warringtonfire
Proud to be part of element

Reaction to fire test report

Test standard: BS 8414-2:2015 and AS5113:2016

Test sponsor: Composite Systems (Aust) Pty Ltd T/A Composite Global Solution

Product: 300 mm Thermomass System NC

Job number: RTF200396

Test date: 19 April 2021 Revision: R1.0

Warringtonfire: accredited for compliance with ISO/IEC 17025 – Testing

ilac-MRA NATA Accreditation No. 3277

Quality management

Revision	Date	Information about the report			
R1.0	31 May 2021	Description	Initial issue.		
			Prepared by	Reviewed by	Authorised by
		Name	Muntaqim Pereira	Tanmay Bhat	Anthony Rosamilia
		Signature			

Executive summary

This report documents the findings of the reaction to fire test for a non-loadbearing external wall system performed on 19 April 2021 in accordance with BS 8414-2:2015+A1:2017 and AS5113:2016+A1:2018.

Warringtonfire performed the test at the request of Composite Systems (Aust) Pty Ltd T/A Composite Global Solution.

Table 4 provides details of the test assembly, and Table 1 provides a summary of the test specimen. A summary of the results is provided in Table 2.

Table 1 Test specimen

Item	Detail
Test specimen	The test specimen, THERMOMASS precast sandwich panel, consists of 75 mm extruded polystyrene (XPS) insulation sandwiched between two layers of precast concrete 75 mm and 150 mm in thickness creating an insulated sandwich precast panel. The THERMOMASS precast sandwich panel is tied together by non-conductive composite fibre connectors, with the anchored ends embedded into the two concrete layers.

Table 2 Test results

Parameter	Results
t_s, start time	6 minutes 05 seconds after ignition of crib
Peak temperature/time at Level 2, 50 mm external	523 °C at 13 minutes 40 seconds after t_s
Peak temperature/time at Level 2, 75 mm concrete layer	49 °C at 41 minutes 30 seconds after t_s
Peak temperature/time at Level 2, 75 mm insulation layer	26 °C at 55 minutes 00 seconds after t_s
Peak temperature/time at Level 2, 150 mm concrete layer	18 °C at 48 minutes 40 seconds after t_s
Peak temperature/time at Level 1, 50 mm external	895 °C at 14 minutes 05 seconds after t_s
Peak temperature/time at 900 mm above lintel	19 °C at 49 minutes 35 seconds after t_s
Flaming on the unexposed side	There was no flaming on the unexposed side of the specimen.
Openings to the unexposed side	No openings to the unexposed side of the specimen were created.
Flame spread	There was flame spread beyond the minimum confines of the specimen located at the main wall of the specimen.[1]
Flaming debris	There was no flaming debris during the period of the test.
Mass of measured debris	1.47 kg
Commentary [1]The XPS insulation melted/retracted beyond the minimum confines of the specimen, defined in AS 5113 as 2400 mm for the main wall. As no flaming was observed, it is a possibility that the radiant heat from the heat source caused the melting/retracting to occur. Only the side insulation next to the heat source experienced melting/retraction, while the insulation above the heat source did not experience any melting/retraction.	

Contents

1. Introduction

This report documents the findings of the reaction to fire test for a non-loadbearing external wall system performed on 19 April 2021 in accordance with BS 8414-2:2015+A1:2017 and AS5113:2016+A1:2018.

Warringtonfire performed the test at the request of the test sponsor listed in Table 3.

Table 3 Test sponsor details

Test sponsor	Address
Composite Systems (Aust) Pty Ltd T/A Composite Global Solution	6a Monomeath Avenue Toorak VIC 3142 Australia

2. Test specimen

As stated by the test sponsor, for the main wall, a panel width of 3100 mm was selected to reflect commercial best practice precast design criteria. A minimal specimen width of 2400 mm with a 2000 mm furnace opening leaves 200 mm for each supporting leg (jambs). This is not structurally sound and against recommended best practice design guidelines.

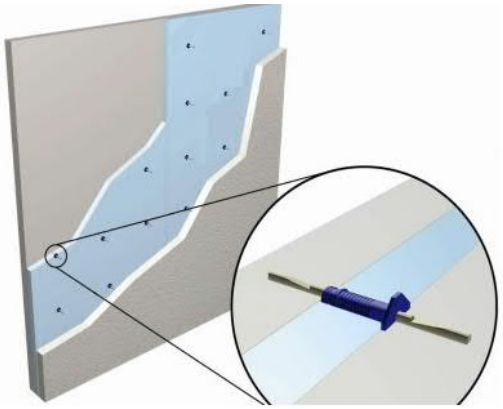
2.1 Schedule of components

Table 4 describes the test specimen and lists the schedule of components. These were provided by the test sponsor and surveyed by Warringtonfire.

All measurements were done by Warringtonfire – unless indicated otherwise.

Detailed drawings of the test specimen are provided in Appendix A.

Table 4 Schedule of components

Item	Description	
Cladding		
1.	Product name	300 mm thick Thermomass System NC
	Material	The front and the back concrete layer were made using 40 MPa concrete mix, while the insulation is made using extruded polystyrene (XPS). The XPS was held in place using Thermomass Composite Fibre Connector. The 75 mm front concrete face had SL62 steel reo mesh embedded in it, while the 150 mm back concrete face had RL718 steel reo mesh embedded in it. A layer of 75 mm x 100 mm x 2000 mm rock wool was inserted in place of the insulation layer at the top lintel of the combustion chamber opening.  **Figure 1 Composite fibre connector detail**
	Thickness	Front concrete face – 75 mm Extruded polystyrene – 75 mm Back concrete face – 150 mm

Item	Description	
	Nominated mass measurements	Extruded polystyrene density – 32 kg/m³ Assembly mass per unit area – 394 kg/m² Rock wool density – 120 kg/m²
Join treatment		
2.	Item name	Fire rated acrylic sealant
	Specific gravity	1.53 (nominated)
3.	Item name	Backing rod (square) – polyurethane foam
	Dimension	20 mm x 30 mm
	Density	25 kg/m³ (uncompressed)
Fixings		
4.	Item name	Bracing bolt – galvanised steel
	Dimension	Ø20 mm (shell)/ Ø 14 mm (rod) x 115 mm with a threaded length of 50 mm and a 3 mm thick washer with OD of 40 mm and ID of 15 mm.
Steel substrate		
5.	Item name	Steel substrate
	Size	The steel substrate was 9300 mm high × 3245 mm wide for the main wall and 9300 mm high × 2000 mm wide for the wing wall
	Description	The substrate consisted of structural steel sections and square hollow sections (SHS). Slotted plates were also welded onto the structure to support the erected specimen.
Installation method		
The assembly were prefabricated off-site and left to cure from December till the test date and delivered to the testing facility for erection. The assembly was divided into 5 sections (item 1), each having dimensions as per drawings in Appendix A. The sections (item 1) were lifted into place and secured to the steel substrate (item 5) using bracing bolts (item 4). Where the section of the main wall and the wing wall met, a 20 mm gap was left between the main wall and the wing wall. All the section-to-section joins were caulked using sealant (item 2) upon backing rods (item 3). The sealant was applied to a depth up to 10 mm, where possible. The sealant was left to cure for 5 days.		

2.2 Installation details

Table 5 lists the installation details for the test specimen.

Table 5 Installation details

Item	Detail
Date of cement pours	16 and 18 December 2020
Date of specimen delivery to Warringtonfire	14 April 2021
Completion date for construction of the test specimen	14 April 2021
External wall system constructed by	Representatives of the test sponsor
Symmetry	The specimen cross section is not symmetrical. It is made up of 150 mm precast concrete (internal side), 75 mm XPS insulation and 75 mm precast concrete (external side). The assembly was erected with the external side facing the outside of the building, as intended use.

3. Test procedure

Table 6 details the test procedure for this reaction to fire test.

Table 6 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of BS 8414-2:2015+A1:2017 and AS5113:2016+A1:2018 for a non-loadbearing external cladding system fixed to and supported by a structural steel frame	
Variations	The ignition source of the test was constructed from Pinus Radiata instead of Pinus Silvestris, which is a variation to BS 8414-2:2015. It however complies to Section 4.2 of AS 5113:2016.	
Environmental conditions at the start of the test	Start of the test	20 °C
	Wind speed	0 - 0.8 m/s
Ignition source	Crib material	Softwood (radiata pine)
	Moisture content	12.3 %
	Density	512 kg/m^3
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for the reaction to fire test. The results obtained during the test only apply to the test samples as received and tested by Warringtonfire.	
Test duration	60 minutes	
Instrumentation and equipment	The instrumentation was provided in accordance with BS 8414-2:2015 as follows: • All exposed and cavity temperatures were measured by mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5 mm with the measuring junction insulated from the sheath. • The unexposed side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5 mm soldered to 12 mm diameter × 0.2 mm thick copper discs covered by 30 mm × 30 mm × 2.0 mm thick inorganic insulating pads. • The thermocouple positions are shown in Figure 17**Figure 18** in Appendix C. • The wind speed was measured by a Testo 425 anemometer at Level 2, 1000 mm forward from the centre line of the combustion chamber. • Timber crib moisture was measured by a Delmhorst J2000 moisture meter.	

