TEST REPORT
FIRE RESISTANCE TEST OF CONSTRUCTION ASSEMBLIES

Test Sponsor:

Alstone Manufacturing Private Limited
1393, Langha Road, Industrial Area
Dehradun -248142
Uttarakhand, India
T: +91 11 4123 2400
Website: www.alstoneindia.com

Test Assembly:

Non-loadbearing 4mm thick Alstone FR A2 Aluminium Composite Panel (ACP) cladding assembly installed on 200mm thick masonry blocks.

Test Standard:

ASTM E119-20; Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E2226-15b: Standard Practice for Application of Hose Stream

THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS

Test Date: 5-Jun-23
Issue Date: 12-Jun-23
Test Reference No: XE070-2

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DUBAI DOHA RIYADH

Accreditation

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories with:

United Kingdom Accreditation Service (UKAS) - Testing Laboratory: **4439**
www.ukas.com

GCC Accreditation Center (GAC) – Testing Laboratory: **ATL-0017**
www.GCC-accreditation.org

Memberships

Members of European Group of Organization for Fire Testing, Inspection and Certification

www.egolf.org.uk

Member of Association for Specialist Fire Protection

www.asfp.org.uk

Member of Centre for Window and Cladding Technology

www.cwct.co.uk

The work which is the subject of this report falls under the accreditations of **ISO 17025 UKAS and ISO 17025 GAC.**

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1. INTRODUCTION

Determination of the fire resistance of a non-loadbearing 4mm thick Alstone FR A2 Aluminium Composite Panel (ACP) cladding assembly installed on 200mm thick masonry blocks according to:

ASTM E119-20: Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E2226-15b: Standard Practice for Application of Hose Stream

2. SPONSOR

Name: Alstone Manufacturing Private Limited
Address: 1393, Langha Road, Industrial Area
Dehradun -248142
Uttarakhand, India
T: +91 11 4123 2400
Website: www.alstoneindia.com

3. TESTING LABORATORY

Name: Thomas Bell-Wright International Consultants (TBWIC)
Address: Corner of 46th and 47th streets, Jebel Ali Industrial Area 1
P.O. Box 26385, Dubai, U.A.E.
T: +971 (0) 4 821 5777
Website: www.bell-wright.com

4. DATE OF TEST

Fire Test Date: 5-Jun-23

The test has been witnessed by:

Name	Company	Contact Number
Mr. Shahul Hameed	Alstone Manufacturing Private Limited	+971 54 793 6045

5. CONSTRUCTION

5.1. General Description of the Assembly

The specimen was constructed of a blockwall comprising solid and hollow masonry concrete blocks onto which support brackets were fixed, anchored into the location of the solid masonry blocks. Vertical runners were fixed to the support brackets. Horizontal runners were fixed to the vertical runners via L-angle connectors. Aluminium cleats of the ACP's were used to fix the ACP's to the runners. Aluminium U-channels were fixed at the panel gaps

The overall dimensions of specimen were 3050 x 3050 x 270mm (w x h x thk).

For full details of the test specimen, refer to Appendix 1 and 2.

5.2. Supporting Construction

The specimen was installed directly in a restraint frame made of steel and dense refractory castable with a density of 2000kg/m³. The overall frame opening was 3050 x 3050 x 300mm (w x h x thk).

5.3. Conditions and Test Situation

In accordance with section 8.3.1 of ASTM E119-20, the specimen was restrained on all four edges, and the overall size was greater than 100ft² (9.3m²), with neither dimension less than 9ft (2.7m).

The specimen was not installed in a symmetrical orientation, and the results outlined in this test report only apply to the configuration tested.

Both horizontal and vertical panel joints were included in the test.

6. SPECIMEN DEFINITION & VERIFICATION

6.1. Specimen Definition & Verification of the Test Specimen.

The choice and design and the definition of the specimen have been made by Alstone Manufacturing Private Limited, and TBWIC testing laboratory has not been involved in the selection or design of the specimen. Similarly, the results of the test apply only to the samples as received.

There are contexts where information has been provided by the sponsor and verification of information has been done through either technical datasheet or other document submission, or as indicated directly by the sponsor. For this reason, materials have been tested in an as-received condition and TBWIC bears no liability for the legitimacy of the submitted information.

6.2. Specimen Installation & Conditioning

Installation of the block wall: TBWIC.

Installation of the ACP cladding: Al Waqt Tech. Cont. LLC.

The specimen was delivered on 30-May-23 and installed between 31-May-23 and 1-Jun-23. The specimen was stored in ambient conditions after installation at temperatures ranging between 28°C and 40°C and 26% to 62% humidity.

7. METHOD OF TEST

7.1. Performance Criteria

The specimen is deemed to have satisfied the criteria of acceptance outlined in ASTM E119-20 and ASTM E2226-15b if the following are met:

i. The specimen has withstood the fire-resistance test without passage of flame or gasses hot enough to ignite cotton waste, for a period equal to that for which classification is desired.
ii. Transmission of heat through the wall or partition during the fire-resistance test shall not raise the mean temperature on its unexposed surface more than 250˚F (139˚C) above its initial temperature, or raise any individual temperature more than 325˚F (181˚C) above the same initial temperature.
iii. No opening develops that permits a projection of water from the stream beyond the unexposed surface during the time of the hose stream test.

7.2. Measurements (for graphs and data, refer to Appendix 3 & 4)

The time-temperature curve has been controlled using nine thermocouples distributed in the furnace.

The furnace thermocouples were placed at 6in. (152mm) from the exposed face of the specimen and this distance has been maintained throughout the entire test duration.

The pressure in the furnace was controlled at -4 Pa at a height of 2500mm above the sill of the specimen, resulting in neutral pressure plane nominally at the head of the specimen, in accordance with section X5.6.3 of ASTM E119:20. An additional probe, for reference, was located

at 1500mm above the sill of the specimen, and readings for both probes are provided in Appendix 3.

Deflections have been measured and recorded (see Appendix 4).

8. OBSERVATION

8.1. Ambient Conditions & Test Situation

The ambient temperature at the commencement of the test was 32°C and the air velocity measured across the unexposed face of the specimen just before the test was recorded at less than 0.1m/s.

8.2. Pre-Test Observations

The specimen was found satisfactory and fit to be tested.

8.3. Fire Test Observations

Time (mm:ss)	Specimen Observations (All observations have been taken from the unexposed face unless otherwise noted)
0:00	**The test was started.**
10:00	The specimen was stable.
20:00	The specimen was stable.
30:00	The specimen was stable.
40:00	The specimen was stable.
60:00	The specimen was stable.
80:00	The specimen was stable.
100:00	The specimen was stable.
120:00	The specimen was stable.
150:00	The specimen was stable.
180:00	**End of test, as agreed upon with the sponsor. Preparations for the hose stream test had begun.**

8.4. Hose Stream Test Observation

Time (mm:ss)	Specimen Observations
0:00	**The hose stream test was started.**
2:30	**The test was stopped, and the specimen had been subjected to the rapid cooling and erosion effects of the ASTM E2226 hose stream test for 2 minutes and 30 seconds at 30 psi. No through openings were observed.**

8.5. After Hose Stream Test Observations

8.5.1. Unexposed Face Observations

The panels were intact and no through openings were observed.

8.5.2. Exposed Face Observations

The block wall was intact and no through openings were observed.

9. CORRECTION FACTOR

When the indicated period is 1/2h or over, determined by the average or maximum temperature rise on the unexposed surface, a correction shall be applied for variation of the furnace exposure from that prescribed, where it will affect the classification, by multiplying the indicated period by two thirds of the difference in area between the curve of average furnace temperature and the standard curve for the first three fourths of the period and dividing the product by the area between the standard curve and a base line of 20°C (68°F) for the same part of the indicated period, the latter area increased by 1800 °C .min (3240 °F.min) to compensate for the thermal lag of the furnace thermocouples during the first part of the test. For a fire exposure in the test higher than standard, the indicated resistance period shall be increased by the amount of correction. For a fire exposure in the test lower than standard, the indicated resistance period shall be similarly decreased for fire exposure below standard. The correction is accomplished by mathematically adding the factor, C, to the indicated resistance period.

