TECHNOLOGY CENTRE

Technical Report

Title: Product wind and impact resistance testing of a sample of Ultralite rainscreen cladding for TI Tiles International Ltd

Report No: N950-17-17478

Technical Report

Title: Product wind and impact testing of a sample of Ultralite rainscreen cladding for TI Tiles International

Customer: TI Tiles International Ltd
Westview House, Devro Campus
Gartferry Road, Moodiesburn G69 0JE

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Author(s): D. Bennett - Technician

Checked by: N. McDonald – Principal Engineer

Authorised by: S. R. Moxon – Operations Director

Distribution: 1 copy to TI Tiles International Ltd
(confidential) 1 copy to project file

UKAS TESTING
0057

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

Registered Office, Watford. Registered No. 05640885 England.

Tel. 01525 859000
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 TI Tiles International Ltd.

The test sample consisted of a sample of Ultralite rainscreen cladding manufactured by TI Tiles International Ltd.

The tests were carried out in September 2017 and were to determine the wind 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 & cyclic.

Impact resistance.

The testing was carried out in accordance with Technology Centre Method Statement C6597/MS rev 1.

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.

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

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

2 SUMMARY AND CLASSIFICATION OF TEST RESULTS

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

2.1 SUMMARY OF TEST RESULTS

TABLE 1

Date	Test number	Test description	Result
26 September 2017	1	Wind resistance – serviceability	Pass
26 September 2017	2	Wind resistance – safety	Pass
27-28 September 2017	3	Wind resistance – cyclic	Pass
29 September 2017	4	Impact resistance	Pass

2.2 CLASSIFICATION

TABLE 2

Test	Standard	Classification / Declared value
Wind resistance	CWCT	±2400 pascals – serviceability ±3600 pascals – safety
Impact resistance	CWCT TN76	<u>Soft body</u> 120 Nm serviceability – Class 1 350 Nm safety – Negligible risk 500 Nm safety – Low risk <u>Hard body</u> 3 Nm serviceability – Class 1 3 Nm safety – Negligible risk 6 Nm serviceability – Class 2 10 Nm serviceability – Class 2 10 Nm safety – Low risk

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.

PHOTO 1654

TEST SAMPLE

3.2 CONTROLLED DISMANTLING

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

PHOTO 1655

SUPPORT FRAME AND EDGE OF PANELS

PHOTO 1658

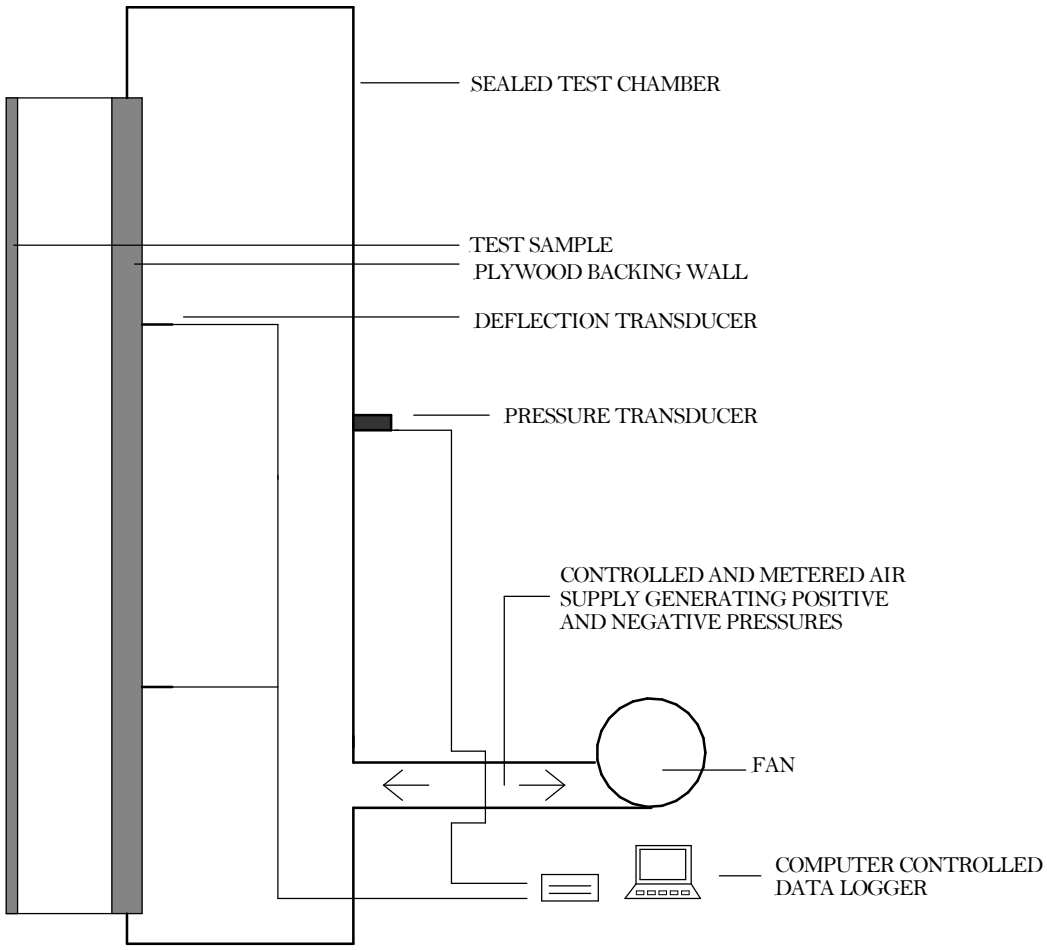
TEST SAMPLE DURING WIND LOADING

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 TI Tiles International 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) Wind resistance - cyclic

(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

Note: *The joints between the panels were taped over for the wind resistance tests.*

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.

6.3.3 Wind Resistance – cyclic

The test sample was subjected to pressure pulses as shown in Table 1. The sequence was repeated five times followed by a single application of the design wind pressure (±2400 pascals). Each pressure cycle took approximately twelve seconds.

Table 3

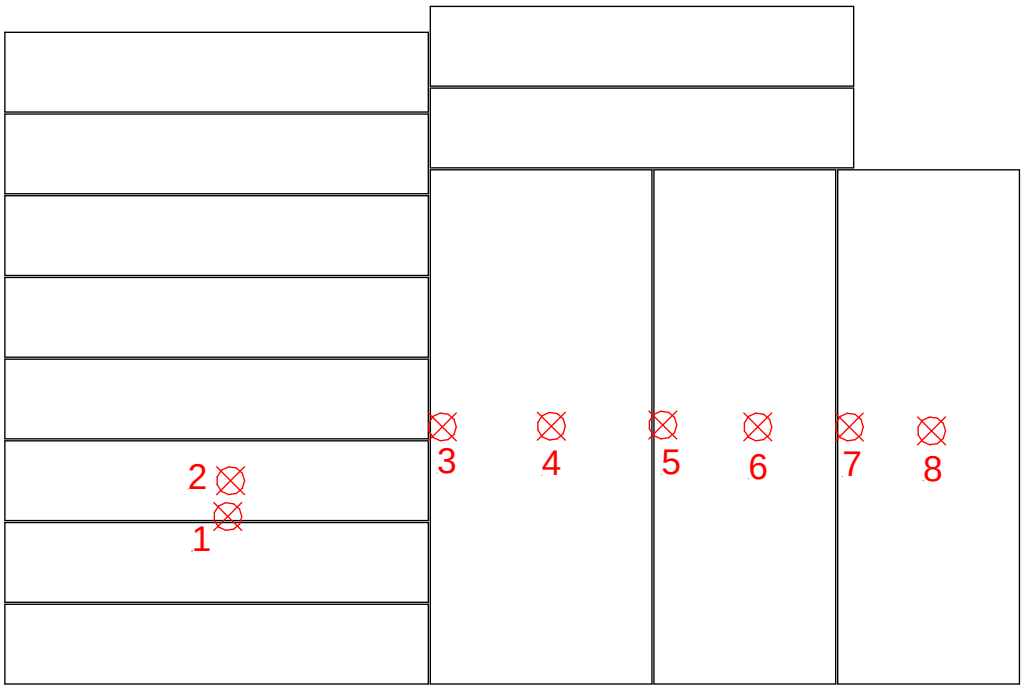
Load as fraction of design wind pressure	Number of cycles	Applied load
90%	1	±2160 Pa
40%	960	±960 Pa
60%	60	±1440 Pa
50%	240	±1200 Pa
80%	5	±1920 Pa
70%	14	±1680 Pa

Any damage or functional defects were recorded.