4. Test measurements and results

Table 7 shows the peak temperatures the test specimen achieved as listed in BS 8414-2:2015.

The temperature measurements for the test specimen are included in Appendix C.

Table 8 in Appendix B includes observations of any significant behaviour of the specimen and details the occurrence of the various performance criteria specified in BS 8414-2:2015+A1:2017.

Photographs of the specimen are included in Appendix D.

Table 7 Test results

Parameter	Results
t_s, start time	6 minutes 05 seconds after ignition of crib
Peak temperature/time at Level 2, 50 mm external	523 °C at 13 minutes 40 seconds after t_s
Peak temperature/time at Level 2, 75 mm concrete layer	49 °C at 41 minutes 30 seconds after t_s
Peak temperature/time at Level 2, 75 mm insulation layer	26 °C at 55 minutes 00 seconds after t_s
Peak temperature/time at Level 2, 150 mm concrete layer	18 °C at 48 minutes 40 seconds after t_s
Peak temperature/time at Level 1, 50 mm external	895 °C at 14 minutes 05 seconds after t_s
Peak temperature/time at 900 mm above lintel	19 °C at 49 minutes 35 seconds after t_s
Flaming on the unexposed side	There was no flaming on the unexposed side of the specimen.
Openings to the unexposed side	No openings to the unexposed side of the specimen were created.
Flame spread	There was flame spread beyond the minimum confines of the specimen located at the main wall of the specimen.[1]
Flaming debris	There was no flaming debris during the period of the test.
Mass of measured debris	1.47 kg
Commentary [1]The XPS insulation melted/retracted beyond the minimum confines of the specimen, defined in AS 5113 as 2400 mm for the main wall. As no flaming was observed, it is a possibility that the radiant heat from the heat source caused the melting/retracting to occur. Only the side insulation next to the heat source experienced melting/retraction, while the insulation above the heat source did not experience any melting/retraction.	

5. Application of test results

5.1 Test limitations

The results of these fire tests 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 fire conditions.

These results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, and they do not necessarily reflect the actual behaviour in fires.

5.2 Variations from the tested specimen

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described here was tested following the procedure outlined in BS 8414-2:2015+A1:2017.

Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions, other than that allowed under the field of direct application in the relevant test method, is not covered by this report.

5.3 Uncertainty of measurements

Because of the nature of reaction to fire testing and the consequent difficulty in quantifying the uncertainty of measurements obtained from a reaction to fire test, it is not possible to provide a stated degree of accuracy of result.

Appendix A Drawings of test assembly

The drawings of the test assembly below were provided by the test sponsor. All measurements – unless indicated – are in millimetres.

