Bushfire test on an external wall system

Test Report

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Clients: Delta Panels Pty Ltd

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Bushfire test on an external wall system
Sponsored Investigation No. FSZ 2373

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as a Delta Panels external panel wall system.

1.2 Sponsor

Delta Panels Pty Ltd
731 Boundary Road
Richlands, QLD 4077

1.3 Manufacturer(s)

Manufacturer(s)	Product(s)
Delta Panels Pty Ltd	DeltaCool thermosetting phenolic core (TPC) insulated panels
Bradnam's Windows and Doors	BAL29 single glazed window

1.4 Test standards

Australian Standard 1530, Methods for fire tests on building materials, components and structures;

Part 8.1-2018: Tests on elements of construction for buildings exposed to simulated bushfire attack – radiant heat and small flaming sources.

Clause 15: Specific Procedures for External Wall Systems.

1.5 Test number

CSIRO Reference test number FS 5267/4847

1.6 Test date

The bushfire test was conducted on 11 May 2023.

2 Description of specimen

2.1 General

The specimen comprised a nominal 3000-mm wide x 2650-mm high x 100-mm thick external panel wall system, mounted on top of a 350-mm high non-combustible sill.

Wall Panels

The external wall system comprised 100-mm thick DeltaCool insulated panels. The panels consisted of thermosetting phenolic core (TPC) with a stated density of 38-42 kg/m^3. The core was bonded on both sides to 0.6-mm thick roll formed steel skins using two-part polyurethane adhesive.

Wall construction

The wall specimen was constructed in accordance with the requirements stipulated in Section 15 of the AS1530.8.1-2018 test standard. The wall incorporated a rebate at the centre, with an internal and an external corner detail on each side of the rebate. The centre part of the wall included a window, with an eaves detail above it. The wall was constructed on top of a non-combustible sill with a representative wall to ground detail, as shown in drawings TPC-T001, sheets 1-4, dated 22 March 2023.

The wall corners were formed using 45-degree mitre joints, with the panels sealed with Soudal Firecryl FR sealant. The centre section of the wall included two panel joints, as it was constructed using three panels, one central 1200-wide panel and two 400-mm wide panels. The wall panels were joined together using slip joint design, and then sealed flush using Boss FireSilicone-EMA sealant.

All other joints including corner joints, panel edges and window surrounds were covered using steel corner and channel flashings fixed with steel rivets at 300-mm. All the flashings would then be sealed with a bead of Boss FireSilicone-EMA sealant.

Window

A Bradnam's "Essential" Series fixed window was installed in the central section of the wall specimen, approximately 500-mm off the bottom sill. The window incorporated clear 5-mm thick toughened glass framed in an 800-mm x 800-mm steel frame and was constructed in accordance with prescribed solution specified in AS 3959 for BAL 29. The window was face mounted on the fire exposed face of the wall into a close-fitting aperture cut out in the central wall panel, and restrained using steel angles and window flashings, as shown in drawing TPC-T001, sheet 3, dated 22 March 2023, and photograph 3 of Appendix B. The window flashings were fixed with steel rivets at 300-mm centres and sealed to the wall panels using Boss FireSilicone-EMA sealant.

Eaves

An eave detail was installed along the top of the rebate of the wall. The eave detail was constructed in accordance with prescribed solution specified in AS 3959 for BAL 29. It included a 250-mm x 250-mm metal framed boxed section lined on the front and the underside with 6-mm fibre cement sheeting. All the external corners of the eave framing were covered with corner flashings and sealed with Boss FireSilicone-EMA sealant.

Sill

The wall was constructed on top of a non-combustible sill. The sill included a 350-mm x 350-mm metal framed boxed section lined with 6-mm fibre cement sheeting. The cavity of the framing was filled with Rockwool insulation.

2.2 Orientation

The external wall specimen was tested with the sill and the exterior face of the wall exposed to the radiant heat source.

2.3 Crib size

The crib size selected by the test sponsor for the relevant BAL level was Class AA, as specified in Table 3.2 of Section 3.8 of AS 3959:2018.

Three cribs were used, crib #1 was located in the internal corner of the wall rebate, Crib #2 was located adjacent to the panel joint left of the window, while crib #3 was located adjacent to the panel joint right of the window, as shown in Photograph 11 (Appendix B).

2.4 Conditioning

The external wall system did not include exposed timber elements.

The specimen construction was completed on 28th April 2022 and stored under standard laboratory atmospheric conditions until the test date.

2.5 Level of radiant heat exposure

The level of radiant heat exposure selected by the test sponsor was Very high - 29 kW/m².

2.6 Selection, construction and installation of the specimen and the supporting construction

The construction was organised by the sponsor, CSIRO was not involved in the selection of the materials.

3 Documentation

The following documents were supplied or referenced by the sponsor as a complete description of the specimen and should be read in conjunction with this report:

- Drawings numbered TPC-T001, sheets 1-4, dated 22 March 2023, by Delta Panels.
- Drawings numbered TPC-T002, dated 15 February 2023, by Delta Panels.
- Drawings numbered TPC-T003, dated 15 February 2023, by Delta Panels.
- Drawings numbered TPC-T004, dated 22 March 2023, by Delta Panels.

No confidential information about the test specimen has been submitted to CSIRO Infrastructure Technologies

4 Equipment

4.1 Furnace

The furnace had a nominal opening of 3000-mm x 3000-mm for the attachment of vertical specimens.

The furnace was lined with refractory bricks and materials with the thermal properties as specified in AS 1530.4-2014 and was heated by combustion of a mixture of natural gas and air.

4.2 Temperature

The temperature in the furnace chamber was measured by eight type K, 3-mm diameter, and 310 stainless steel Mineral Insulated Metal Sheathed (MIMS) thermocouples. Each thermocouple was housed in high-nickel steel tubes opened at the exposed end.

Locations of the thermocouples on the unexposed face of the specimen are described in Appendix A.

4.3 Radiant heat source

The radiant heat source consisted of a 3-mm thick stainless-steel sheet mounted into a refractory frame in two sections with a vertical joint at its centre. The frame housing the steel sheet was positioned and sealed up against the front of the furnace aperture.

4.4 Radiant heat flux calibration

Prior to the test, the positions of the specimen (relative to the radiant heat source) were established that corresponded to the required radiant heat flux levels.

Radiation distribution was also established by measuring radiant heat flux levels at the centre and the centre of each quarter section of the specimen in a plane approximating the intended position of the specimen such that the central value will be approximately equal to the rest of the radiant heat flux.

4.5 Measurement system

The primary measurement system comprised multiple-channel data loggers, scanning at five second intervals during the test.

5 Ambient temperature

The temperature of the test area was 21°C at the commencement of the test.

6 Departure from standard

The specimen was left to cure under standard laboratory atmospheric conditions as opposed to a controlled environment of the average temperature of 25 ± 2 deg C and relative humidity of 45 ± 5%. The specimen was conditioned for a period of 5 days prior to testing, the requirements of AS 1530.8.1-2018 stipulates a minimum 7 days. The test laboratory confirms that the minor departure in conditioning would not have significantly affected the results of this test.

7 Termination of the test

The test was terminated at 61 minutes in accordance with the standard.

8 Test results

8.1 Critical observations

The following observations were made during the fire-resistance test:

0 minutes -	Alight cribs placed in position.
25 seconds -	Specimen moved in position – exposure to 29 kW/m².
1:00 minutes -	Smoke is emitted from the exposed face of the wall, flaming of the sealant along the panel joint adjacent to Crib #4.
2:25 minutes -	Specimen moved in position – exposure to 21 kW/m².
3:18 minutes -	Crib #3 has ceased flaming.
3:25 minutes -	Specimen moved in position – exposure to 14 kW/m². Seals around the exposed side of perimeter of the window are starting to melt, photograph 10.
4:25 minutes -	Specimen moved in position – exposure to 11 kW/m². Crib #1 has ceased flaming.
5:10 minutes -	Flaming of the sealant along the corner panel joint adjacent to Crib #1.
5:25 minutes -	Specimen moved in position – exposure to 8 kW/m².
5:50 minutes -	Cribs #1 and #2 have ceased flaming.
6:25 minutes -	Specimen moved in position – exposure to 7 kW/m².
6:40 minutes -	Smoke is observed on the unexposed side of the wall, adjacent to the corner crib #1.
7:45 minutes -	Flaming on sealant in the corner, adjacent to crib #1 has ceased.
15 minutes -	Radiant heat source shielded from the specimen. Radiometer is positioned 250-mm from the exposed face of the wall specimen in front of the inside corner, adjacent to crib #1. Cracks in the sealant along the panel joint adjacent to crib #2 have been observed, photograph 17.
17 minutes -	No flaming, cracking or signs of any 3-mm through gaps.

20 minutes -	Pilot flame was applied over the exposed face of the specimen – no ignition was noted at this time. 3-mm gap gauge applied to the specimen – No through gaps were noted.
58 minutes -	Pilot flame was applied over the exposed face of the specimen – no ignition was noted at this time.
61 minutes -	Test terminated.
Post Test Inspection	3-mm gap gauge applied to the specimen – no through gaps were noted.

8.2 Radiant heat flux

Figure 1 shows the curves of target and incident radiation versus time recorded during the test period.

Figure 2 shows the curve of received radiation versus time at 250-mm from the exposed face of the specimen.

8.3 Specimen temperature

Figure 3 shows the temperature versus time recorded on the unexposed face of the wall.

Figure 4 shows the temperature versus time associated with crib 1.

Figure 5 shows the temperature versus time associated with crib 2.

