TECHNOLOGY CENTRE

Technical Report

Title: Product weathertightness testing of a Matrix "IP" Rainscreen Cladding system for PSP Architectural Limited

Report No: N950-12-16511

VINCI CONSTRUCTION UK

Technical Report

Title:	Product weathertightness testing of a Matrix "IP" Rainscreen Cladding system for PSP Architectural Ltd.
Client:	PSP Architectural Ltd Unit 11, All Saints Industrial Estate, Shildon, County Durham DL4 2RD
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CONTENTS

1 INTRODUCTION

This report describes tests carried out at the Technology Centre at the request of PSP Architectural Ltd.

The test sample consisted of a sample of Rainscreen Cladding manufactured by PSP Architectural Ltd. The rainscreen system was attached to an insulated backing wall.

The tests were carried out in January 2012 and were to determine the weathertightness of the test sample. The test methods were in accordance with the CWCT Standard Test Methods for building envelopes, 2005, for:

Air permeability.

Watertightness – static pressure, dynamic pressure and hose.

Wind resistance – serviceability & safety.

Impact resistance.

The testing was carried out in accordance with Technology Centre Method Statement C4148MSrev0.

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.

Technology Centre is accredited to ISO/IEC 17025:2008 by the United Kingdom Accreditation Service as UKAS Testing Laboratory No.0057.

Technology Centre 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 wholly or in part by:

Heath Hindmarch - PSP Architectural Ltd
Barry Gittins - PSP Architectural Ltd
John Burrell - JBC

2 DESCRIPTION OF TEST SAMPLE

2.1 GENERAL ARRANGEMENT

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

The rainscreen used 1 mm thick zinc panels.

PHOTO 1010111

TEST SAMPLE ELEVATION

PHOTO 1010101

TEST SAMPLE DURING CONSTRUCTION

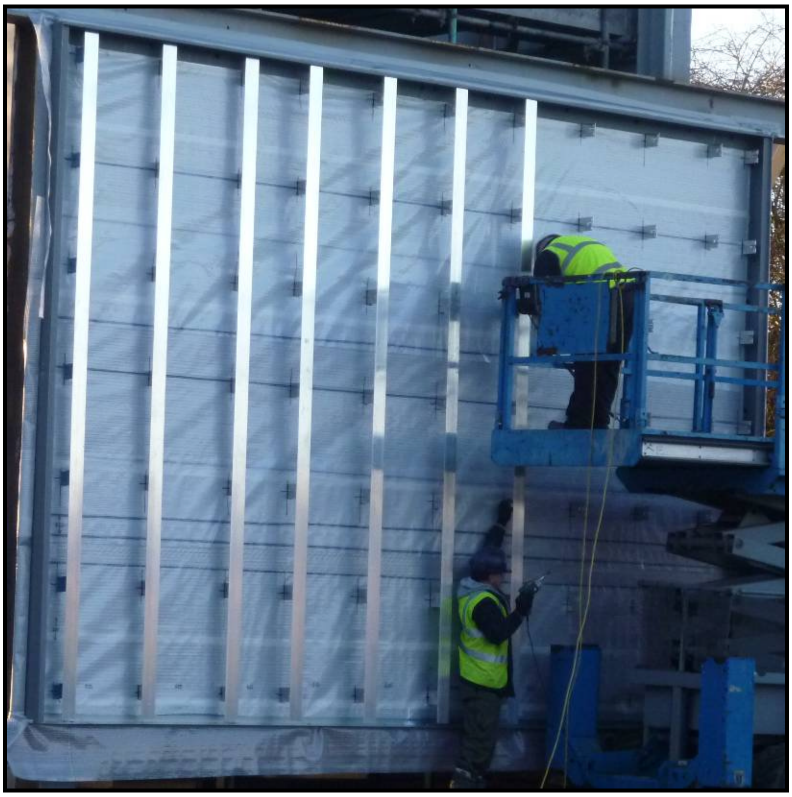


PHOTO 1010113

TEST SAMPLE SEALED FOR WIND REISTANCE TESTING

2.2 CONTROLLED DISMANTLING

During the dismantling of the sample no water penetration or discrepancies from the drawing were found.

