TEST REPORT

Lucideon Reference:	UK222081 (QT-67623/2/KNA)/Ref. 2
Project Title:	60-Year Study for TI Tiles International Ltd's Aerolite Monolith Stone and Ceramic Cladding Panels
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1 INTRODUCTION

Lucideon Limited were contracted by TI Tiles International Ltd. to evaluate the performance and durability of their Aerolite Monolith Stone and Ceramic ventilated cladding system panels.

There were 4 No. panels tested, and these are described as: -

System One

TI Tiles International Ltd.'s Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm gloss ceramic veneer.

System Two

TI Tiles International Ltd.'s Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm marble finish ceramic veneer.

System Three

TI Tiles International Ltd.'s Aerolite Monolith Stone ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm stone veneer.

System Four

TI Tiles International Ltd.'s Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm gloss white ceramic veneer.

This evaluation is performed in three parts as detailed below:

- Part 1: Report UK222081/Ref. 1 – Testing of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic Cladding Panels in Accordance with the Methods Given in EAD 040914-00-0404:2018 (Appendix A).
- Part 2: VINCI TECHNOLOGY CENTRE UK LIMITED REPORT NO. N950-17-17478 (Appendix B).
- Part 3: Report UK222081/Ref. 2 - Desk Top Study for 60-Year Durability of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic Cladding Panels.

This report contains a desk top study to evaluate the life expectancy of each of TI Tiles International Ltd. Aerolite Monolith Stone and Ceramic cladding panel systems as described previously.

This information coupled with:

1. Any Literature containing concise and effective installation and storage instructions produced by TI Tiles International Ltd.
2. Any literature detailing factory quality management systems.

will allow the design life of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic Cladding Panels to be extended to 60 years.

2 REPORT UK222081/Ref. 1- STRUCTURAL AND ENVIRONMENTAL TESTING

Under Test Report: UK222081/Ref. 1 – Testing of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic Cladding Panels in Accordance with the Methods Given in EAD 040914-00-0404:2018 are details of all testing carried out by Lucideon Limited at their test laboratory based in Penkhull, Stoke on Trent.

2.1 Hygrothermal Testing

TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels underwent hygrothermal testing in accordance with EAD 040914-00-0404:2018 were inspected and assessed prior to, during and post testing and were found to have no defects as are outlined within Annex D Clause D 1.4 of EAD 040914-00-0404:2018.

Report UK222081/Ref.1 states:

System	System Description	Pass/Fail
One	Aerolite Monolith Ceramic, installed Top Left	Pass No Defects
Two	Aerolite Monolith Ceramic, installed Bottom Left	Pass No Defects
Three	Aerolite Monolith Stone, installed Top Right	Pass No Defects
Four	Aerolite Monolith Ceramic, installed Bottom Right	Pass No Defects

Further to this testing, TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels were subjected to a freeze/thaw test in accordance with Annex D of EAD 040914-00-0404:2018.

Report UK222081/Ref.1 states:

System	System Description	Pass/Fail
One	Aerolite Monolith Ceramic, installed Top Left	Pass No Defects
Two	Aerolite Monolith Ceramic, installed Bottom Left	Pass No Defects
Three	Aerolite Monolith Stone, installed Top Right	Pass No Defects
Four	Aerolite Monolith Ceramic, installed Bottom Right	Pass No Defects

All hygrothermal testing has a direct correlation to the assessment of life expectancy of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels.

Generally, as previously stated, this testing is performed with a view to establishing a life expectancy of the system of a minimum of 25 years following successful assessment.

2.2 Soft and Hard Body Impact Testing

TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels underwent soft and hard body impact testing in accordance with Annex G of EAD 040914-00-0404:2018.

UK222081 Ref. 1 States that:

For soft body testing, the panels achieved a Category 1 rating.

System	System Description	Maximum Impact Achieved Without Damage	Category
One	Aerolite Monolith Ceramic, installed Top Left	400 Joules S4	I
Two	Aerolite Monolith Ceramic, installed Bottom Left	400 Joules S4	I
Three	Aerolite Monolith Stone, installed Top Right	400 Joules S4	I
Four	Aerolite Monolith Ceramic, installed Bottom Right	400 Joules S4	I

For hard body testing, the panels achieved a Category 1 rating.

System	System Description	Maximum Impact Achieved Without Damage	Category
One	Aerolite Monolith Ceramic, installed Top Left	10 Joules H3	I
Two	Aerolite Monolith Ceramic, installed Bottom Left	10 Joules H3	I
Three	Aerolite Monolith Stone, installed Top Right	10 Joules H3	I
Four	Aerolite Monolith Ceramic, installed Bottom Right	10 Joules H3	I

Category 1 rating products can be used in the following areas:

A zone readily accessible at ground level to the public and vulnerable to hard body impacts, but not subjected to abnormally rough use (e.g., façade bases in buildings sited in public locations such as squares, school yards or parks. Cleaning gondolas may be used on the façade).

Whilst these tests have no direct correlation to the extension of the durability of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels, they do have some bearing on the likelihood (risk) of the system experiencing water ingress to components otherwise not exposed to such weathering.

2.3 Bond Strength Testing

TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic ventilated cladding system panels underwent bond strength testing in accordance with Annex H of EAD 040914-00-0404:2018 prior to and following accelerated weathering testing.

This testing establishes the deterioration of the bond between the exterior face and the substrate.

It establishes the likelihood (risk) over time that any portion of the face could become detached and fall, exposing materials that would normally not be exposed in normal conditions.

Annex H of EAD 040914-00-0404 gives a minimum value for the bond strength of 0.08 N/mm^2.

For a design life of 60 years, the bond strength at 60 years would be required to still fulfil the 0.08 N/mm² bond strength minimum value as stated within Annex H of EAD 040287-00-0404.

Report UK222081/Ref.1 states that:

According to Table H.1, Annex H of EAD 040287-00-0404:

“The minimum failure resistance, after the hygrothermal test at Connection 1 (between external skin and the insulation panel) and Connection 2 (between the insulation panel and base adhesive), shall be at least equal to 0.08 N/mm^2 with cohesive or adhesive rupture or, the rupture shall occur in the insulation product if the failure load is less than 0.08 N/mm^2.

Due to the construction of TI Tiles International Ltd.’s panel system, it has been assumed that Connection 1 refers to the bond between the veneer layer and the honeycomb and Connection 2 refers to the bond between the honeycomb and the backing of the panel.

Bond strength results following hygrothermal testing for Systems 1 to 4 and had a minimum mean bond of 0.6 N/mm^2 (System 3).

Ideally a set of control bond tests would be performed to enable an extrapolated value at 60 years to be determined using the assumption that any degradation would be linear.

No control bond tests were carried out for these systems; however, the manner in which the systems are constructed ‘should’ mean that nothing other than the face of each of the panel types would be subjected to weathering and, as such, any degradation would be minimal.

This, coupled with the high bond strength values achieved following accelerated weathering testing, leads Lucideon Limited to assume that the degradation due to the 25-year accelerated weathering testing ‘was minimal’.

It would be beneficial to TI Tiles International Ltd. to establish the bond strength base level prior to any weathering, to prove Lucideon Limited’s assumption that any degradation would be minimal and alleviate any caveats placed on the system due to this lack of data.

2.4 EAD 040914-00-0404 Working Life/Durability Guidance

EAD 040914-00-0404 states under Section One, Clause 1.2.2: Working Life (Durability) and serviceability:

"The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take in to account a working life of the VETURE kit for the intended use of 25 years when installed in the works. These provisions are based upon the current state of the art and available knowledge and experience."

"When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works."

"The indications given as to the working life of the construction product cannot be interpreted as a guarantee, neither given by the product manufacturer or its representative, by the EOTA when drafting this EAD, nor by the Technical Assessment Body issuing an ETA based on this EAD but are regarded only as a means for expressing the expected economically reasonable working life of the product."

These statements allow for any system tested following EAD 040914-00-0404 guidelines and to have subsequently passed any assessment criteria, laid out within, to be expected to have a working life (Design life) of 25 years.

However, it is possible to theoretically prove that this life expectancy could be extended or reduced based on the mentioned criteria.

3 VINCI TECHNOLOGY CENTRE UK LIMITED REPORT NO. N950-17-17478

Under report No. N950-17-17478, TI Tiles International Ltd. had their Aerolite Monolith Stone and Ceramic Cladding Panels tested in accordance with the Centre for Window and Cladding Technology standard.

Testing comprised of: -

- Wind Resistance – Serviceability.
- Wind Resistance – Safety.
- Wind Resistance – Cyclic.
- Impact Resistance (TN76).

The report states within Section 2, Clause 2.1, that the samples passed all testing.

Based upon the results of the impact testing performed under TN76, the panels would be classified as Class 2 for serviceability performance with low-risk rating for safety performance.

Class 2 is defined as surface damage of an aesthetic nature, which is unlikely to require remedial action – dents or distortion of the panel not visible from more than 5 metres (note: - visibility of damage will depend on the surface finish and lighting conditions – damage will generally be more visible on reflective surfaces), and any damage visible from closer than 5 metres unlikely to lead to significant deterioration.

Low risk is defined as maximum mass of falling particle less than 50 grams, and maximum mass of particle that may fall subsequent to impact less than 50 grams, and no sharp edges produced that would be likely to cause severe injury during impact.

A low risk classification is usually awarded when small pieces of the surface have come away from the sample following impact, or there is a risk of pieces falling subsequent to the test, or the impactor has penetrated the sample.

Due to this, the report was reviewed in depth to establish the risk to components not usually exposed to the elements.

After reviewing the test report there were no impacts that produced any fallout during testing. The only defects that were noted during testing were those of hairline cracks within the surface of the panel and small indents.

It is Lucideon Limited's view that these would be classified as negligible risk as the following criteria laid out in TN76 had been passed:

- No material dislodging during the test.
- No damage likely to lead to materials falling subsequent to test.
- No sharp edges produced that would be likely to cause severe injury to a person during impact.
- Cladding not penetrated by the impactor.

Therefore, it is Lucideon Limited's view that the risk to components usually shielded from the elements, being exposed due to impact damage is taken as negligible for these systems.

4 LIFE EXPECTANCY OF INDIVIDUAL COMPONENTS/CONSUMABLE

For the life expectancy to be increased from 25 years following successful completion of a testing regime, a desk top study of individual components (screws, framing) and consumables (mastics, backer-boards) must be completed.

Overleaf is a Table detailing all components and materials used within the construction of TI Tiles International Ltd.'s Aerolite Monolith Stone and Ceramic Cladding Panels.

Manufacturer	Manufacturer Product ID	Product Dimensions (mm)	Product Description	Batch Coded	Material	Data Sheet
Hilti	MFT-Fox VI	200 mm x 75 mm x 6 mm	Helping Hand Bracket	Y	Extruded Aluminium (EN AW-6063 T66)	Y
	MFT-Fox VI	200 mm x 150 mm x 6 mm	Helping Hand Bracket	Y	Extruded Aluminium (EN AW-6063 T66)	Y
	S-MD LSS 5.5x32	5.5 x 32 mm	Fixings	Y	Stainless steel (A4)	Y
Fixfast	DFS-SS-A15-5.5x55 Fixings	5.5 x 55 mm	Fixings	Y	Stainless steel (A15)	N
Hilti	MFT-L	60 mm x 40 mm x 3 mm	L shaped rail	N	Aluminium	N
	MFT-T	150 mm x 60 mm x 3 mm	T shaped Rail	N	Aluminium	N
TI Tiles International Ltd.	TI tracking System	Various	Top middle and Bottom Rail Track System	N	Aluminium	N
	Aerolite Monolith Ceramic panel	1300 mm x 1400 mm x 26 mm	20 mm fully encased aluminium cassette with 6 mm gloss ceramic Veneer	N	Aluminium and ceramic	Y
	Aerolite Monolith Ceramic panel		20 mm fully encased aluminium cassette with 6 mm marble finish ceramic Veneer	N	Aluminium and ceramic	Y
	Aerolite Monolith Stone		20 mm fully encased aluminium cassette with 6 mm stone Veneer	N	Aluminium and stone	Y
	Aerolite Monolith Ceramic panel		20 mm fully encased aluminium cassette with 6 mm gloss white ceramic Veneer	N	Aluminium and ceramic	Y

The technical data sheets for all items listed above can be found in Appendix C.

For each of these components or consumables, a minimum life expectancy had to be found whether that be from the product data sheet, from comparable products which had been tested or some form of study.

Below is the list of components and consumables with their minimum life expectancy under normal conditions, where normal conditions are defined as exposed to the elements in an average climate.

Manufacturer	Manufacturer Product ID	Product Description	Composition	Minimum Life Expectancy
Hilti	MFT-Fox VI	Helping Hand Bracket	Extruded Aluminium (EN AW-6063 T66)	40 years +
	MFT-Fox VI	Helping Hand Bracket	Extruded Aluminium (EN AW-6063 T66)	
	S-MD LSS 5.5x32	Fixings	Stainless steel (A4)	50 Years +
Fixfast	DFS-SS-A15-5.5x55 Fixings	Fixings	Stainless steel (A15)	
Hilti	MFT-L	L shaped rail	Aluminium	Aluminium 40 years + Ceramic veneer 100 Years + Stone Veneer 100 Years +
	MFT-T	T shaped Rail	Aluminium	
TI Tiles International Ltd.	TI tracking System	Top middle and Bottom Rail Track System	Aluminium	
	Aerolite Monolith Ceramic panel	20 mm fully encased aluminium cassette with 6 mm gloss ceramic Veneer	Aluminium and ceramic	
	Aerolite Monolith Ceramic panel	20 mm fully encased aluminium cassette with 6 mm marble finish ceramic Veneer	Aluminium and ceramic	
	Aerolite Monolith Stone	20 mm fully encased aluminium cassette with 6 mm stone Veneer	Aluminium and stone	
	Aerolite Monolith Ceramic panel	20 mm fully encased aluminium cassette with 6 mm gloss white ceramic Veneer	Aluminium and ceramic	

As previously noted, the life expectancy of the individual components and consumables used within the construction of TI Tiles International Ltd's Aerolite Monolith Stone and Ceramic Cladding Panels are stated as in normal condition, where normal conditions are defined as exposed to the elements in an average climate.

Articles relating to the lifespan of materials can be seen in Appendix E.

5 QUALITY CONTROL

TI Tiles International Ltd. have supplied no literature with regards to quality management and traceability throughout the manufacturing process.

TI Tiles International Ltd. have supplied no literature in relation to handling, storage and installation procedures for their Aerolite Monolith Stone and Ceramic Cladding Panels.

Quality management and the traceability of components and materials during the manufacturing process is of upmost importance. Documentation detailing the quality checks and measures in place during this period should be something that TI Tiles International Ltd. would benefit from publishing.

A storage and handling guide, accompanied by an installation method publication would be beneficial in order to establish standardised practices regarding their Aerolite Monolith Stone and Ceramic Cladding Panels.

Standardised practices in installation, handling and storage reduces the risk of incorrect installation, and the risk of faulty goods being installed and utilised, which, in turn reduces the risk of components being exposed to conditions they normally would not. This increases the risk of failure of those components and could shorten the life expectancy of the system.

6 CONCLUSIONS

When the system is fully built up and installed, the only products that would be subjected to anything like normal conditions would be the Aerolite Monolith Stone and Ceramic Cladding Panels.

All other components and consumables would be sheltered from the elements with little moisture or sunlight affecting them. Based upon this, the expected life span of said product should increase.

Taking these considerations into account, along with the information gained by way of data sheets provided by TI Tiles International Ltd., research and the results obtained from the extensive testing Aerolite Monolith Stone and Ceramic Cladding Panels have undergone, it is Lucideon Limited's view that TI Tiles International Ltd's Aerolite Monolith Stone and Ceramic Cladding Panels shall have a life expectancy of 60 years.

It was, however, pointed out that testing under VINCI Report N950-17-17478 has the name of the product as Ultralite Rainscreen Cladding, whilst TI Tiles International Ltd. instructed Lucideon to complete testing under the name Aerolite Monolith Stone and Ceramic Cladding Panels.

Appendix F shows an official statement from TI Tiles International Ltd. stating that there was a name change due to a copyright issue in 2020. Lucideon Limited has taken this on face value, however a caveat has been added which voids the 60-year study report should it be found that the two systems are indeed non-identical.

This life expectancy is on the provision that:

i. Aerolite Monolith Stone and Ceramic Cladding Panels are manufactured in the same manner as when referred to as Ultralite Rainscreen Cladding up to 2020. If this ceases to be the case then this report is void and testing completed in 2017 would have to be repeated under the new name of Aerolite Monolith Stone and Ceramic Cladding Panels.

ii. All components and consumables used are only those listed within this report.

iii. Batch numbers are recorded for each delivery of every component detailed above.

iv. A quality management document is produced by TI Tiles International Ltd.

v. In-house quality checks are performed within the factory prior to release.

vi. TI Tiles International Ltd. create an installation, handling, and storage guide.

vii. Installation is carried out by competent installers.

NOTE: The results given in this report apply only to the samples that have been tested.

END OF REPORT

TEST REPORT

Lucideon Reference:	UK222081 (QT-67623/2/KNA)/Ref. 1
Project Title:	Testing of TI Tiles International Ltd's Aerolite Monolith Stone and Ceramic Cladding Panels in Accordance with the Methods Given in EAD 040914-00-0404:2018
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EXECUTIVE SUMMARY

System One – TI Tiles International Ltd's Aerolite Monolith Gloss White Ceramic Ventilated Cladding System, Installed Top Left

Test	Method	Requirement	Classification
Hygrothermal Performance	EAD 040914-00-0404 Annex D	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	EAD 040914-00-0404 Annex H	≥ 0.08 N/mm^2 or cohesive failure of insulation	1.072 N/mm^2
Impact Resistance – Wall	EAD 040914-00-0404 Annex G	Hard body Category I, II or III	Category I
		Soft body Category S1, S2, S3 or S4	Category I

System Two – TI Tiles International Ltd's Aerolite Monolith Marble Finish Ceramic Ventilated Cladding System, Installed Bottom Left

Test	Method	Requirement	Classification
Hygrothermal Performance	EAD 040914-00-0404 Annex D	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	EAD 040914-00-0404 Annex H	≥ 0.08 N/mm^2 or cohesive failure of insulation	0.792 N/mm^2
Impact Resistance – Wall	EAD 040914-00-0404 Annex G	Hard body Category I, II or III	Category I
		Soft body Category S1, S2, S3 or S4	Category I

System Three – TI Tiles International Ltd's Aerolite Monolith Stone Ventilated Cladding System, Installed Top Right

Test	Method	Requirement	Classification
Hygrothermal Performance	EAD 040914-00-0404 Annex D	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	EAD 040914-00-0404 Annex H	≥ 0.08 N/mm^2 or cohesive failure of insulation	0.600 N/mm^2
Impact Resistance – Wall	EAD 040914-00-0404 Annex G	Hard body Category I, II or III	Category I
		Soft body Category S1, S2, S3 or S4	Category I

System Four – TI Tiles International Ltd's Aerolite Monolith Gloss White Ceramic Ventilated Cladding System, Installed Bottom Right

Test	Method	Requirement	Classification
Hygrothermal Performance	EAD 040914-00-0404 Annex D	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	EAD 040914-00-0404 Annex H	≥ 0.08 N/mm^2 or cohesive failure of insulation	0.728 N/mm^2
Impact Resistance – Wall	EAD 040914-00-0404 Annex G	Hard body Category I, II or III	Category I
		Soft body Category S1, S2, S3 or S4	Category I

1 INTRODUCTION

TI Tiles International Ltd's facades require a range of testing to warranty/certify their Aerolite Monolith Stone and Ceramic ventilated cladding system panels, in accordance with the methods given in EAD 040914-00-0404:2018[1].

The samples under test were:

1.1 System One

TI Tiles International Ltd's Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm gloss white ceramic veneer, installed on the top left quadrant of the test wall.

1.2 System Two

TI Tiles International Ltd's Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm marble finish ceramic veneer, installed on the bottom left quadrant of the test wall.

1.3 System Three

TI Tiles International Ltd's Aerolite Monolith Stone ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm stone veneer, installed on the top right quadrant of the test wall.

1.4 System Four

TI Tiles International Ltd's Aerolite Monolith Ceramic ventilated cladding system: 20 mm fully encased aluminium cassette with 6 mm gloss white ceramic veneer, installed on the bottom right quadrant of the test wall.

2 TEST PROGRAMME

The TI Tiles International Ltd's wall was subjected to the tests listed in Table 1.

Table 1 - Test Programme

Sample	Test	Standard	Clause	No. of Tests per System
Wall One	Hygrothermal Behaviour	EAD 040914-00-0404	Annex E	1
	Bond Strength (After hygrothermal and freeze/thaw testing)	EAD 040914-00-0404	Annex H	5
	Freeze/Thaw	EAD 040914-00-0404	Annex E	1
	Soft Body Impact	EAD 040914-00-0404	Annex G	3
	Hard Body Impact			6

[1] EAD 040914-00-0404:2018 Veture Kits – Prefabricated Units for External Wall Insulation and their Fixings.

3 TEST SAMPLE

The wall was installed onto a 2.6 m high x 3.2 m long steel test frame, featuring vertical steel section at 600 mm centres.

Four systems, three of the ceramic veneers in different finishes and one of the stone veneers, were installed onto a single wall.

Each of the systems incorporated the following common components:

- Lucideon Lightweight Steel Frame.
- Cement Particle Board.
- Hilti Helping Hand Bracket 'M' 200 mm x 75 mm x 3 mm (L x W x T).
- Hilti Helping Hand Bracket 'L' 200 mm x 150 mm x 3 mm (L x W x T).
- FixFast Self Drilling 5.5 x 55 mm Fixings.
- L-Shaped Generic Rail, 3 mm thick.
- T-Shaped Generic Rail, 3 mm thick.
- Hilti Stainless A4 5.5 x 32 mm Fixings.
- TI Generic Horizontal Starter Rail.
- TI Generic Horizontal Mid Rail.
- TI Generic Horizontal Top Rail.
- Generic Stainless Steel 5.5 x 28 mm Fixings.

Onto this shared backing, the following components were installed for each respective cladding system:

3.1 System One (Installed Top Left)

- Aerolite Monolith Ceramic panel, 1300 mm x 1400 mm x 26 mm (L x W x T), gloss white finish.

3.2 System Two (Installed Bottom Left)

- Aerolite Monolith Ceramic panel, 1300 mm x 1400 mm x 26 mm (L x W x T), gloss marble finish.

3.3 System Three (Installed Top Right)

- Aerolite Monolith Stone, 1300 mm x 1400 mm x 26 mm (L x W x T), gloss white finish.

3.4 System Four (Installed Bottom Right)

- Aerolite Monolith Ceramic panel, 1300 mm x 1400 mm x 26 mm (L x W x T), gloss white finish.

4 TEST METHOD

4.1 Hygrothermal Test

The wall frame was centrally clamped to the face of a 2.4 m high x 3.0 m long test aperture.

Testing was carried out in accordance with EAD 040914-00-0404 Annex E. The testing involved subjecting a wall to repeated heat/rain cycles, followed by repeated heat/cold cycles, at controlled humidity conditions designed to simulate naturally occurring conditions.

4.1.1 Weathering Cycles

The walls were subjected to cyclic heat/rain conditions, followed by heat/cold cycles according to the following programme.

4.1.2 Heat/Rain – 80 Cycles

Heating to 70°C, rising over 1 hour and maintaining at 70ºC (± 5) at 10-15% RH for a further 2 hours.

Followed by spraying with water (water temperature 15 (± 5)°C) at 1 l/m^2/min for 1 hour.

Draining for 2 hours.

On completion of the heat/rain cycles, the wall was conditioned for 48 hours at a temperature between 10 and 25°C, with a minimum RH of 50%.

4.1.3 Heat/Cold – 5 Cycles

Exposure to 50°C (± 5) with a rise of 1 hour and maximum 10% RH for 7 hours.

Exposure to -20°C (± 5) with a fall over 2 hours and hold for 14 hours.

The walls were inspected every four heat/rain cycles, and daily under the heat/cold cycles, to observe changes in the visual characteristics of the wall.