FIGURE 2

DEFLECTION GAUGE LOCATIONS

External View



⊗ Deflection gauge

6.4 PASS/FAIL CRITERIA

6.4.1 Calculation of permissible deflection

Gauge number	Member	Span (L) (mm)	Permissible deflection (mm)	Permissible residual deformation
2	Panel width	524	L/360 = 1.4	1 mm
4	Panel width	1200	L/360 = 3.3	1 mm
6	Panel width	1000	L/360 = 2.7	1 mm
8	Panel width	1000	L/360 = 2.7	1 mm

6.5 RESULTS

Test 1 (serviceability) Date: 26 September 2017

The deflections measured during the wind resistance test, at the positions shown in Figure 2, are shown in Tables 4 and 5.

Summary Table:

Gauge number	Member	Pressure differential (Pa)	Measured deflection (mm)	Residual deformation (mm)
2	Panel width	2405 -2397	0.5 -0.5	0.0 -0.1
4	Panel width	2405 -2397	0.2 0.0	0.0 0.0
6	Panel width	2405 -2397	0.3 -1.2	0.1 -0.1
8	Panel width	2405 -2397	1.4 -1.7	0.0 -0.2

Note: *Deflections taken with edge movement deducted from reading.*

No damage to the test sample was observed.

Ambient temperature = 21°C
Chamber temperature = 22°C

Test 2 (safety) Date: 26 September 2017

The deflections measured during the structural safety test, at the positions shown in Figure 2, are shown in Table 6.

No damage to the sample was observed.

Ambient temperature = 21°C
Chamber temperature = 22°C

TABLE 4

WIND RESISTANCE – POSITIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	594	**1202**	**1801**	**2405**	**Residual**
1	2.9	4.0	4.8	5.5	0.0
2	3.5	4.5	5.3	6.0	0.0
3	2.8	4.0	4.9	5.8	0.2
4	2.6	3.9	4.8	5.6	0.2
5	1.9	3.0	3.8	4.5	0.0
6	1.9	2.8	3.6	4.2	0.1
7	3.1	4.1	4.9	5.7	0.2
8	2.6	3.3	3.8	4.3	0.2

TABLE 5

WIND RESISTANCE – NEGATIVE **SERVICEABILITY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)				
	-600	**-1208**	**-1788**	**-2397**	**Residual**
1	-1.7	-3.1	-4.5	-5.8	0.0
2	-1.8	-3.3	-4.8	-6.3	-0.1
3	-2.5	-4.5	-6.7	-8.7	-0.3
4	-2.5	-4.6	-6.7	-8.7	-0.3
5	-2.8	-4.7	-6.6	-8.5	-0.2
6	-2.6	-4.2	-5.8	-7.3	-0.1
7	-2.0	-3.8	-5.4	-7.0	-0.2
8	-1.7	-3.0	-4.2	-5.3	0.0

TABLE 6

WIND RESISTANCE - **SAFETY** TEST RESULTS

Position	Pressure (pascals) / Deflection (mm)			
	3602	**Residual**	**-3604**	**Residual**
1	6.9	-0.1	-7.9	0.1
2	7.4	-0.1	-8.5	0.0
3	7.0	0.1	-11.5	-0.6
4	6.8	0.1	-11.3	-0.5
5	5.7	0.0	-10.6	-0.3
6	5.4	0.0	-9.4	-0.2
7	6.8	0.1	-9.2	-0.3
8	5.0	0.1	-6.5	-0.2

7 IMPACT TESTING

7.1 IMPACTOR

7.1.1 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.

PHOTO 6024

SOFT BODY IMPACTOR

7.1.2 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.

PHOTO 6038

HARD BODY IMPACTOR

7.2 PROCEDURE

7.2.1 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.

7.2.2 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 4. The impact energies were 3 Nm, 6 Nm and 10 Nm.

7.3 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.

7.4 RESULTS

Test 4 Date: 29 September 2017

The impact test results are shown in Tables 7 and 8.

Ambient temperature = 20°C

TABLE 7

SOFT BODY IMPACTS

Impact location	Impact energy (Nm)	Observations
1	120 x 3 350 500	No damage observed. “ “
2	120 x 3 350 500	No damage observed. “ “
3	120 x 3 350 500	No damage observed. “ “
4	120 x 3 350 500	No damage observed. “ “
5	120 x 3 350 500	No damage observed. “ “
6	120 x 3 350 500	No damage observed. “ “
7	120 x 3 350 500	No damage observed. “ “
8	120 x 3 350 500	No damage observed. “ “
9	120 x 3 350 500	No damage observed. “ Hairline crack. No fallout.
10	120 x 3 350 500	No damage observed. “ “
11	120 x 3 350 500	No damage observed. “ “
12	120 x 3 350 500	No damage observed. “ “
13	120 x 3 350 500	No damage observed. “ “
14	120 x 3 350 500	No damage observed. “ Hairline crack. No fallout.
15	120 x 3 350 500	No damage observed. “ Hairline crack. No fallout.

TABLE 8

HARD BODY IMPACTS

Impact location	Impact energy (Nm)	Observations
16	3 6	No damage observed. Minor indent.
17	3 6	No damage observed. Minor indent.
18	3 6	No damage observed. “
18A	3 6	No damage observed. Small crack.
19	3 6	No damage observed. Minor indent.
20	3 6	No damage observed. Minor indent.
21	3 6	No damage observed. Minor indent.
22	10	Minor indent.
23	10	No damage observed.
24	10	Minor indent.
25	10	Minor indent.
26	10	Minor indent.
27	10	No damage observed.
28	10	Minor indent.
29	10	No damage observed.

FIGURE 3

SOFT BODY IMPACT TEST LOCATIONS
External View

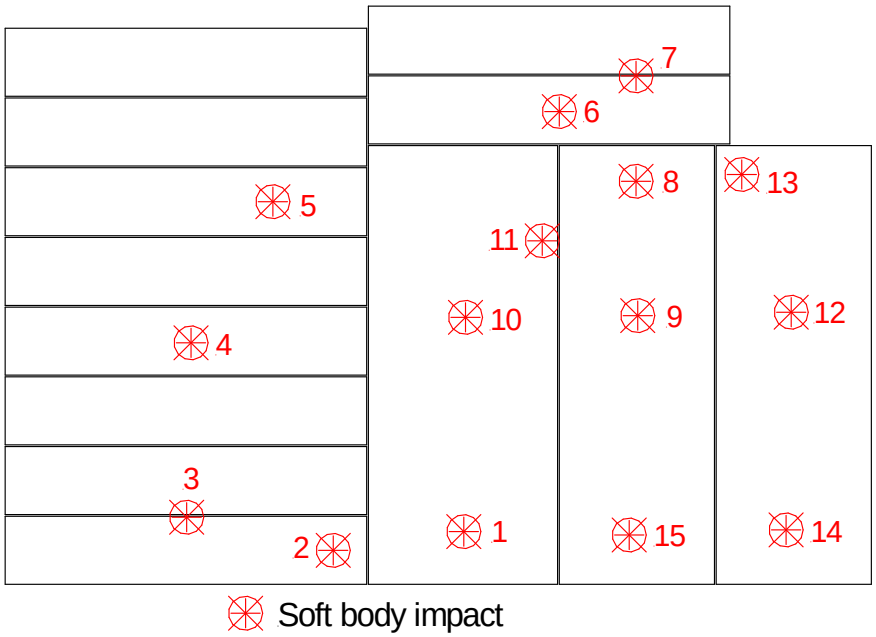


FIGURE 4

HARD BODY IMPACT TEST LOCATIONS
External View

PHOTO 6025

SOFT BODY IMPACT AT LOCATION 9 (marker pen line along hairline crack)

