

Technical Report

Title: Product wind resistance, dynamic water tightness and impact resistance testing of a rainscreen panel assembly for Architectural Profiles Limited

Report No: N950-21-18153



Technical Report

Title: Product wind resistance, dynamic water tightness and impact resistance testing a rainscreen panel assembly for Architectural Profiles Limited

Customer: Architectural Profiles Limited,
53 Crockhamwell Road,
Woodley, Berkshire, RG5 3JP

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Author(s): D. Bennett - Technician



Checked by: N. McDonald – Manager



Authorised by: S. R. Moxon – Operations Director



Distribution: 1 copy to Architectural Profiles Limited
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**VINCI Technology Centre UK Limited,
Stanbridge Road, Leighton Buzzard, Bedfordshire, LU7 4QH**

Registered Office, Watford. Registered No. 05640885 England.

Tel. 0333 5669000

email info@technology-centre.co.uk

web www.technology-centre.co.uk

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1 INTRODUCTION

This report describes tests carried out at VINCI Technology Centre UK Limited at the request of Architectural Profiles Limited.

The test sample consisted of a sample of rainscreen cladding manufactured by Architectural Profiles Limited.

The tests were carried out on 6 September 2021 and were to determine the wind, water and impact resistance of the test sample. The test methods were in accordance with the CWCT Standard Test Methods for building envelopes, 2005, for:

Wind resistance – serviceability & safety.

Watertightness – dynamic pressure.

Impact resistance.

The testing was carried out in accordance with Technology Centre Method Statement C8582MS rev 0.

This test report relates only to the actual sample as tested and described herein.

The results are valid only for sample(s) tested and the conditions under which the tests were conducted.

The long-term durability of the façade system is not assessed by these test methods.

VINCI Technology Centre UK Limited is accredited to ISO/IEC 17025:2017 by the United Kingdom Accreditation Service as UKAS Testing Laboratory No. 0057.

VINCI Technology Centre UK Limited is Approved Body No. 1766.

VINCI Technology Centre UK Limited is certified by BSI for:

- ISO 9001:2008 Quality Management System,
- ISO 14001:2004 Environmental Management System,
- BS OHSAS 18001:2007 Occupational Health and Safety Management System.

The tests were witnessed by David Dunne of Architectural Profiles Ltd.

2 SUMMARY AND CLASSIFICATION OF TEST RESULTS

The following summarises the results of the tests carried out. For full details refer to Sections 6, 7 and 8.

2.1 SUMMARY OF TEST RESULTS

TABLE 1

Date	Test number	Test description	Result
6 September 2021	1	Wind resistance – serviceability	Pass
6 September 2021	2	Wind resistance – safety	Pass
6 September 2021	3	Watertightness - dynamic	Pass
6 September 2021	4	Impact resistance	Pass

2.2 CLASSIFICATION

TABLE 2

Test	Standard	Classification / Declared value
Wind resistance	CWCT	±2400 pascals serviceability ±3600 pascals safety
Watertightness - dynamic	CWCT	600 pascals
Impact resistance	CWCT TN76	<p><u>Soft body</u></p> <p>120 J - Class 1 serviceability (flat panels) Class 2 serviceability</p> <p>350 J & 500 J - Negligible risk safety</p> <p><u>Hard body</u></p> <p>3 J - Class 1 serviceability (flat panels) Class 2 serviceability</p> <p>6 J - Class 2 serviceability</p> <p>10 J - Class 3 serviceability</p> <p>3 J & 10 J - Negligible risk safety</p>

3 DESCRIPTION OF TEST SAMPLE

3.1 GENERAL ARRANGEMENT

The sample was as shown in the photo below and the drawings included as an appendix to this report.

The test sample measured 6.0 m high by 6.0 m wide.

The sample was mounted on a backing wall supplied by Technology Centre, comprising of 100 x 100 mm angle and 19 mm plywood boards.

PHOTO 1759

TEST SAMPLE ELEVATION



3.2 CONTROLLED DISMANTLING

During the dismantling of the sample no discrepancies from the drawings were found.

SAMPLE DURING DISMANTLE



PHOTO 1973

SAMPLE DURING DISMANTLE



PHOTO 4276

SAMPLE DURING DISMANTLE



PHOTO 1975

SAMPLE DURING DISMANTLE



PHOTO 1977

SAMPLE DURING DISMANTLE



PHOTO 1982

SAMPLE DURING DISMANTLE



PHOTO 1986

SAMPLE DURING DISMANTLE

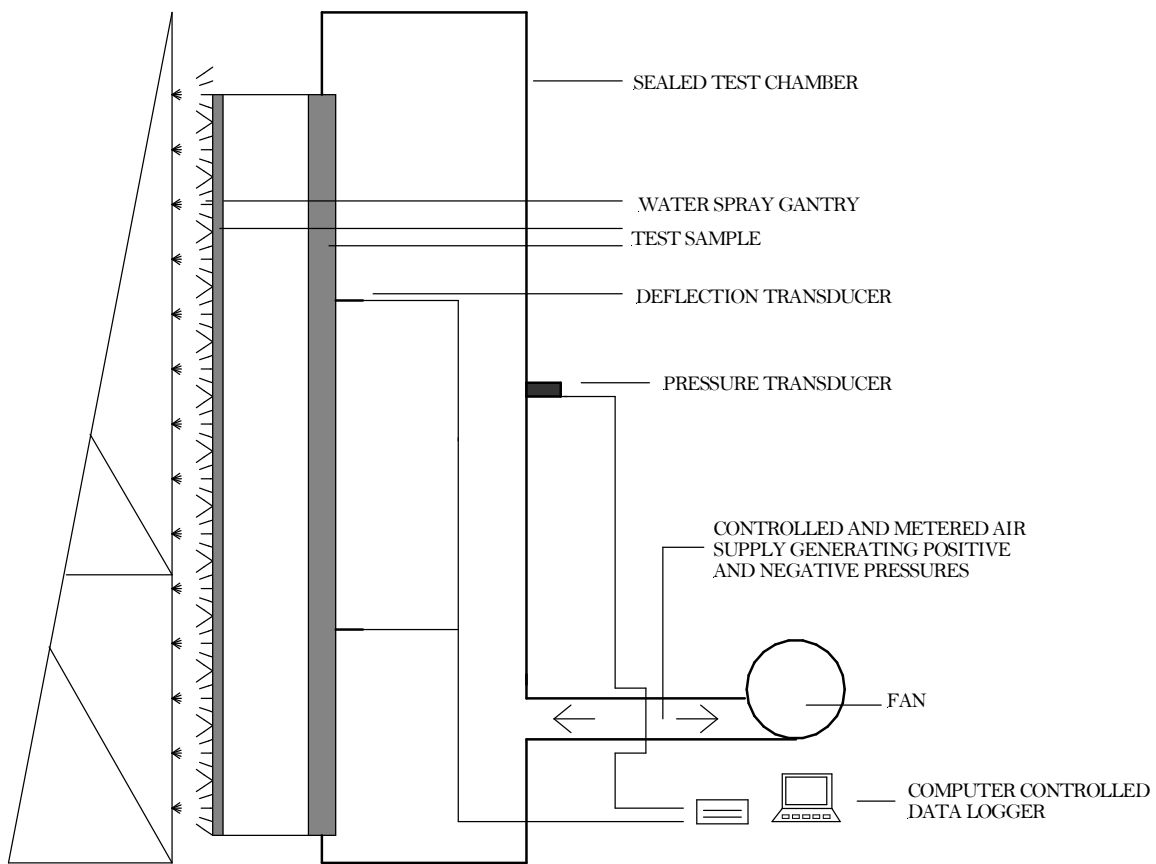


4 TEST RIG GENERAL ARRANGEMENT

The test sample was mounted on a rigid test rig with support steelwork designed to simulate the on-site/project conditions. The test rig comprised a well sealed chamber, fabricated from steel and plywood. A door was provided to allow access to the chamber. Representatives of Architectural Profiles Ltd installed the sample on the test rig. See Figure 1.

FIGURE 1

TEST RIG SCHEMATIC ARRANGEMENT



SECTION THROUGH TEST RIG

5 TEST SEQUENCE

The test sequence was as follows:

- (1) Wind resistance – serviceability
- (2) Wind resistance - safety
- (3) Watertightness – dynamic
- (4) Impact resistance

6 WIND RESISTANCE TESTING

6.1 INSTRUMENTATION

6.1.1 Pressure

One static pressure tapping was provided to measure the chamber pressure and was located so that the readings were unaffected by the velocity of the air supply into or out of the chamber.

A pressure transducer, capable of measuring rapid changes in pressure to within 2% was used to measure the differential pressure across the sample.

6.1.2 Deflection

Displacement transducers were used to measure the deflection of principle framing members to an accuracy of 0.1 mm. The gauges were set normal to the sample framework at mid-span and as near to the supports of the members as possible and installed in such a way that the measurements were not influenced by the application of pressure or other loading to the sample. The gauges were located at the positions shown in Figure 2.

6.1.3 Temperature

Platinum resistance thermometers (PRT) were used to measure air temperatures to within 1°C.

6.1.4 General

Electronic instrument measurements were scanned by a computer controlled data logger, which also processed and stored the results.

All measuring instruments and relevant test equipment were calibrated and traceable to national standards.

6.2 FAN

The air supply system comprised a variable speed centrifugal fan and associated ducting and control valves to create positive and negative static pressure differentials. The fan provided essentially constant air flow at the fixed pressure for the period required by the tests and was capable of pressurising at a rate of approximately 600 pascals in one second.

6.3 PROCEDURE

6.3.1 Wind Resistance – serviceability

Three positive pressure differential pulses of 1200 pascals were applied to prepare the sample. The displacement transducers were then zeroed.

The sample was subjected to one positive pressure differential pulse from 0 to 2400 pascals to 0. The pressure was increased in four equal increments each maintained for 15 ±5 seconds. Displacement readings were taken at each increment. Residual deformations were measured on the pressure returning to zero.

Any damage or functional defects were recorded.

The test was then repeated using a negative pressure of -2400 pascals.

6.3.2 Wind Resistance – safety

Three positive pressure differential pulses of 1200 pascals were applied to prepare the sample. The displacement transducers were then zeroed.

The sample was subjected to one positive pressure differential pulse from 0 to 3600 pascals to 0. The pressure was increased as rapidly as possible but not in less than 1 second and maintained for 15 ± 5 seconds. Displacement readings were taken at peak pressure. Residual deformations were measured on the pressure returning to zero.

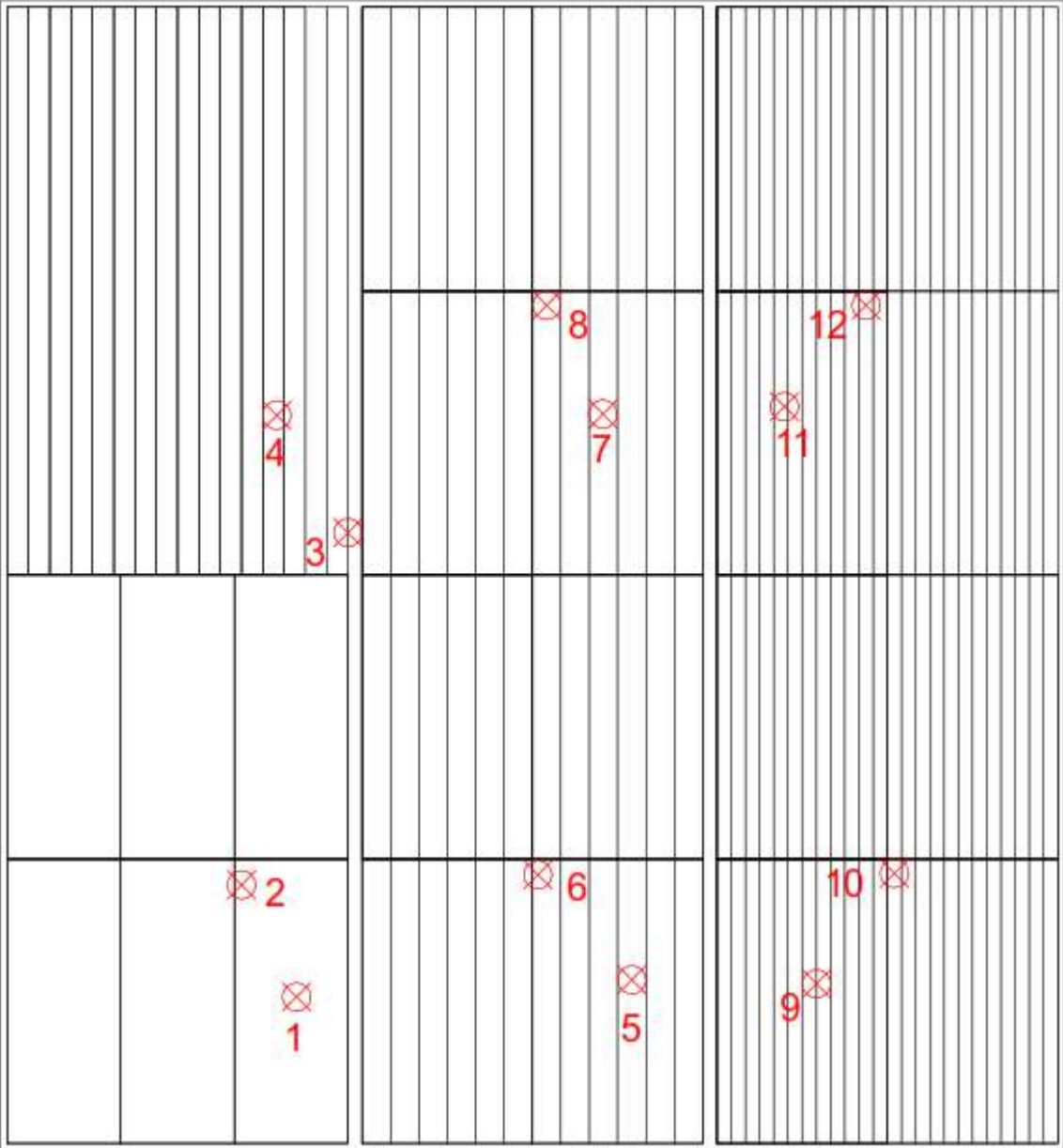
Any damage or functional defects were recorded.

The test was then repeated using a negative pressure of -3600 pascals.

FIGURE 2

DEFLECTION GAUGE LOCATIONS

External View



 Deflection gauge

6.4 PASS/FAIL CRITERIA

6.4.1 Calculation of permissible deflection

Serviceability Test

TABLE 3

Gauge number	Panel span (L) (mm)	Permissible deflection (mm)
1	1494	$L/90 = 16.6$
4	2998	$L/90 = 33.3$
5, 7, 9, 11	1549	$L/90 = 17.2$

6.5 RESULTS

Test 1 (serviceability) Date: 6 September 2021

The deflections measured during the wind resistance test, at the positions shown in Figure 2, are shown in Tables 5 and 6.

Summary:

Serviceability Test

TABLE 4

Gauge number	Pressure differential (Pa)	Measured deflection (mm)	Residual deformation (mm)
1	2403	8.5	0.2
	-2408	-11.6	-0.1
4	2403	5.9	0.1
	-2408	-9.3	-0.2
5	2403	6.9	0.0
	-2408	-7.5	0.0
7	2403	4.3	0.1
	-2408	-7.0	-0.1
9	2403	5.0	0.1
	-2408	-5.1	0.0
11	2403	5.6	0.1
	-2408	-6.2	-0.1

No damage to the test sample was observed.

Ambient temperature = 20°C
Chamber temperature = 21°C

Test 2 (safety) Date: 6 September 2021

The deflections measured during the structural safety test, at the positions shown in Figure 2, are shown in Table 7.

No damage to the sample was observed.

Ambient temperature = 22°C
Chamber temperature = 23°C

TABLE 5

WIND RESISTANCE – POSITIVE SERVICEABILITY TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	600	1203	1808	2403	Residual
1	2.4	4.7	7.3	10.0	0.3
2	0.4	0.8	1.2	1.5	0.1
3	2.5	5.0	7.4	10.3	0.5
4	1.4	2.1	3.1	4.4	0.4
5	2.0	4.3	6.7	9.0	0.4
6	0.4	1.1	1.5	2.1	0.4
7	1.5	3.2	4.9	6.7	0.3
8	0.4	0.9	1.6	2.4	0.2
9	1.4	3.0	4.4	6.4	0.2
10	0.3	0.6	1.0	1.4	0.1
11	1.5	3.2	4.6	6.7	0.3
12	0.2	0.4	0.7	1.1	0.5

TABLE 6

WIND RESISTANCE – NEGATIVE SERVICEABILITY TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	-605	-1203	-1800	-2408	Residual
1	-3.3	-6.9	-10.4	-14.6	0.0
2	-0.5	-1.3	-2.2	-3.0	-0.1
3	-3.1	-6.4	-10.2	-14.3	-1.0
4	-0.7	-1.9	-3.9	-5.0	-1.1
5	-2.9	-6.0	-9.2	-12.5	-0.5
6	-1.1	-2.4	-3.6	-5.0	-0.5
7	-2.5	-5.3	-7.8	-10.9	-0.3
8	-0.9	-1.9	-2.9	-3.9	-0.2
9	-2.4	-4.9	-7.5	-10.0	-0.6
10	-0.7	-1.7	-3.1	-4.8	-0.6
11	-2.1	-3.6	-4.8	-7.3	-0.8
12	-0.3	-0.3	-0.4	-0.9	-0.7

TABLE 7

WIND RESISTANCE - SAFETY TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)			
	3601	Residual	-3599	Residual
1	16.4	0.2	-22.0	-0.3
2	2.1	0.1	-3.4	-0.2
3	16.8	0.5	-21.3	-2.2
4	6.0	0.5	-7.1	-1.4
5	14.9	0.9	-18.8	-1.7
6	3.3	1.0	-7.2	1.0
7	10.2	0.4	-16.8	-1.0
8	4.1	0.6	-6.8	-1.1
9	9.6	0.7	-16.3	-1.4
10	2.7	0.6	-7.1	-1.5
11	10.6	0.9	-12.5	-1.6
12	1.5	0.7	-2.1	-1.0

7 WATERTIGHTNESS TESTING

7.1 INSTRUMENTATION

7.1.1 Pressure

One static pressure tapping was provided to measure the chamber pressure and was located so that the readings were unaffected by the velocity of the air supply into or out of the chamber.

