TECHNOLOGY CENTRE

Technical Report

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

Report No: N950-20-17917

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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

Issue date: 22 September 2020

VTC job no.: TR0165-3VQ6

Author(s): D. Bennett - Technician

Checked by: N. McDonald – Manager

Authorised by: S. R. Moxon – Operations Director

Distribution: 1 copy to Architectural Profiles Limited
(confidential) 1 copy to project file

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

CONTENTS

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 7 August 2020 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 C7905MS 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 Notified 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 Brian Livett 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
3 August 2020	1	Wind resistance – serviceability	Pass
3 August 2020	2	Wind resistance – safety	Pass
3 August 2020	3	Watertightness - dynamic	Pass
3 August 2020	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	Class 1 serviceability Negligible risk safety

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 5.0 m high by 6.0 m wide.

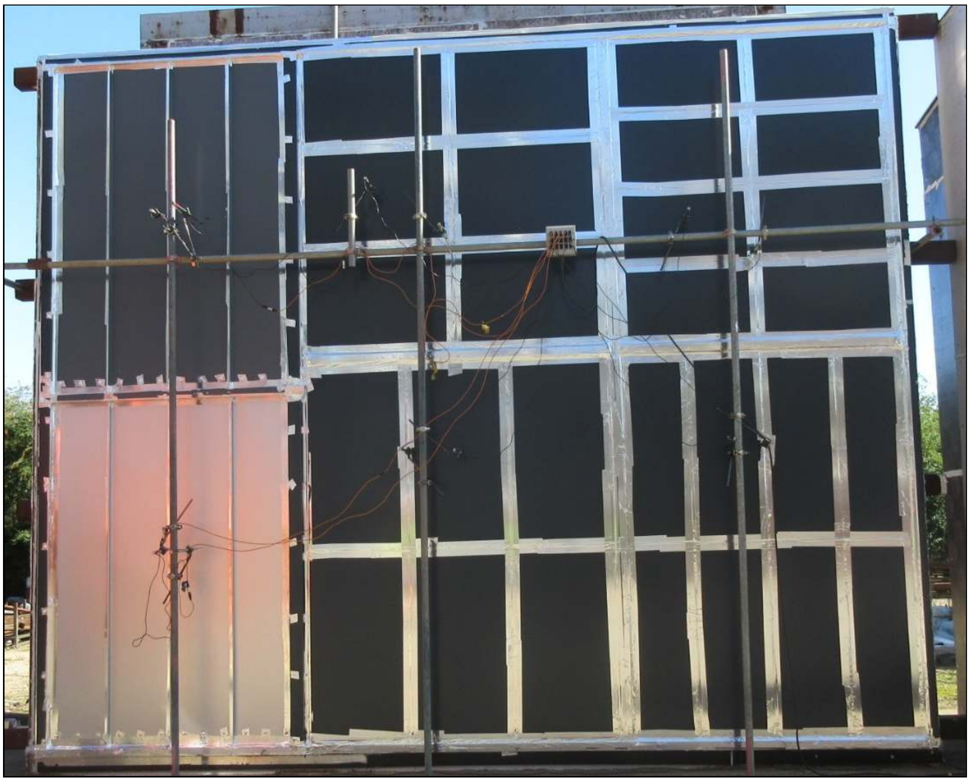
The sample was mounted on a backing wall supplied by Technology Centre, comprising of 100 x 100 m angle and 12 mm plywood boards.

PHOTO 4128

TEST SAMPLE ELEVATION

PHOTO 4243

TEST SAMPLE DURING WIND LOAD TEST



3.2 CONTROLLED DISMANTLING

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

PHOTO 4274

SAMPLE DURING DISMANTLE

PHOTO 4275

SAMPLE DURING DISMANTLE

PHOTO 4276

SAMPLE DURING DISMANTLE

PHOTO 4277

SUPPORT CLIP

PHOTO 4280

SAMPLE DURING DISMANTLE

PHOTO 2793

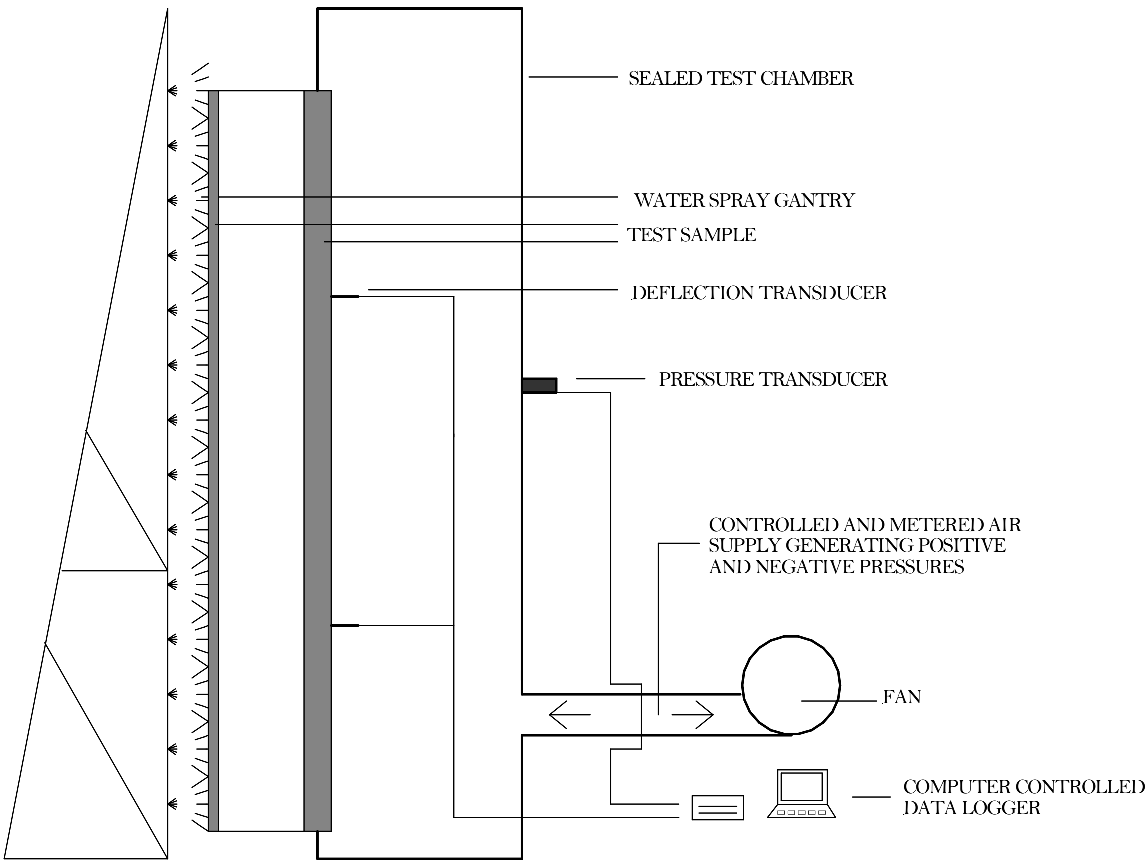
COMPONENTS REMOVED FROM TEST RIG

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.

