Technical Report

Title	**Weathertightness testing of a sample of Matrix SFM Rainscreen Cladding for PSP**
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Abstract

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UKAS TESTING 0057

Taylor Woodrow

CONTENTS

1. INTRODUCTION

This report describes tests carried out at the Taylor Woodrow Technology Centre at the request of PSP Architectural Limited (PSP), Unit 11, All Saints Industrial Estate, Shildon County Durham, DL4 2RD.

The test sample consisted of a Matrix SFM rainscreen cladding system.

Taylor Woodrow is accredited by the United Kingdom Accreditation Service as UKAS Testing Laboratory No.0057 and is also approved with Lloyds Register of Quality Assurance for ad-hoc in-service inspections and tests to ISO 9001 2000.

The tests were carried on 6th June 2008 and were to determine the weathertightness of the test samples. The test methods were in accordance with the CWCT Standard Test Methods for building envelopes, 2005, for:

Wind resistance – serviceability & safety.

Watertightness – dynamic pressure & hose.

The sample was also subjected to the following non UKAS accredited tests in accordance with the Taylor Woodrow Quality System:

Impact resistance (BS 8200).

The testing was carried out in accordance with Taylor Woodrow Method Statement C2707/MSrev 0 and the project specification.

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

The results are valid only for the conditions under which the tests were conducted.

The tests were witnessed wholly or in part by:

John Burrell - P.S.P.
Michael Hawkes - P.S.P.
Neville Thompson - P.S.P.

2. DESCRIPTION OF TEST SAMPLE

2.1 GENERAL ARRANGEMENT

The sample is shown in the photo below and detailed in the drawing in the appendix.

The Matrix SFM system used 3 mm thick aluminium panels.

A plywood wall was located behind the rainscreen system. Viewing panels were incorporated in the wall to allow inspection during the dynamic water and hose tests.

