minutes.

5.3.3 Side details

Side details by using C-track

In the proposed construction, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks with dimensions of 50 mm × 56 mm × 50 mm. The Speedpanel edge to be connected to concrete/masonry can be female side (refer to Figure 20 to Figure 23), male side (refer to Figure 28 to Figure 32) or cut side (refer to Figure 38 to Figure 41).

In the referenced test EWFA 2736002.1, both side details of male side and cut side were tested and there was no sign of impending insulation failure to be observed at the side track of tested Speedpanel wall for at least 60 minutes.

The fire rated sealant (item 8) is proposed to be installed at two locations of the C-track and another between C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

The presence of the sealant within cavity between the C-track and panel is expected to significantly interrupt the steam from the panel core and the hot gases from exposed side to heat up the unexposed side flange of C-track. In addition, the sealant located within the cavity is protected by the surrounding C-tracks and will stay in place longer.

Based on the above, it is considered that the difference between the proposed sealant location variation will not introduce any insulation weakness for at least 60 minutes,

Therefore, it is considered the proposed construction is positively assessed for an FRL of -/60/60 in accordance with AS1530.4:2014.

Side details by using equal angle section

The side of Speedpanel wall system is also proposed to be connected to concrete/masonry structures by equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of wall panel and the free flange will attach to surface of the wall panel. Same as the previously discussed connected via C-track, wall panel edge to be connected to concrete/masonry can be female side (refer to Figure 24 to Figure 27), male side (refer to Figure 33 to Figure 37) or cut side (refer to Figure 42 to Figure 45).

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle section and the concrete/masonry structure. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away. In addition, the sealant located within the cavity is protected by the surrounding angle sections and will stay in place longer.

As previously discussed, the base details tested in EWFA 2736002.1 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performances for at least more than 60 minutes.

The proposed side details are expected to perform at least equivalent to those tested in the referenced test report, EWFA 2736002. Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

5.3.4 Base details

Base details shown in Figure 46 to Figure 49

The proposed base details shown in Figure 46 to Figure 49 are similar to the base detail tested in the referenced test EWFA 2736002.1. Referenced test EWFA 2736002.1 consisted of a vertically oriented 51 mm thick Speedpanel wall and had a similar base detail but was fixed to the furnace frame instead of fixing to the floor. When tested, the detail achieved both integrity and insulation performances for at least mor than 60 minutes.

All these details shown in Figure 46 to Figure 49 are more or less similar and has fire rated sealant (item 8) installed at two locations of the C-track and another between C-track and concrete floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, the proposed base details are expected to perform better than those tested in the referenced test report, EWFA 2736002. Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed base details is expected to achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Base details shown in Figure 50 to Figure 53

In the proposed base details shown in Figure 50 to Figure 53, the Speedpanel is connected to the concrete floor via equal angle sections on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of wall panel and the free flange will attach to surface of the wall panel.

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

As previously discussed, the base details tested in EWFA 2736002.1 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performances for at least more than 60 minutes.

The proposed base details are expected to perform better than those tested in the referenced test report, EWFA 2736002. Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed base details is expected to achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

5.3.5 Corner details

Test evidence

It is proposed that the corner details of the Speedpanel wall systems shall be as shown in Figure 54 to Figure 63.

Referenced test EWFA 2736002 consisted of a vertically oriented 51 mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant were installed at the edge of side track at two locations. When tested there was no sign of impending insulation or integrity failure around the side tracks for at least 60 minutes.

Corner details shown in Figure 54 to Figure 57

The proposed corner details shown in Figure 53 to Figure 56 are related to vertically oriented Speedpanel walls. The connecting sides, either male or female, are capped by the 1.15 mm BMT C-tracks of 50 mm × 56 mm × 50 mm. Additionally, the panels are connected by the 1.15 mm BMT equal angle section on the interior side. The angle section is connected to the panels via minimum

10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and wall panel.

Both perpendicular Speedpanel walls that are intersecting must be self-supported and one wall is not expected to provide any vertical or lateral support/restrain to the other.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2736002 with an increased thickness of 1.15 mm BMT. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

In addition, a 0.7 mm BMT corner flashing has been proposed. With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 112°C at 60 minutes. Even though the proposed wall thickness is 51mm instead of tested 78mm thick panel in EWFA 2741700, given that the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 60 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Corner details shown in Figure 58 and Figure 59

The proposed corner details shown Figure 58 and Figure 59 consist of Speedpanel walls connected to concrete structures via 1.15 mm BMT J-tracks and the panels are laterally restrained at the corner by the concrete member. Fire rated sealant will be applied at the gap between the J-track and concrete element.

In the corner detail option 5 shown in Figure 57, an internal 1.15 mm BMT equal angle section is also proposed as flashing at the corner. The exposed flange of the J-track will not be screw fixed to the wall panel. The corner detail option 6 in Figure 59 will not incorporate an equal angle section but the exposed flange of the J-track will be fixed to the wall panel.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2736002 except that a J-track is used instead of the tested 0.6 mm side C-track. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

The proposed connection between Speedpanel and concrete structure is expected to be better than the head details tested in EWFA 2736002. As shown in Figure 58 and Figure 59, the fixing is covered by the Speedpanel and such not directly expose to fire. Therefore, the heat transfer caused by conduction, convection and radiation to the fixing will be less than the fixing tested in EWFA 2736002.

Therefore, the performance of the corner details is expected to be similar or better than the tested system in EWFA 2736002 and thus will achieve an FRL of -/60/60 in accordance with AS 1530.4:2014.

Corner details shown in Figure 60 to Figure 63

The corner details shown in Figure 60 to Figure 63 are similar to the previously assessed details shown in Figure 54 to Figure 57. The differences in the proposed corner details are that an external 0.7 mm corner flashing is used to connect the perpendicular wall panels and the wall panels are fixed to each other by 14g × 115 mm course thread screws at minimum 500 mm centres.

With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 112°C at 60 minutes. Even though the proposed wall thickness is 51 mm instead of tested 78mm thick panel in EWFA 2741700, given that the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 60 minutes. The flashing tested in EWFA 2741700 also maintain the integrity performance for 132 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Corner details shown in Figure 64 to Figure 71

The corner details shown in Figure 64 to Figure 71 are similar to the previously assessed details shown in Figure 60 to Figure 63. The only difference in the proposed corner details is that one layer of 13 mm thick fire grade plasterboard fixed on either external or internal side of the corner instead of an external 0.7 mm corner flashing. The perpendicular wall panels are fixed to each other by 14g × 115 mm course thread screws at minimum 500 mm centres.

With reference to the test results of EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 60 minutes for 13mm fire grade plasterboard fixed on the fire side of head track was 101°C. The temperature recorded on the unexposed side at 60 minutes for plasterboard fixed on the non-fire side of head track was less hot (95°C). Even though the proposed wall thickness is 51 mm instead of tested 78mm thick panel in EWFA 2741700, given that the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 60 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

5.3.6 T-intersection details

It is proposed that the T-intersection details of the Speedpanel wall systems shall be as shown in Figure 72 for option one and Figure 73 for option two. Both proposed connection details utilise the C-track. The only difference between the two connection methods is that 10 g × 30 screws used in option one while 14g × 115 mm course thread used in option two.

The key aspect of integrity performance is when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, hence create a free path for hot gases to pass through to the unexposed side.

Referenced test EWFA 2736002.1 consisted of a vertically oriented 51 mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant were installed at the edge of side track at two locations. When tested there was no sign of impending insulation or integrity failure around the side tracks for at least 60 minutes. The fixing method adopted in option two is not expected to be detrimental the fire resistance performance achieved in the referenced test.

Fire rated sealant (item 8) is proposed to be installed at two locations of the C-track and between the C-track and the perpendicular wall panel. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, it is considered that the proposed T-intersection details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

5.3.7 Angled details

Angled corner details shown in Figure 74 to Figure 77

The proposed acute corner details shown in Figure 74 to Figure 77 consist of Speedpanel wall capped by 1.15 mm BMT C-tracks at the connecting sides. The angle section is connected to the panels via minimum 10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and wall panel.

For option 1 shown in Figure 74 and Figure 76, for acute and obtuse angled connection respectively, an external 0.7 mm corner flashing is used to connect the wall panels. For option 2 shown in Figure 75 and Figure 77, for acute and obtuse angled connection respectively, one layer of 13 mm thick fire grade plasterboard is fixed on the internal side of the corner. The proposed acute angled corner details are considered to be similar as the corner details with perpendicularly connected panels which have been assessed in section 5.3.5.

As previously discussed, with reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 112°C at 60 minutes. Even though the proposed wall thickness is 51 mm instead of tested 78 mm thick panel in EWFA 2741700, given that the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 60 minutes.

The angled connection will not reduce the overall thickness of the Speedpanel wall system. The proposed details are expected to have the same fire resistance performance as the corner details shown in Figure 54 to Figure 63. Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Angled T-junction details shown in Figure 78 and Figure 79

It is proposed that the angled T-junction details of the Speedpanel wall systems shall be as shown in Figure 78 and Figure 79 for option 1 and option 2, respectively. The key difference between the two options is that C-section is used in option one while two angled sections are used for option two. Both proposed connection details utilise 10 g × 30 screws for fixing.

The key aspect of integrity performance is when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, hence create a free path for hot gases to pass through to the unexposed side.

The proposed angled T-junction details are considered to be similar to the T-intersection details shown in Figure 72 and Figure 73 and assessed in section 5.3.6. The angled orientation will not reduce the overall thickness of the angled wall panels. Thus, based on the discussed in section 5.3.6, it is considered that the proposed angled T-junction details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Angled wall details shown in Figure 80 and Figure 81

The angled wall details shown in Figure 80 and Figure 81 are considered to be similar to the previously assessment side details in section 5.3.3.

In Figure 80, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks. The fire rated sealant (item 8) is proposed to be installed at two locations of the C-track and another between C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

In Figure 81, the side of Speedpanel wall system is also proposed to be connected to concrete/masonry structures by equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of wall panel and the free flange will attach to surface of the wall panel. The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle section and the concrete/masonry structure.

As previously discussed, the base details tested in EWFA 2736002.1 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performances for at least more than 60 minutes.

The angled orientation does not reduce the overall thickness of the Speedpanel wall system. Therefore, the proposed side details are expected to perform at least equivalent to those tested in the referenced test report, EWFA 2736002. Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Circular column details shown in Figure 82 and Figure 83

The side of Speedpanel wall system is proposed to be connected to concrete/masonry circular columns by 1.15 mm thick custom angle section on one side of the wall. An additional equal angle section will be fixed to the column on the other side of wall panel and the free flange will attach to surface of the wall panel. The wall panel edge to be connected to concrete/masonry as option 1 shown in Figure 82 and as option 2 shown in Figure 83.

The void between the wall edge and circular column will be filled by either non-combustible rockwool of minimum density 120 kg/m³ or non-shrink grout. The proposed details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle section and the concrete/masonry structure. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away. In addition, the sealant located within the cavity is protected by the surrounding angle sections and will stay in place longer.

The proposed connection details are considered to be similar as the slide details discussed in section 5.3.3. As previously discussed, the base details tested in EWFA 2736002.1 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performances for at least more than 60 minutes.

The proposed side details are expected to perform at least equivalent to those tested in the referenced test report, EWFA 2736002. The infilled compressed rockwool or non-shrink grout is expected to further prevent hot gases from freely passing through to the unexposed side from the fire exposed side at the connection between the wall panel and column.

Therefore, it is considered that the 51 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014. Please note that this assessment is based on that the circular column can achieve an FRL of 60/60/60.

5.3.8 Multi-angled corner details

The multi-angled corner details shown in Figure 84 and Figure 85 are similar to the previously assessed details shown in Figure 60 and Figure 64, respectively. The connection of the perpendicular wall panels is same as the corner details shown in Figure 54 and Figure 57. The key differences in the proposed corner details are the addition of vertically oriented angled Speedpanel wall panel will be fixed to the internal side of the corner by 1.15 mm BMT custom angle sections. The void at the connection of the additional wall panel will be filled by either non-combustible rockwool (minimum density 120 kg/m³), non-shrinkable grout or plasterboard strips.

The fire resistance performance regarding the connection of the two perpendicular wall panels have been previously discussed. The additional wall panel is connected to the perpendicular wall panels via customised angle sections using minimum 10g × 30 mm SDS at 500 mm centres. In the case of fire exposure from either side of the inclined wall panel, one of the perpendicular wall panels is expected to be at ambient condition and thus will be capable to laterally support the angled wall section.

The provision of the additional wall panel is also expected to add lateral support to the corner details and thus will not be detrimental to the fire resistance performance of the corner details assessed previously.

Therefore, it is considered that the proposed multi-angled corner details will achieve an FRL of at least -/60/60 in accordance with AS 1530.4:2014.