Figure 6 shows the temperature versus time associated with crib 3.

Figure 7 shows the temperature versus time associated with the eave.

8.4 Performance

Performance observed in respect of Clause 14.4 of AS 1530.8.1-2018 criteria:

Performance Criteria		Time to failure (min)	Position of failure
A gap from the fire exposed face to the non-fire exposed face greater than 3-mm		No Failure	-
Sustained flaming for 10 seconds on the non-fire side		No failure	-
Flaming on the fire-exposed side at the end of the 60 minutes test period		No failure	-
Radiant heat flux 365-mm from the non-fire side exceeding 15-kW/m²		Not Applicable	-
Mean and maximum temperature rises greater than 140 K and 180 K		No failure	-
Radiant heat flux 250-mm from the specimen, greater than 3-kW/m² between 20 minutes and 60 minutes		No failure	-
Mean and maximum temperature of internal faces exceeding 250°C and 300°C respectively between 20 minutes and 60 minutes after the commencement of the test		Not Applicable	-
Crib class	**AA**	**Peak heat flux**	**29 kW/m²**

For the purpose of building regulations in Australia, the test specimen achieved a **Bushfire Attack Level (BAL) of AA29**.

This report details the methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested in accordance with the test method of AS 1530.8.1.

9 Tested by

Chris Wojcik
Testing Officer

Appendices

Appendix A – Measurement location

Measurement Location		
Group location	**T/C Position**	**T/C designation**
Unexposed Face	Top left quarter point – centre section	S1
	Top right quarter point – centre section	S2
	Bottom left quarter point – left wing wall	S3
	Bottom right quarter point – right wing wall	S4
	Centre – below window – centre section	S5
Unexposed face – crib locations	Crib- #1– corner crib – wing wall	S6
	Crib- #1 – corner crib – main wall	S7
	Crib- #2 – panel joint crib – main wall	S8
	Crib- #3 – panel joint crib – main wall	S9
Eaves	In line with corner crib #1	S10
	In line with panel joint crib #2	S11
	Centre	S12
	In line with panel joint crib #3	S13
Rover		
Ambient		