The correction can be expressed by the following equation:

$$C = 2I(A-A_s) \div 3(A_s+L)$$

Where:

C = Correction, in the same units as I

I = Indicated fire-resistance period

A = Area under the curve of indicated average furnace temperature for the first three fourths of the indicated period

A_S = Area under the standard furnace curve for the same part of the indicated period, and

L = Lag correction in the same units as A and A_s (SI: 30°C·h or 1800°C·h, BG: 54°F·h or 3240°F·h)

In accordance with the ASTM E119-20 test standard, a calculation for any correction to the indicated fire resistance period was done. The correction factor was then mathematically added to the indicated fire resistance period, yielding the fire resistance period achieve by this specimen:

Time Correction Values		
Item	**Description**	**Test value**
C	Correction factor	0.13 minutes (8 seconds)
I	Indicated fire-resistance	180 minutes
A	Area under the curve of indicated average furnace temperature for the first three fourths of the indicated period	118046 (°C·min)
As	Area under the standard furnace curve for the same part of the indicated period	117915 (°C·min)
L	Lag correction	1800 (°C·min)

10. SUMMARY OF RESULTS

The non-loadbearing 4mm thick Alstone FR A2 Aluminium Composite Panel (ACP) cladding assembly installed on 200mm thick masonry blocks has been evaluated in accordance with ASTM E119-20; Standard Test Methods for Fire Tests of Building Construction and Materials and ASTM E2226-15b; Standard Practice for Application of Hose Stream.

The requirements of the standards were satisfied for:

FIRE RESISTANCE RATING
180 MINUTES

This report and all records of the test to which it relates may not be retained by TBWIC beyond 5 years from the date of testing. This test report is respectfully submitted by: Thomas Bell-Wright International Consultants

Prepared By:

Kevin A. Zachariah
Senior Fire Testing Engineer

Reviewed & Authorized By:

Daisan Dippi, AIFireE
Fire Testing Manager

P.O.Box: 26385
DUBAI - U.A.E.
Thomas Bell-Wright Int'l Consultants (Dubai Br.)

Report Revision Tracking		
Revision No.	**Date Issued**	**Notes & Amendments**
Rev. 00	12-Jun-23	This is the first issue of the report. No revisions are included.

11. APPENDIX 1 – DESCRIPTION OF SPECIMEN

Note: All information provided herein Appendix 1 has been provided either by TBWIC or Test Sponsor. Information marked with a single asterisk indicates information provided by the Test Sponsor which has been checked against the materials used in the test where appropriate, however does not fall under the responsibility of TBWIC. All dimensions are expressed in millimetres (mm), unless otherwise specified.

Overall	
Type	Non-loadbearing 4mm thick Alstone FR A2 Aluminium Composite Panel (ACP) cladding assembly installed on 200mm thick masonry blocks
Dimensions	3050 x 3050 x 70mm (w x h x t)

Block Wall			
	8'' Solid Block	**8'' Hollow Block**	**Mortar**
Material	Aggregate Concrete	Aggregate Concrete	Portland Limestone Cement
Manufacturer	Khaloori Block Factory	Khaloori Block Factory	Ultratech
Dimension	400 x 200 x 200mm (l x w x thk.)	400 x 200 x 200mm (l x w x thk.)	5mm thick
Weight	35.45kg(measured)	20.65kg(measured)	50kg per bag

Mix Ratio for Blocks (1m³)	**Sl. No**	**Material**	**Quantity**
	1	10mm Crushed Aggregate*	800kg*
	2	5mm Limestone Aggregate*	250kg*
	3	Black Washed Sand*	800kg*
	4	White Washed Sand*	800kg*
	5	Cement*	220kg*
	6	Water*	200 litres*

Mortar Mix Ratio	**Sl. No**	**Description**	**Weight Percentage (%)**
	1	Cement	20
	2	Water	30
	3	Sand	50

Fixing method	The wall was built in a symmetrical orientation. Two cement bags were used for the mortar for laying the whole block wall. A 5mm thick layer of Portland cement was applied and maintained between each block both vertically and horizontally. Solid blocks were laid out in a horizontal line at the location of the wall brackets. Hollow blocks were used to construct the rest of the block wall.

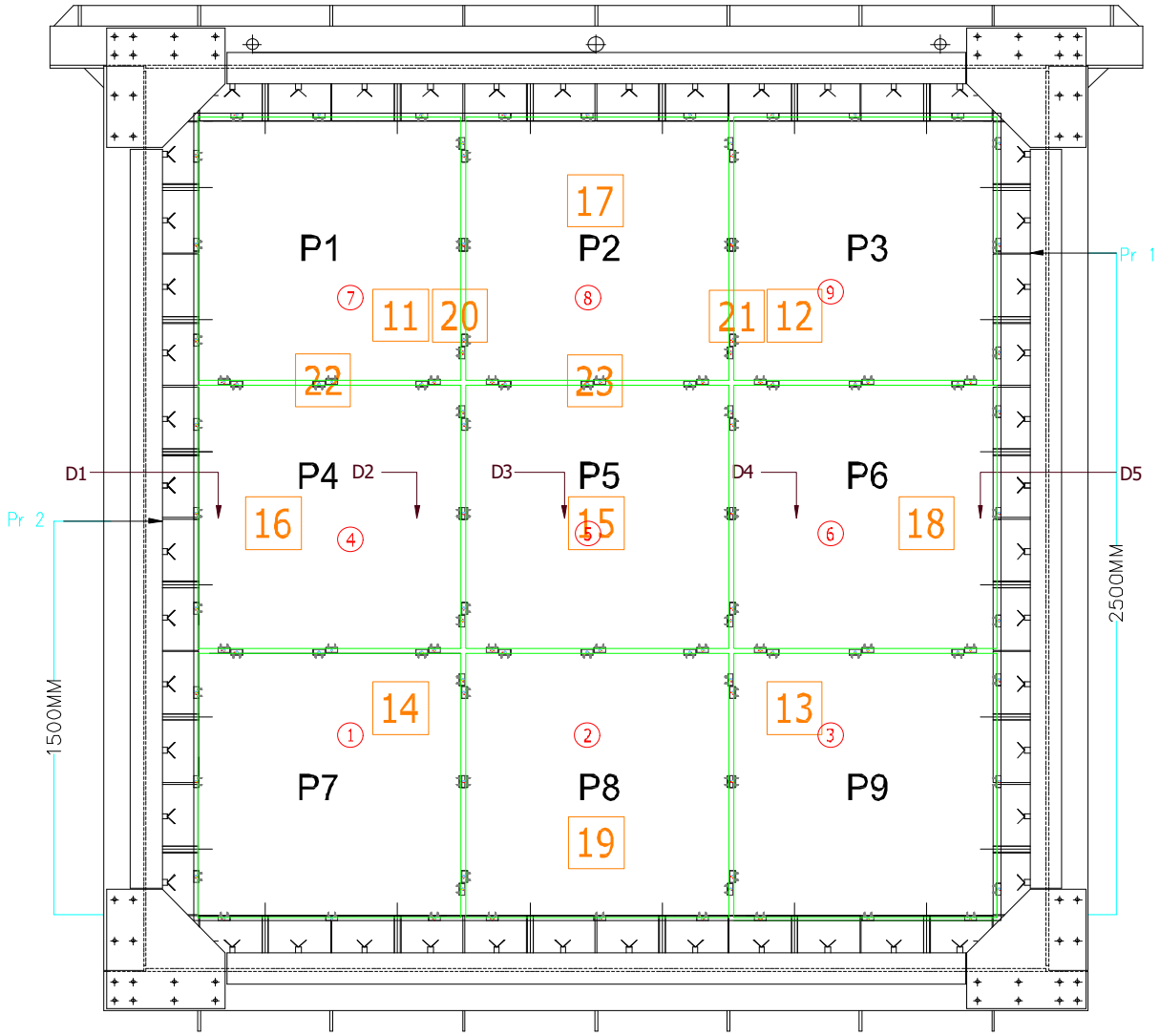
Framing Components			
	Wall Brackets	**Runner Profiles**	**Runner Profile Connectors**
Manufacturer	Arabian Extrusion Factory*	Arabian Extrusion Factory*	Arabian Extrusion Factory*
Material	Aluminium 6063-T6	Aluminium 6063-T6	Aluminium 6063-T6
Dimension	50 x 50 x 65 x 3mm (leg x leg x l x thk.)	50 x 25 x 2mm RHS section (l x w x thk.)	25 x 20 x 40 x 2mm (leg_1 x leg_2 x l x thk.)
Fixing Method & Application	The wall brackets were fixed to the block wall using M8 x 80mm long anchor bolts as shown in Drawing 2 of Appendix 2. The vertical oriented runners were fixed to the wall brackets via M8 x 70mm hexagonal bolt with washer. Runner profile connectors were		