PHOTO 6050074

TEST SAMPLE ELEVATION

2.2 CONTROLLED DISMANTLING

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

PHOTO P6050078

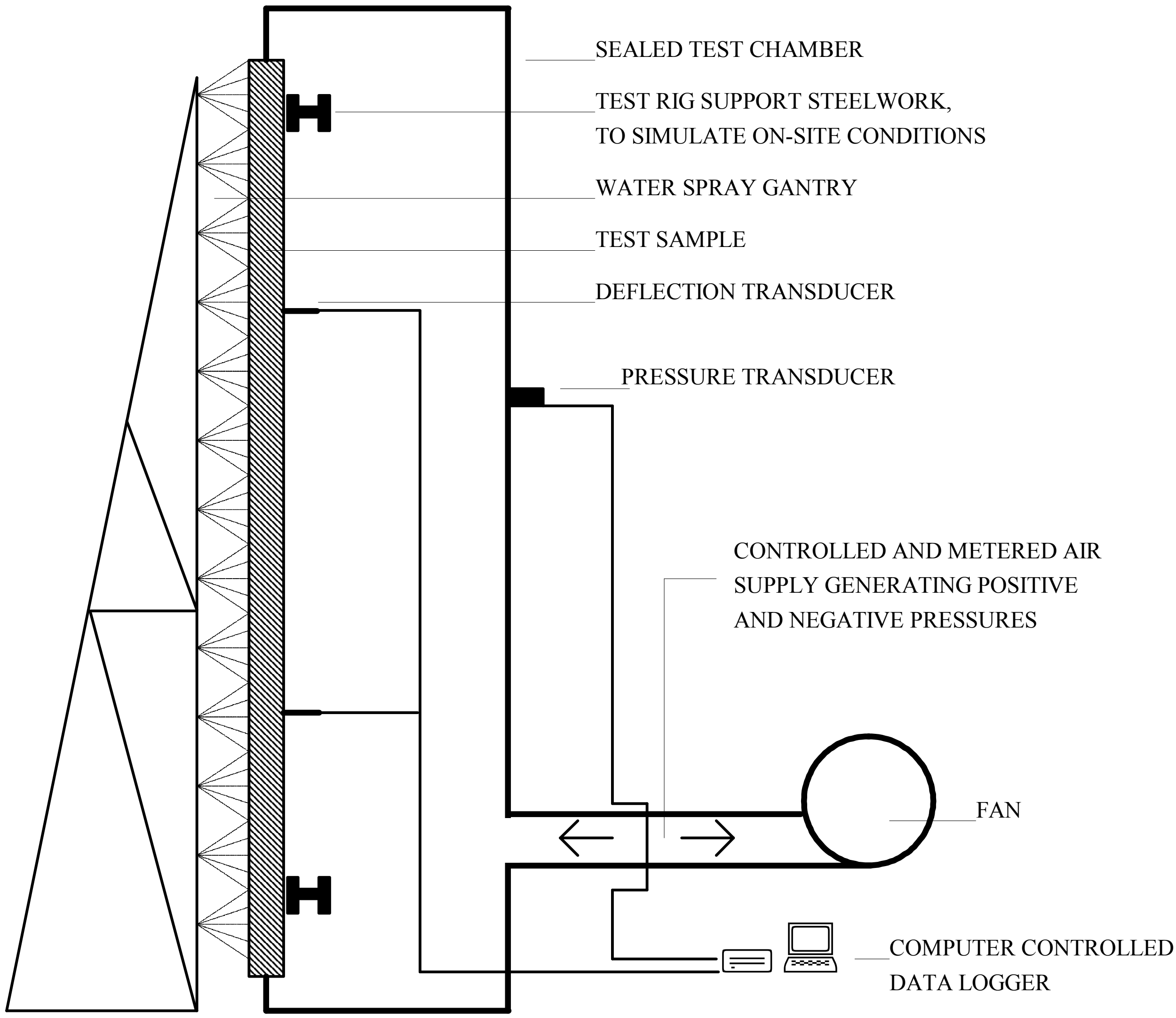
SUPPORT FRAME

3. TEST RIG GENERAL ARRANGEMENT

The test sample was mounted on a rigid test rig. 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 installed the sample on the test rig. See Figure 1.

FIGURE 1

<u>TYPICAL TEST RIG GENERAL ARRANGEMENT</u>



SECTION THROUGH TEST RIG

4. TEST SEQUENCE

The test sequence was as follows:

(1) Wind resistance – serviceability

(2) Watertightness – dynamic

(3) Watertightness – hose

(4) Wind resistance – safety

(5) 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 and 8.

5.1 TEST RESULTS

TABLE 1

Date	Test number	Test description	Result
6 June 2008	1	Wind resistance – serviceability	Pass
6 June 2008	2	Water tightness – dynamic	Pass
6 June 2008	3	Watertightness – hose	Pass
6 June 2008	4	Wind resistance – safety	Pass
6 June 2008	5	Impact resistance	Pass

5.2 CLASSIFICATION

TABLE 2

Test	Standard	Classification / Declared value
Wind resistance	CWCT	2400 pascals

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 the tiles 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 tiles 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

During these tests the joints between the tiles were taped over.

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.

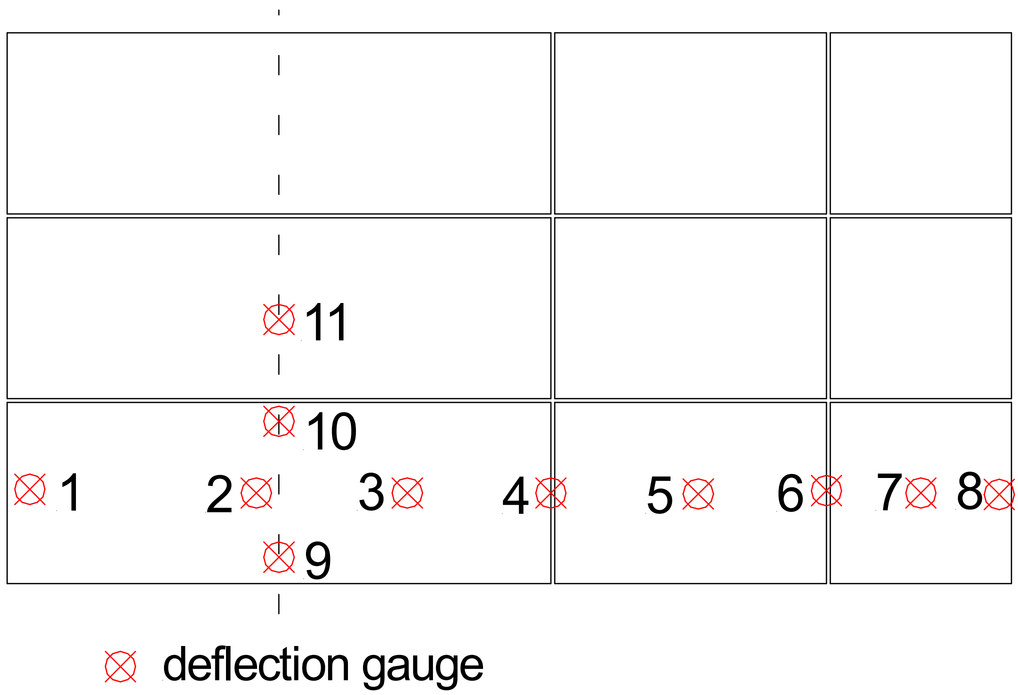
Any damage or functional defects were recorded.