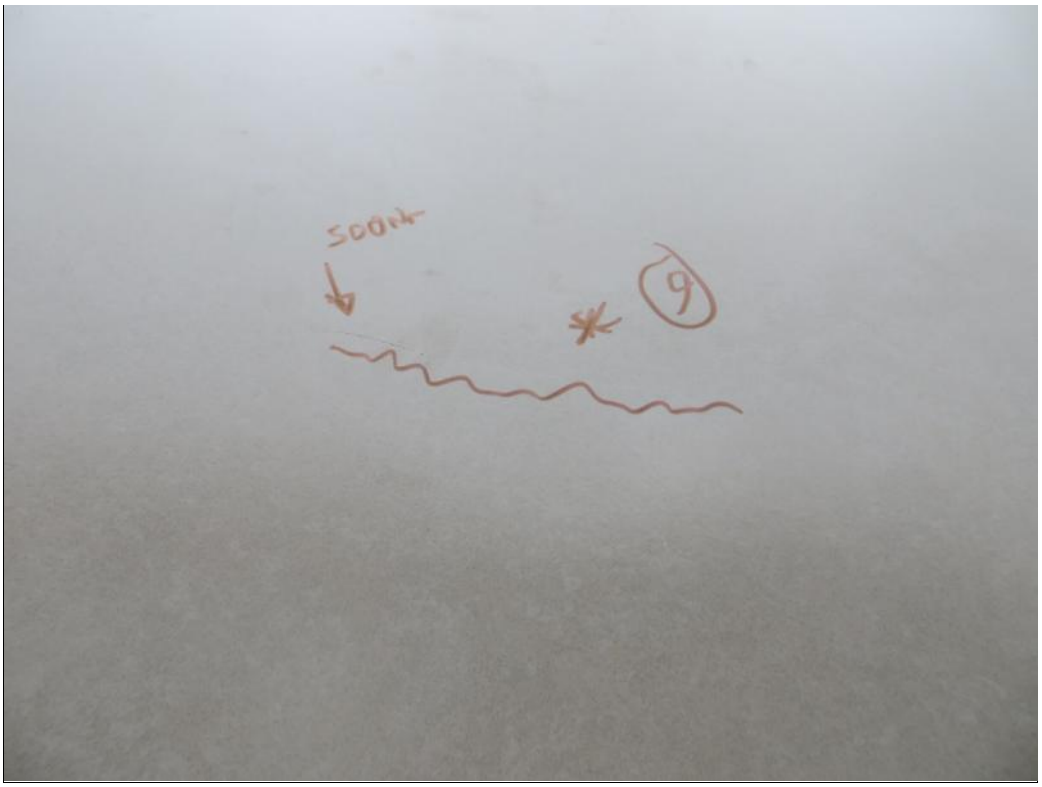


PHOTO 6026

SOFT BODY IMPACT AT LOCATION 14 (marker pen line along hairline crack)

PHOTO 6027

SOFT BODY IMPACT AT LOCATION 15 (marker pen line along hairline crack)