Appendix B – Test photographs

PHOTOGRAPH 1 – CONSTRUCTION OF SPECIMEN – FORMING UP OF THE TWO REBATE CORNERS

PHOTOGRAPH 2 – CONSTRUCTION OF SPECIMEN – INSTALLATION OF THE MAIN WALL SECTION

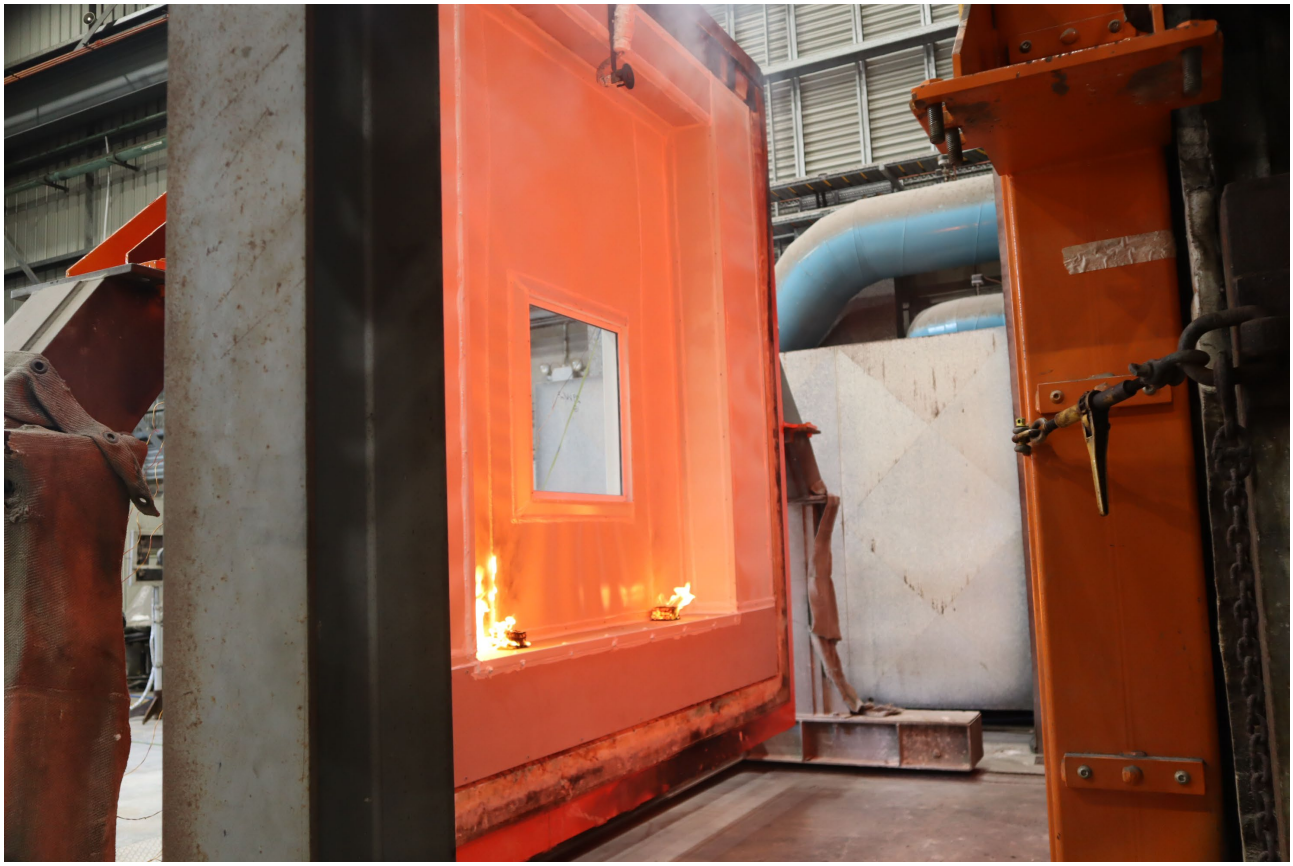
PHOTOGRAPH 3 – CONSTRUCTION OF SPECIMEN – INSTALLATION OF THE WINDOW FLASHING

PHOTOGRAPH 4 – CONSTRUCTION OF SPECIMEN – SILL DETAIL

PHOTOGRAPH 5 – CONSTRUCTION OF SPECIMEN – EAVES DETAIL

PHOTOGRAPH 6 – EXPOSED FACE OF THE SPECIMEN PRIOR TO TESTING

PHOTOGRAPH 7 – UNEXPOSED FACE OF THE SPECIMEN PRIOR TO TESTING