A pressure transducer, capable of measuring rapid changes in pressure to within 2% was used to measure the differential pressure across the sample.

7.1.2 Water Flow

An in-line water flow meter was used to measure water supplied to the spray gantry to within 5%.

7.1.3 Temperature

Platinum resistance thermometers (PRT) were used to measure air and water temperatures to within 1°C.

7.1.4 General

Electronic instrument measurements were scanned by a computer controlled data logger, which also processed and stored the results.

All measuring instruments and relevant test equipment were calibrated and traceable to national standards.

7.2 FAN

A wind generator was mounted adjacent to the external face of the sample and used to create positive pressure differentials during dynamic testing. The wind generator comprised a piston type aero-engine fitted with 4 m diameter contra-rotating propellers.

7.3 WATER SPRAY

The water spray system comprised nozzles spaced on a uniform grid not more than 700 mm apart and mounted approximately 400 mm from the face of the sample. The nozzles provided a full-cone pattern with a spray angle between 90° and 120°. The spray system delivered water uniformly against the exterior surface of the sample.

7.4 PROCEDURE

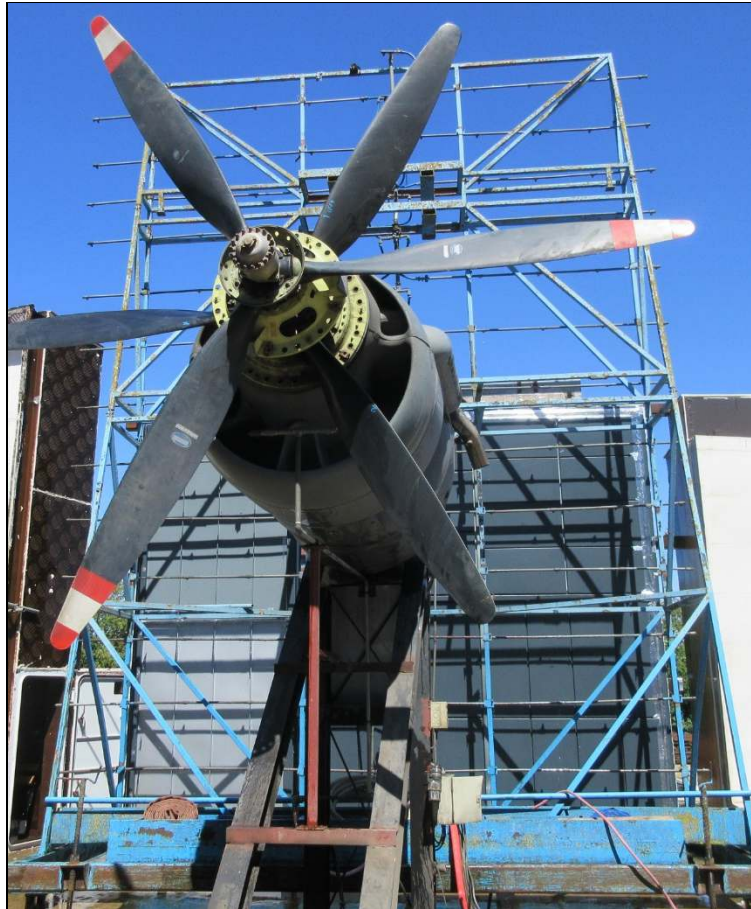
Water was sprayed onto the sample using the method described above at a flow rate of at least 3.4 litres/m²/minute.

The aero-engine was used to subject the sample to wind of sufficient velocity to produce average deflections in the principle framing members equal to those produced by a static pressure differential of 600 pascals. These conditions were maintained for 15 minutes. Throughout the test the inside of the sample was examined for water penetration.

7.5 PASS/FAIL CRITERIA

There shall be no water penetration to the internal face of the backing wall throughout testing. At the completion of the test there shall be no standing water in locations intended to remain dry.

DYNAMIC WIND GENERATOR



7.6 RESULTS

Test 3

Date: 6 September 2021

No water penetration was observed through the backing wall.

Chamber temperature= 21°C

Ambient temperature = 20°C

Water temperature = 18°C

8 IMPACT TESTING

8.1 IMPACTOR

8.1.1 Soft body

The soft body impactor comprised a canvas spherical/conical bag 400 mm in diameter filled with 3 mm diameter glass spheres with a total mass of 50 kg suspended from a cord at least 3 m long.

8.1.2 Hard body

The hard body impactor was a solid steel ball of 50 mm or 62.5 mm diameter and approximate mass of 0.5 kg or 1.0 kg.

8.2 PROCEDURE (CWCT TN76)

8.2.1 Soft body

The impactor almost touched the face of the sample when at rest. It was swung in a pendular movement to hit the sample normal to its face. The test was performed at the locations shown in Figure 3. The impact energies were 120 J for serviceability and 350 J and 500 J for safety.

8.2.2 Hard body

The impactor almost touched the face of the sample when at rest. It was swung in a pendular movement to hit the sample normal to its face. The test was performed at the locations shown in Figure 3. The impact energies were 3 J, 6 J and 10 J.

8.3 PASS/FAIL CRITERIA

Note: Tables 1 to 2 are taken from CWCT TN76.

Table 1 - Classes for serviceability performance

Class	Definition	Explanation/Examples
1	No damage.	No damage visible from 1m, and Any damage visible from closer than 1m unlikely to lead to significant deterioration.
2	Surface damage of an aesthetic nature which is unlikely to require remedial action.	Dents or distortion of panels not visible from more than 5m (note visibility of damage will depend on surface finish and lighting conditions – damage will generally be more visible on reflective surfaces), and Any damage visible from closer than 5m unlikely to lead to significant deterioration.
3	Damage that may require remedial action or replacement of components to maintain appearance or long term performance but does not require immediate action.	Dents or distortion of panels visible from more than 5m, or Spalling of edges of panels of brittle materials, or Damage to finishes that may lead to deterioration of the substrate.
4	Damage requiring immediate action to maintain appearance or performance. Remedial action may include replacement of a panel but does not require dismantling or replacement of supporting structure.	Significant cracks in brittle materials e.g. cracks that may lead to parts of tile falling away subsequent to test, or Fracture of panels causing significant amounts of material to fall away during test.
5	Damage requiring more extensive replacement than 4.	Buckling of support rails.

Table 2 - Classes for safety performance

Class	Explanation/examples
Negligible risk	No material dislodged during test, and No damage likely to lead to materials falling subsequent to test, and No sharp edges produced that would be likely to cause severe injury to a person during impact, and Cladding not penetrated by impactor.
Low risk	Maximum mass of falling particle 50g, and Maximum mass of particle that may fall subsequent to impact 50g, and No sharp edges produced that would be likely to cause severe injury during impact.
Moderate risk	Maximum mass of falling particle less than 500g, and Maximum mass of particle that may fall subsequent to impact less than 500g, and Cladding not penetrated by impact, and No sharp edges produced that would be likely to cause severe injury during impact.
High risk	Maximum mass of falling particle greater than 500g, or Cladding penetrated by impact, or Sharp edges produced that would be likely to cause severe injury during impact.

8.4 RESULTS

Test 4

Date: 6 September 2021

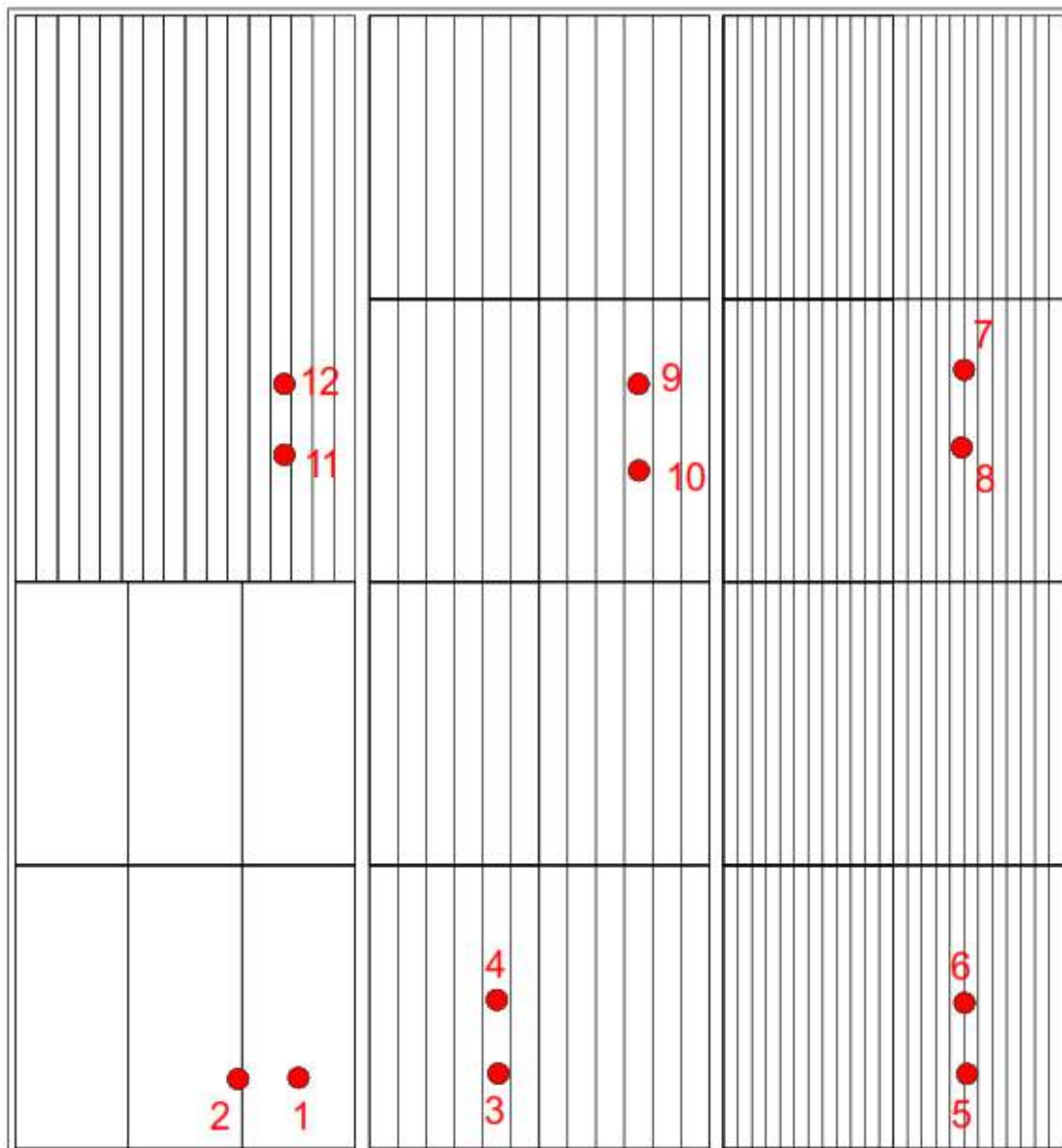
The impact test results are shown in Tables 8 and 9.

Ambient temperature = 21°C

FIGURE 3

IMPACT TEST LOCATIONS

External View



● Impact location

TABLE 8

SOFT BODY IMPACT RESISTANCE TEST RESULTS

Impact location	Impact energy (Nm)	Observations	Classification
1	120 x 3 350 500	No damage observed 2 mm deformation 5 mm deformation	Class 1 Negligible risk Negligible risk
2	120 x 3 350 500	No damage observed No damage observed No damage observed	Class 1 Negligible risk Negligible risk
3	120 x 3 350 500	No damage observed Large deformation Large deformation	Class 1 Negligible risk Negligible risk
4	120 x 3 350 500	Small crease at panel fixings Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
5	120 x 3 350 500	Small crease at panel fixings Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
6	120 x 3 350 500	Small crease at panel fixings Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
7	120 x 3 350 500	Small crease in panel Small crease in panel Small crease in panel	Class 2 Negligible risk Negligible risk
8	120 x 3 350 500	Small crease in panel Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
9	120 x 3 350 500	Small crease in panel Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
10	120 x 3 350 500	Small crease in panel Minor crumpling Further crumpling	Class 2 Negligible risk Negligible risk
11	120 x 3 350 500	10 mm deformation 15 mm deformation 20 mm deformation	Class 2 Negligible risk Negligible risk
12	120 x 3 350 500	Small crease in panel Large crease in panel Large crease in panel	Class 2 Negligible risk Negligible risk

T

TABLE 9

HARD BODY IMPACT RESISTANCE TEST RESULTS

Impact location	Impact energy (Nm)	Observations	Classification
1	3 6 10	No damage Slight mark Large indent	Class 1 / Negligible risk Class 1 Class 3 / Negligible risk
2	3 6 10	Slight indent Minor indent Large indent	Class 1 / Negligible risk Class 2 Class 3 / Negligible risk
3	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
4	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
5	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
6	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
7	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
8	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
9	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
10	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
11	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk
12	3 6 10	Minor indent Minor indent Large indent	Class 2 / Negligible risk Class 2 Class 3 / Negligible risk