Please note the assessment only considers the fire exposure from either side of one of the three wall panels forming the multi-angled corner details but not simultaneously.

5.4 64 mm thick vertically oriented Speedpanel wall systems

5.4.1 Increased wall height

The proposed construction is a vertically oriented Speedpanel wall system similar to the tested wall system in EWFA 2848300, but with an increased height of 5 m. As Speedpanel walls are non-load bearing systems, it is assumed that only integrity performance will be compromised as a result of increased wall height.

A load bearing test has not been conducted on 64mm thick Speedpanel wall system to determine the impact of increased wall height (self-weight). Therefore, as illustrated in previous sections, the results of the test report EWFA 2736002, which consisted of a load-bearing test on a 51 mm thick vertically oriented Speedpanel wall was used in this analysis.

The test report states that the integrity failure was observed at 87 minutes. Accordingly, it can be considered that the 51 mm thick Speedpanel wall maintained its integrity performance up to

86 minutes by demonstrating significant axial compression and bending strengths under an axial load of 3.94 kN/m. The maximum lateral deflection at 86 minutes was 241 mm.

Based on these test results, the maximum allowable axial and bending moment capacity of a 51 mm thick Speedpanel wall was calculated. Even though 64 mm thick Speedpanel walls are expected to have higher bending and compression strengths than the 51 mm thick Speedpanel wall, it is conservatively assumed that the maximum capacities of both these walls are the same.

Then the obtained maximum strength limits were used to demonstrate that the 64 mm thick Speedpanel wall systems up to 5 m high walls will maintain integrity performance for at least 86 minutes as in EWFA 2736002.

It is proposed that the criteria to demonstrate adequacy of the proposed Speedpanel wall systems up to 5 m high depends on the predicted bending moment and axial compression load. It is considered that the design is safe.

- if the maximum predicted bending moment is less than the maximum bending moment capacity obtained from the test.
- if the maximum predicted axial compression load is less than the maximum axial compression capacity obtained from the test.

The calculation is based on the following assumptions:

- The deflection is based on the deflection measured at 86 minutes in fire test report EWFA 2736002.
- The lateral deflections measured at the mid-point of the wall was used directly in determining the bending moment capacity of the proposed construction.
- The radius of curvature of the expected deflection behaviour of the proposed constructions would be similar to that of the tested system. This is a conservative assumption as the radius of curvature is expected to be higher for thicker panels.

Table 8 Structural performance of 64mm thick vertically oriented 5 m high wall

Description		Value
Tested system	Weight of the panel	30.12 kg/m^2
	Height of the wall	3 m
	Width of the wall	3 m
	Wall thickness	51 mm
	Applied load	3.94 kN/m
	Self-weight at mid height (1.5m from the base)	0.44 kN/m
	Load at wall mid height in the test	4.38 kN/m
	Deflection before the integrity failure	241 mm
	Maximum bending moment capacity (calculated)	**1.056 kNm/m**
	Maximum axial compression capacity (calculated)	**4.83 kN/m**
Proposed system	Measured weight of the panel	33.0 kg/m^2
	Height of the wall	5.0 m
	Wall thickness	64 mm
	Self-weight at mid height (2.5m from the base)	0.81 kN/m

Description		Value
	Total self-weight	1.62 kN/m
	Predicted maximum deflection at 90 minutes	704.4 mm
	Determined bending moment capacity at integrity failure	0.57 kNm/m
	Ratio of safety with respect to bending moment	**0.54 < 1.0**
	Ratio of safety with respect to axial compression	**0.34 < 1.0**

As shown in Table 8, the induced maximum bending moment and the axial load of the proposed 5 m high 64 mm thick vertically oriented Speedpanel wall is less than the allowable limits obtained from the test. Therefore, it is considered that the proposed wall system is expected to demonstrate integrity performance for 86 minutes as the tested system in EWFA 2736002.

However, given that both ratios of safety are below 0.54 with significant margins of safety and adaptation of very conservative assumptions in this analysis, it is expected that the proposed wall system will demonstrate integrity performance for at least further 4 minutes. Therefore, it is the opinion of this testing authority that the 64 mm Speedpanel wall systems with a height up to 5 m are expected to achieve an FRL of -/90/90 in accordance with AS 1530.4:2014.

5.4.2 Head details

Test evidence

It is proposed that the head details of the Speedpanel wall systems shall be as shown in Figure 3 to Figure 19. The proposed head details are expected to be used in Speedpanel wall systems exposed to fire from both sides, but not simultaneously.

Referenced test EWFA 2848300.2 consisted of a vertically oriented 64 mm thick Speedpanel wall. The head detail did not include any flashing and incorporated a 30 mm gap between the head track and the Speedpanel. When tested, the head detail failed the insulation criteria at 14 minutes and recorded a maximum temperature of 706°C at 90 minutes. The insulation weakness at the top of the panel was associated with the absence of a flashing detail and the gap at the top of the panel without a fire rated sealant. This allowed rapid conduction of heat to the unexposed side.

The tested assembly in test EWFA 2741700 consisted of a 78 mm thick vertically oriented Speedpanel panel wall incorporating two doorsets. The standard 82mm deep × 1.2mm head C-track of Speedpanel wall was protected by a flashing cap or 13 mm thick × 120 mm deep fire grade plasterboard strip protected at either fire exposed side or unexposed side. When tested, all four head details performed well and achieved integrity and insulation performances of 132 minutes.

Based on the test results of EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 129°C at 90 minutes. Similarly, it was observed that the maximum temperature recorded at the unexposed side for 13mm fire grade plasterboard strip fixed on either side of the wall was 111°C at 90 minutes. Even though the Speedpanel wall thickness (64 mm) is less than the tested 78 mm thick Speedpanel wall in EWFA 2741700, the wall thickness is not expected to significantly affect the performance of the head detail as the primary mode of heat transfer is via conduction (through C-track) and convection at the head. Provided that the measured temperatures of the unexposed side of the wall in EWFA 2741700 are less with a significant margin of safety with respect to insulation failure temperature rise limit, it is expected that a 64 mm thick Speedpanel wall with similar head details (as of those in EWFA 2741700) are expected to achieve an FRL of -/90/90 in accordance with AS 1530.4:2014.

Head details shown in Figure 3 to Figure 10

A 68 mm deep standard C-track is proposed to be instead of the tested intumescent C-track in EWFA 2848300.2. There are two kinds of proposed head track protection options. The first option is flashing cap installed on one side of the head track which refers to Figure 3 to Figure 6, the second option is one layer of 13mm thick fire grade plasterboard fixed on one side of the head track that refers to Figure 7 to Figure 10.

With reference to test EWFA 2848300.2, the gap between head track and Speedpanel panels was 30 mm. it was observed the deformation on the top track and panel had become evident at 77 minutes.

The deformation of top track is likely to form a gap for hot gasses passing through and heat up the unexposed side. The insulation weakness at the top of the panel is associated with either the gap at the top of the panel or conduction through the top track.

The tested assembly in test EWFA 2741700 comprised 78 mm thick vertically orientated Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm BMT head C-track of Speedpanel wall was protected by five different ways which are flashing cap protected on either fire exposed side or unexposed side, one layer of 13 mm thick CSR Fyrchek fixed on either fire exposed side or unexposed side and one layer of 13 mm thick CSR Fyrchek fixed on both sides of head C-track. Fire rated sealant was applied in the 20 mm gap between top C-track and wall panels.

With reference to the test results of EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 90 minutes for 13 mm fire grade plasterboard fixed on the fire side of head track was 111°C. The temperature recorded on the unexposed side at 90 minutes for plasterboard fixed on the non-fire side of head track was less hot (105°C).

The proposed head C-track is similar to that tested in EWFA 2741700 except the size is 67mm deep in lieu of tested 82 mm deep and no fire rated sealant is filled in the 20 mm gap between head track and wall panels.

With reference to test EWFA 2848300.2, the test results indicate the cementitious core of 64mm thick Speedpanel wall panel was still releasing steam at 90 minutes and the steam significantly affected the heat transfer, namely caused the temperature rise to dwell around 100°C. It is therefore expected in this particular case, the heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case the 20 mm gap between panels and head track was much weaker.

In light of the above, it is considered the C-track made of same material and thickness but in a smaller size will not significantly raise the temperature on the unexposed side at 90 minutes.

In addition, with reference to test EWFA 2741700, it was observed fire rated sealant was applied in the 20 mm gap between the top C-track and panels. The applied sealant was considered to reduce the gap size and hence resisted heat to transfer to the unexposed side.

With reference to EWFA 2848300.2, the proposed 20 mm gap between head track and panels is expected to be filled with steam from the panels interrupting radiant heat transfer across this cavity and dominating the surface temperatures in the vicinity of the head. It is therefore considered the temperature recorded on the unexposed side will not significantly different the partially filled gap at the top is removed.

Therefore, it is considered that the 64 mm thick Speedpanel wall system with one of the proposed head details are expected to achieve an FRL of at least - /90/90 in accordance with AS 1530.4:2014.

Head details shown in Figure 11 to Figure 18

In the proposed head details shown in Figure 11 to Figure 18, the head Speedpanel wall is connected masonry or concrete by using equal angle sections on both sides of the wall panel. Similar as the head details with C-track, there as two kinds of proposed head track protection options. The first option is flashing cap installed on one side of the head track which refers to Figure 11 to Figure 14, the second option is one layer of 13mm thick fire rated plasterboard fixed on one side of the head track that refers to Figure 15 to Figure 18.

The proposed unexposed side steel angle is not directly exposed to the heat source and the 20 mm gap between concrete lintel and Speedpanel panel is sealed with fire resistant sealant at one side. Steel flashing or 13 mm thick fire grade plasterboard is protected at the one side.

It is therefore considered the temperature on the unexposed side steel angle would be much less than the cold side flange of C-tracks tested.

As discussed previously, it is confirmed the head details protected with either a steel flashing or a layer of 13 mm thick fire grade plasterboard on either fire side or non-fire side, the maximum temperature of cold flange of C-track would remain below 180°C after 90 minutes.

It is therefore considered the proposed steel angles head detail will maintain the structural capacity of the steel angle head connection for up to 120 minutes based on designs and thereby allowing to provide vertical some support the top of the wall. In addition, it is expected the temperature on the unexposed side steel angle would be less than 180°C for up to 90 minutes based on designs.

Based on the above discussion it is considered that the proposed construction will achieve an insulation and integrity performance up to 90 minutes in accordance with AS1530.4:2014.

Alternative sealant locations

The proposed head details incorporate various sealant location options as shown in Figure 3 to Figure 18.

The presence of the sealant between the C-track/angle section flange and wall panel is expected to prevent hot gases from the exposed side from freely passing through to the cavity within the C-track or between the two angle sections, at least until the sealants fall away.

The presence of the sealant within the cavity between the head track and panel is expected to significantly interrupt the steam from the panel core and the hot gases from the exposed side to heat up the flange of the C-track or the angle section on the unexposed side.

With reference to tests 2848300.2, test results indicate the cementitious core of 64 mm thick Speedpanel wall panel started dehydrating around 90 minutes.

With reference to test BWA 2286900, test results indicate the cementitious core of 78 mm Speedpanel wall panel started dehydrating around 120 minutes. The proposed 20 mm gap between head track and panel is still expected to be filled with steam from the panel, interrupting radiant heat transfer across this cavity and dominating the surface temperature in the vicinity of the head. The heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case, the 20 mm gap between panels and head track) was much weaker.

It is therefore considered the proposed alternative sealant location options will not introduce any foreseeable weakness to the performance of 64 mm thick Speedpanel wall systems up to 90 minutes.

5.4.3 Side details

Side details by using C-track

In the proposed construction, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks with dimensions of 50 mm × 68 mm × 50 mm. The Speedpanel edge to be connected to concrete/masonry can be a female side (refer to Figure 20 to Figure 23), a male side (refer to Figure 28 to Figure 32) or cut side (refer to Figure 38 to Figure 41). One flange of the C-track will be screw fixed to the Speedpanel wall. The gap between the side of Speedpanel and the concrete/masonry structural must not be greater than 20 mm wide.

In the referenced test EWFA 2848300.2, both side details with cut sides were tested and there was no sign of impending insulation failure to be observed at the side track of tested Speedpanel wall for at least 90 minutes.

The fire rated sealant (item 8) is proposed to be installed at two locations on the C-track and another between the C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

The presence of the sealant within the cavity between the C-track and the panel is expected to significantly interrupt the steam from the panel core and the hot gases from exposed side to heat up the unexposed side flange of C-track. In addition, the sealant located within the cavity is protected by the surrounding C-tracks and will stay in place longer.

Based on the above, it is considered that the difference between the proposed sealant location variation will not introduce any insulation weakness for at least 90 minutes. With the provision of fire rated sealant, replacing the cut side within the C-track by either the male or female side is unlikely to be detrimental to the fire resistance of the side detail tested in EWFA 2848300.2.