PHOTOGRAPH 8 – EXPOSED FACE OF SPECIMEN DURING 29 KW/M² EXPOSURE

PHOTOGRAPH 9 – EXPOSED FACE OF SPECIMEN DURING 21 KW/M² EXPOSURE

PHOTOGRAPH 10 – EXPOSED FACE OF SPECIMEN DURING 14 KW/M² EXPOSURE

PHOTOGRAPH 11 – EXPOSED FACE OF SPECIMEN DURING 11 KW/M² EXPOSURE

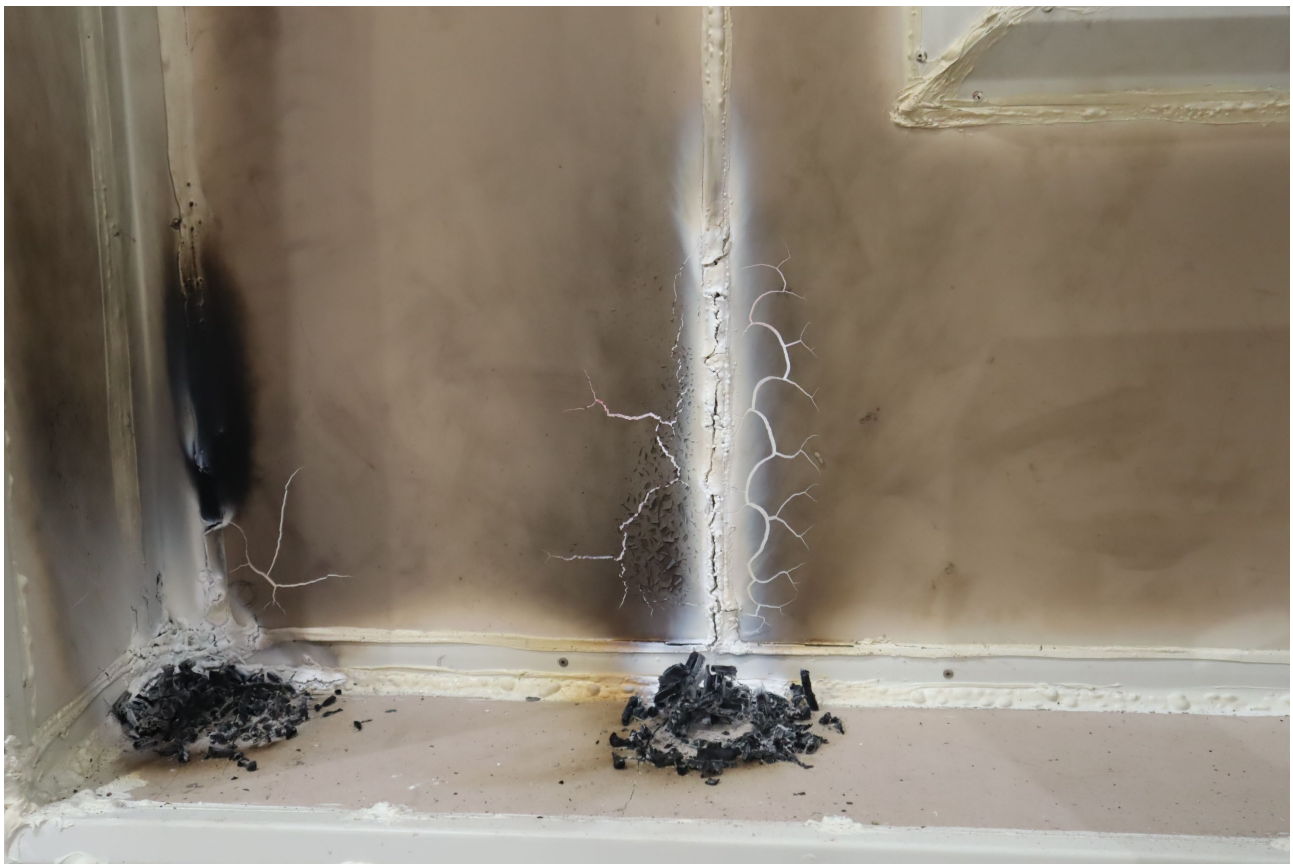
PHOTOGRAPH 12 – EXPOSED FACE OF SPECIMEN DURING 8 KW/M² EXPOSURE

PHOTOGRAPH 13 – UEXPOSED FACE OF THE SPECIMEN AT 7 MINUTES INTO THE TEST

PHOTOGRAPH 14 – EXPOSED FACE OF THE SPECIMEN AT 7 MINUTES INTO THE TEST

PHOTOGRAPH 15 – EXPOSED FACE OF SPECIMEN AT 12 MINUTES INTO THE TEST