PHOTO 1923

SOFT BODY IMPACTOR



PHOTO 1929

SOFT BODY IMPACT



PHOTO 1931

SOFT BODY IMPACT

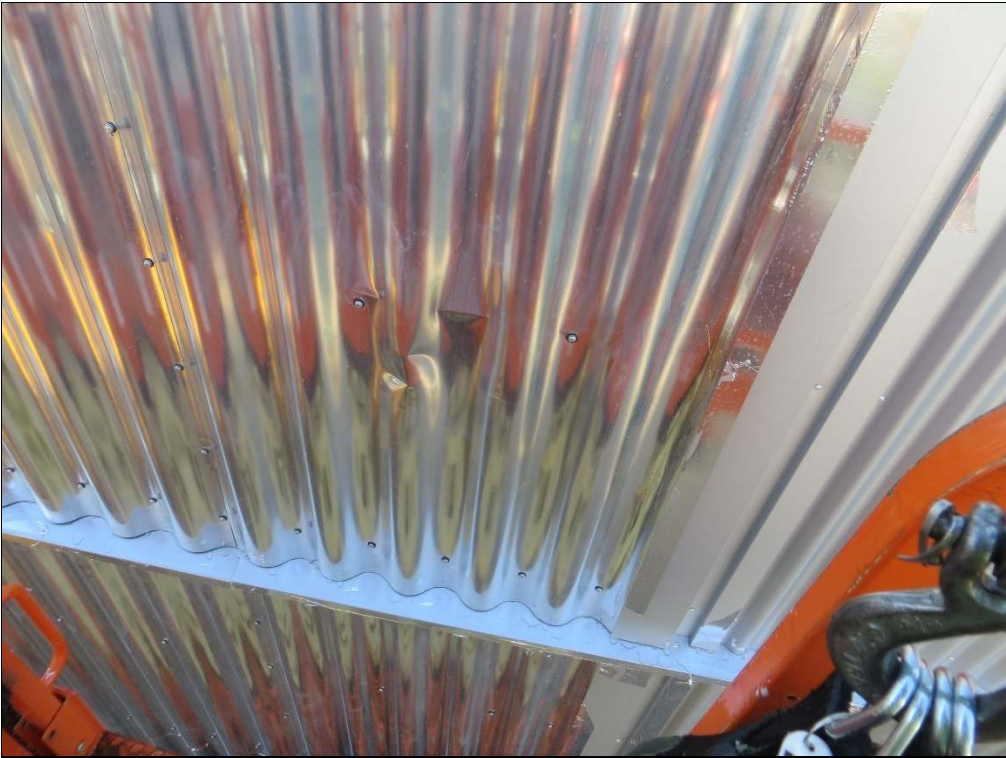


PHOTO 1933

SOFT BODY IMPACT

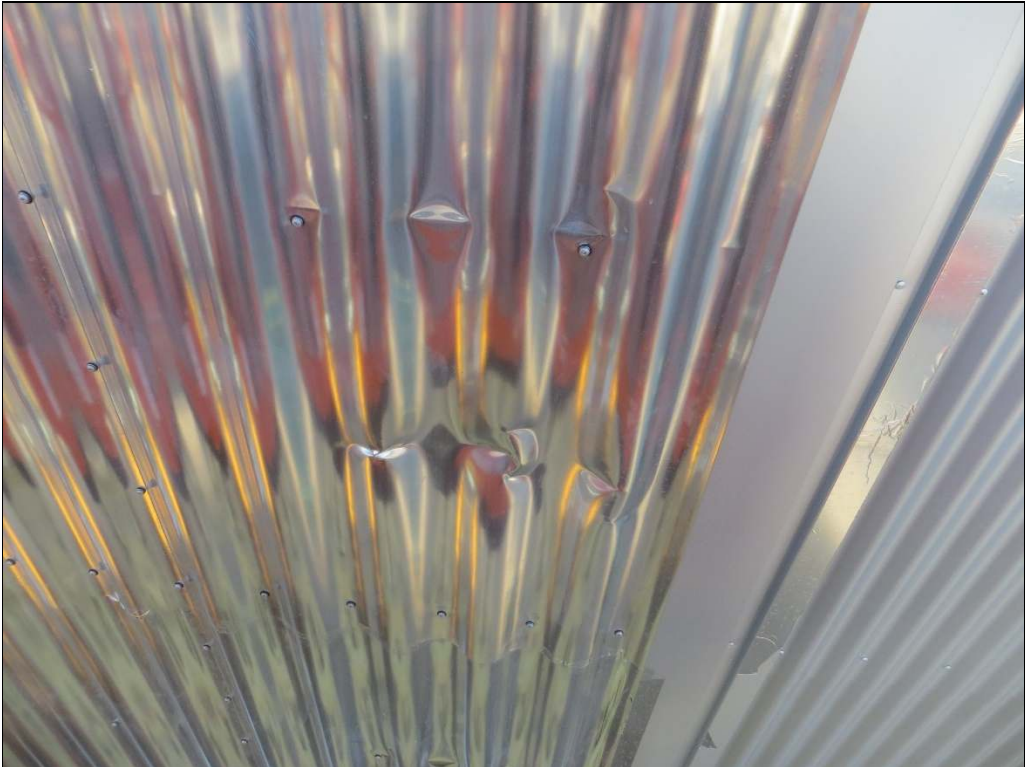


PHOTO 1958

HARD BODY IMPACTOR

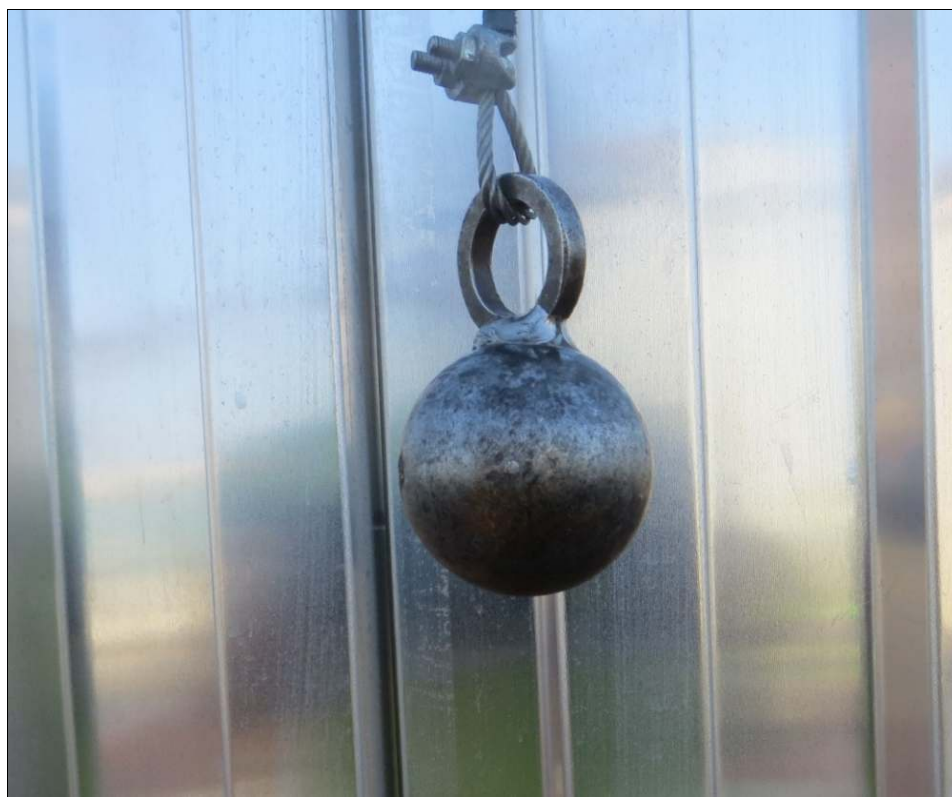


PHOTO 1939

HARD BODY IMPACTS

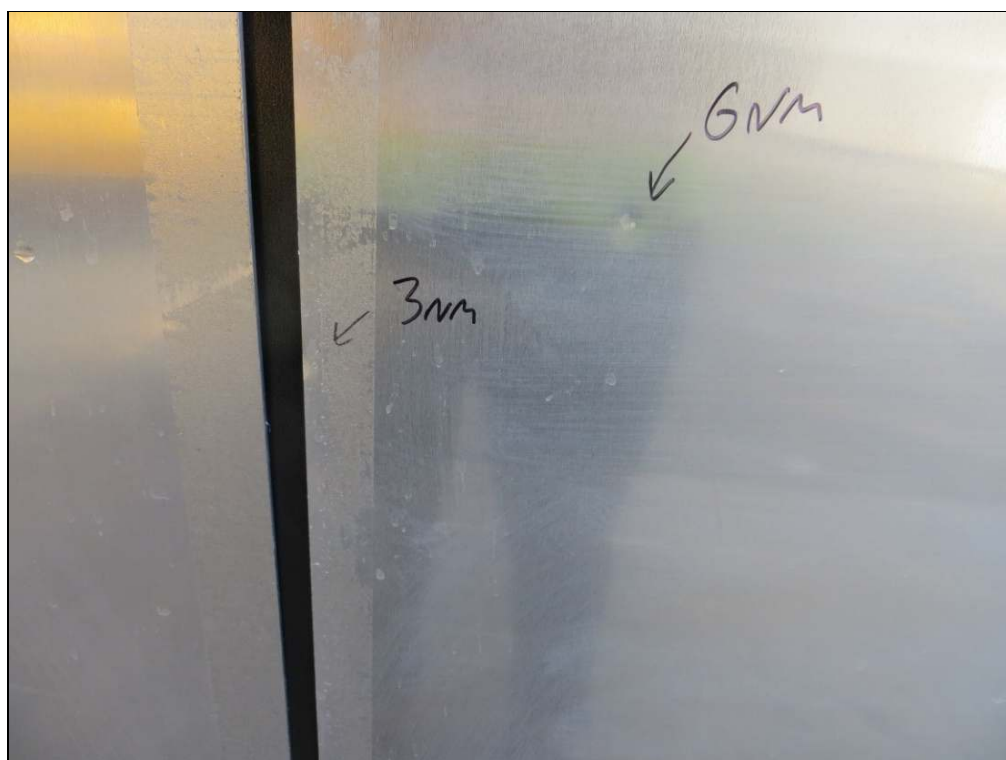


PHOTO 1941

HARD BODY IMPACT



PHOTO 1943

HARD BODY IMPACTS



PHOTO 1945

HARD BODY IMPACTS



PHOTO 1947

HARD BODY IMPACTS



PHOTO 1949

HARD BODY IMPACTS



PHOTO 1951

HARD BODY IMPACTS



PHOTO 1953

HARD BODY IMPACTS

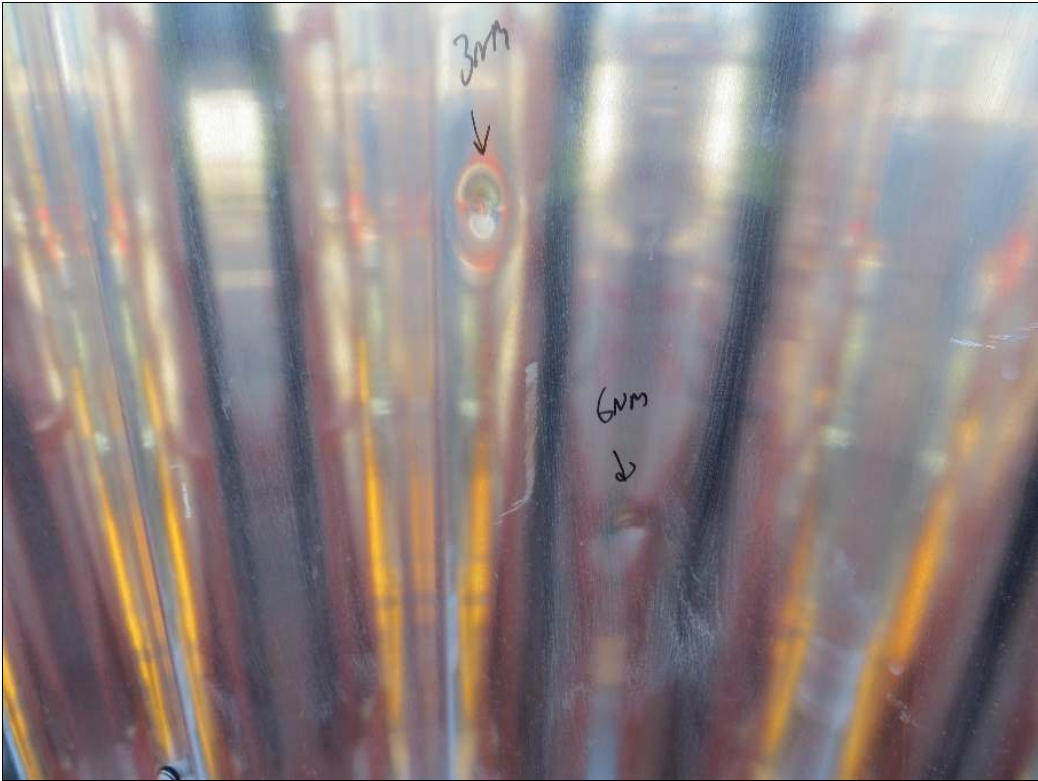


PHOTO 1955

HARD BODY IMPACTS

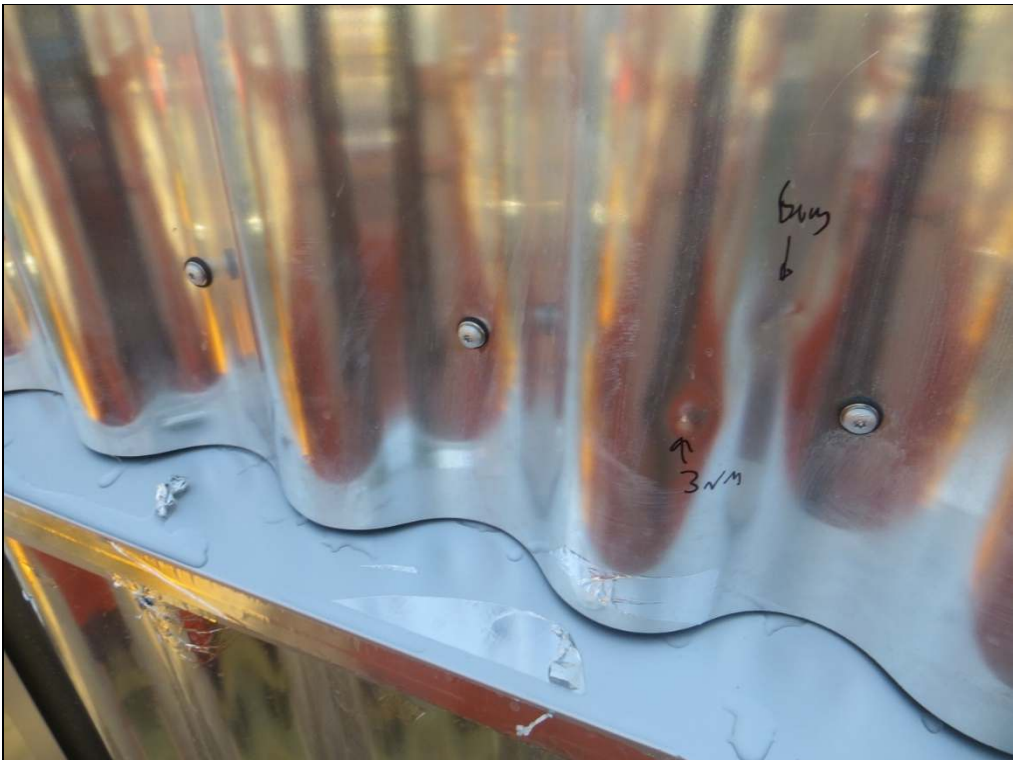


PHOTO 1957

HARD BODY IMPACTS



PHOTO 1957

HARD BODY IMPACTS



PHOTO 1957

HARD BODY IMPACTS



PHOTO 1963

HARD BODY IMPACTS



PHOTO 1964

HARD BODY IMPACTS



PHOTO 1966

HARD BODY IMPACTS



PHOTO 1967

HARD BODY IMPACTS



PHOTO 1968

HARD BODY IMPACTS



PHOTO 1969

HARD BODY IMPACTS

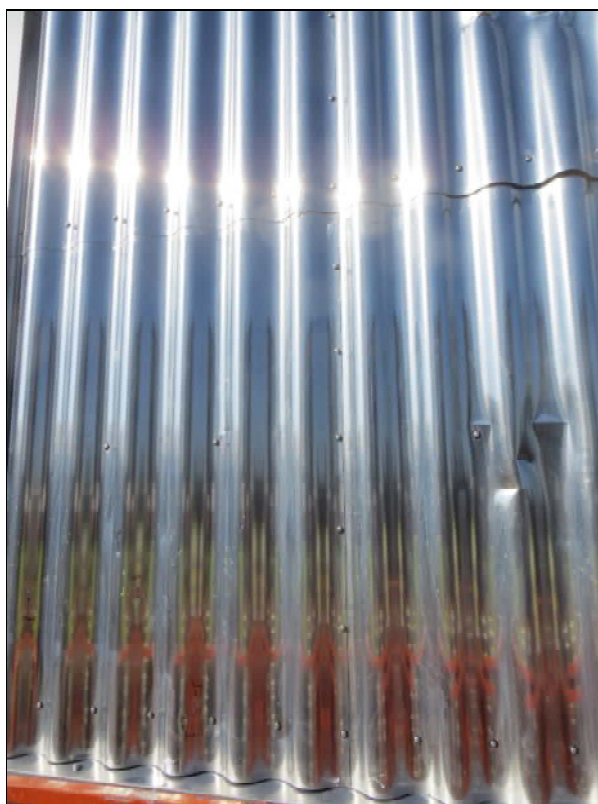


PHOTO 1970

HARD BODY IMPACTS



9 APPENDIX

The following 11 unnumbered pages are copies of Architectural Profiles Limited drawings numbered:

TEST-VIN-2/01/c,

TEST-VIN-2/02/c,

TEST-VIN-2/03/c,

TEST-VIN-2/04/c,

TEST-VIN-2/05/c,

TEST-VIN-2/06/c,

TEST-VIN-2/07/c,

TEST-VIN-2/08/c,

TEST-VIN-2/09/c,

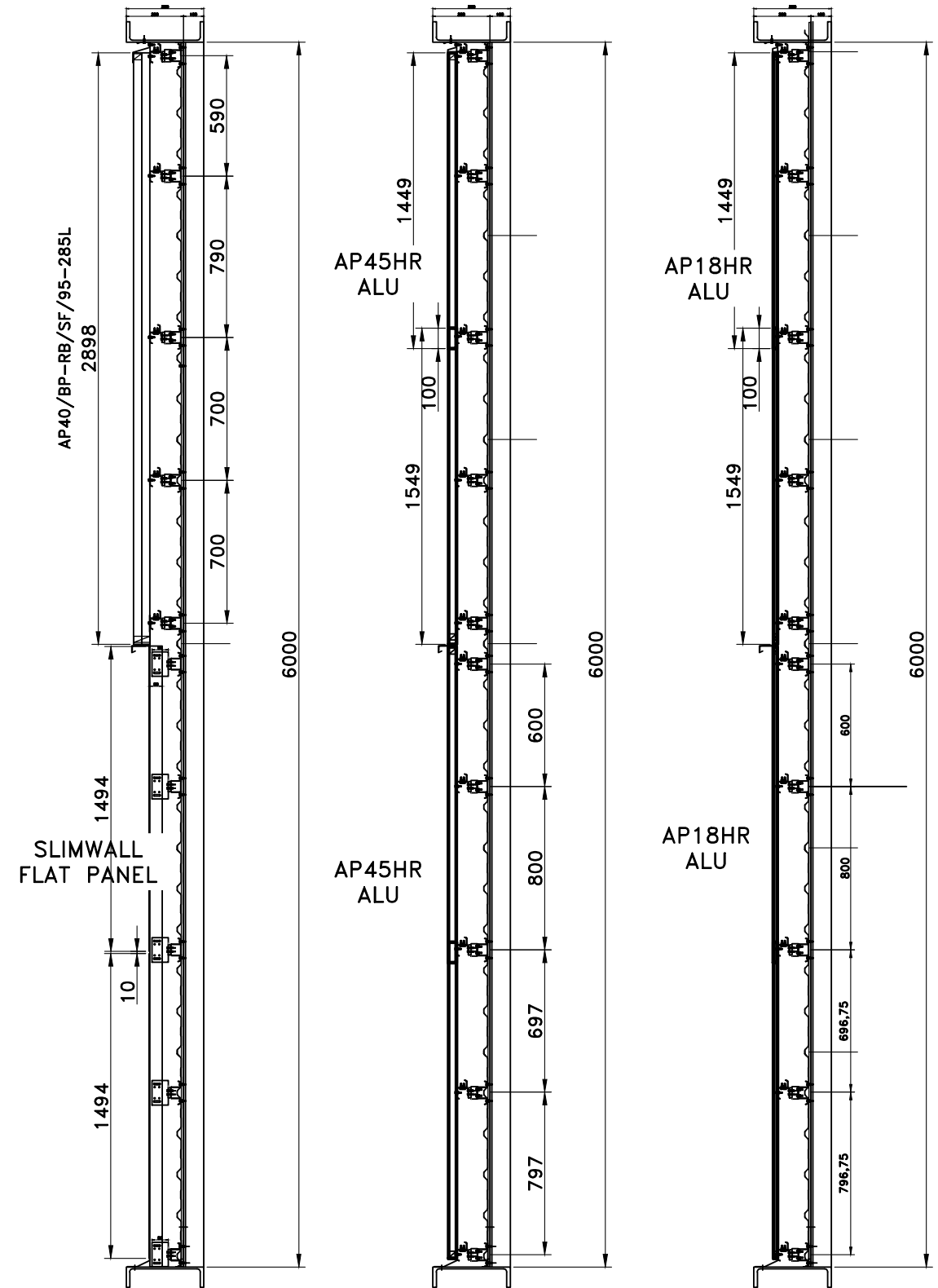
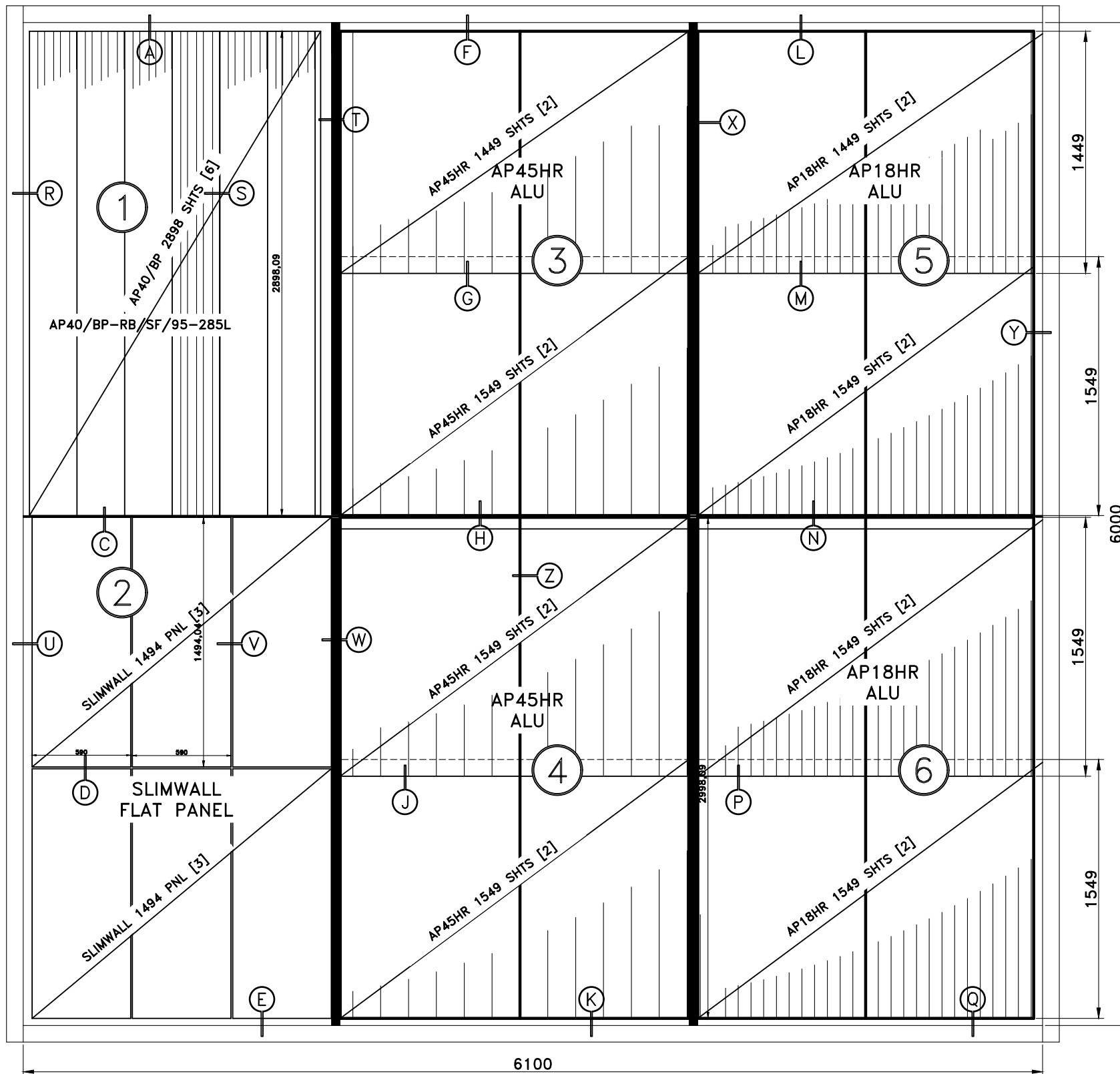
TEST-VIN-2/10/c,

TEST-VIN-2/11/c.

END OF REPORT

- IMPORTANT NOTES :**
- 1) All steelwork or supporting structure shown are indicative only of face area and levels required and subject to final engineers design
 - 2) Use isolating tape between dissimilar metals where applicable
 - 3) Aluminium flashings should be installed with oversize holes to allow for expansion – i.e. allow 2mm per metre of length dependant on colour

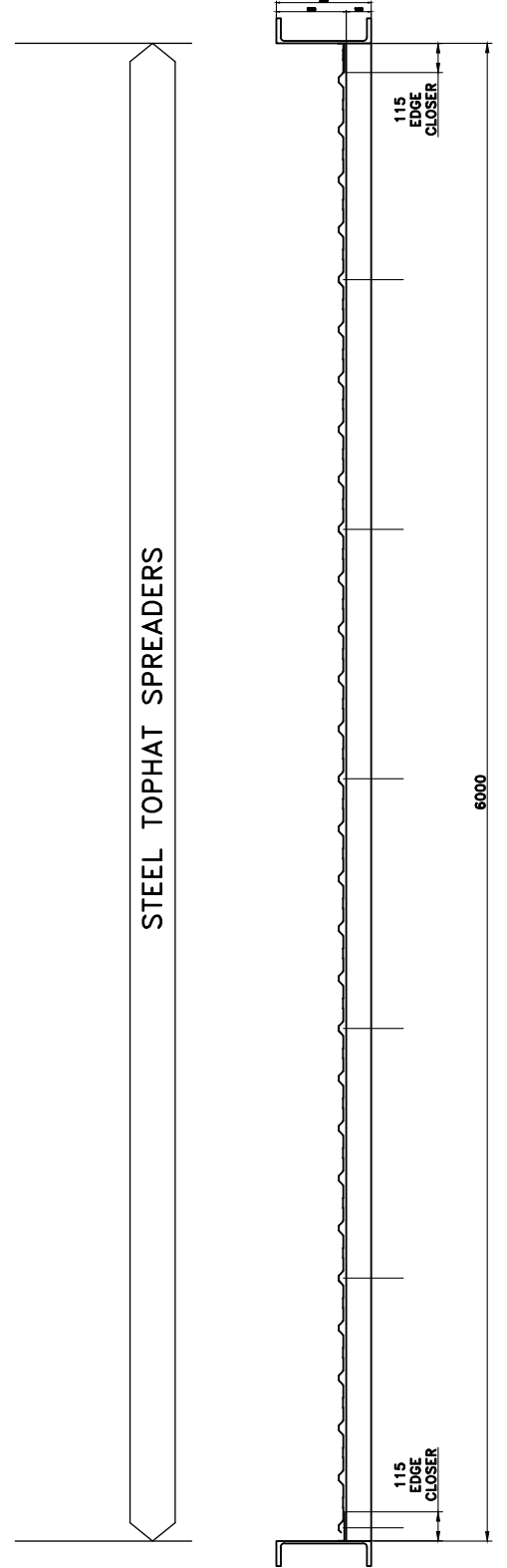
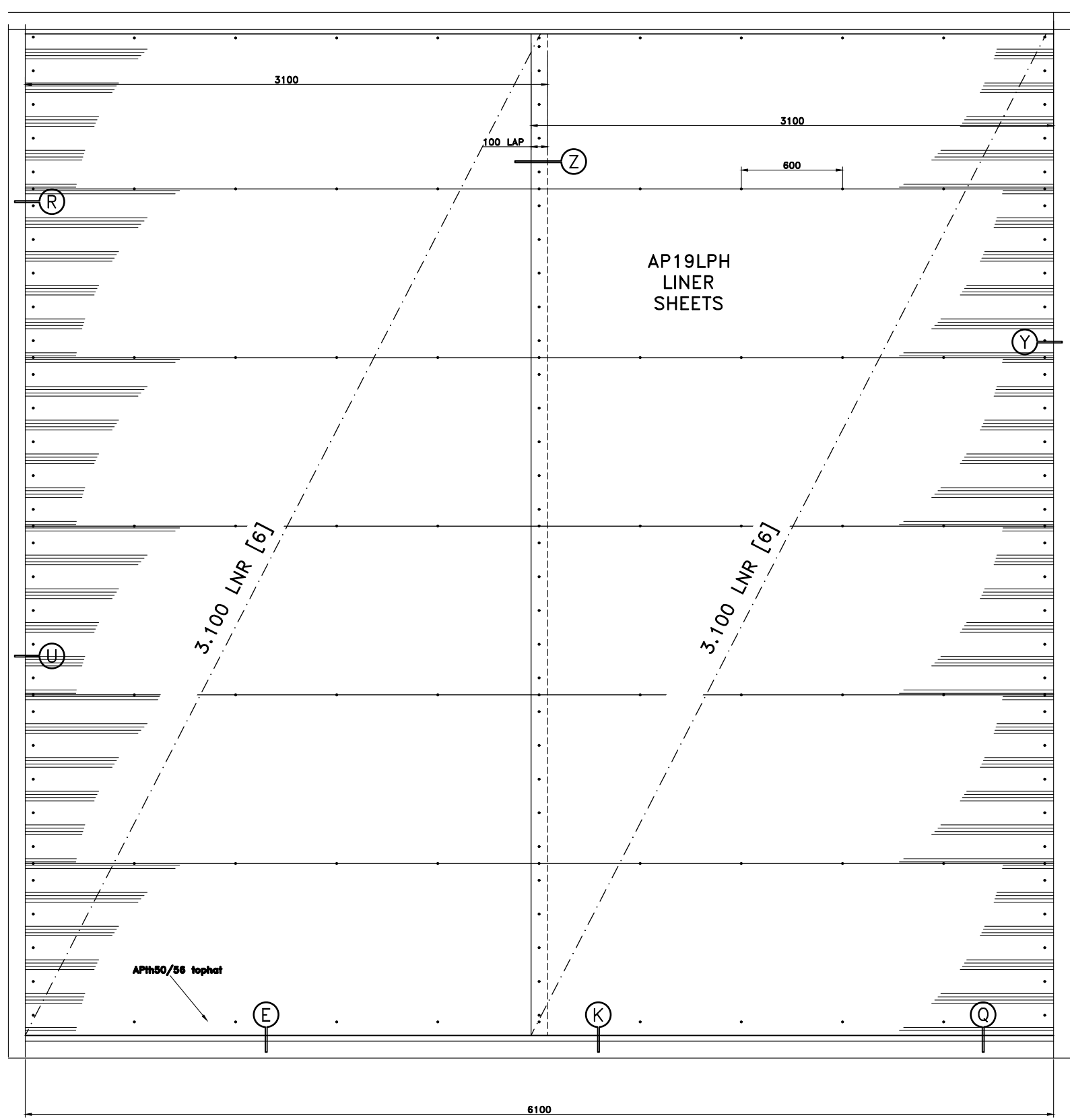
SCALE –



IMPORTANT NOTES :

- 1) All steelwork or supporting structure shown are indicative only of face area and levels required and subject to final engineers design
- 2) Use isolating tape between dissimilar metals where applicable
- 3) Aluminium flashings should be installed with oversize holes to allow for expansion – i.e. allow 2mm per metre of length dependant on colour

SCALE –



AP19LPH LINER SHEETS
 0.4MM STEEL PROFILE LINER
 FIXED AT EACH VALLEY AT ENDS
 WITH 6Ø SEAL TO CENTRE
 ENDLAP.
 SIDELAPS STITCHED AT 600mm
 CRS. and 50x1 VCT SEAL



APL
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 53 CROCKHAMWELL ROAD,
 WOODLEY, READING, RG5 3JH, ENGLAND
 Telephone: 0118 927 2424 Fax: 0118 927 2400

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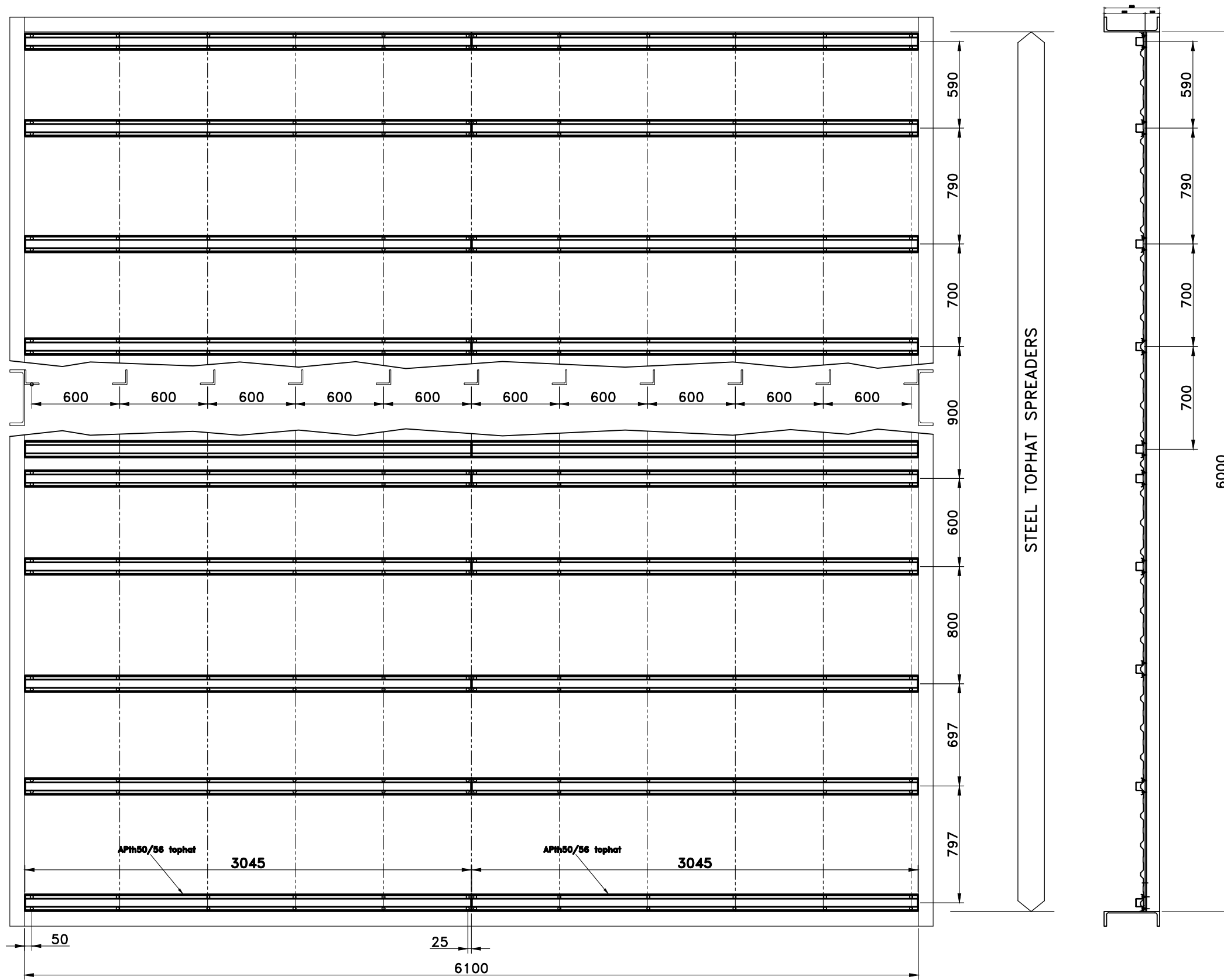
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 Architectural Profiles Ltd. reserves the right to amend product specifications without prior notice.
 All dimensions thicknesses, coatings etc. are nominal as coated and subject to coil and manufacturing tolerances.