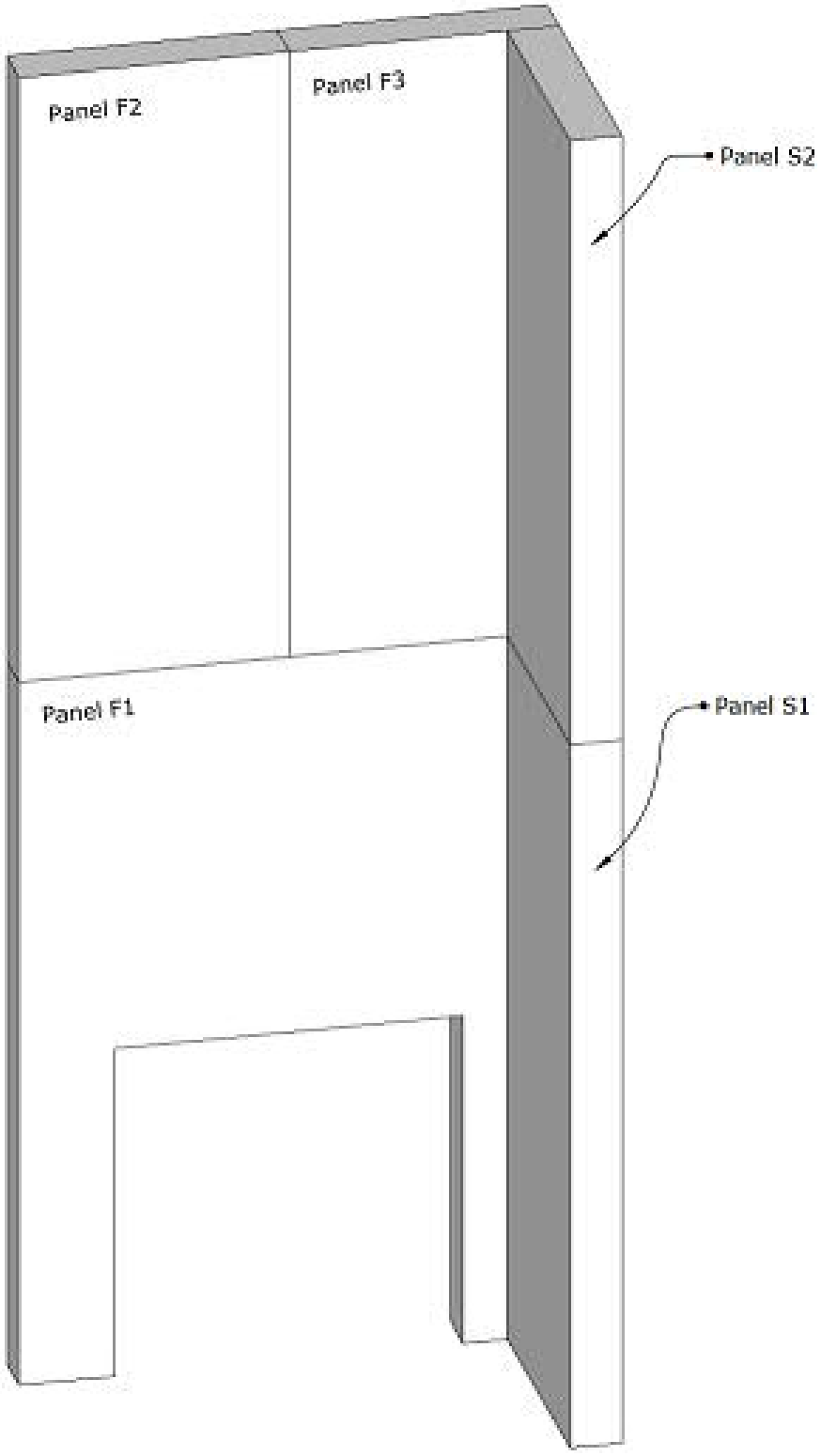


Figure 2 Panel layout

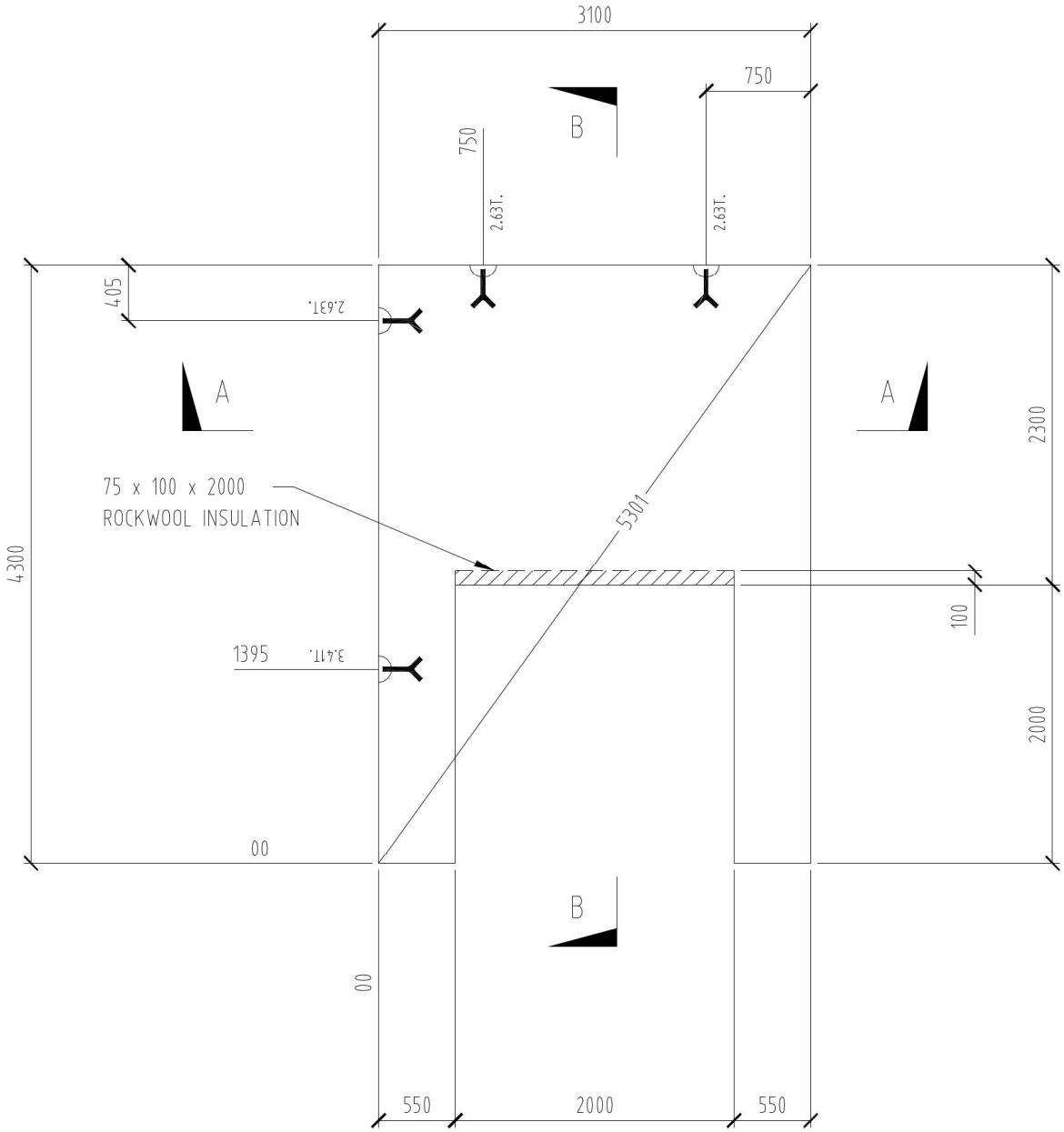


Figure 3 F1 – panel dimensions

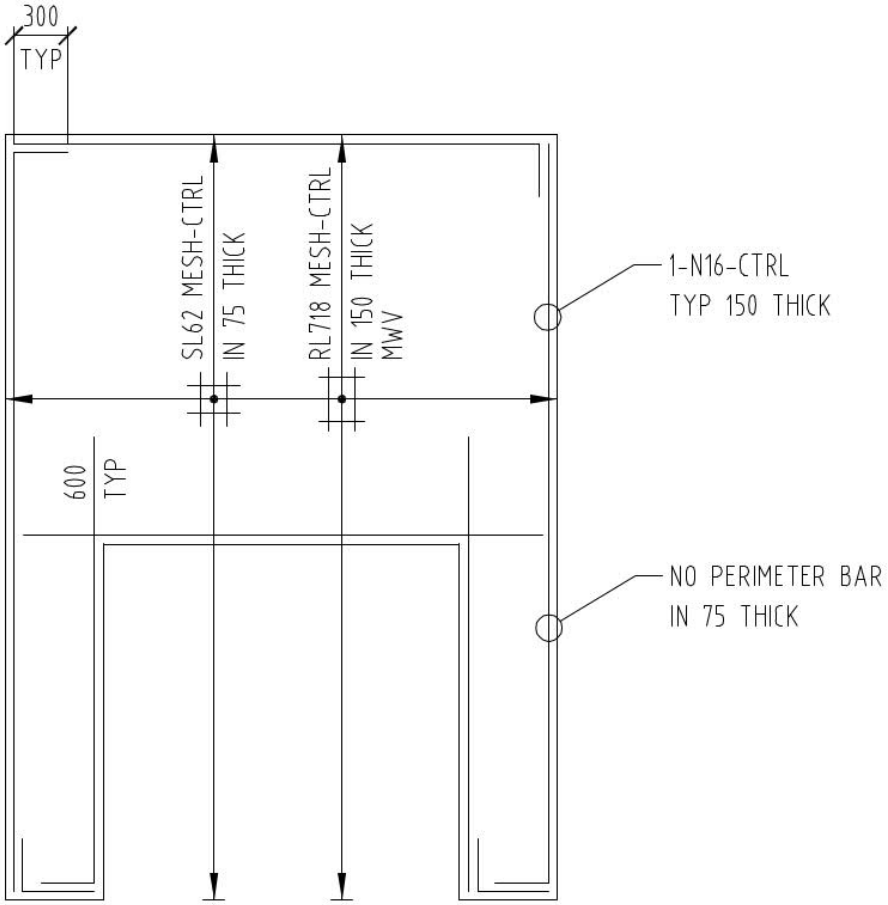


Figure 4 F1 – rebar locations

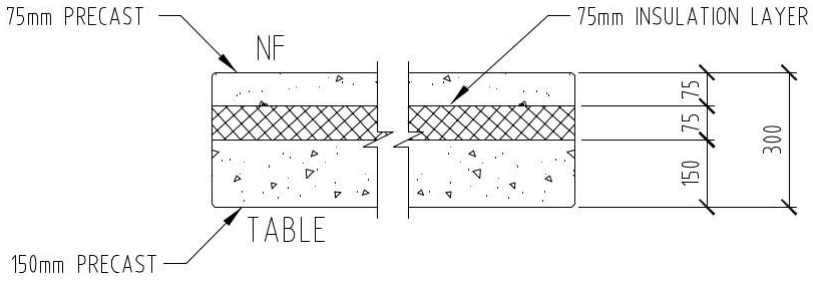


Figure 5 Cross-section A-A

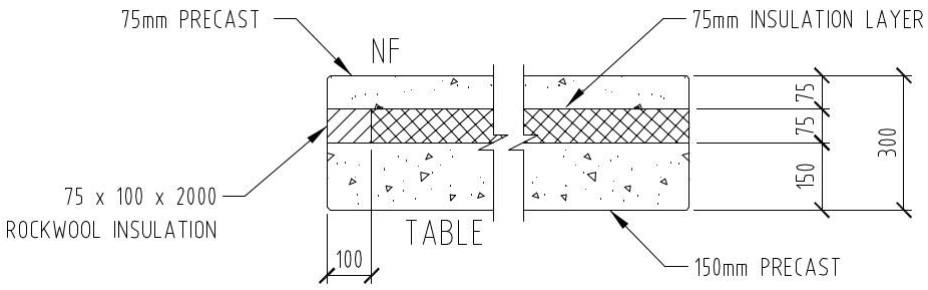


Figure 6 Cross-section B-B

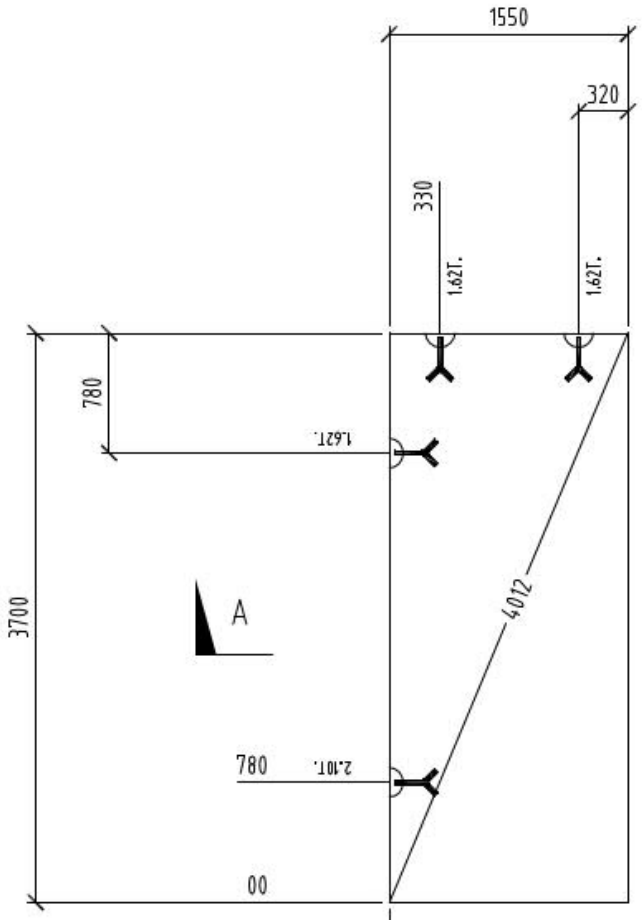