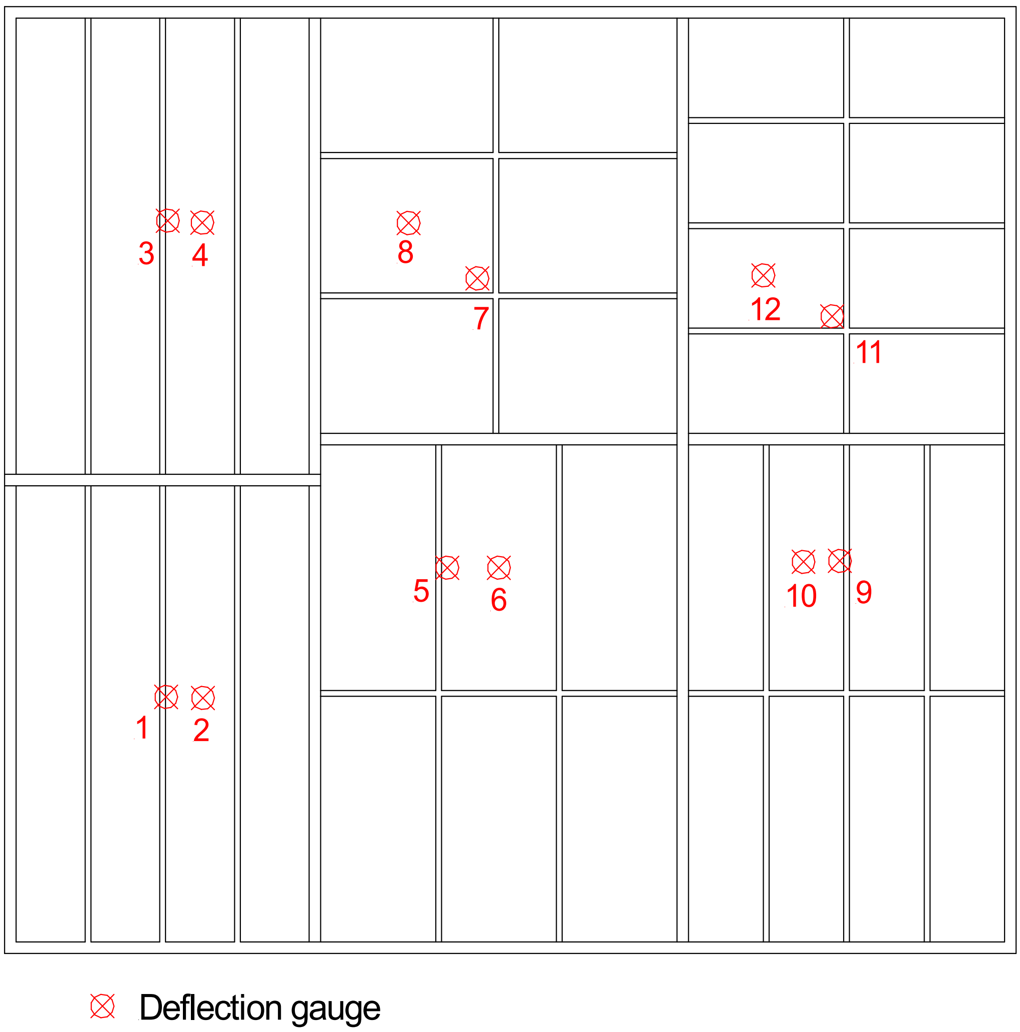
Any damage or functional defects were recorded.

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

FIGURE 2

DEFLECTION GAUGE LOCATIONS

External View



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)
6	1535	L/90 = 17.0
8	1305	L/90 = 14.9
10	1480	L/90 = 16.4
12	1144	L/90 = 12.7

Note: Span based on diagonal distance between supports.

6.5 RESULTS

Test 1 (serviceability) Date: 7 August 2020

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)
6	2399 -2401	9.2 -5.1	0.3 -0.3
8	2399 -2401	11.7 -6.8	0.2 -0.1
10	2399 -2401	8.2 -7.2	0.0 0.0
12	2399 -2401	12.2 -11.0	0.2 -0.1

No damage to the test sample was observed.

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

Test 2 (safety) Date: 7 August 2020

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 = 21°C
Chamber temperature = 22°C

TABLE 5

WIND RESISTANCE – POSITIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	601	1205	1803	2399	Residual
1	4.7	8.1	10.8	13.2	0.6
2	4.8	8.5	11.5	14.0	0.8
3	3.4	6.1	8.5	10.5	0.5
4	3.7	6.4	8.7	10.7	0.5
5	4.3	8.1	11.9	15.7	0.7
6	7.2	14.0	19.8	24.9	1.0
7	1.7	3.6	5.6	7.6	0.4
8	5.7	10.7	15.3	19.3	0.6
9	6.7	11.8	16.7	21.6	1.1
10	9.4	17.3	24.0	29.8	1.1
11	1.9	3.4	5.0	6.2	0.5
12	6.3	10.8	14.7	18.4	0.7

TABLE 6

WIND RESISTANCE – NEGATIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	-610	**-1199**	**-1822**	**-2401**	**Residual**
1	-4.9	-8.6	-13.3	-16.4	-1.0
2	-22.6	-34.7	-45.0	-51.2	-1.2
3	-4.6	-9.9	-14.4	-17.5	-1.0
4	-8.2	-32.7	-41.0	-46.3	-0.8
5	-5.4	-9.7	-14.7	-19.0	-1.5
6	-7.8	-13.3	-19.1	-24.1	-1.8
7	-2.8	-4.6	-6.3	-7.8	-0.1
8	-5.3	-9.1	-12.3	-14.6	-0.2
9	-7.9	-13.0	-18.1	-22.4	-1.4
10	-11.5	-18.4	-24.8	-29.6	-1.4
11	-2.9	-5.8	-9.0	-11.5	-1.2
12	-7.9	-13.6	-18.9	-22.5	-1.3

TABLE 7

WIND RESISTANCE - **SAFETY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)			
	3611	**Residual**	**-3596**	**Residual**
1	18.8	2.1	-23.6	-2.5
2	22.2	4.2	-72.5	-2.7
3	14.8	1.4	-25.3	-1.5
4	15.2	1.4	-65.8	-1.4
5	25.1	2.8	-28.2	-4.1
6	36.0	3.7	-34.7	-4.7
7	11.2	0.7	-11.8	-1.0
8	26.3	1.3	-20.4	-1.5
9	34.2	5.3	-31.5	-4.6
10	42.4	5.6	-41.4	-4.3
11	9.0	1.1	-16.9	-2.9
12	25.3	1.9	-30.1	-3.1

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/m^2/minute.