4.2 Freeze/Thaw Test

After hygrothermal testing, the wall was subjected to freeze/thaw testing. The test involved subjecting the wall to repeated freeze/thaw cycles as follows:

4.2.1 Freeze/Thaw – 30 Cycles

Condition the test wall initially by wetting for eight hours with an amount of 1.5 (± 0.5) l/(m^2/minute) water, with a temperature of 15 (± 5)°C, then start the cycles consisting of the following:

Freeze the surface of the test wall within 2 hours to −20 (± 5)°C and maintain it for 4 hours (in total 6 hours).

Thaw the test wall for 1 hour at a temperature of 20 (± 5)°C.

Spray the test wall for 8 hours with an amount of 1.5 (± 0.5) l/(m^2/minute) water, with a temperature of 15 (± 5)°C.

After the 30 cycles, condition the test wall at ambient temperature 20 (± 10)°C.

On completion of the cyclic testing, the wall was left to dry for 7 days.

4.3 Soft Body Impact Test

Testing was carried out in accordance with EAD 040914-00-0404 Annex G.

A rigid scaffold framework was constructed to hold the impactor, such that, the centre of the soft body impactor was aligned with the panelled wall.

The scaffold framework was then extended to provide a pulley point to retract the impactor.

The drop height for the impactor for each impact energy was calculated and can be seen in Table 2.

Table 2 - Impactor Drop Heights

Impact Energy (J)	Distance from Face of Wall (mm)	Drop Height (mm)
10	282	20
60	680	120
300	1430	600
400	1600	800

The impact test consisted of a 50 kg bag suspended by a 3 m steel wire, swung from differing drop heights, as stated inTable 2, giving an impact energy as stated above.

The impactor was pulled back to the desired distance from the face of the wall, using a steel cable and then released.

Test positions were chosen, taking into account various modes of behaviour of the systems. The presence of any cracks at the impact point were noted.

4.4 Hard Body Impact Test

Testing was carried out in accordance with EAD 040914-00-0404 Annex G.

The system was held in a steel frame and fixed back to a rigid scaffold framework.

To obtain an impact energy of 3 Joules, a 500 g steel ball was released from a drop height of 613 mm and to obtain a 10 Joule impact energy, a 1000 g steel ball was released from a drop height of 1020 mm.

Test positions were chosen, taking into account various modes of behaviour of the systems. On completion of each impact, the area was inspected and the presence of any cracks at the impact point, was noted.

4.5 Bond Strength Test

Testing was carried out in accordance with EAD 040914-00-0404 Annex H.

4.5.1 After Hygrothermal and Freeze/Thaw Testing

The test was undertaken on the wall, after being subjected to hygrothermal, freeze/thaw cycles.

For each system, 50 mm x 50 mm specimens were cut through the ceramic layer at a depth of 5 mm.

A steel plate corresponding to the specimen size was bonded to the face of the sample with an epoxy resin and allowed to cure for 24 hours. A centralised tensile load was provided to the plate at a rate of 1-10 mm/minute through a tensile load machine until failure was recorded.

Bond strength (σ_B) was determined using the tensile load at failure (f) and the area of the plate (A) according to the equation below:

$$\sigma_B = f/A$$

5 RESULTS

5.1 Hygrothermal Test

According to EAD 040914-00-0404, the performance requirements of the large scale hygrothermal test rig is that neither the base coat, nor finish, should show evidence of any of the following defects:

- Deterioration such as blisters, flaking, cracking, or delamination of the cladding element, that allows water penetration to the insulation.
- Detachment of the cladding element.
- Irreversible deformation.

At the end of the test programme, no water penetration shall be evident up to the interface kit/substrate.

5.1.1 Results

Wall	System	System Description	Pass/Fail
Wall One	One	Aerolite Monolith Ceramic, installed Top Left	Pass No Defects

Wall	System	System Description	Pass/Fail
	Two	Aerolite Monolith Ceramic, installed Bottom Left	Pass No Defects
	Three	Aerolite Monolith Stone, installed Top Right	Pass No Defects
	Four	Aerolite Monolith Ceramic, installed Bottom Right	Pass No Defects

5.2 Freeze/Thaw Test

According to EAD 040914-00-0404 Annex D the sample is deemed to have satisfactorily completed the wet freeze/thaw testing if the following defects don't occur during or at the end of the test programme:

- Cracking or delamination of the skin that allows water penetration to the insulation.
- Blistering, flaking, or other visible change to the surface.
- Detachment of the skin.
- Irreversible deformation.

5.2.1 Results

Wall	System	System Description	Pass/Fail
Wall One	One	Aerolite Monolith Ceramic, installed Top Left	Pass No Defects
	Two	Aerolite Monolith Ceramic, installed Bottom Left	Pass No Defects
	Three	Aerolite Monolith Stone, installed Top Right	Pass No Defects
	Four	Aerolite Monolith Ceramic, installed Bottom Right	Pass No Defects

5.3 Soft Body Impact Test

The results of the soft body impact testing carried out, are as follows and can be categorised in accordance with Annex G of EAD 040914-00-0404.

Wall	System	System Description	Maximum Impact Achieved Without Damage	Category
Wall One	One	Aerolite Monolith Ceramic, installed Top Left	400 Joules S4	I
	Two	Aerolite Monolith Ceramic, installed Bottom Left	400 Joules S4	I
	Three	Aerolite Monolith Stone, installed Top Right	400 Joules S4	I
	Four	Aerolite Monolith Ceramic, installed Bottom Right	400 Joules S4	I

5.4 Hard Body Impact Test

The results of the hard body impact testing carried out at both 3 Joules and 10 Joules energy, are given in the Tables, and can be categorised in accordance with Annex G of EAD 040914-00-0404.

Wall	System	System Description	Maximum Impact Achieved Without Damage	Category
Wall One	One	Aerolite Monolith Ceramic, installed Top Left	10 Joules H3	I
	Two	Aerolite Monolith Ceramic, installed Bottom Left	10 Joules H3	I
	Three	Aerolite Monolith Stone, installed Top Right	10 Joules H3	I
	Four	Aerolite Monolith Ceramic, installed Bottom Right	10 Joules H3	I

Category I can be used in the following areas:

A zone readily accessible at ground level to the public and vulnerable to hard body impacts, but not subjected to abnormally rough use (e.g. façade bases in buildings sited in public locations such as squares, school yards or parks. Cleaning gondolas may be used on the façade).

5.5 Bond Strength

According to Table H.1, Annex H of EAD 040287-00-0404[2]: "The minimum failure resistance, after the hygrothermal test at Connection 1 (between external skin and the insulation panel) and Connection 2 (between the insulation panel and base adhesive), shall be at least equal to 0.08 N/mm^2 with cohesive or adhesive rupture or: The rupture shall occur in the insulation product, if the failure load is less than 0.08 N/mm^2".

Due to the construction of TI Tiles International Ltd's panel system, it has been assumed that Connection 1 refers to the bond between the veneer layer and the honeycomb and Connection 2 refers to the bond between the honeycomb and the backing of the panel.

The results of the bond strength testing carried out on the four systems are given in the Results Tables. The failure resistance of all systems was above 0.08 N/mm^2. The most common mode of failure across the range of systems was failure within the honeycomb structure. Pictures of different typical failure modes on both the wall and the 50 mm square samples are shown in Appendix 3.

6 CONCLUSIONS

The performance of TI Tiles International Ltd's systems is detailed in the Executive Summary.

[2] EAD 040287-00-0404 Kits for External Thermal Insulation Composite System (ETICS) with Panels as Thermal Insulation Product and Discontinuous Claddings as Exterior Skin.

TABLES

Table 3 - Results of Hard Body Impact Tests Carried Out on Top Left Panel

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking Depth (mm)
1	0	N/A	0	N/A
2	0	N/A	0	N/A
3	0	N/A	0	N/A

Table 4 - Results of Hard Body Impact Tests Carried Out on Bottom Left Panel

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking
1	0	N/A	0	N/A
2	0	N/A	0	N/A
3	0	N/A	0	N/A

Table 5 - Results of Hard Body Impact Tests Carried Out on Top Right Panel

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking Depth (mm)
1	0	N/A	0	N/A
2	0	N/A	0	N/A
3	0	N/A	0	N/A

Table 6 - Results of Hard Body Impact Tests Carried Out on Bottom Right Panel

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking
1	0	N/A	0	N/A
2	0	N/A	0	N/A
3	0	N/A	0	N/A

Table 7 - Results of the Soft Body Impact Tests Carried Out on Top Left Panel

Impact Energy (Joules)	Observations
10	No damage recorded
60	No damage recorded
300	No damage recorded
400	No damage recorded

Table 8 - Results of the Soft Body Impact Tests Carried Out on Bottom Left Panel

Impact Energy (Joules)	Observations
10	No damage recorded
60	No damage recorded
300	No damage recorded
400	No damage recorded

Table 9 - Results of the Soft Body Impact Tests Carried Out on Top Right Panel

Impact Energy (Joules)	Observations
10	No damage recorded
60	No damage recorded
300	No damage recorded
400	No damage recorded

Table 10 - Results of the Soft Body Impact Tests Carried Out on Bottom Right Panel

Impact Energy (Joules)	Observations
10	No damage recorded
60	No damage recorded
300	No damage recorded
400	No damage recorded

Table 11 - Results of Bond Strength Tests Carried Out on Top Left Panel

Sample Reference	Sample Size (mm)	Test No.	Ultimate Load (N)	Ultimate Strength (N/mm^2)	Mode of Failure
Top Left	50 x 50	1	3700	1.48	Failure in the veneer-honeycomb interface
		2	2700	1.08	Failure within the honeycomb
		3	2400	0.96	Failure in the plate- veneer interface
		4	2300	0.92	Failure in the veneer - honeycomb interface
		5	2300	0.92	Failure within the honeycomb
Mean			**2680**	**1.072**	**-**

Table 12 - Results of Bond Strength Tests Carried Out on Bottom Left Panel

Sample Reference	Sample Size (mm)	Test No.	Ultimate Load (N)	Ultimate Strength (N/mm^2)	Mode of Failure
Bottom Left	50 x 50	1	3000	1.2	Failure in the plate-veneer interface
		2	1900	0.76	Failure in the plate-veneer interface
		3	1300	0.52	Failure in the plate-veneer interface
		4	1800	0.72	Failure in the plate-veneer interface
		5	1900	0.76	Failure in the veneer-honeycomb interface
Mean			**1980**	**0.792**	**-**

Table 13 - Results of Bond Strength Tests Carried Out on Top Right Panel

Sample Reference	Sample Size (mm)	Test No.	Ultimate Load (N)	Ultimate Strength (N/mm^2)	Mode of Failure
Top Right	50 x 50	1	1700	0.68	Failure within the honeycomb
		2	1400	0.56	Failure within the honeycomb
		3	1500	0.60	Failure within the honeycomb
		4	1200	0.48	Failure within the honeycomb
		5	1700	0.68	Failure within the honeycomb
Mean			**1500**	**0.60**	**-**

Table 14 - Results of Bond Strength Tests Carried Out on Bottom Right Panel

Sample Reference	Sample Size (mm)	Test No.	Ultimate Load (N)	Ultimate Strength (N/mm^2)	Mode of Failure
Bottom Right	50 x 50	1	1900	0.76	Failure within the honeycomb
		2	1100	0.44	Failure within the honeycomb
		3	1600	0.64	Failure in the plate- veneer interface
		4	1300	0.52	Failure within the honeycomb
		5	3200	1.28	Failure within the honeycomb
Mean			**1820**	**0.728**	**-**

NOTE: The results given in this report apply only to the samples that have been tested.

END OF REPORT

APPENDIX 1 - Sample Construction

The cladding system was installed onto a 2.6 m high x 3.2 m long steel test frame.

The steel frame featured vertical section at 600 mm centres.

2400 x 1200 x 9 mm RCM cement particle board was fixed to the steel frame at 300 mm vertical centres 150 mm to the perimeter edges.

Hilti helping hand brackets having dimensions of 200 mm x 75 mm x 4 mm (L x W x T) were installed at 600 mm vertical and 600 mm horizontal centres with five brackets installed per vertical run and six brackets per horizontal run. The middle bracket on the vertical run was a double and had dimensions 200 mm x 150 mm x 4 mm (L x W x T). The helping hand brackets were installed into the cement particle board using Fixfast DF3-ss-A15-5.5 x 55 fixings with two fixings per helping hand.

A 3 mm L-shaped vertical rail was installed vertically onto the helping hand brackets at the edge of the wall. A 3 mm T-shaped rail was installed vertically at 600 mm centres on the remaining helping hands. The metal rails were fixed to the helping hands using Hilti S-MD LSS 5.5 x 32 stainless A4 fixings.

TI generic horizontal starter rail was installed at the base of the wall using generic self-drill stainless 5.5 x 28 mm steel fixings at 600 mm horizontal centres. A second TI generic horizontal starter rail was installed 650 mm above the first starter rail fixed using generic self-drill stainless 5.5 x 28 mm steel fixings at 600 mm horizontal centres.

Ceramic panels having dimensions of 1400 mm x 1300 mm (W x H) were installed onto the starter track and fixed onto the mid rail via a groove cut across the rear face of the panel at a depth of 10 mm (5 mm tile veneer onto 20 mm metal backing).

TI generic horizontal centre mid-rail was installed 650 mm above the second starter rail using generic self-drill stainless 5.5 x 28 mm steel fixings and slotted behind the top of panel to form a seal.

A third TI generic horizontal starter rail was installed 650 mm above the centre rail fixed using generic self-drill stainless 5.5 x 28 mm steel fixings at 600 mm horizontal centres. The second row of ceramic and stone panels having dimensions of 1400 mm x 1300 mm (w x h) was installed onto this TI generic horizontal starter rail and fixed onto the mid-rail.

The wall was completed using a TI generic horizontal top rail, which was installed using generic self-drill stainless 5.5 x 28 mm steel fixings at 600 mm horizontal centres over the top edges of the ceramic panels.

APPENDIX 2 - Construction Details (Plates)

Plate 1 - Installation of Cement Particle Board and Helping Hand Brackets

Plate 2 - Installation of 3 mm L-Shaped and T-Shaped Vertical Rails

Plate 3 - Application of TI Generic Horizontal Starter Rails for the Bottom Row of Ceramic Panels

Plate 4 - Installation of the Bottom Row of Ceramic Panels on the Rail System

Plate 5 - Installation of the Top Row of Ceramic and Stone Panels on the Rail System

APPENDIX 3 - Bond Strength Test (Plates)

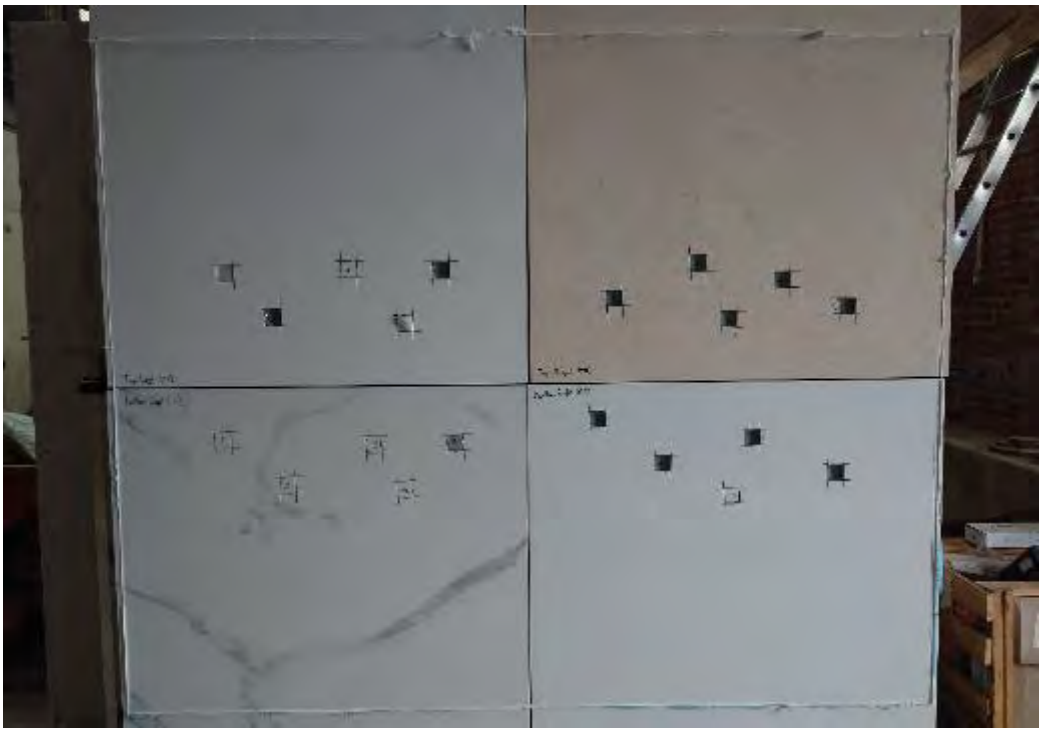


Plate 6 - Sample Wall, with all Test Locations

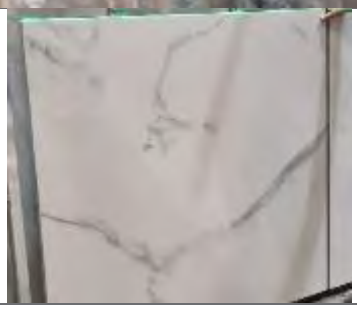
Plate 7 - Typical Sample where Failure Mode is in the Honeycomb Layer

Plate 8 - Typical Sample where Failure Mode is Between the Veneer and Honeycomb Layers

Plate 9 - Typical Sample where Failure Mode is Between the Plate and Veneer Layer

APPENDIX 4 - Batch Details for TI Tiles International Ltd's Ventilated Cladding System

Product	Description	Batch Reference	Image of Label
Hilti MFT-Fox VI	Helping Hand Bracket 200 mm x 75 mm x 6mm	001765	
Hilti MFT-Fox VI	Helping Hand Bracket 200 mm x 150 mm x 6mm	001156	
FixFast Screws	Self-Drilling Screws DF3-SS-A15-5.5 x 55 Fixings	97367	
L-shaped Vertical Rail	Generic L-shaped Rail 3 mm thick	-	
T-shaped Vertical Rail	Generic T-shaped Rail 3 mm thick	-	
Hilti Fixings	S-MD LSS 5.5 x 32 Stainless A4	2201130487001	
Horizontal Starter Rail	TI Generic Horizontal Starter Rail	-	

Product	Description	Batch Reference	Image of Label
Horizontal Mid Rail	TI Generic Horizontal Mid Rail		
Horizontal Top Rail	TI Generic Horizontal Top Rail		
Stainless Steel Fixings	Generic Self-drill Stainless 5.5 x 28 mm Steel Fixings	0000033844-WMD-DH	
Ceramic Panels	Ceramic Panels 1300 mm x 1400 mm x 26 mm (6 mm Ceramic Veneer)	-	
Stone Panels	Stone Panels 1300 mm x 1400 mm x 26 mm (6 mm Stone Veneer)	-	

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

TECHNOLOGY CENTRE

Technical Report

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

Customer: TI Tiles International Ltd
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Issue date: 10 October 2017

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1 copy to project file

UKAS TESTING
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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.

VINCI Technology Centre UK Limited is accredited to ISO/IEC 17025:2008 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 for:

- 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

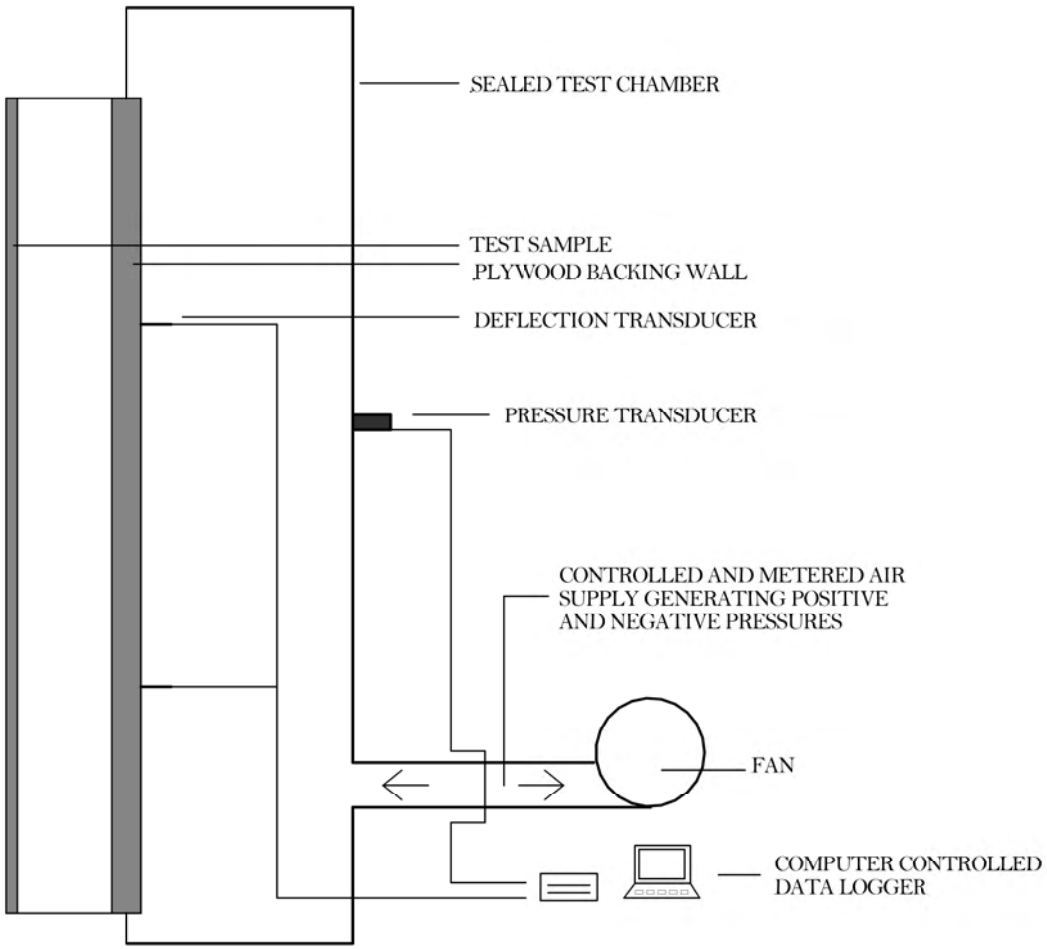
TEST SAMPLE DURING WIND LOADING

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

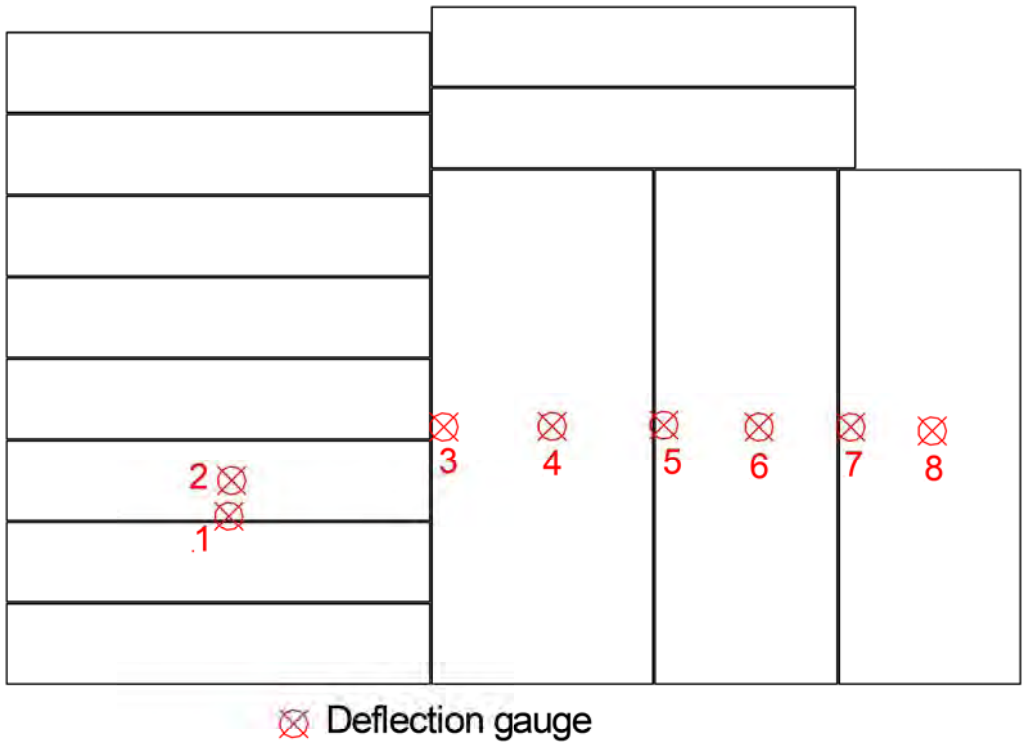
Load as fraction of design wind pressure	Number of cycles	Applied load
90%	1	±2160 Pa
40%	960	±960 Pa
60%	60	±1440 Pa
50%	240	±1200 Pa
80%	5	±1920 Pa
70%	14	±1680 Pa

Any damage or functional defects were recorded.