**TEST-VINCI-2
 ELEVATION PANELS
 LINER**
TEST-VIN-2/02/c

IMPORTANT NOTES :

- 1) All steelwork or supporting structure shown are indicative only of face area and levels required and subject to final engineers design
- 2) Use isolating tape between dissimilar metals where applicable
- 3) Aluminium flashings should be installed with oversize holes to allow for expansion – i.e. allow 2mm per metre of length dependant on colour

SCALE –



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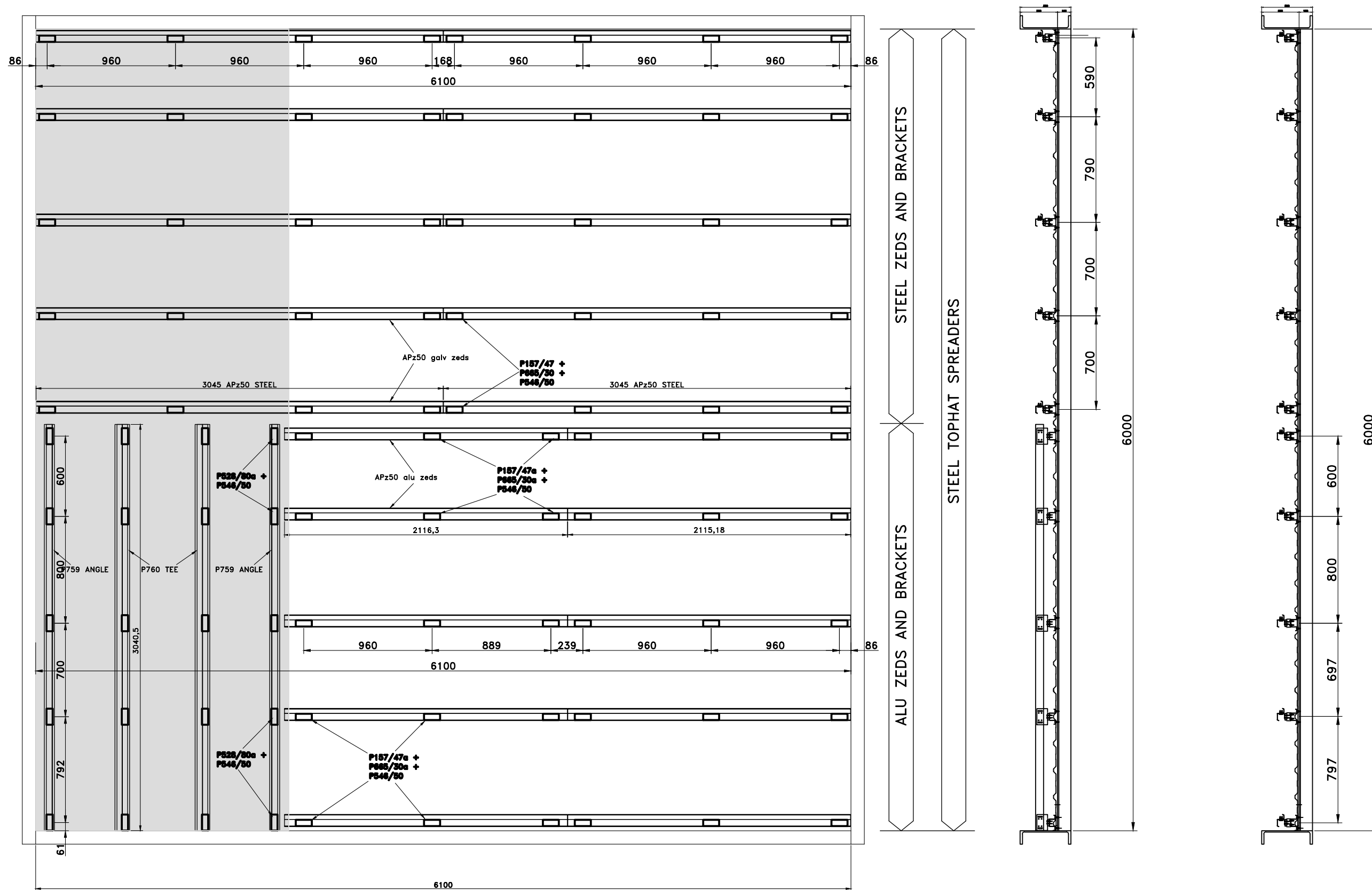
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TEST-VINCI-2
ELEVATION
TOPHAT LAYOUT
TEST-VIN-2/03/c

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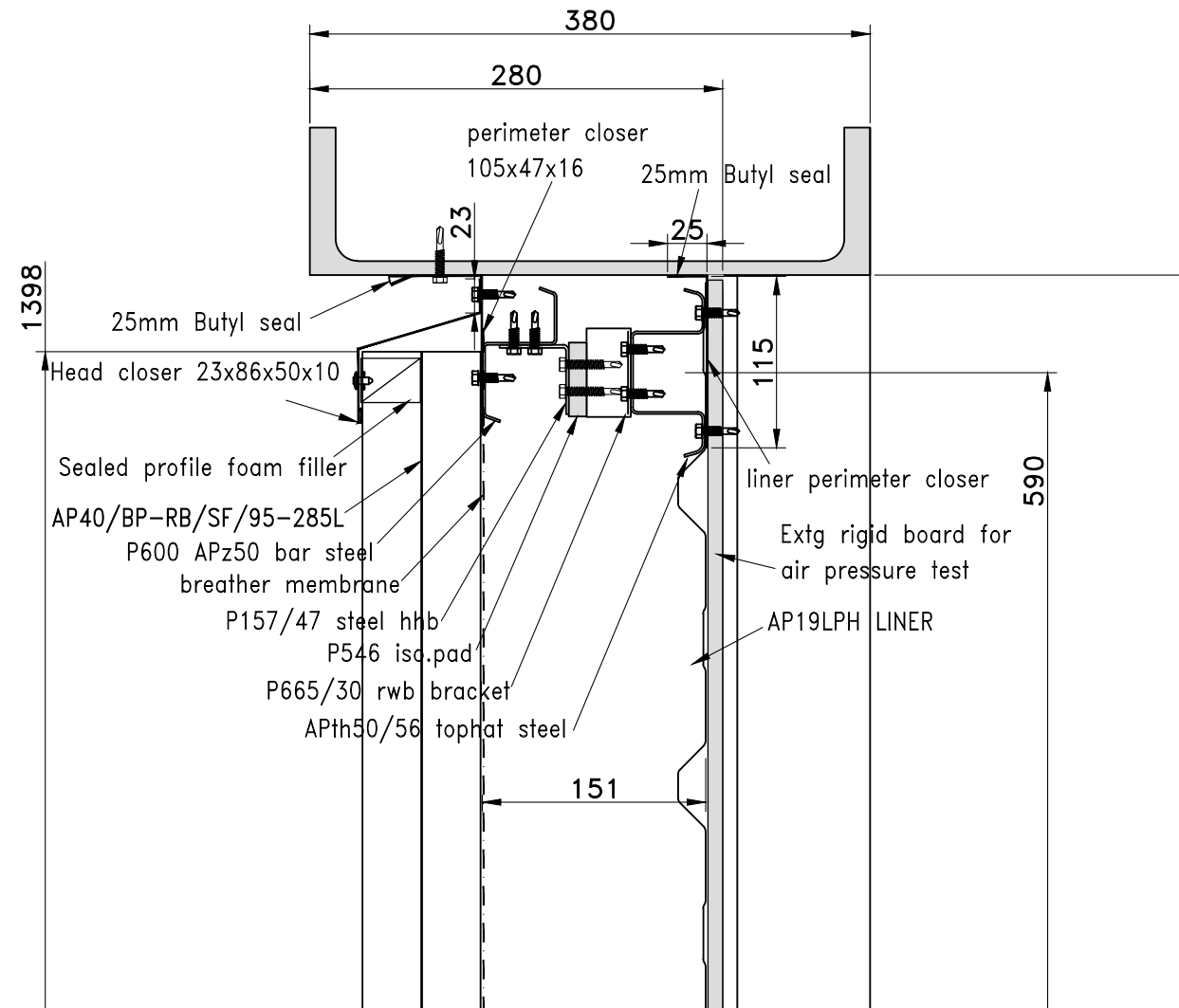
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TEST-VINCI-2
ELEVATION
ZEDS - TEE - ANGLES
TEST-VIN-2/04/c

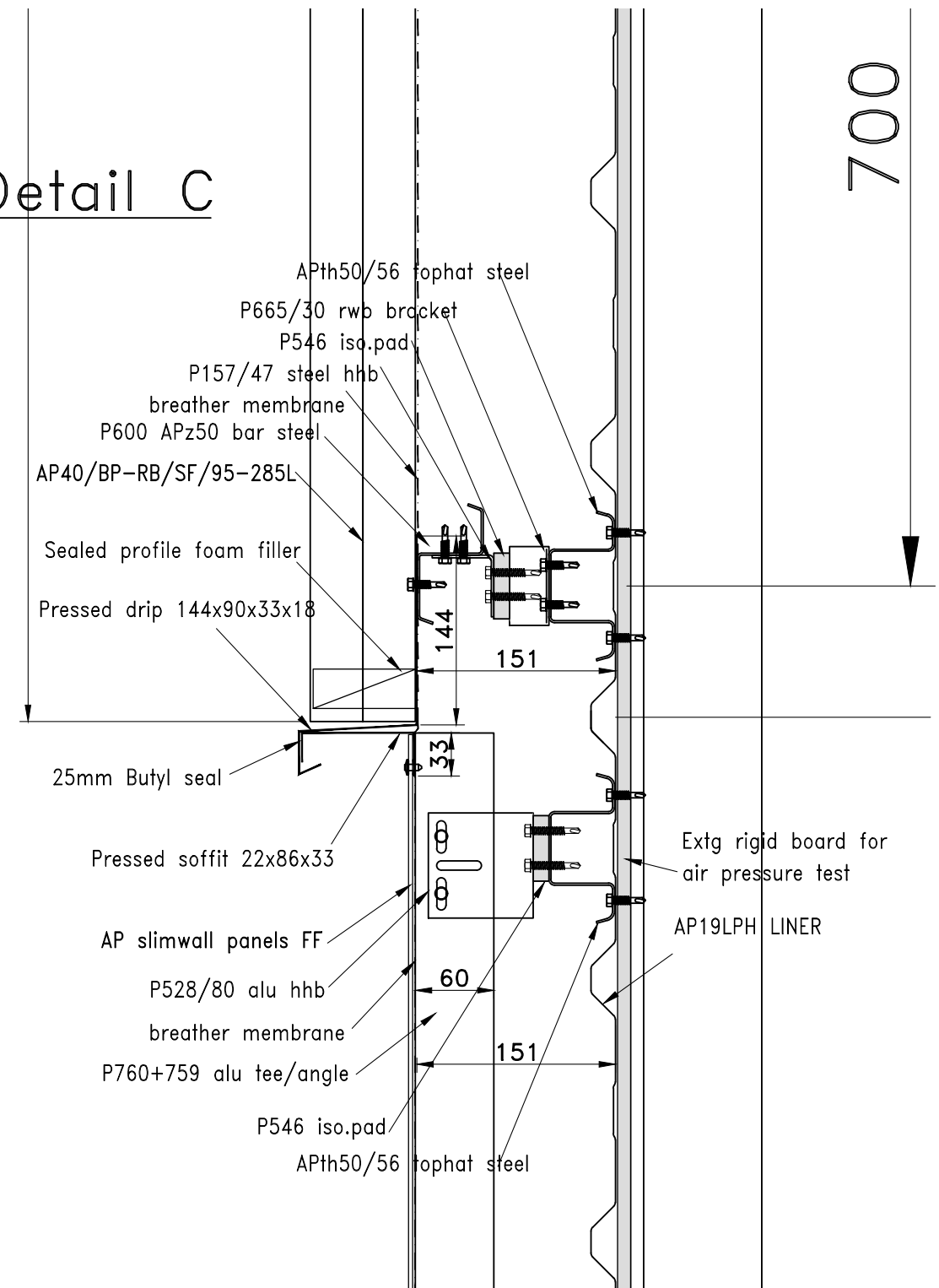
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SCALE 1:5