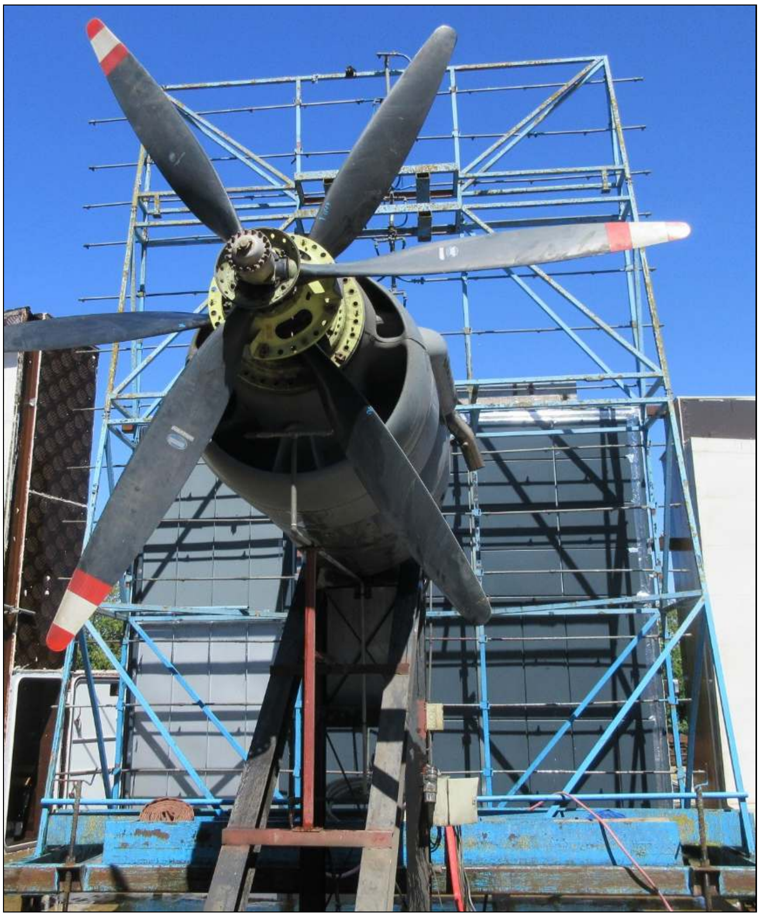
The aero-engine was used to subject the sample to wind of sufficient velocity to produce average deflections in the principle framing members equal to those produced by a static pressure differential of 600 pascals. These conditions were maintained for 15 minutes. Throughout the test the inside of the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

PHOTO 4246

DYNAMIC WIND GENERATOR



7.6 RESULTS

Test 3 Date: 7 August 2020

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 Nm for serviceability and 350 Nm and 500 Nm 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 Nm, 6 Nm and 10 Nm.

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 then 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: 7 August 2020

The impact test results are shown in Tables 16 and 17.

Ambient temperature = 21°C

FIGURE 3

IMPACT TEST LOCATIONS

External View

TABLE 8

SOFT BODY IMPACT RESISTANCE TEST RESULTS

Impact location	Impact energy (Nm)	Observations	Classification
1	120 x 3 350 500	No damage observed 10 mm deformation 50 mm deformation	Class 1 Negligible risk Negligible risk
2	120 x 3 350 500	3 mm deformation 30 mm deformation 60 mm deformation	Class 1 Negligible risk Negligible risk
3	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk
4	120 x 3 500	No damage observed 1 mm deformation	Class 1 Negligible risk
5	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk
6	120 x 3 500	No damage observed 1 mm deformation	Class 1 Negligible risk
7	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk
8	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk
9	120 x 3 500	No damage observed 10 mm deformation	Class 1 Negligible risk
10	120 x 3 500	No damage observed 10 mm deformation	Class 1 Negligible risk
11	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk
12	120 x 3 500	No damage observed No damage observed	Class 1 Negligible risk

T

TABLE 9

HARD BODY IMPACT RESISTANCE TEST RESULTS

Impact location	Impact energy (Nm)	Observations	Classification
13	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
14	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
15	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
16	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
17	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
18	3 6 10	Minor indent Minor indent Minor indent	Class 1 / Negligible risk Class 1 Class 1 / Negligible risk
19	3 6	Minor indent Minor indent	Class 1 / Negligible risk Class 1
20	3 6	Minor indent Minor indent	Class 1 / Negligible risk Class 1
21	10	Minor indent	Class 1 / Negligible risk
22	10	Minor indent	Class 1 / Negligible risk