Therefore, it is considered the proposed construction is positively assessed for an FRL of -/90/90 in accordance with AS1530.4:2014.

Side details by using equal angle section

The side of the Speedpanel wall system is also proposed to be connected to concrete/masonry structures by an equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel, and the free flange will be attached to the surface of the wall panel. Same as the previously discussed connection via C-track, the wall panel edge to be connected to concrete/masonry can be female side (refer to Figure 24 to Figure 27), male side (refer to Figure 33 to Figure 37) or cut side (refer to Figure 42 to Figure 45).

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the concrete/masonry structure. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away. In addition, the sealant located within the cavity is protected by the surrounding angle sections and will stay in place longer.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at least 90 minutes.

The proposed side details are expected to perform at least as well as those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 64 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

5.4.4 Base details

Base details shown in Figure 46 to Figure 49

The proposed base details shown in Figure 46 to Figure 49 are similar to the base details tested in the referenced test EWFA 2848300.2. The referenced test EWFA 2848300.2 consisted of a vertically oriented 64 mm thick Speedpanel wall and had a similar base detail but was fixed to the furnace frame instead of being fixed to the floor. When tested, there was no visible failure around the base, and both sides. Ultimately, the base details achieved an integrity and insulation performance of 181 minutes and 137 minutes, respectively.

All these details shown in Figure 46 to Figure 49 are more or less similar and have fire rated sealant (item 8) installed at two locations of the C-track and another between the C-track and concrete floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, the proposed base details are expected to perform better than those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 64 mm thick Speedpanel wall systems with the proposed base details are expected to achieve an FRL of at least - /90/90 in accordance with AS 1530.4:2014.

Base details shown in Figure 50 to Figure 53

In the proposed base details shown in Figure 50 to Figure 53, the Speedpanel is connected to the concrete floor via equal angle sections on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel, and the free flange will be attached to surface of the wall panel.

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at least 90 minutes.

The proposed base details are not expected to be detrimental to the fire resistance performance of those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 64 mm thick Speedpanel wall systems with the proposed base details are expected to achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

5.4.5 Corner details

Test evidence

It is proposed that the corner details of the Speedpanel wall systems shall be as shown in Figure 54 to Figure 63.

The referenced test EWFA 2848300.2 consisted of a vertically oriented 64 mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant were installed at the edge of side track at two locations and in between the C-track and the concrete frame. When tested, there was no sign of impending insulation or integrity failure around the side tracks for at least 90 minutes.

Corner details shown in Figure 54 to Figure 57

The proposed corner details shown in Figure 53 to Figure 56 are related to vertically oriented Speedpanel walls. The connecting sides, either male or female, are capped by the 1.15 mm BMT C-tracks of 50 mm × 68 mm × 50 mm. Additionally, the panels are connected by a 1.15 mm BMT equal angle section on the interior side. The angle section is connected to the panels using minimum 10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and the wall panel.

Both perpendicular Speedpanel walls that are intersecting shall be self-supported and one wall is not expected to provide any vertical or lateral support/restrain to the other.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2848300.2 with an increased thickness of 1.15 mm BMT. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

In addition, a 0.7 mm BMT corner flashing has been proposed. With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side of the flashing cap fixed on either side of the wall was 129°C at 90 minutes. Even though the proposed wall thickness is 64 mm instead of the tested 78 mm thick panel in EWFA 2741700, given the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 90 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

Corner details shown in Figure 58 and Figure 59

The proposed corner details shown in Figure 58 and Figure 59 consist of Speedpanel walls connected to concrete structures via 1.15 mm BMT J-tracks and the panels are laterally restrained at the corner by the concrete member. Fire rated sealant will be applied at the gap between the J-track and the concrete element.

In the corner detail option 5 shown in Figure 57, an internal 1.15 mm BMT equal angle section is also proposed as flashing at the corner. The exposed flange of the J-track will not be screw fixed to the wall panel. The corner detail option 6 in Figure 59 will not incorporate an equal angle section, but the exposed flange of the J-track will be fixed to the wall panel.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2848300.2 except that a J-track is used instead of the tested 0.6 mm side C-track. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

The proposed connection between Speedpanel and concrete structure is expected to perfume better than the head details tested in EWFA 2848300.2. As shown in Figure 58 and Figure 59, the fixing is covered by the Speedpanel and, as such, not directly exposed to fire. Therefore, the heat transfer caused by conduction, convection and radiation to the fixing will be less than the fixing tested in EWFA 2848300.2.

Therefore, the performance of the corner details is expected to be similar to or better than the tested system in EWFA 2736002 and thus will achieve an FRL of -/90/90 in accordance with AS 1530.4:2014.

Corner details shown in Figure 60 to Figure 63

The corner details shown in Figure 60 to Figure 63 are similar to the previously assessed details shown in Figure 54 to Figure 57. The differences in the proposed corner details are that an external 0.7 mm corner flashing is used to connect the perpendicular wall panels and the wall panels are fixed to each other by 14g × 115 mm course thread screws at a minimum of 500 mm centres.

With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side of the flashing cap fixed on either side of the wall was 129°C at 90 minutes. Even though the proposed wall thickness is 64 mm instead of the tested 78 mm thick panel in EWFA 2741700, given that the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 90 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

Corner details shown in Figure 64 to Figure 71

The corner details shown in Figure 64 to Figure 71 are similar to the previously assessed details shown in Figure 60 to Figure 63. The only difference in the proposed corner details is that one layer of 13 mm thick fire grade plasterboard fixed on either the external or internal side of the corner instead of an external 0.7 mm corner flashing. The perpendicular wall panels are fixed to each other by 14g × 115 mm course thread screws at minimum 500 mm centres.

With reference to the test results of EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side at 90 minutes for 13 mm fire grade plasterboard fixed on the fire side of the head track was 111°C. The temperature recorded on the unexposed side at 90 minutes for plasterboard fixed on the non-fire side of the head track was less hot (105°C). Even though the proposed wall thickness is 64 mm instead of the tested 78 mm thick panel in EWFA 2741700, given the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 90 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

5.4.6 T-intersection details

It is proposed that the T-intersection details of the Speedpanel wall systems be as shown in Figure 72 for option one and Figure 73 for option two. Both proposed connection details utilise the C-track. The only difference between the two connection methods is that 10 g × 30 screws are used in option one, while 14g × 115 mm course thread is used in option two.

The key aspect of integrity performance is that when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, creating a free path for hot gases to pass through to the unexposed side.

Referenced test EWFA 2848300 consisted of a vertically oriented 64mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant were installed at the edge of the side track at two locations and in between the C-track and the concrete frame. When tested, there was no sign of impending insulation or integrity failure around the side tracks for at least 90 minutes. The fixing method adopted in option two is not expected to be detrimental to the fire resistance performance achieved in the referenced test.

Fire rated sealant (item 8) is proposed to be installed at two locations on the C-track and between the C-track and the perpendicular wall panel. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, it is considered that the proposed T-intersection details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

5.4.7 Angled details

Angled corner details shown in Figure 74 to Figure 77

The proposed acute corner details shown in Figure 74 to Figure 77 consist of Speedpanel wall capped by 1.15 mm BMT C-tracks at the connecting sides. The angle section is connected to the panels via minimum 10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and wall panel.

For option 1, shown in Figure 74 and Figure 76, for acute and obtuse angled connections, respectively, an external 0.7 mm corner flashing is used to connect the wall panels. For option 2 shown in Figure 75 and Figure 77, for acute and obtuse angled connections respectively, one layer of 13 mm thick fire grade plasterboard is fixed on the internal side of the corner. The proposed acute angled corner details are considered to be similar to the corner details with perpendicularly connected panels which have been assessed in section 5.4.5.

As previously discussed, with reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 129°C at 90 minutes. Even though the proposed wall thickness is 64 mm instead of the tested 78 mm thick panel in EWFA 2741700, given the significant margin with respect to the insulation failure threshold, it is expected that the unexposed side temperature rise of the proposed corner detail will not likely increase by more than 180°C from the initial temperature if exposed to fire for 90 minutes.

The angled connection will not reduce the overall thickness of the Speedpanel wall system. The proposed details are expected to have the same fire resistance performance as the corner details shown in Figure 54 to Figure 63. Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

Angled T-junction details shown in Figure 78 and Figure 79

It is proposed that the angled T-junction details of the Speedpanel wall systems shall be as shown in Figure 78 and Figure 79 for option 1 and option 2, respectively. The key difference between the two options is that C-section is used in option one, while two angled sections are used for option two. Both proposed connection details utilise 10 g × 30 screws for fixing.

The key aspect of integrity performance is when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, creating a free path for hot gases to pass through to the unexposed side.

The proposed angled T-junction details are considered to be similar to the T-intersection details shown in Figure 72 and Figure 73 and assessed in section 5.4.6. The angled orientation will not reduce the overall thickness of the angled wall panels. Thus, based on the discussion in section 5.4.6, it is considered that the proposed angled T-junction details will achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

Angled wall details shown in Figure 80 and Figure 81

The angled wall details shown in Figure 80 and Figure 81 are considered to be similar to the previously assessed side details in section 5.4.3.

In Figure 80, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks. The fire rated sealant (item 8) is proposed to be installed at two locations on the C-track and another between the C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

In Figure 81, the side of the Speedpanel wall system is also proposed to be connected to concrete/masonry structures by an equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel and the free flange will be attached to the surface of the wall panel. The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the concrete/masonry structure.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at more than 90 minutes.

The angled orientation does not reduce the overall thickness of the Speedpanel wall system. Therefore, the proposed side details are expected to perform at least as well as those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 64 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

Circular column details shown in Figure 82 and Figure 83

As discussed in section 5.3.7, the proposed detail is positively assessed for an FRL of at least -/90/90 in accordance with AS 1530.4:2014. Please note that this assessment is based on that fact that the circular column can achieve similar fire performance.

5.4.8 Multi-angled corner details

As discussed in section 5.3.8, the proposed details are positively assessed for an FRL of at least -/90/90 in accordance with AS 1530.4:2014.

5.5 78 mm thick vertically oriented Speedpanel wall systems

5.5.1 Increased wall height

The proposed construction is a vertically oriented Speedpanel wall system similar to the tested wall system in BWA 2286900 but with an increased height of 6 m. As Speedpanel walls are non-load bearing systems, it is assumed that only integrity performance will be compromised as a result of increased wall height. The reference test report BWA 2286900 consisted of a load-bearing test on a 78 mm thick vertically oriented Speedpanel wall. The panels incorporated a tongue and groove detail on their vertical edges. The uniformly distributed axial load applied on the wall at the start of the test (including the prior to the conditioning period) was 12.0 kN (or 4.3 kN/m) for the whole duration of the test. The test report states that the integrity failure was observed just after 120 minutes.

Therefore, the test specimen demonstrated that 78 mm thick Speedpanel wall systems are capable of demonstrating integrity performance for at least 120 minutes under significant bending and compression loads. The maximum lateral deflection at 120 minutes was 177 mm.

It should be noted that the Speedpanel walls are not designed to act as load bearing walls and the load applied on BWA 2286900 test was to determine the impact of increased wall height (self-weight). Based on these test results, the maximum allowable axial compression and bending moment capacities of a 78 mm thick Speedpanel wall was calculated. Then the obtained maximum strength limits were used to demonstrate that the Speedpanel wall systems up to 6 m high walls will maintain integrity performance the same as the tested system in BWA 2286900 for at least 120 minutes.

Table 9 Structural performance of 78 mm thick vertically oriented 6 m high wall

Description		Value
Tested system	Weight of the panel	36.5 kg/m^2
	Height of the wall	3 m
	Width of the wall	3 m
	Wall thickness	78 mm

Description		Value
	Applied load	4.3 kN/m
	Self-weight at mid height (1.5m from the base)	0.54 kN/m
	Load at wall mid height in the test	4.84 kN/m
	Deflection before the integrity failure	177 mm
	Maximum bending moment capacity (calculated)	**0.856 kNm/m**
	Maximum axial compression capacity (calculated)	**5.37 kN/m**
Proposed system	Measured weight of the panel	36.5 kg/m^2
	Height of the wall	6.0 m
	Wall thickness	78 mm
	Self-weight at mid height (3.0 m from the base)	1.07 kN/m
	Total self-weight	2.15 kN/m
	Predicted maximum deflection at 120 minutes	740.9 mm
	Determined bending moment capacity at integrity failure	0.54 kNm/m
	Ratio of safety with respect to bending moment	**0.93 < 1.0**
	Ratio of safety with respect to axial compression	**0.40 < 1.0**

Similar to previous calculations, it is proposed that the criteria to demonstrate adequacy of the proposed Speedpanel wall systems up to 6 m high depend on the predicted bending moment and axial compression load. It is considered that the design is safe,

- if the maximum predicted bending moment is less than the maximum bending moment capacity obtained from the test.
- if the maximum predicted axial compression load is less than the maximum axial compression capacity obtained from the test.