	fixed to the vertically and horizontally oriented runners via Ø4 x 25mm hexagonal head self-tapping screws, thereby connecting them as shown in Drawing 3 of Appendix 2.

Aluminium Composite Panels		
Material	4mm thick Aluminium Composite Panel	
Fabricator	Alstone Manufacturing Private Limited	
Reference	Alstone FR A2	
	Material	**Thickness**
Top skin	PVDF coated Aluminium 3003-H16	0.5mm
Bottom skin	Polyester coated Aluminium 3003-H16	0.5mm
Core	FR A2 Mineral core	3mm
Panel Thickness	4mm	
Each Panel Dimension	995 x 995 x 20 (w x l x flange)	
Air Cavity and Specimen Depth	The total exterior cavity depth from the exterior face of the block wall to the exterior face of the ACP panel was nominally 70mm. The air gap between the exterior face of the block wall and the inner face of the panel was 66mm.	
Fixing Method	The ACP panels were fixed to the runners via panel cleats using Ø4 x 25mm hexagonal head self-tapping screws	

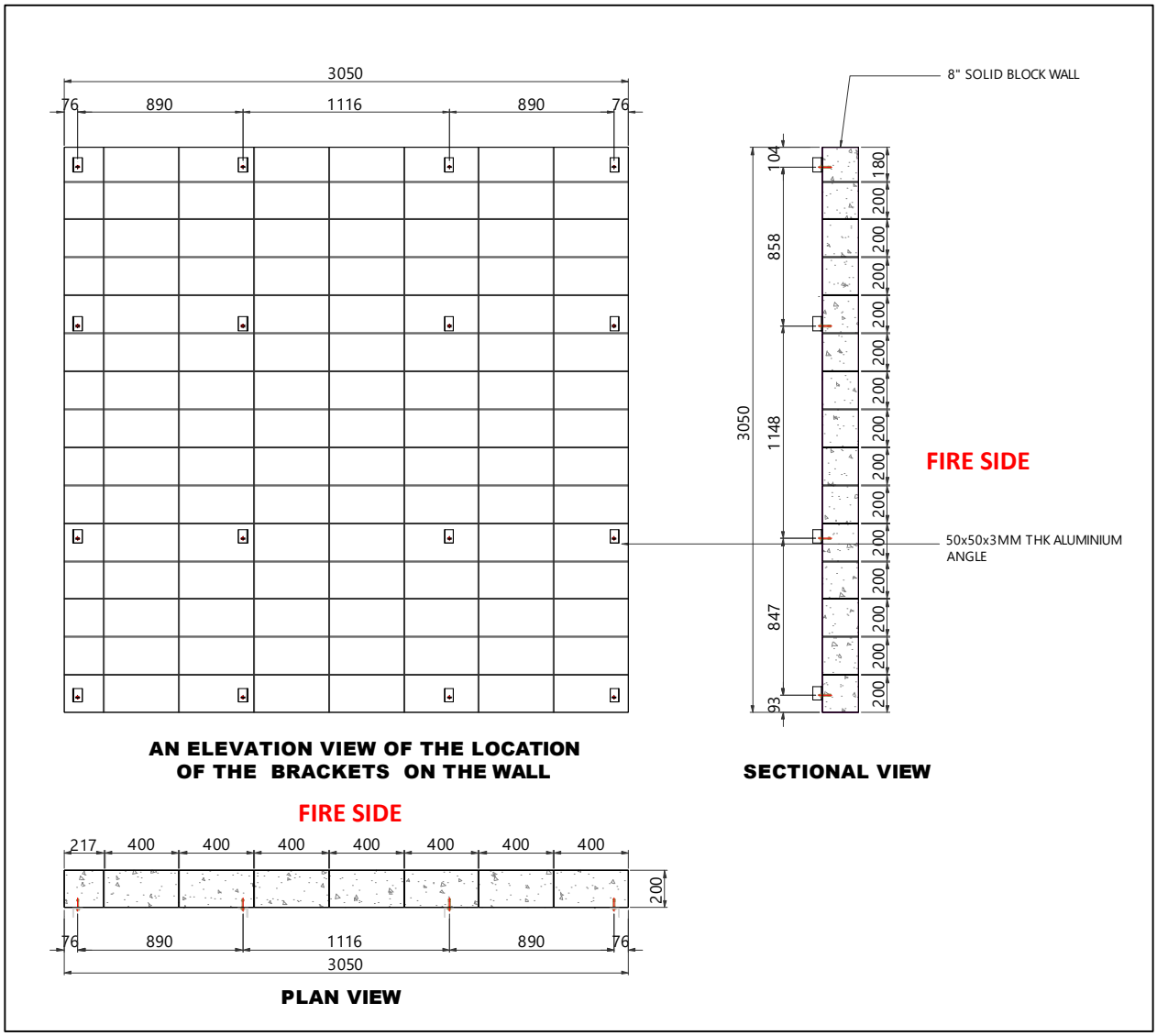
Panel Cleat, Corner Cleat and Gap Fill			
	Panel Cleat	**Corner Cleat**	**Gap Fill**
Manufacturer	Arabian Extrusion Factory*	Arabian Extrusion Factory*	Arabian Extrusion Factory*
Material	Aluminium 6063-T6	Aluminium 6063-T6	Aluminium 6063-T6
Dimensions	20 x 20 x 40 x 2mm (leg x leg x l x thk.)	20 x 20 x 16 x 2mm (leg x leg x l x thk.)	20 x 20 x 1mm U-channel (l x w x thk.)
Fixing Method & Application	The ACP panels were fixed to the system with the support of angle cleats which were rivet fixed to the tray profile of the panels using two Ø5x12mm rivets for each cleat. A corner cleat reinforcement was fixed to the inner face of the return bend of the ACPs using two Ø5x12mm rivets for each reinforcement. The panels were spaced 20mm from one another vertically and horizontally and an Aluminium U-profile channel was fixed within the panel gap and reinforced with Ø3.9 x 35mm flathead self-tapping screws.		