PHOTO 4250

SOFT BODY IMPACTOR

PHOTO 4253

SOFT BODY IMPACTS

PHOTO 4254

SOFT BODY IMPACTS

PHOTO 4255

SOFT BODY IMPACTS

PHOTO 3718

HARD BODY IMPACTOR

PHOTO 3725

HARD BODY IMPACTS

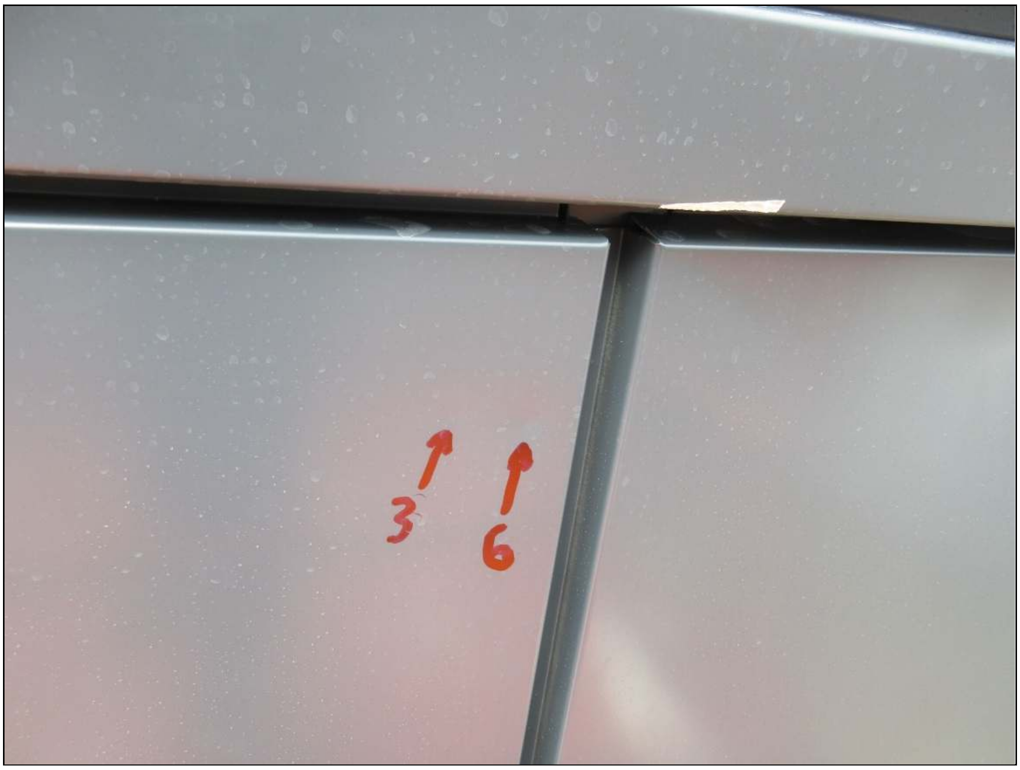


PHOTO 4264

HARD BODY IMPACT

PHOTO 4265

HARD BODY IMPACTS

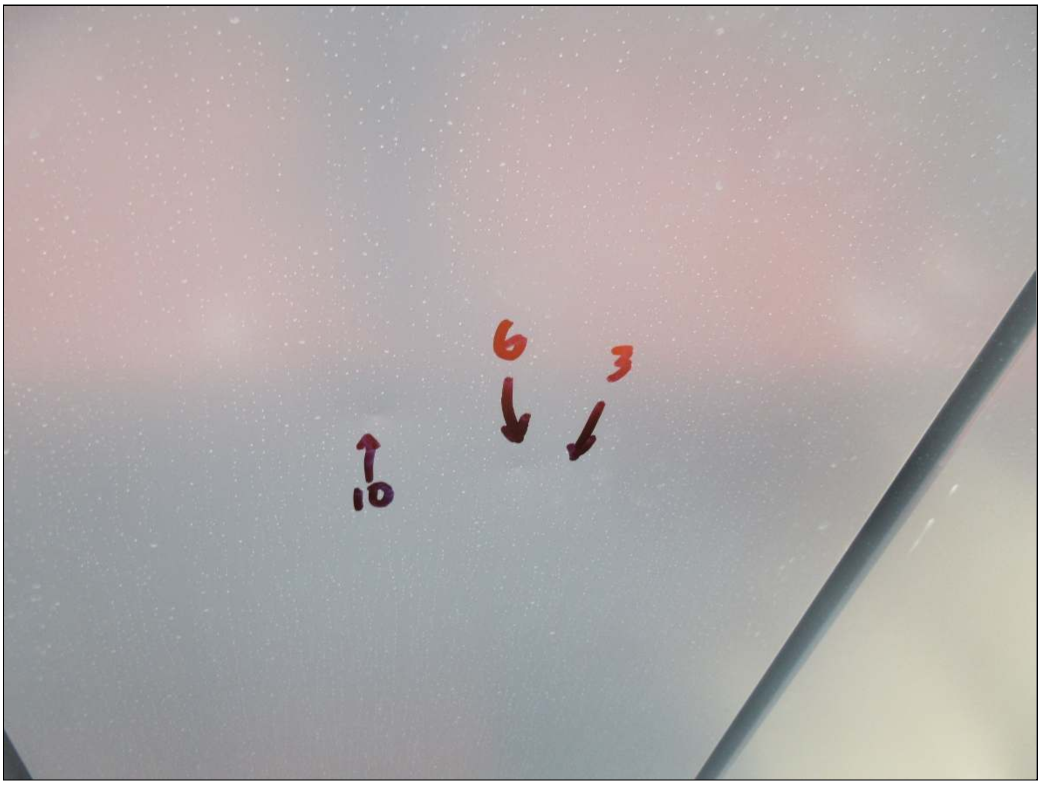


PHOTO 4266

HARD BODY IMPACTS

PHOTO 4267

HARD BODY IMPACTS

PHOTO 4268

HARD BODY IMPACTS

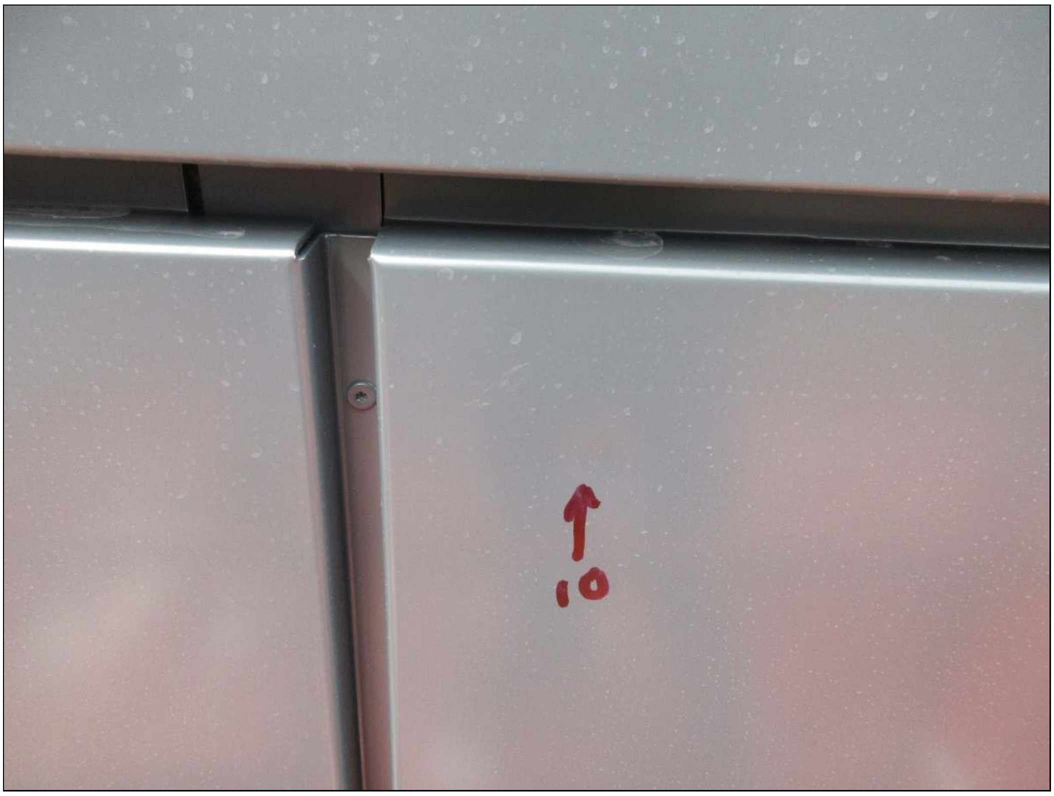


PHOTO 4269

HARD BODY IMPACTS

PHOTO 4270

HARD BODY IMPACTS

PHOTO 4271

HARD BODY IMPACTS

PHOTO 4272

HARD BODY IMPACTS

9 APPENDIX

The following 7 unnumbered pages are copies of Architectural Profiles Limited drawings numbered:

TEST-VINCI-101/b,

TEST-VINCI-102/b,

TE-VI-02/b,

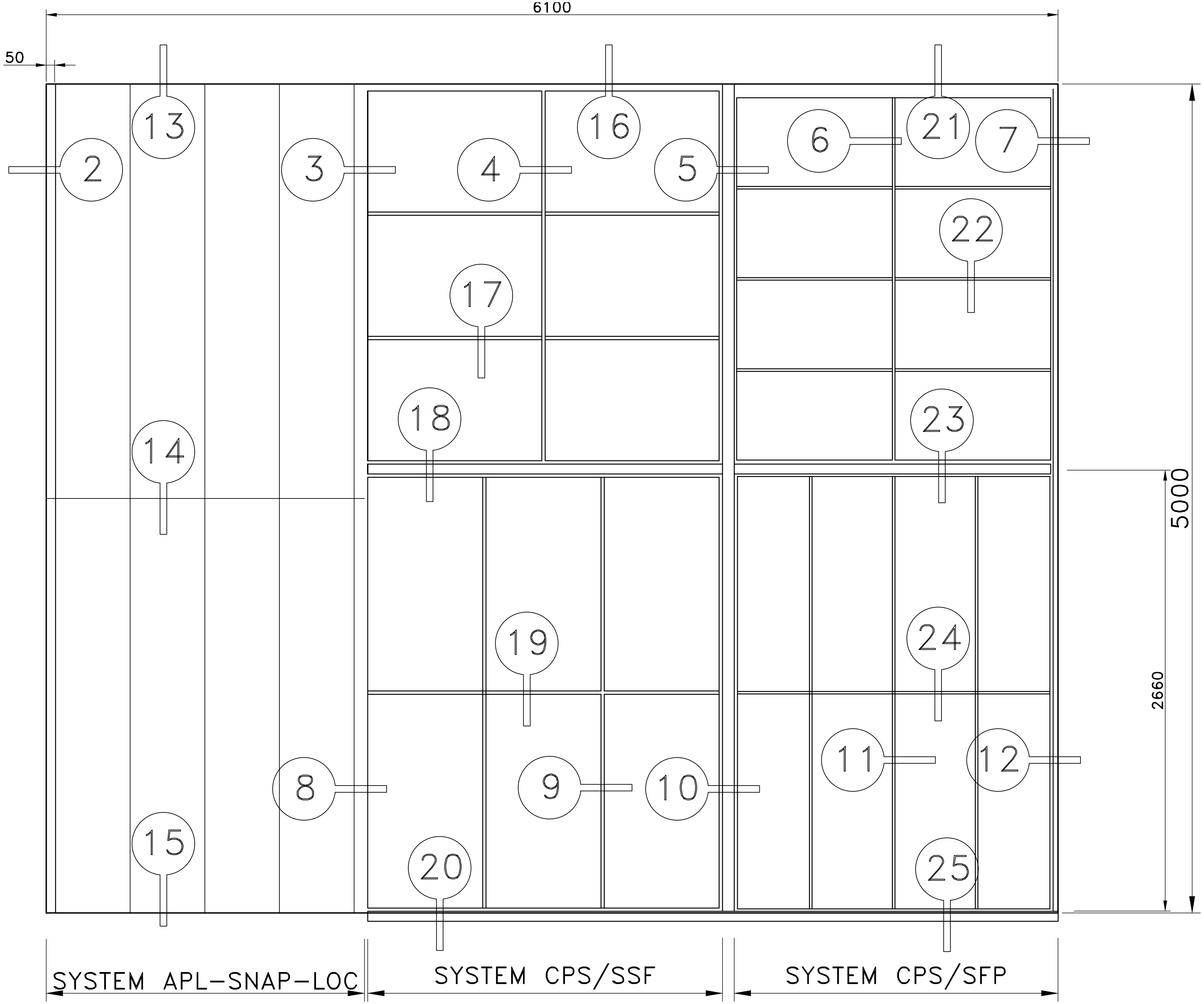
TE-VI-03/b,

TE-VI-04/a,

TE-VI-05/a,

TE-VI-06/a.

END OF REPORT



ARCHITECTURAL PROFILES LTD.
53 CROCKHAMWELL ROAD,
WOODLEY, READING, RG5 3JH, ENGLAND
Telephone: 0118 927 2424 Fax: 0118 927 2400

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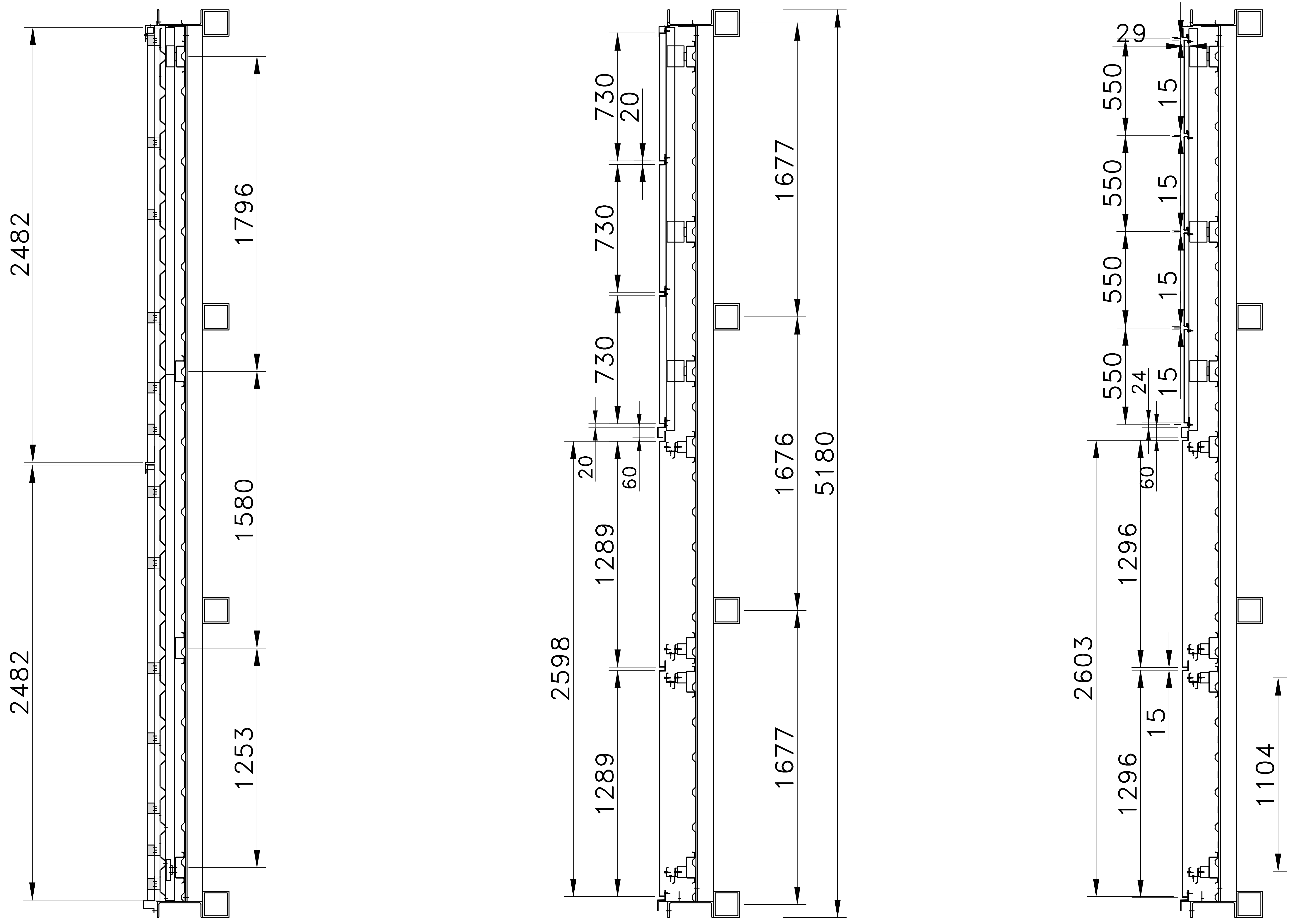
details