The calculation is based on the following assumptions:

- The deflection is based on the deflection measured at 120 minutes in fire test report BWA 2286900.
- The lateral deflections measured at the mid-point of the wall were used directly in determining the bending moment capacity of the proposed construction.
- The radius of curvature of the expected deflection behaviour of the proposed construction would be similar to that of the tested system.

As shown in Table 9, the induced maximum bending moment and the axial load of the proposed 6 m high 78 mm thick vertically oriented Speedpanel wall is less than the allowable limits obtained from the test. Therefore, it is considered that the proposed wall system is expected to achieve an FRL of - /120/120 in accordance with AS 1530.4:2014.

Fixing spacing at panel joint

For the 78 mm Speedpanel wall more than 5 m high, it is proposed that the panels be stitched together at 500 mm centers for the first two panels from a support and 750 mm centers for panels 3 and 4 and 1000 mm centers for remaining panels instead of the 1500 mm centers as tested in BWA

2286900 – see Figure 2. This increase in screw specification will have two effects, it will tend to keep the joints closed and tight and it will induce tension horizontally across the panel wall system, which will reduce the tendency for the joints to open on both the non-fire side and the fire side.

With reference to the insulation of the panel joins, the performance achieved in BWA 2286900 showed a hot spot near thermocouple B8 where the temperature rose to 317℃ at 120 minutes. With reference to FR 4322, the insulation performance of a panel join was measured and found to only rise by 142℃, which is well within the limits of AS 1530.4:2014.

It is concluded that the difference is not due to conduction through the joint as the materials and thickness are the same. Based on this observation, it is considered likely that the difference was associated with the potential loosening of the joint.

It is considered that the additional screw fixings will enhance the joint tightness to such a degree that the performance measured in FR 4322 can be applied to the proposed wall construction. Based on the above discussion, it is considered that the proposed construction will achieve an insulation performance of 120 minutes in accordance with AS 1530.4:2014.

5.5.2 Head details

Test evidence

It is proposed that the head details of the Speedpanel wall systems shall be as shown in Figure 3 to Figure 19. The proposed head details are expected to be used in Speedpanel wall systems exposed to fire from both sides, but not simultaneously.

The tested assembly in test EWFA 2741700, consisted of a 78 mm thick vertically oriented Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm head C-track of the Speedpanel wall was protected by a flashing cap or a 13 mm thick × 120 mm deep fire grade plasterboard strip protected on either fire exposed side or the unexposed side. When tested all four head details performed well and achieved integrity and insulation performances of 132 minutes.

Based on the test results of EWFA 2741700, it was observed that the maximum temperature recorded at the unexposed side for flashing cap fixed on either side of the wall was 177°C at 120 minutes. Similarly, it was observed that the maximum temperature recorded at the unexposed side of the 13 mm fire grade plasterboard strip fixed on either side of the wall was 154°C at 120 minutes.

Head details shown in Figure 3 to Figure 10

An 82 mm deep standard C-track is proposed to be installed for the 78 mm thick Speedpanel wall system. There are two kinds of proposed head track protection options. The first option is a flashing cap installed on one side of the head track, which refers to Figure 3 to Figure 6. The second option is one layer of 13 mm thick fire grade plasterboard fixed on one side of the head track, as shown in Figure 7 to Figure 10.

The tested assembly in test EWFA 2741700 comprised a 78 mm thick vertically orientated Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm BMT head C-track of Speedpanel wall was protected by a flashing cap protected on either the fire exposed side or the unexposed side.

With reference to the test results of EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 120 minutes for flashing fixed on either the fire side or non-fire side of head C-track was 177°C with a 20°C margin to meet the maximum temperature rise criteria.

The proposed head C–track is similar to that tested in EWFA 2741700 except there is no fire rated sealant is filled in the gap between head track and wall panels.

With reference to test BWA 2286900, test results indicate the cementitious core of the 78 mm Speedpanel wall panel started dehydrating around 120 minutes. The temperature on the Speedpanel wall panel at 120 minutes was around 120°C. It is therefore expected to last up to 120 minutes in this particular case. The proposed 20 mm gap between head track and panel is still expected to be filled with steam from the panel, interrupting radiant heat transfer across this cavity and dominating the surface temperature in the vicinity of the head. The heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case, the 20 mm gap between panels and head track) was much weaker. It is therefore considered that the temperature recorded on the unexposed side will not significantly differ when the partially filled gap at the top is removed.

Based on the above, it is considered the proposed construction is capable of maintaining insulation performance for a period of 120 minutes.

In addition, with reference to test EWFA 2741700, it was observed fire rated sealant was applied in the 20 mm gap between the top C-track and panels. The applied sealant was considered to reduce the gap size and hence resist heat transfer to the unexposed side.

With reference to EWFA 2741700, the proposed 20 mm gap between head track and panels is expected to be filled with steam from the panels, interrupting radiant heat transfer across this cavity and dominating the surface temperatures in the vicinity of the head. It is therefore considered the temperature recorded on the unexposed side will not significantly differ when the partially filled gap at the top is removed.

Therefore, it is considered that the 78 mm thick Speedpanel wall system with one of the proposed head details are expected to achieve an FRL of at least - /120/120 in accordance with AS 1530.4:2014.

Head details shown in Figure 11 to Figure 18

In the proposed head details shown in Figure 11 to Figure 18, the head Speedpanel wall is connected to masonry or concrete by using equal angle sections on both sides of the wall panel. Similar to the head details with C-track, there are two kinds of proposed head track protection options. The first option is a flashing cap installed on one side of the head track, which refers to Figure 11 to Figure 14. The second option is one layer of 13 mm thick fire rated plasterboard fixed on one side of the head track that refers to Figure 15 to Figure 18.

The proposed unexposed side steel angle is not directly exposed to the heat source, and the 20 mm gap between the concrete lintel and Speedpanel panel is sealed with fire resistant sealant on one side. Steel flashing or 13mm thick fire grade plasterboard is protected on one side.

It is therefore considered the temperature on the unexposed side steel angle would be much less than the cold side flange of C-tracks tested.

As discussed previously, it is confirmed that the head details protected with either a steel flashing or a layer of 13 mm thick fire grade plasterboard on either the fire side or non-fire side, the maximum temperature of the cold flange of C-track would remain below 180°C after 120 minutes.

It is therefore considered the proposed steel angle head detail will maintain the structural capacity of the steel angle head connection for up to 120 minutes based on designs, thereby allowing it to provide some vertical support at the top of the wall. In addition, it is expected the temperature on the unexposed side steel angle would be less than 180°C for up to 120 minutes based on designs.

Based on the above discussion, it is considered that the proposed construction will achieve an insulation and integrity performance of up to 120 minutes in accordance with AS 1530.4:2014.

Alternative sealant locations

The proposed head details incorporate various sealant location options as shown in Figure 3 to Figure 18.

The presence of the sealant between the C-track/angle section flange and the wall panel is expected to prevent hot gases from the exposed side from freely passing through to the cavity within that C-track or between the two angle sections, at least until the sealants fall away.

The presence of the sealant within cavity between the head track and panel is expected to significantly interrupt the steam from the panel core and the hot gases from exposed side to heat up the flange of the C-track or the angle section on the unexposed side.

With reference to test BWA 2286900, test results indicate the cementitious core of a 78 mm Speedpanel wall panel started dehydrating around 120 minutes, the proposed 20 mm gap between head track and panel is still expected to be filled with steam from the panel, interrupting radiant heat transfer across this cavity and dominating the surface temperature in the vicinity of the head. The heat transfer in the direction of the surrounding construction via conduction (contact) and convection (in this case the 20 mm gap between panels and head track) was much weaker.

It is therefore considered the proposed alternative sealant location options will not introduce any foreseeable weakness to the performance of 78 mm thick Speedpanel wall systems up to 120 minutes.

5.5.3 Side details

Side details by using C-track

In the proposed construction, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks with dimensions of 50 mm × 82 mm × 50 mm. The Speedpanel edge to be connected to concrete/masonry can be a female side (refer to Figure 20 to Figure 23), a male side (refer to Figure 28 to Figure 32), or a cut side (refer to Figure 38 to Figure 41). One flange of the C-track will be screw fixed to the Speedpanel wall. The gap between the side of the Speedpanel and the concrete/masonry structural must not be greater than 20 mm wide.

In the referenced test EWFA 2848300.2, both side details with cut side were tested, and there was no sign of impending insulation failure to be observed at the side track of tested Speedpanel wall for 137 minutes.

The fire rated sealant (item 8) is proposed to be installed at two locations on the C-track and another between the C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

The presence of the sealant within the cavity between the C-track and panel is expected to significantly interrupt the steam from the panel core and the hot gases from exposed side to heat up the unexposed side flange of the C-track. In addition, the sealant located within the cavity is protected by the surrounding C-tracks and will stay in place longer.

Based on the above, it is considered that the proposed sealant location variation will not introduce any insulation weakness for at least 120 minutes. With the provision of fire rated sealant, replacing the cut side within the C-track by either the male or female side is unlikely to be detrimental to the fire resistance of the side detail tested in EWFA 2848300.2.

Therefore, it is considered the proposed construction is positively assessed for an FRL of -/120/120 in accordance with AS 1530.4:2014.

Side details by using equal angle section

The side of the Speedpanel wall system is also proposed to be connected to concrete/masonry structures by an equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel, and the free flange will be attached to the surface of the wall panel. Same as the previously discussed connected via C-track, the wall panel edge to be connected to concrete/masonry can be female side (refer to Figure 24 to Figure 27), male side (refer to Figure 33 to Figure 37) or cut side (refer to Figure 42 to Figure 45).

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the concrete/masonry structure. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away. In addition, the sealant located within the cavity is protected by the surrounding angle sections and will stay in place longer.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at least 120 minutes.

The proposed side details are expected to perform at least as well as those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 78 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

5.5.4 Base details

Base details shown in Figure 46 to Figure 49

The proposed base details shown in Figure 46 to Figure 49 are similar to the base details tested in the referenced test EWFA 2848300.2. The referenced test EWFA 2848300.2 consisted of a vertically oriented 64 mm thick Speedpanel wall and had a similar base detail but was fixed to the furnace frame instead of fixing to a structural steel member. When tested, there was no visible failure around the base or on both sides. Ultimately, the base details achieved an integrity and insulation performance of 181 minutes and 137 minutes, respectively.

All these details shown in Figure 46 to Figure 49 are more or less similar and has fire rated sealant (item 8) installed at two locations on the C-track and another between the C-track and concrete floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, the proposed base details are expected to perform better than those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 78 mm thick Speedpanel wall systems with the proposed base details are expected to achieve an FRL of at least - /120/120 in accordance with AS 1530.4:2014.

Base details shown in Figure 50 to Figure 53

In the proposed base details shown in Figure 50 to Figure 53, the Speedpanel is connected to the concrete floor via equal angle sections on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel, and the free flange will be attached to the surface of the wall panel.

The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the floor. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at least 120 minutes.

The proposed base details are not expected to be detrimental to the fire resistance performance of those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 78 mm thick Speedpanel wall systems with the proposed base details are expected to achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

5.5.5 Corner details

Test evidence

It is proposed that the corner details of the Speedpanel wall systems shall be as shown in Figure 54 to Figure 63.

The referenced test, EWFA 2848300, consisted of a vertically oriented 64 mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant was installed at the edge of side track two locations and in between the C-track and the concrete frame. When tested, there was no sign of impending insulation or integrity failure around the side tracks for at least 120 minutes.

Therefore, it is expected that a 78mm thick Speedpanel wall system would perform similar to or better than the tested system in EWFA 2848300, thereby enabling it to be positively assessed for at least 120 minutes.

Corner details shown in Figure 54 to Figure 57

The proposed corner details shown in Figure 53 to Figure 56 are related to vertically oriented Speedpanel walls. The connecting sides, either male or female, are capped by a 1.15 mm BMT C-tracks of 50 mm × 56 mm × 50 mm. Additionally, the panels are connected by the 1.15 mm BMT equal angle section on the interior side. The angle section is connected to the panels via minimum

10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and the wall panel.

Both perpendicular Speedpanel walls that are intersecting shall be self-supported and one wall is not expected to provide any vertical or lateral support/restrain to the other.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2848300 with an increased thickness of 1.15 mm BMT. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

In addition, a 0.7 mm BMT corner flashing has been proposed. With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side of the flashing cap fixed on either side of the wall was 177°C at 120 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

Corner details shown in Figure 58 and Figure 59

The proposed corner details shown in Figure 58 and Figure 59 consist of Speedpanel walls connected to concrete structures via 1.15 mm BMT J-tracks, and the panels are laterally restrained at the corner by the concrete member. Fire rated sealant will be applied to the gap between the J-track and the concrete element.