12. APPENDIX 2 – DRAWINGS

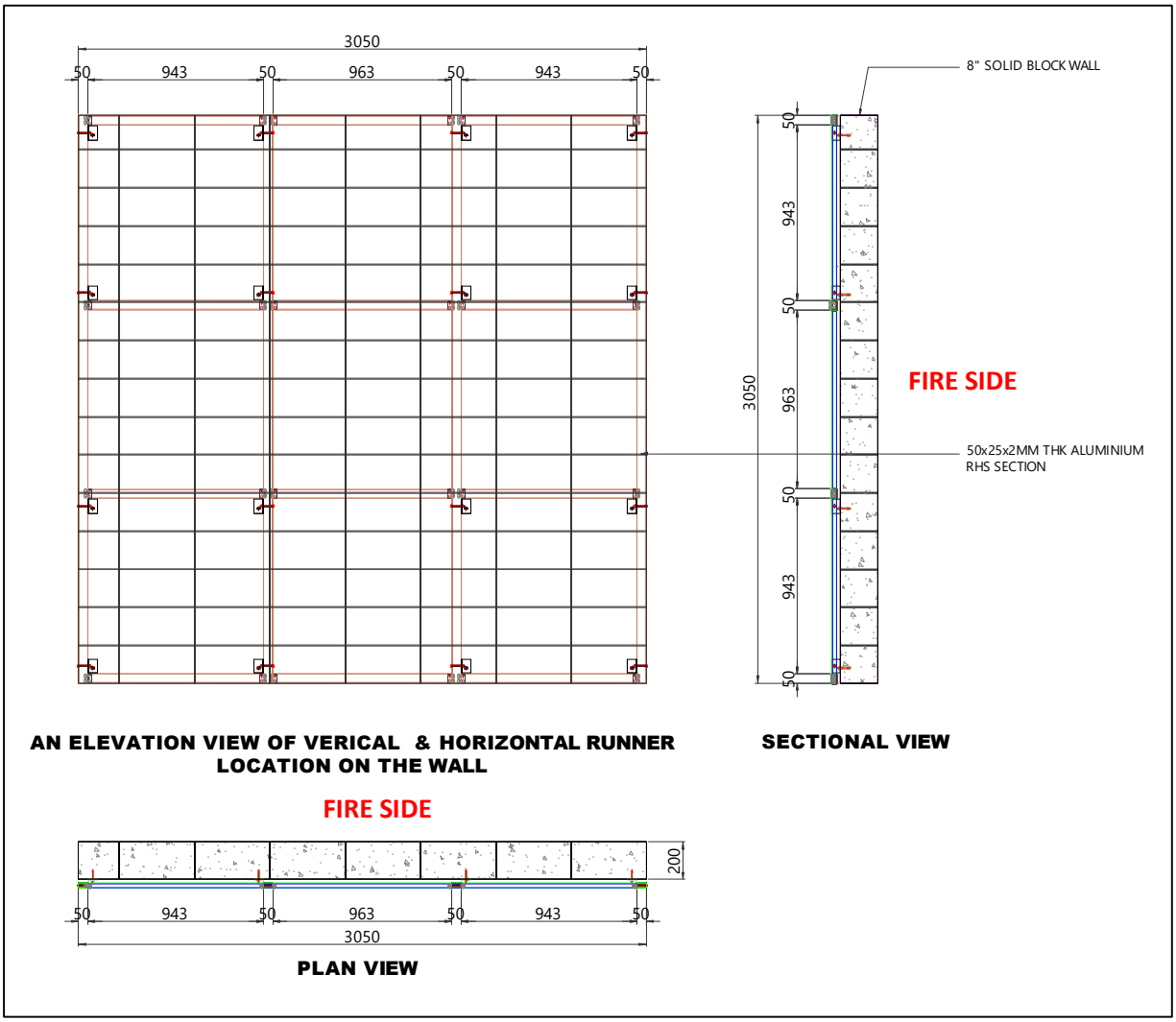


INSTRUMENTATION	
Pr1	Furnace pressure probe 1 located at 2500mm above the furnace floor level
Pr2	Furnace pressure probe 2 located at 1500mm above the furnace floor level
Tc1 - Tc9	Thermocouples to measure furnace temperature
Tc11 – Tc19	Thermocouples to measure the temperature on the unexposed face of the specimen
D1 – D5	Deflection measurement points

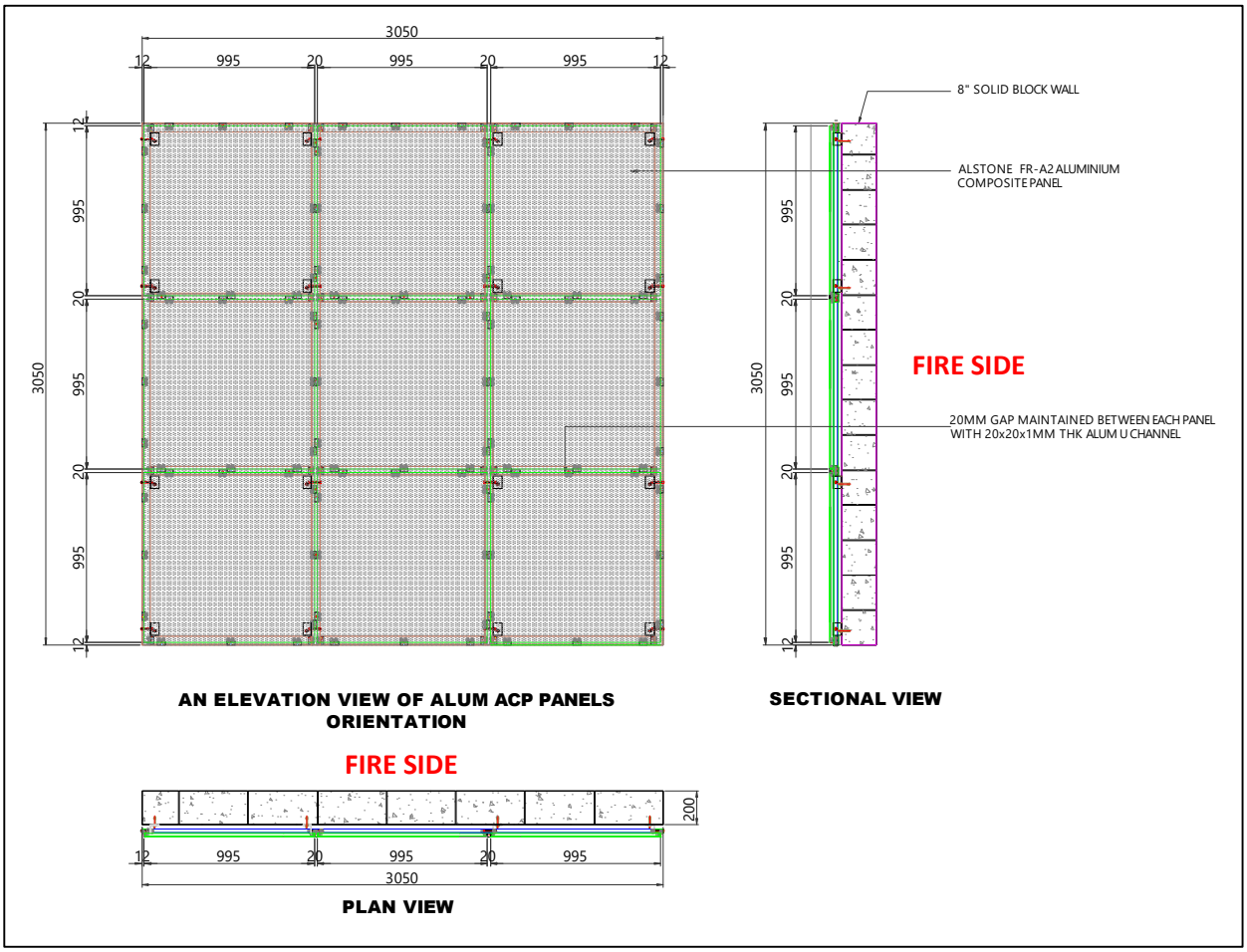
Drawing 1: Overall instrumentation of the specimen.
(Drawing produced by TBWIC)