PHOTO 1010173

SUPPORT RAILS AT BASE OF SAMPLE

PHOTO 1010174

RAIL SUPPORT BRACKETS

PHOTO 1010179

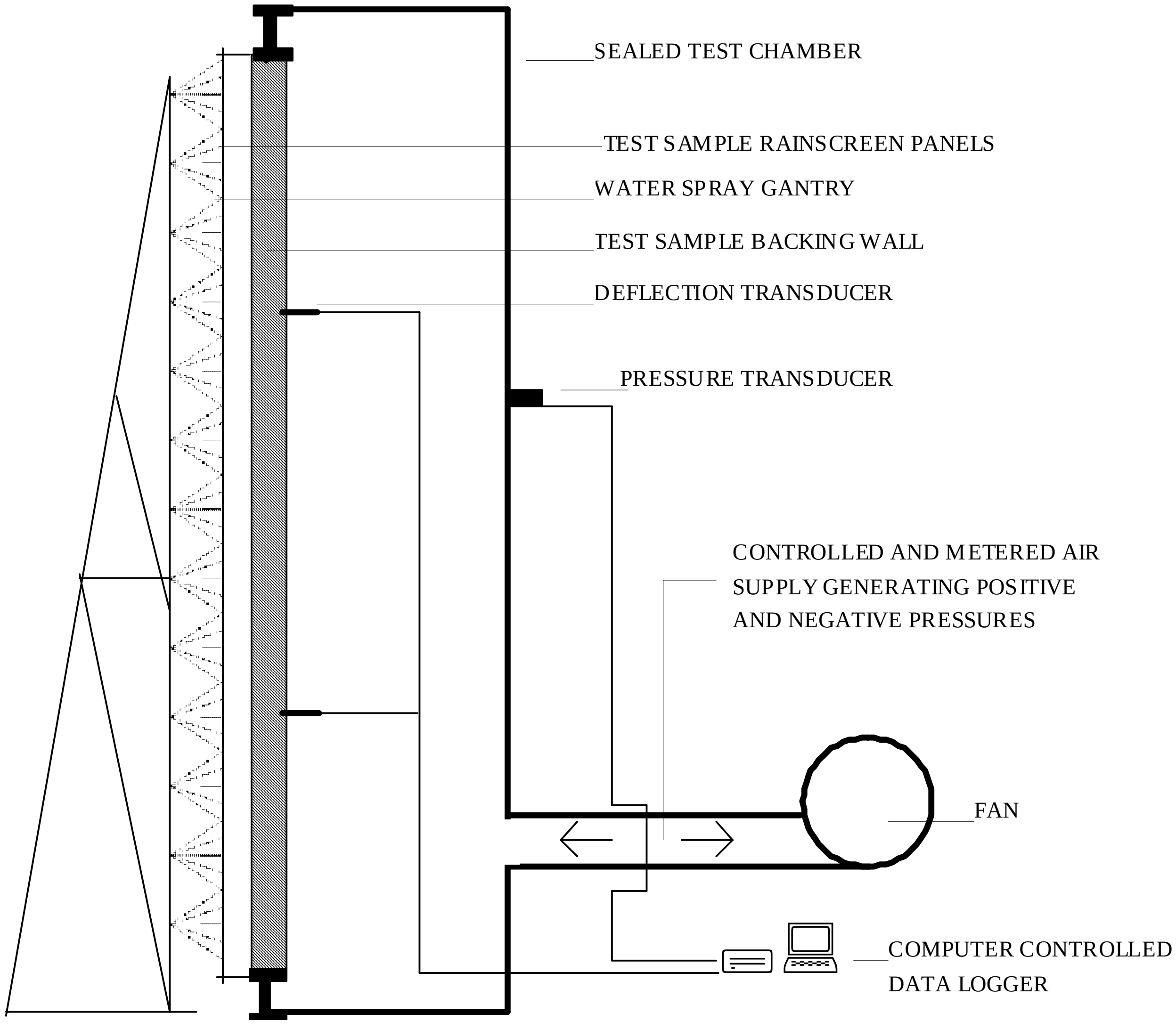
LEFT HAND SUPPORT FRAME

3 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 PSP Architectural Ltd installed the sample on the test rig. See Figure 1.

FIGURE 1

TEST RIG SCHEMATIC ARRANGEMENT



SECTION THROUGH TEST RIG

4 TEST SEQUENCE

The test sequence was as follows:

(1) Air permeability

(2) Watertightness – static

(3) Wind resistance – serviceability

(4) Air permeability

(5) Watertightness – static

(6) Watertightness – dynamic

(7) Watertightness – hose

(8) Wind resistance – safety

(9) Wind resistance – serviceability on rainscreen panels

(10) Wind resistance – safety on rainscreen panels

(11) Impact resistance

5 SUMMARY AND CLASSIFICATION OF TEST RESULTS

The following summarises the results of the tests carried out. For full details refer to Sections 6, 7, 8 and 9.

5.1 SUMMARY OF TEST RESULTS

TABLE 1

Date	Test number	Test description	Result
30 January 2012	1	Air permeability	Pass
30 January 2012	2	Watertightness – static	Pass
30 January 2012	3	Wind resistance – serviceability	Pass
30 January 2012	4	Air permeability	Pass
30 January 2012	5	Watertightness – static	Pass
31 January 2012	6	Watertightness – dynamic	Pass
31 January 2012	7	Watertightness – hose	Pass
31 January 2012	8	Wind resistance – safety	Pass
31 January 2012	9	Wind resistance – serviceability (rainscreen panels)	Pass
31 January 2012	10	Wind resistance – safety (rainscreen panels)	Pass
31 January 2012	11	Impact resistance	Pass

5.2 CLASSIFICATION

TABLE 2

Test	Standard	Classification / Declared value
Air permeability	CWCT	A4
Watertightness	CWCT	R7
Wind resistance	CWCT	±2400 pascals serviceability ±3600 pascals safety

6 AIR PERMEABILITY 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 Air Flow

A laminar flow element mounted in the air system ductwork was used with a pressure transducer to measure the air flow into the chamber. This device was capable of measuring airflow through the sample to within 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

Three positive pressure pulses of 1200 pascals were applied to prepare the test sample.

The average air permeability was determined by measuring the rate of air flow through the chamber whilst subjecting the sample to positive pressure differentials of 50, 100, 150, 200, 300, 450 and 600 pascals. Each pressure increment was held for at least 10 seconds.

Extraneous leakage through the test chamber and the joints between the chamber and the test sample was determined by sealing the sample with adhesive tape (polythene sheet as mentioned in CWCT clause 5.10.3.1 was not used on this occasion) and measuring the air flow at the pressures given above.

The test was then repeated with the sample unsealed; the difference between the readings being the rate of air flow through the sample.

The test was then repeated using negative pressure differentials.

6.4 PASS/FAIL CRITERIA

The permissible air flow rate, Q_o, at peak test pressure, p_o, could not exceed:
1.5 m^3 per hour per m^2.

At intermediate pressures, p_n, flow rates, Q_n, were calculated using $Q_n = Q_o(p_n/p_o)^{2/3}$
The area of the sample was 22.8 m^2.

6.5 RESULTS

TABLE 3

Pressure differential (pascals)	Measured air flow through sample (m^3/hour/m^2)			
	Test 1 Date: 30 January 2012		Test 4 Date: 30 January 2012	
	Infiltration	Exfiltration	Infiltration	Exfiltration
50	0.00	0.03	0.00	0.01
100	0.07	0.06	--	--
150	0.08	0.04	--	--
200	0.07	0.05	--	--
300	0.09	0.04	0.02	0.00
450	0.07	0.07	--	--
600	0.10	0.12	0.00	0.00
Temperatures	Ambient = 0°C Chamber = 8°C		Ambient = 3°C Chamber = 11°C	

The results are shown graphically in Figures 2 and 3.

Note: Due to the low air flow readings, for Test 4, measurements were taken at pressure differentials of 50, 300 and 600 pascals only.