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

Gauge number	Member	Span (L) (mm)	Permissible deflection (mm)	Permissible residual deformation
3	Back of panel	1800*	L/90 = 20.0	1 mm
5	Back of panel	1800*	L/90 = 20.0	1 mm
7	Back of panel	1200*	L/90 = 13.3	1 mm
10	Back of support rail	1250	L/200 = 6.2	1 mm

*diagonal span between supports

6.5 RESULTS

<u>Test 1 (serviceability)</u> Date: 5 June 2008

The deflections measured during the wind resistance test, at the positions shown in Figure 2, are shown in Tables 3 and 4.

Summary Table:

Gauge number	Member	Pressure differential (Pa)	Measured deflection (mm)	Residual deformation (mm)
3	Back of panel	2400 -2386	2.9 -2.8	0.4 -0.8
5	Back of panel	2421 -2386	17.7 -13.8	0.3 -0.3
7	Back of panel	2421 -2386	19.2 -15.2	0.0 -0.1
10	Back of support rail	2421 -2386	8.7 -7.4	0.1 0.0

No damage to the test sample was observed.

Ambient temperature = 16°C
Chamber temperature = 18°C

Test 4 (safety) Date: 5 June 2008

The deflections measured during the structural safety test, at the positions shown in Figure 2, are shown in Table 5.

No damage to the sample was observed.

Ambient temperature = 16°C
Chamber temperature = 18°C

TABLE 3

WIND RESISTANCE – POSITIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	613	1208	1797	2400	Residual
1	1.7	3.0	4.2	5.3	0.1
2	2.4	4.7	7.3	9.8	0.4
3	9.9	15.9	21.6	26.8	0.6
4	1.9	3.9	6.3	8.4	0.1
5	10.7	16.1	22.0	26.1	0.0
6	1.3	2.7	4.1	5.5	-0.1
7	5.4	8.8	11.7	14.1	-0.1
8	1.8	3.2	4.3	5.3	-0.2
9	1.2	2.5	4.0	5.4	0.2
10	2.2	4.6	7.8	10.4	0.5
11	2.1	4.3	7.5	10.0	0.8
3 *	7.7	11.6	14.8	17.7	0.4
5 *	9.1	12.8	16.8	19.2	0.3
7 *	3.8	5.9	7.5	8.7	0.0
10 *	0.6	1.2	2.0	2.7	0.1

* Mid-span reading adjusted between end support readings

TABLE 4

WIND RESISTANCE – NEGATIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	-602	**-1204**	**-1785**	**-2386**	**Residual**
1	-1.3	-2.4	-.35	-4.6	-0.2
2	-2.2	-4.4	-7.2	-10.0	-0.9
3	-8.9	-14.1	-19.0	-23.7	-0.7
4	-2.0	-4.4	-7.2	-9.9	0.0
5	-8.4	-13.7	-18.4	-23.2	0.0
6	-1.3	-2.9	-4.5	-6.2	0.2
7	-5.1	-8.3	-10.9	-13.4	0.2
8	-1.8	-3.3	-4.5	-5.7	0.2
9	-1.1	-2.4	-4.4	-6.4	-1.0
10	-2.0	-4.3	-7.7	-10.7	-0.9
11	-1.9	-4.1	-7.2	-10.0	-0.7
2 *	-0.5	-1.0	-1.9	-2.8	-0.8
3 *	-6.8	-9.7	-11.8	-13.8	-0.3
5 *	-6.7	-10.1	-12.6	-15.2	-0.1
7 *	-3.5	-5.2	-6.4	-7.4	0.0