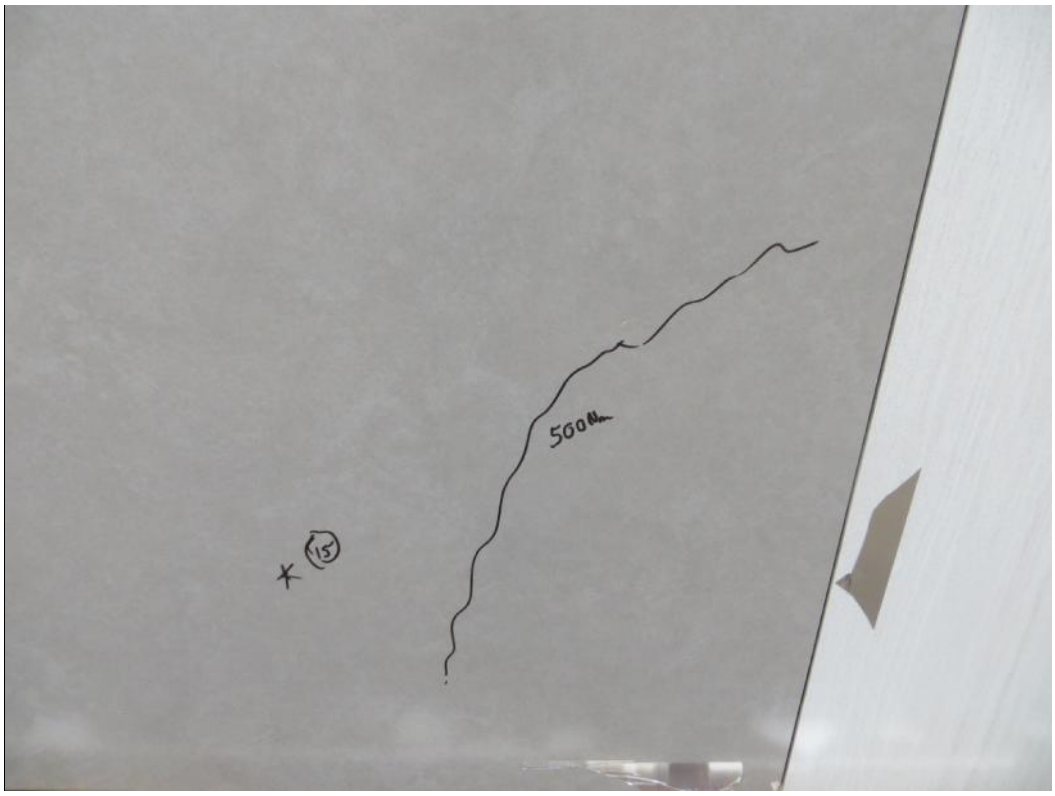


PHOTO 6030

HARD BODY IMPACT AT LOCATION 16

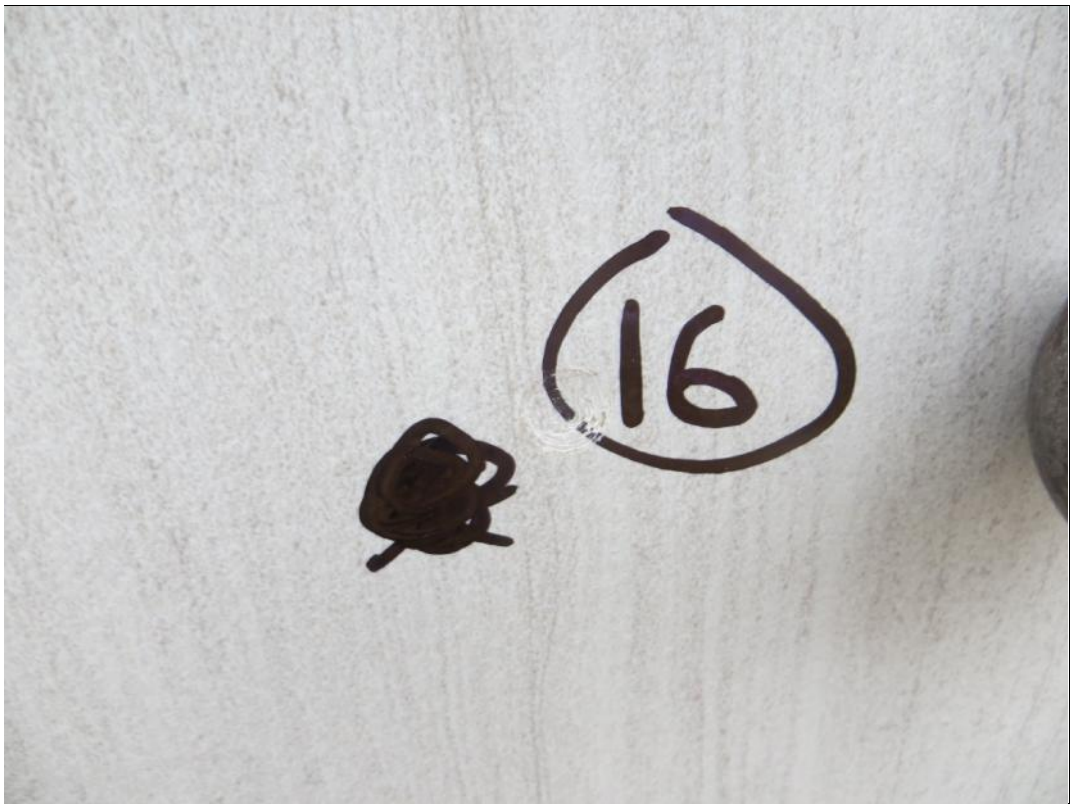


PHOTO 6034

HARD BODY IMPACTS AT LOCATIONS 17 & 18

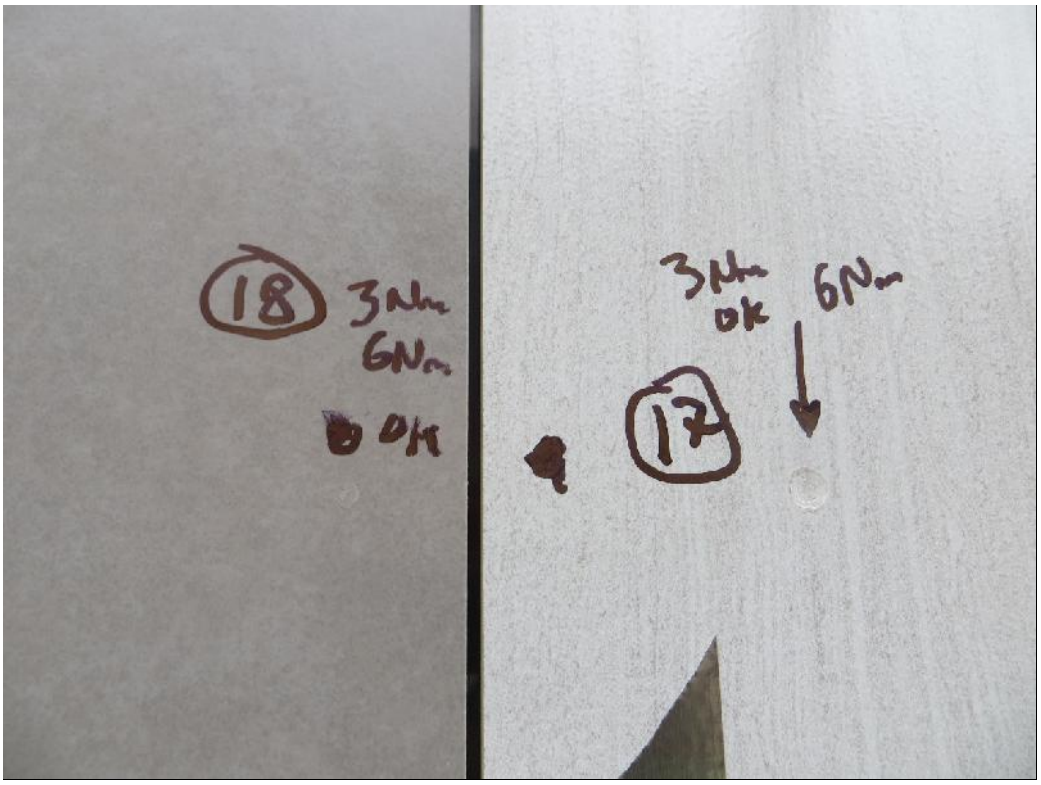


PHOTO 6037

HARD BODY IMPACTS AT LOCATIONS 20 & 21

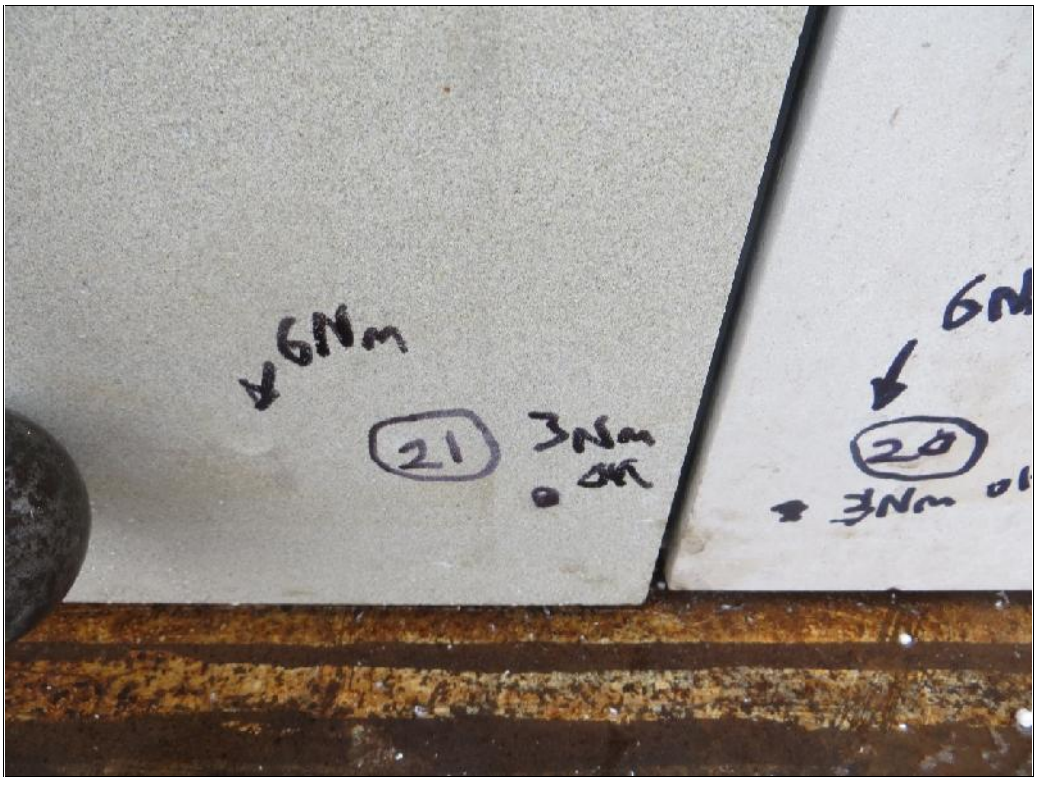


PHOTO 6039

HARD BODY IMPACT AT LOCATION 22

PHOTO 6039

HARD BODY IMPACTS AT LOCATIONS 23 & 24