FIGURE 2

Air infiltration test results

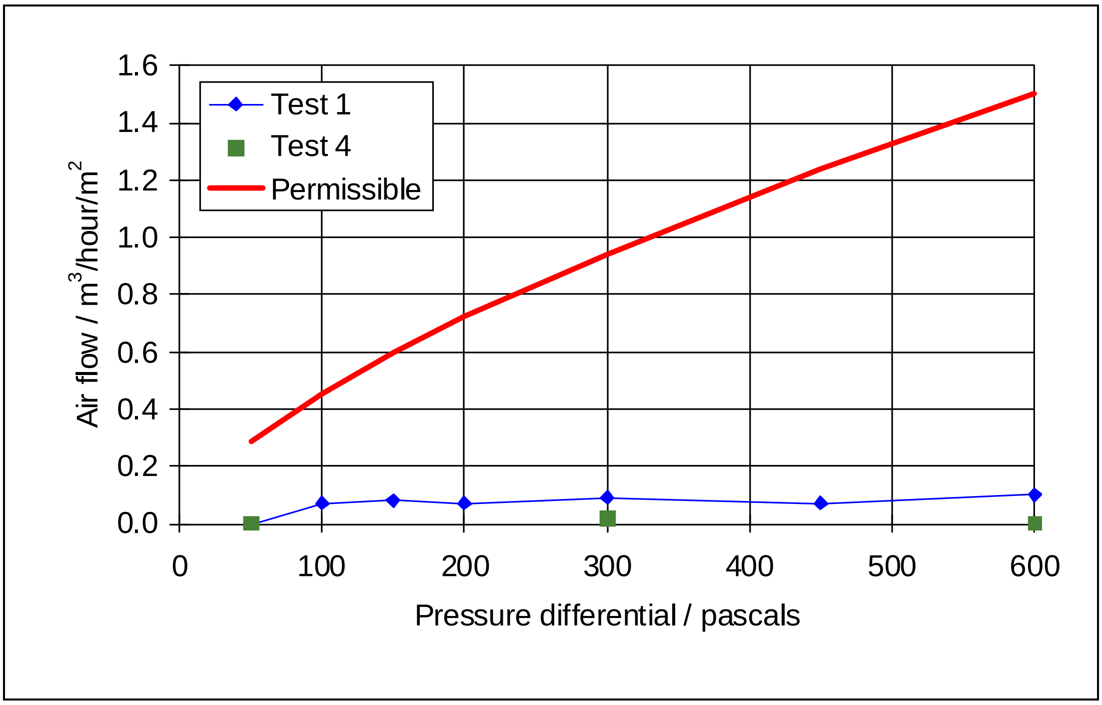
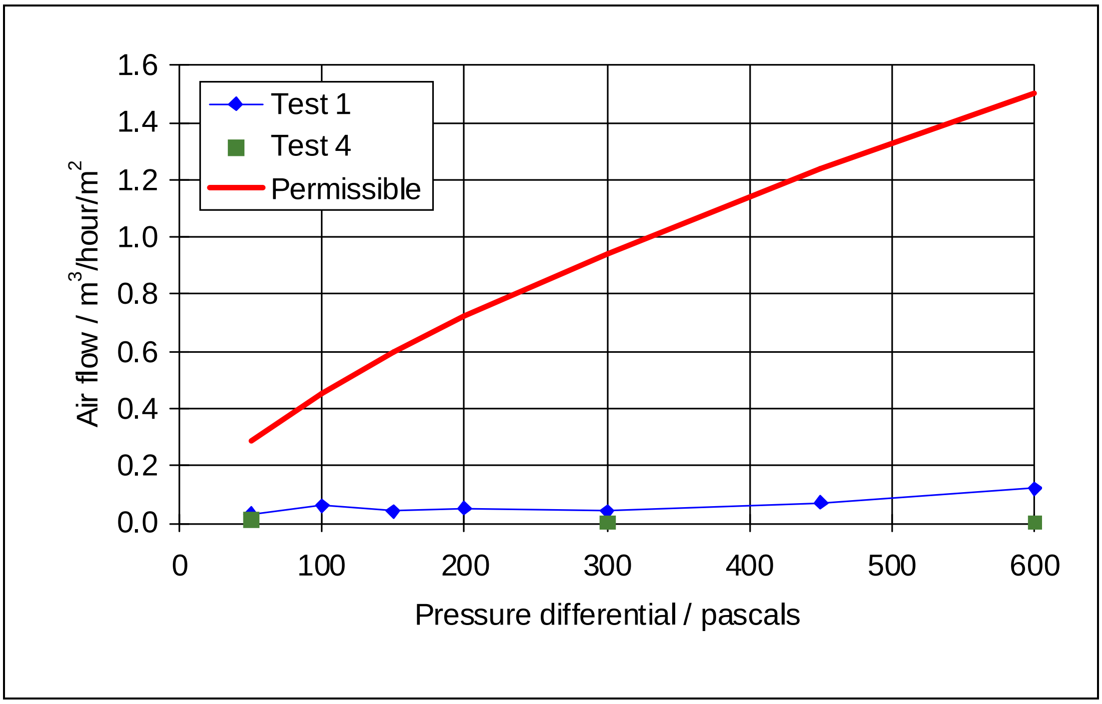


FIGURE 3

Air exfiltration test results



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

7.2.1 Static Pressure Testing

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.

7.2.2 Dynamic Pressure Testing

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

7.3.1 Spray Gantry

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.

7.3.2 Hose test

The water was applied using a brass nozzle that produced a full-cone of water droplets with a nominal spray angle of 30°. The nozzle was used with a ¾" hose and provided with a control valve and a pressure gauge between the valve and nozzle.

7.4 PROCEDURE

7.4.1 Watertightness – static

Three positive pressure pulses of 1200 pascals were applied to prepare the test sample.

Water was sprayed onto the sample using the method described above at a rate of at least 3.4 litres/m^2/minute for 15 minutes at zero pressure differential. With the water spray continuing the pressure differential across the sample was then increased in increments of: 50, 100, 150, 200, 300, 450 and 600 pascals, each held for 5 minutes.