Figure 7 F2 – panel dimensions

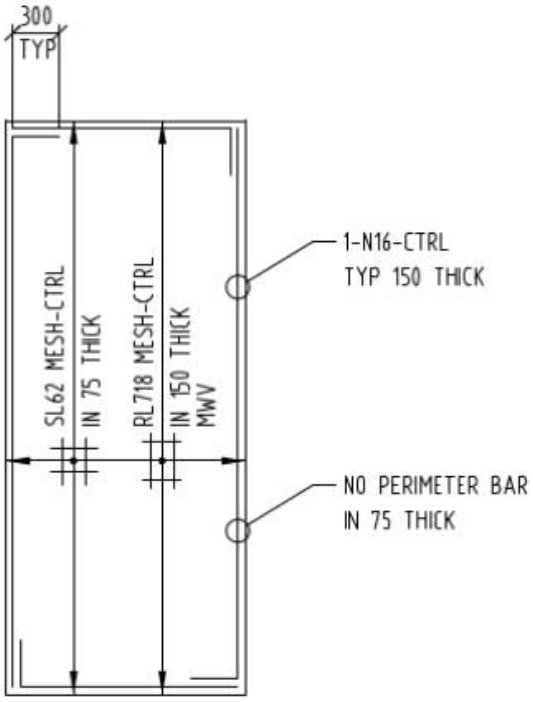


Figure 8 F2 – rebar locations

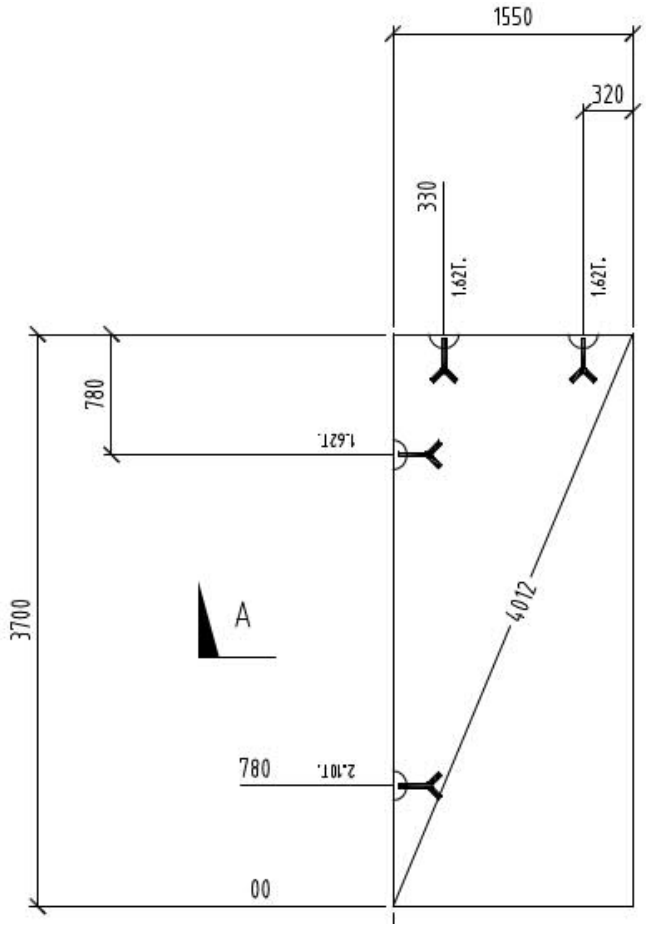


Figure 9 F3 – panel dimensions

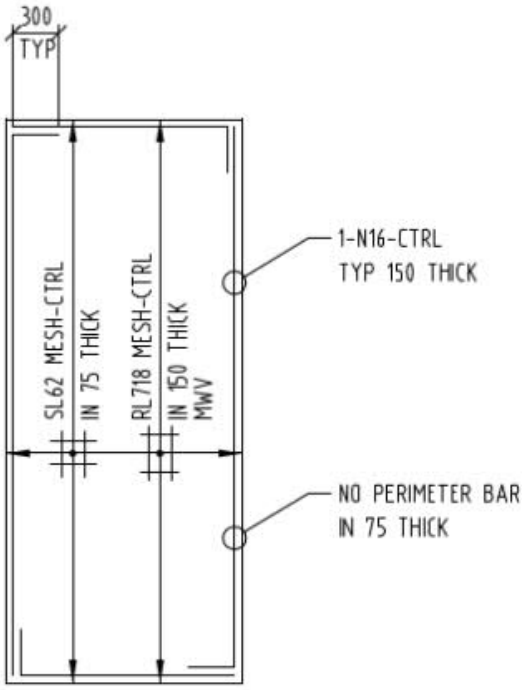


Figure 10 F3 – rebar locations

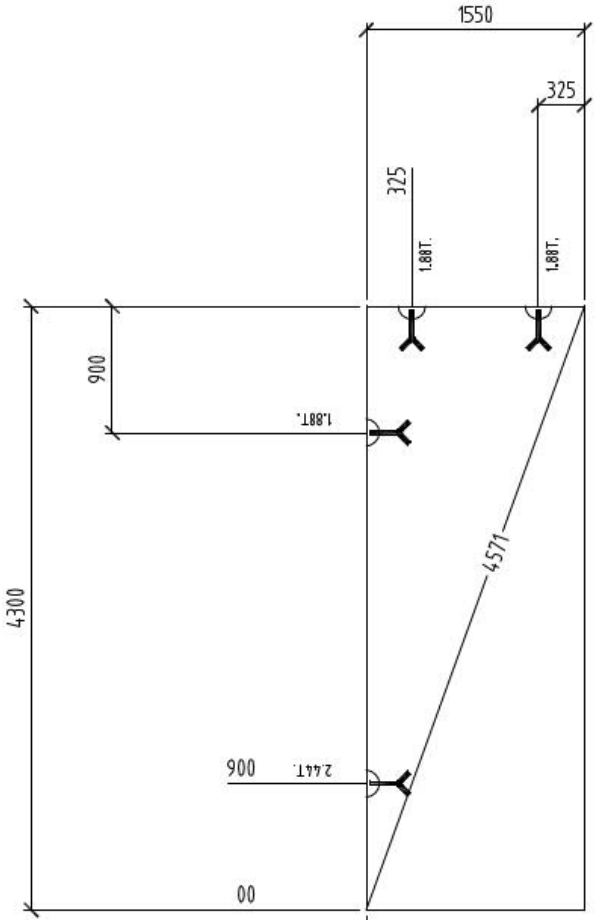


Figure 11 S1 – panel dimensions

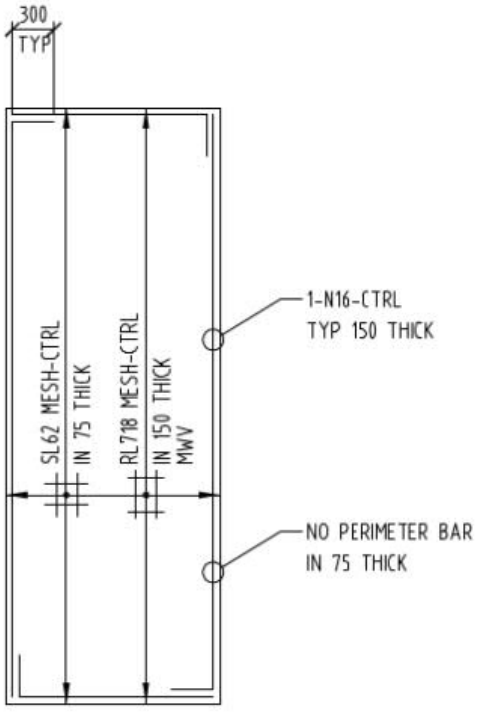


Figure 12 S1 – rebar locations