* Mid-span reading adjusted between end support readings

TABLE 5

WIND RESISTANCE - **SAFETY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)			
	3581	Residual	-3601	Residual
1	7.3	0.3	-7.3	-0.3
2	15.6	1.6	-14.5	-1.6
3	36.5	1.9	-30.7	-1.6
4	12.6	0.5	-14.2	-0.5
5	38.6	0.8	-30.4	-1.5
6	8.1	0.0	-9.3	-0.1
7	18.6	0.1	-17.4	-0.3
8	7.0	-0.3	-8.0	0.2
9	9.0	1.1	-9.5	-1.3
10	16.2	1.3	-15.5	-1.6
11	15.1	0.8	-14.6	-1.5
2 *	5.6	1.2	-3.7	-1.2
3 *	22.4	0.9	-16.4	-0.6
5 *	28.2	0.5	-18.7	-1.2
7 *	11.0	0..2	-8.7	-0.3

* Mid-span reading adjusted between end support readings

7. WATERTIGHTNESS TESTING

7.1 INSTRUMENTATION

7.1.1 Water Flow

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

7.1.2 Temperature

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

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

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 – 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 equivalent to 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.

7.4.2 Watertightness – hose

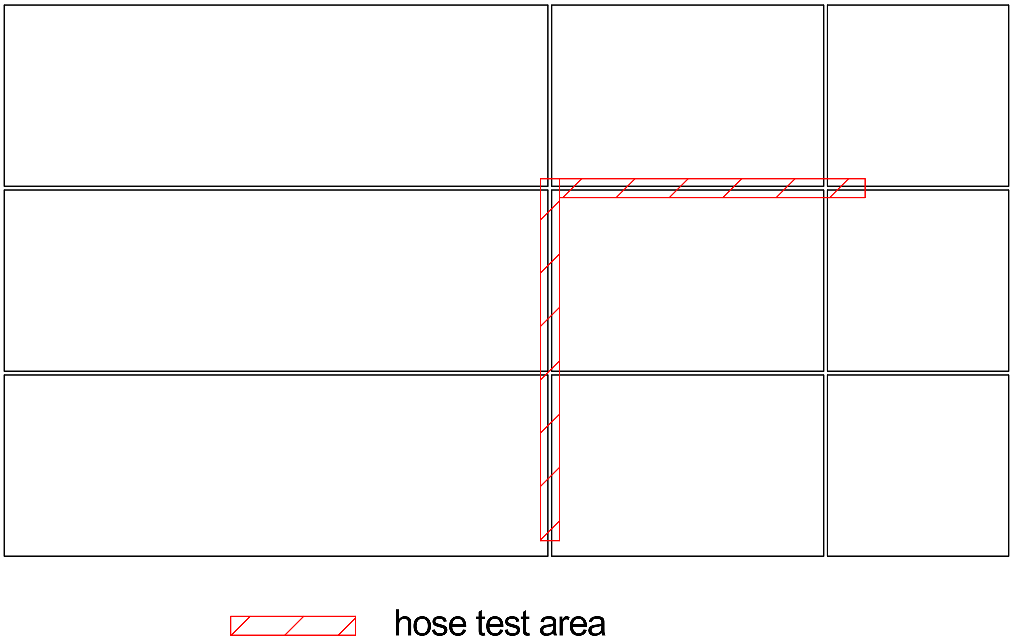
Working from the exterior, the selected area was wetted progressing from the lowest horizontal joint, then the intersecting vertical joints, then the next horizontal joint above, etc. The water was directed at the joint and perpendicular to the face of the sample. The nozzle was moved slowly back and 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 3.

FIGURE 3

HOSE TEST AREAS

External View



7.5 PASS/FAIL CRITERIA

There shall be no water leakage into the test chamber.

7.6 RESULTS

Test 2 (Dynamic pressure) Date: 5 June 2008

Few drops of water observed on viewing ports but mainly confined to back of rainscreen panels.

Chamber temperature= 21°C
Ambient temperature = 18°C
Water temperature = 16°C

Test 3 (Hose) Date: 5 June 2008

Minor leakage confined to back of rainscreen panels and rails.

Chamber temperature= 20°C
Ambient temperature = 18°C
Water temperature = 10°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 approximately 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 diameter and approximate mass of 0.5 kg.

8.2 PROCEDURE (BS 8200)

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 locations 1, 2 and 3 shown in Figure 4. The impact energies were 120 and 500 Nm.

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 locations 4 and 5 shown in Figure 4. The impact energy was 10 Nm.