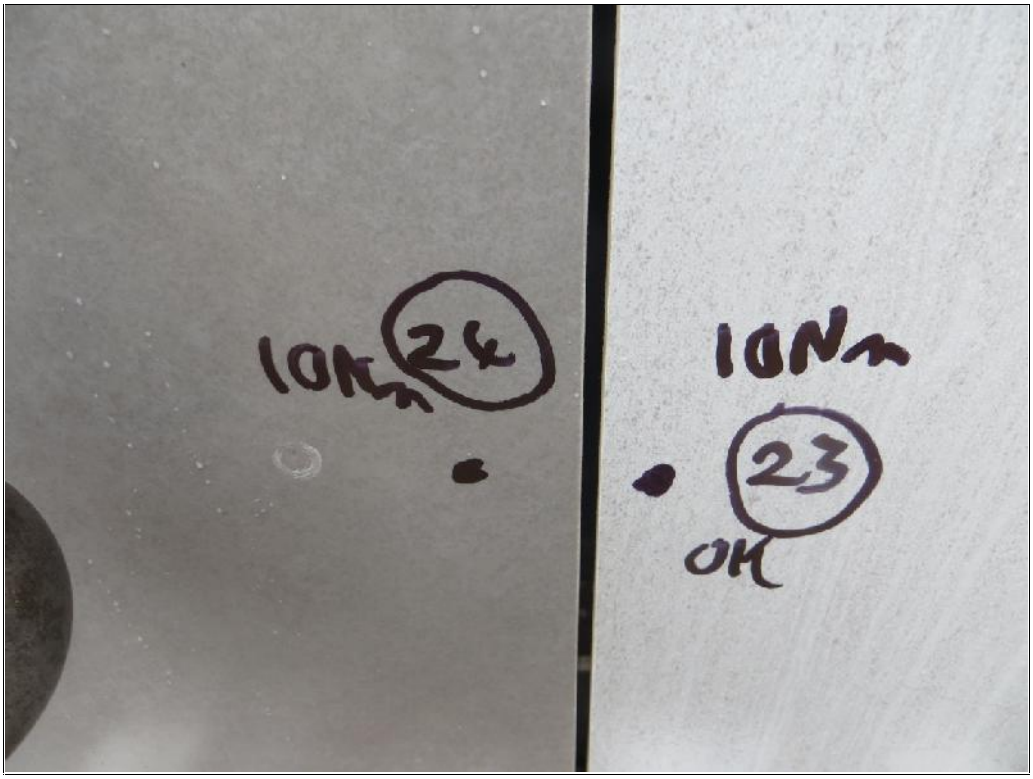
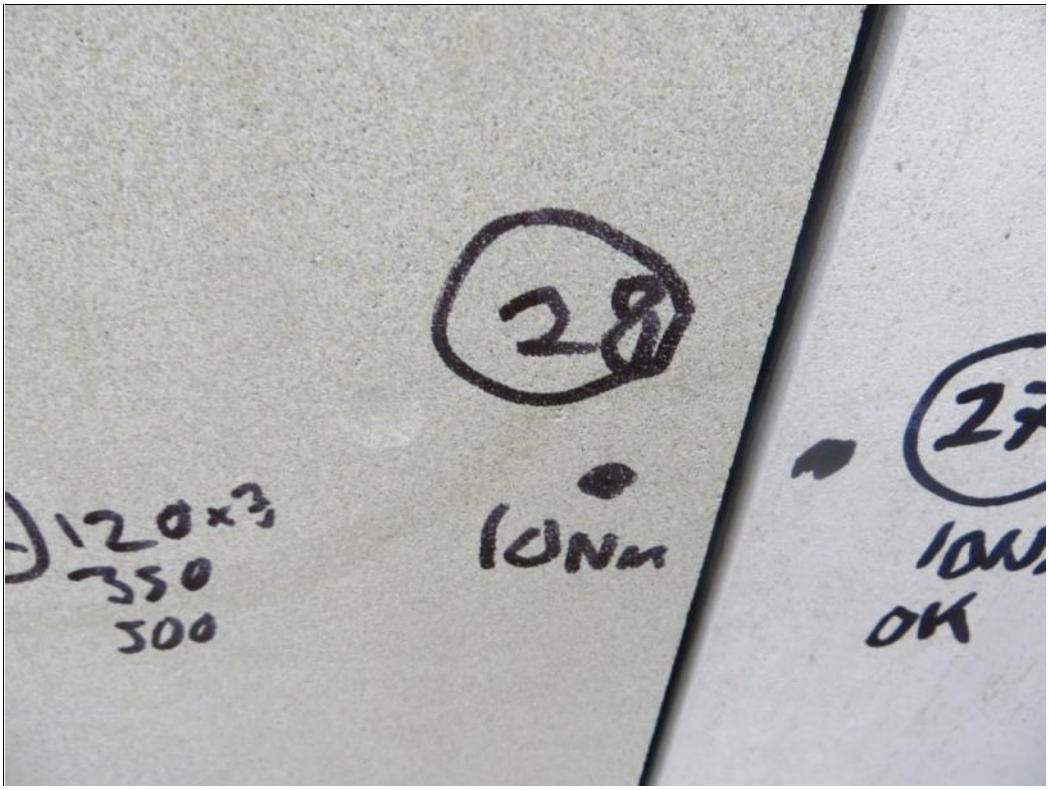


PHOTO 6042

HARD BODY IMPACT AT LOCATION 26

PHOTO 6043

HARD BODY IMPACTS AT LOCATIONS 27 & 28



8 APPENDIX - DRAWINGS

The following 5 unnumbered pages are copies of TI Tiles International Limited drawings numbered:

T101,

T102,

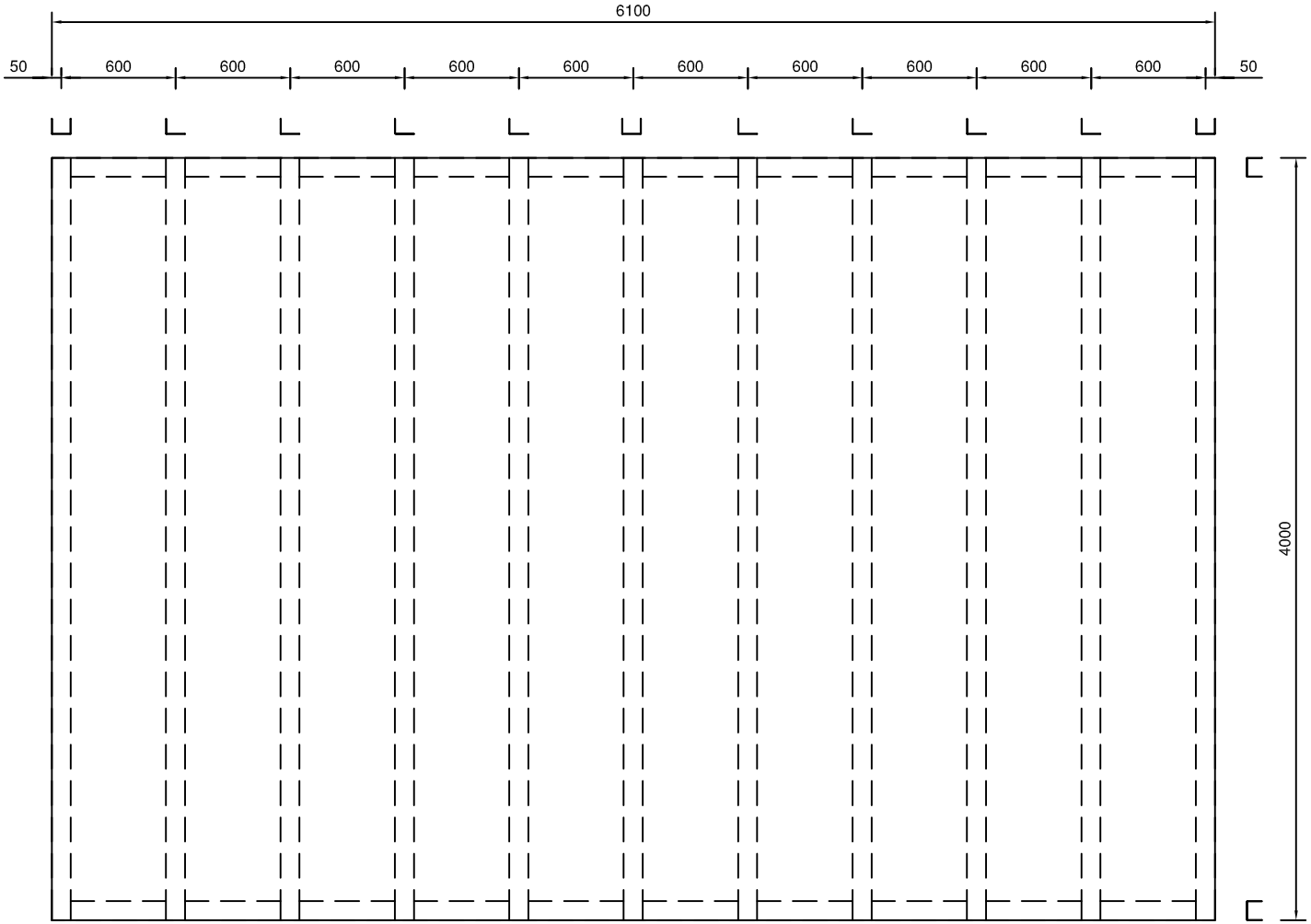
T103,

T104,

T105.