panels

DWG NO. TEST-VINCI-101/b

CWCT TEST

26.02.2020



APL–SNAP–LOC

CPS/SSF

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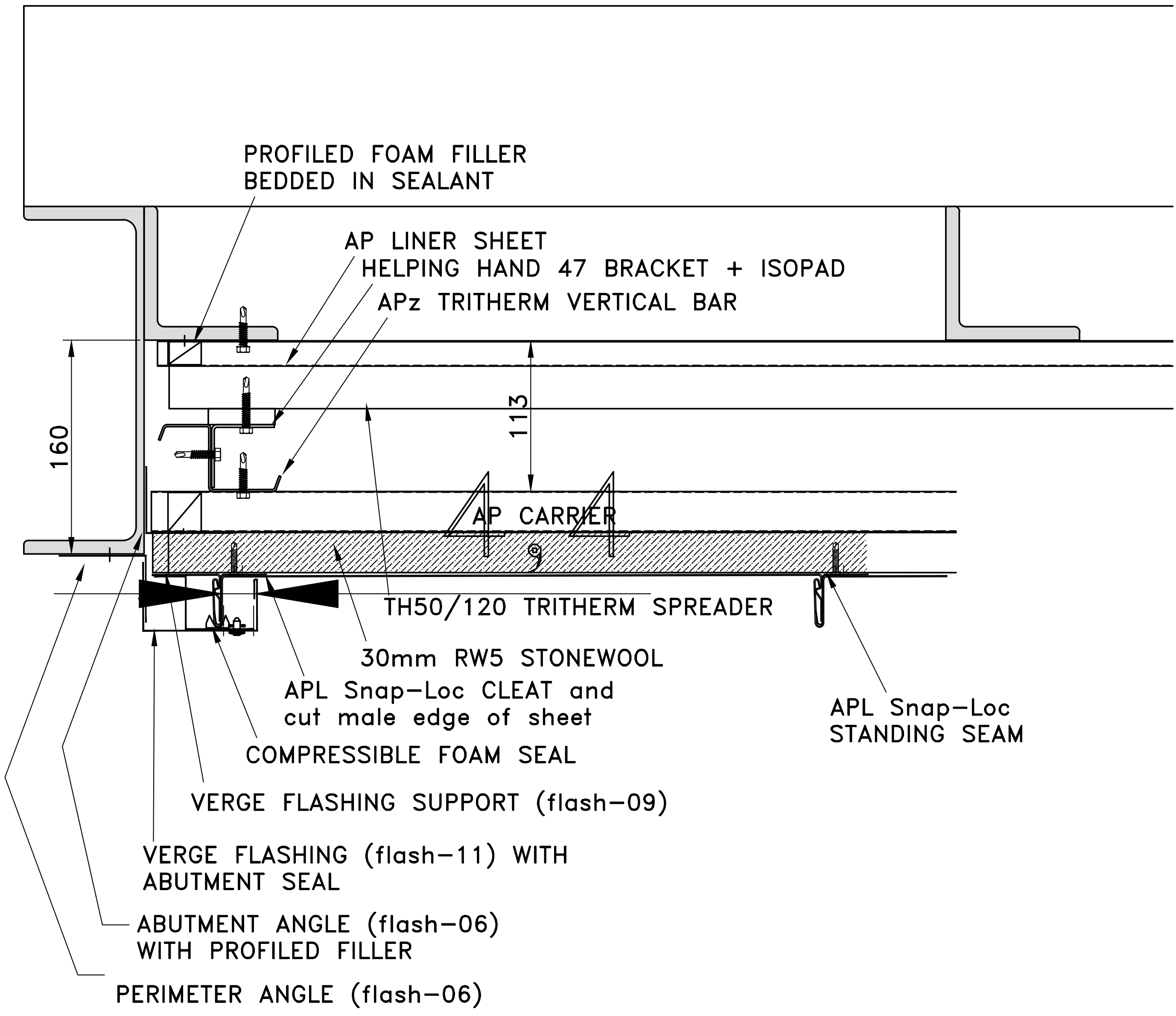
CWCT TEST

DWG NO. TEST–VINCI–102/b
26.02.2020

VINCI-CWCT-TEST

IMPORTANT NOTES :	1) All steelwork or supporting structure shown are <u>indicative only</u> 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 1-2mm per metre of length depending on colour	**SCALE**	**-**



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-

TE-VI-02/b

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VINCI-CWCT-TEST

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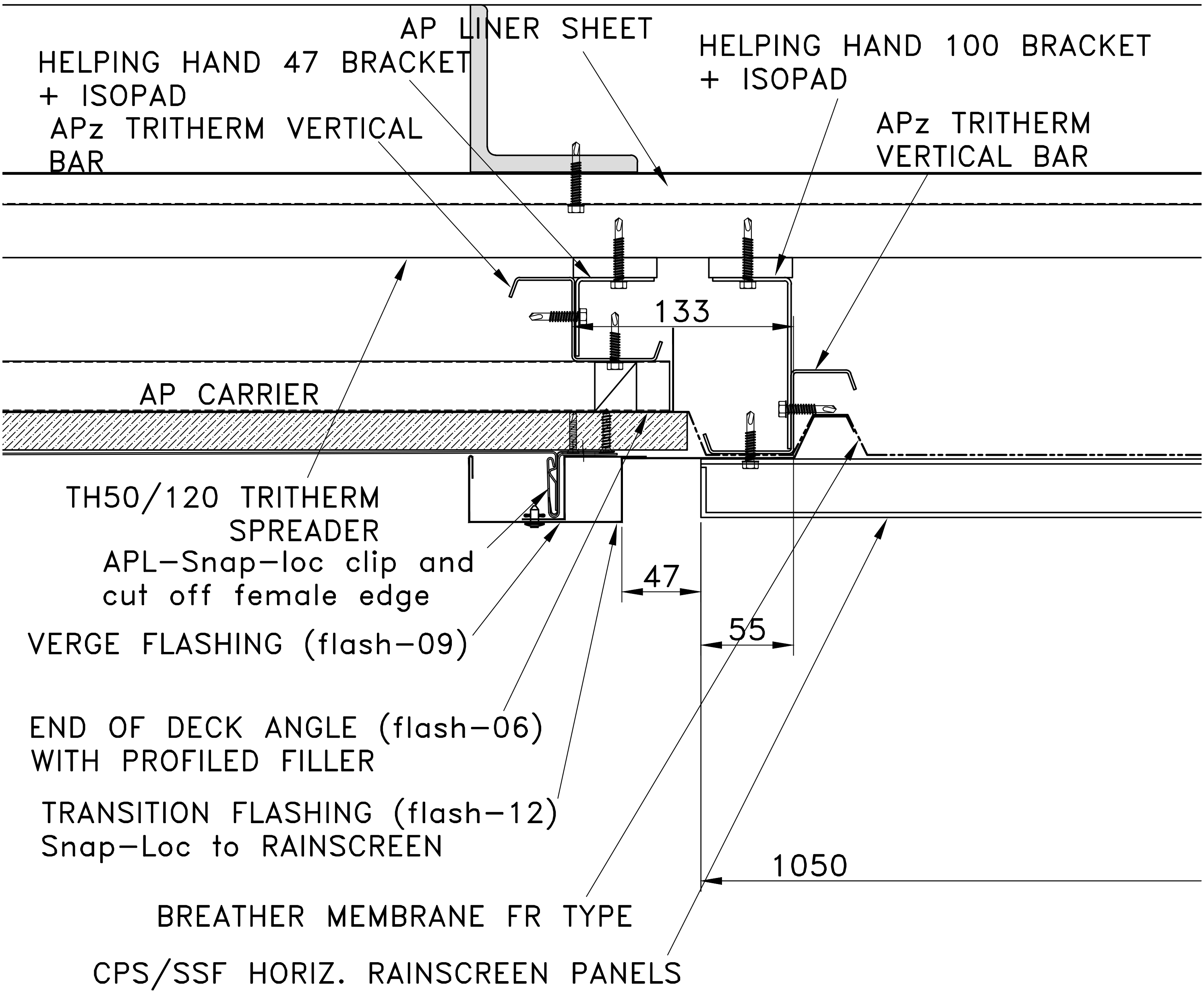