8.3 PASS/FAIL CRITERIA

8.3.1 At impact energies for retention of performance

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

8.3.2 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.

8.4 RESULTS

<u>Test 5 Impact resistance</u>

Date: 5 June 2008

Location 1

120 Nm soft body: No damage to the test sample was observed.

500 Nm soft body: No damage to the test sample was observed.

Location 2

120 Nm soft body: No damage to the test sample was observed.

500 Nm soft body: Bottom of panel bent in but remained secure.

Location 3

500 Nm soft body. Bottom of panel bucked but remained secure.

Location 4

10 Nm hard body: Small indent observed – 0.5 mm deep.

Location 5

10 Nm hard body: Small indent observed – 1 mm deep.

FIGURE 4

IMPACT TEST LOCATIONS

External View

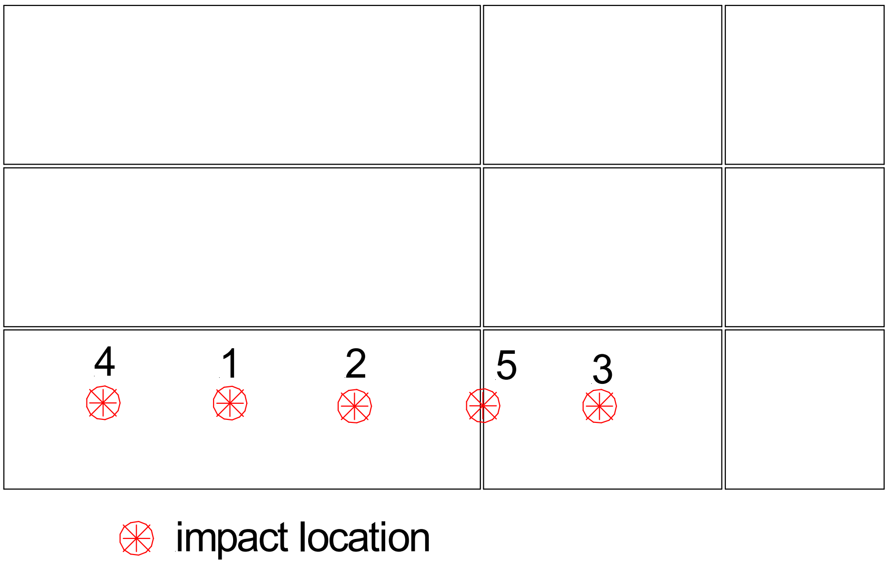


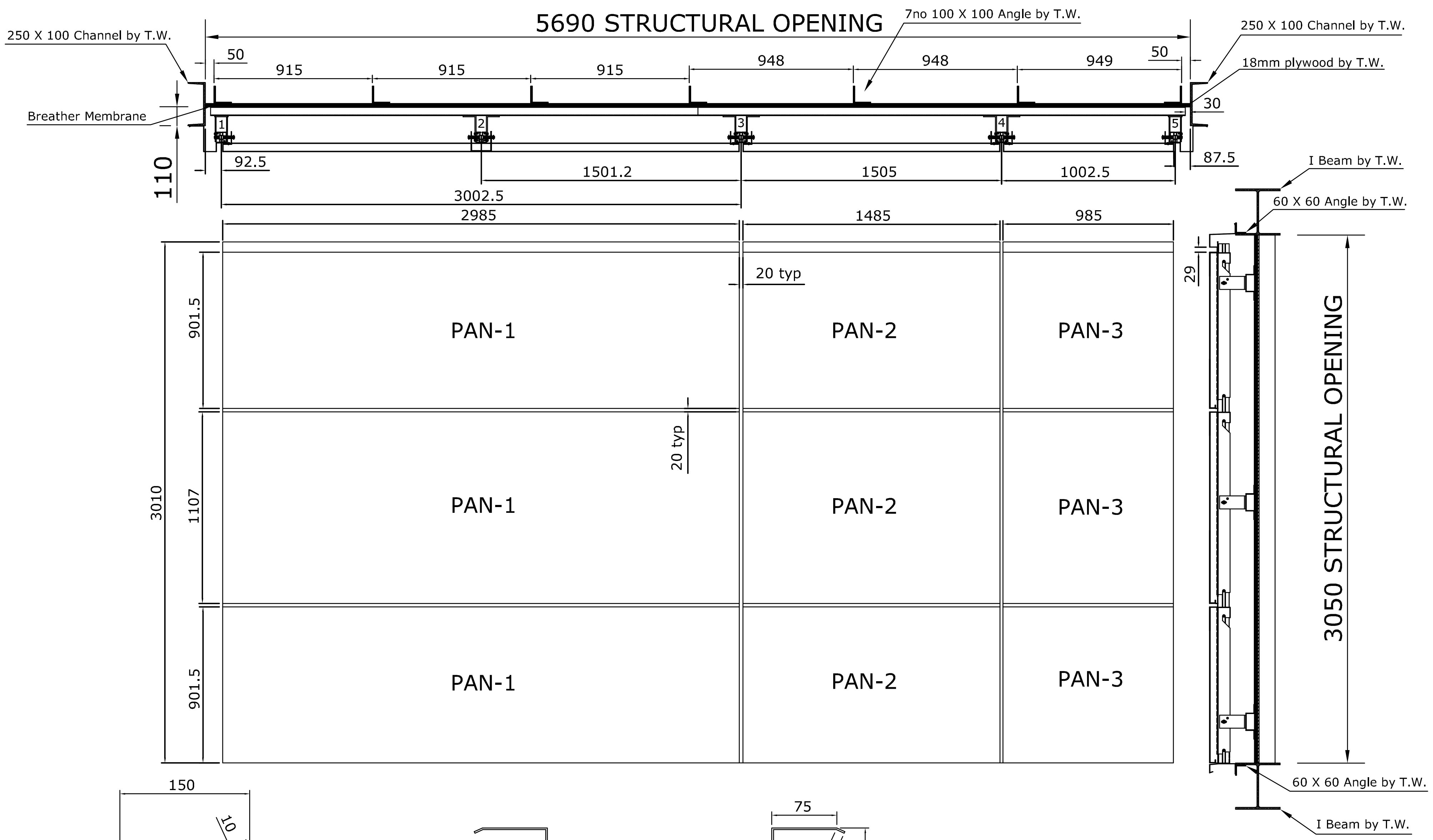
PHOTO 6050074

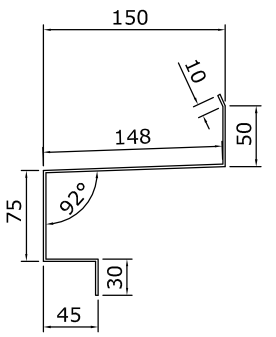
SAMPLE AFTER IMPACT TESTS

9. APPENDIX – DRAWING

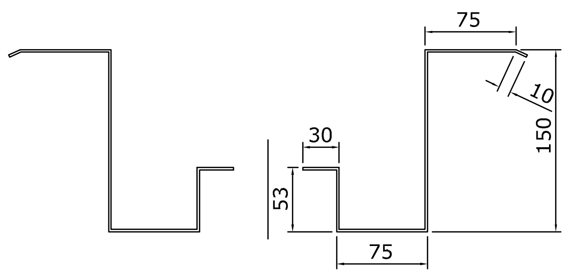
The following unnumbered page is a copy of PSP drawing of the test sample.

END OF REPORT

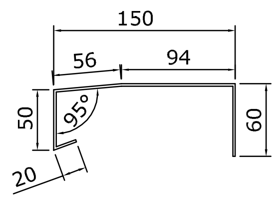




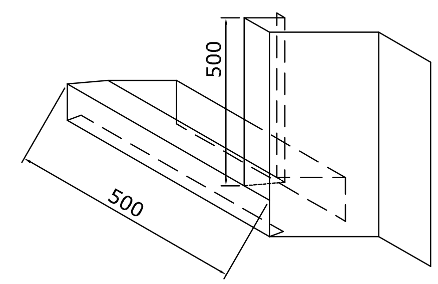
2MM ALI HEAD FLASH
2no @ 2353 LONG(1no with butt)
1no @ 3000 LONG(no butt)



2MM ALI SIDE FLASH
2no @2058 LONG(no butts)
1no @3000 LONG(no butt)

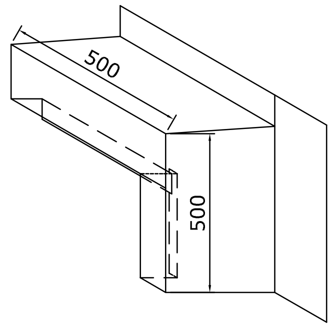


2MM ALI DRIP FLASH
2no @ 2353 LONG(1no with butt)
1no @ 3000 LONG(no butt)