FIGURE 2

DEFLECTION GAUGE LOCATIONS

External View



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

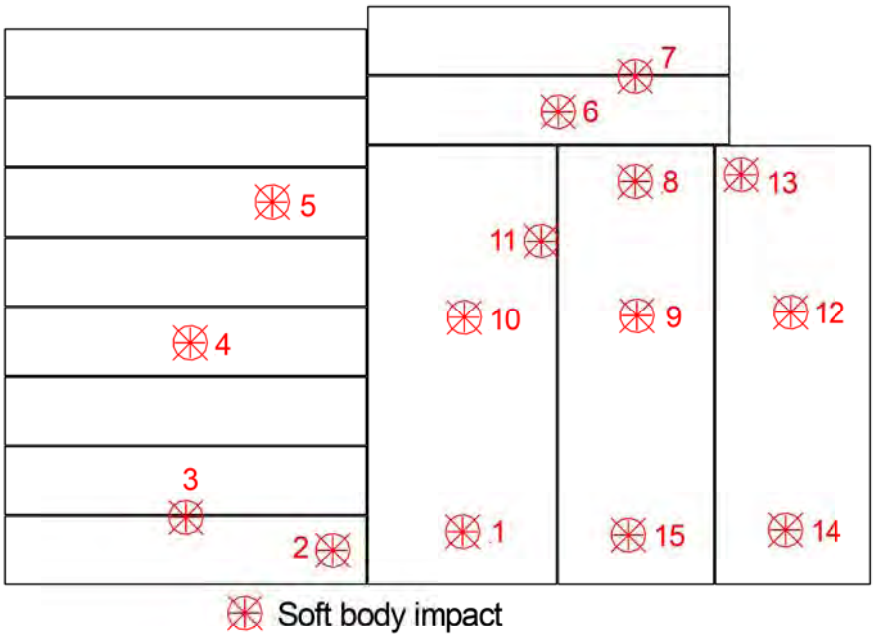


FIGURE 4

HARD BODY IMPACT TEST LOCATIONS

External View

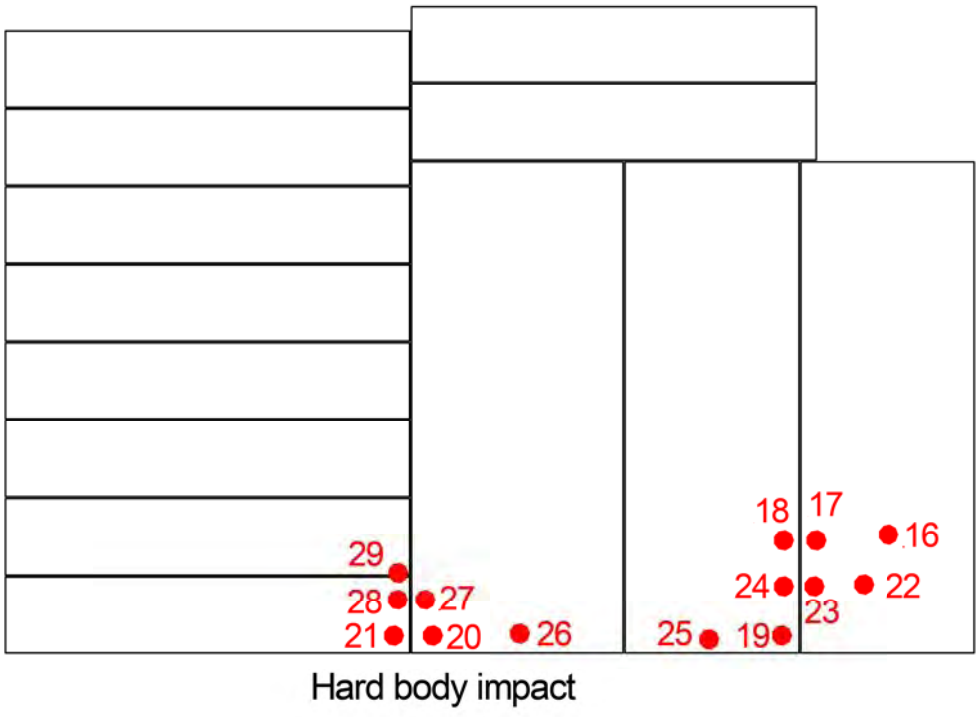


PHOTO 6025

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

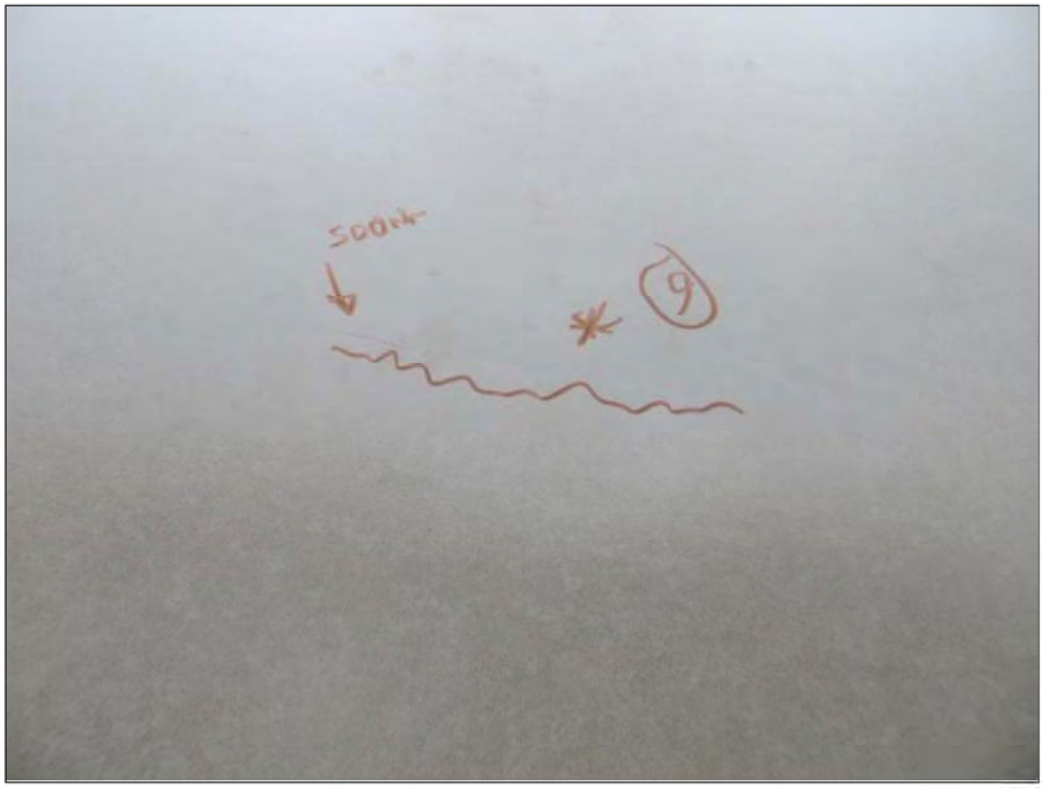


PHOTO 6026

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)

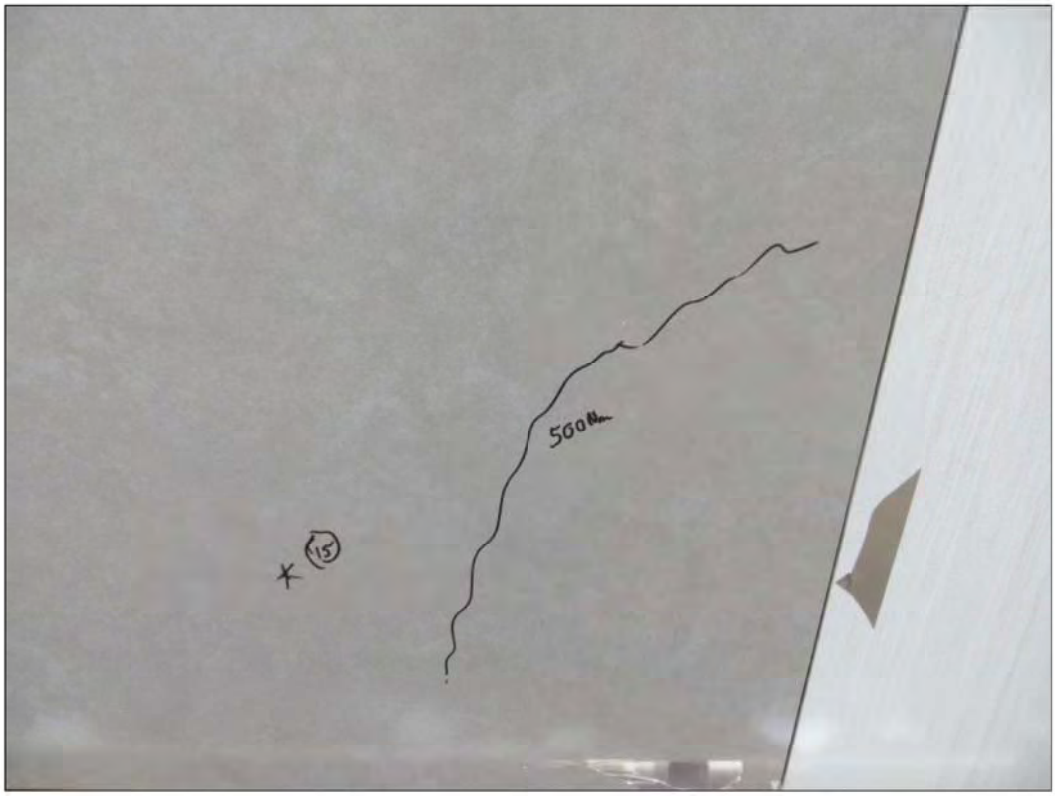


PHOTO 6030

HARD BODY IMPACT AT LOCATION 16

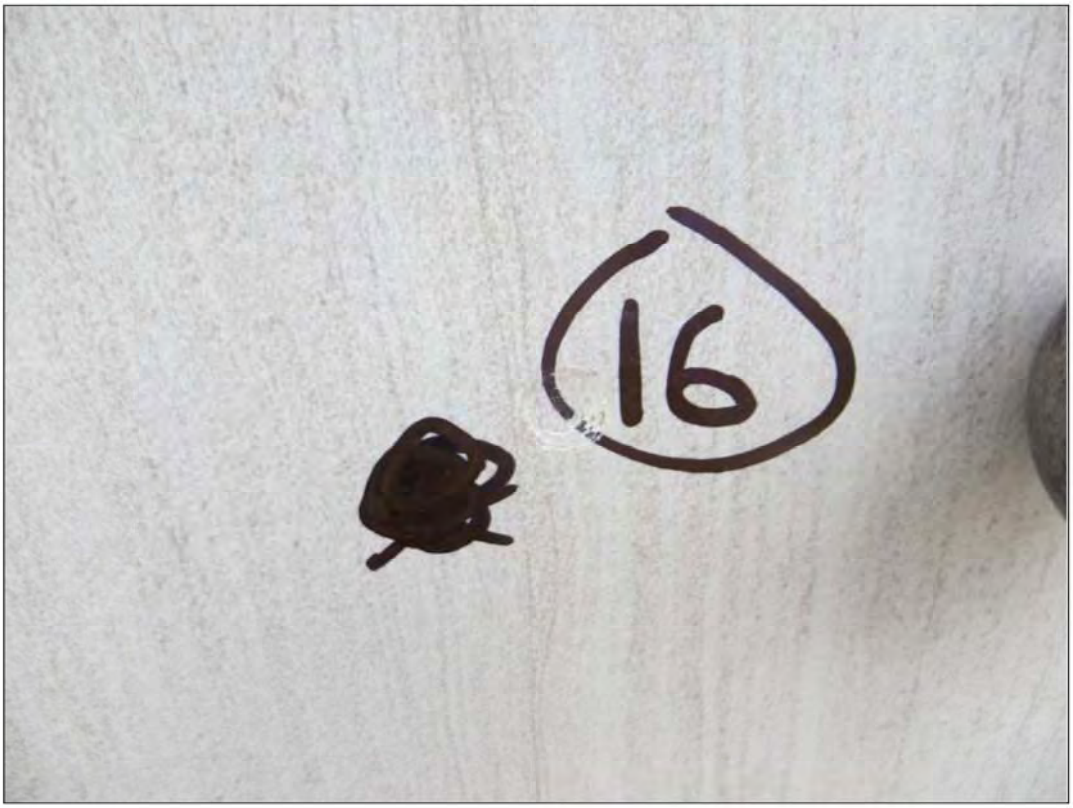


PHOTO 6034

HARD BODY IMPACTS AT LOCATIONS 17 & 18

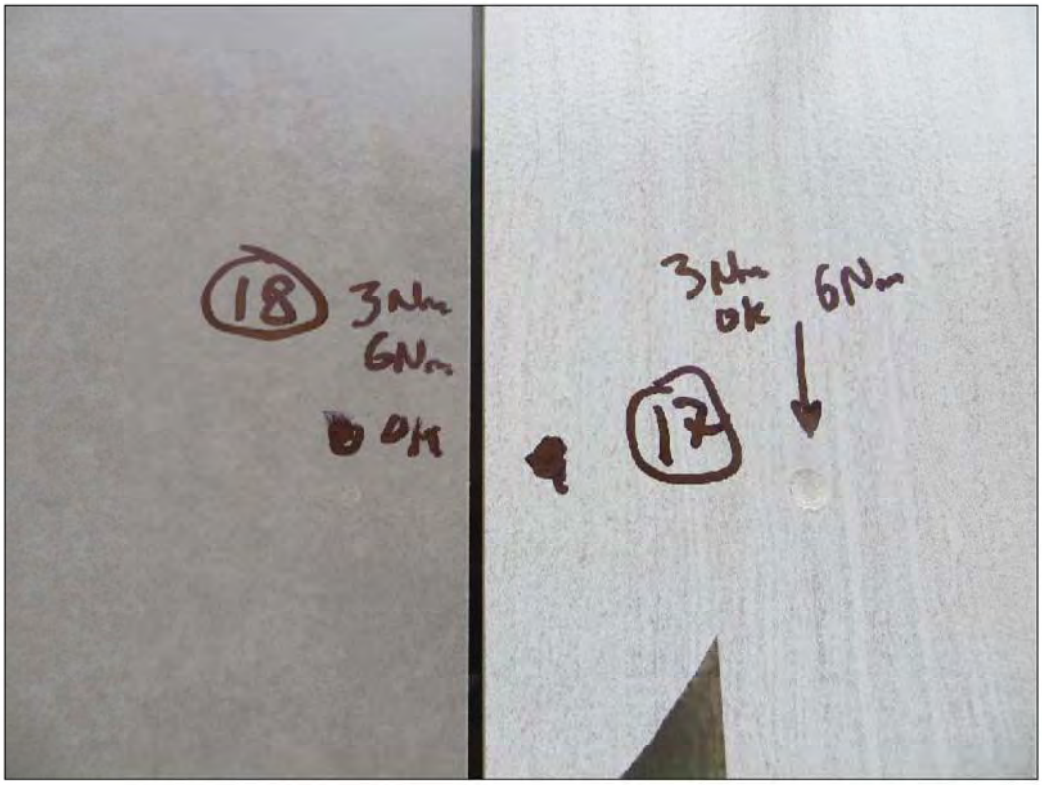


PHOTO 6037

HARD BODY IMPACTS AT LOCATIONS 20 & 21

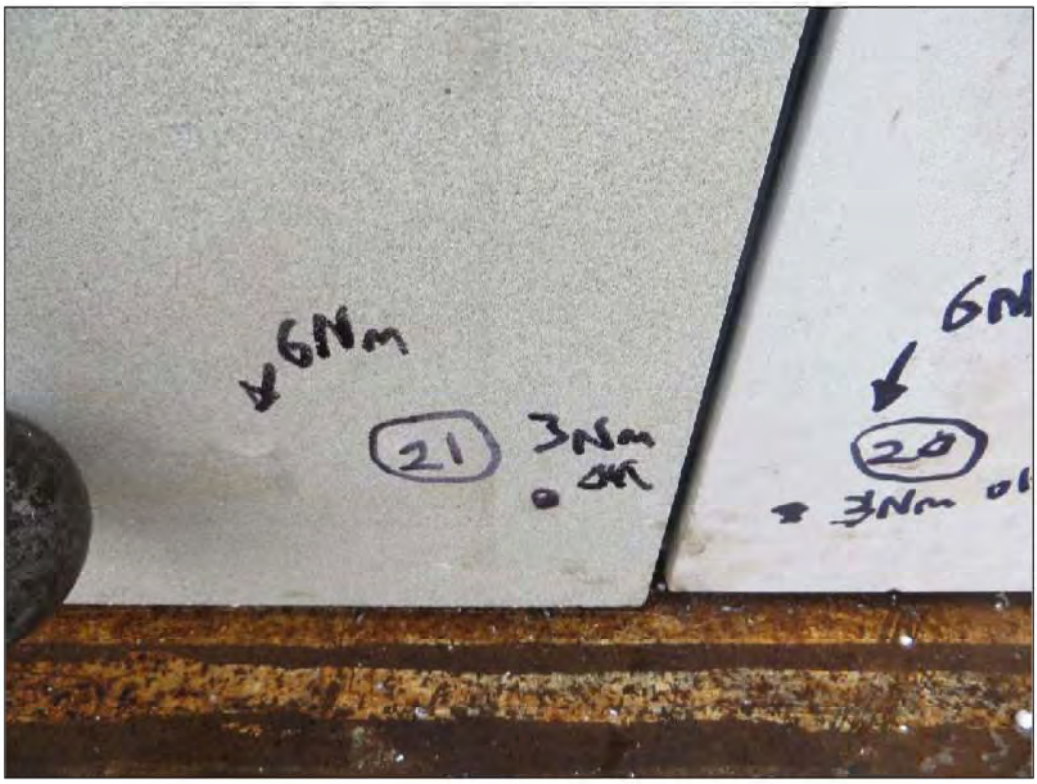


PHOTO 6039

HARD BODY IMPACT AT LOCATION 22

PHOTO 6039

HARD BODY IMPACTS AT LOCATIONS 23 & 24

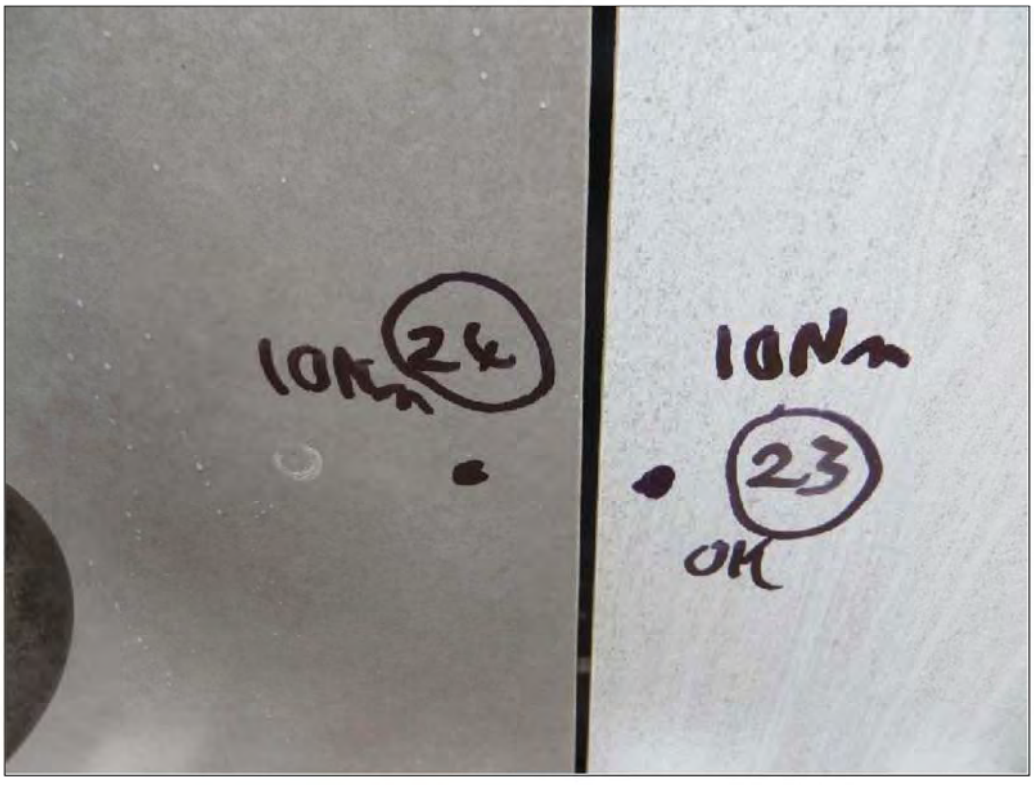
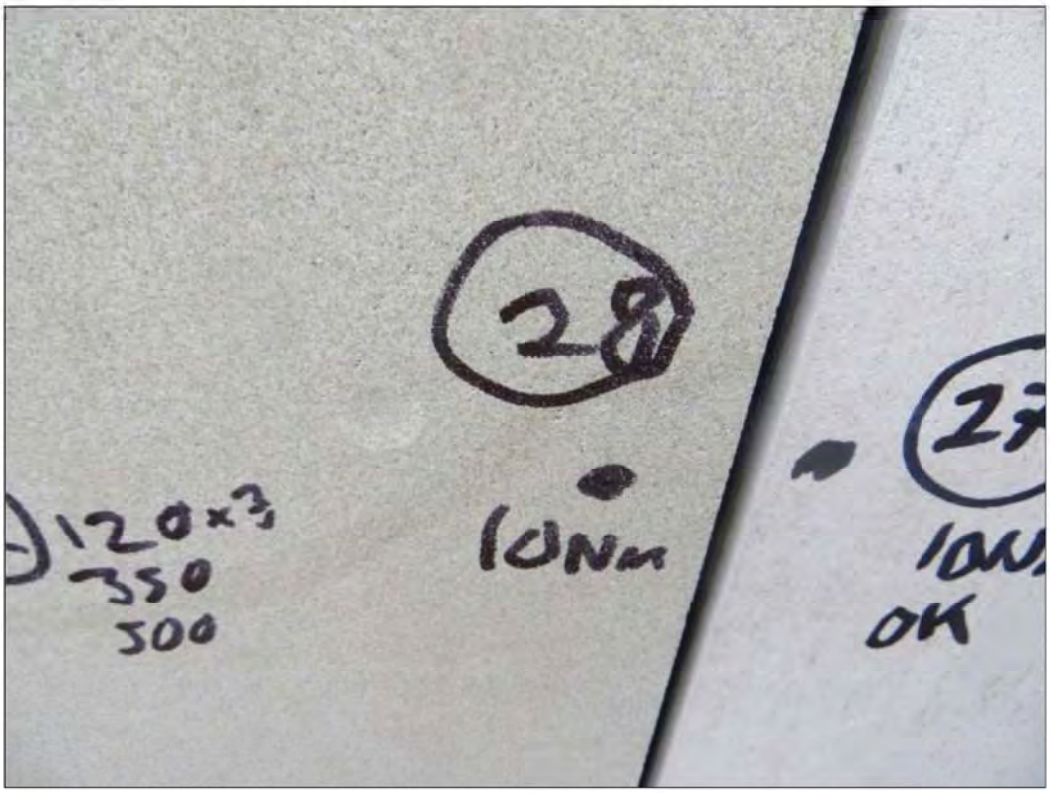