Detail A

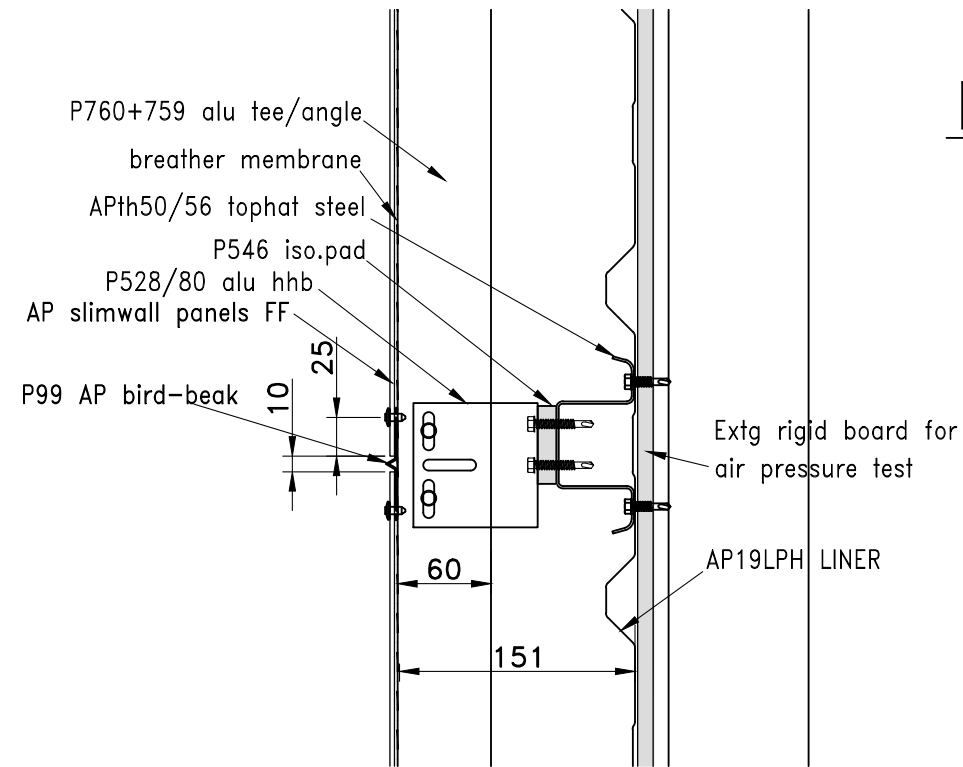


Detail C

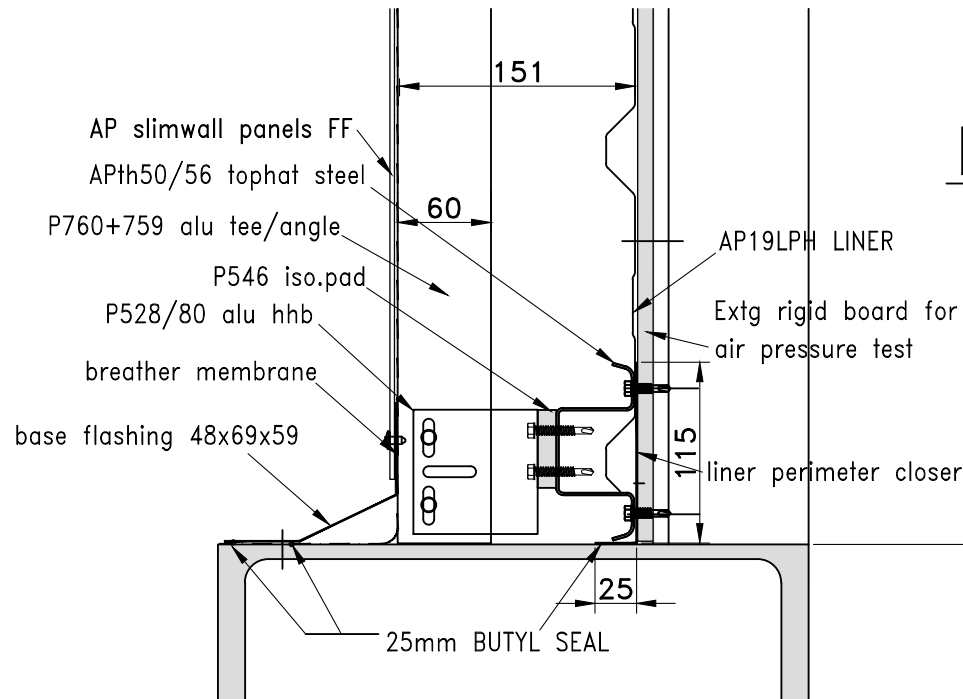


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SCALE 1:5

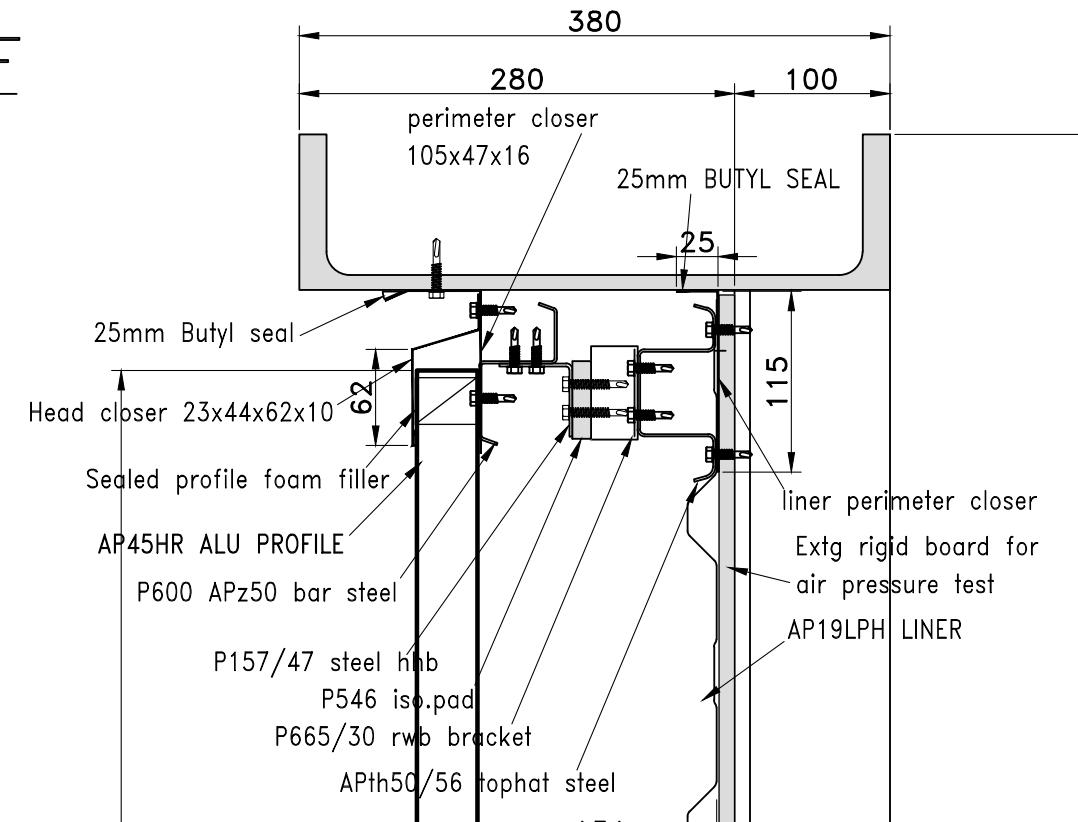


Detail D

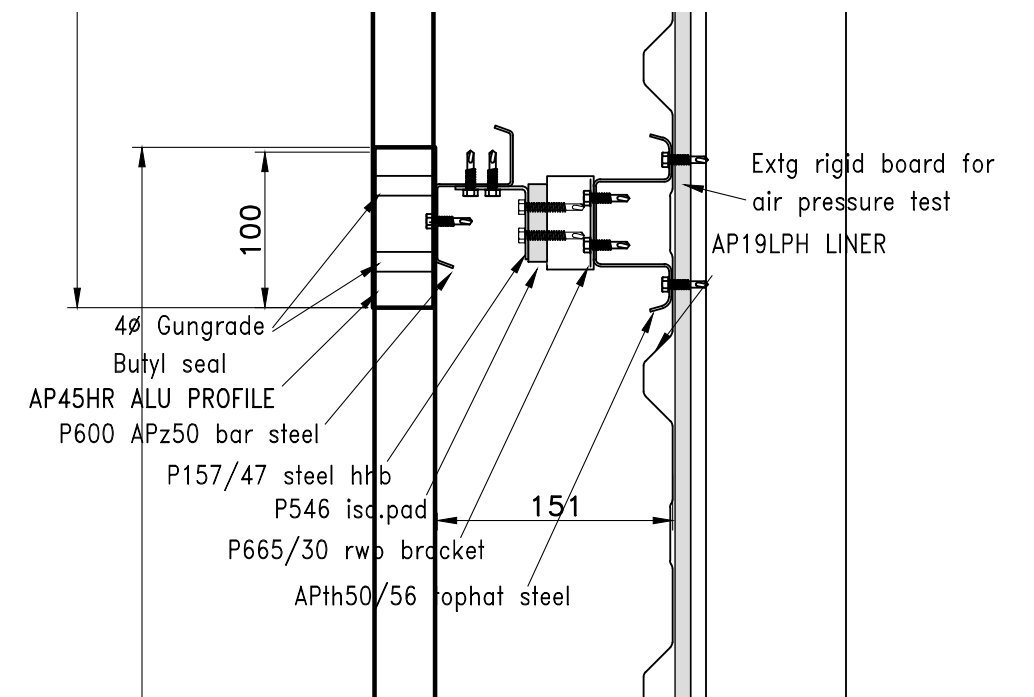


Detail E

Detail F

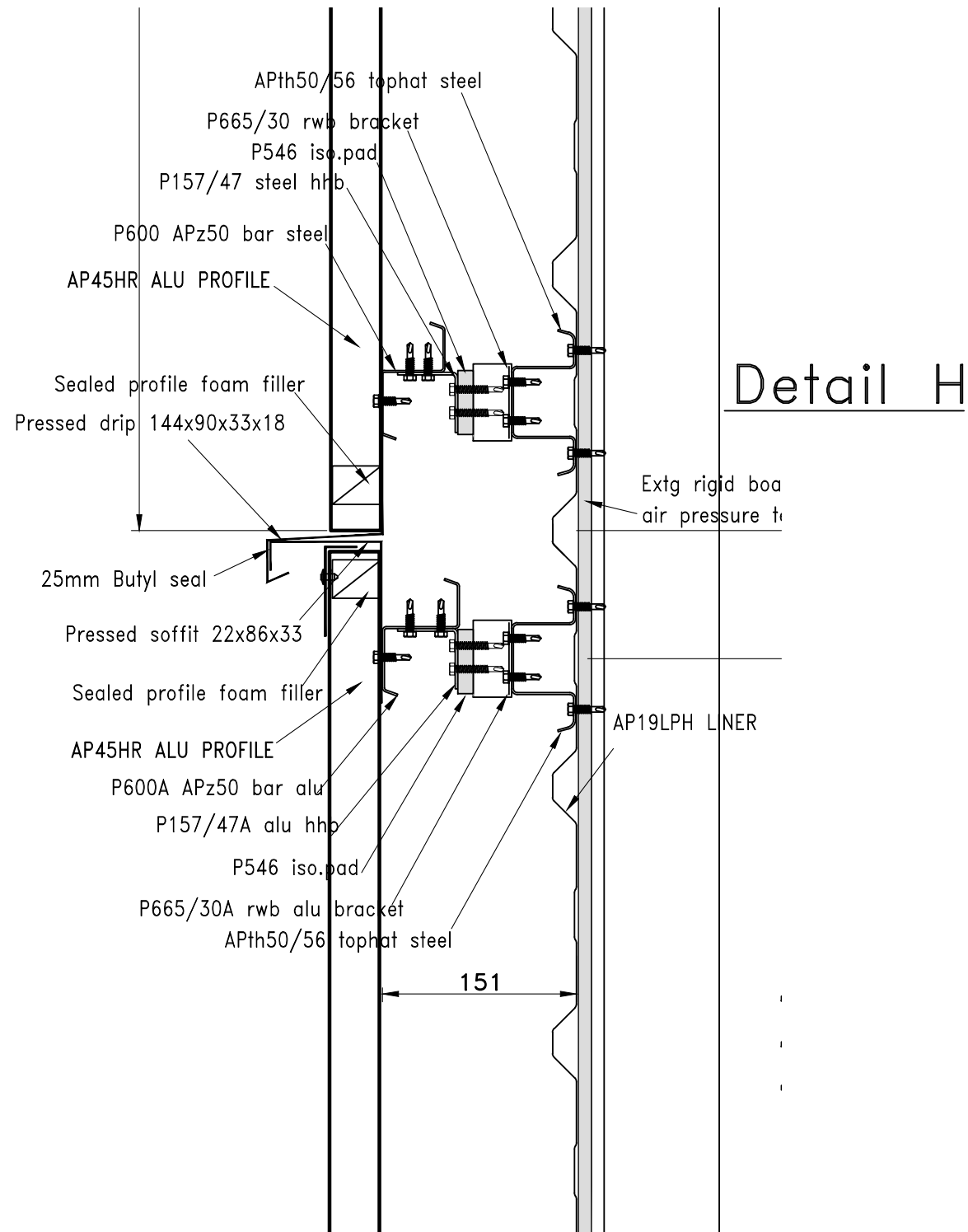


Detail G

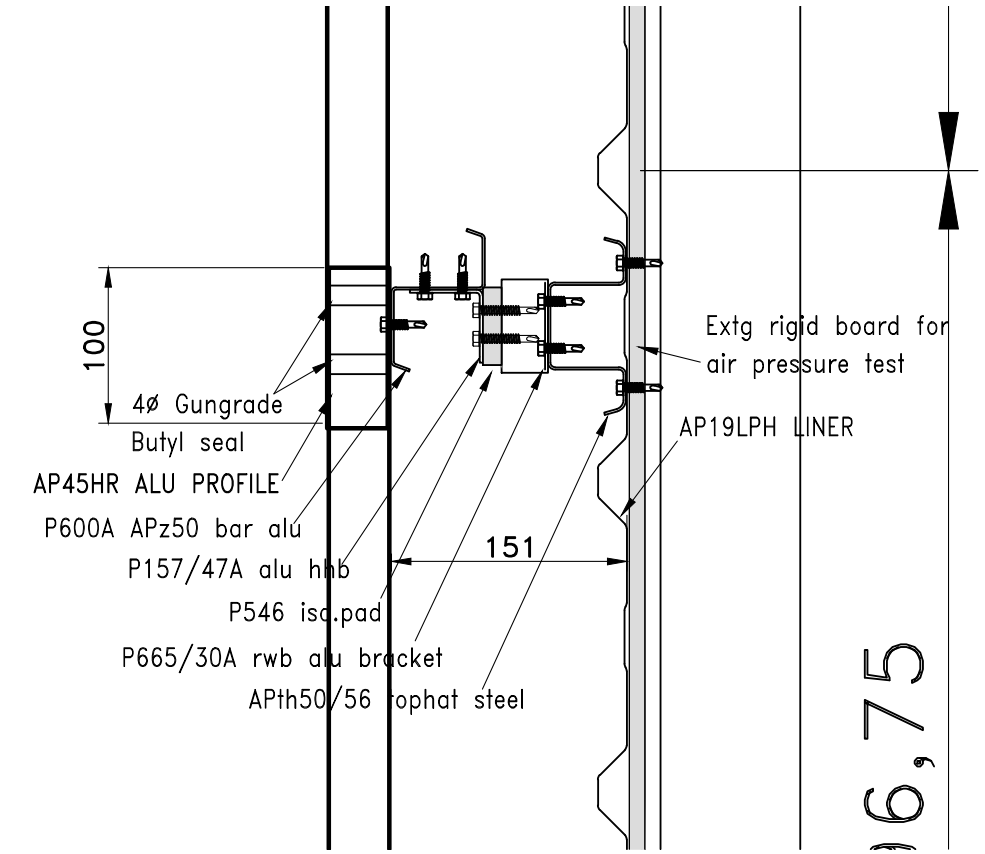


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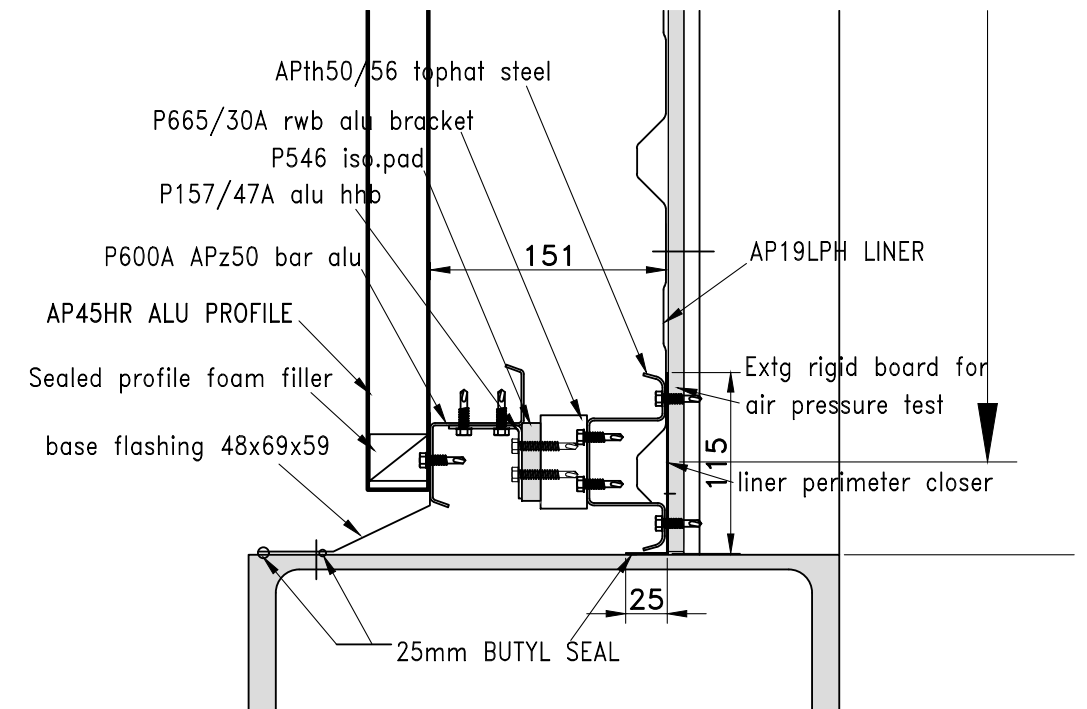
SCALE 1:5



Detail J



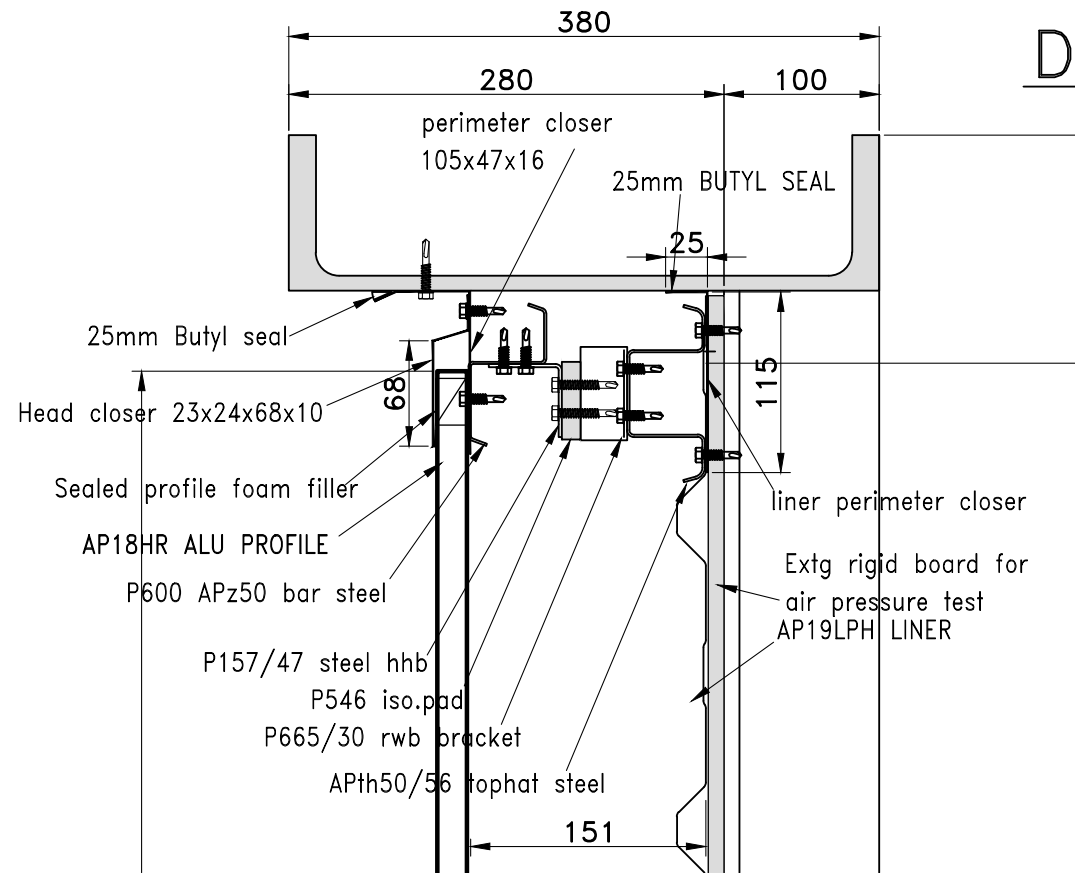
Detail K



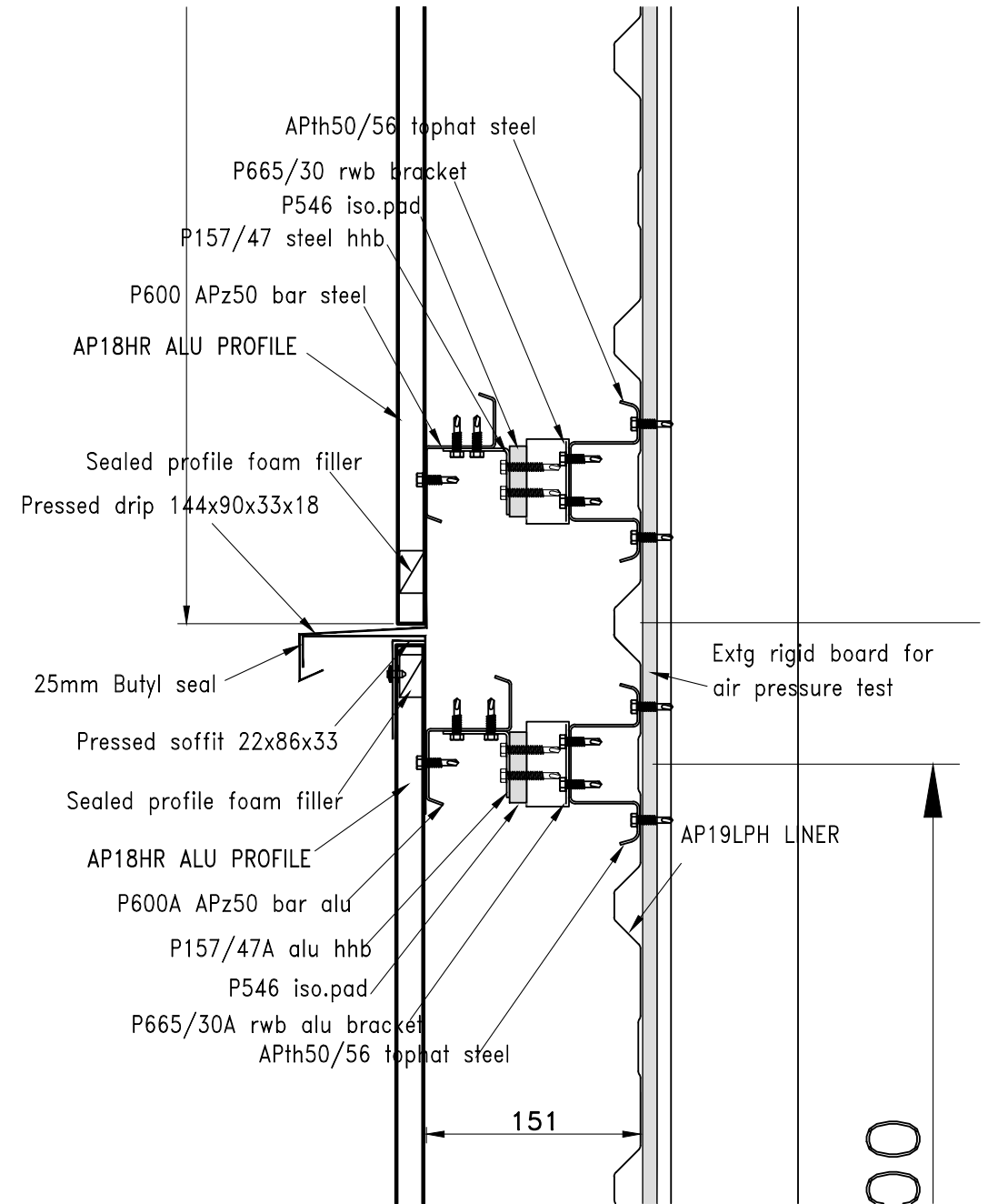
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SCALE 1:5