END OF REPORT

Steel By Vinci-UK: Dims and materials Gauge to be confirmed by Vinci



Steel Layout For Test Rig (6m x 4m):

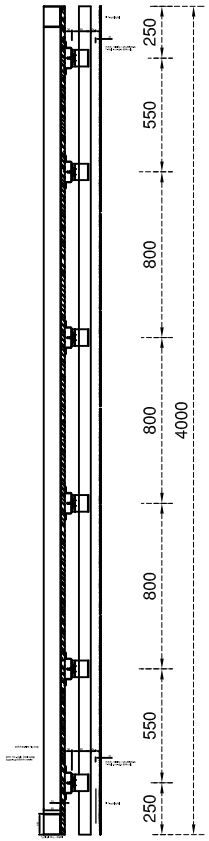
100mm Wide Vertical studs at 600mm Centres -

80 x 100 x 80mm U Channel to be incorporated at each end and intermediate rail, 100 x 80mm Angles to be incorporated at all other areas

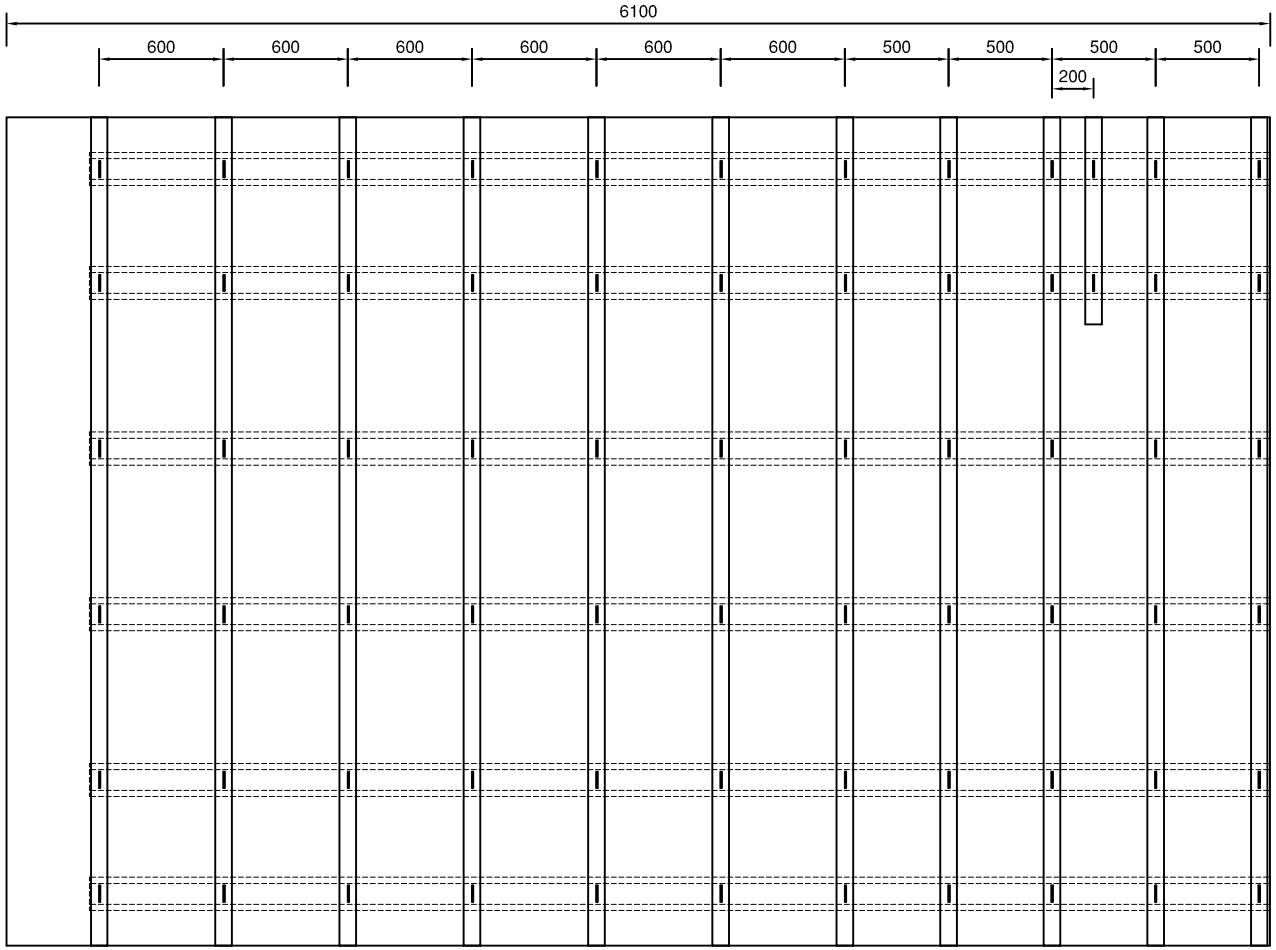
Drawing Title	Test Rig Steel Layout		
Scale	n.t.s	Date Drawn	Sept 2018
Drawing Number	TI01	Revision	0

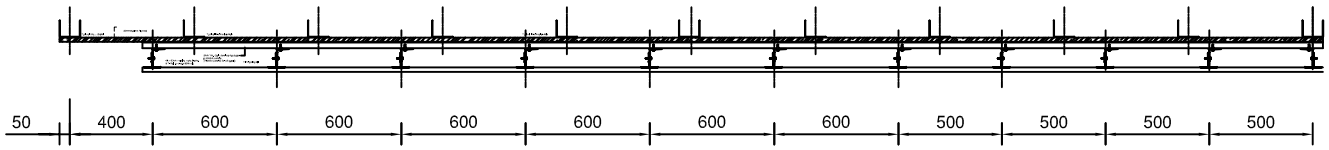
dynamic facades
by ti tiles international ltd
london
tel +44 (0) 20 8735 9100
email sales@tilesint.co.uk
glasgow
tel +44 (0) 8700 500981
web www.tilesint.co.uk

Head Detail



Base Detail





Plan Detail 1

Plan Detail 2

Plan Detail 3

Top Hat, Helping Hand & Rail Set Out (6m x 4m)

Drawing Title	Test Rig Top Hat & Rail Layout		
Scale	n.t.s	Date Drawn	Sept 2018
Drawing Number	TI02	Revision	0