PHOTOGRAPH 16 – EXPOSED FACE OF THE SPECIMEN AT 16 MINUTES INTO THE TEST



PHOTOGRAPH 17 – EXPOSED FACE ADJACENT TO CRIB #1 AND #2 AT 16 MINUTES INTO THE TEST

PHOTOGRAPH 18 – EXPOSED FACE OF THE SPECIMEN AT THE CONCLUSION OF TESTING

Appendix C – Test data charts

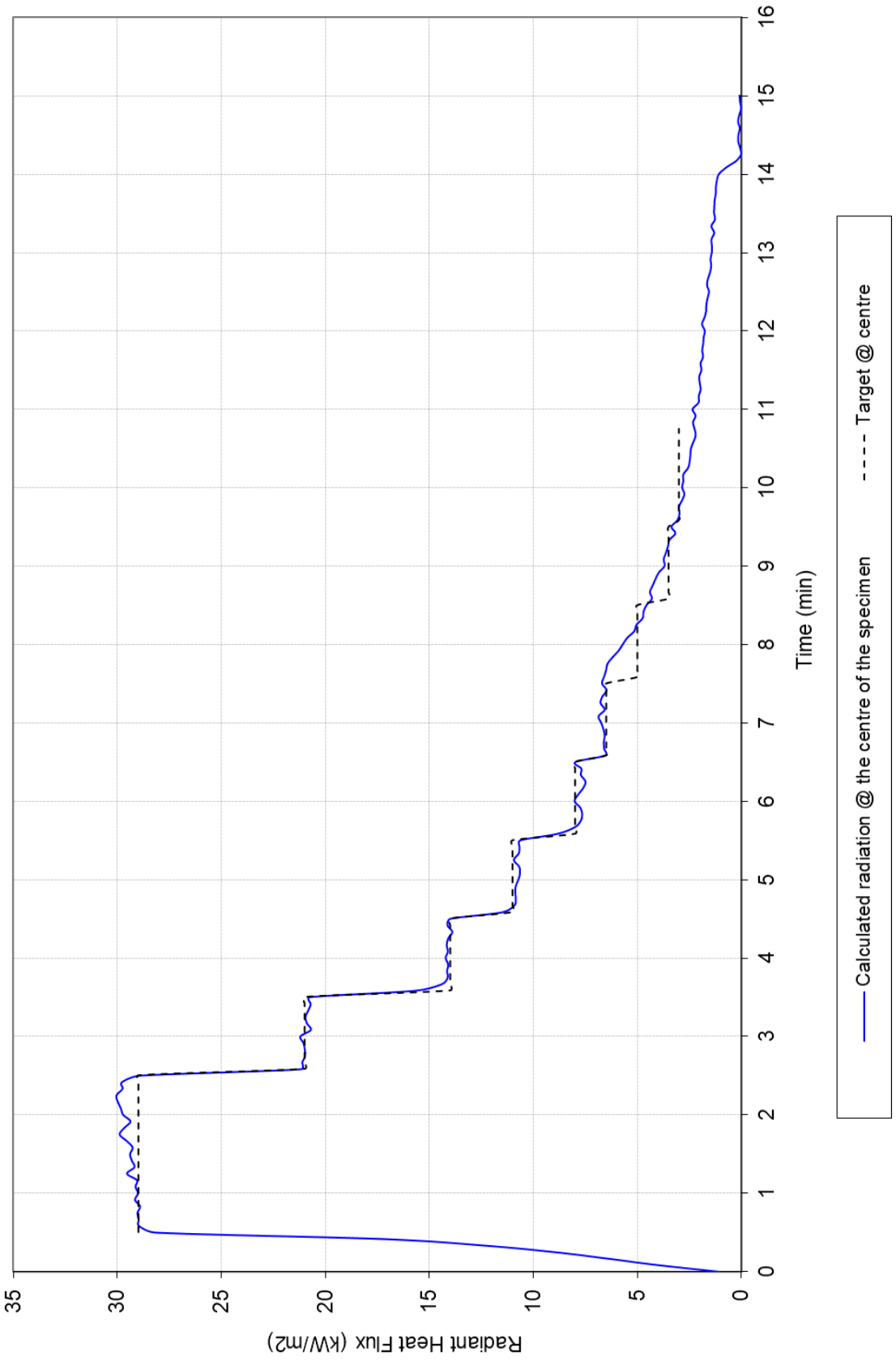


FIGURE 1 – RADIANT HEAT FLUX

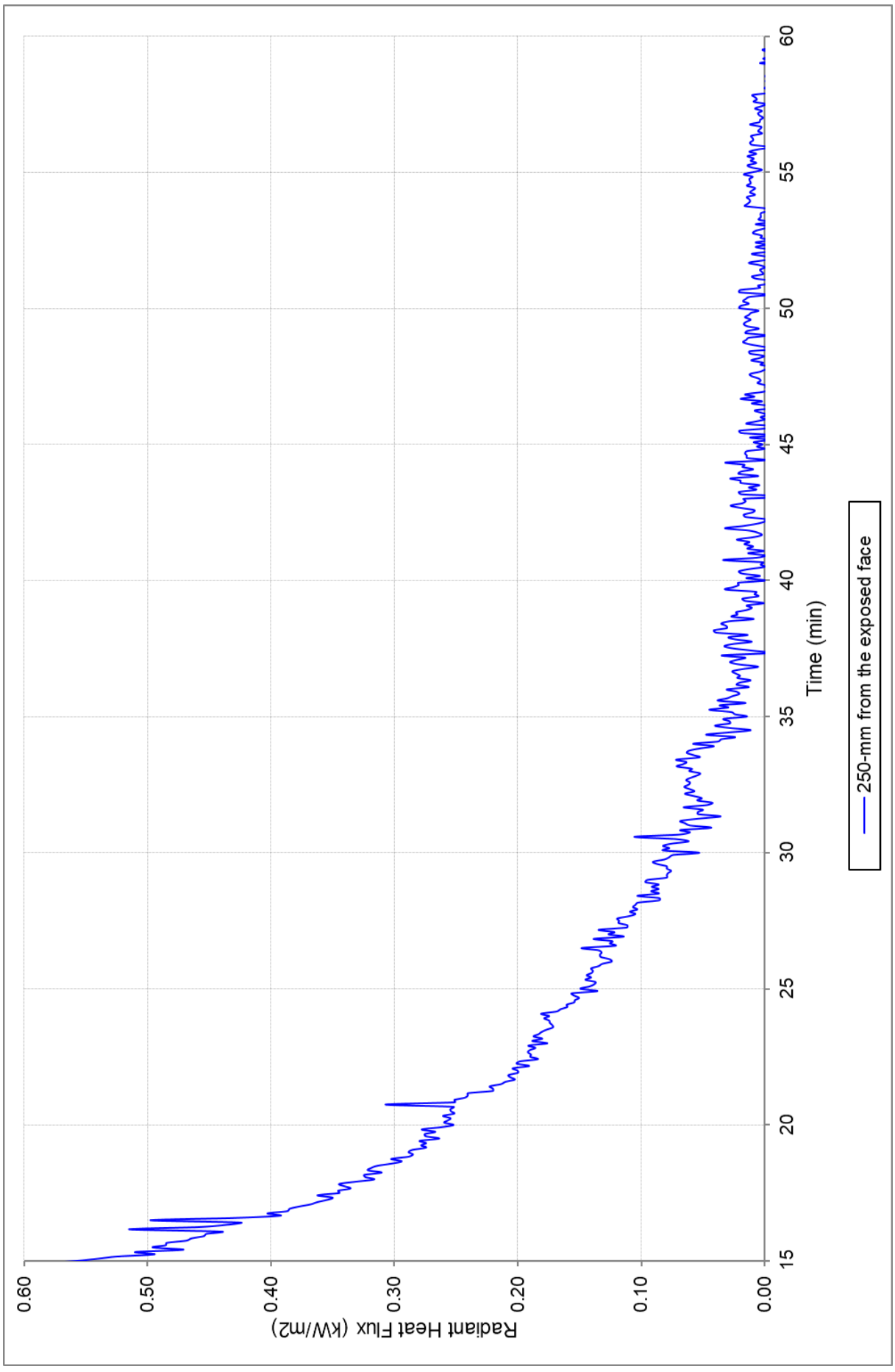


FIGURE 2 – RADIANT HEAT FLUX RECEIVED AT 250-MM FROM THE EXPOSED FACE

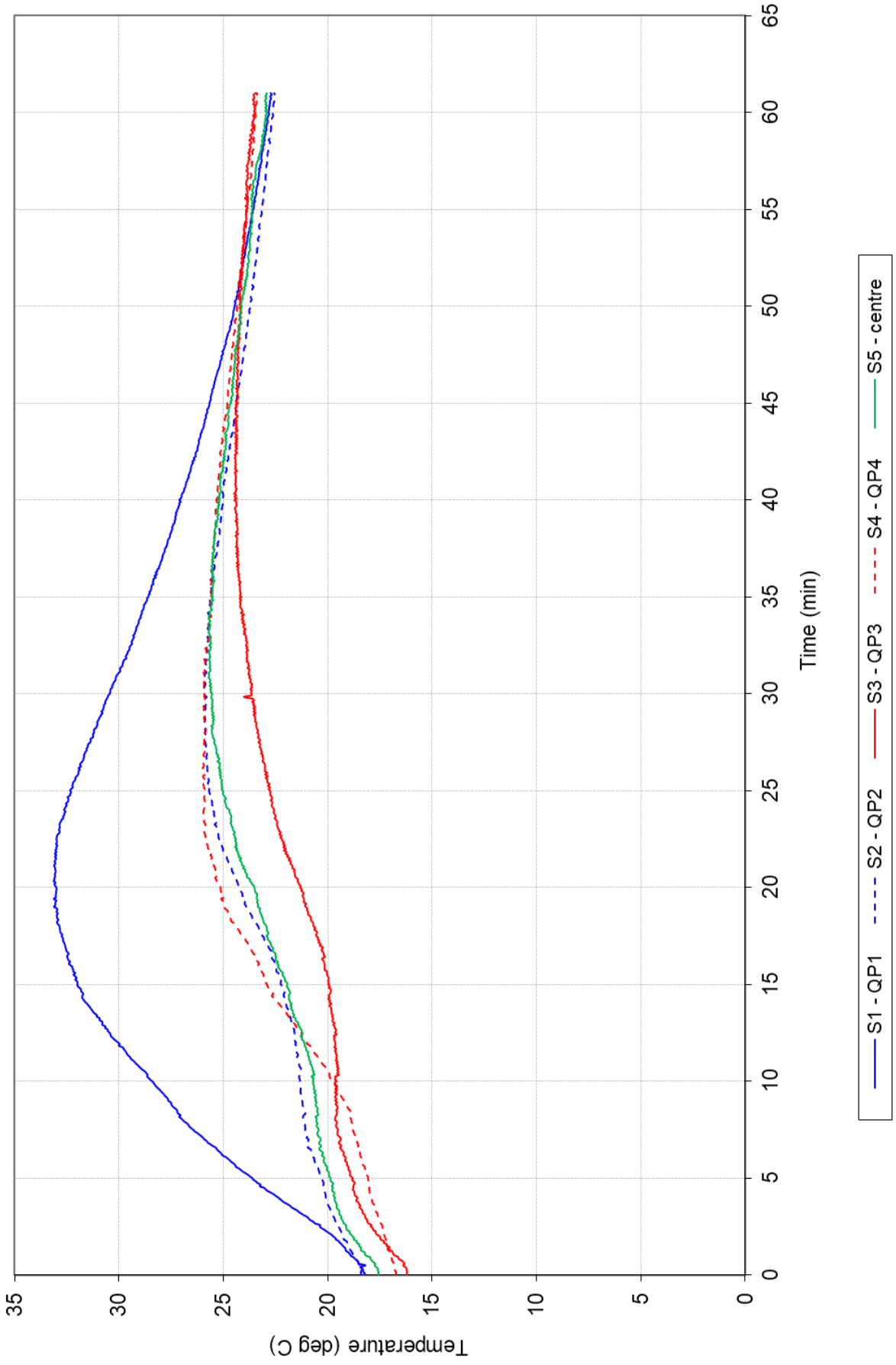


FIGURE 3 – TEMPERATURE VERSUS TIME ASSOCIATED WITH THE UNEXPOSED FACE OF THE WALL