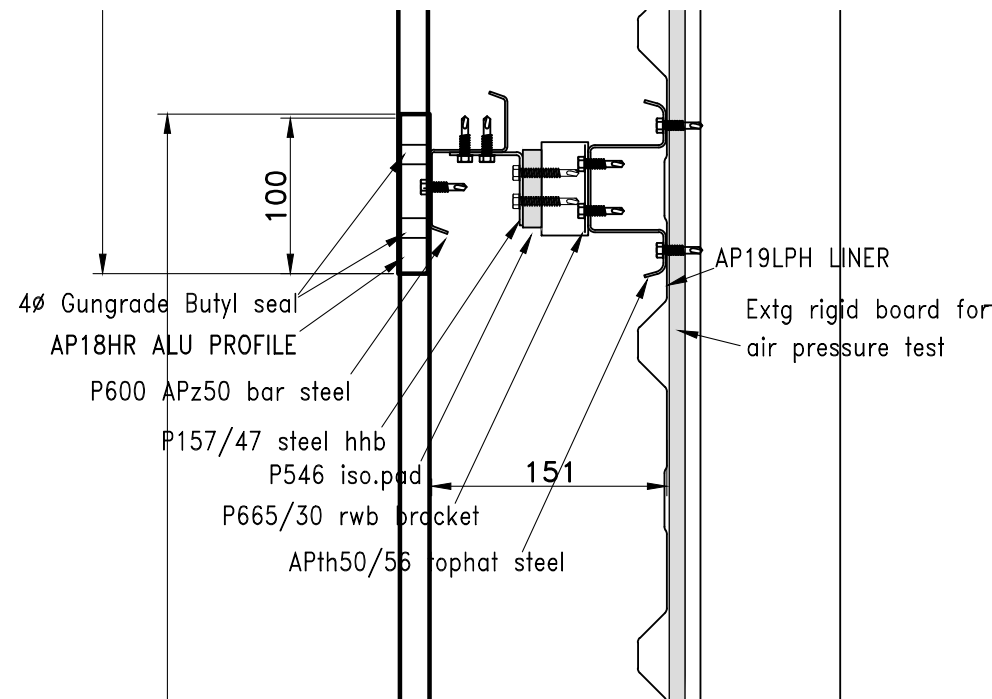
Detail L



Detail N



Detail M

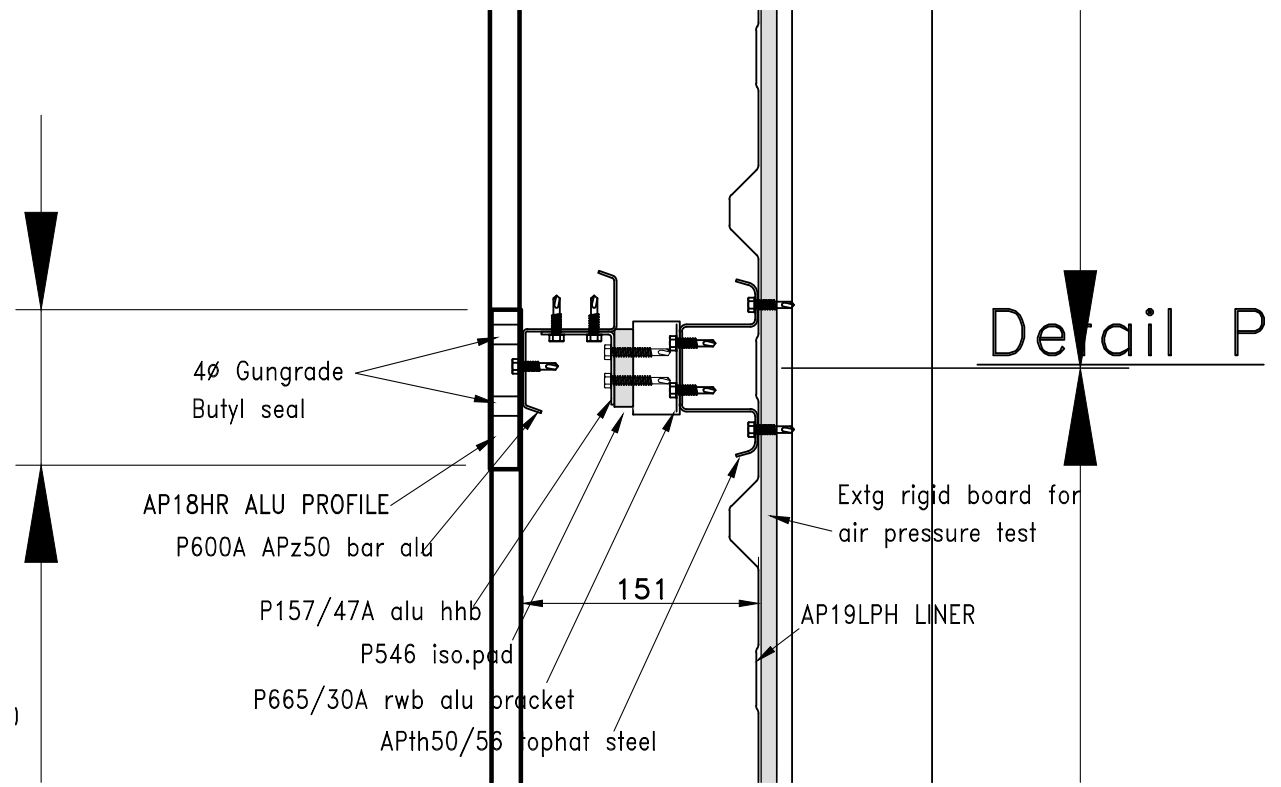


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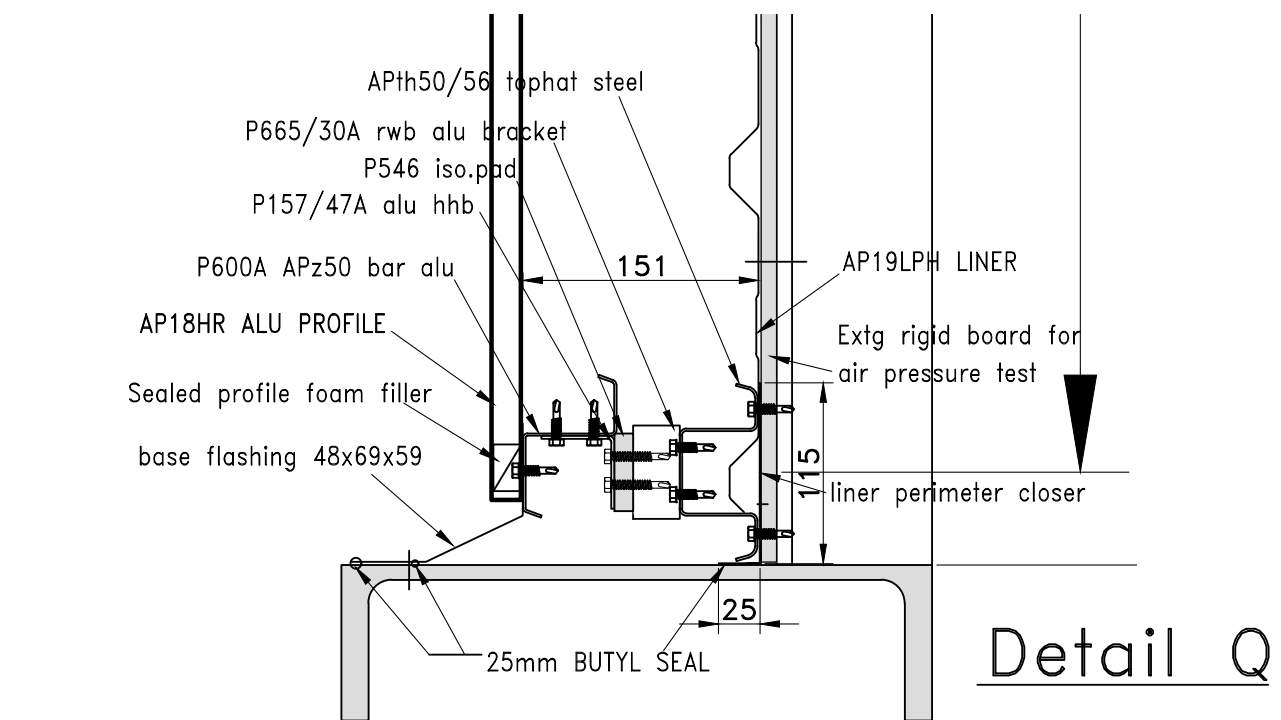
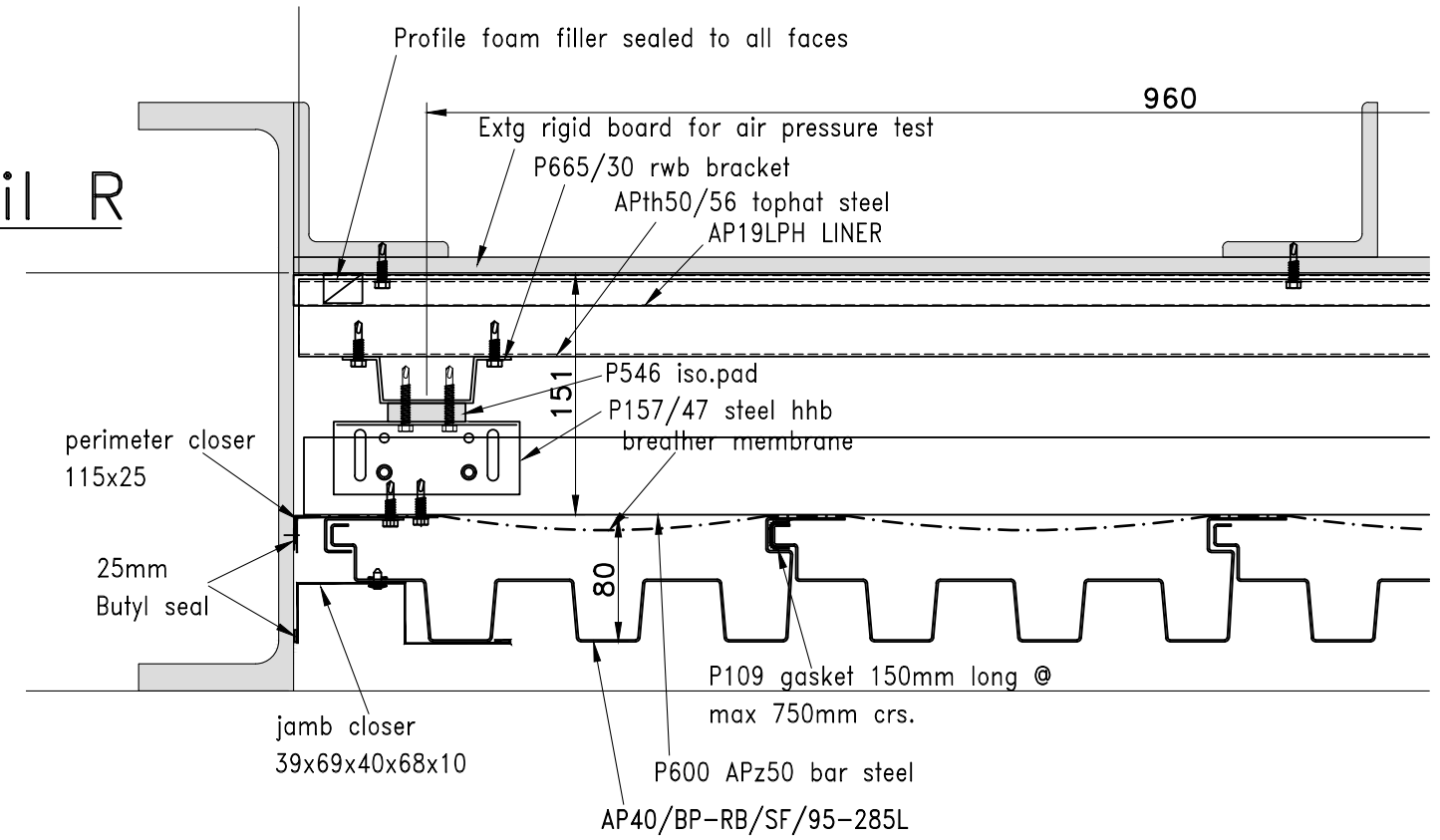
CWCT TEST – SERIES 2 VINCI

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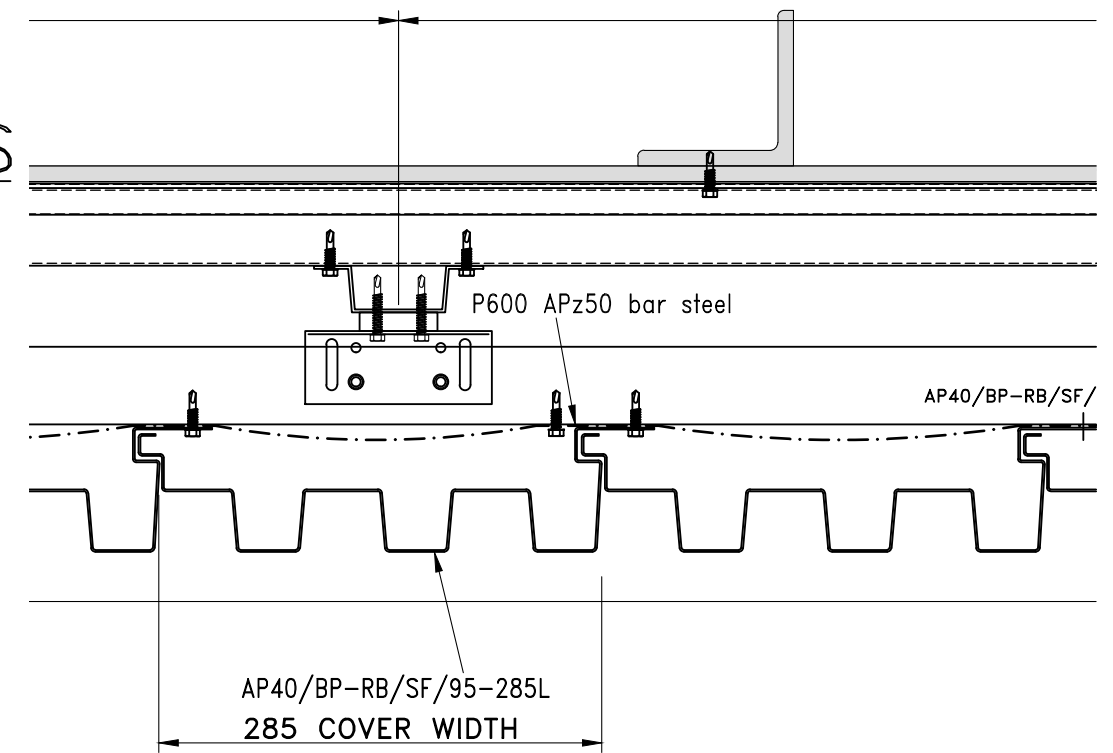
SCALE 1:5