In the corner detail option 5 shown in Figure 57, an internal 1.15 mm BMT equal angle section is also proposed as flashing at the corner. The exposed flange of the J-track will not be screw fixed to the wall panel. The corner detail option 6 in Figure 59 will not incorporate an equal angle section, but the exposed flange of the J-track will be fixed to the wall panel.

The proposed detail at the side perimeter track is similar to that tested in EWFA 2848300 except that a J-track is used instead of the tested 0.6mm side C-track. This variation is expected not to detrimentally affect the fire performance as the thickness of the perimeter track is increased in the proposed construction.

The proposed connection between Speedpanel and the concrete structure is expected to be better than the head details tested in EWFA 2848300. As shown in Figure 58 and Figure 59, the fixing is covered by the Speedpanel and, as such, not directly exposed to fire. Therefore, the heat transfer caused by conduction, convection and radiation to the fixing will be less than the fixing tested in EWFA 2848300.

Therefore, the performance of the corner details is expected to be similar to or better than the tested system in EWFA 2848300 and thus will achieve an FRL of -/120/120 in accordance with AS 1530.4:2014.

Corner details shown in Figure 60 to Figure 63

The corner details shown in Figure 60 to Figure 63 are similar to the previously assessed details shown in Figure 54 to Figure 57. The differences in the proposed corner details are that an external 0.7 mm corner flashing is used to connect the perpendicular wall panels and the wall panels are fixed to each other by 14g × 115 mm course thread screws at minimum 500 mm centres.

With reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side of the flashing cap fixed on either side of the wall was 177°C at 120 minutes. The flashing tested in EWFA 2741700 also maintains the integrity performance for 132 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

Corner details shown in Figure 64 to Figure 71

The corner details shown in Figure 64 to Figure 71 are similar to the previously assessed details shown in Figure 60 to Figure 63. The only difference in the proposed corner details is that one layer of 13 mm thick fire grade plasterboard is fixed on either the external or internal side of the corner instead of an external 0.7 mm corner flashing. The perpendicular wall panels are fixed to each other by 14g × 115 mm course thread screws at minimum 500 mm centres.

The tested assembly in test EWFA 2741700 consisted of a 78 mm thick vertically oriented Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm head C-track of Speedpanel wall was protected by a flashing cap or 13 mm thick × 120 mm deep fire grade plasterboard strip protected at either fire exposed side or unexposed side. When tested, all four head details performed well and achieved integrity and insulation performances of 132 minutes.

Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

5.5.6 T-intersection details

It is proposed that the T-intersection details of the Speedpanel wall systems be as shown in Figure 72 for option one and Figure 73 for option two. Both proposed connection details utilise the C-track. The only difference between the two connection methods is that 10 g × 30 screws are used in option one, while 14g × 115 mm course thread is used in option two.

The key aspect of integrity performance is that when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, creating a free path for hot gases to pass through to the unexposed side.

The referenced test EWFA 2848300 consisted of a vertically oriented 64 mm thick Speedpanel wall system. The panels were restrained to the concrete test frame via C-track at the sides and the fire rated sealant were installed at the edge of side track two locations and in between the C-track and the concrete frame. When tested, there was no sign of impending insulation or integrity failure around the side tracks for at least 120 minutes. The fixing method adopted in option two is not expected to be detrimental to the fire resistance performance achieved in the referenced test.

Therefore, it is expected that a 78 mm thick Speedpanel wall system would perform similar to or better than the tested system in EWFA 2848300 and will not introduce any integrity or insulation related failure at the perimeter edges for at least 120 minutes.

Fire rated sealant (item 8) is proposed to be installed at two locations of the C-track and between the C-track and the perpendicular wall panel. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

Based on the above discussion, it is considered that the proposed T-intersection details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

5.5.7 Angled details

Angled corner details shown in Figure 74 to Figure 77

The proposed acute corner details shown in Figure 74 to Figure 77 consist of Speedpanel wall capped by 1.15 mm BMT C-tracks at the connecting sides. The angle section is connected to the panels via minimum 10g × 30 mm SDS at 500 mm centres in the proposed construction. Fire rated sealant will be applied at the gap between the C-tracks and the cavity between the C-track and wall panel.

For option 1, shown in Figure 74 and Figure 76, for acute and obtuse angled connections, respectively, an external 0.7 mm corner flashing is used to connect the wall panels. For option 2 shown in Figure 75 and Figure 77, for acute and obtuse angled connections respectively, one layer of 13 mm thick fire grade plasterboard is fixed on the internal side of the corner. The proposed acute angled corner details are considered to be similar to the corner details with perpendicularly connected panels which have been assessed in section 5.5.5.

As previously discussed with reference to the results of the EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side for flashing cap fixed on either side of the wall was 177°C at 120 minutes.

The angled connection will not reduce the overall thickness of the Speedpanel wall system. The proposed details are expected to have the same fire resistance performance as the corner details shown in Figure 54 to Figure 63. Based on the above discussion, it is considered that the proposed corner details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

Angled T-junction details shown in Figure 78 and Figure 79

It is proposed that the angled T-junction details of the Speedpanel wall systems shall be as shown in Figure 78 and Figure 79 for option 1 and option 2, respectively. The key difference between the two options is that the C-section is used in option one, while two angled sections are used for option two. Both proposed connection details utilise 10 g × 30 screws for fixing.

The key aspect of integrity performance is when the T-intersection gets exposed to fire from the external side, the two wall sections are likely to deflect away from each other, creating a free path for hot gases to pass through to the unexposed side.

The proposed angled T-junction details are considered to be similar to the T-intersection details shown in Figure 72 and Figure 73 and assessed in section 5.5.6. The angled orientation will not reduce the overall thickness of the angled wall panels. Thus, based on the discussion in section 5.4.6, it is considered that the proposed angled T-junction details will achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

Angled wall details shown in Figure 80 and Figure 81

The angled wall details shown in Figure 80 and Figure 81 are considered to be similar to the previously assessed side details in section 5.5.3.

In Figure 80, the side of the Speedpanel wall system will be connected to the concrete/masonry structure by using 1.15 mm BMT C-tracks. The fire rated sealant (item 8) is proposed to be installed at two locations on the C-track and another between the C-track and concrete/masonry structure element. The presence of the sealant is expected to prevent hot gases from freely passing through to the unexposed side from the fire exposed side, at least until the sealants fall away.

In Figure 81, the side of the Speedpanel wall system is also proposed to be connected to concrete/masonry structures by equal angle section on one side of the wall. An additional equal angle section will be fixed to the floor on the other side of the wall panel, and the free flange will attached to the surface of the wall panel. The proposed base details will also have fire rated sealant (item 8) installed at two locations of the angle sections and between the two angle sections and the concrete/masonry structure.

As previously discussed, the base details tested in EWFA 2848300.2 consisted of C-track being fixed to the furnace frame. When tested, the detail achieved both integrity and insulation performance for at least 120 minutes.

The angled orientation does not reduce the overall thickness of the Speedpanel wall system. Therefore, the proposed side details are expected to perform at least as well as those tested in the referenced test report, EWFA 2848300.2. Therefore, it is considered that the 64 mm thick Speedpanel wall system with one of the proposed side details is expected to achieve an FRL of at least -/120/120 in accordance with AS 1530.4:2014.

Circular column details shown in Figure 82 and Figure 83

As discussed in section 5.3.7, the proposed detail is positively assessed for an FRL of at least - /120/120 in accordance with AS 1530.4:2014. Please note that this assessment is based on that fact that the circular column can achieve similar fire performance.

5.5.8 Multi-angled corner details

As discussed in section 5.3.8, the proposed details are positively assessed for an FRL of at least - /120/120 in accordance with AS 1530.4:2014.

5.5.9 Inclined wall system

The proposed construction is a vertically oriented Speedpanel wall system similar to the tested wall system in BWA 2286900, but with an inclined orientation as shown in Figure 86. As Speedpanel walls are non-load bearing systems, it is assumed that only integrity performance will be compromised as a result of increased wall height with inclination. The reference test report BWA 2286900 consisted of a load-bearing test on a 78 mm thick vertically oriented Speedpanel wall. The panels incorporated a tongue and groove detail on their vertical edges. The uniformly distributed axial load applied to the wall at the start of the test (including the prior to the conditioning period) was 12.0 kN (or 4.3 kN/m) for the whole duration of the test. The test report states that the integrity failure was observed just after 120 minutes.

Therefore, the test specimen demonstrated that 78 mm thick Speedpanel wall systems are capable of demonstrating integrity performance for at least 120 minutes under significant bending and compression loads. The maximum lateral deflection at 120 minutes was 177 mm.

It should be noted that the Speedpanel walls are not designed to act as load bearing walls and the load applied on BWA 2286900 test was to determine the impact of increased wall height (self-weight). Based on these test results, the maximum allowable axial compression and bending moment capacities of a 78 mm thick Speedpanel wall were calculated. See Table 10 in section 5.5.1 for the maximum bending moment and axial force resisted by the tested specimen.

Then the obtained maximum strength limits were used to demonstrate that the inclined Speedpanel wall systems up to 6 m high walls will maintain integrity performance same as the tested system in BWA 2286900 for at least 120 minutes.

Similar to previous calculations and assumptions summarised in section 5.5.1, it is proposed that the criteria to demonstrate adequacy of the proposed Speedpanel wall systems up to 6 m high depend on the predicted bending moment and axial compression load. The wall constructions with corresponding inclined angles and distances summarised in Table 11 are expected to achieve an FRL of - /120/120 in accordance with AS 1530.4:2014.

Table 12 Inclined wall height with corresponding inclined angle

Wall thickness (mm)	Wall height (H, m)	Maximum inclined distance (D, m)	Maximum inclined angle (ϴ, °)
78	4.0	1.34	19
	4.2	1.18	16
	4.5	0.94	12
	4.7	0.79	10
	4.8	0.71	8
	4.9	0.64	7
	5.0	0.56	6
	5.2	0.42	5
	5.5	0.19	2
	5.7	0.04	0
	5.8	0.00	0
	6.0	0.00	0

5.5.10 Angel connection (segmented) details

Angle connection details options 1 and 2

The proposed angle connection detail options 1 and 2 Figure 87 and Figure 88 are formed by two vertical Speedpanel walls comprises C-track capping each end of vertical Speedpanel panels, which are protected with one layer of 13 mm thick fire rated plasterboard strips. For angle connection 1 in Figure 87, a minimum 1.2 mm thick steel flashing capping is fixed on each side of the connection. For angle connection 2, shown in Figure 88, a minimum 1.2 mm thick steel flashing capping is fixed to one side of the connection only.

As discussed in previous sections, the steel flashing or 13 mm fire grade plasterboard protection at the head has the ability to maintain an FRL of -120/120. As the proposed details have protection from both metal flashing and 13 mm fire grade plasterboard, it is expected that the details will maintain integrity and insulation performance for up to 120 minutes in accordance with AS 1530.4:2014.

Angle connection detail option 3 shown Figure 89

The proposed angle connection detail 3, formed by two vertical Speedpanel walls, comprises C-track capping at each end of vertical Speedpanel panels, which are protected with a minimum 1.2 mm thick steel flashing cap fixed to one side of the connection only. The gap between two Speedpanel walls is less than 20 mm wide and filled with fire rated sealant. The two C-tracks are fixed together at one end; hence the fire rated sealant would stay in place during the exposure.

With reference to test EWFA 2741700, it was observed the maximum temperature recorded on the unexposed side at 120 minutes for steel flashing fixed on either fire side or non-fire side of head C-track was 177°C with a 20°C margin to meet the maximum temperature rise criteria.

It is considered if the proposed construction is exposed to fire from the wider flashing side, the proposed steel flashing capping was tested as in EWFA 2741700 with steel flashing fixed on either the exposed side of the head of C-track.

In light of the above, it is considered the proposed construction will maintain integrity and insulation performance for up to 120 minutes in accordance with AS 1530.4:2014.

5.5.11 Head details (segmented)

For the 78 mm vertically orientated Speedpanel wall system of a height between 5 m and 6 m, the head details shown in Figure 91 to Figure 93 are proposed. Compared to the head details shown in Figure 3 to Figure 18 and discussed in section 5.5.2, the proposed head details will incorporate an additional layer of 13 mm plasterboard on either side of the wall and be held in place with a steel flashing that is mechanically fixed to the wall panel and track.

The tested assembly in test EWFA 2741700 consisted of a 78 mm thick vertically oriented Speedpanel panel wall incorporating two doorsets. The standard 82 mm deep × 1.2 mm head C-track of the Speedpanel wall was protected by a flashing cap or a 13 mm thick × 120 mm deep fire grade plasterboard strip protected on either fire exposed side or unexposed side. When tested, all four head details performed well and achieved integrity and insulation performances of 132 minutes.