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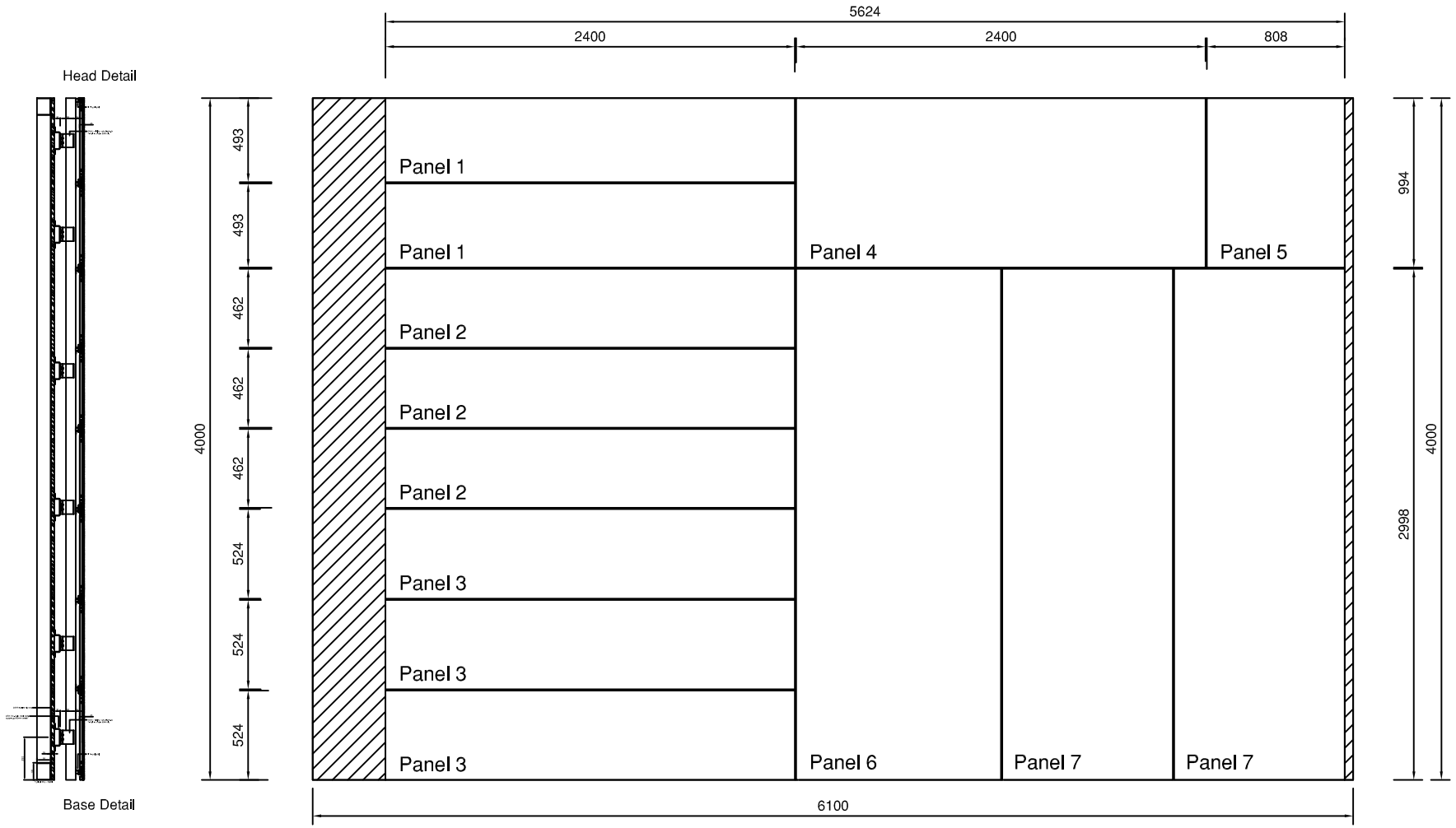
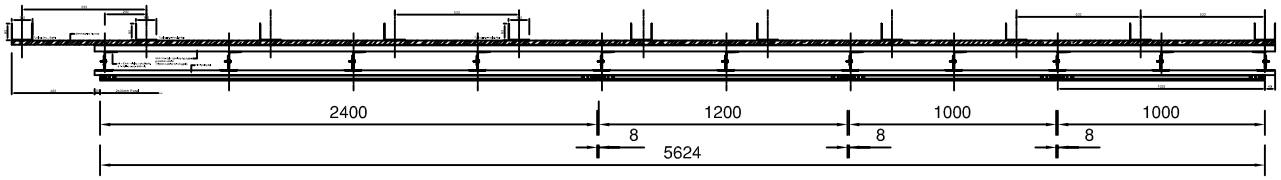
by ti tiles international ltd
london
tel +44 (0) 20 8735 9100
email sales@tilesint.co.uk
glasgow
tel +44 (0) 8700 500981
web www.tilesint.co.uk





Plan Detail 1 Plan Detail 2 Plan Detail 3

Drawing Title	Test Rig - Panel Layout		
Scale	n.t.s	Date Drawn	Sept 2018
Drawing Number	TI03	Revision	0

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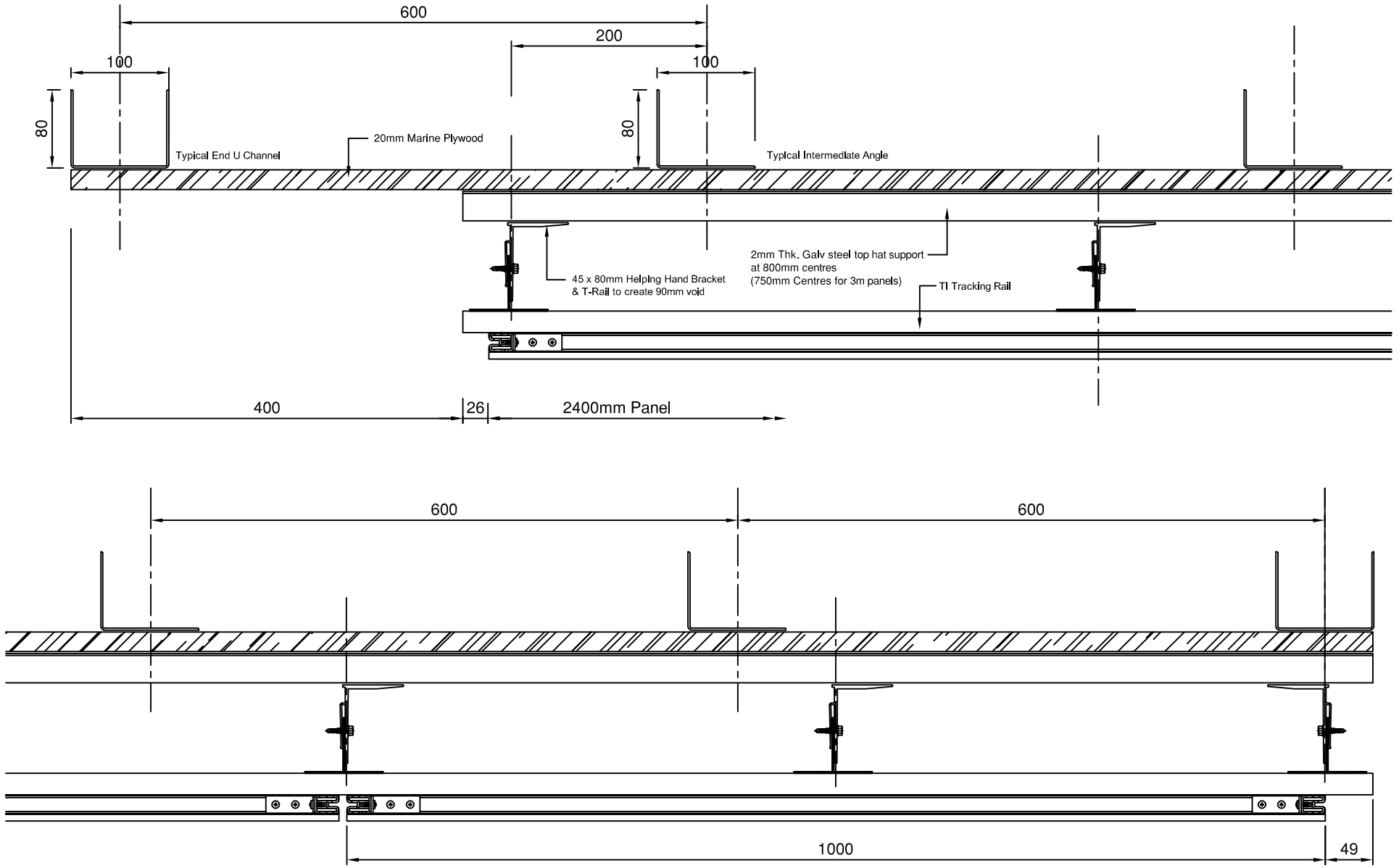
london
tel +44 (0) 20 8735 9100
email sales@tilesint.co.uk
glasgow
tel +44 (0) 8700 500981
web www.tilesint.co.uk