Throughout the test the interior face of the sample was examined for water penetration.

7.4.2 Watertightness – dynamic

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. Suction was applied to the inside of the specimen to achieve the required test deflections but was limited to 25% of the peak static pressure. These conditions were maintained for 15 minutes. Throughout the test the inside of the sample was examined for water penetration.

PHOTO 1010112

WIND GENERATOR IN FRONT OF SAMPLE

7.4.3 Watertightness – hose

Working from the exterior, the selected area was wetted progressing from the lowest horizontal joint, then the intersecting vertical joints, then the next horizontal joint above, etc. The water was directed at the joint and perpendicular to the face of the sample. The nozzle was moved slowly back and forth above the joint at a distance of 0.3 metres from it for a period of 5 minutes for each 1.5 metres of joint. Shorter or slightly longer joints were tested pro rata. The water flow to the nozzle was adjusted to produce 22, ±2 litres per minute when the water pressure at the nozzle inlet was 220, ±20 kPa.

Throughout the test the interior face of the sample was examined for water penetration. The joints tested are shown in Figure 4.

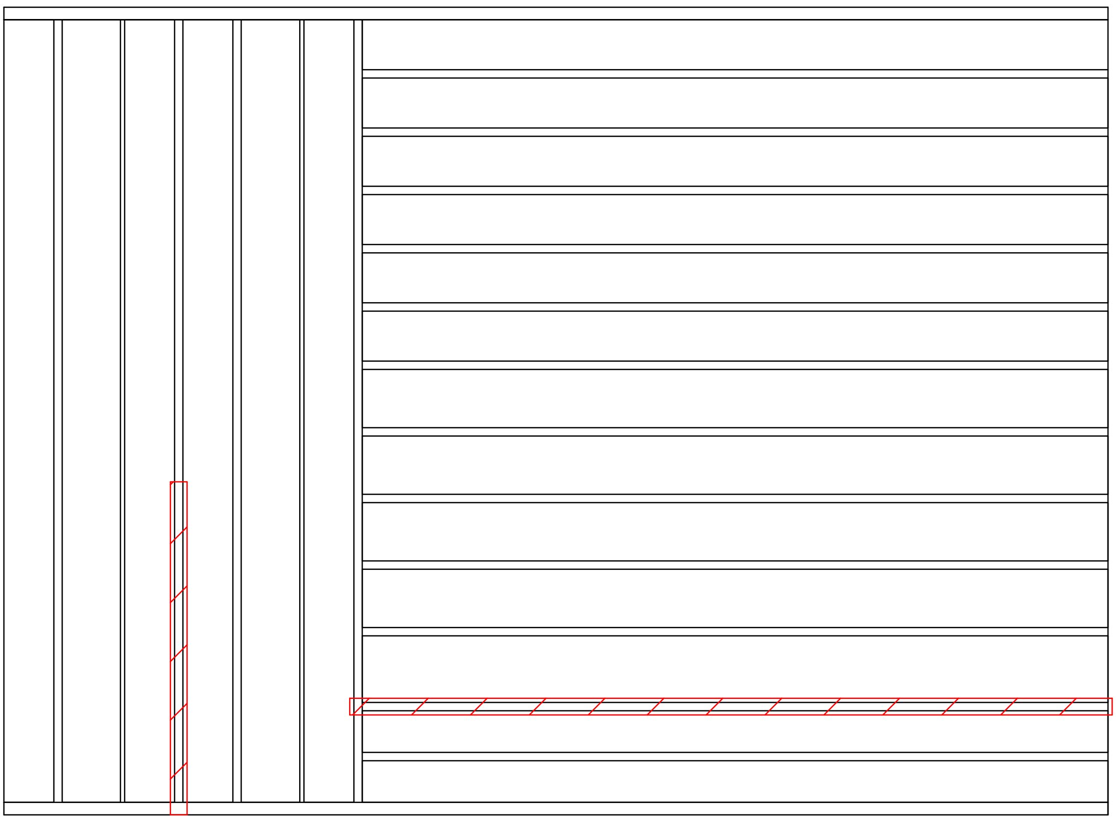
7.5 PASS/FAIL CRITERIA

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

FIGURE 4

HOSE TEST AREAS

External View



hose test area

7.6 RESULTS

Test 2 (Static pressure) Date: 30 January 2012

No water penetration was observed throughout the test.

Chamber temperature= 12°C
Ambient temperature = 1°C
Water temperature = 8°C

Test 5 (Static pressure) Date: 30 January 2012

No water penetration was observed throughout the test.

Chamber temperature= 12°C
Ambient temperature = 3°C
Water temperature = 8°C

Test 6 (Dynamic pressure) Date: 31 January 2012

No water penetration was observed throughout the test.

Chamber temperature= 13°C
Ambient temperature = 0°C
Water temperature = 8°C

Test 7 (Hose) Date: 31 January 2012

No water penetration was observed throughout the test.

Chamber temperature= 13°C
Ambient temperature = 1°C
Water temperature = 8°C

8 WIND RESISTANCE TESTING

8.1 INSTRUMENTATION

8.1.1 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.

8.1.2 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 5.

8.1.3 Temperature

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

8.1.4 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.

8.2 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.

8.3 PROCEDURE

8.3.1 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.

8.3.2 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.