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53 CROCKHAMWELL ROAD,
WOODLEY, READING, RG5 3JH, ENGLAND
Telephone: 0118 927 2424 Fax: 0118 927 2400

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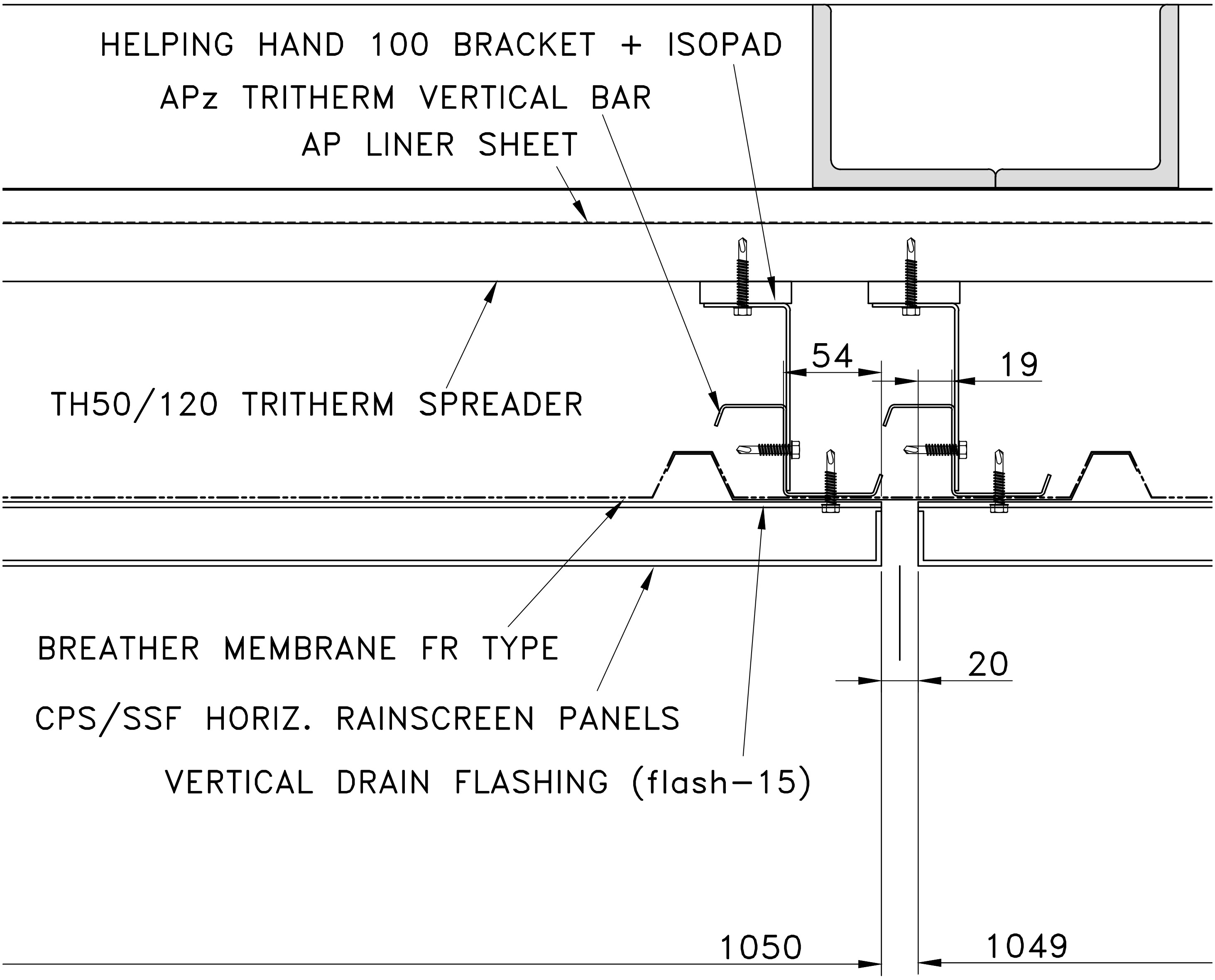
TE-VI-03/b

VINCI-CWCT-TEST

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 1–2mm per metre of length depending on colour

SCALE –



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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.

ISO 9001 REGISTERED FIRM
ARCHITECTURAL PROFILES LTD.
53 CROCKHAMWELL ROAD,
WOODLEY, READING, RG5 3JH, ENGLAND
Telephone: 0118 927 2424 Fax: 0118 927 2400