The incorporation of an additional layer of plasterboard is expected to further improve the insulation and integrity performance of the head connection details. Therefore, it is considered that the 78 mm thick Speedpanel wall system with one of the proposed head details is expected to achieve an FRL of at least - /120/120 in accordance with AS 1530.4:2014.

5.5.12 Vertical wall system curved in plan

It is proposed to have the vertically orientated 78 mm thick wall system be installed with a curve in plan. As shown in Figure 90, the maximum width of the gap on the convex side at the panel joint will be 20 mm and protected by 1.15 mm BMT (1.2 mm TCT) galvanised mild steel flat plate fixed at 500 mm centres. Fire rated sealant will be applied on both the convex and concave sides of the panel joints, as well as within the joint between the male and female sides.

Upon inspection of test observations of test BWA 2286900.5, the vertically orientated Speedpanel wall deflected towards the heat and thus it is considered that the worst scenario is when the vertical wall with radius is exposed to exposure from the convex side, as the panel joints on the convex side will tend to open up at an earlier stage.

The key aspect of the integrity performance of the Speedpanel wall with radius is the viability of the panel joint to resist the formation of gaps that could allow the transmission of hot gases to ignite a cotton pad and maintain a temperature below the prescribed temperature criteria on the unexposed side.

With reference to the insulation of the panel joins, the performance achieved in BWA 2286900 showed a hot spot near thermocouple B8 (at mid-height) where the temperature rose to 317℃ at 120 minutes. With reference to FR 4322, the insulation performance of a panel joint was measured and found to only rise by 142℃, which is well within the limits of AS 1530.4:2014.

It is concluded that the difference is not due to conduction through the joint as the materials and thickness are the same. Rather, it is considered the temperature rise is due to loosening of the joint.

It is proposed that the panels be stitched together on each side at maximum 1000 mm centres for all the panels instead of the 1500 mm centers as tested in BWA 2286900.5. The increase in screw specification will have two effects. It will tend to keep the joints closed and tight, and it will induce tension horizontally across the panel wall system, which will reduce the tendency for the joints to open on both the non-fire side and the fire side and most likely reduce lateral deflection as a result.

It is also proposed that 1.15 mm BMT mild steel strips are fixed with two 10 gauge × 30 mm SDS screws at 500 mm centers on the convex side of the wall and fire rated sealant is applied at the panel joints on each side.

The steel strips will keep the joints closed and prevent the panel joint from directly being exposed to the heat, and the fire rated sealant applied at the joint on both sides would prevent the hot gases passing through the form of gap during the exposure to heat up the exposed side.

On the balance of the above discussion, it is considered that the proposed construction will achieve the insulation and integrity performance of 120 minutes in accordance with AS 1530.4:2014.

5.6 Head connected to structural steel – Figure 19

The proposed head detail connected to the steel structure beam in Figure 19 comprises Promat CAFCO® 300 vermiculite gypsum based wet mix spray applied over the steel structure beam, the flange of the top track, and the interface of the track and the Speedpanel panels with a minimum thickness of 20 mm for 51 mm and 64 mm wall systems and 25 mm for 78 mm wall systems. The fire protection system shall be lapped for at least a minimum 90 mm onto both faces of the Speedpanel wall.

5.6.1 Discussion

The non-loadbearing beam specimen A and loadbearing beam tested in test TE 93878 comprised steel beams which were included in the furnace with a mineral-fibre gasket forming a seal between the top flange and the light weight concrete roof of the furnace. The steel beams were protected with 18.9 mm and 32 mm thick CAFCO® 300 spray, except the top flange, which was connected to the furnace.

When tested, it was observed that the CAFCO® 300 vermiculite gypsum at a thickness of 18.9 mm and 32 mm stayed in place during the test duration of 180 minutes.

With reference to test TE 93878, it is confirmed that stickability was demonstrated for the tested vermiculite spray for at least 120 minutes.

The presence of the vermiculite spray on the exposed side of the wall system head is likely to prevent the top track from directly being exposed to the heat, though a conservative approach has been applied in this assessment to ignore the contribution on the fire side.

The vermiculite component of fire grade plasterboard is an important and active constituent, and the primary effect of Vermiculite is that it expands in volume or exfoliates when exposed to heat. Fire grade plasterboard also contains plaster, which dehydrates and shrinks when heated.

Upon inspection of the compositions of Promat CAFCO® 300 vermiculite gypsum based wet mix spray, it is noted the Promat CAFCO® 300 spray comprises similar materials to the fire grade plasterboard though applied at a greater thickness.

Based on the above, it is expected that the contribution of minimum 20 mm thick vermiculite gypsum based wet mix spray to be at least that of one layer of 13 mm fire grade board on one side only as the thickness is greater and the material composition and thermal properties similar.

With reference to the test results of EWFA 2741700, it was observed that the maximum temperature recorded on the unexposed side at 120 minutes for 13 mm fire grade plasterboard fixed on the fire side of the head track was 154°C. The temperature recorded on the unexposed side at 120 minutes for plasterboard fixed on the non-fire side of head track was less hot.

It is therefore expected that the behaviour of Promat CAFCO® 300 spray to be similar and most likely better than the fire grade plasterboard tested in EWFA 2741700.

Based on the above, it is considered the proposed construction is positively assessed for insulation performance up to 120 minutes in accordance with AS1530.4:2014.

5.7 Conclusion

Based on the discussion presented in this report, it is the opinion of this registered testing authority that the proposed wall systems will achieve the FRLs stated in Table 13 and Table 14 – in accordance with AS 1530.4:2014.

The outcome of this assessment are subject to the limitations and requirements described in sections 2, 3 and 6 of this report.

Table 13 Vertical Speedpanel wall systems

Wall thickness (mm)	Max. wall height (m)	Panel-to-panel fixings	Connections								FRL
			Head to concrete slab	Head to steel structure	Side/edge	Base	Corner	T-intersection	Angled	Multi-Angled	
51	5.0	Required to be installed to one face of the panels across the wall at 1000 mm centres (Figure 1)	Figure 3 to Figure 18	Figure 19	Figure 20 to Figure 45	Figure 46 to Figure 53	Figure 54 to Figure 71	Figure 72 to Figure 73	Figure 74 to Figure 83	Figure 84 to Figure 85	-/60/60
64	5.0										-/90/90
78	5.0										-/120/120
78	6.0	Required to be installed to one face of the panels at (Figure 2): • 500 mm centres (1st two joints); • 750 mm centres (2nd two joints); and then • 1000 mm centres									-/120/120

Table 14 Inclined and curved/segmented Speedpanel wall systems

Wall thickness (mm)	Wall height (H) (m)	Maximum inclined distance (D) (m)	Maximum inclined angle (ϴ) (°)	Connections Head	Side/Edge	Base	Minimum radius of curvature view (m)	FRL
78	4.0	1.34	19	Figure 86	Figure 20 to Figure 45	Figure 86	-	-/120/120
	4.2	1.18	16					
	4.5	0.94	12					
	4.7	0.79	10					
	4.8	0.71	8					
	4.9	0.64	7					
	5.0	0.56	6					
	5.2	0.42	5	Figure 91 to Figure 93	Figure 20 to Figure 45	Figure 86		
	5.5	0.19	2					
	5.7	0.04	0					
	5.8	0.00	0					
	6.0	0.00	0					
78	5.0	-	-	Figure 3 to Figure 18	Figure 87 to Figure 89	Figure 46 to Figure 53	-	-/120/120
	5.01 – 6.0	-	-	Figure 91 to Figure 93			-	-/120/120
78	6.0	-	-	Figure 3 to Figure 18	Figure 90	Figure 46 to Figure 53	1.35 (int) / 1.45 (ext)	-/120/120
Note: Situations where two angle sections are used to connect the Speedpanel system, both angle sections may face opposite directions and achieve the relevant FRLs in Table 13 and Table 14.								

6. Validity

Warringtonfire Australia does not endorse the tested or assessed product in any way. The conclusions of this assessment may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all conditions.

Due to the nature of fire testing and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement. It is therefore recommended that this report be reviewed on, or before, the stated expiry date.

This assessment represents our opinion about the performance likely to be demonstrated on a test in accordance with AS 1530.4:2014, based on the evidence referred to in this report.

This assessment is provided to Speedpanel Holdings Pty Ltd and H B Fuller Company Australia Pty Ltd for their own specific purposes. Building certifiers and other third parties are responsible for deciding if they accept this assessment in a particular context.

Appendix A Summary of supporting test data

A.1 Test report – BWA 2286900.5

Table 15 Information about test report

Item	Information about test report
Report sponsor	Speedpanel (Vic) Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 18 August 2008.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test specimen comprised a nominal 2790 mm wide × 3000 mm high × 78 mm thick loadbearing wall made of vertically oriented 78 mm thick Speedpanel panels that incorporated a tongue and groove detail on their vertical edges. The panels were made from 0.42 mm galvanized mild steel. The perimeter framing comprised 83 mm wide × 58 mm high × 1.2 mm thick steel C-tracks on the top and bottom of the wall system. The end cap on the west side was 50 mm wide × 59 mm high × 0.6 mm thick C-track, and on the east side was 17 mm wide × 60 mm high × 0.6 mm thick C-track. The panels were fixed to the top and bottom C-tracks at nominal 250 mm centres and fixed to each other along the horizontal centreline on both exposed and unexposed sides with 15 mm long self-tapping screws. Fire rated acrylic sealant was used to seal any gaps in the construction prior to testing. The wall was loaded from the base of the wall at six points at 500 mm centres. The average load that was applied at each point for the duration of the test was approximately 2.0 kN per load point (4.3 kN/m).
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The test specimen achieved the following results – see Table 16.

Table 16 Results summary for this test report

Performance criteria	Time of failure	Position of failure
Structural adequacy	No failure at 144 minutes	NA
Integrity	120 minutes	Ignition of sealant at interface of top C-track and panel initiated failure of specimen by sustained flaming
Insulation (wall system)	64 minutes	Maximum temperature on top C-track (T/C B6) exceeded 180 K above the initial temperature
Insulation (panel only)	80 minutes	Maximum temperature at 15 mm from the edge of a vertical joint (T/C B8) exceeded 180 K above the initial temperature.

A.2 Test report – EWFA 2736000

Table 17 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 22 June 2012.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test assembly comprised a nominal 2950 mm wide × 3000 mm high × 78 mm thick loaded wall system that incorporated various apertures. The tested configuration incorporated 78 mm thick Speedpanel panels vertically orientated to form a vertical wall system, which consisted of three apertures that were filled with Firetherm Intubatt. Apertures A and B were filled with 50 mm thick Firetherm Intubatt and Aperture C was filled with one layer of 50 mm thick Intubatt and one layer of 30 mm thick Intubatt. For the purpose of this assessment report, only Apertures A and B are relevant. The test was terminated at 121 minutes.

The temperatures at various locations on the unexposed side of the test specimen are summarised in Table 18.

Table 18 Results summary for this test report

Location	Temperature on the unexposed side at 120 minutes
Unexposed side of the Intubatt filled in Aperture A.	238°C
Unexposed side of the Intubatt filled in Aperture B	243°C

A.3 Test report – EWFA 2736002.1

Table 19 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 13 July 2012.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test specimen comprised a nominal 3010 mm wide × 2970 mm high × 51 mm thick loadbearing wall made of vertically orientated 255 mm wide × 51 mm thick Speedpanel panels that incorporated a tongue and groove detail on their vertical edges. The panels were made from 0.2 mm BMT (0.27 mm measured thickness) galvanised mild steel. Steel skin was joined on the male and female sides with pop-rivets at nominal 50 mm centres. The test assembly was asymmetric with the west edge fixed and the East edge free from lateral restraint from the formal segment of the test. The fixed edge was then released for the second stage of the test. The perimeter framing comprised two kinds of head tracks. The west side head track was 885 mm long × 53 mm deep × 50 mm high × 1.01 mm thick (measured) galvanised steel C-track with intumescent strip in channels in the web. 2-off 2 mm thick × 9 mm wide strips, 2-off 4 mm thick × 10 mm wide strips and 1-off 4 mm thick ×7 mm wide strips were fixed on the top face of the track web and 2-off 4 mm thick × 10 mm wide and 1-off 4 mm thick × 7 mm wide strips on the bottom face of the track web. Strips were held in place using Intumastic acrylic sealant mastic. The east side head track was 2135 mm long × 55 mm deep × 50 mm high × 0.75 mm (measured) of galvanised steel C-track with intumescent strips installed in a similar manner to the west side head track. The head track is fixed to the lintel with 6.5 mm × 50 mm galvanised steel spikes, mushroom head at 400 mm centres. The panels were fixed to the top and bottom C-tracks at nominal 500 mm centres and fixed to each other along the horizontal centreline on both exposed and unexposed sides with 16 mm long self-tapping screws. Fire Resistance Acoustic Mastic was used to seal any gaps in the construction prior to testing. A load of 2.876 kN was applied at three points, 1450 mm apart at the base of the wall. The applied load at each hydraulic jack was 0.959 kN, and was applied for the duration of the formal part of the test. The load was later increased, and post-test observations were collected.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The test specimen achieved the following results – see Table 20.