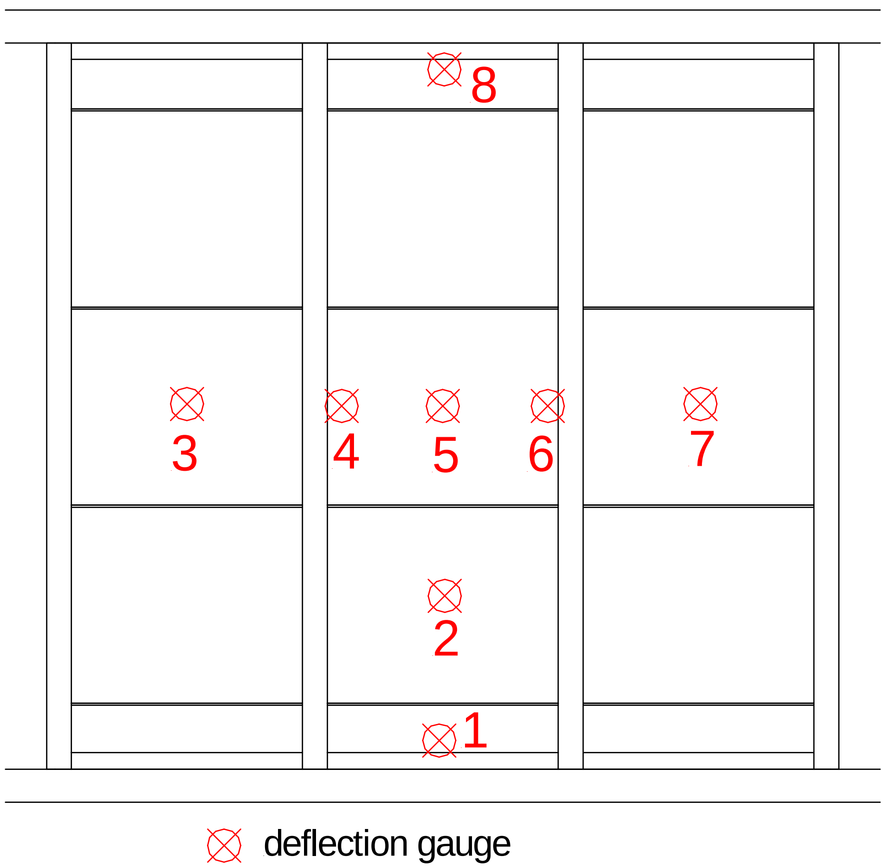
The test was then repeated using a negative pressure of –3600 pascals.

Note: The above tests were carried out on the backing wall. The tests were then repeated on the rainscreen panels. To do this, holes were made through the backing wall, and the joints between the rainscreen panels were sealed over with aluminium tape.

FIGURE 5

DEFLECTION GAUGE LOCATIONS

Internal View



PASS/FAIL CRITERIA

8.3.3 Calculation of permissible deflection

Gauge number	Member	Span (L) (mm)	Permissible deflection (mm)	Permissible residual deformation
5*	Horizontal span	1700	L/200 = 8.5	1 mm
5**	Vertical span	4000	L/300 + 5 mm = 18.3	1 mm

8.4 RESULTS

Test 3 (serviceability) Date: 30 January 2012

The deflections measured during the wind resistance test, at the positions shown in Figure 5, are shown in Tables 4 and 5.

Summary Table:

Gauge number	Member	Pressure differential (Pa)	Measured deflection (mm)	Residual deformation (mm)
5*	Horizontal span	2396 -2398	2.6 -2.8	0.0 -0.1
5**	Vertical span	2396 -2398	2.3 -6.6	0.1 -0.7

No damage to the test sample was observed.

Ambient temperature = 3°C
Chamber temperature = 8°C

Test 8 (safety) Date: 31 January 2012

The deflections measured during the structural safety test, at the positions shown in Figure 5, are shown in Table 6.

No damage to the sample was observed.

Ambient temperature = 2°C
Chamber temperature = 7°C

Test 9 (serviceability on rainscreen panels) Date: 31 January 2012

No damage to the sample was observed.

Ambient temperature = 2°C
Chamber temperature = 8°C

Test 10 (safety on rainscreen panels) Date: 31 January 2012

No damage to the sample was observed.

Ambient temperature = 2°C
Chamber temperature = 8°C

TABLE 4

WIND RESISTANCE – POSITIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	603	**1221**	**1778**	**2396**	**Residual**
1	0.6	1.2	1.6	2.0	0.1
2	1.6	2.8	3.6	4.4	0.1
3	1.6	2.9	3.8	4.6	0.1
4	1.5	2.3	2.8	3.1	0.2
5	1.9	3.2	4.0	4.8	0.2
6	1.1	1.5	1.5	1.2	0.1
7	1.5	2.6	3.6	4.5	0.0
8	1.0	1.8	2.4	2.9	0.1
5*	0.6	1.3	1.9	2.6	0.0
5**	1.1	1.7	2.1	2.3	0.1

*Mid-span reading adjusted horizontally between end support readings
**Mid-span reading adjusted vertically between end support readings

TABLE 5

WIND RESISTANCE – NEGATIVE **SERVICEABILITY** TEST RESULTS

Position	**Pressure (pascals) / Deflection (mm)**				
	-599	**-1197**	**-1815**	**-2398**	**Residual**
1	-0.7	-1.3	-2.1	-2.9	-0.2
2	-1.8	-3.6	-5.9	-8.4	-0.7
3	-1.8	-3.7	-6.1	-8.7	-0.6
4	-1.7	-3.4	-5.6	-8.1	-1.0
5	-2.3	-4.5	-7.3	-10.4	-0.9
6	-1.6	-3.0	-4.9	-7.0	-1.0
7	-1.6	-3.2	-5.1	-7.2	-0.7
8	-1.0	-2.1	-3.4	-4.8	-0.3
5*	-0.6	-1.3	-2.0	-2.8	0.1
5**	-1.4	-2.8	-4.5	-6.6	-0.7

*****Mid-span reading adjusted horizontally between end support readings
******Mid-span reading adjusted vertically between end support readings

TABLE 6

WIND RESISTANCE - **SAFETY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)			
	3604	**Residual**	**-3604**	**Residual**
1	2.9	0.1	-4.7	-0.3
2	6.5	0.0	-14.3	-1.5
3	6.6	0.1	-14.5	-1.1
4	4.9	0.1	-14.1	-1.6
5	7.2	0.0	-18.0	-1.8
6	2.6	-0.1	-12.9	-1.7
7	6.6	0.0	-12.3	-1.2
8	4.4	0.1	-8.2	-0.6
5 *	3.4	0.0	-4.5	-0.1
5 **	3.5	-0.1	-11.6	-1.3

*Mid-span reading adjusted horizontally between end support readings
**Mid-span reading adjusted vertically between end support readings

9 IMPACT TESTING

9.1 IMPACTOR

9.1.1 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 approximately 50 kg suspended from a cord at least 3 m long.