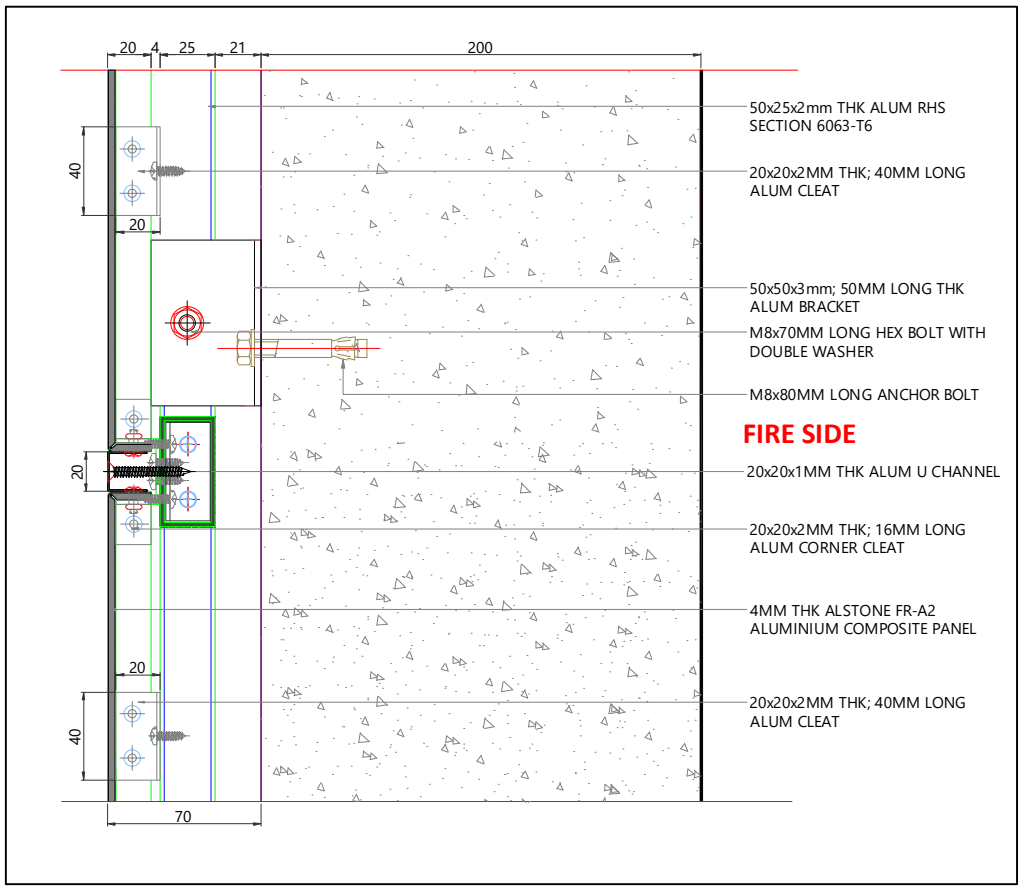
Drawing 2: Elevation of the wall bracket layout along with plan and sectional view.
(Drawing provided by sponsor)



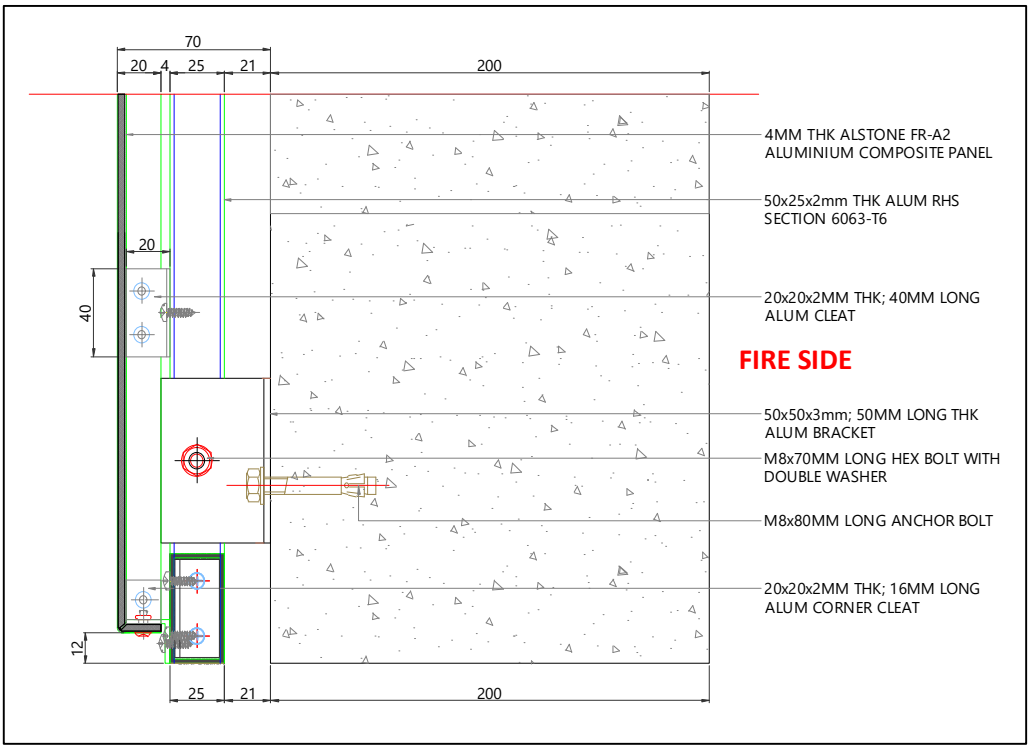
Drawing 3: Elevation of the runner layout along with plan and sectional view.
(Drawing provided by sponsor)



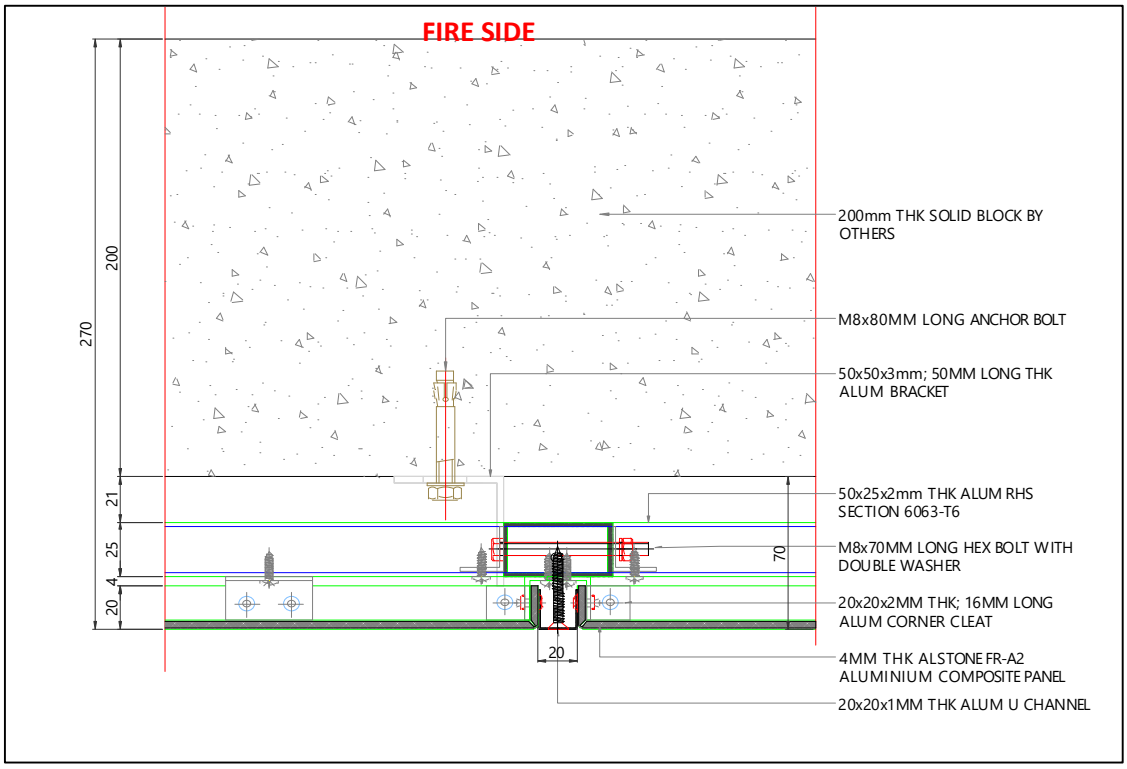
Drawing 4: Elevation of the ACP layout along with plan and sectional view.
(Drawing provided by sponsor)