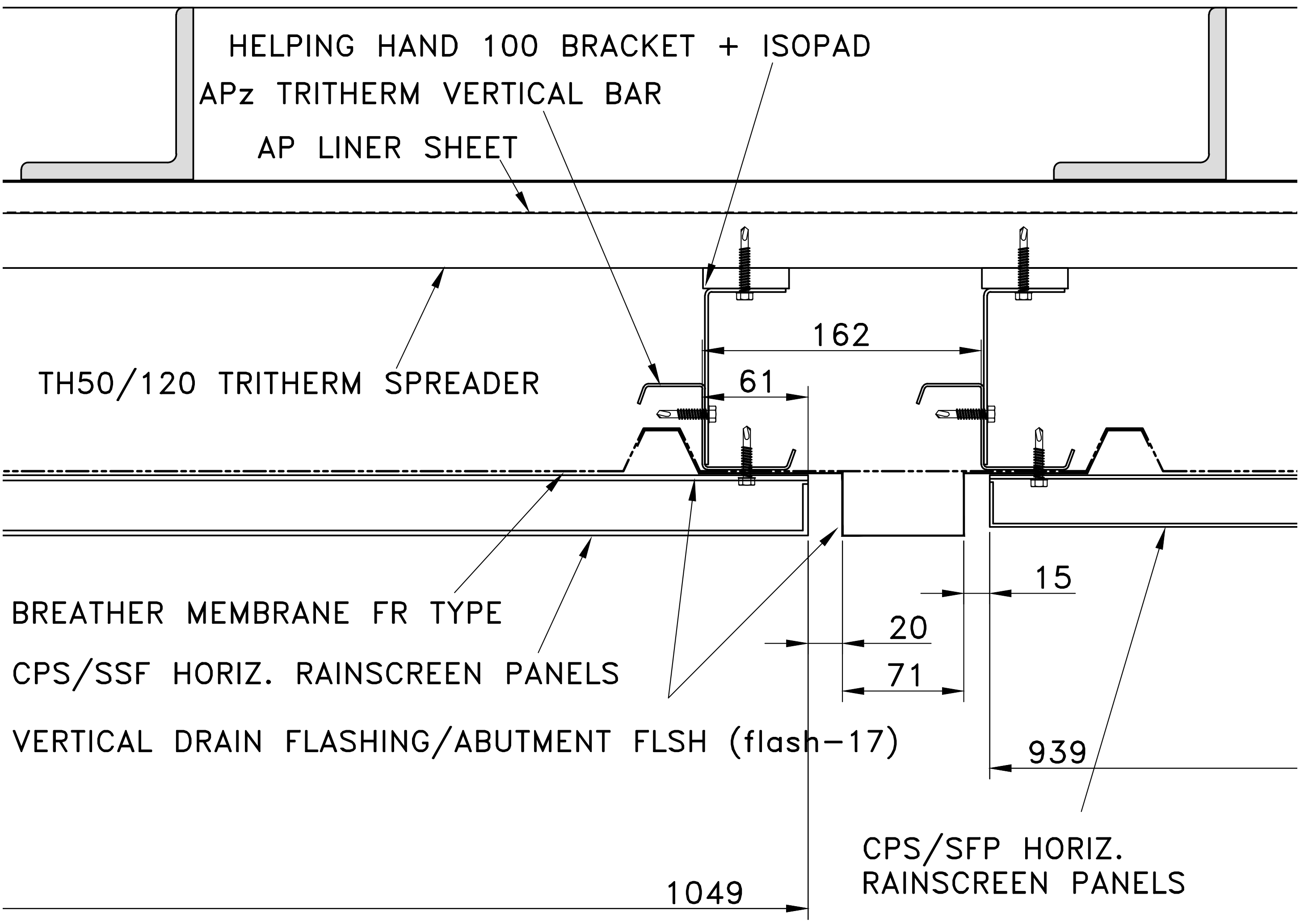
CPS/SSF HORIZ
VERTICAL JOINT
–

TE–VI–04/a

-

VINCI-CWCT-TEST

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 1-2mm per metre of length depending on colour	**SCALE**	**-**



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-DO NOT SCALE-
-USE ONLY FIGURED DIMENSIONS-

CPS/SSF HORIZ
ABUT TO CPS/SFP HORIZ.
-

TE-VI-05/a

VINCI–CWCT–TEST

IMPORTANT NOTES :
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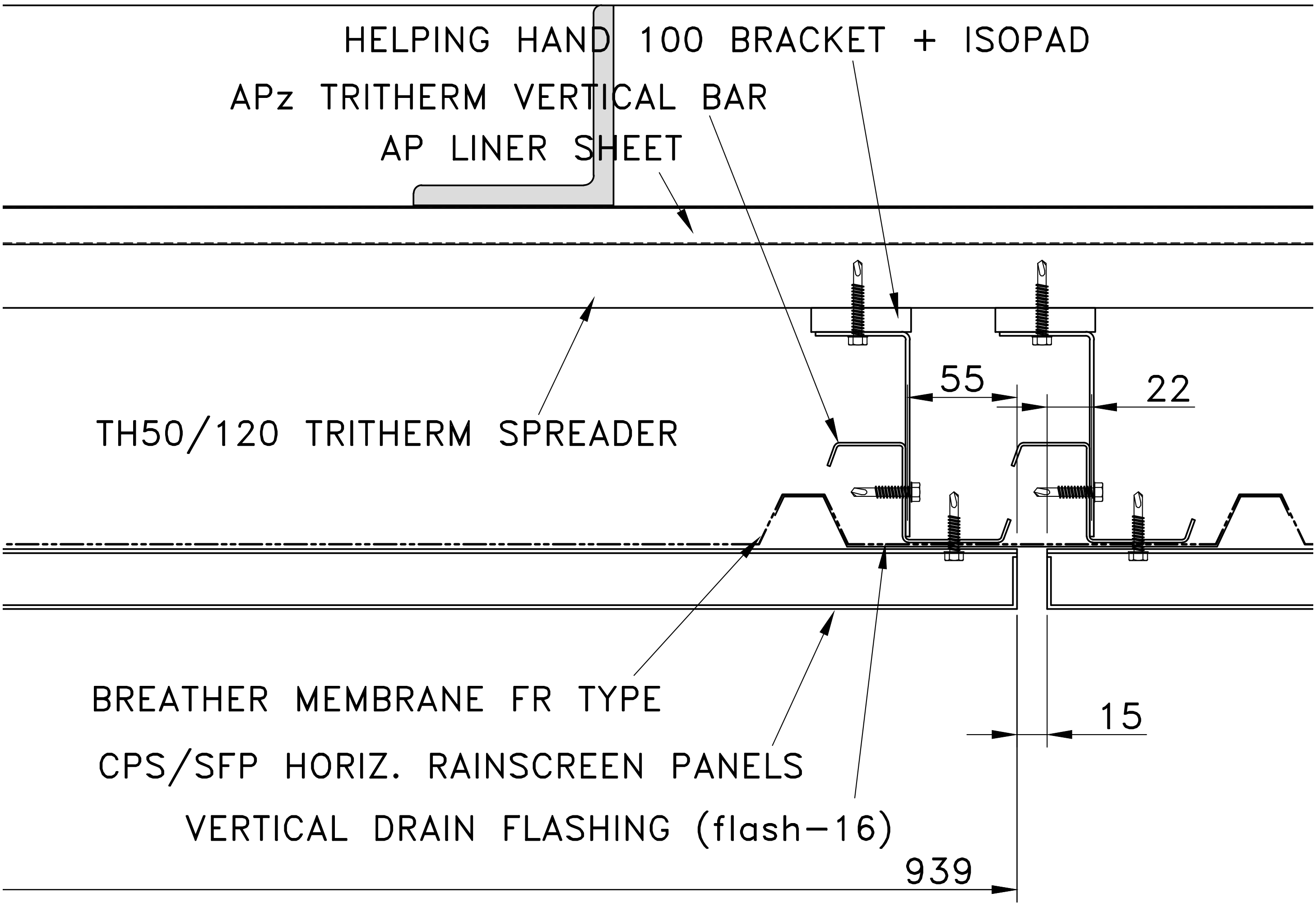
SCALE	–



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VERTICAL JOINT
–

TE–VI–06/a

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