9.1.2 Hard body

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

9.2 PROCEDURE (BS 8200)

9.2.1 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 6. The impact energies were 120 and 500 Nm.

9.2.2 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 6. The impact energy was 10 Nm.

9.3 PASS/FAIL CRITERIA

9.3.1 At impact energies for retention of performance

There shall be no failure, significant damage to surface finish or significant indentation.

9.3.2 At impact energies for safety

The structural safety of the building shall not be put at risk, no parts shall be made liable to fall or to cause serious injury to people inside or outside the building. The soft body impactor shall not pass through the wall. Damage to the finish and permanent deformation on the far side of the wall may occur.

9.4 RESULTS

Test 11 Date: 31 January 2012

Location	Impact energy (Nm)	Observation
1	120 (soft body) 500 (soft body)	1 mm indent in panel – remained secure. 18mm indent in panel – remained secure.
2	120 (soft body) 500 (soft body)	2 mm indent in panel – remained secure. 20 mm indent in panel – remained secure.
3	120 (soft body) 500 (soft body)	2 mm indent in panel – remained secure. 19 mm indent in panel – remained secure.
4	120 (soft body) 500 (soft body)	2 mm indent in panel – remained secure. 24 mm indent in panel – remained secure.
5	120 (soft body) 500 (soft body)	No damage observed. 14 mm indent in panel – remained secure.
6	120 (soft body) 500 (soft body)	1 mm indent in panel – remained secure. 16 mm indent in panel – remained secure.
7	120 (soft body) 500 (soft body)	1 mm indent in panel – remained secure. 15 mm indent in panel – remained secure.
8	120 (soft body) 500 (soft body)	No damage observed. 12 mm indent in panel – remained secure.
9	120 (soft body) 500 (soft body)	No damage observed. 14 mm indent in panel – remained secure.
10	120 (soft body) 500 (soft body)	No damage observed. 10 mm indent in panel – remained secure.
11	120 (soft body) 500 (soft body)	No damage observed. 8 mm indent in panel – remained secure.
12	120 (soft body) 500 (soft body)	No damage observed. 9 mm indent in panel – remained secure.
13	10 (hard body)	Minor indent less than 1 mm deep.
14	10 (hard body)	Minor indent less than 1 mm deep.
15	10 (hard body)	Minor indent less than 1 mm deep.
16	10 (hard body)	Minor indent less than 1 mm deep.

Ambient temperature = 2°C

All the panels remained secure after impact testing was complete.