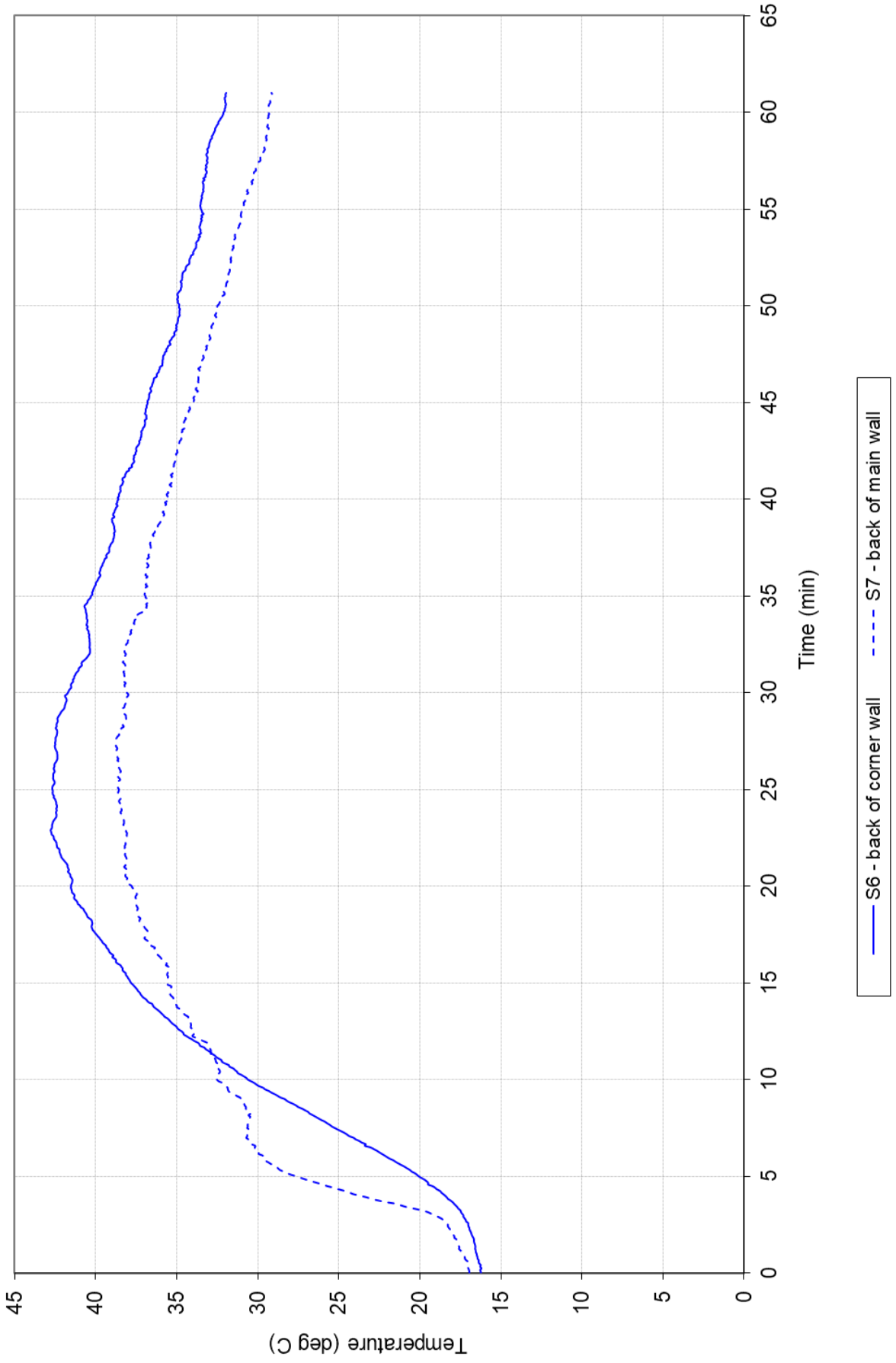


FIGURE 4 – TEMPERATURE VERSUS TIME ASSOCIATED WITH CRIB #1

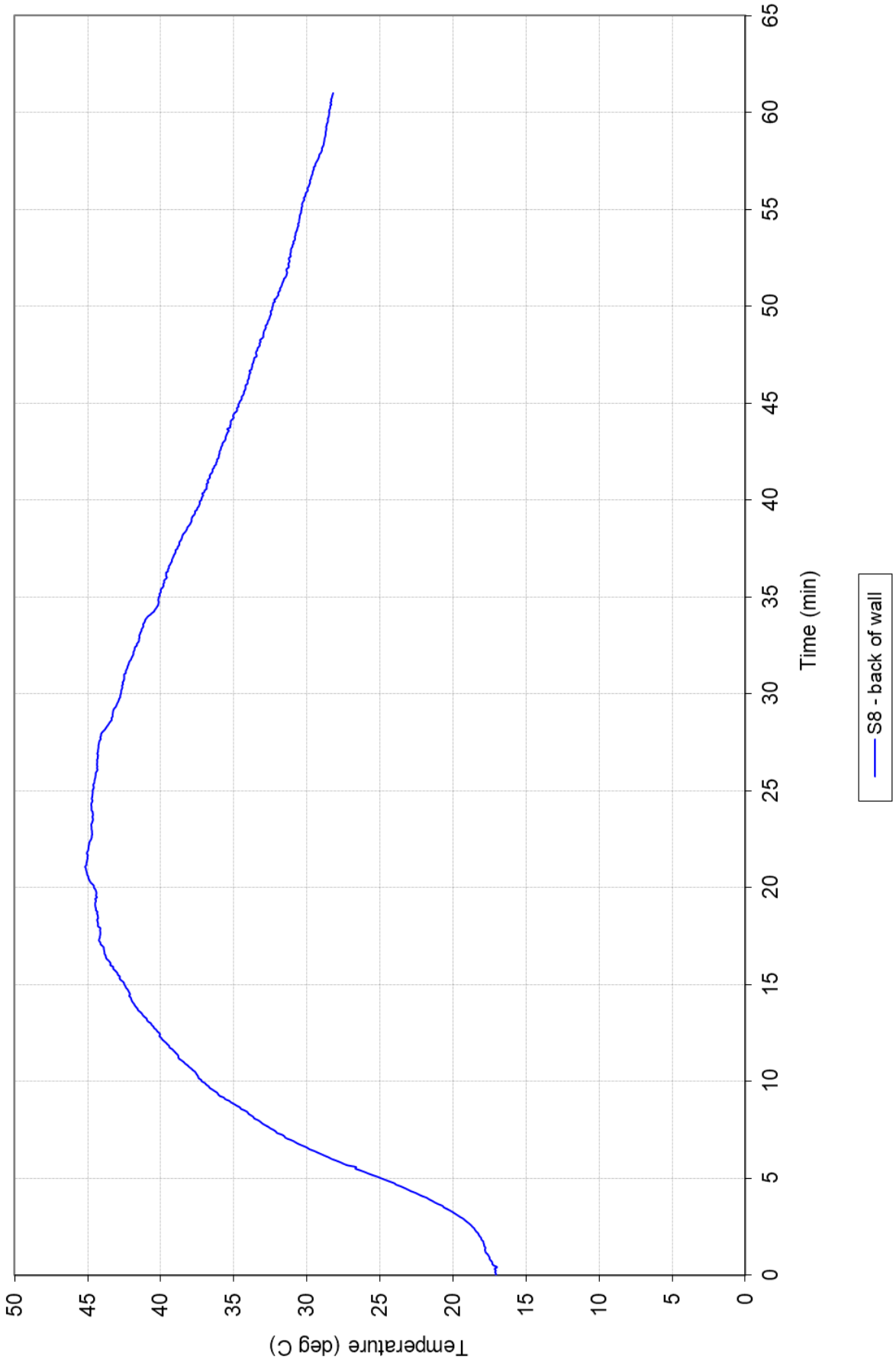


FIGURE 5 – TEMPERATURE VERSUS TIME ASSOCIATED WITH CRIB #2

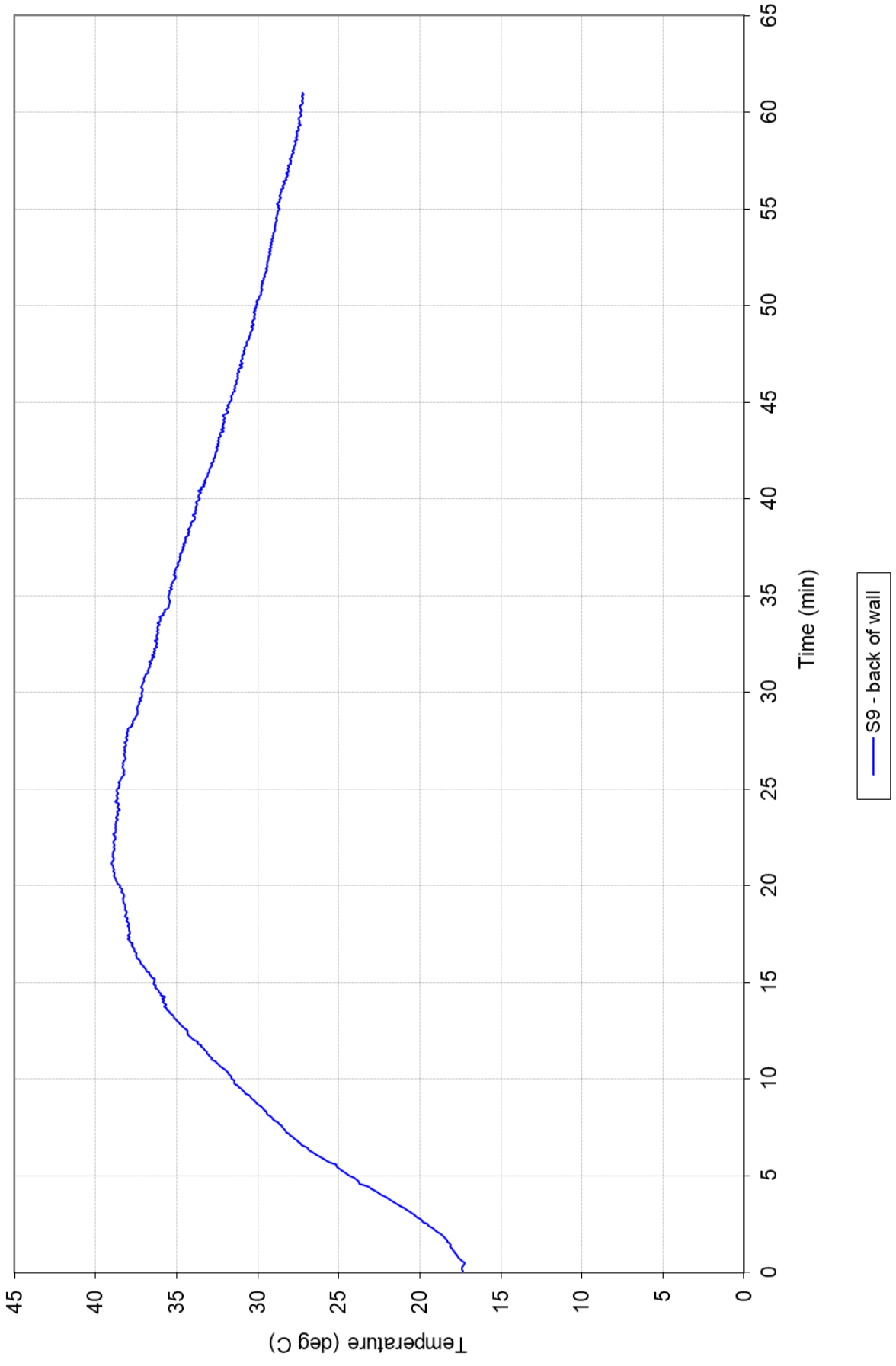


FIGURE 6 – TEMPERATURE VERSUS TIME ASSOCIATED WITH CRIB #3

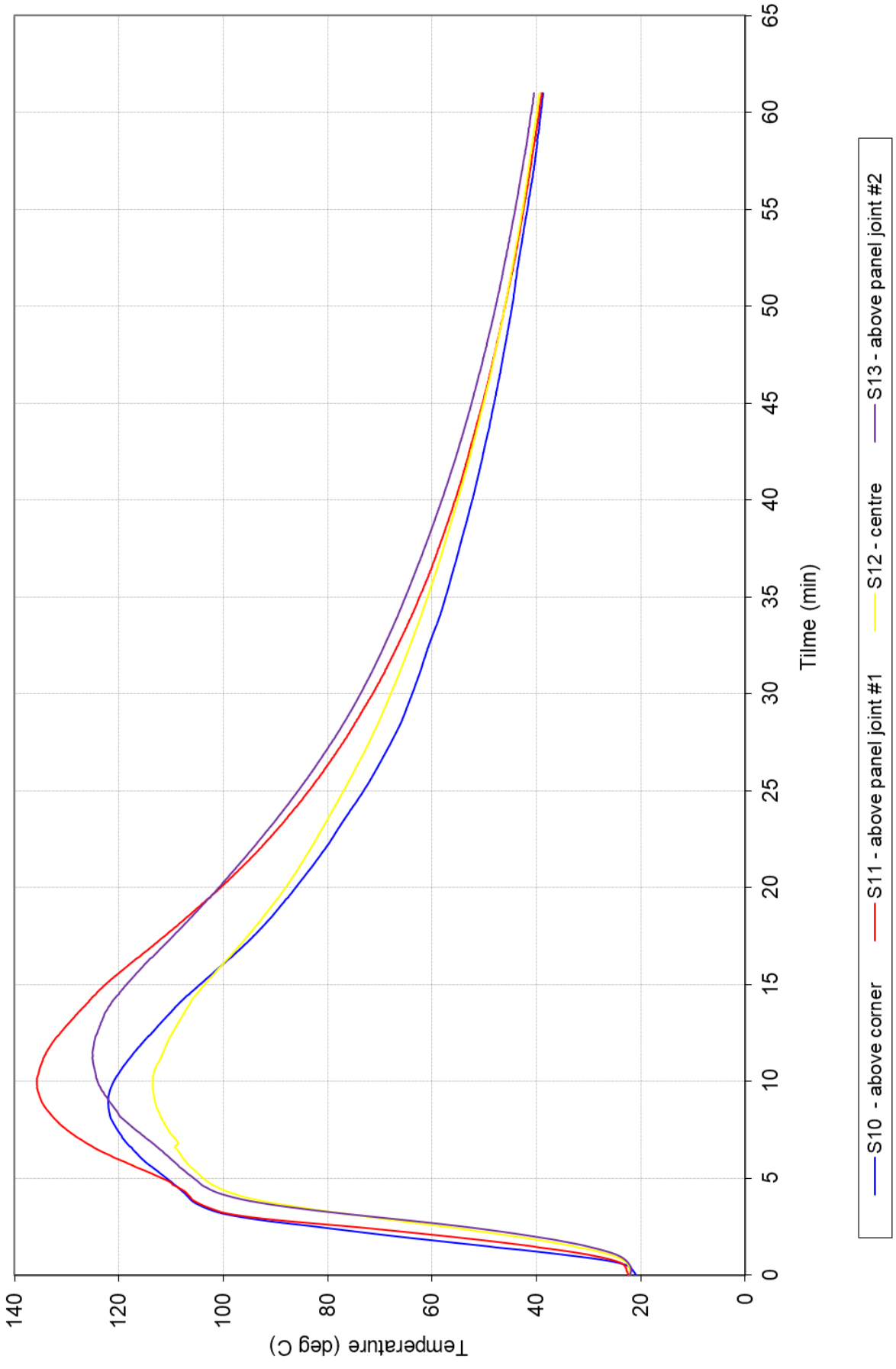
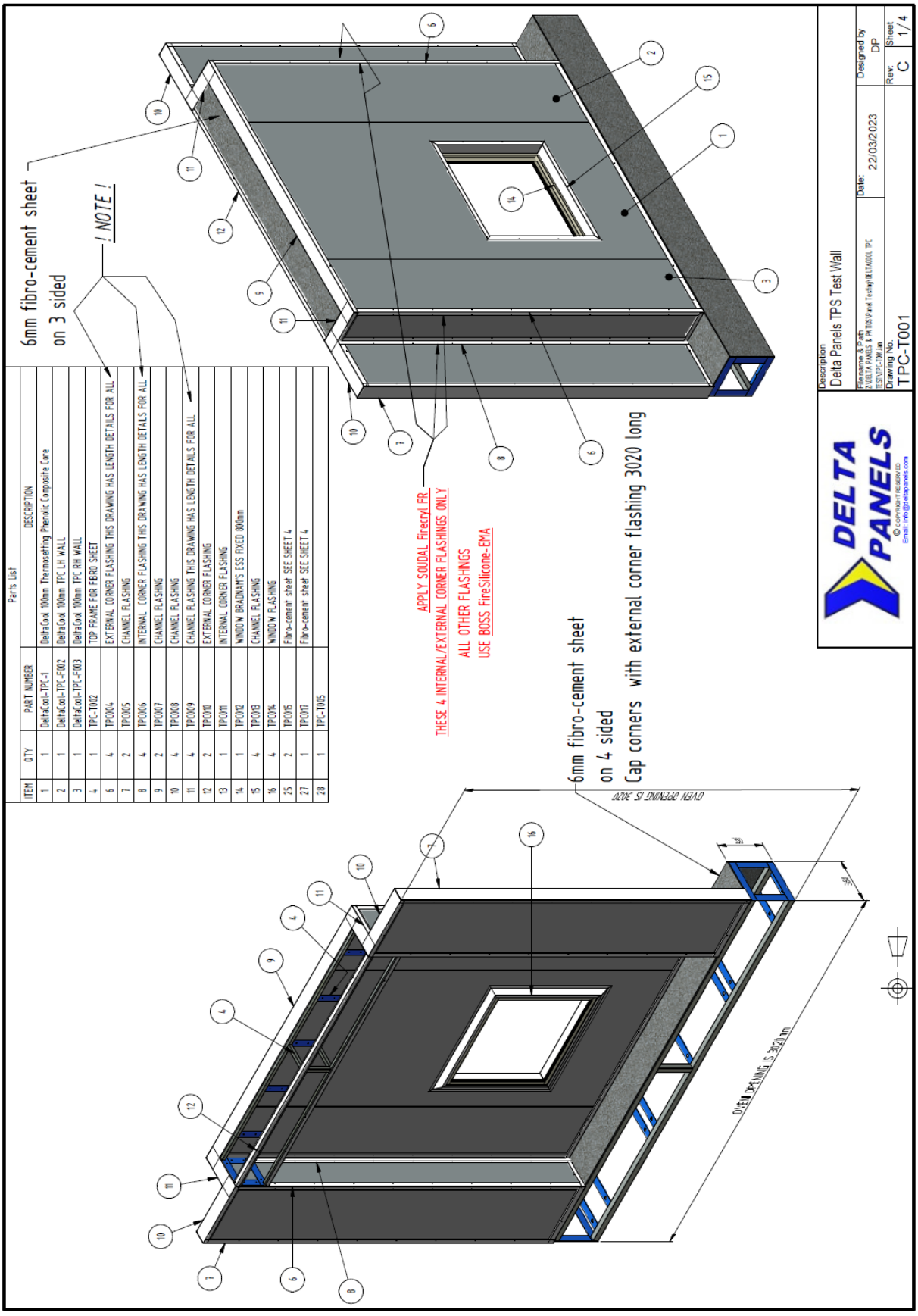


FIGURE 7 – TEMPERATURE VERSUS TIME ASSOCIATED WITH THE EAVE

Appendix D – Specimen drawings



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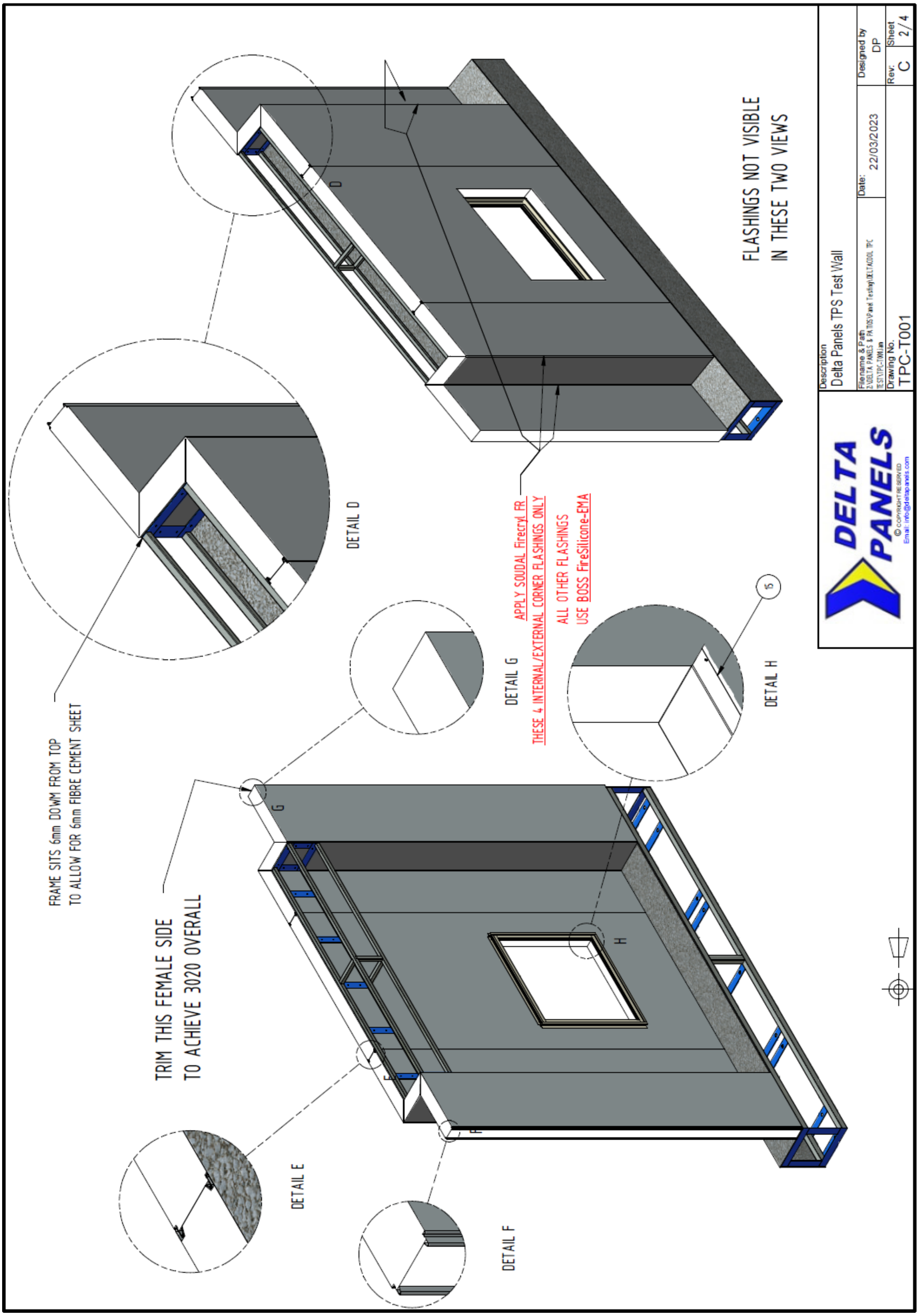