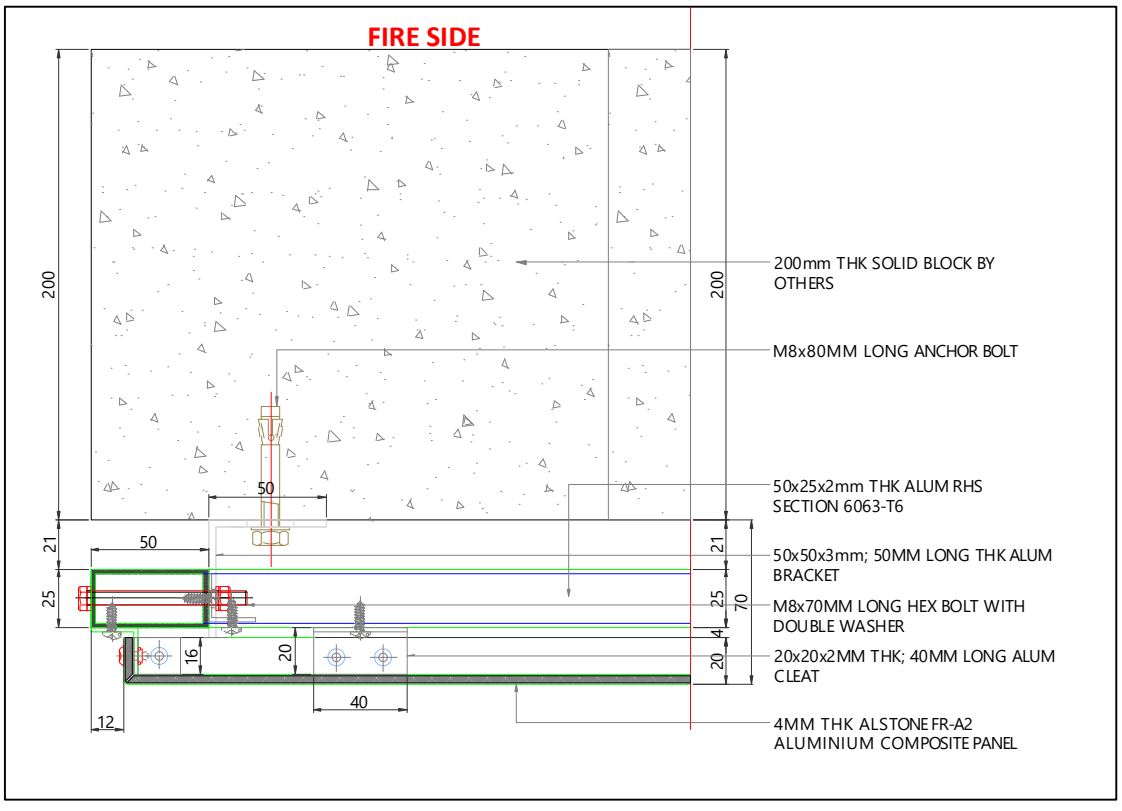
Drawing 5: Vertical section detail of the specimen at the ACP horizontal joint.
(Drawing provided by sponsor)



Drawing 6: Vertical section detail of the specimen at the bottom.
(Drawing provided by sponsor)

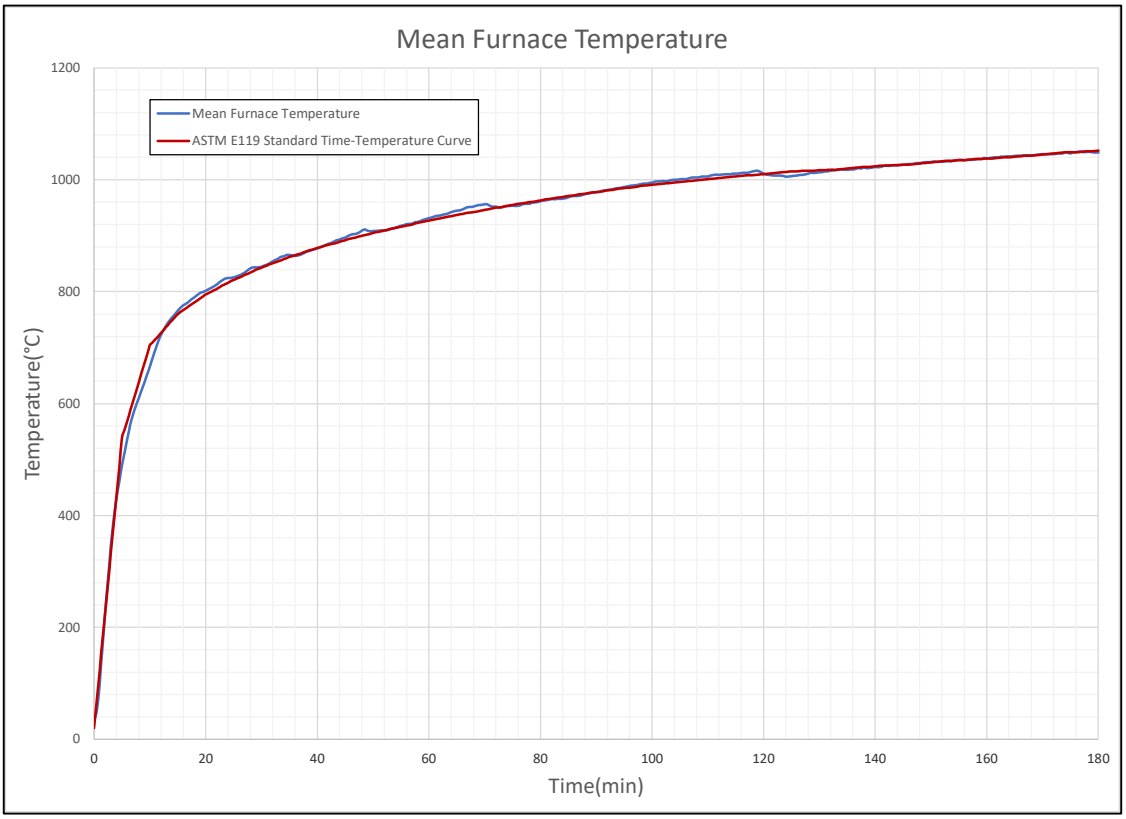


Drawing 7: Horizontal section detail of the specimen at the ACP vertical joint.
(Drawing provided by sponsor)