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FIGURE 6

IMPACT TEST LOCATIONS

External View

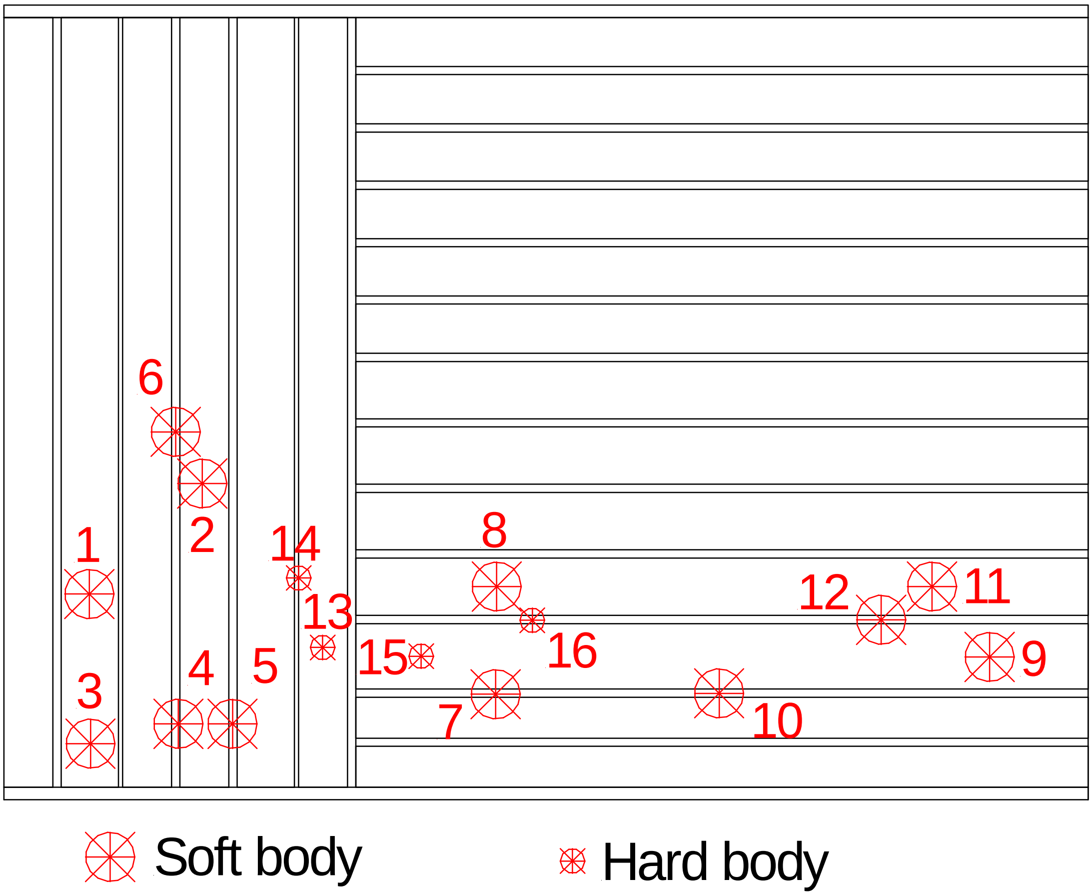


PHOTO 1010115

SOFT BODY IMPACTOR

PHOTO 1010127

HARD BODY IMPACTOR

PHOTO 1010114

LOCATION 1 AFTER 500 NM IMPACT

PHOTO 1010120

LOCATION 4 AFTER 500 NM IMPACT

PHOTO 1010128

LOCATION 13 AFTER 10 NM IMPACT

PHOTO 1010132

LOCATION 16 AFTER 10 NM IMPACT

PHOTO 1010133

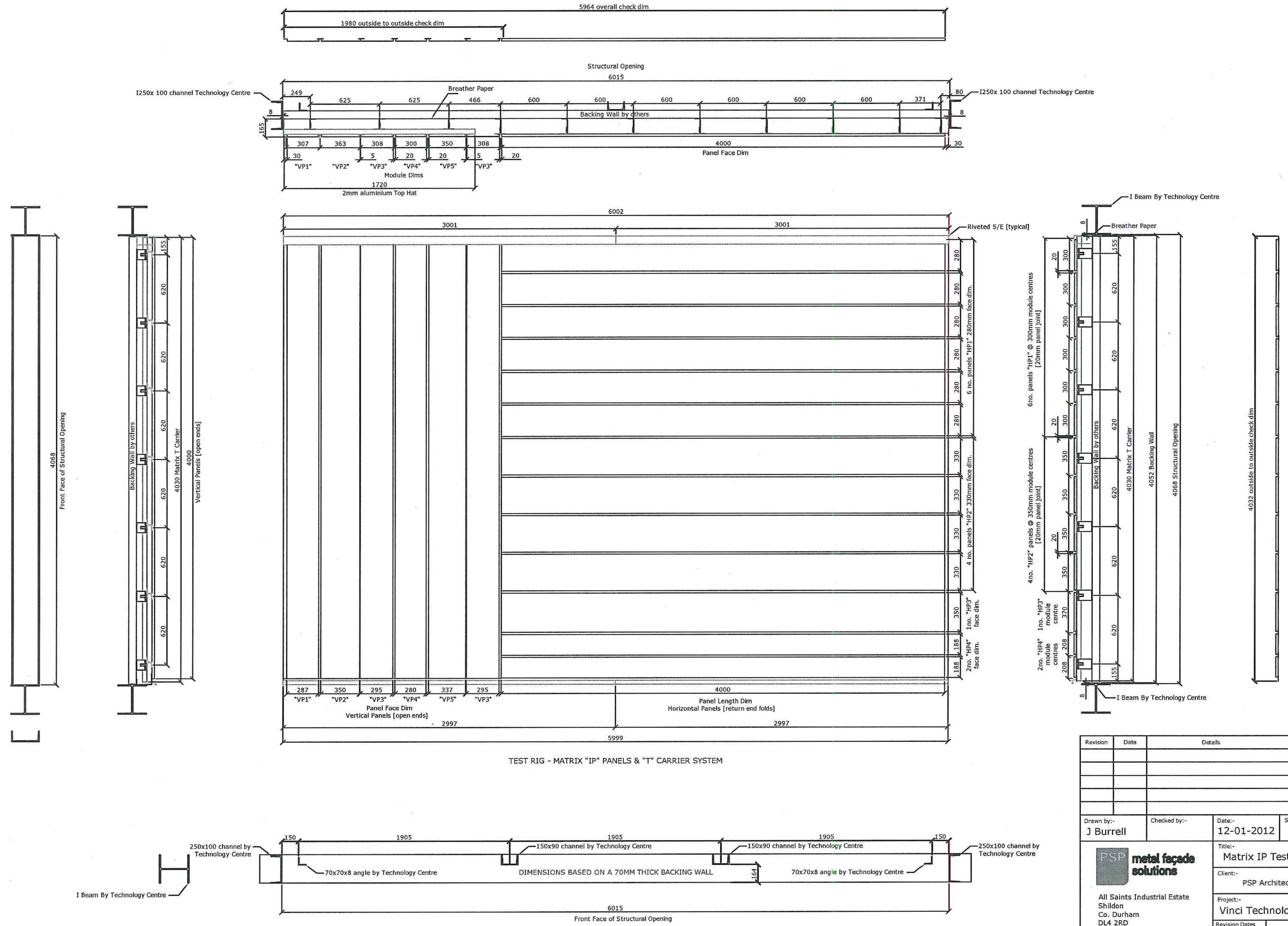
SAMPLE AFTER IMPACT TESTING

10 APPENDIX - DRAWINGS

The following 2 unnumbered pages are copies of PSP drawings numbered:

MIP TR1 and MIP TR2.

END OF REPORT



TEST RIG - MATRIX "IP" PANELS & "T" CARRIER SYSTEM

Revision	Date	Details

Drawn by:- J Burrell	Checked by:-	Date:- 12-01-2012	Scale:- NTS
PSP metal façade solutions		Title:- Matrix IP Test Rig	
		Client:- PSP Architectural	
		Project:- Vinci Technology Centre	
		Revision Dates Original	
		Drwg. No.:- MIP TR1	Latest Revision:-

All Saints Industrial Estate
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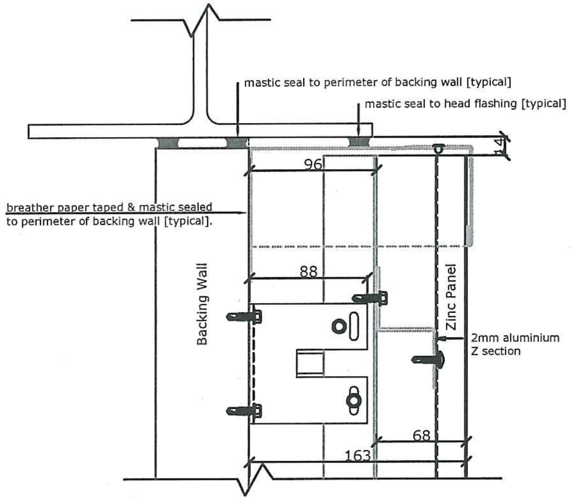
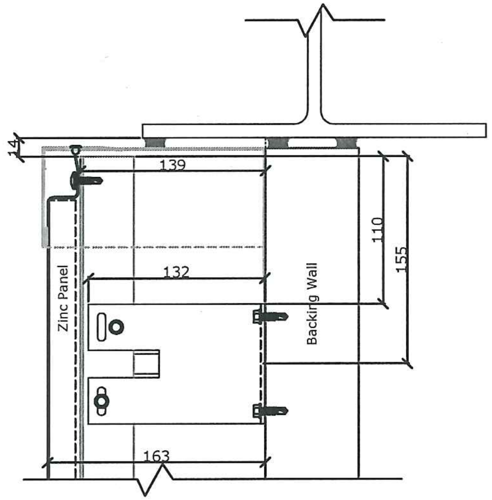
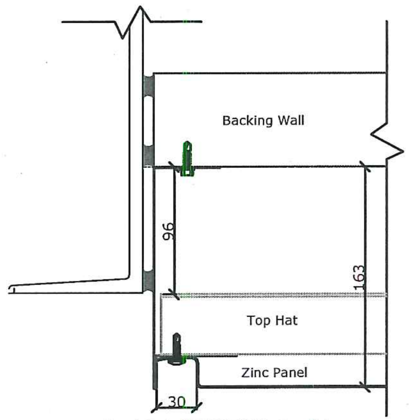
Email:-design@pspuk.com
www.pspuk.com