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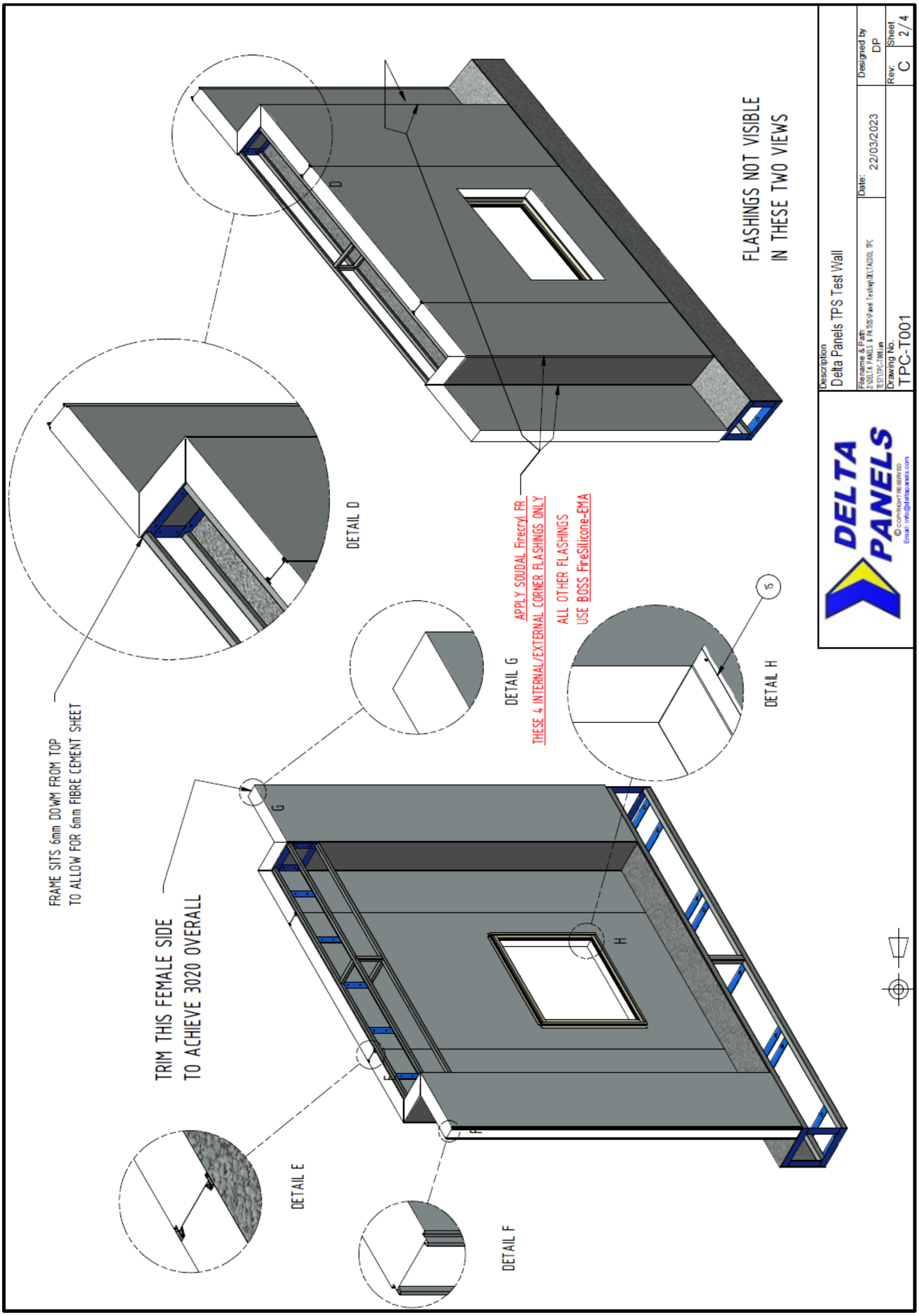

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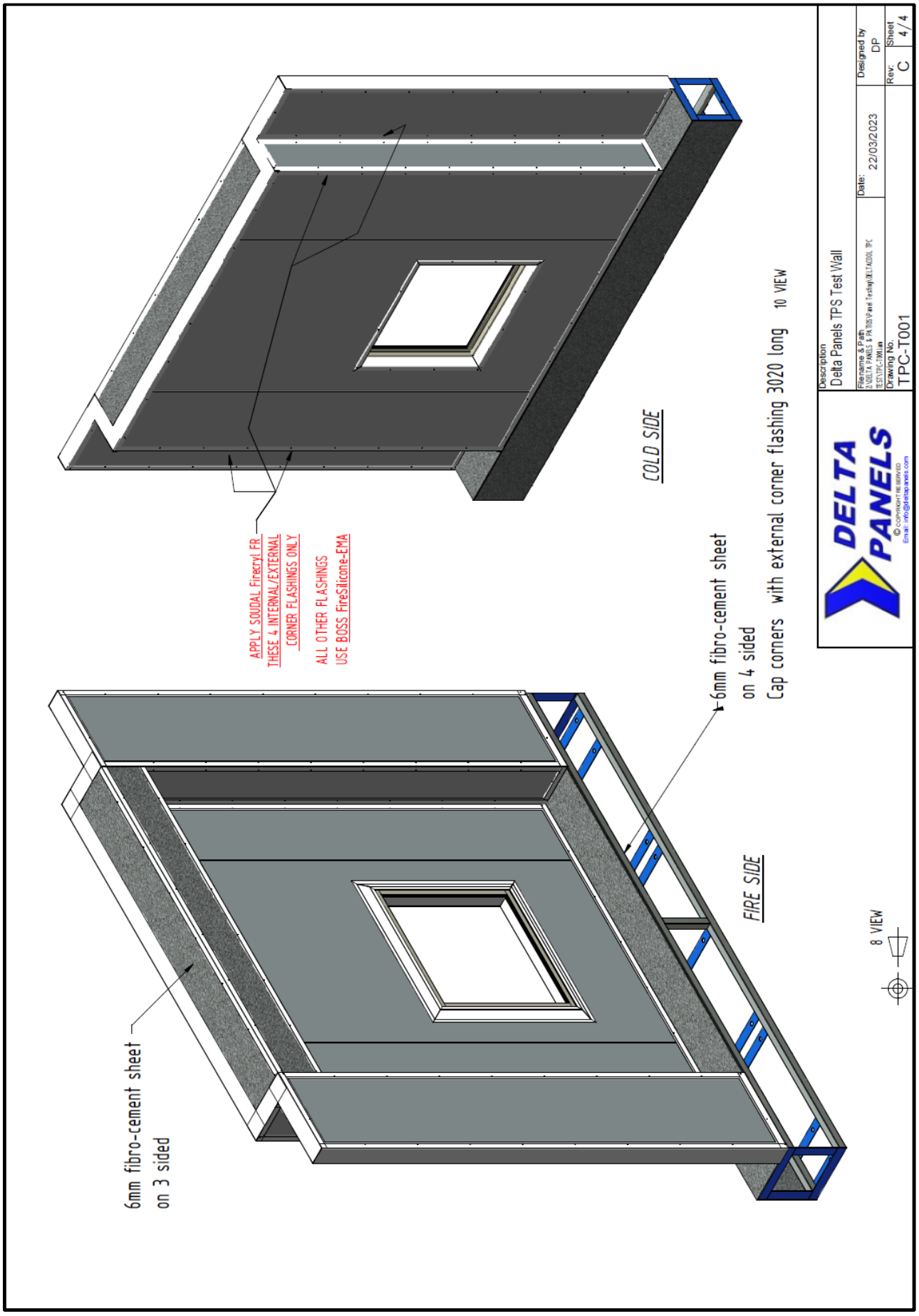

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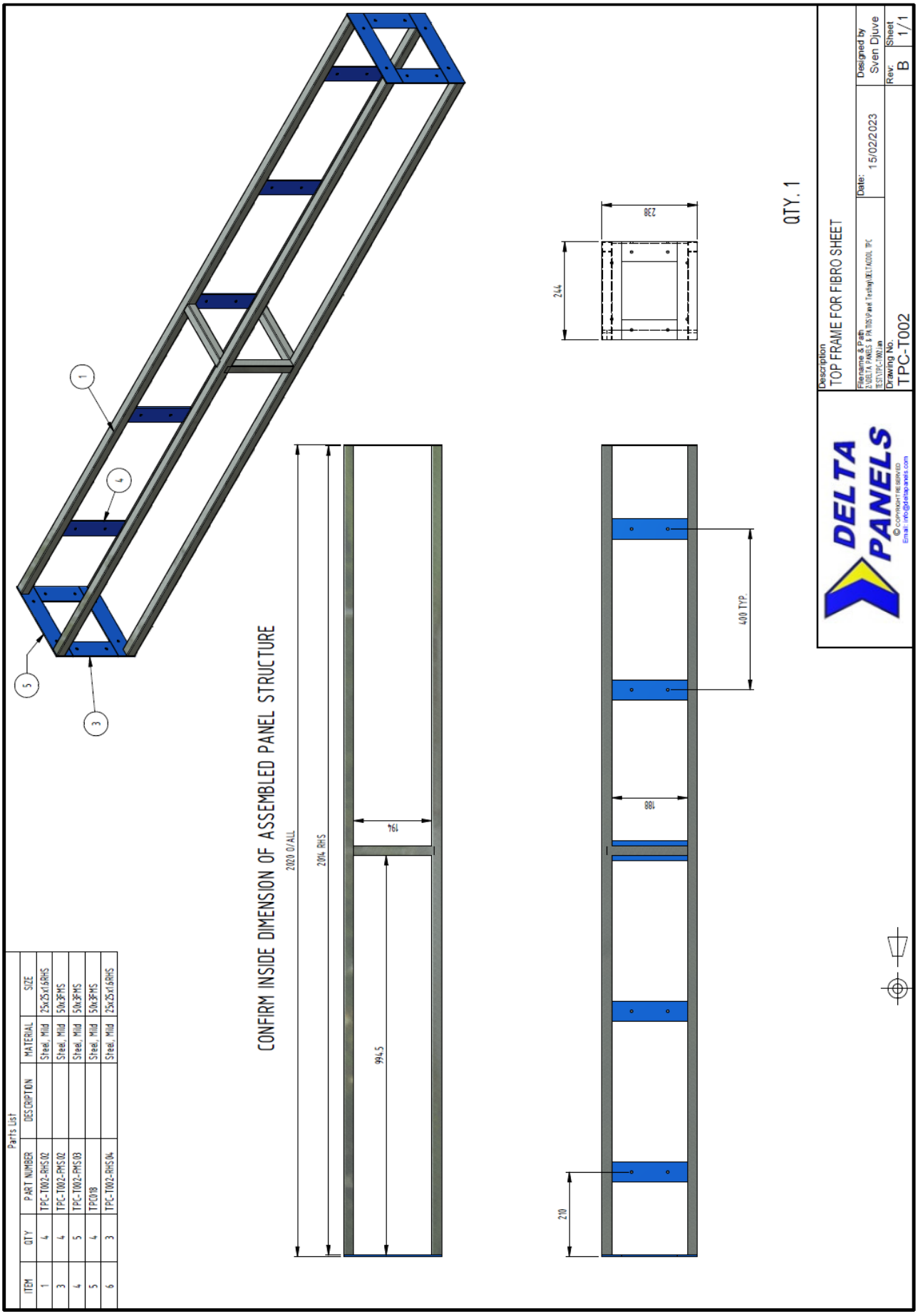