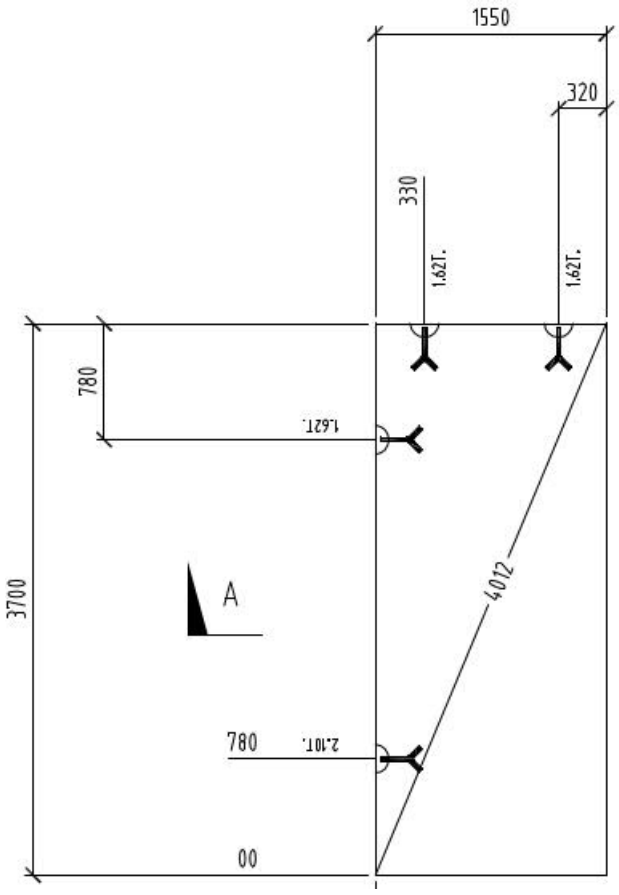


Figure 13 S2 – panel dimensions

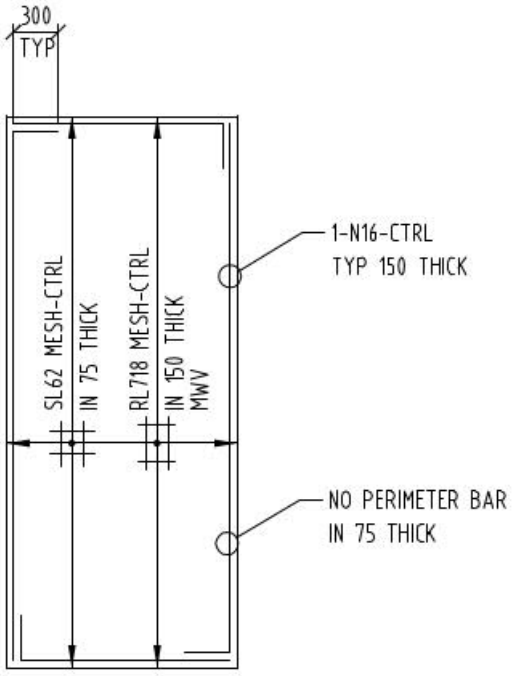


Figure 14 S2 – rebar locations

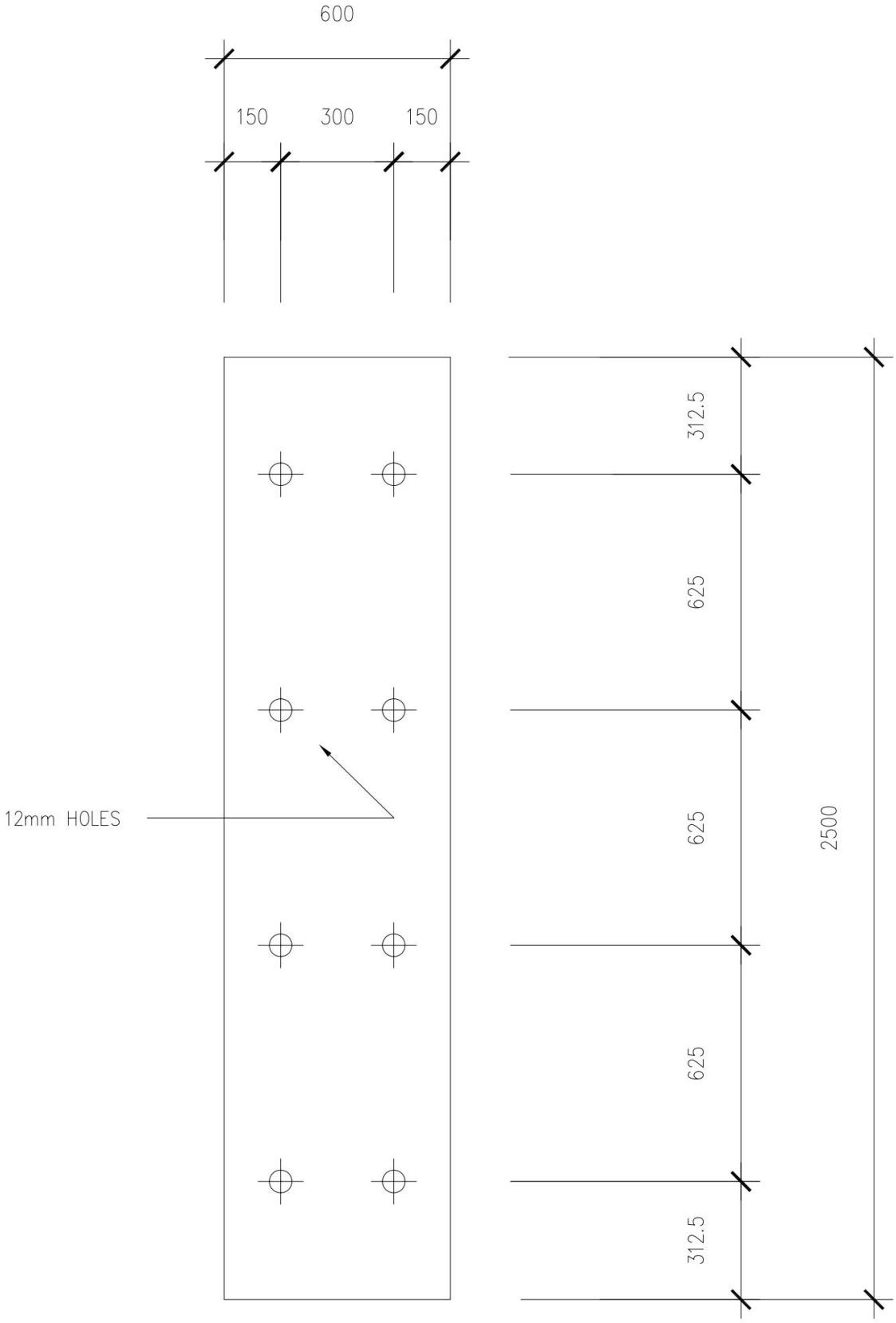


Figure 15 Insulation fixing locations

Appendix B Test observations

B.1 Visual observation

Table 8 shows the observations of any significant behaviour of the specimen during the test. Section designations can be referred to in Figure 16.