Detail R



Detail S

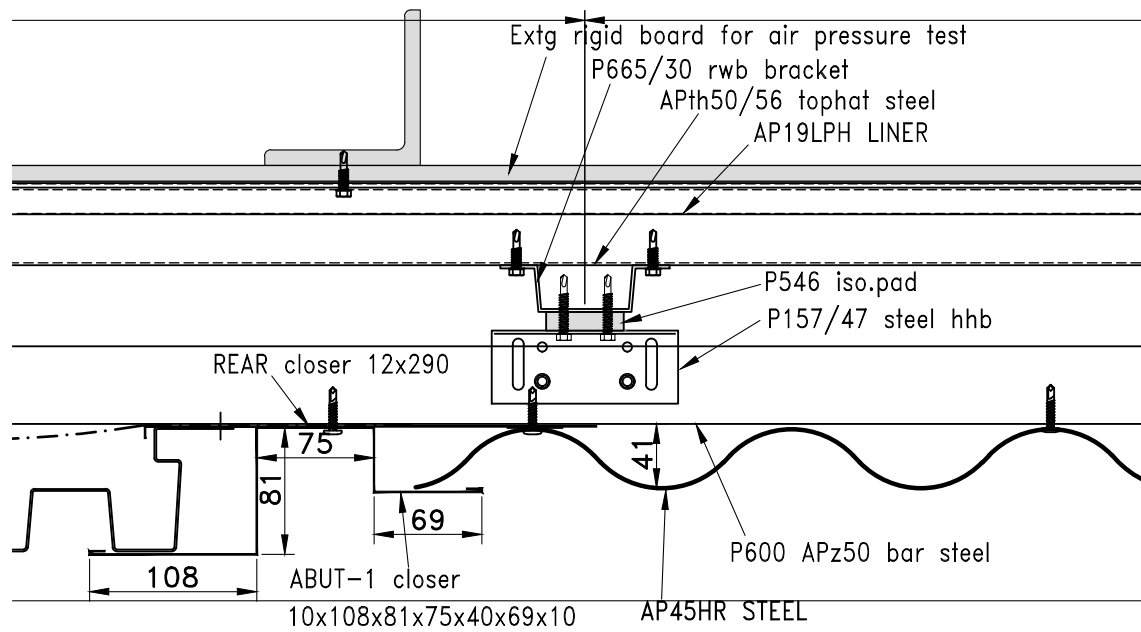


T

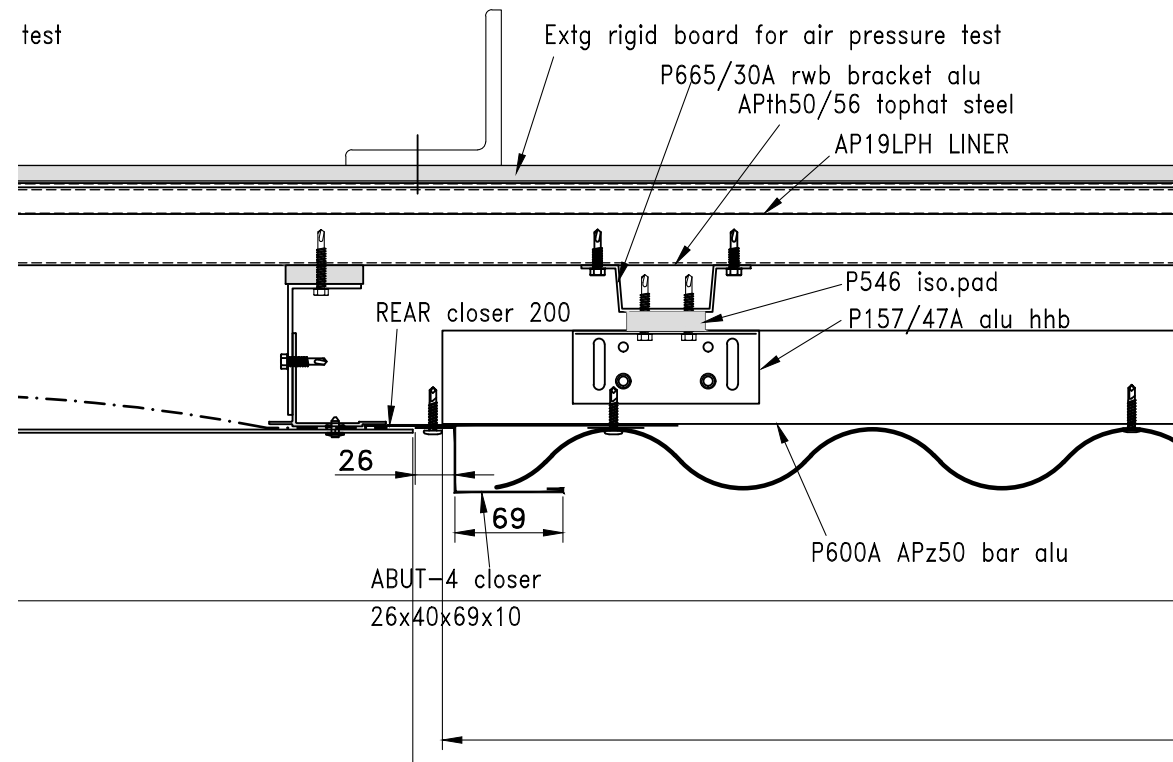
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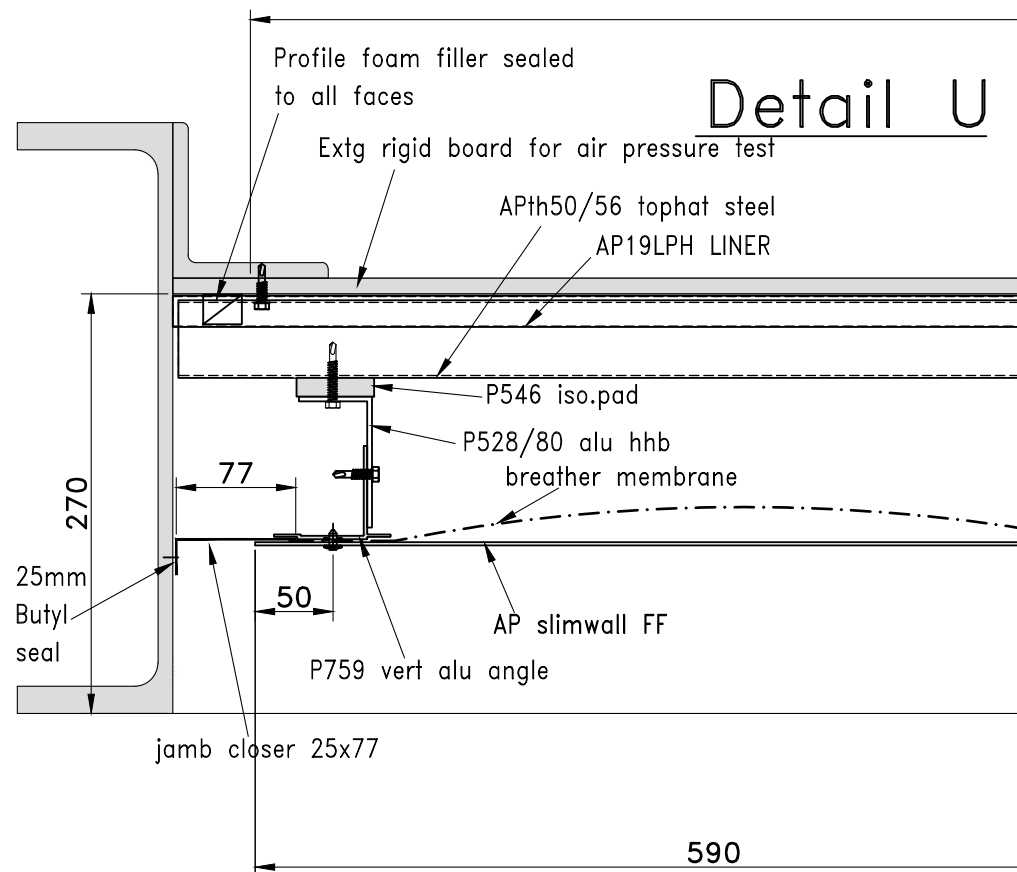
SCALE 1:5



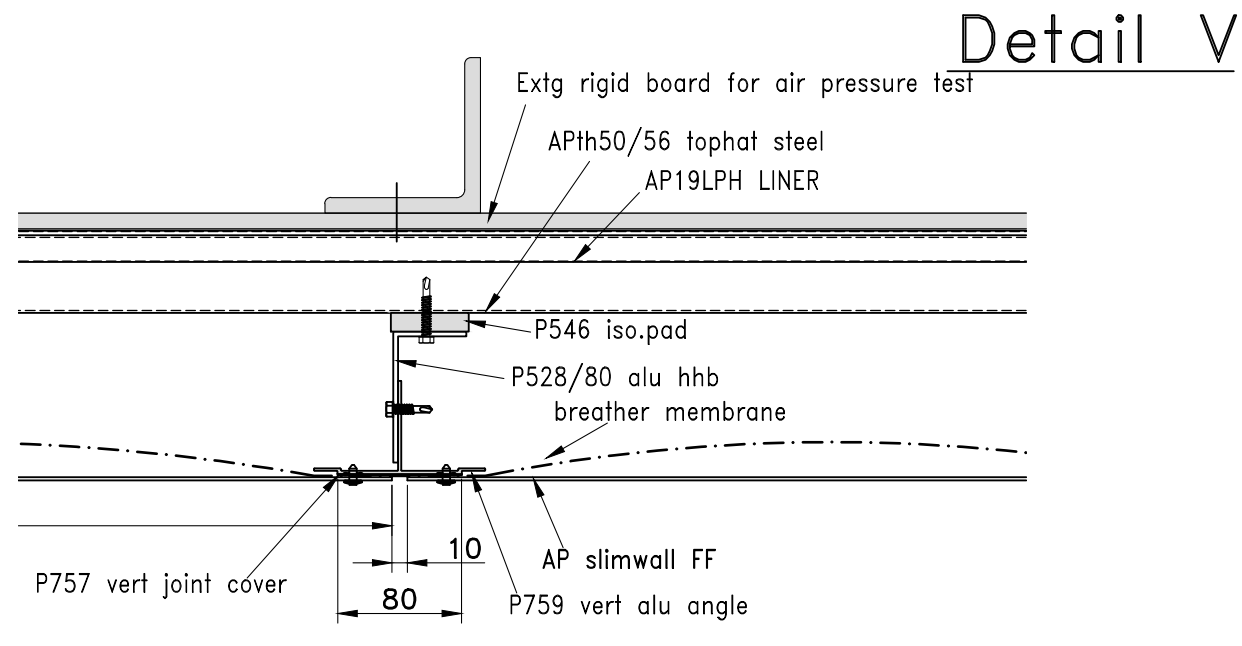
Detail T



Detail W



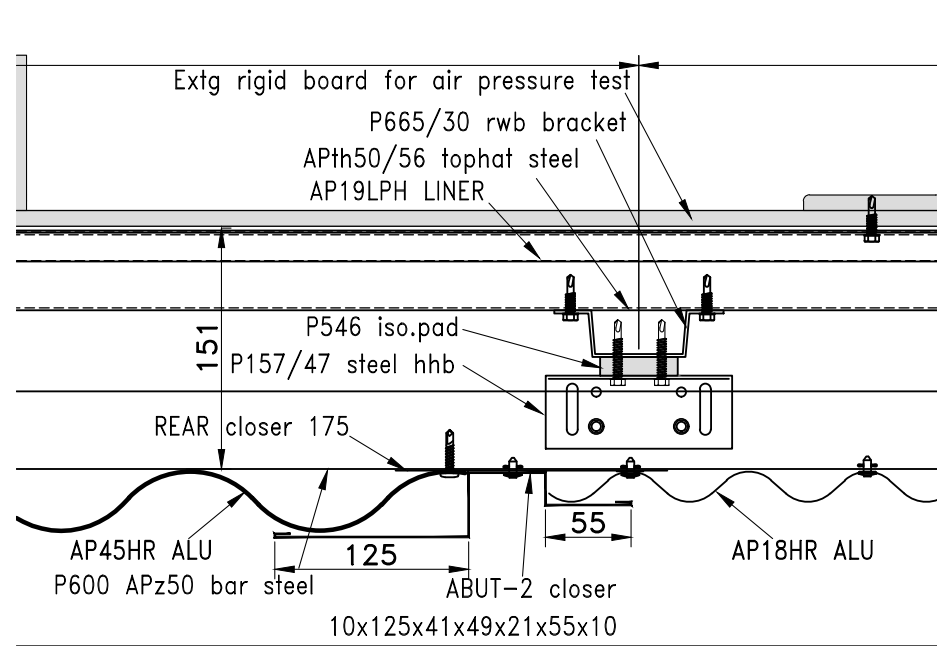
Detail U



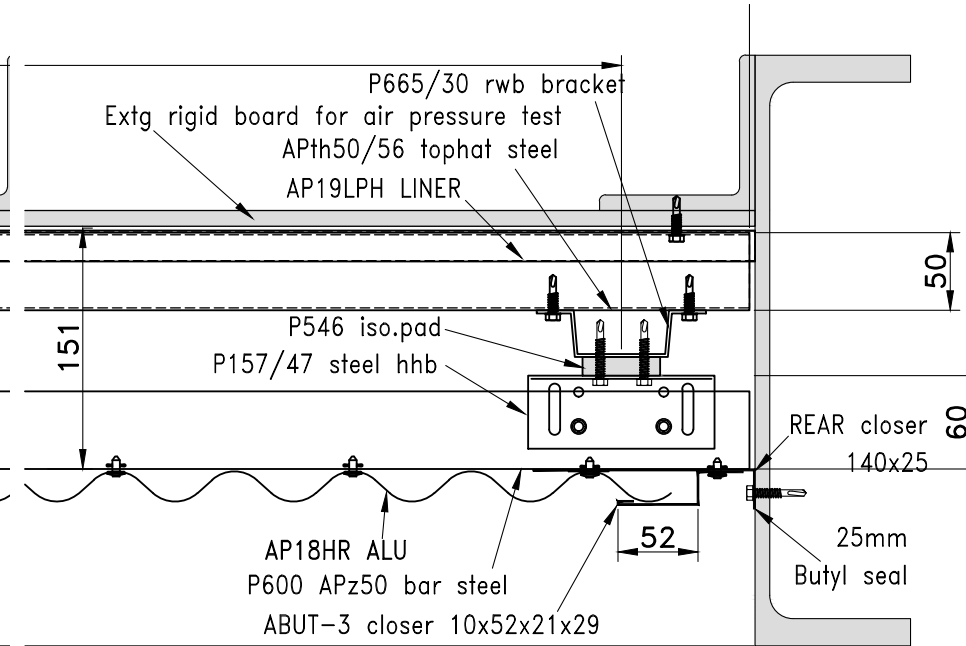
Detail V

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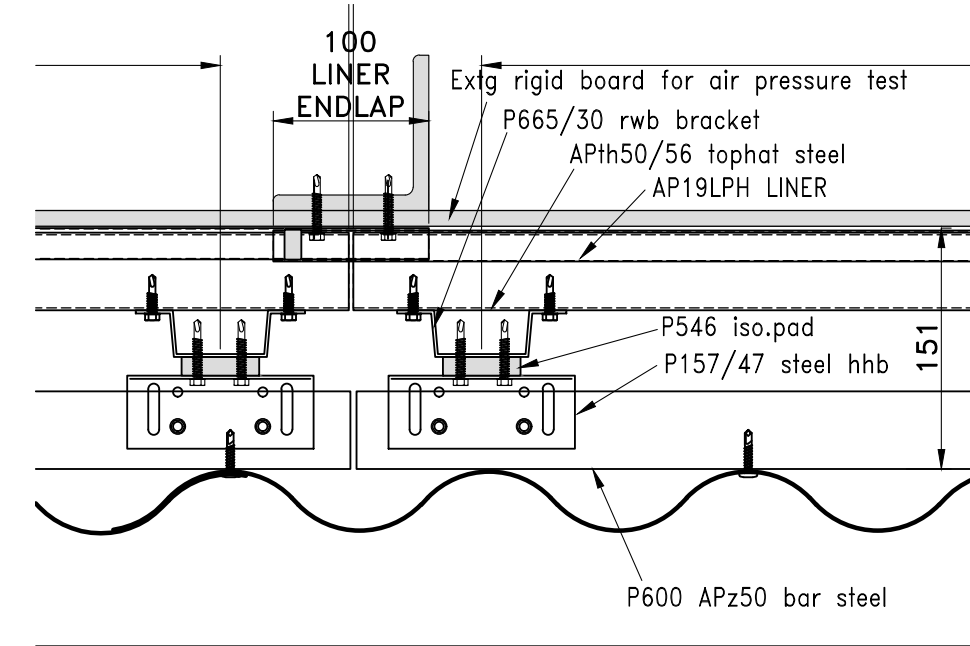
SCALE 1:5



Detail X



Detail Y



Detail Z



VINCI Technology Centre UK Limited
Stanbridge Road
Leighton Buzzard
Bedfordshire
LU7 4QH
UK

0333 5669000

info@technology-centre.co.uk

www.technology-centre.co.uk