Table 20 Results summary for this test report

Performance criteria	Time of failure
Structural adequacy	No failure at 66 minutes
Integrity	No failure at 66 minutes
Insulation (head track)	Failed at 23 minutes,
Insulation (panels only)	Maximum temperature on head C-track (T/C 017) exceeded 180 K rise above the initial temperature.

A.4 Test report – EWFA 2741700.1

Table 21 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 20 July 2012.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test assembly comprised a nominal 2950 mm wide × 3000 mm high × 78 mm thick non-loadbearing wall system made of vertically orientated 285 mm × 78 mm thick Speedpanel panels incorporated a tongue and groove detail on their vertical edges. The specimen was tested unloaded and with free vertical edges. The wall incorporated two Pyropanel FR Maxi doors, both opening inwards towards the furnace. The panels were made from an aerated cementitious core encased in a 0.4 mm BMT galvanised steel skin. The test assembly was asymmetrical in that the head details varied from the East side to the West side. Fire rated sealant was applied in the 20 mm gap between the top C-track and wall panels. The five tested head track protecting options are summarised below: • Option 1: Flashing installed on the exposed side only. (Temperatures recorded by T/C 121 and 122 on the unexposed side.) • Option 2: One layer of 13 mm thick × 120 mm deep CSR Fyrchek plasterboard on the unexposed side only. (Temperatures recorded by T/C 123 and 124 on the unexposed side.) • Option 3: One layer of 13 mm thick × 120 mm deep CSR Fyrchek plasterboard on each side of the head tracks. (Temperatures recorded by T/C 125 and 126 on the unexposed side.) • Option 4: Flashing installed on the unexposed side only. (Temperature recorded by T/C 127 and 128 on the unexposed side.) • Option 5: One layer of 13 mm thick × 120 mm deep CSR Fyrchek plasterboard on the exposed side only. (Temperatures recorded by T/C 129 and 130 on the unexposed side.) The perimeter framing comprised head and bottom tracks made of 82 mm deep × 50 mm high × 1.2 mm thick galvanised steel C-tracks and side tracks made of 82 mm deep × 50 mm high × 0.5 mm thick galvanised steel C-tracks. The panels were fixed to the top and bottom C-tracks at nominal 400 mm centres and fixed to each other at 500 mm centres on both exposed and unexposed side with 16 mm long flat top self-drilling, zinc coated steel screws. Fire rated acrylic sealant was used to seal any gaps in the construction prior to testing. Details of the doors are not relevant to this assessment report.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The temperatures on the unexposed side of the test head track options are summarised in Table 22.

Table 22 Results summary for this test report

Head track protection options	Temperature on the unexposed side at 120 minutes
Option 1	177°C
Option 2	154°C
Option 3	163°C

Head track protection options	Temperature on the unexposed side at 120 minutes
Option 4	145°C
Option 5	177°C

A.5 Test report – EWFA 2798800.1

Table 23 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 29 January 2013.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test assembly comprised a nominal 1200 mm wide × 1200 mm high × 51 mm thick Speedpanel wall system penetrated by various services. A 600 mm long × 55 mm wide × 52 mm deep × 1.2 mm galvanised steel head track was installed on the west side and fixed to the lintel with 6.5g × 38mm Mushroom Head Nails. A 600 mm long × 60 mm wide × 52 mm deep × 1.2 BMT galvanised steel head track with intumescent strips in the recessed part of the flange, on either side was installed on the east side and fixed to the lintel with 6.5g × 38mm Mushroom Head Nails. The side and bottom tracks were made of 55 mm wide × 52 mm deep × 1.2 mm galvanised steel track. One layer of 13 mm thick × 100 mm wide × 750 mm high Fyrchek plasterboard was installed along the west edge of the specimen wall and fixed to the Speedpanel through the west vertical track with 6g × 40 mm Bugle Head, Fine Thread, Self-drilling screws. One layer of 20 mm thick × 100 mm wide × 750 mm high PROMATECT® 100 was installed along the east edge of the specimen wall and fixed to Speedpanel through the east vertical track with 6g × 40 mm Bugle Head, Fine Thread, Self-drilling screws. Fire rated acrylic sealant was used to seal any gaps in the construction prior to testing. Details of the service penetrations are not relevant to this assessment report.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The temperatures at various locations on the unexposed side of the test specimen are summarised in Table 24.

Table 24 Results summary for this test report

Location	Temperature on the unexposed side at 120 minutes
Unexposed side of west head C-track	351°C
Unexposed side of 13 mm thick Fyrchek plasterboard	192°C
Unexposed side of 20 mm thick PROMATECT® 100	104°C
Unexposed side of wall panel	367°C

A.6 Test report – EWFA 2848300.2

Table 25 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 29 May 2013.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The The test assembly comprised a nominal 3000 mm wide × 3000 mm high × 64 mm thick Speedpanel wall system. The tested configuration incorporated 64 mm thick Speedpanel panels vertically orientated to form a vertical wall system with 0.75 mm BMT perimeter track. The panels incorporate a tongue and groove detail on their vertical edges. The side and bottom tracks were made of 67 mm wide × 51 mm deep × 0.8 mm galvanised steel track. Flat top self-drilling, zinc coated steel screws, 10g × 16 mm fixed the side tracks to the panels at 500 mm centres on exposed and unexposed side. Flat top self-drilling, zinc coated steel screws, 10g × 30 mm, fixed the head and bottom tracks to the panels at every second panel join on both exposed and unexposed sides. Head fixings were staggered. Flat top self-drilling, zinc coated steel screws, 10g × 16 mm used to fix panels to each other at every second panel join at 1500 mm height from the bottom on both exposed and unexposed sides. These fixings were staggered such that one join had one screw fixing at 1500 mm height. Fire resistant joint filler applied to the joints between the panel and the C-track at the head, base and vertical edges on both exposed and unexposed sides and also applied to joints between tracks and surround block work along head, base and fixed edges. The test was terminated at 181 minutes.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The test specimen achieved the following results – see Table 26.

Table 26 Results summary for this test report

Performance criteria	Head and side track		Wall panel	
	Time of failure	Position of failure	Time of failure	Position of failure
Structural adequacy	Not applicable	Not applicable	Not applicable	Not applicable
Integrity	133 minutes	Sustained flaming at base track	No failure at 181 minutes	Not applicable
Insulation	14 minutes	The maximum temperature measured at the head track of the specimen in line with join exceeded the maximum temperature rise of 180 K.	93 minutes	The maximum temperature measured at 15 mm from a vertical join exceeded the maximum temperature rise of 180 K.

A.7 Test report – EWFA 29942200.1

Table 27 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 31 July 2014.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	The damper was not tested in full accordance with AS 1530.4-2005 as a pressure differential was not applied across the damper. The junction of the damper and the wall was tested in accordance with AS 1530.4:2005.
General description of tested specimen	The tested assembly comprised a nominal 3000 mm wide × 3000 mm high × 78 mm thick Speedpanel wall system penetrated by eight different service penetrations which were protected with various protection systems with Fire rated sealant. The top edge of the Speedpanel wall system was protected with flashing, and the bottom edge of the wall was protected by Fire rated sealant on the unexposed side. For the purpose of the assessment, only the perimeter details of the 78mm thick Speedpanel wall is relevant. The tested wall configuration incorporated 78 mm thick Speedpanel panels vertically orientated to form a vertical wall system with 1.26 mm of BMT perimeter track. The panels incorporate a 'tongue and groove' detail on their vertical edges. The panels were installed vertically starting from the north edge with the groove ending in the north vertical track with a 20 mm gap between the top edge of the Speedpanel and the top track. Panels were screw fixed to each other at 1000 mm centres on the unexposed side only at every panel join. Panels were screw fixed to vertical tracks at 500 mm centres on the unexposed side only and fixed to head and bottom track at every 2nd panel join on the unexposed side only. The perimeter tracks were made of 85 mm × 55 mm × 1.26 mm BMT galvanised steel C-track. The top head of the Speedpanel wall was protected with 144mm wide × 1610 mm long × 0.7 mm BMT Galvabond® steel flashing. The South half of wall head was protected with flashing on the unexposed side and the North half of wall head was protected with flashing on the exposed side. The overlap of flashing was nominally 200 mm. The Fire rated sealant was applied in the following areas: • Applied to the interface between the perimeter tracks and the surrounding blockwork along the head, base and fixed edge. • Applied to the spacing between the unexposed side flange of bottom track and the Speedpanel contours. The sealant was applied to the specimen from the unexposed side only. • 20 mm high × 100 mm wide sealant fillet was applied to the spacing between the top track and the Speedpanel at the mid width of the specimen wall to create a fire seal in the head track to separate north and south flashing. The test was terminated at 123 minutes.

The fire resistance performance of the test specimen is summarised in Table 28.

Table 29 Results summary for this test report

Location	Insulation	Integrity
Head detail of wall	16 minutes	No failure at 123 minutes
Side detail of wall	28 minutes	
Bottom detail of wall	45 minutes	

A.8 Test report – FR 3754

Table 30 Information about test report

Item	Information about test report
Report sponsor	Speedwall New Zealand Ltd
Test laboratory	BRANZ, Moonshine Road, Judgeford, Porirua City, New Zealand
Test date	The fire resistance test was completed on 17 May 2006.
Test standards	The test was done in accordance with AS 1530.4:1997.
Variation to test standards	None
General description of tested specimen	The test specimen consisted of a non-loadbearing Speedwall® panel wall, 3000 mm high by 3000 mm wide. The wall comprised eleven interlocking panels, each 285 mm wide × 76 mm thick × 2900 mm high and one interlocking panel 250 mm wide × 76 mm thick × 2900 mm high. Steel angles, 64 mm × 55 mm × 1.15 mm thick, were fixed to the top, base and left-hand perimeter edges of the wall with bolts at 500 mm centres. The angles were sealed to the specimen frame and the panels with fire rated acrylic sealant. The panels were fixed together and to the angles with Hilti DB7 6 mm diameter fasteners. The panels were fixed to the angles at the top and base at each end of the panel on each face. At the left-hand vertical edge, the panel was fixed to the angle at 400 mm to 450 mm centres. Each panel was fixed to the next at 1000 mm centres. A 10 mm expansion gap was provided between the top edge of the panels and the specimen frame and filled with a bead of sealant. A second set of angles were screw fixed to the unexposed face of the panels at the top, base and left-hand side with Hilti DB7 fasteners at 400 mm to 450 mm centres and a bead of sealant, and to the specimen frame at 500 mm centres and a bead of sealant. The right-hand end panel was 500 mm wide with a level exposed concrete trailing edge. Two angles were fixed to each face, overlapping on the trailing edge of the panel and sealed under each component with a bead of sealant. The angles were fixed at 400 mm to 450 mm centres on each face and the trailing edge. This end panel was left free and sealed to the specimen holder with ceramic fibre.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:1997.

The test specimen achieved the following results – see Table 31.

Table 31 Results summary for this test report

Performance criteria	Time of failure
Integrity	No failure at 245 minutes
Insulation	123 minutes.

A.9 Test report – FR 4322

Table 32 Information about test report

Item	Information about test report
Report sponsor	Speedpanel Vic Pty Ltd
Test laboratory	BRANZ, Moonshine Road, Judgeford, Porirua City, New Zealand
Test date	The fire resistance test was completed on 22 October 2009.
Test standards	The test was done in accordance with AS 1530.4:2005.
Variation to test standards	None
General description of tested specimen	The test specimen consisted of a non-loadbearing aerated concrete wall system manufactured by Speedpanel. The nominal dimensions of the wall system were 3000 mm high × 3000 mm wide × 78 mm thick and made up of 12 pre-fabricated panels with two integrated Pyropanel fire doorsets. The two single acting doorsets were labelled doorset A and B. Both doorsets had the latch engaged and opened into the furnace. The wall system consisted of 12 "Speedpanel" panels fitted together with tongue and groove (T&G) joints. The panels consisted of aerated concrete enclosed within a nominally 0.4 mm thick galvanised steel envelope. The overall dimensions of an individual section (uncut) were measured as 2975 mm long × 285 mm wide × 78 mm thick. The wall sections tongue and groove was measured at 56 mm wide × 38mm deep/long and tapered to 20 mm wide. Twelve sections were installed within a galvanised steel perimeter frame, which was fixed to the specimen holder. The perimeter frame was constructed from 1.2 mm thick galvanised steel C track on the sides and sill and galvanised steel angle at the head of the specimen. The C track measured 55 mm × 80 mm × 55 mm and the angle measure 55 mm × 70 mm. The C track web was fixed on the vertical left hand side of the specimen holder using six M12 (furnace frame) bolts spaced at 500 mm centres. To secure the T&G fitting of the wall panels, two rows of 12 screws were fixed at the panel joining seams 297 mm and 740 mm from the head of the specimen holder (i.e. just above the head of the doorsets) As the wall was constructed, the aerated concrete panels were cut to size to accommodate two doorset apertures. The straight edges required for fixing the door frames to the wall system were achieved using "C" track sections fixed to the cut out jambs and head. Fire rated sealant was applied to the inside of the track and both track flanges were screwed to the wall panel using 6 equally spaced screws. Once the wall panels were fully installed, the final section of angle (50 mm × 50 mm) was fixed to the head of the unexposed face of the wall using 12 equally spaced self tapping screws and the outer angle flange was bolted to the specimen holder with 11 equally spaced bolts. Fire rated sealant was applied where the wall system interfaced with the "C" track sections, angle sections, specimen frame and doorset frames. The right hand side of the specimen was capped with a C track section and remained unfixed as a 35 mm wide floating edge which was packed with thermal ceramic insulation.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005.