PHOTO 6042

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,

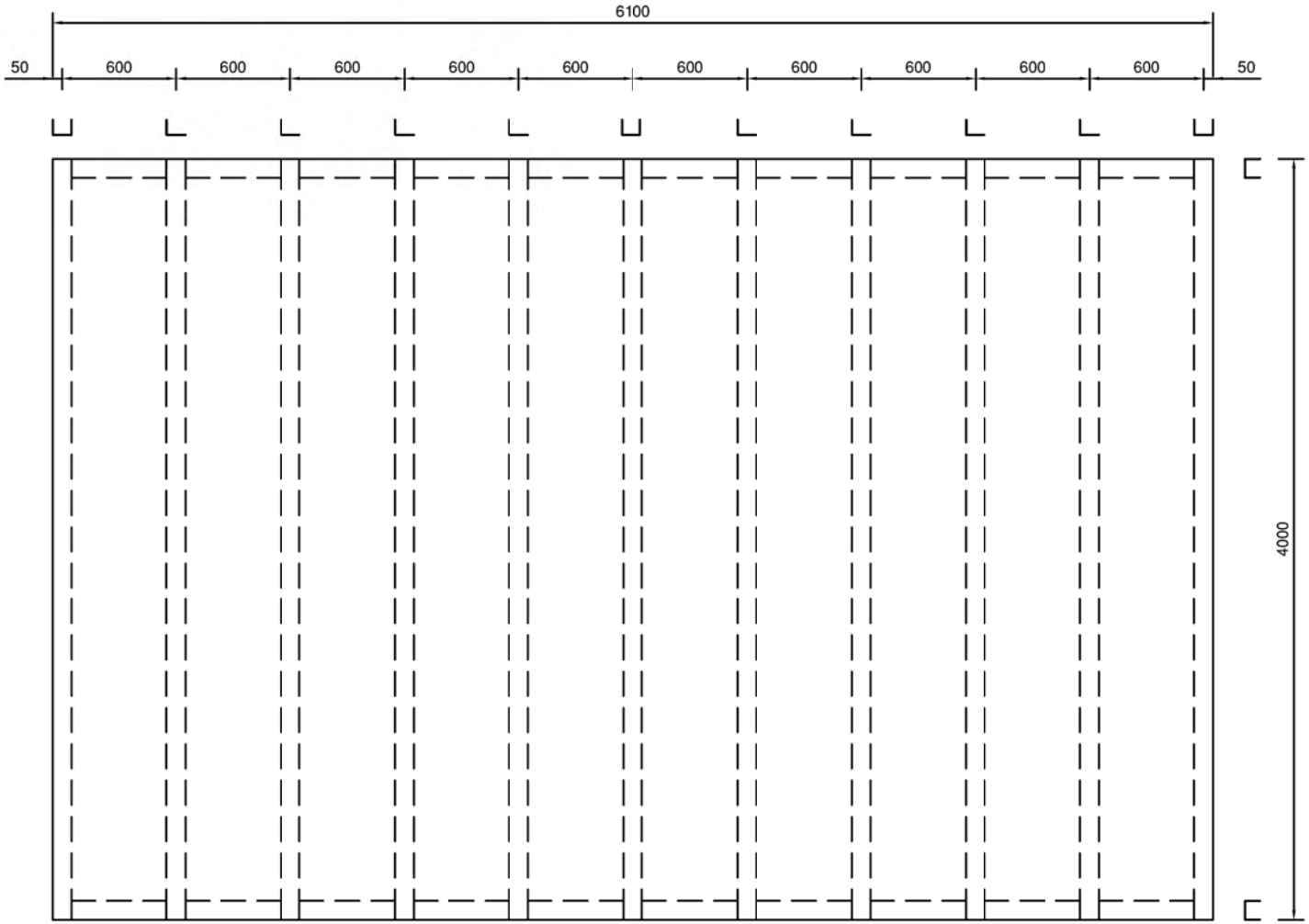
T103,

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
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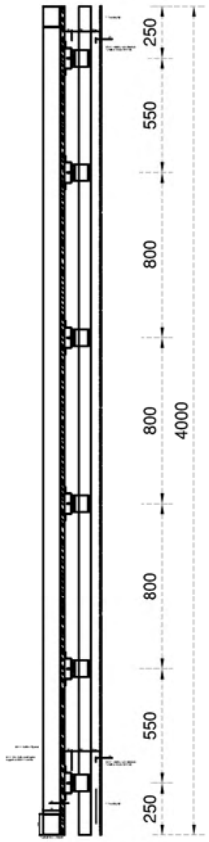
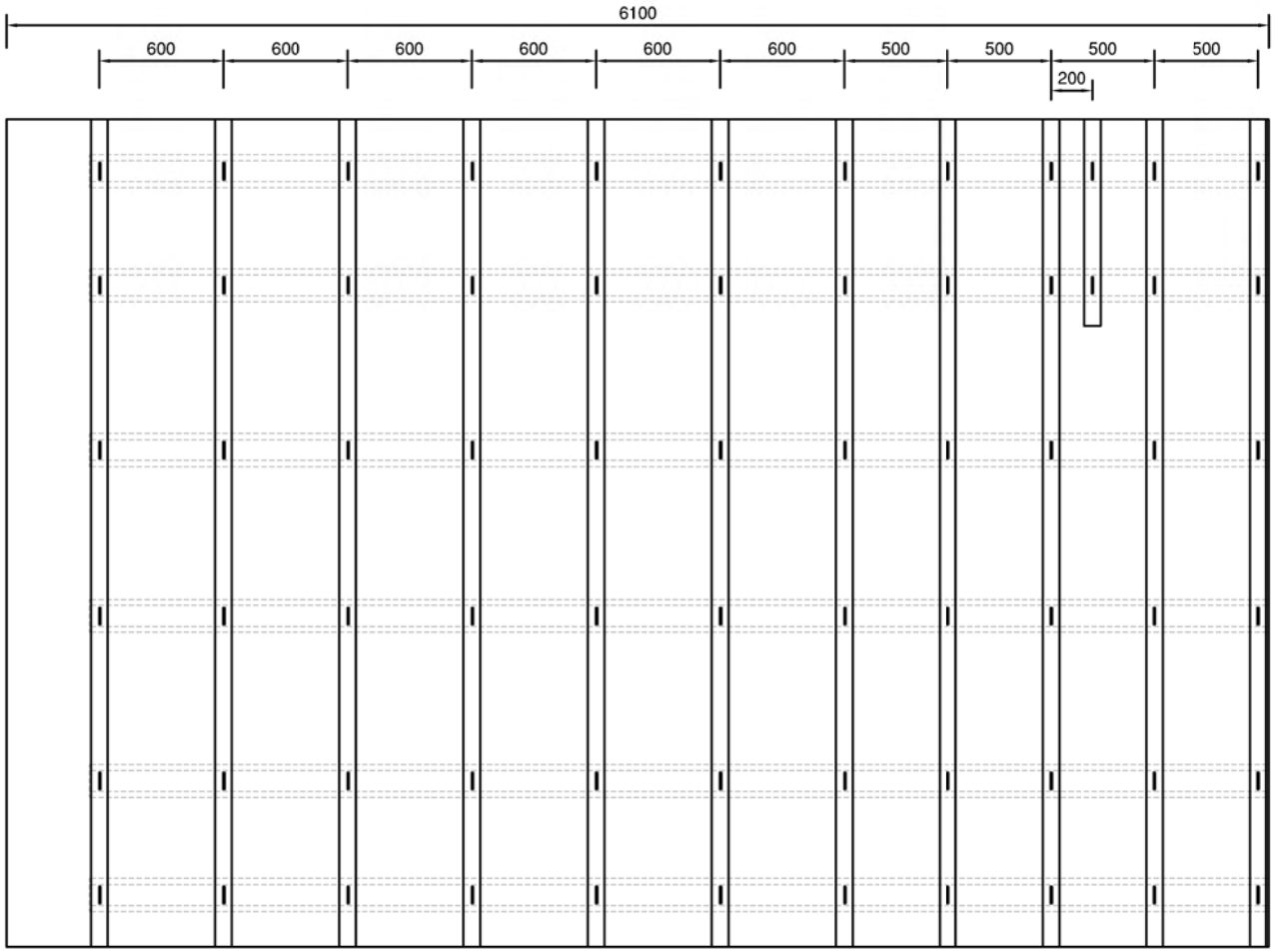
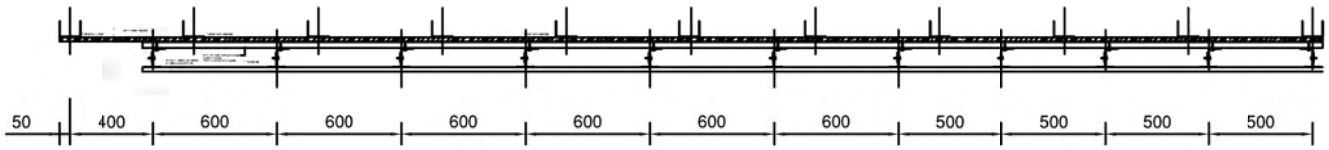
Head Detail



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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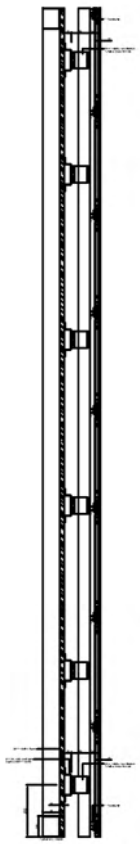

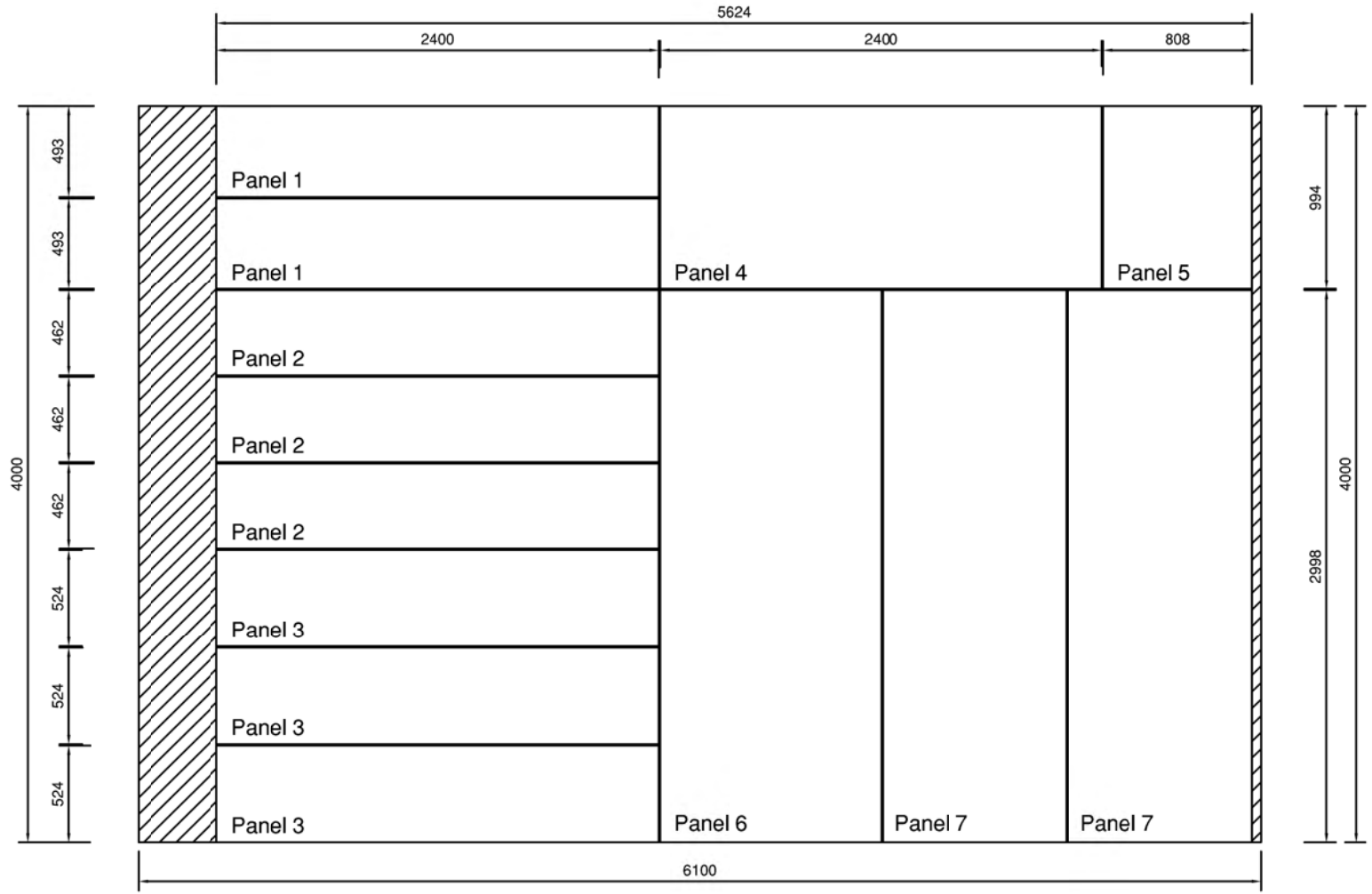

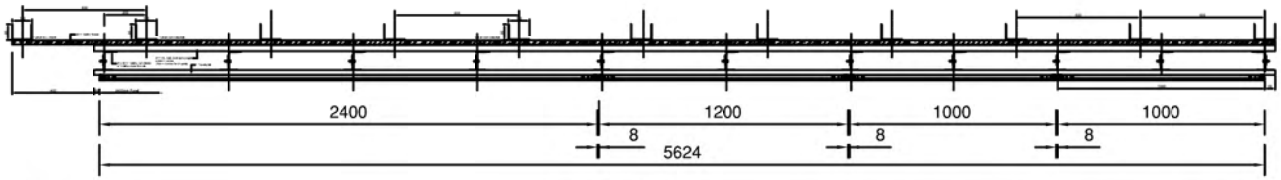

Plan Detail 1 Plan Detail 2 Plan Detail 3

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

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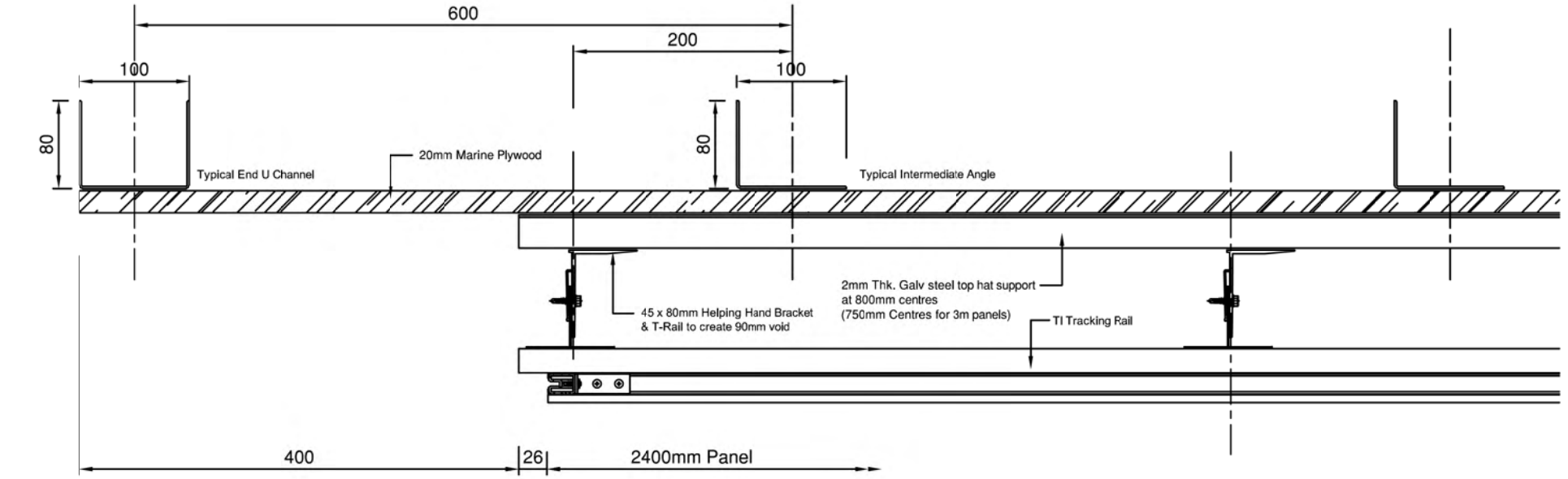
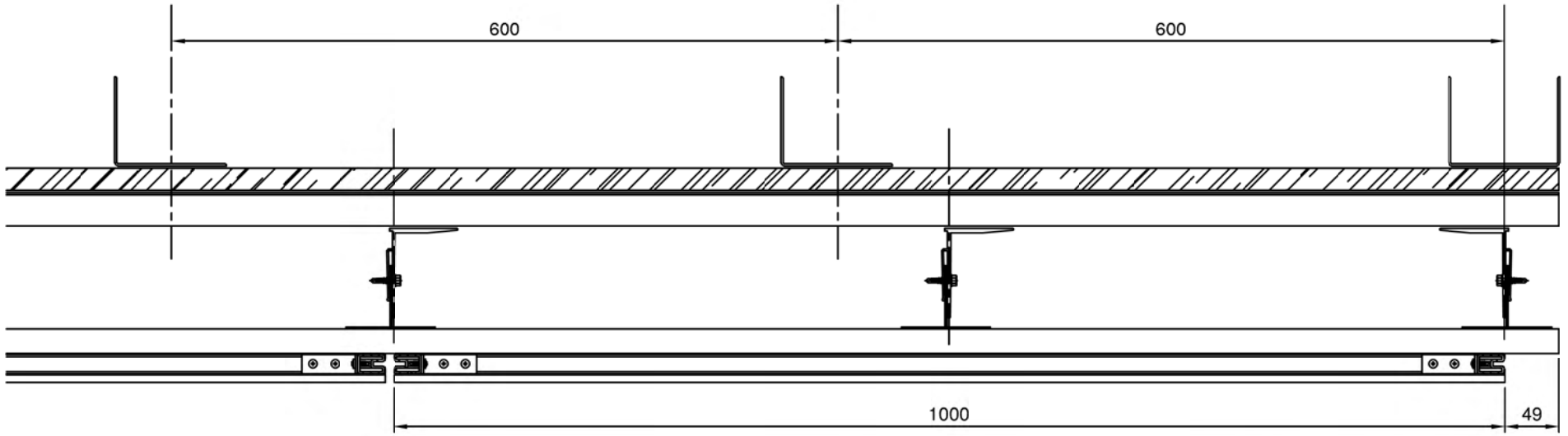
Stone Panel Set Out





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

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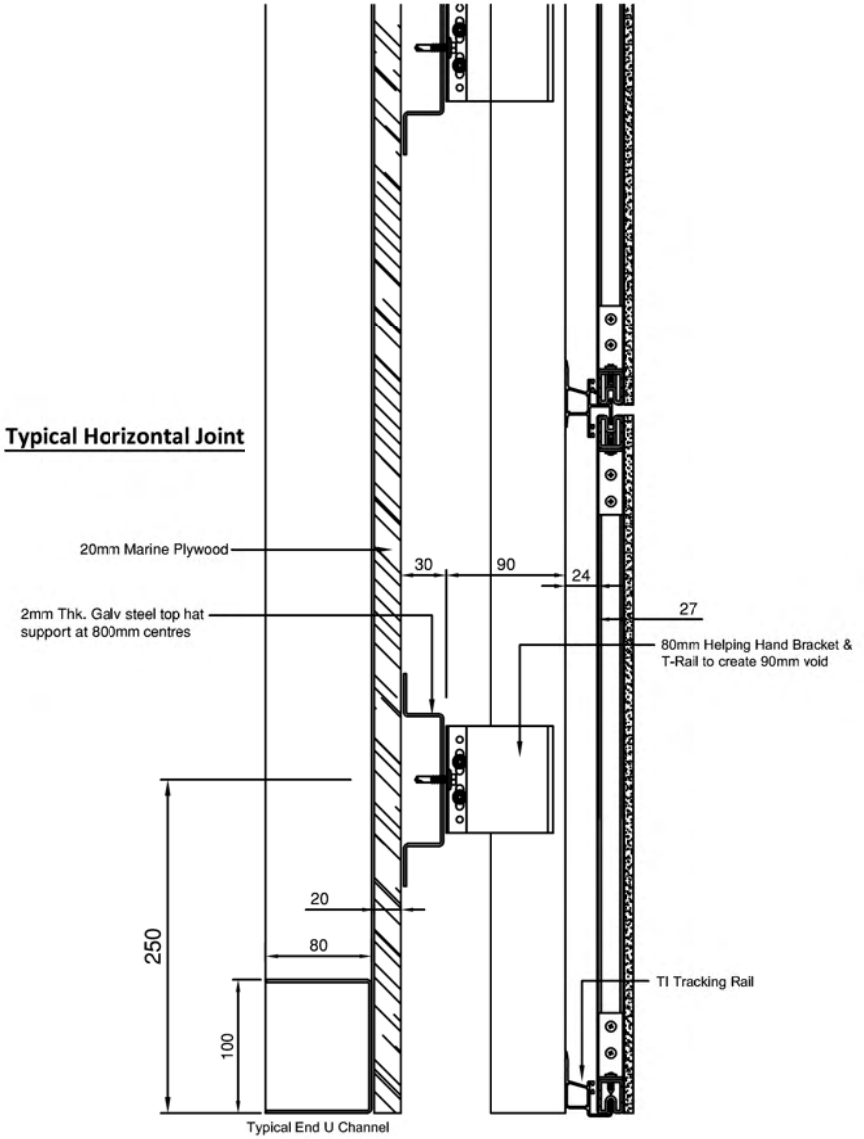
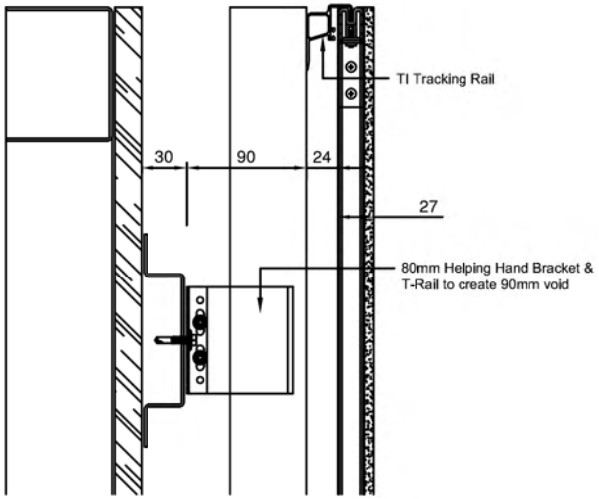
Typical Horizontal Joint

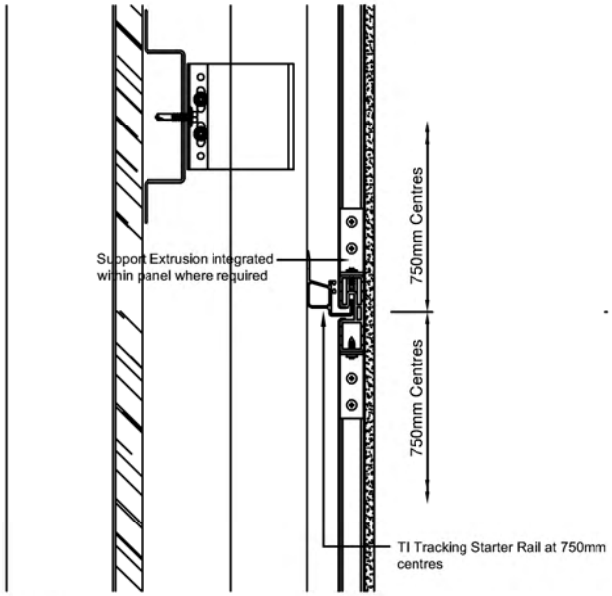


Test Rig Base Detail

Test Rig Head 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

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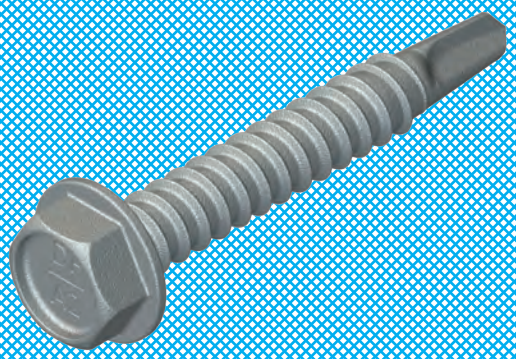

DrillFast® Stainless
DF3-SS
Standard fasteners

Stainless steel self-drilling fasteners for roofing and cladding

Application

- For mechanically fixing metal sheeting systems to light metal purlins and rails.
- For mechanically fixing components of steel, aluminium and metal framing systems

Key Features

- A2/304 stainless steel for optimum resistance to corrosion
- Bi-metal manufactured for superior drilling performance
- Excellent pull-out and shear performance
- Purpose designed and precision manufactured by Fixfast

CE

01 FASTENER SYSTEMS
DrillFast® Stainless Fasteners

Technical Data

Document reference	*FF P DF3SS 002*

DF3-SS Standard fasteners

Specification	
Material	1.4301 stainless steel (304M), with carbon steel case hardened welded point
Coating	Organic
Head Type	Hexagon 8mm
Drilling Capacity	1.2 – 3.0mm Steel

Installation and handling	
Installation tool	Variable speed electric screwdriver
Installation drive	Fixfast GreenDrive (8mm hex integral socket with retaining clip)
Installation speed	1500rpm
Correct installation	Fasteners should be driven within three degrees of perpendicular to the surface of the fastened material. Use a depth-setting nosepiece to avoid over-driving, and do not over-tighten. Variants with bonded washers should not have the rubber compressed to less than two-thirds of its uncompressed height. Care should be taken when engaging and disengaging from the fastener head to avoid damage to the protective coating.
Handling	Fasteners may have sharp edges, and the use of power tools can be dangerous. Use personal protective equipment. Store fasteners in dry conditions. Inspect each fastener before use and do not use damaged fasteners. Replace any fasteners which appear to have been installed incorrectly.