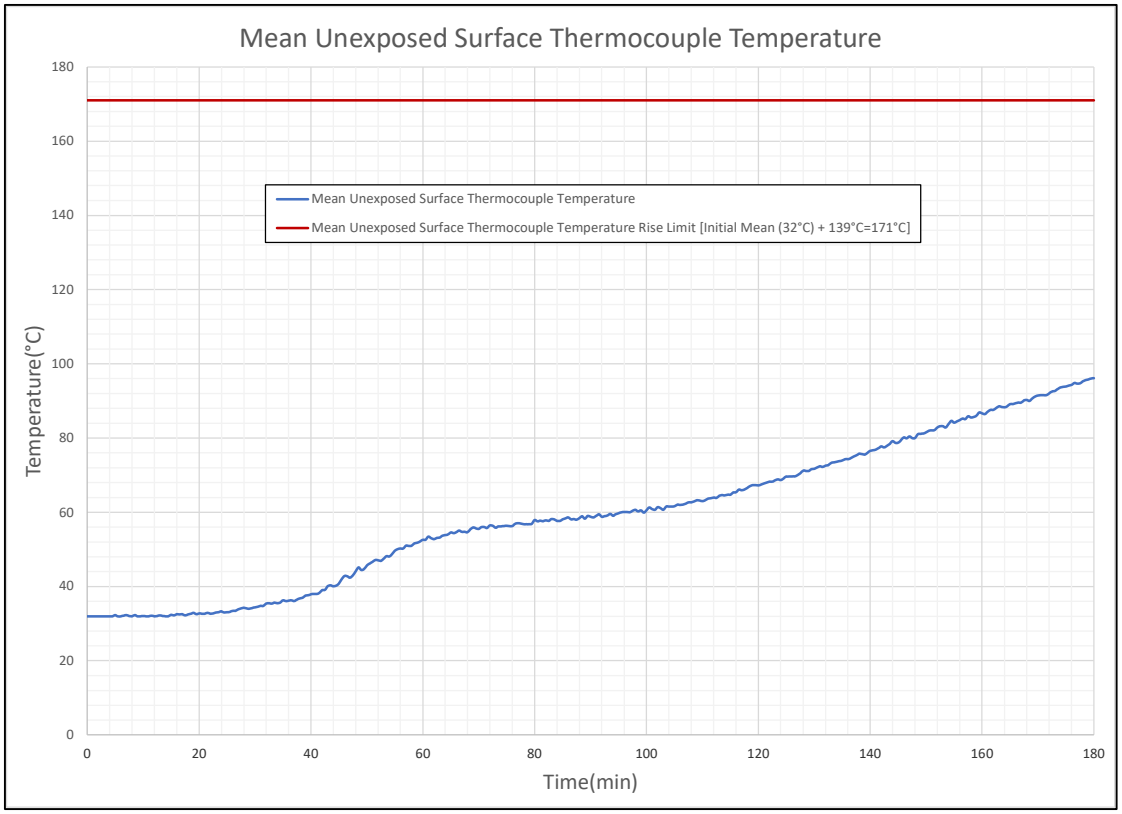


Drawing 8: Horizontal section detail of the specimen at the edge.
(Drawing provided by sponsor)