The test specimen achieved the following results – see Table 33.

Table 33 Results summary for this test report

Performance criteria	Time of failure
Integrity of panel	No failure at 92 minutes
Insulation of panel joint	126 minutes. Maximum temperature on joint exceeded 180℃ above the initial temperature.

A.10 Test report – TE 93878

Table 34 Information about test report

Item	Information about test report
Report sponsor	Cafco Europe Group SA (T/A Cafco International), Bluebell Close, Clover Nook, Industrial Estate, Alfreton, Derbyshire, DE55 4RA.
Test laboratory	BRE laboratories, Borehamwood.
Test date	The fire resistance test was completed on 9 January 2001.
Test standards	The test was done in accordance with BS 476.21:1987.
Variation to test standards	None.
General description of tested specimen	A universal steel beam (designated 305 mm × 127 mm × 42 kg/m) insulated with CAFCO 300 vermiculite protection spray applied to a mean thickness of 31.9 mm (target protection 33 mm), was submitted to a fire resistance test in accordance with BS 476.21:1987[7]. The beam was protected by a three-sided contoured protection system of CAFCO 300 spray. A load of 143.4 kN was applied to the beam to induce the maximum permissible bending stress calculated in accordance with BS 449.2:1969[8]. When placed in the loading rig, the simply supported clear span of the beam was 4.25 m. 5 mm thick web stiffeners were welded to the beam 200 mm from each end at the boundaries of the 4 m exposed length. A 920 mm wide × 130 mm deep concrete slab was cast along the top of the steel beam and keyed to the beam with five steel lugs. The mean and maximum web and flange steel temperatures were measured.
Instrumentation	The test report states that the instrumentation was in accordance with BS 476.20:1987 and BS 476.21:1987.

The test specimen achieved the following results – see Table 35.

Table 35 Results summary for this test report

Performance criteria	Time to failure
Loadbearing capacity	164 minutes*
* The specimen supported the full test load for 164 completed minutes, after which the imposed load was removed, and the heating continued for a further 16 minutes.	

[7] British Standards 1987. Part 21. Fire tests on building materials and structures— Methods for determination of the fire resistance of loadbearing elements of construction. British Standards Institution, London, UK.
[8] British Standards 1969. Part 2. The use of structural steel in building – Metric units. British Standards Institution, London, UK

A.11 Relevance of BS 476.21:1987 data with respect to AS 1530.4:2014

The fire resistance test TE 93878 was conducted in accordance with BS 476.21:1987, which differs from AS 1530.4:2014. It is noted that BS 476.21:1987[9]frequently references the requirements of BS 476.20:1987[10]. Both BS standards will be referenced in the discussion below.

The differences in test methods considered capable of significantly altering specimen performance are discussed below.

Furnace regime

The furnace temperature regime for fire resistance tests conducted in accordance with AS 1530.4:2014 follows a similar trend to BS 476.20:1987.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and BS 476.20:1987 are not appreciably different.

Furnace thermocouples

For furnace thermocouples specified in AS 1530.4:2014 are Type K, mineral insulated metal sheathed (MIMS), with a stainless-steel sheath having a wire diameter of less than 1 mm and an overall diameter of 3 mm. The measuring junction protrudes at least 25 mm from the supporting heat resistant tube.

The furnace thermocouple types in BS 476.20:1987 shall be one of the following two types:

- Bare nickel chromium/nickel aluminium wires – 0.75 mm to 1.5 mm in diameter – welded or crimped together at their ends and supported and insulated from each other in a twin bore porcelain insulator. However, for 25 mm approximately from the weld/crimp, the wires shall be exposed and separated from each other by at least 5 mm (to be replaced or recalibrated after six hours of usage).
- Nickel chromium/nickel aluminium wire contained within mineral insulation in a heat resisting steel sheath of diameter 1.5 mm; the hot junctions being electrically insulated from the sheath. The thermocouple hot junction shall project 25 mm from a porcelain insulator. The assembly shall have a response time on cooling in air not greater than 30 seconds.

The relative distance of the furnace thermocouples from the exposed face of the specimen – for both AS 1530.4:2014 and BS 476.20:1987 – is 100 mm + 10 mm.

Furnace pressure

It is a requirement of AS 1530.4:2014 that for vertical elements, a furnace gauge pressure of zero (0) Pa is established at a height of 500 mm above the notional floor level. For horizontal elements a furnace pressure of 20 Pa is established at 100 mm below the underside of the concrete slab.

For BS 476.20:1987 – for vertical elements – the neutral axis is maintained at a height of 1000 mm. For horizontal elements, the pressure is 20 Pa at a point 100 mm below the soffit of the floor assembly.

Therefore, based on an average pressure gradient of 8.5 Pa/m at a particular height above the notional floor level, AS 1530.4:2014 requires the pressure to be approximately 4 Pa higher than BS 476.20:1987 for vertical elements.

Performance criteria

AS 1530.4:2014 specifies the following performance criteria for building materials and structures:

- structural adequacy.

[9] British Standards, 1987, Fire tests on building materials and structures – Part 21: Methods for determination of the fire resistance of loadbearing elements of construction, BS 472.21:1987, British Standards Institution, London, UK.

[10] British Standards, 1987, Fire tests on building materials and structures – Part 20: Method for determination of the fire resistance of elements of construction (general principles), BS 472.20:1987, British Standards Institution, London, UK.

- Integrity (not relevant to the referenced test).
- Insulation (not relevant to the referenced test).

Structural adequacy

The performance criteria regarding the rate of deflection in AS 1530.4:2014 and BS 476.21:1987 are not appreciably different.

In AS 1530.4:2014, failure is deemed to have occurred if the deflection exceeds $L^2/400d$ mm. d represents the distance from the top of the structural section to the bottom of the design tension zone and L is the clear span if the specimen. In BS 476.21:1987, the failure criteria for deflection is $L/20$ mm, which does not consider the impact of the section of the tested specimen.

Based on the test data in TE 93878, the specimen is deemed to fail marginally earlier in accordance with AS 1530.4:2014.

Application of referenced test data to AS 1530.4:2014

The variations in furnace heating regimes, furnace thermocouples, and the responses of the different thermocouple types to the furnace conditions are not expected to have an overall significant effect on the outcome of the referenced fire resistance test.

Based on the above and in the absence of any foreseeable detrimental effects, it is considered that the results of the referenced test can otherwise be used to assess the structural adequacy performance in accordance with AS 1530.4:2014.

A.12 Relevance of AS 1530.4:2005 test data with respect to AS 1530.4:2014

The fire resistance tests BWA 2286900.5, EWFA 2848300.2, EWFA 2736002.1, EWFA 2798800.1, 2736000, EWFA 2741700 and EWFA 29942200.1 were conducted in accordance with AS 1530.4:2005 and the test FR 3754 was conducted in accordance with AS 1530.4:1997, which differs from AS 1530.4:2014. The effect these differences have on the fire resistance performance of the referenced test specimens is discussed below.

Furnace temperature regime

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4:2014 follows a similar trend to that in AS 1530.4:1997/2005.

AS 1530.4:1997 specifies furnace temperature to follow the following trend:

$$T_{AS1530.4-1997} = 345log_{10}(8t+1) + T_{0,} 10°C \leq T_0 \geq 40°C$$

The specified specimen heating rate in AS 1530.4:2005 is given by:

$$T_t - T_0 = 345 \log(8t+1) + 20$$

Where:

Tt = furnace temperature at time t, in degrees Celsius.

T_0 = initial furnace temperature, in degrees Celsius.

t = the time into the test, measured in minutes from the ignition of the furnace.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and AS 1530.4:1997/2005 are not appreciably different.

Furnace pressure

It is a requirement of AS 1530.4:2014 that for vertical elements, a furnace gauge pressure of zero (0) Pa is established at a height of 500 mm above the notional floor level.

The furnace pressure conditions in AS 1530.4:1997/2005 and AS 1530.4:2014 are not appreciably different.

The parameters outlining the accuracy of control of the furnace pressure in AS 1530.4:2014 and AS 1530.4:1997/2005 are not appreciably different.

Specimen temperature measurement

AS 1530.4:2005/2014 specifies specimen thermocouples as Type K, MIMS thermocouples with a stainless-steel sheaf, having a wire diameter not exceeding 0.5 mm and an overall diameter of 3 mm. The thermocouples shall be supported by a heat-resisting tube with the measuring junction protruding a minimum 25 mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12 mm diameter × 0.2 mm thick copper disc. The disc shall be covered by 30 $\pm$ 0.5 mm ×30 $\pm$ 0.5mm × 2.0 $\pm$ 0.5 mm thick inorganic insulating pad with a density of 900 ± 100kg/m³.

AS 1530.4:1997 specifies specimen thermocouples as Type K, MIMS thermocouples with a stainless-steel sheaf, having a wire diameter not exceeding 0.5 mm and an overall diameter of 3mm. The thermocouples shall be supported by a heat-resisting tube with the measuring junction protruding a minimum 25mm. Each thermocouple shall have the tail of its measuring junction soldered to the centre of a 12mm diameter × 0.2mm thick copper disc. The disc shall be covered by an oven-dry pad, no less than 30 mm square, made from material of a value √(kρc) not greater than 600 at 150°C, and of such thickness as to give a thermal resistance (R = t/K) of 0.015 K/W – 0.025 K/W at 150°C.

Based on the above discussion, it is considered that the insulation performance of specimens tested in the above mentioned tests can be used to assess the performance in accordance with AS 1530.4:2014.

Performance criteria

AS 1530.4:2014 specifies the following performance criteria for building materials and structures:

- structural adequacy
- integrity.
- insulation.

Structural adequacy

The failure criteria for structural adequacy in AS 1530.4:2014 and AS 1530.4:1997/2005 are not appreciably different.

Integrity

AS 1530.4:2014 stipulates, in addition to the 20 mm thick × 100 mm × 100 mm cotton pads, additional cotton pads shall be provided with a reduced 30 mm × 30 mm × 20 mm with additional wire frame holder and shall be used to determine integrity failure.

AS 1530.4:1997 deems integrity failure to occur upon collapse, the development of cracks, fissures, or other openings through which flames or hot gases can pass.

Apart from the above variation, the failure criteria for integrity in AS 1530.4:2014 and AS 1530.4:1997/2005 are not appreciably different.

Insulation

The positions of thermocouples and failure criteria for insulation in AS 1530.4:2014 and AS 1530.4:1997/2005 are not appreciably different.

Application of test data to AS 1530.4:2014

The minor variations in furnace heating regimes and specimen thermocouple specifications are not considered likely to significantly affect the behaviour of the specimens relevant to this assessment.

Based on the above, it is considered that the integrity and insulation behaviour of the specimens in the above mentioned tests can be used to assess the likely performance if the specimen was tested in accordance with AS 1530.4:2014.

warringtonfire
Proud to be part of element

Warringtonfire Australia Pty Ltd
ABN 81 050 241 524

Perth

Unit 22, 22 Railway Road
Subiaco WA 6008
Australia
T: +61 8 9382 3844

Canberra

Unit 10, 71 Leichhardt Street
Kingston ACT 2604
Australia
T: +61 2 6260 8488

Melbourne

Level 9, 401 Collins Street
Melbourne VIC 3000
Australia
T: +61 3 9767 1000

Sydney

Suite 802, Level 8, 383 Kent Street
Sydney NSW 2000
Australia
T: +61 2 9211 4333

Brisbane

Suite 6, Level 12, 133 Mary Street
Brisbane QLD 4000
Australia
T: +61 7 3238 1700

Melbourne – NATA registered laboratory

Unit 2, 409-411 Hammond Road
Dandenong South VIC 3175
Australia
T: +61 3 9767 1000