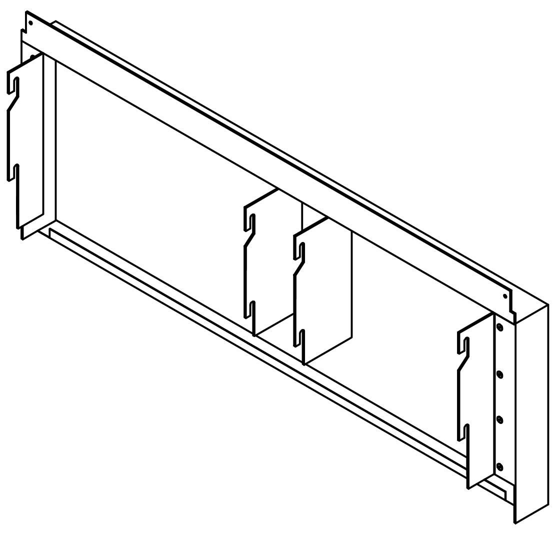


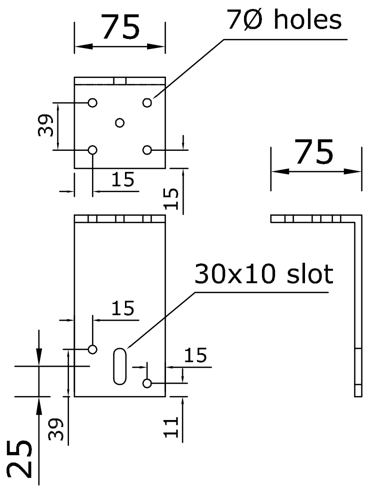
500x500 cill/side cnr 1no Each hand

corners welded not dressed
corners double butt
all aluminium mill finish
butts made from .9 ali

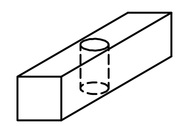


500x500 head/side cnr 1no Each hand

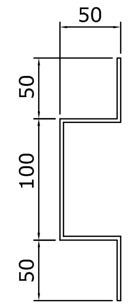




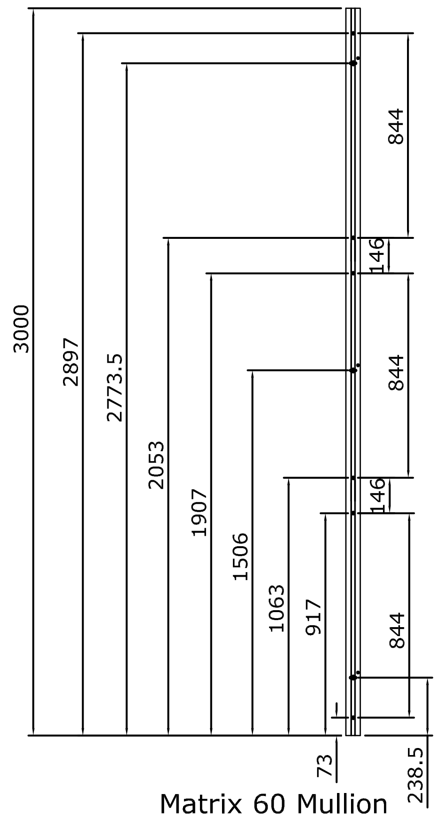
6MM ALI STRUCTURAL CLEAT
30no REQD



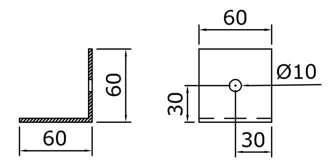
12sq bar 30mm long
drill@tap m6 hole
70no reqd



3MM GALV TOP HAT
3no @ 2815 LONG
1no @ 3000 LONG



Matrix 60 Mullion
6no @ 3000 LONG



3MM GALV DRIP FIX ANGLE
10no @ 60 LONG

Revision	Date	Details	
A	27/06/08	Panel width changed	MH

Drawn by:- M Hawkes
Checked by:-
Date:- 02/05/08
Scale:- NTS

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Title:- Matrix 2 CWCT Test
3mm Aluminium
Client:- PSP
Project:- Taylor Woodrow
Test Centre

Revision Dates	
Original	A
02-05-08	03-05-08

Drwg. No.:-
Latest Revision:- A