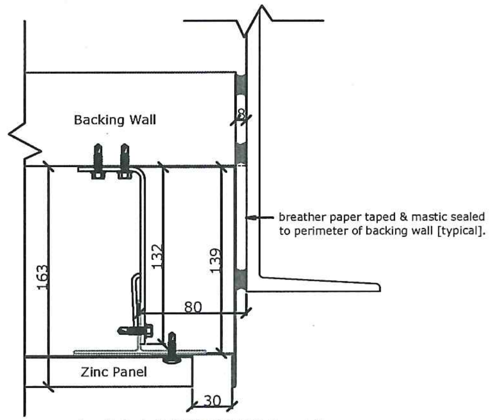
Head & Bracket Detail for VERTICAL Panels [showing the fixings to the "T" section, one no. via the slot, one no. fixed point].



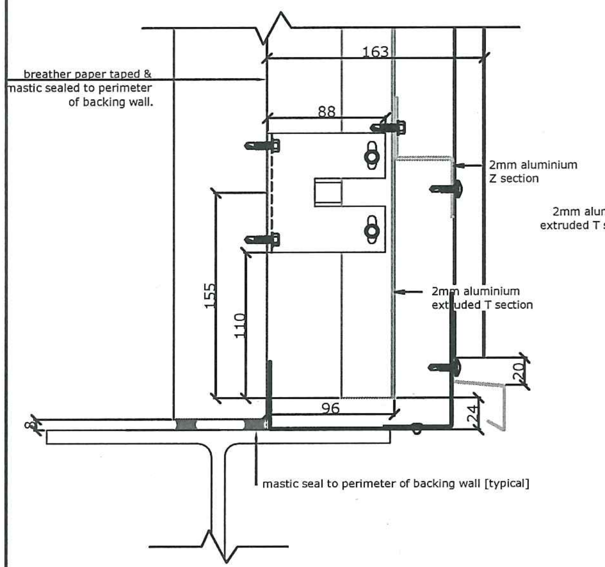
Head & Bracket Detail for HORIZONTAL Panels [showing the fixings to the "T" section, one no. via the slot, one no. fixed point].



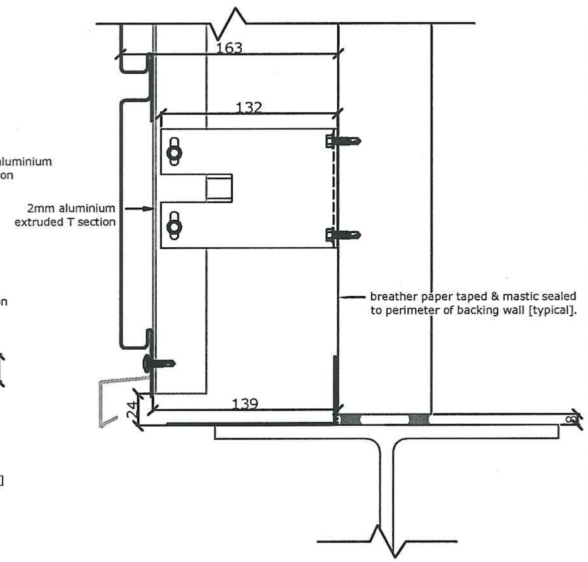
Jamb Detail [VERTICAL Panels]



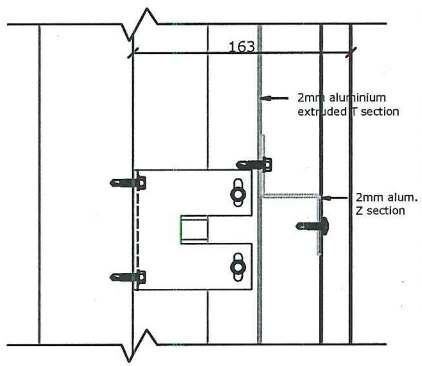
Jamb Detail HORIZONTAL Panels]



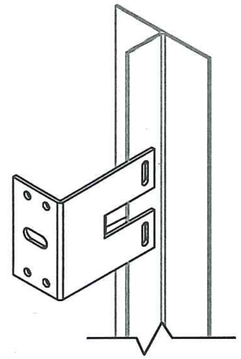
Cill & Bracket Detail for VERTICAL Panels showing both fixings to the "T" section, via the slotted holes].



Cill & Bracket Detail for HORIZONTAL Panels showing both fixings to the "T" section via the slotted holes].



Intermediate Bracket Detail showing both fixings into the "T" section via the slotted holes [typical throughout].



Typical Bracket & T Carrier Detail

Revision	Date	Details

Drawn by:- J Burrell	Checked by:-	Date:- 12-01-2012	Scale:- N.T.S.
PSP metal façade solutions		Title:- Matrix IP Test Rig	
		Client:- PSP Architectural	
		Project:- Vinci Technology Centre	
		Revision Dates	
		Original xxxxxx	
		Drwg. No.:- MIP TR2 - Details	Latest Revision:-

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