Stone Panel Set Out



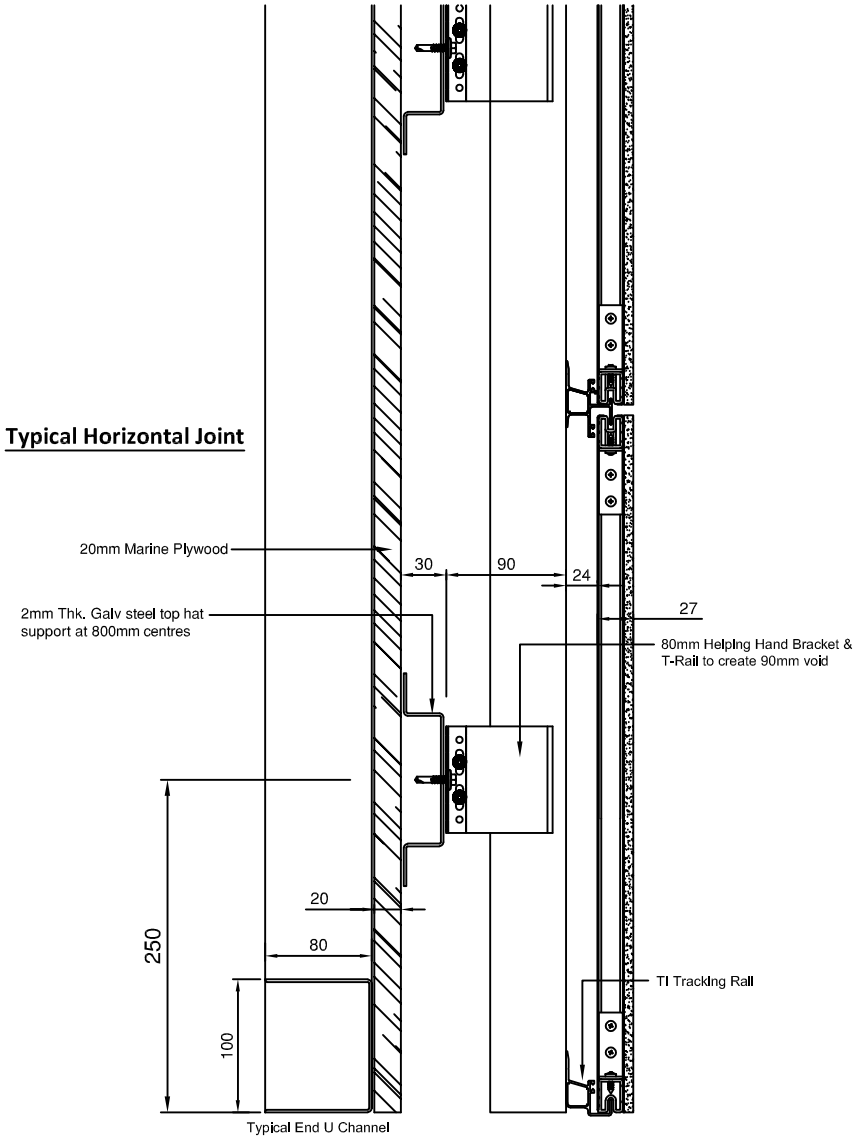
Fixing Requirements

:- Top Hat to Steel Frame - 2No. 75mm long heavy steel drillers at 1200mm centres
:- Helping Hand To Top Hat - 2No. 25mm Light Steel S/S Self Driller per bracket
:- T-Rail to bracket - 1No. 25mm Light Steel S/S Self Driller per bracket
:- TI Tracking Carrier rails to Top Hat - Sealed Rivets at 150mm Centres

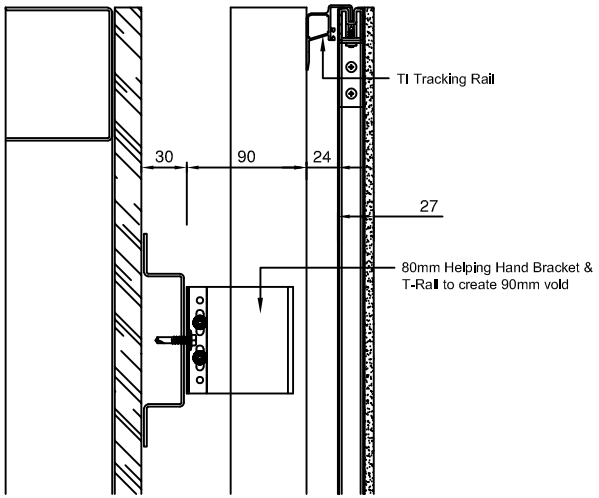
Drawing Title	Test Rig Plan Details		
Scale	n.t.s	Date Drawn	Sept 2018
Drawing Number	TI04	Revision	0

dynamic facades
by ti tiles international ltd
london
tel +44 (0) 20 8735 9100
email sales@tilesint.co.uk
glasgow
tel +44 (0) 8700 500981
web www.tilesint.co.uk

Typical Horizontal Joint

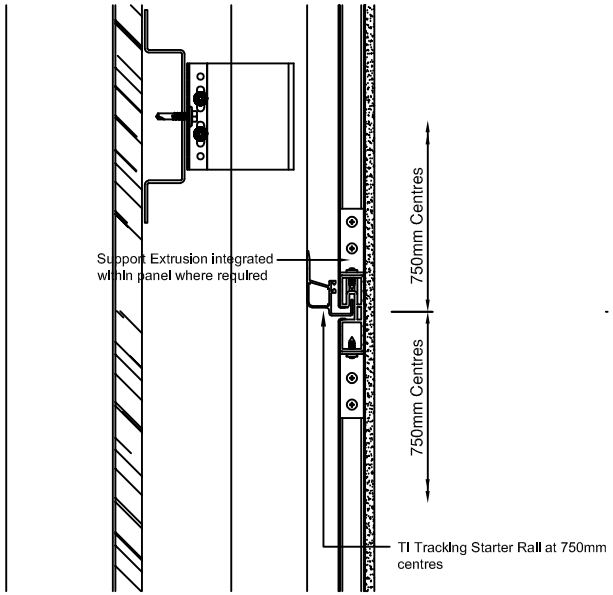


Test Rig Head Detail



Test Rig Base Detail

Extrusion Detail at 3m Panel



Fixing Requirements

:- Top Hat to Steel Frame - 2No. 75mm long heavy steel drillers at 1200mm centres
:- Helping Hand To Top Hat - 2No. 25mm Light Steel S/S Self Driller per bracket
:- T-Rail to bracket - 1No. 25mm Light Steel S/S Self Driller per bracket
:- TI Tracking Carrier rails to Top Hat - Sealed Rivets at 150mm Centres

Drawing Title	Test Rig Typical Details		
Scale	n.t.s	Date Drawn	Sept 2018
Drawing Number	TI05	Revision	0

dynamic facades
by ti tiles international ltd
london
tel +44 (0) 20 8735 9100
email sales@tilesint.co.uk
glasgow
tel +44 (0) 8700 500981
web www.tilesint.co.uk

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

01525 859000

info@technology-centre.co.uk

www.technology-centre.co.uk