Installation details		
Substrates	**Thickness limits**	**Minimum penetration**
Light steel purlins	1.2mm – 3.0mm thickness	19mm through underside

Dimensions		
Fastener	**Nominal length**	**Nominal diameter**
DF3-SS-4.8 x 25	25mm	4.8mm
DF3-SS-5.5 x 25	25mm	5.5mm
DF3-SS-5.5 x 35	35mm	5.5mm
DF3-SS-5.5 x 55	55mm	5.5mm

Build-ups

Fastener	No washer	A15 / A19 washer	A29 washer
DF3-SS-4.8 x 25	0-5mm	0-2mm	n/a
DF3-SS-5.5 x 25	0-3mm	0	0
DF3-SS-5.5 x 35	0-13mm	0-10mm	0-9mm
DF3-SS-5.5 x 55	0-33mm	0-30mm	0-29mm

Build-up figures are shown for installation into maximum 3.0mm thickness steel. Figures may be increased by the difference in substrate thickness for thinner materials. For assistance with selecting the correct fastener please contact Fixfast.

Performance

Pull-out values (axial load resistance)

Fastener	Substrate	Characteristic Value	Design Value
DF3-SS-4.8	1.2mm steel*	1.20 kN	0.84 kN
	2.0mm steel*	2.19 kN	1.65 kN
	3.0mm steel	4.10 kN	3.08 kN
DF3-SS-5.5	1.2mm steel*	1.30 kN	0.98 kN
	2.0mm steel*	2.62 kN	1.96 kN
	3.0mm steel	4.76 kN	3.58 kN

Pull-through values (axial load resistance)

	Characteristic Value	Design Value
0.5mm steel / A15 washer	3.33 kN	2.50 kN

Shear Values (lateral load resistance)

No washer	Material (i)		
	Metal sheeting: 0.5mm		
Fastener	**Material (ii)**	**Characteristic Value**	**Design Value**
DF3-SS-4.8	1.2mm steel	1.81 kN	1.36 KN
DF3-SS-5.5	1.2mm steel	1.95 kN	1.47 KN
Failure mode: hole elongation in sheeting material			

Steel S275 nominal, Metal sheeting 0.5mm.
Independently tested to CUAP 06.02/07 and CUAP 06.02/12.
Design values include safety factor γ_m = 1.33.
* In-house tested to BS5427
Other figures and specific testing are available on request. For more information please contact Fixfast.

DF3-SS Standard fasteners

Durability class							
	Years / Environment						
	Interior	Semi-interior	Rural	Urban	Industrial / Coastal	Marine	Swiming pools & Chemical plants
Corrosivity Category	**C1**	**-**	**C2**	**C3**	**C4**	**C5**	**-**
A2 stainless grade 304	30	25	25	25	15	n/a	n/a

Environment Conditions are defined in Fixfast's ***Terms and Conditions of Warranty***

Atmospheric environments are now commonly categorised by reference to an international standard, of which the UK version is BS EN ISO 9223:2012.

Certification	
ETA	ETA_18/0943
	CE 19

Notes

Usage conditions

The fasteners are for use with the substrates and materials shown in this datasheet within the limits stated. The fixing area must be solid with no perforations and must be chemically inert and dry.

The fasteners must be stored with due care and must not be allowed to suffer any corrosion or damage prior to installation.

Fixing patterns must be established on the basis of load calculations to Eurocode standards. It is the designer's responsibility to take into account all loading criteria and apply appropriate safety factors in accordance with performance data issued by Fixfast. The design of the building and application where the fastener is to be used must be to the minimum standard of mechanical performance laid down from time to time in the appropriate Codes of Practice or Building Regulations.

Where the fastener is in contact with materials which are not an inherent part of the system being fixed, these materials must be approved by the system manufacturer or relevant body for use with the system and must be chemically inert and dry. Such materials and their effects on the fasteners' performance are not the responsibility of Fixfast.

Fixfast products must be used as a complete system with tools and accessories as recommended, according to Fixfast's recommended procedures and according to good practice as detailed by the appropriate body for the type of work. They must be used only with other Fixfast products where such other products are available. They must not be cut, altered or modified.

The stated performance of the fastener will only apply while there is no damage or degradation to the materials and components it is associated with in the application, including damage resulting from incorrect installation, and as long as there is no change to the fasteners' immediate environment.

Performance data is applicable to use with new materials as detailed in a new-build application. Refurbishment or extensions/additions/abutments may be considered new-build if all materials used in conjunction with the fasteners are themselves new and unaffected and uncontaminated by any previous installation. Performance data for fasteners used in refurbishments and in contact with previously used materials must be agreed by Fixfast for each specific project and Fixfast given the opportunity to establish values by testing.

The fasteners are suitable for use in buildings for residential and commercial use governed by any regulations in force concerning the well-being of the occupants, where the immediate fastener environment is safe for human presence without any protection. They are suitable for use in buildings for industrial use where the same conditions apply and the materials used or stored are chemically inert. Use within atmospheres containing chlorides and substances known to affect stainless steel, such as around swimming pools, is specifically excluded.

The fasteners are suitable for use in buildings with humidity class of Class 1, Class 2, Class 3 or Class 4 to BS 5250 provided the other environmental conditions also apply. They are suitable for use in buildings with an internal temperature range of -45°C to 50°C. They are suitable for use in Coastal locations (defined as any point between 2km and 10km of the sea). These environmental conditions must remain unaffected throughout the installed life of the fastener, and any change will invalidate the performance data for the fastener.

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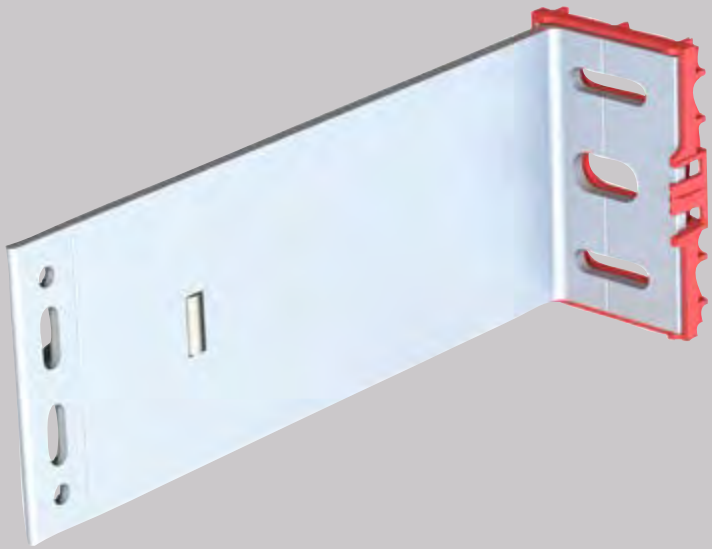
MFT-FOX VI-1L-CLAMPS-STAINLESS STEEL

Hilti facade system

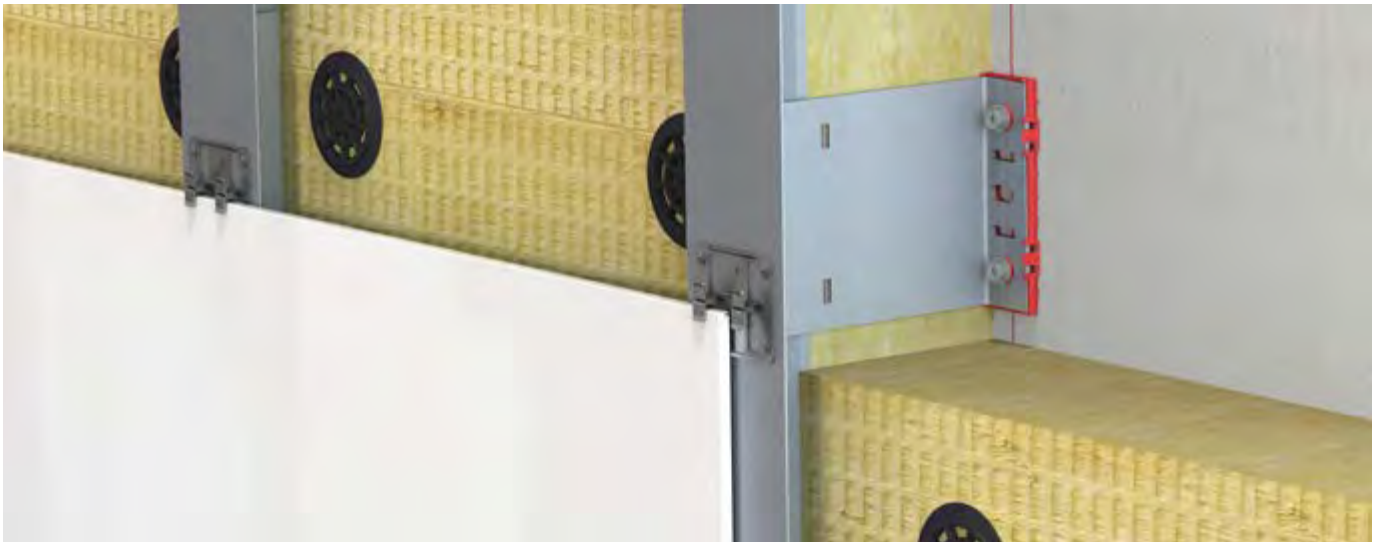


CONTENT AND OVERVIEW

MFT-FOX VI-1L-clamps-stainless steel

Stone

Ceramic



This is an interactive page! Click on the move-back button to jump back to the CONTENT AND OVERVIEW.

APPLICATION AND DESCRIPTION

MFT-FOX VI-1L-clamps-stainless steel

The system consists of aluminium brackets and profiles, and the system is specifically designed for vertical substructures in ventilated facades. The cladding material is fixed with stainless steel clamps to the vertical profiles.

The brackets are supplied with pre-assembled isolators and, according to the method of installation to the base material – anchors, screws or direct fastening – with different hole geometries in the base plate (available hole geometries are shown in the catalogue or on the following pages).

The brackets are designed with both fixed and flexible points to allow for thermal expansion of the profile. The fixed point takes the weight of the panels and substructure and the proportional wind loads, while the flexible point only assumes the proportional wind loads.

The vertical profiles are connected to the brackets with specially designed screws for fixed and flexible points. The fixed points do not allow the profiles vertical movement against the brackets, while the flexible points allow virtually frictionless sliding of the profiles against the brackets. The flexible point makes sure that there are no additional loads on the substructure from the profile's expansion forces.

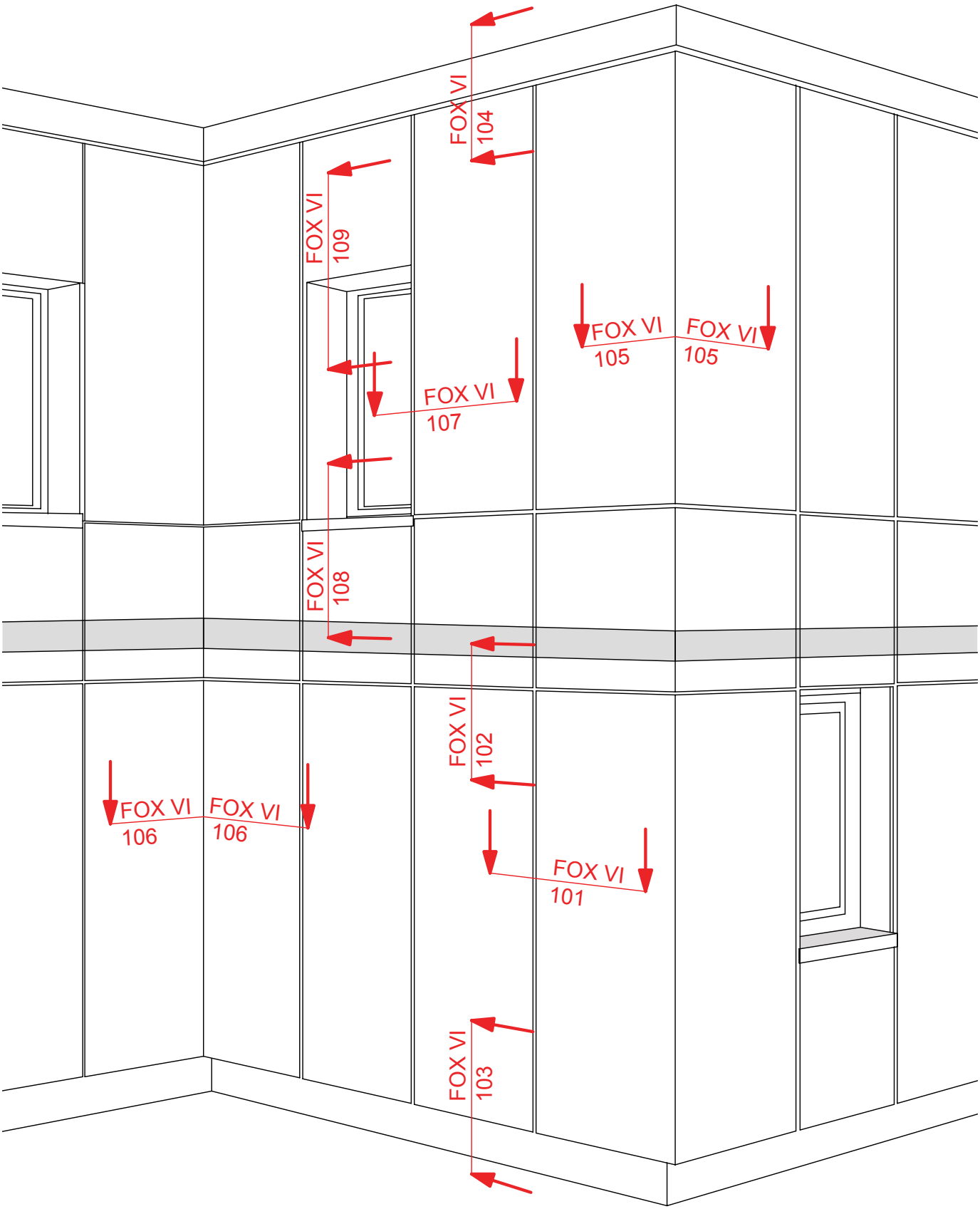
The adjustment of the profiles against the brackets is facilitated by a 'helping hand'. The helping hand keeps the profile in position whilst the profile is being fixed with screws, allowing a fast connection to the bracket. With this system, wall tolerances of up to 40 mm can be perfectly balanced. The brackets are available in 3 different sizes (large, medium & small) from 40 mm to 300 incl. 6mm isolator in 20 mm increments. The isolator separates the substructure from the base material to reduce thermal bridging.

The stainless steel clamps are fixed to the profiles by using screws or rivets. The clamps are available in different shapes.

Advantages

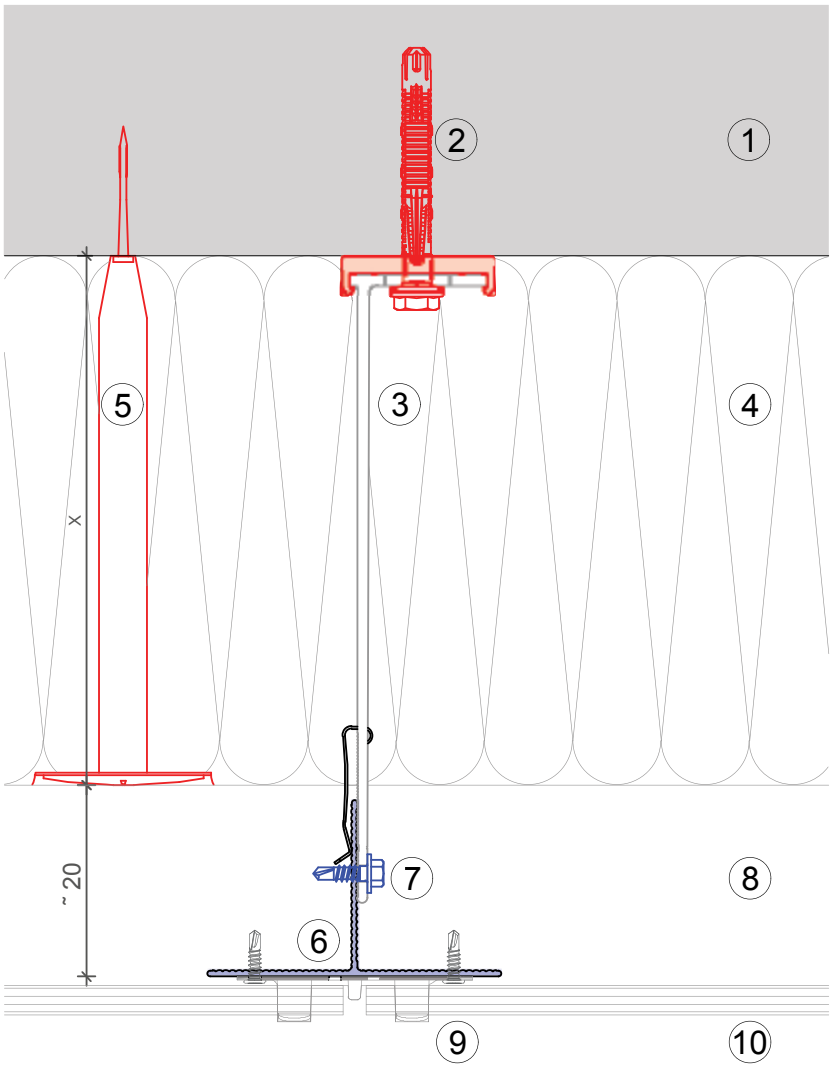
- Flexible design using fixed and flexible points
- 3 different sizes of brackets (large, medium & small)
- 40 mm adjustment capability of the profiles in the brackets
- Brackets can be mounted using a range of methods - anchors, screws or direct fastening
- 6 mm isolator separates the substructure from the base material to reduce thermal bridging
- Substructures can be designed with PROFIS Facade to generate technicly-sound and economically optimized solutions
- Can be used with all common cladding materials

VIEW OF CLADDING



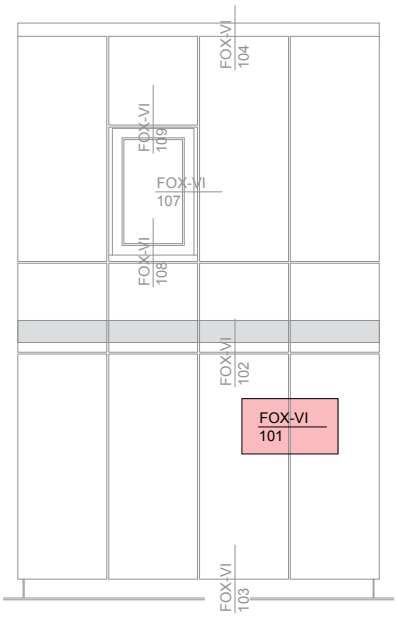
This is an interactive page! By clicking on a system part you get directed to the respective detail page.
Click on the move-back button to jump back to the CONTENT AND OVERVIEW.