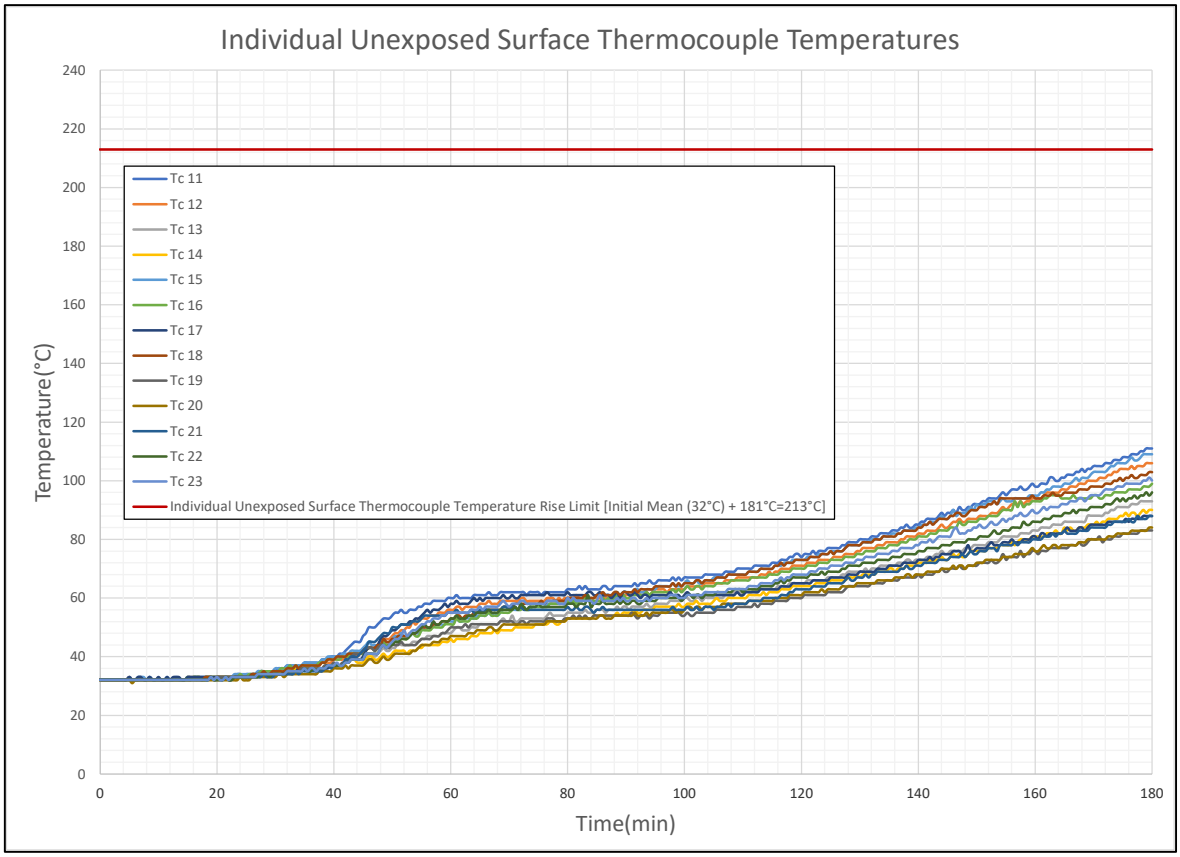
13. APPENDIX 3 – GRAPHS



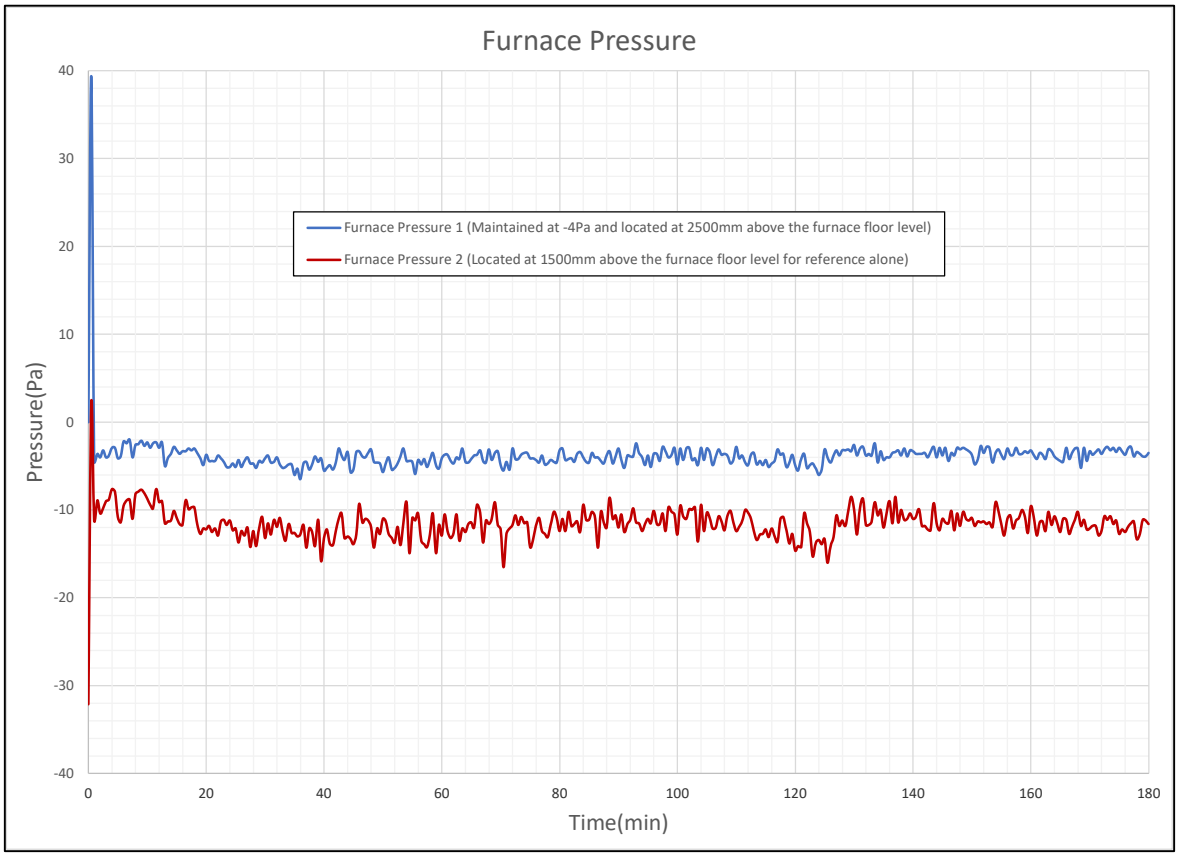
Graph 1: Mean Furnace Temperature



Graph 2: Mean Unexposed Surface Temperature



Graph 3: Individual Unexposed Surface Thermocouple Temperatures



Graph 4: Furnace Pressure

14. APPENDIX 4 – DEFLECTION

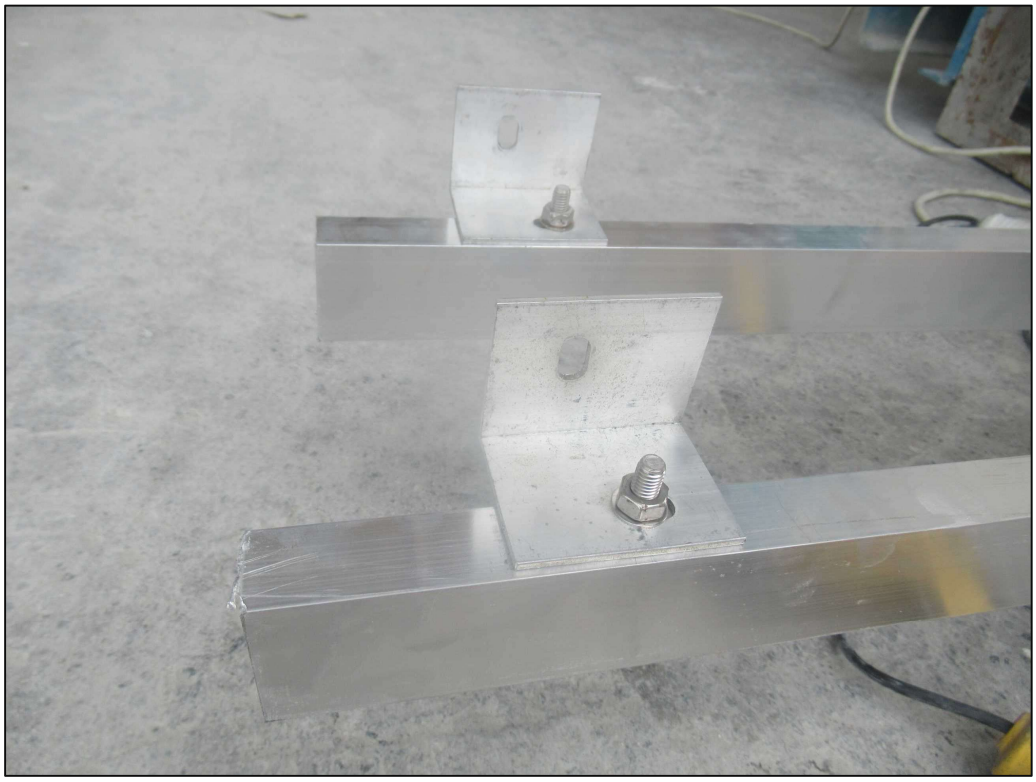
The following table shows the deflection measurements in mm. recorded during the test.

(+) are for measurements going into the furnace.

(-) are for measurements coming out of the furnace.

Time (min)	Deflection Point				
	D1	D2	D3	D4	D5
0:00	0	0	0	0	0
5:00	0	0	0	0	0
10:00	3	2	5	4	2
15:00	3	5	7	6	2
30:00	4	4	8	7	5
40:00	3	8	8	7	5
50:00	2	6	7	4	4
60:00	2	4	6	5	2
70:00	2	4	7	5	2
80:00	2	4	7	5	2
90:00	2	4	8	4	4
100:00	2	4	6	7	4
110:00	2	4	8	7	4
120:00	2	4	7	6	4
130:00	2	4	7	5	4
140:00	3	4	8	5	5
150:00	4	7	8	6	5
160:00	5	6	10	6	4
165:00	4	6	14	7	4
170:00	4	8	14	7	4
175:00	2	8	14	12	4

15. APPENDIX 5 – CONSTRUCTION PHOTOGRAPHS



Picture 1: The brackets fastened to the runners.

Picture 2: The horizontal runners connected to the vertical runners.

Picture 3: The specimen after the framing system was completely installed.

Picture 4: The tray profile of the ACPs.

Picture 5: The ACP being fastened to the runners.

Picture 6: The U-channels being fixed to the panel gaps.

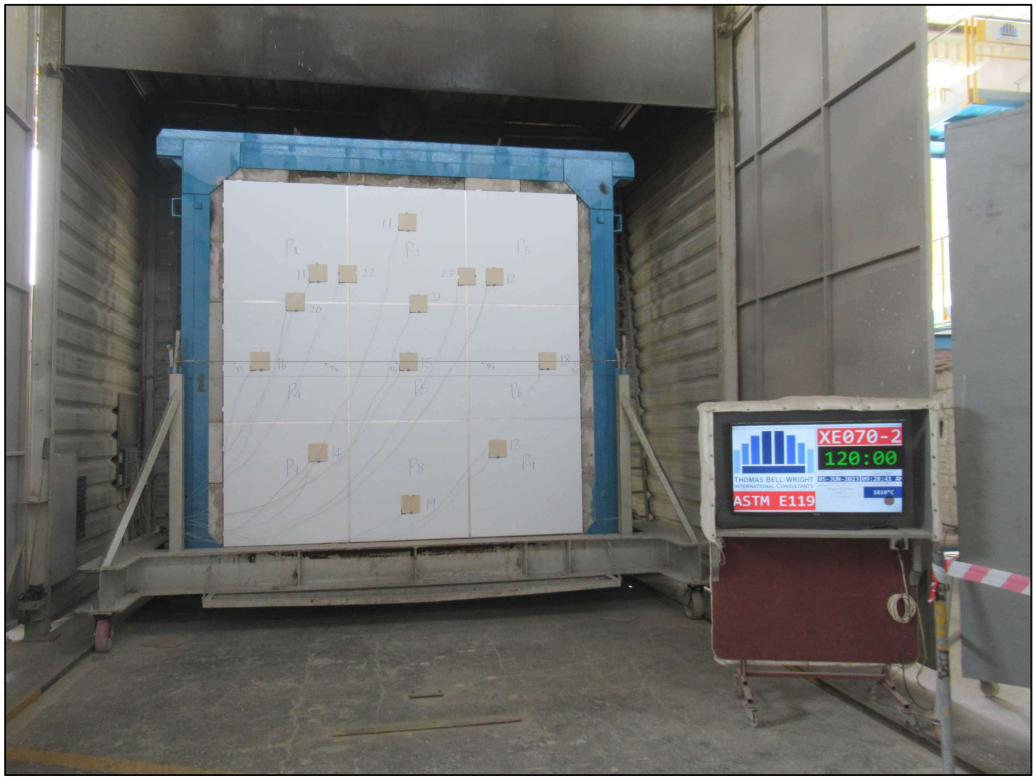
16. APPENDIX 6 – TEST PHOTOGRAPHS

Picture 7: The exposed face of the specimen prior to the start of the test.

Picture 8: The unexposed face of the specimen after the start of the test.

Picture 9: The unexposed face of the specimen after 30:00 minutes.

Picture 10: The unexposed face of the specimen after 60:00 minutes.



Picture 11: The unexposed face of the specimen after 120:00 minutes.

Picture 12: The unexposed face of the specimen after 180:00 minutes.

Picture 13: The exposed face of the specimen prior to the start of the hose stream test.

Picture 14: The exposed face of the specimen during the hose stream test.

Picture 15: The exposed face of the specimen prior after the hose stream test.

Picture 16: The unexposed face of the specimen after the hose stream test.

----- End of Test Report -----