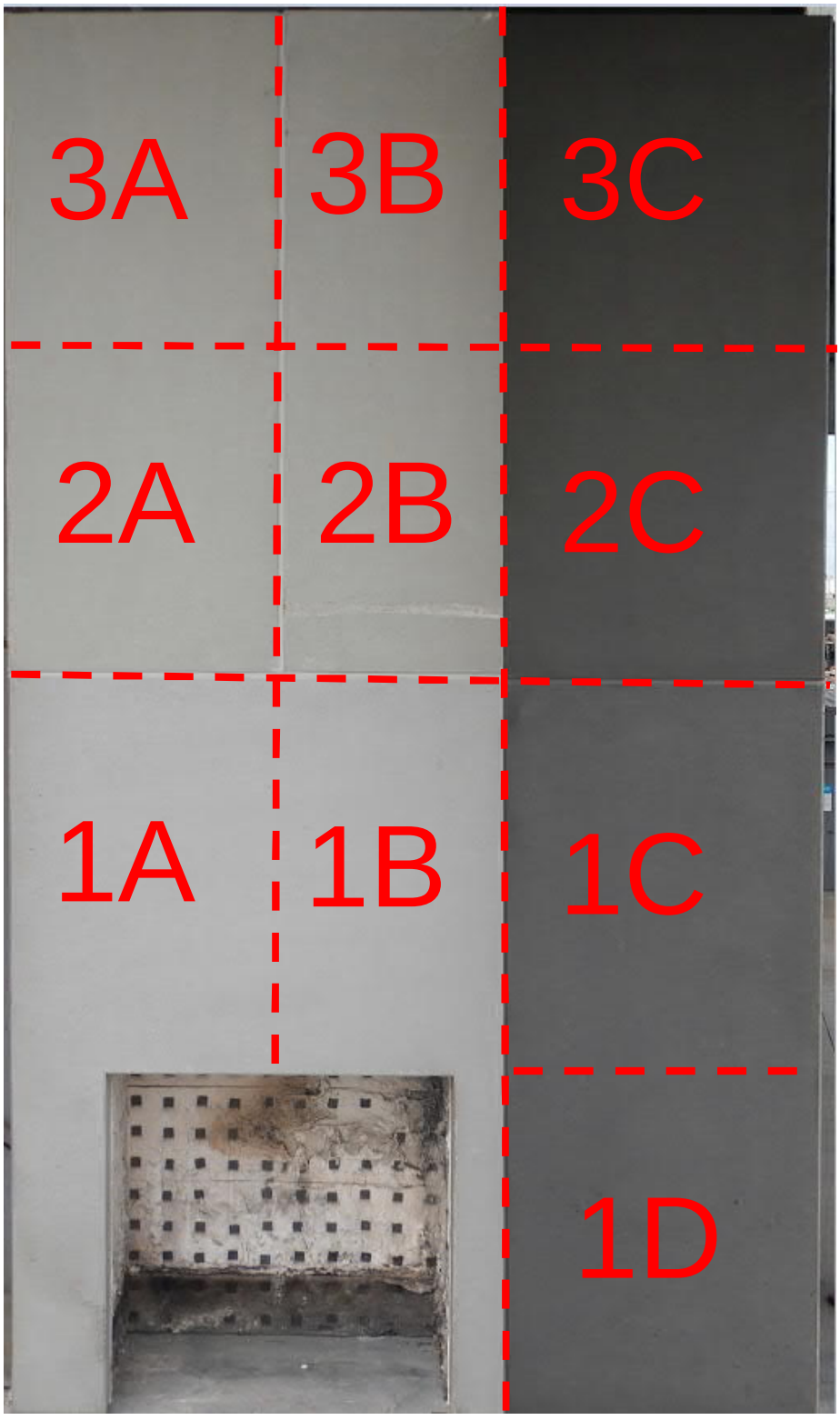


Figure 16 Observation – section designation

Table 8 Test observations

Time		Observation
Min	Sec	
0	00	The crib was lit, marking the start of the reaction to fire test.
0	35	The area above the combustion chamber, at the join between section 1A and 1B started to discolour.
4	51	The discolouration had spread upwards, towards the top of section 1A and 1B.
5	18	The lower part of section 2A and 2B started to discolour.
7	24	The face of section 1C and 2C started to discolour.
12	03	The thin layer of cement covering the XPS on the right jamb detached.
14	29	The thin layer of cement covering the XPS on the left jamb detached.
15	30	Part of the exposed XPS on the left jamb had melted/retracted, and continued melting/retracting from this point forward.
17	28	The face of sections 1A and 1B started to whiten.
18	58	The sealant applied at the join between section 2A, 2B, 1A and 1b started to intumesce.
21	35	More of the thin layer of cement covering the XPS on the right jamb detached, with the XPS behind it melting/retracting further.
22	35	Moisture/droplets started to drip from the top of the chamber opening.
30	00	The crib was removed, leaving behind some charred and glowing embers in the path of travel. The crib material was not included in the post test collected debris.
60	00	The reaction to fire test was ended. The vertical stone wool above the chamber opening was fully intact.

B.2 Post-test observations

External wall system

The affected area of the cladding system is described as follows;

- Approximately 6.5 m^2 of panels displayed face discolouration and sot marking from the flames,
- Approximately 1.2 m^2 of insulation had melted or retracted. The insulation behind the stone wool was still intact.

See Figure 37 for more details.

The approximate mass of collected debris that fell in front of the specimen was less than 2 kg.

Approximate total mass of debris fragments under 100 g was 741 g.

Approximate total mass of debris and number of fragments between 100 g and 200 g was 726g and 6.