MFT-FOX VI 101



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

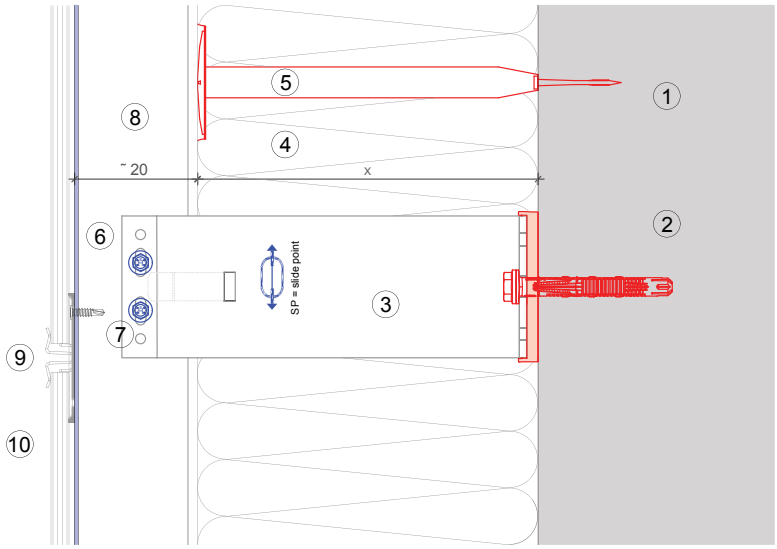


This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

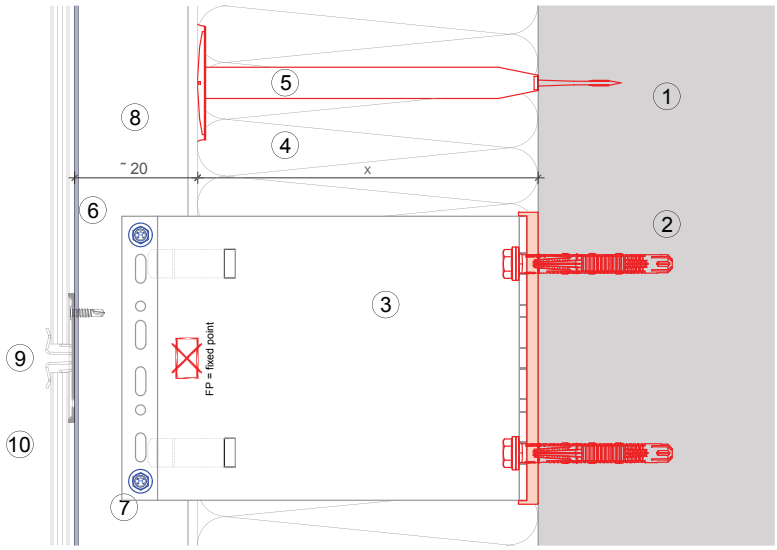
MFT-FOX VI 102

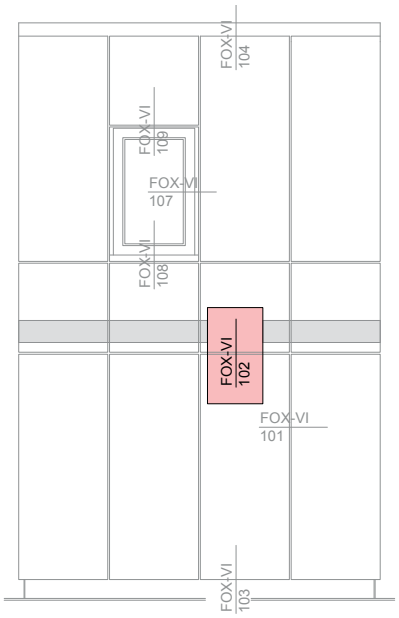
Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding



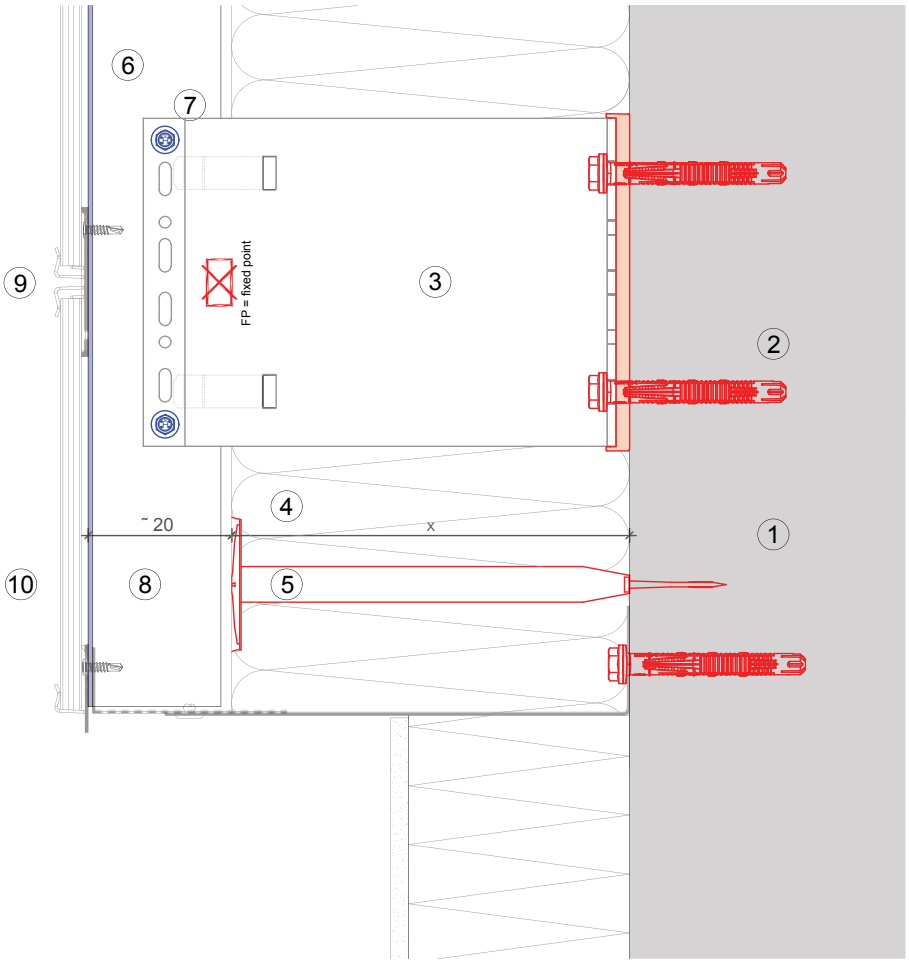
Vertical section-fixed point





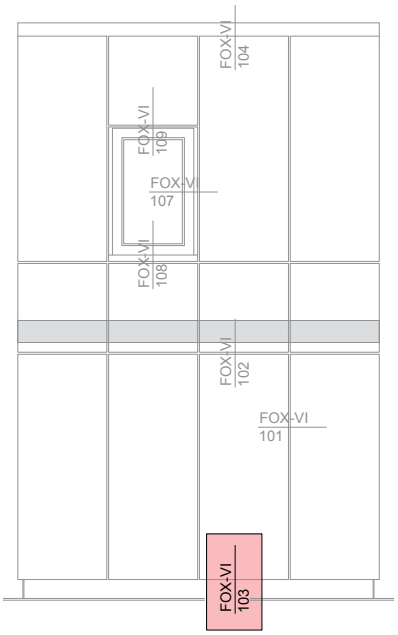
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 103



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

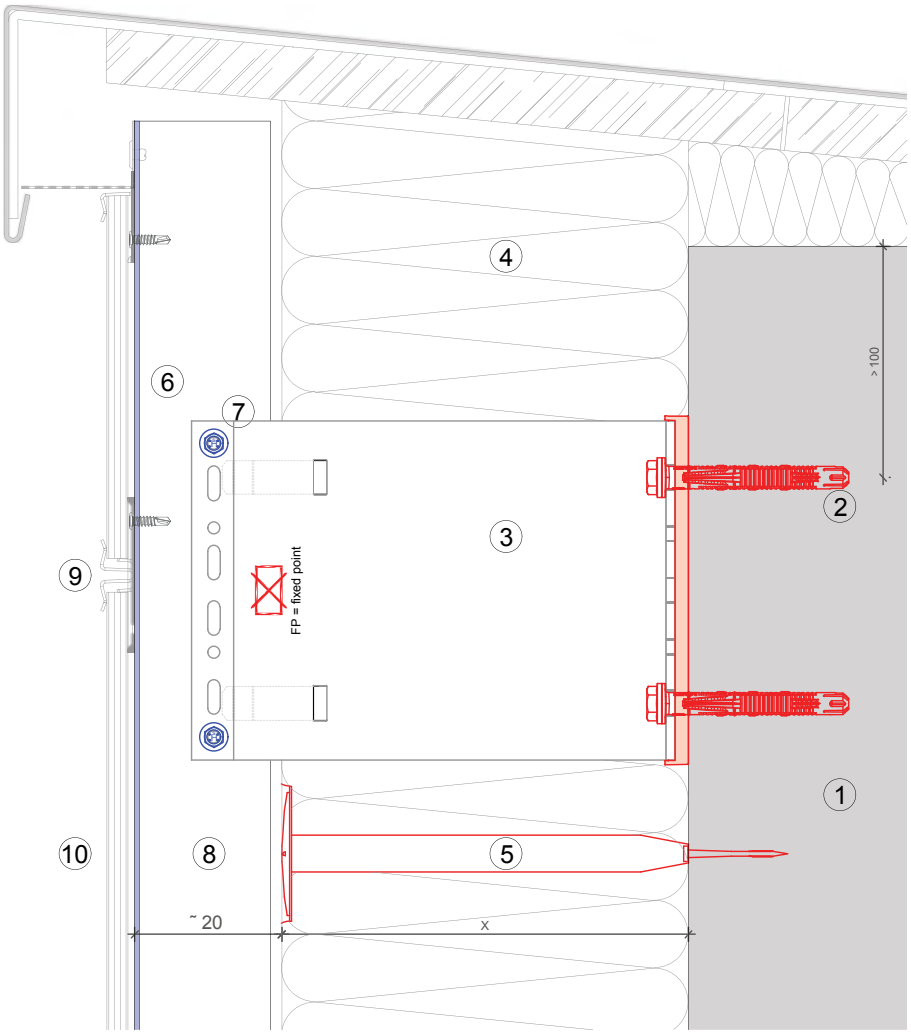


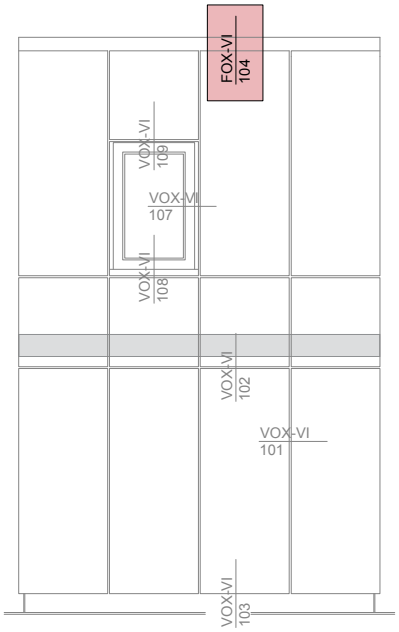
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 104

Legend:

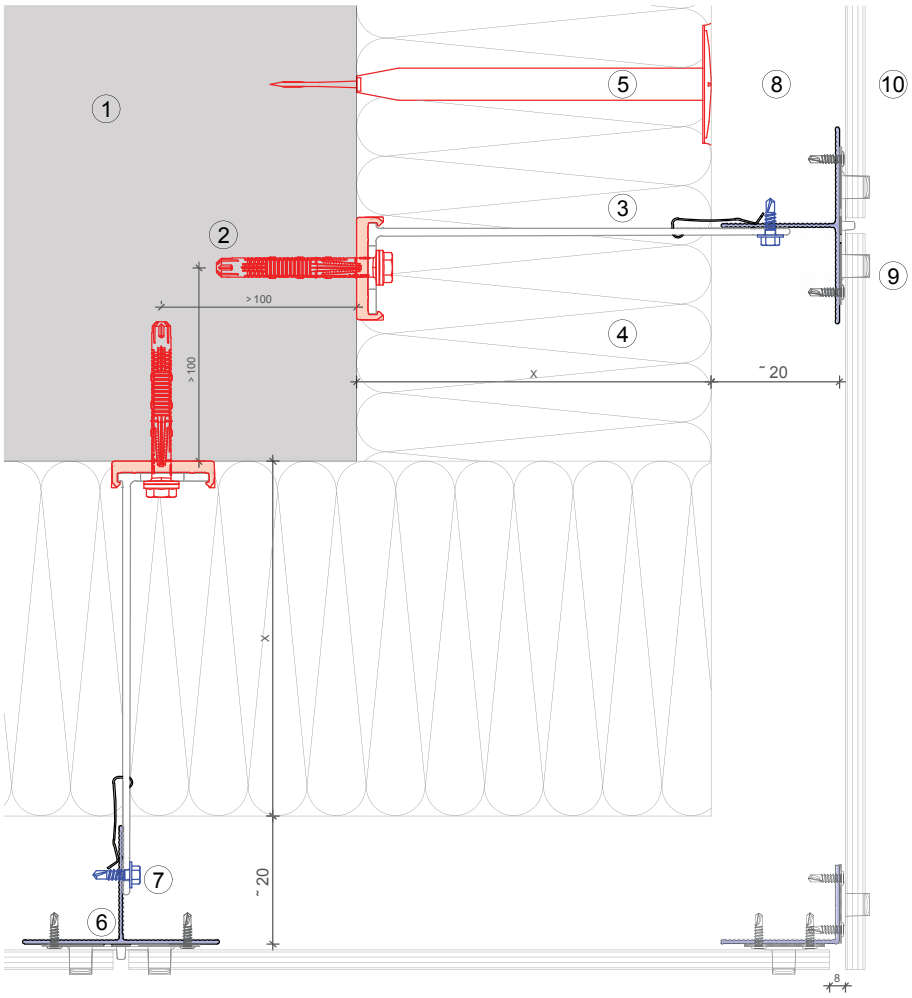
① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding





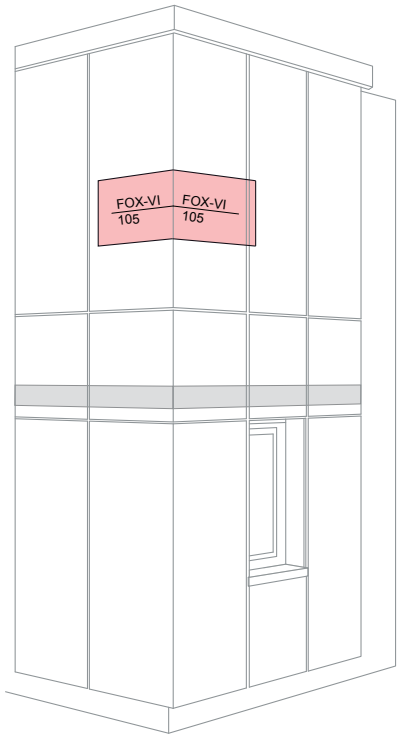
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 105



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

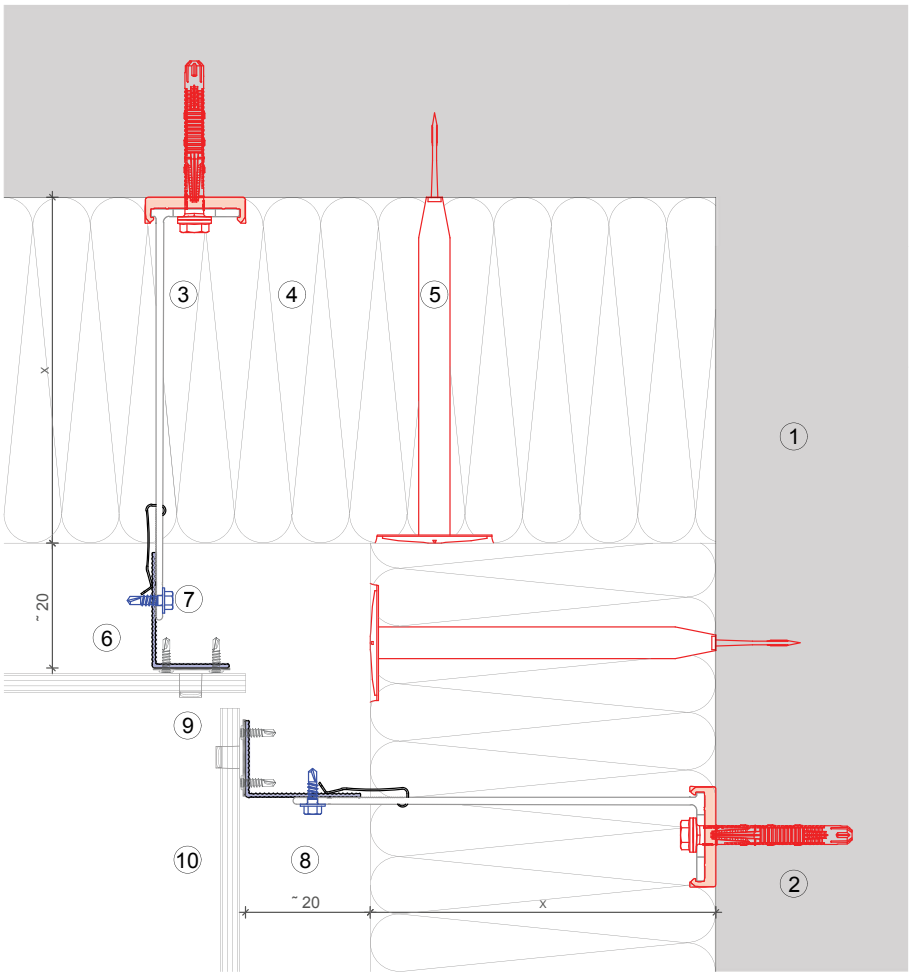


This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 106

Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding



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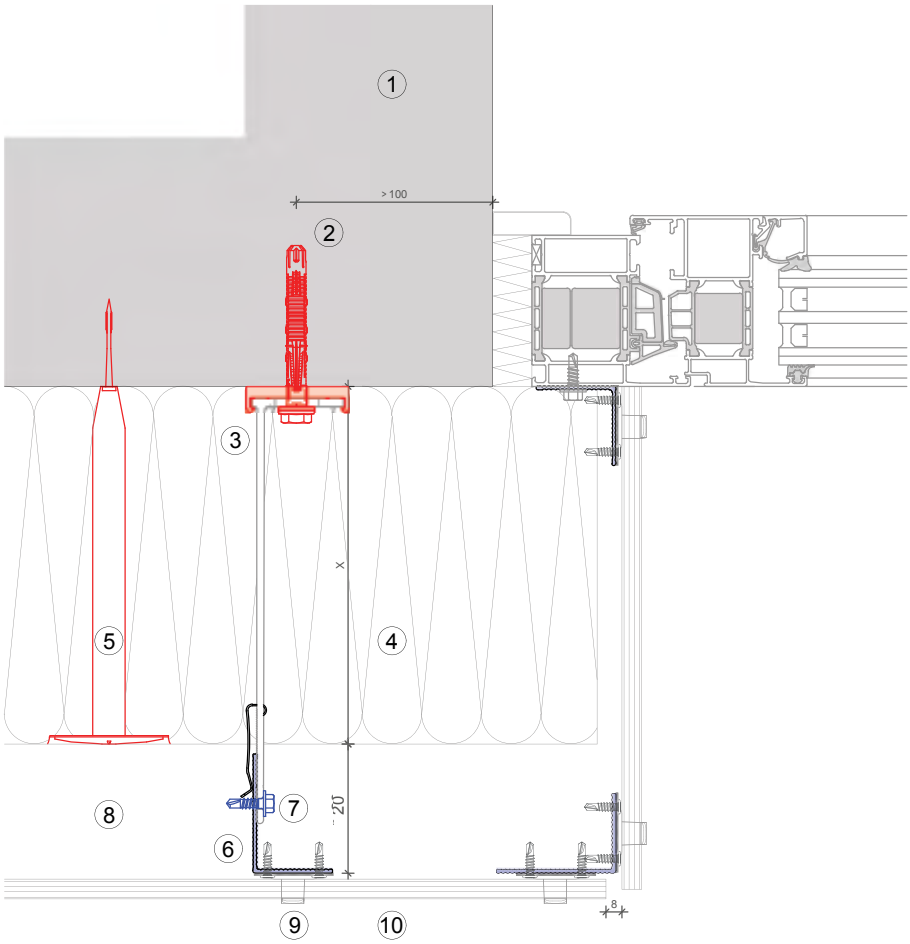
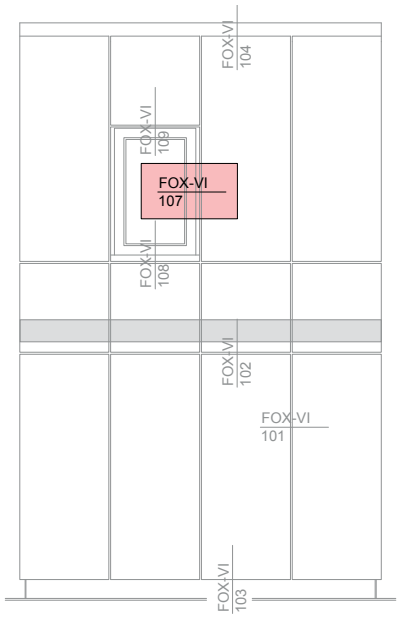
MFT-FOX VI 107



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

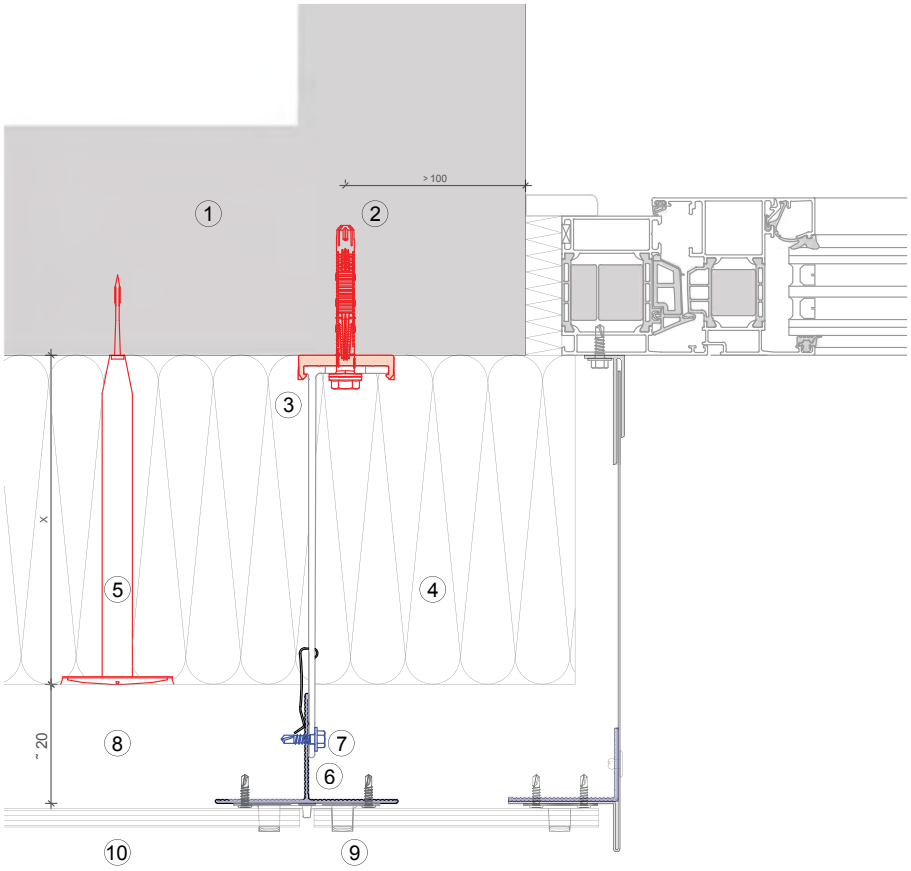


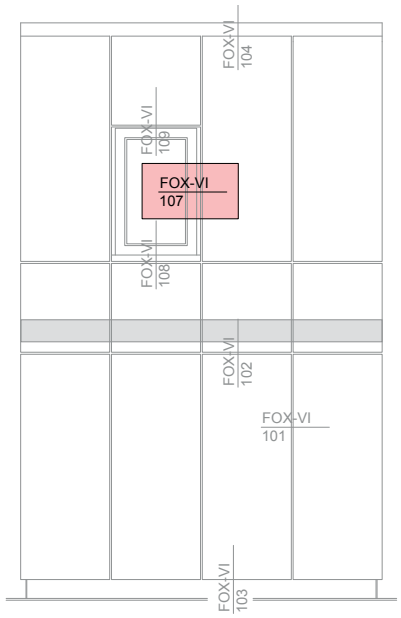
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 107

Legend:

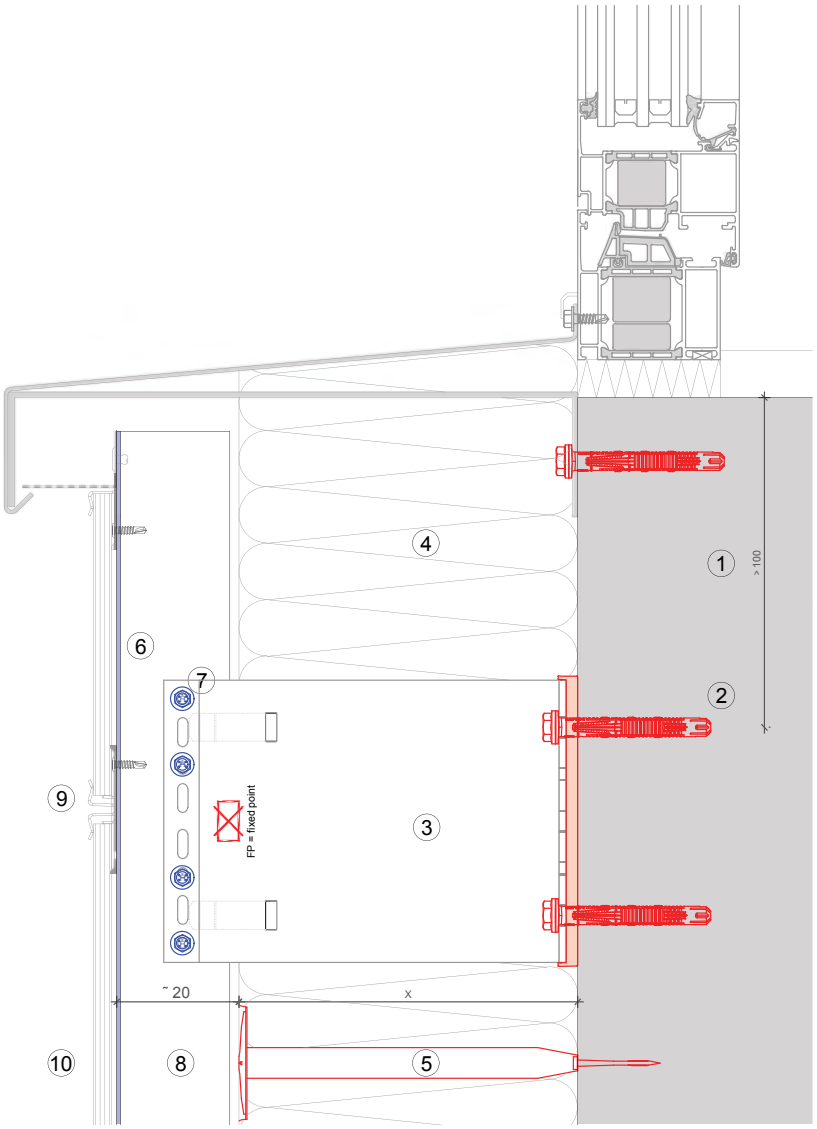
① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding