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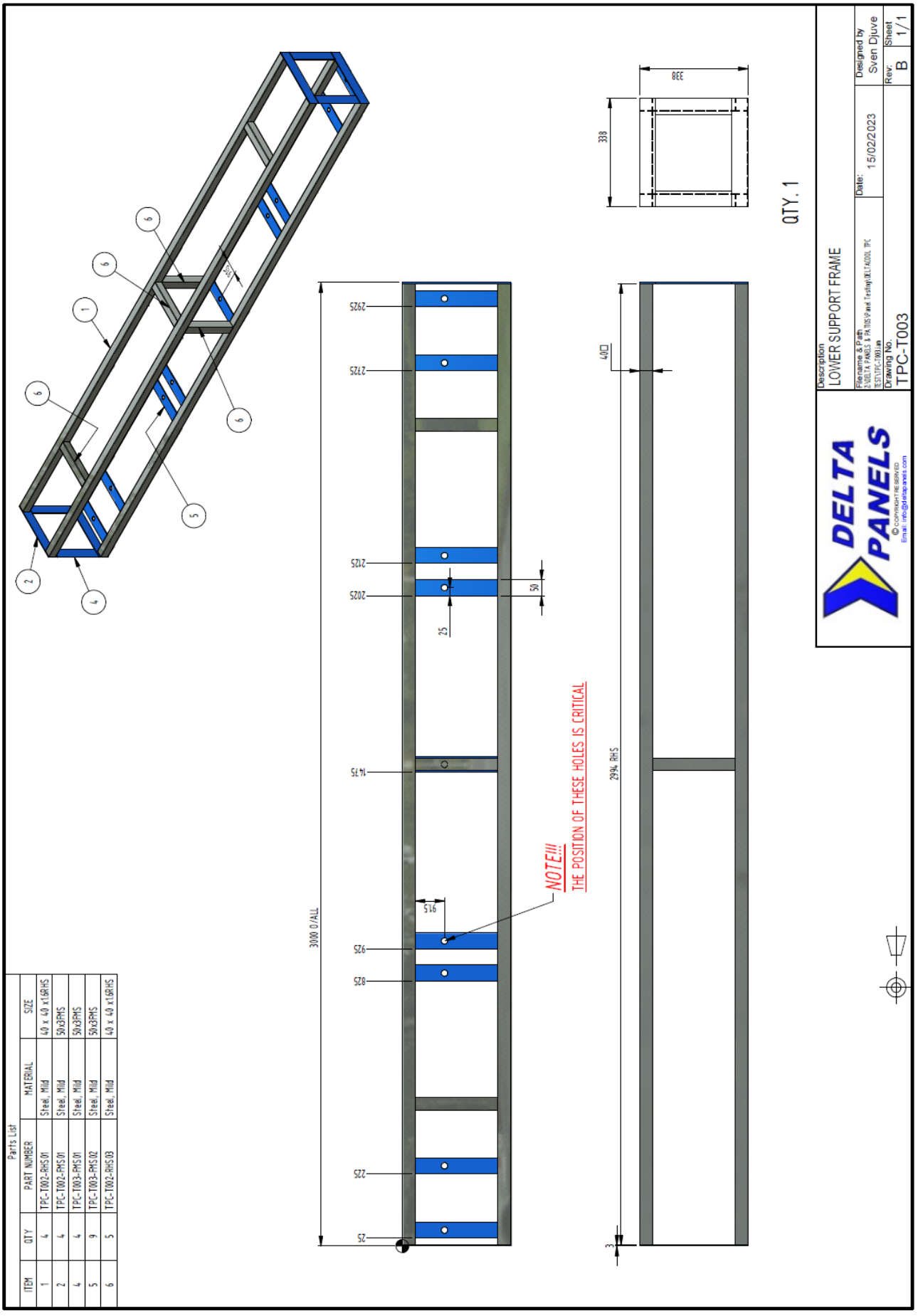

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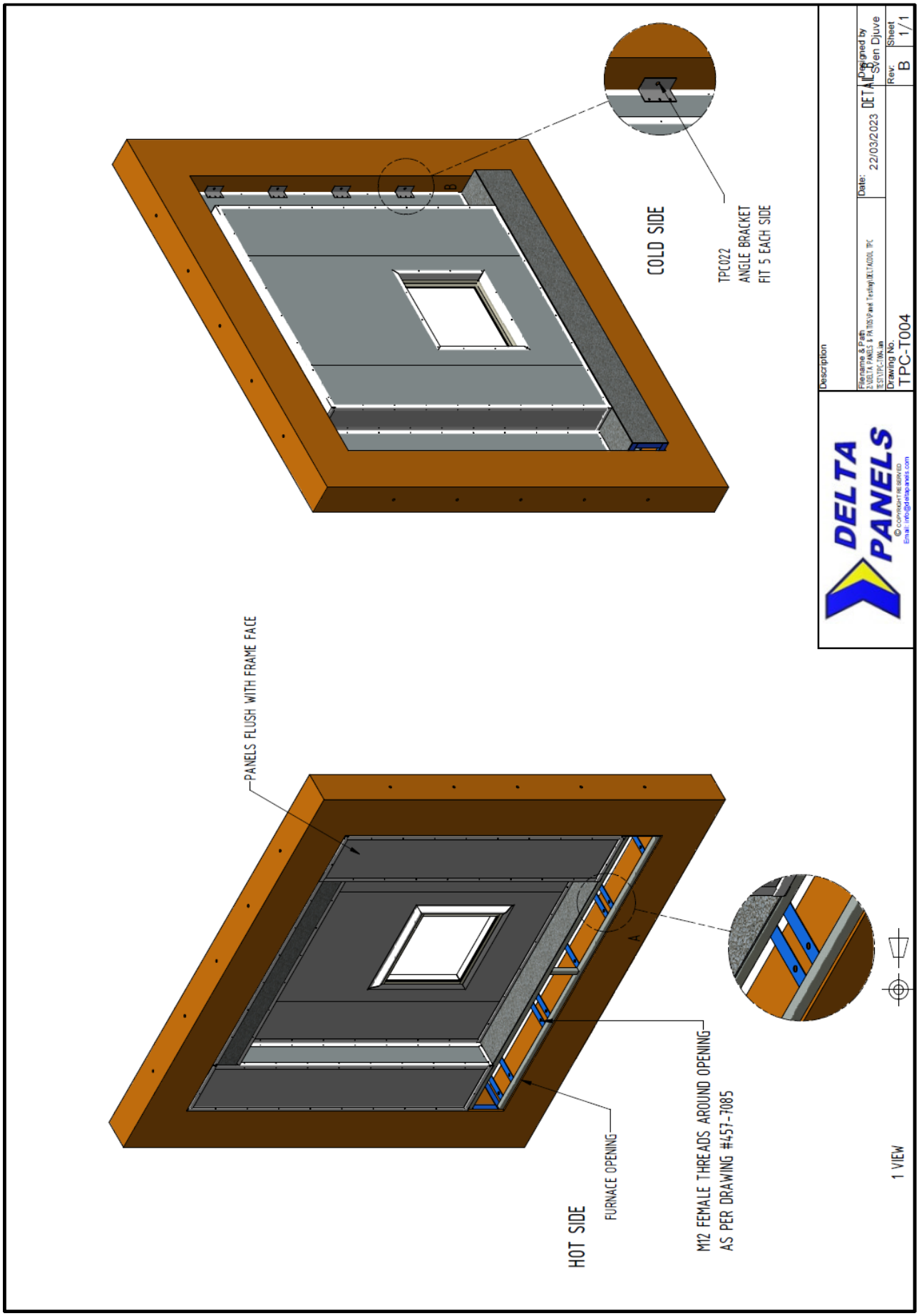

DRAWING NUMBERED TPC-T004, DATED 22 MARCH 2023, BY DELTA PANELS

References

The following informative documents are referred to in this Report:

AS 1530.8.1-2018	Methods for fire tests on building materials, components and structures. Part 8.1: Tests on elements of construction for buildings exposed to simulated bushfire attack – Radiant heat and small flaming sources
AS 3959:2018	Construction of buildings in bushfire prone areas

*** end of report ***

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