Appendix C Test data

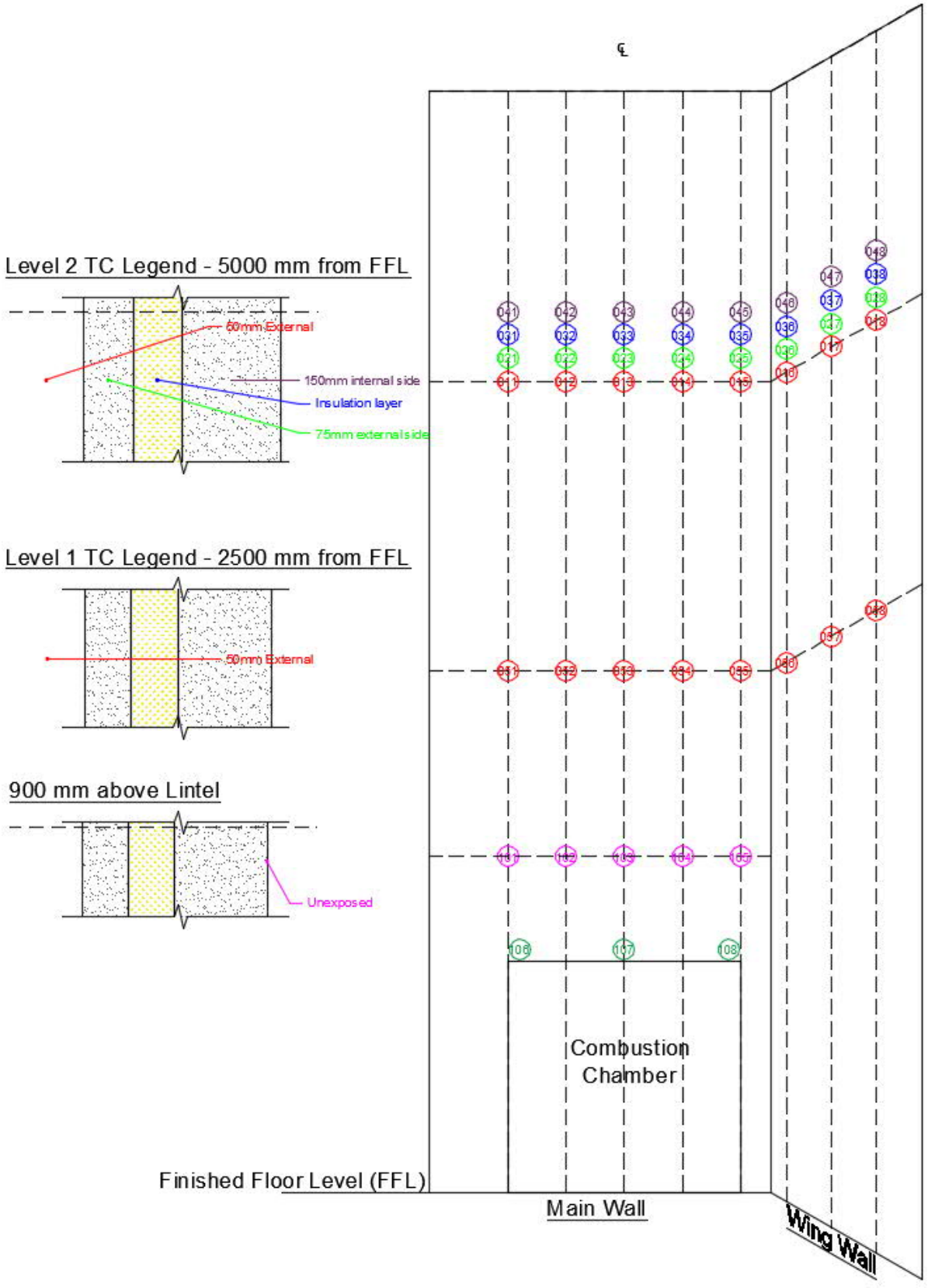


Figure 17 Thermocouple locations

C.1 Specimen temperatures

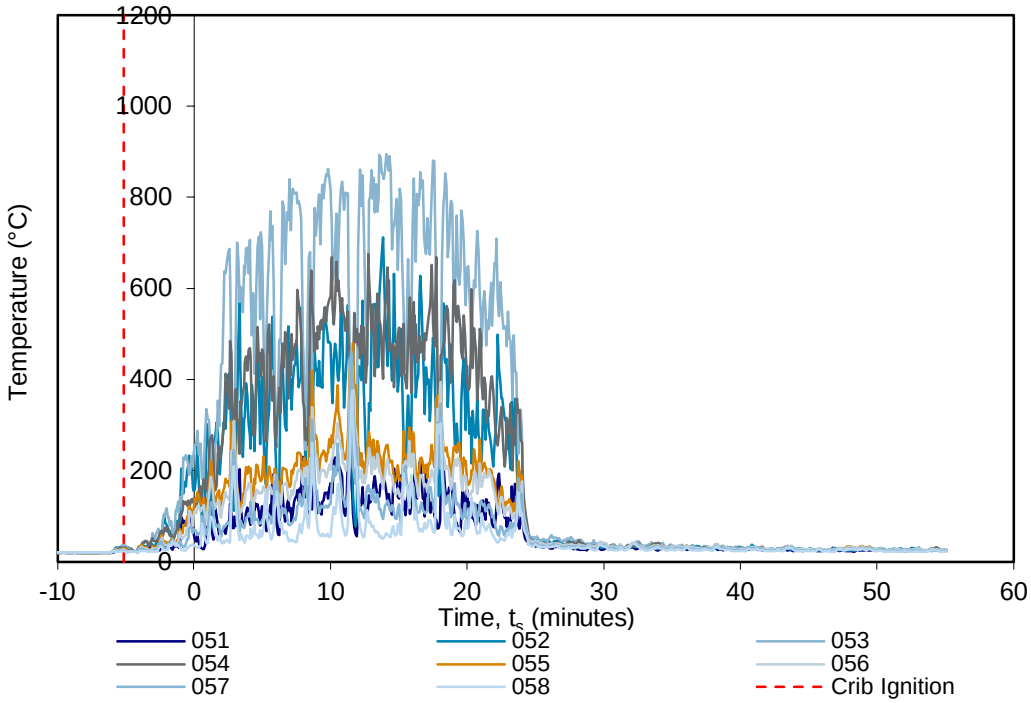


Figure 18 Level 1, external – temperature vs time

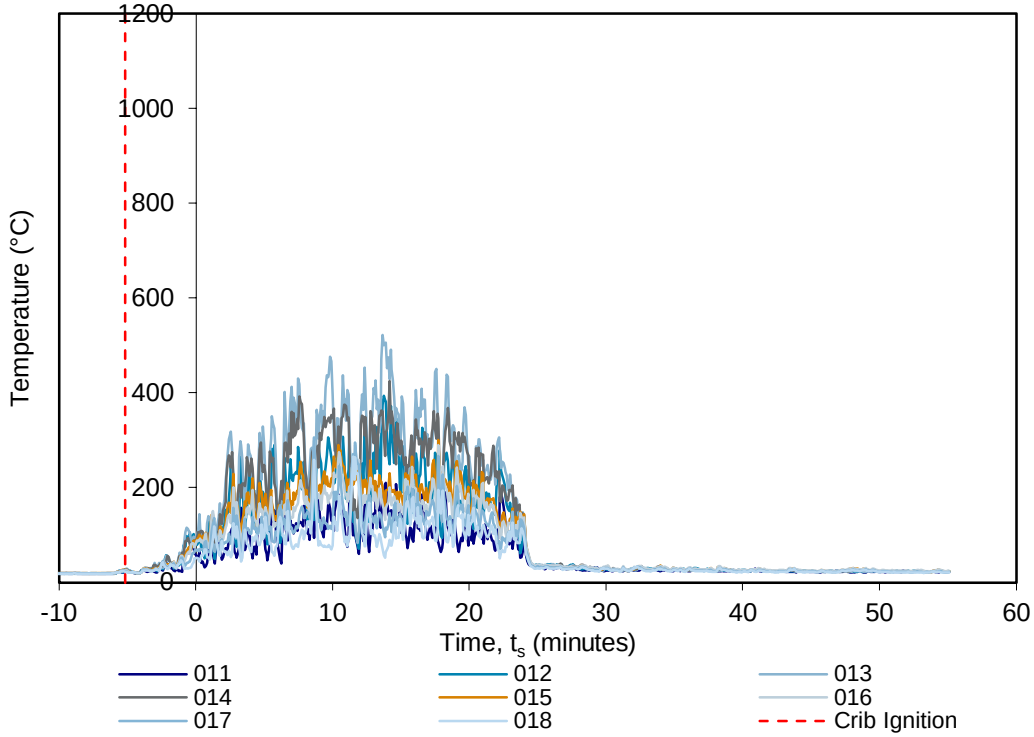


Figure 19 Level 2, external – temperature vs time

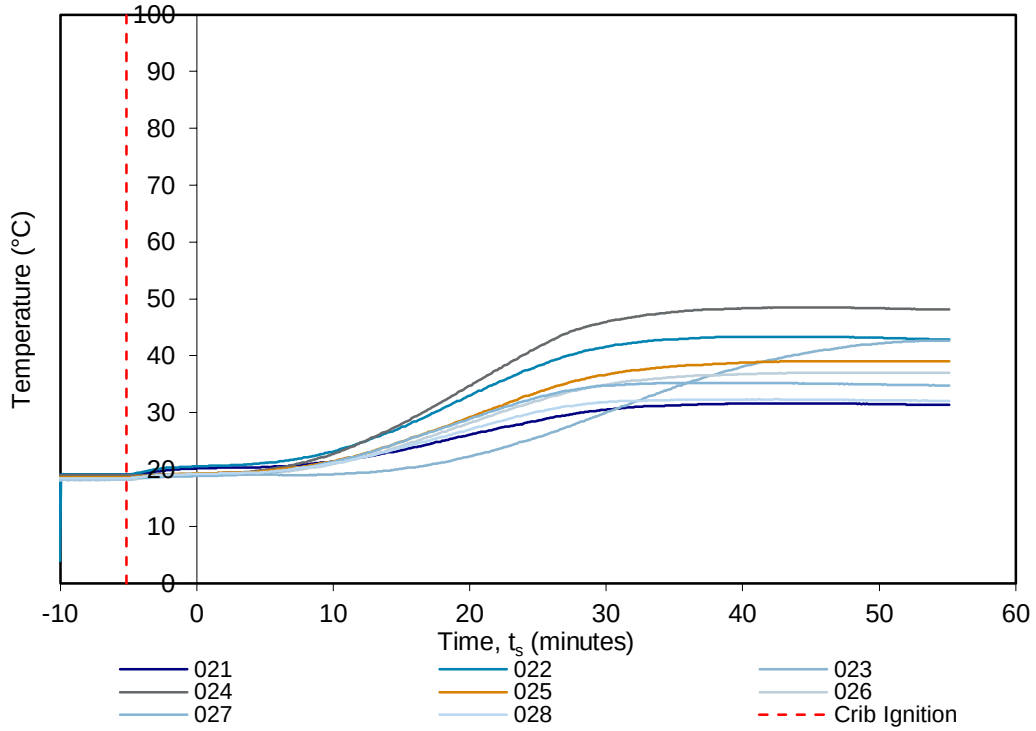


Figure 20 Level 2, 75 mm concrete layer – temperature vs time

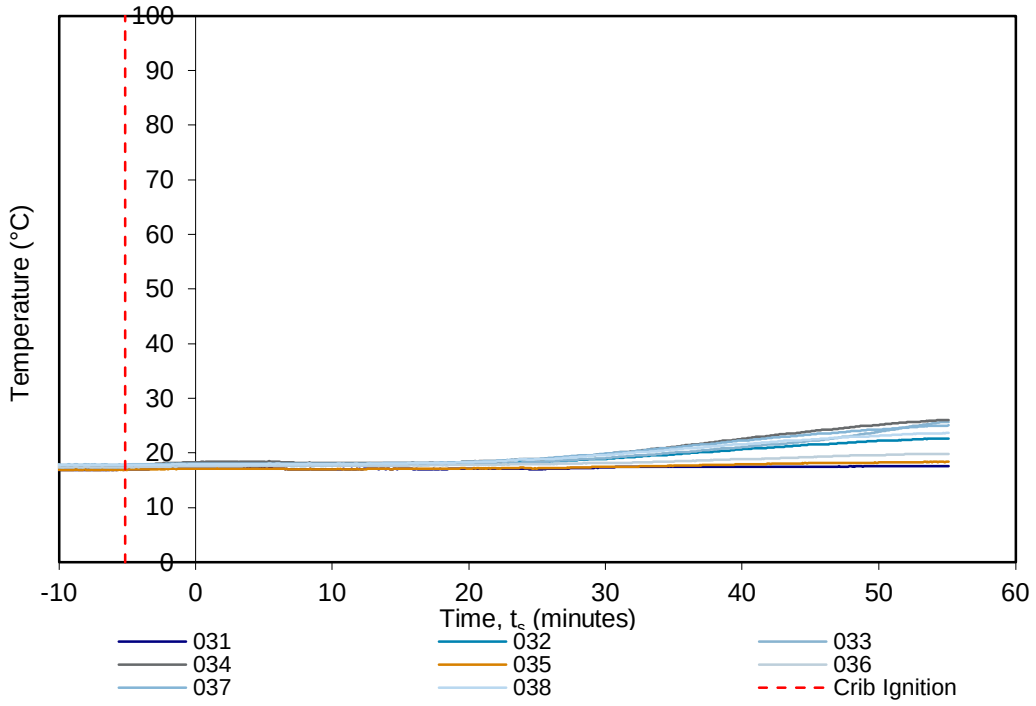


Figure 21 Level 2, 75 mm insulation layer – temperature vs time

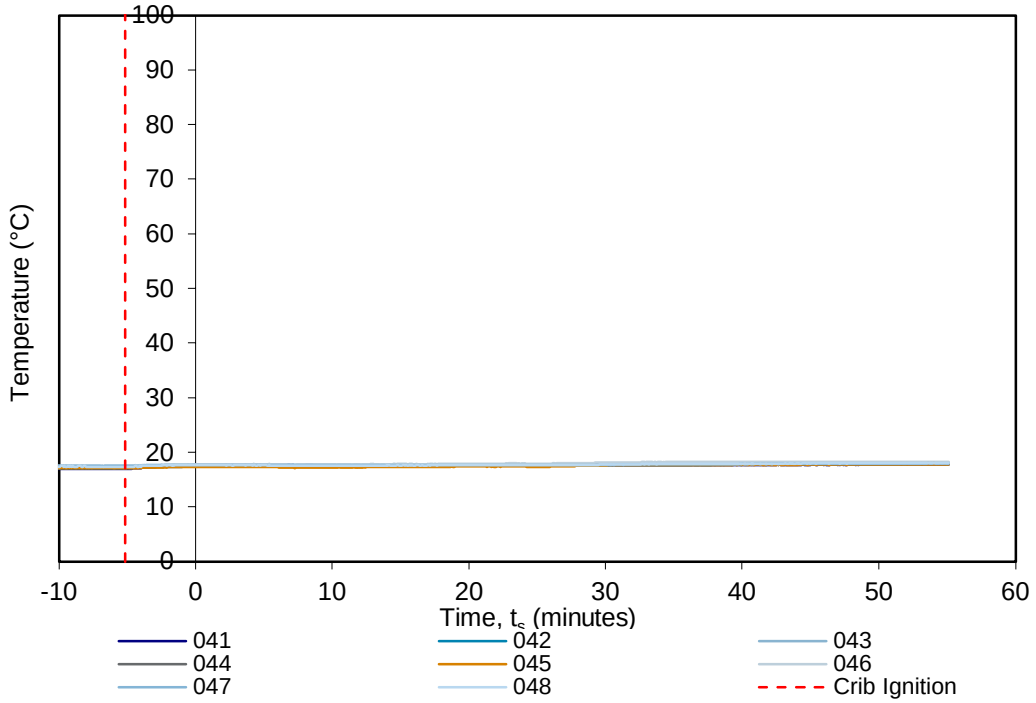


Figure 22 Level 2, 150 mm concrete layer – temperature vs time

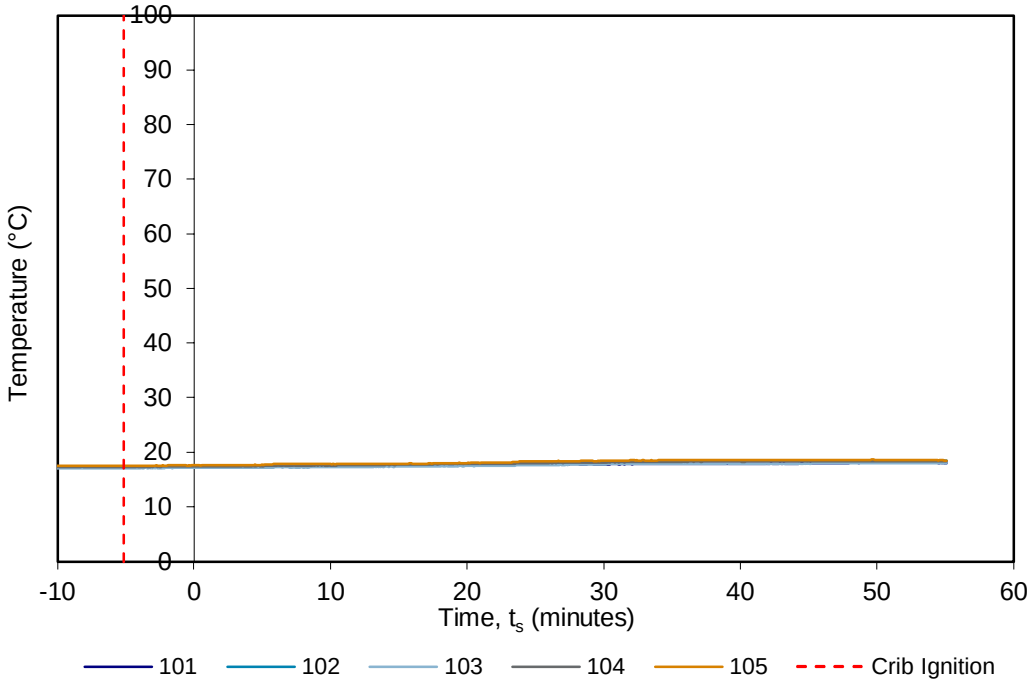


Figure 23 unexposed face 900 mm above chamber opening – temperature vs time

Appendix D Photographs

Figure 24 The external cladding system before the start of the test – main wall

Figure 25 The external cladding system before the start of the test – wing wall

Figure 26 The external wall system during the test – 17 seconds after crib ignition

Figure 27 The external wall system during the test – 5 minutes 17 seconds after crib ignition

Figure 28 The external wall system during the test – 10 minutes 17 seconds after crib ignition