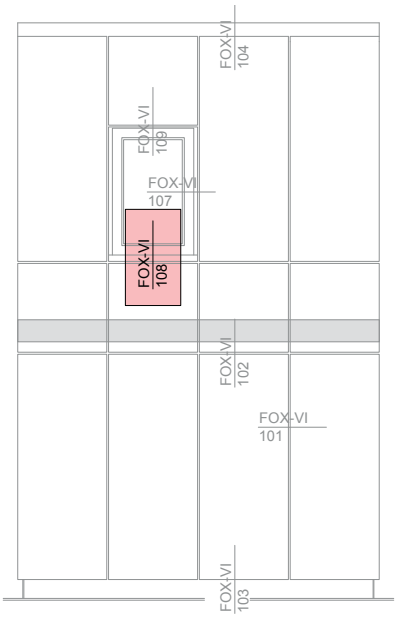
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 108



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

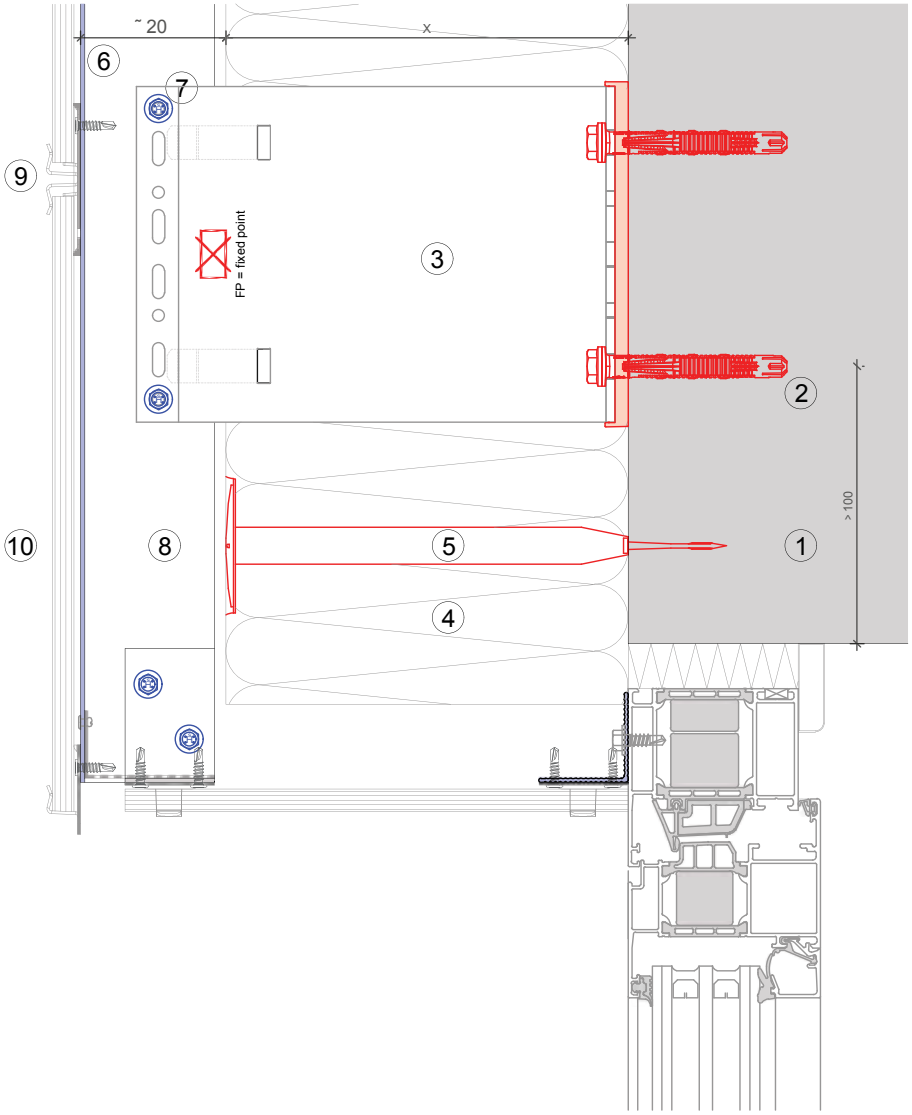


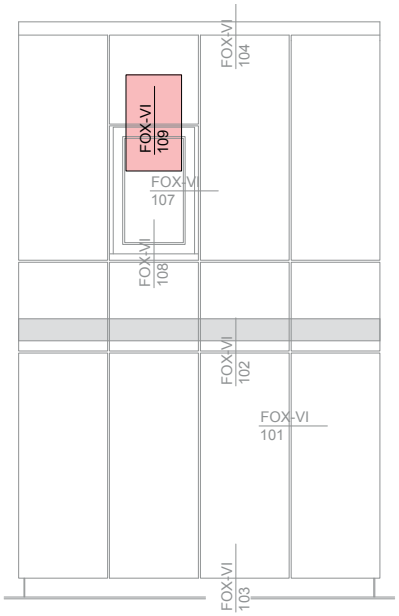
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 109

Legend:

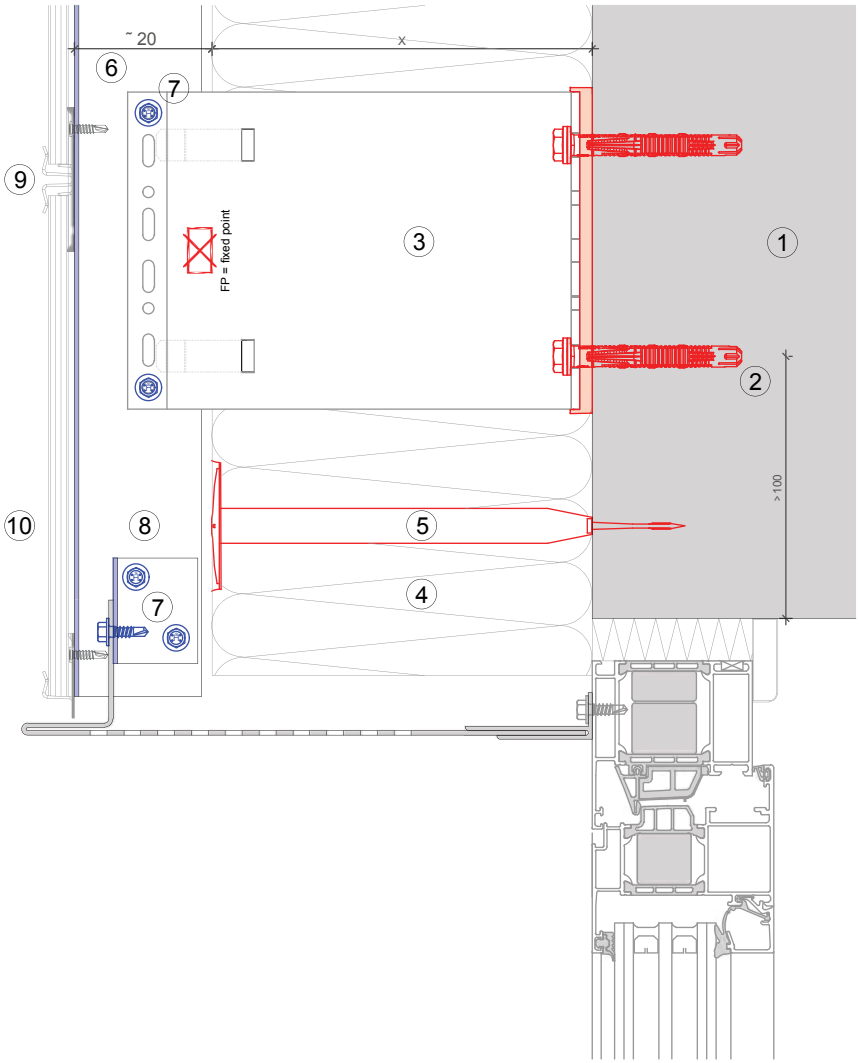
① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding





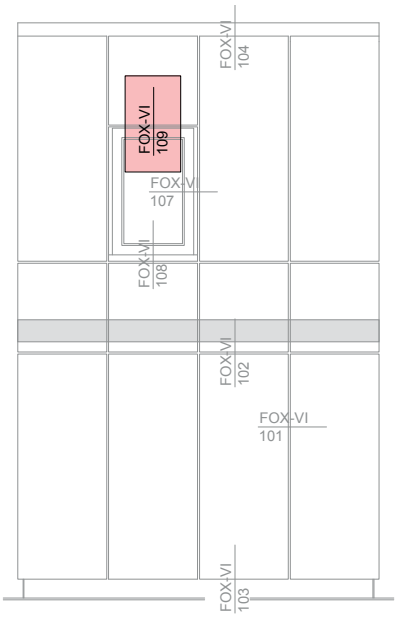
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 109



Legend:

① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding

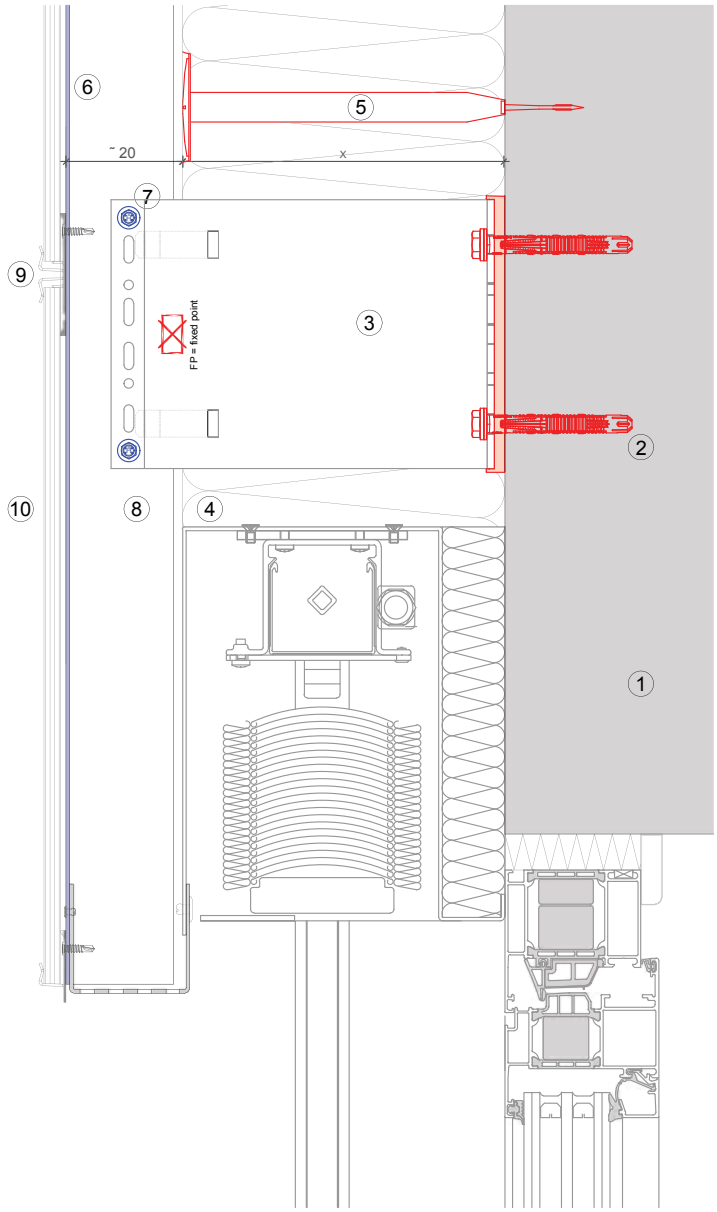


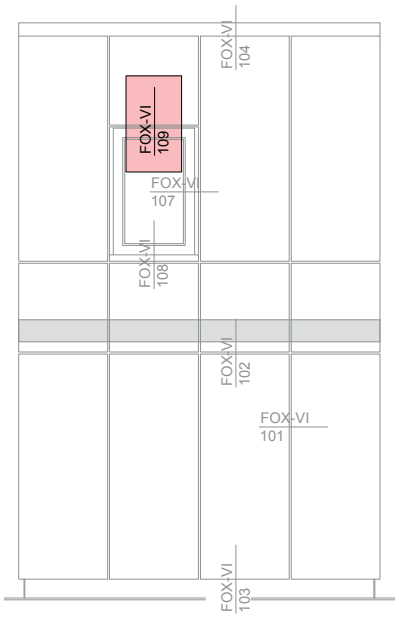
This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.

MFT-FOX VI 109

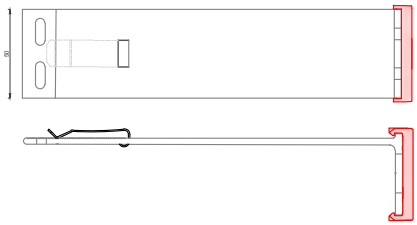
Legend:

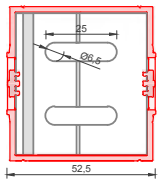
① Base material
② Anchor acc. to static
③ Bracket and isolator MFT-FOX VI
④ Insulation
⑤ Fixing insulation
⑥ Profile
⑦ Self drilling screw
⑧ Ventilation gap
⑨ Fixing cladding MFT-CV
⑩ Cladding



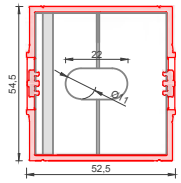


This is an interactive page! Click on the move-back button to jump back to the VIEW OF CLADDING.





Direct fastening and Screws



Anchors

MFT-FOX VI Small

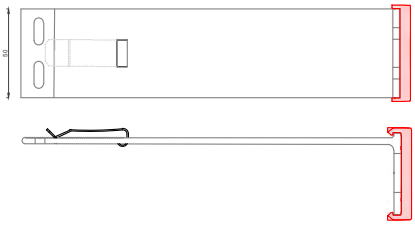
Order description	Item No.	Length
DIRECT FASTENING and SCREWS D=6,5 mm		
MFT-FOX VI 40 S 6.5	2305768	40 mm
MFT-FOX VI 60 S 6.5	2305769	60 mm
MFT-FOX VI 80 S 6.5	2305892	80 mm
MFT-FOX VI 100 S 6.5	2305893	100 mm
MFT-FOX VI 120 S 6.5	2305894	120 mm
MFT-FOX VI 140 S 6.5	2305895	140 mm
MFT-FOX VI 160 S 6.5	2305896	160 mm
MFT-FOX VI 180 S 6.5	2305891	180 mm
MFT-FOX VI 200 S 6.5	2305890	200 mm
MFT-FOX VI 220 S 6.5	2305889	220 mm
MFT-FOX VI 240 S 6.5	2305888	240 mm
MFT-FOX VI 260 S 6.5	2305887	260 mm
MFT-FOX VI 280 S 6.5	2305886	280 mm
MFT-FOX VI 300 S 6.5	2305885	300 mm
ANCHORS D=11 mm		
MFT-FOX VI 40 S 11	2305884	40 mm
MFT-FOX VI 60 S 11	2305883	60 mm
MFT-FOX VI 80 S 11	2305882	80 mm
MFT-FOX VI 100 S 11	2305881	100 mm
MFT-FOX VI 120 S 11	2305880	120 mm
MFT-FOX VI 140 S 11	2305897	140 mm
MFT-FOX VI 160 S 11	2305898	160 mm
MFT-FOX VI 180 S 11	2305899	180 mm
MFT-FOX VI 200 S 11	2305900	200 mm
MFT-FOX VI 220 S 11	2305901	220 mm
MFT-FOX VI 240 S 11	2305902	240 mm
MFT-FOX VI 260 S 11	2305903	260 mm
MFT-FOX VI 280 S 11	2305904	280 mm
MFT-FOX VI 300 S 11	2305905	300 mm

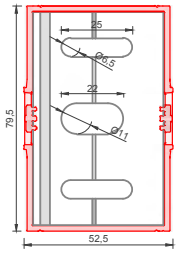
The length shown includes the isolator thickness.

BRACKETS RANGE

MFT-FOX VI Medium

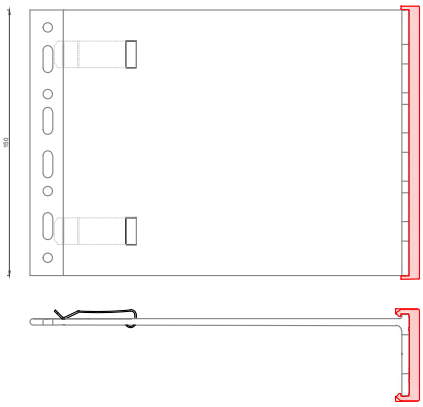
Order description	Item No.	Length
DIRECT FASTENING, SCREWS D=6,5 mm and ANCHORS D=11 mm		
MFT-FOX VI 40 M 6.5 / 11	2305984	40 mm
MFT-FOX VI 60 M 6.5 / 11	2305983	60 mm
MFT-FOX VI 80 M 6.5 / 11	2305982	80 mm
MFT-FOX VI 100 M 6.5 / 11	2305981	100 mm
MFT-FOX VI 120 M 6.5 / 11	2305980	120 mm
MFT-FOX VI 140 M 6.5 / 11	2305979	140 mm
MFT-FOX VI 160 M 6.5 / 11	2305978	160 mm
MFT-FOX VI 180 M 6.5 / 11	2305977	180 mm
MFT-FOX VI 200 M 6.5 / 11	2305976	200 mm
MFT-FOX VI 220 M 6.5 / 11	2305975	220 mm
MFT-FOX VI 240 M 6.5 / 11	2305974	240 mm
MFT-FOX VI 260 M 6.5 / 11	2305973	260 mm
MFT-FOX VI 280 M 6.5 / 11	2305972	280 mm
MFT-FOX VI 300 M 6.5 / 11	2305971	300 mm





Direct fastening
Screws and
Anchors

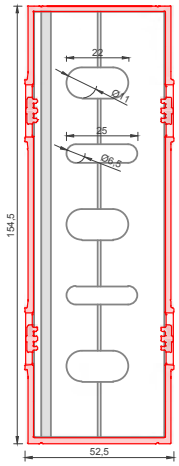
The length shown includes the isolator thickness.



MFT-FOX VI Large

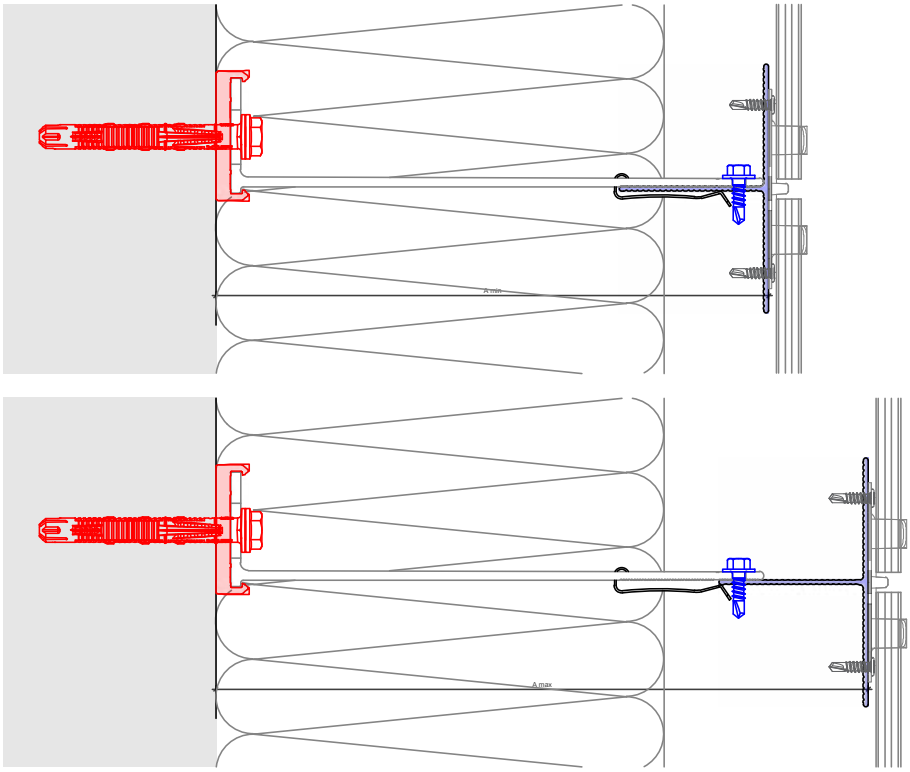
Order description	Item No.	Length
DIRECT FASTENING, SCREWS D=6,5 mm and ANCHORS D=11 mm		
MFT-FOX VI 40 L 6.5 / 11	2305950	40 mm
MFT-FOX VI 60 L 6.5 / 11	2305949	60 mm
MFT-FOX VI 80 L 6.5 / 11	2305948	80 mm
MFT-FOX VI 100 L 6.5 / 11	2305947	100 mm
MFT-FOX VI 120 L 6.5 / 11	2305946	120 mm
MFT-FOX VI 140 L 6.5 / 11	2305945	140 mm
MFT-FOX VI 160 L 6.5 / 11	2305944	160 mm
MFT-FOX VI 180 L 6.5 / 11	2305943	180 mm
MFT-FOX VI 200 L 6.5 / 11	2305942	200 mm
MFT-FOX VI 220 L 6.5 / 11	2305941	220 mm
MFT-FOX VI 240 L 6.5 / 11	2305940	240 mm
MFT-FOX VI 260 L 6.5 / 11	2305939	260 mm
MFT-FOX VI 280 L 6.5 / 11	2305938	280 mm
MFT-FOX VI 300 L 6.5 / 11	2305937	300 mm

The length shown includes the isolator thickness.



Direct fastening
Screws and
Anchors

BRACKET PROFILE ADJUSTMENT



Profiles	MFT-T 60x80x1,8 6m 60x100x1,8 6m 60x120x1,8 6m		MFT-T 40x80x1,8 6m		MFT-L 60x40x1,8 6m		MFT-L 40x40x1,8 6m"	
Brackets	A min*	A max*	A min*	A max*	A min*	A max*	A min*	A max*
MFT-FOX VI 40 S/M/L 6,5/11	75,8	80	55,8	60	75,8	80	55,8	60
MFT-FOX VI 60 S/M/L 6,5/11	75,8	100	61,8	80	75,8	100	60	80
MFT-FOX VI 80 S/M/L 6,5/11	81,8	120	81,8	100	80	120	80	100
MFT-FOX VI 100 S/M/L 6,5/11	101,8	140	101,8	120	100	140	100	120
MFT-FOX VI 120 S/M/L 6,5/11	121,8	160	121,8	140	120	160	120	140
MFT-FOX VI 100 S/M/L 6,5/11	141,8	180	141,8	160	140	180	140	160
MFT-FOX VI 40 S/M/L 6,5/11	161,8	200	161,8	180	160	200	160	180
MFT-FOX VI 60 S/M/L 6,5/11	181,8	220	181,8	200	180	220	180	200
MFT-FOX VI 80 S/M/L 6,5/11	201,8	240	201,8	220	200	240	200	220
MFT-FOX VI 100 S/M/L 6,5/11	221,8	260	221,8	240	220	260	220	240
MFT-FOX VI 120 S/M/L 6,5/11	241,8	280	241,8	260	240	280	240	260
MFT-FOX VI 140 S/M/L 6,5/11	261,8	300	261,8	280	260	300	260	280
MFT-FOX VI 160 S/M/L 6,5/11	281,8	320	281,8	300	280	320	280	300
MFT-FOX VI 180 S/M/L 6,5/11	301,8	340	301,8	320	300	340	300	320

* The distance shown is valid for profile of 1,8 mm.