Figure 29 The external wall system during the test – 15 minutes 16 seconds after crib ignition

Figure 30 **The external wall system during the test – 20 minutes 17 seconds after crib ignition**

Figure 31 The external wall system during the test – 25 minutes 17 seconds after crib ignition

Figure 32 The external wall system during the test –during removal of the crib, 30 minutes after ignition of crib[12]

[1] The charred and glowing embers in the photograph are part of the crib and was not included in the post-test debris measurement.
[2] Picture shows the portion of the right jamb that detached.

Figure 33 The external wall system on completion of the test – main wall

Figure 34 The external wall system on completion of the test – wing wall

Figure 35 Condition of insulation behind the stone wool layer above the opening, with the stone wool removed

Figure 36 Melted/retracted XPS insulation of the right jamb

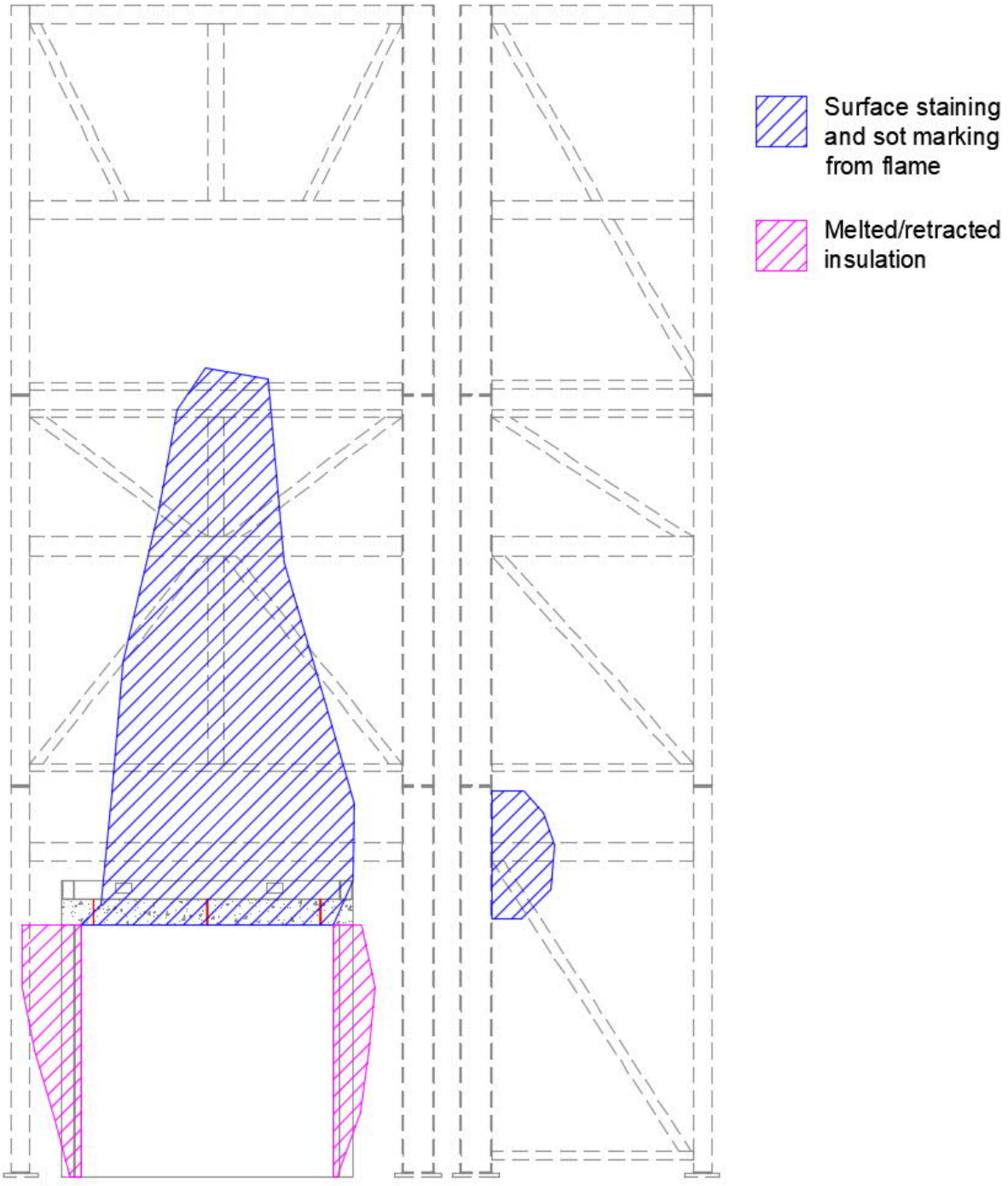


Figure 37 Mark up of the damaged area of the cladding system

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

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 accredited laboratory

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