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PRODUCTS RANGE

Bracket fastener	
HUS-HR	
HRD-H	
HST-R	
HSA-R	
HIT-HY 270	
HIT-HY 200-A	
S-MP 53S	
S-MD 51S / S-MD 53S / S-MD 55S	
Direct fastening:	
Powder-actuated tool	
Universal nail X-CR P8	
DX cartridge 6.8/11 M10	
Brackets	
MFT-FOX VI Small	
MFT-FOX VI Medium	
MFT-FOX VI Large	

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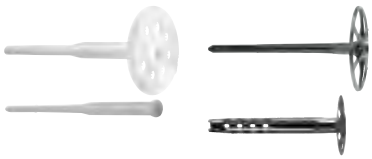
PRODUCTS RANGE

Profiles	
MFT-L	
MFT-T	
Accessories to profile fastener	
S-AD 01S	
Accessories to profile fastener	
S-AD 01LHSS	
Other Accessories	
MFT-CV	
Insulation fasteners	
Insulation fasteners	

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Aerolite Monolith Data Sheet

t.i. dynamic facades

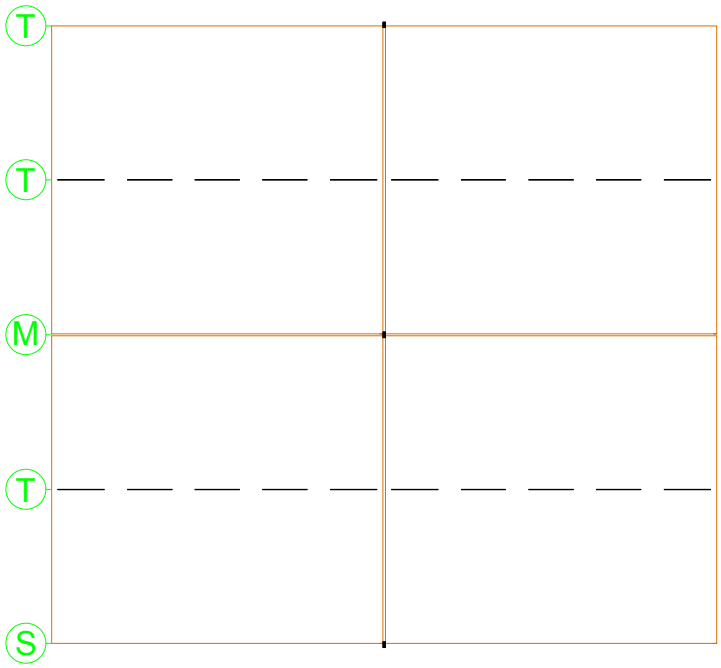
be different. be recognised. be innovative

- Panel weight – 25kg/m2
- Max panel size tested
- backing panel for glazing in or unitization
- Self supporting pre-formed corners upto 250mm
- Large format available
- 2/3/4 sided panels available
- Panel tolerances to BS EN 1469 – length and height +/- 1mm and thickness +/-1.5mm
- Lead-in times – 14-18 weeks
- Fire rated to A2 – s1, d0
- Water absorbency less than 1%

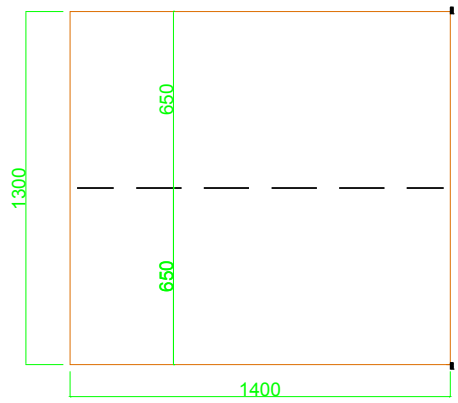
TI Aerolite Monolith was tested at Technology Centre Vinci UK (Vinci) to CWCT test guidelines for Standardized Building Envelopes 2005 for the following:

- – Wind serviceability – +/-2400 Pascal's
- – Wind safety – +/-3600 Pascal's
- – Cyclic wind loading – +/-600 Pascal's to +/-2400 Pascal's over a 24 hour period
- – Impact resistance to BS 8200 (Soft and hard body rating category 'B')

APPENDIX D - Technical Drawings



Typical Setting-Out (Multi Panel)



Individual Tile Setting-Out

KEY

T	TI Tracking *'Generic'* Horizontal Carrier Top Rail
M	TI Tracking *'Generic'* Horizontal Carrier Mid Rail
S	TI Tracking *'Generic'* Horizontal Carrier Start Rail

NOTES:

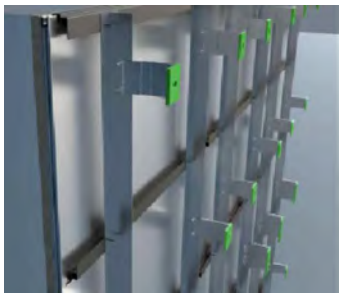
CWCT TEST GUIDELINES STANDARD BUILDING ENVELOPES 2005:-
WIND SERVICEABILITY :- 2400Pa
WIND SAFETY:- 3600Pa
CYCLIC WIND LOADINGS
IMPACT RESISTANCE BS8200 DISCLAIMER

PLEASE CHECK WITH DYNAMIC SUPPORT FOR EXACT TEST CRITERIA. THE VERTICAL RAILS MUST BE INSTALLED AT A MAXIMUM OF 600mm TO ENSURE COMPLIANCE WITH THE TEST CRITERIA. THE RAIL & BRACKET CENTRES SHOULD BE CALCULATED BY THE CLADDING CONTRACTOR FOR EACH INDIVIDUAL BUILDING LOCATION

FREQUENCY AND TYPE OF FASTENERS SHOULD BE CALCULATED BY THE CLADDING CONTRACTOR FOR EACH INDIVIDUAL BUILDING LOCATION

THE SYSTEM MUST BE ATTACHED TO A SUITABLY DESIGNED BACKING STRUCTURE

This information is indicative, it is the recipients responsibilty to ensure the design is relevant to project specific requirements.



Isometric Assembly Render

REV 1 - JV - 11.10.22 - Panel quantity reduced to 4.

Drawing Title	Hunslet Road - Mock Up Panel Proposed Rail Setting Out - Typical Detail FOR COMMENT ONLY		
Scale	NTS	Date Drawn	15.08.22 -JV
Drawing Number	001	Revision	1

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13.02 Component life

Introduction
The life to maintenance, repair or replacement of a component depends on the mateials used, the use to which the component is put and the environment in which it is used. The use to which a component is put, its service environment, and the need for repair or maintenance is covered in Section 13.04. This Section describes the different materials used, factors affecting their durability and their impact on the life expectancy of facade components..

Metals
Metals include all the common metals and alloys, together with some materials which are comparatively new to the facade industry:

- Iron and steel, including stainless steel
- Aluminium and its alloys
- Copper and its alloys (brasses and bronzes)
- Lead and its alloys
- Titanium and its alloys
- Zinc and its alloys

It should be noted that whilst zinc is often used as a coating, particularly as galvanising of steel it could also be used as a material in its own right.

Although there is potentially an infinite number of combinations of different metal elements, it is a feature of metal alloys that for each base metal there are only a few proven alloys which are frequently used.

Some materials which had fallen out of fashion, for example bronze, have recently shown a resurgence in use. Similarly an increase in the complexity of modern facades has introduced new interactions between ‘old world’ metals and ‘new world’ polymers and the need to limit weight and improve cost effectiveness has lead to a reduction in the thickness of sheet metal components.

Main forms of deterioration
The main form of deterioration of metals is corrosion. It may be avoided by choosing a corrosion resistant metal or use of a protective coating. Deterioration mechanisms are generally well understood and the main uncertainties relate to the durability of finishes and protective coatings.

Life expectancy and maintenance requirements
The life expectancy and maintenance requirements for metals vary greatly. Corrosion resistant metals such as copper, lead and stainless steel may last for more than 100 years with little maintenance whereas plain carbon steel will have a very short life in external conditions unless protected and will generally require regular maintenance to ensure continued durability. The frequency of maintenance will depend on the protective system adopted see Section 12.03.

Timber
There are many species of timber which find their way into the facade industry, both softwoods and hardwoods. Whilst some timbers are particularly durable in their natural state, many are treated with preservatives and surface coatings to improve their durability. The use of green timber is increasing, and more new timbers are being introduced from tropical sources.

Timber may be used as a material in its own right but is also used in manufactured products including plywood, particleboard and fibreboard.

Main forms of deterioration
The main forms off deterioration are fungal decay and attack by wood boring insects. The heartwood of some species is resistant to fungal attack but the sapwood of all species is vulnerable. Fungal decay can be prevented by keeping the moisture content below 20 per cent and preservatives may be used to provide additional protection where this cannot be achieved.

The risk of insect attack is less predictable than for fungal attack. Generally only the sapwood is affected and painted timber is rarely attacked. Preservatives may be used to provide protection to unpainted timber.

Unprotected timber will deteriorate if exposed to UV light.

Manufactured board products may be subject to breakdown of adhesives particularly in the presence of moisture. This problem can be overcome by using a grade of material appropriate to the exposure conditions.

Life expectancy and maintenance requirements
Where timber remains dry it may last for over 100 years without maintenance. However there are examples of window joinery that have shown evidence of decay after five to ten years.

BS 5589 gives guidance on preservative treatments for external timber intended to achieve design lives of 30 or 60 years and BS 5268 gives treatments for structural timber intended to give a design life of 60 years. These treatments assume that good practice will be used in the design and construction to reduce the risk of decay. The preservative treatments are primarily designed to give protection against fungal attack but some treatments will also protect against insect attack. Externally exposed timber will also require protection against UV light.

Apart from durability considerations, exposed timber will normally require regular treatment to restrict moisture movement and maintain appearance.

Glass and ceramic
The principal type of glass that is used is soda-lime silicate glass, but borosilicate glass is also used where reaction to fire is important. A number of other types of glass may be encountered, as may other ceramic materials with similar properties.
In addition to its use as a glazing material, glass is also used in the form of glass fibres for reinforcement of cement and plastic which are considered under cementitious materials and plastics respectively. Glassfibre is also used for thermal insulation.

Main forms of deterioration
Glass is a very durable material but it can be attacked by alkalis or prolonged contact with water and is vulnerable to fracture.

Procedures to be adopted to ensure durability are covered by British Standards and if this guidance is followed the durability of plain glass is unlikely to govern the life of the structure.

Durability problems are more likely to occur in components containing glass, such as double glazing units where failure of the unit may result from failure of other materials used in the component. There may also be durability problems associated with the use of coatings applied to glass.

Life expectancy and maintenance requirements
For plain glass, maintenance should be limited to regular cleaning and replacement of breakages. Double glazing units may need wholesale replacement after 20 to 30 years. Maintenance is likely to be required for associated components such as seals and frames.

Cement and concrete
A wide range of cementitious materials may be used in claddings as follows:

- Precast concrete cladding panels
- Cast stone, either as masonry units or cladding panels
- Concrete bricks and blocks
- Concrete tiles
- Mortars
- Renders
- Glass reinforced cement
- Fibre cement boards

Cladding panels made of concrete and cast stone will normally contain steel reinforcement and for the durability considerations of this report the composite material will be considered under this material type.

Main forms of deterioration
Cementitious materials may suffer from frost attack, sulfate attack and alkali aggregate attack. Selection of appropriate mix proportions in accordance with codes of practice and British Standards should overcome these problems. Carbonation and chloride contamination of reinforced concrete may lead to corrosion of the reinforcement but, for most cladding situations in the UK, these problems can also be prevented by correct choice of mix proportions. It may, however, be necessary to use stainless steel to ensure the durability of reinforcement in cast stone.

Renders may fail due to loss of bond to the substrate and may be susceptible to sulfate attack when applied to clay brickwork.
The durability of glass reinforced cement is affected by the reaction between the alkali in the cement and the glass fibres and there have also been problems due to failure to make sufficient provision for movement. Cem-Fil fibres for glass reinforced cement were introduced in 1971 and Cem-Fil 2 fibres with improved durability were introduced in 1979. There is, therefore, limited experience to gauge the long-term durability.

Life expectancy and maintenance requirements
Well designed concrete structures should not require regular maintenance however there have been problems in the past arising from poor design and workmanship and the use of unsuitable materials such as chloride based admixtures. No clear reference to design life is given in the codes of practice for concrete structures but it is generally assumed that a life of at least 60 years is expected.

Concrete masonry may require repointing during the life of the structure.

Renders can provide maintenance free service for 50 years or more but may require patching of debonded areas and where they are painted will require repainting at intervals.

Brick and terracotta
Clay based components are key elements in domestic and commercial buildings. Clay bricks are a staple component in low-rise wall construction and clay tiles are widely used in roofing. Brick slips can be used to decorate pre-cast concrete panels and terracotta tiles are now being used as the outer element in vertical cladding systems

Main forms of deterioration
Although fired clay products can be very durable, some materials are susceptible to frost attack when wet. There is no established relationship between measurable properties of the brick and frost resistance and the best guide to durability is performance in service. British Standards give guidance on the suitability of different types of brick for various exposure conditions.

Problems can also arise due to differential movement particularly where brickwork is used in conjunction with concrete. The shrinkage of the concrete and moisture induced expansion of the brickwork can lead to severe problems if the design does not allow for the movement.

Tiles may fail due to breakdown of the bond to the substrate.

Clay bricks contain sulfates which can cause sulfate attack of cementitious mortars.

Life expectancy and maintenance requirements
Brickwork is generally a very durable material capable of lasting over 100 years. It should not require regular maintenance but may require repointing during the life of the structure.

Stone
Natural stone has been widely used as a building material in the form of large blocks but is increasingly being used in thinner layers and in combination with other materials in composite panels. The decorative effect that is available with natural stone has often been allowed to overshadow the engineering issues, and concerns about durability are increasing. The huge natural variability of this material often makes it difficult to select appropriate materials for use on facades and the frequent presence of internal pores and fractures complicates selection.

Reconstituted stone is also used on facades and can generally be relied upon to be more regular in terms of properties and uniformity than natural stone. Reconstituted stone is considered as a cementitious material in this report.

Main forms of deterioration
The main forms of stone deterioration are frost attack, erosion by acid rain and salt crystallisation. The dense cladding stones are generally more durable than some stones used in masonry however for thin panels the effects of movements and fixings are important. For prestige structures staining may be a major factor.

Life expectancy and maintenance requirements
Guidance on the durability of stone is given in British Standards and other documents but these recommendations require interpretation and there is a degree of uncertainty particularly in respect of novel uses of stone.

Stonework may perform satisfactorily for many years with little or no maintenance although regular washing is recommended for some stones to maintain their appearance.

Finishes
Finishes is a very diverse group of materials, some for general use, others limited to use on specific backgrounds. Traditional finishes such as paints and wood stains have been joined by flexible polymer coatings suitable for use on metals and plastics. Coloured foil coatings have also been developed, and galvanising and anodising are widely used for corrosion protection of steel and colouring of aluminium, respectively.

Main forms of deterioration
The main forms of deterioration of finishes are loss of adhesion to the substrate and breakdown due to weathering particularly due to exposure to UV light. Durability can be improved by selecting a material which is compatible with the substrate and environmental conditions and by good site practice.

Life expectancy and maintenance requirements
The life of many finishes will be less than the life of the structure and they will therefore require replacement at intervals.

Formulations are constantly being changed to improve performance and the life of materials currently on the market is therefore uncertain.

BS 6150 suggests that site applied paints are generally expected to give a life of 5 to 10 years depending on type of paint and exposure.

BS 5427 suggests that factory applied polymer coatings on profiled metal sheet may give a life of 10 to 30 years depending on the type and colour of coating and the exposure conditions.

Anodising on aluminium may give a life of 50 years or more.

Regular cleaning is recommended for some finishes such as anodising of aluminium. Some finishes may not be replaceable and it may be necessary to replace the components affected.

Rubber and plastic
Whilst natural rubber is rarely used in cladding, synthetic rubbers find their way into facade components ranging from gaskets and weatherseals to damp-proof membranes. The large number of different chemicals that can be incorporated into a typical rubber make this probably the largest group of materials that is encountered. However it is generally possible to blend a rubber that is durable under given conditions.

Plastics are also diverse in the number of basic types, but there tends to be more standardisation in terms of those which are used.

- Unplasticised polyvinylchloride (PVC-U)is widely used in glazing frames and sheet claddings
- Polycarbonate (PC), polymethylmethacrylate (PMMA, acrylic) and ethylenetetraflouroethylene (ETFE) are used as glazing materials
- Polyamide (PA, nylon) is used for the manufacture of thermal and electrical isolators
- Glass reinforced polyester (GRP) is used for cladding panels and as a glazing material

Many of the agents that affect rubbers also affect plastics due to the close relationships between the two groups of materials. Many of the materials in these groups can exist as either rubber or plastic depending on the formulation and processing.

Note that there are also a number of polymer foam insulation materials which fall into this category.

Main forms of deterioration
The main form of deterioration is degradation due to exposure to UV light which may result in loss of flexibility, yellowing or chalking.
Plastics have a high coefficient of thermal expansion and allowance must be made for the resulting movements.

Life expectancy and maintenance requirements
Plastics generally require little maintenance. Cleaning may be required to maintain appearance but dirt can be beneficial in blocking out UV radiation. Many materials will have a life less than that of the structure and will therefore need to be replaced.

Some PVC-U window frames have been in service for 30 years but there is insufficient experience to know whether this is representative of the general standard of material in use.

BS 6093 suggests that most gasket materials have a life expectancy of up to 20 years.

BS 5427 Suggests that profiled cladding made from PVC-U, polycarbonate and GRP has an expected service life of up to 20 years.

Sealants and adhesives
Sealants and adhesives could be grouped together with rubbers and plastics under a 'polymer' material type. However, rubbers and plastics are predominately used in preformed components whilst the majority of sealants and adhesives are applied in liquid form and allowed to cure. For this reason fabrication and installation agents play a much larger role in the durability of these materials.

Sealants covers a wide range of materials with different movement characteristics and life expectancies as follows:

Type	Behaviour	Life
Oleo-resinous	Plastic	up to 10 years
Bituminous	Plastic	up to 10 years
Butyl	Plastic	up to 10 years
Acrylic	Plasto-elastic	up to 15 years
Acrylic (solvent-based)	Plasto-elastic/plastic	15 years
Polysulfide	Elasto-plastic	20 years
Polyurethane	Elastic	20 years
Silicone	Elastic	25 years

Some sealants are also used as adhesives, for example in double glazing units and structural silicone glazing, however, adhesives also covers a wide range of other materials ranging from animal and vegetable glues to synthetic resins. Uses of adhesives in cladding include the manufacture of board products, joinery and fixing ceramic tiles.

Main forms of deterioration
The main form of deterioration of sealant materials is weathering however the causes of failure of sealant joints are often related to the choice of the sealant material, geometry of the joint, poor workmanship during installation and stresses and strains imposed by joint movement. Prediction of service life is difficult due to the many factors affecting joint life and the fact that material formulations are developing.

Life expectancy and maintenance requirements
With correct design and installation, sealants should require little maintenance other than possible removal of mould growth and replacement of sections with minor defects. However the life of the sealant will often be less than the life of the building and complete replacement of the sealant will therefore be necessary. BS 6093 and BS 6213 give guidance on the design life to be expected for different materials and typical life expectancy for various materials is given in the table above.

Bitumen
Bituminous materials are generally used for waterproofing, for example in the form of bitumen-impregnated damp proof membranes, bitumen-mastic backed aluminium foil for use as flashings and bituminous paints. Bituminous materials also include mastic asphalt, pitch and coal tar, and each of these products has different uses. Whilst bituminous materials are often used to protect materials, acidic by-products are formed by exposure to UV radiation and these can cause problems.

Main forms of deterioration
The main form of deterioration is embrittlement due to loss of volatiles, oxidation and the effect of UV light.

Many materials such as dpcs are built into the structure where they are not accessible to affecting agents and do not require maintenance. Where bituminous materials are exposed on the outside of the facade they may need replacing during the life of the structure.

Fabrics
Fabrics are being used as cladding materials in a variety of applications. The basic fabrics are often treated with various chemicals to make them weather-resistant (water-repellent, draught-proof) and to reduce dirt retention. The most commonly used fabrics are as follows:

- PVC coated polyester
- PTFE coated glass fibre
- Silicone coated glass fibre

Research into new materials is continuing and PVDF coating has been introduced in an attempt to overcome problems with PVC and PTFE

Main forms of deterioration
PVC is subject to degradation by UV light and with ageing the surface becomes sticky and attracts dirt. Polyester fibres creep and may need re-tensioning during the life of the structure.

Glass fibres are attacked by water and rely on the coating for protection. The fibres are also brittle and can be damaged by rough handling or flapping in the wind during construction. Glass fibre materials are also vulnerable to damage from sharp objects.

Life expectancy and maintenance requirements
The anticipated lifespan of PVC coated polyester is approximately 15 years whereas glass fibre materials are expected to have a life of approximately 50 years.

THE LIFESPAN AND RECYCLABILITY OF ALUMINIUM AND STAINLESS STEEL

April 9, 2021

Share this post

Metals Warehouse, an ISO-certified company with over 20 years of experience in supplying the production industry, offers you a wealth of information, skills and a vast selection of stainless steel products and aluminium supplies.

We are the largest suppliers of aluminium and stainless steel in the UK, selling a wide range of high-quality products, including checker plates, metal sheets, bars, tubes, and much more. They are available in different sizes, whether standard or cut to size and are fully-certified premium materials.

At Metals Warehouse, our aluminium products consist of sheets, angles, U channels, flat bars, rectangular and square tubes, rods, t-sections, and tread plates that are all available in different sizes and can be cut to a required size by the customer. Our stainless steel products consist of sheets, angles, rods and rectangular, square and round tubes with a variety of thicknesses, grades and finishes.

Aluminium Uses And Recyclability

Aluminium is the most abundant metallic element on Earth, which is a lightweight and silvery-white metal with a lifespan of over 40 years for building and over 80 years for window frames.

It is the most commonly used non-ferrous metal used for a wide range of items including cans, foil, utensils for the kitchen, window frames, and airplane parts, which are composed of aluminium due to the special properties of the element.

It is not toxic, has high thermal conductivity, has excellent corrosion resistance, and is easy to cast, machine and shape. The recyclability and reuse without the loss of material quality is the fundamental property of this lightweight metal.

Aluminium is also beneficial in every step of its lifecycle, from production to its end. It can be recycled and reused, thereby preventing the use of primary metal and saving CO_2 emissions.

Recycling can occur at any stage of the aluminium life cycle:

Scrap created during the transformation in internal processes.

Scrap provided by customers during milling, stamping, and other processes. Due to their cleanliness and value, recycling the scrap provided during all production phases is crucial.

The end-of-life scrap of the by-products containing aluminium such as beverage cans or automobile hoods is a major factor in saving CO2 emissions as recycling only needs 5% of the energy.

Stainless Steel Uses And Recyclability

Stainless steel refers to any kind of steel containing a chromium content greater than 10.5% and with a lifespan of over fifty years. Stainless steel is easy to sterilise, 100% recyclable, and used in many applications.

In contrast to regular steel, stainless steel is prone to rust and corrosion due to water exposure. Stainless steel is most often used in applications that require the unique properties of steel and corrosion resistance. For example, perforated stainless steel sheets are widely used in industrial applications for proper ventilation of the room comprising machines.

It is melted in coils, boards, plates, tubes, and bars. Within the lifecycle of stainless steel, recycling and production are not considered different stages. Each stainless steel product consists of at least 60% of recycled steel.

Stainless steel can be recycled an infinite number of times without losing its strength and other properties. All stainless steel has magnetic properties, with the notable exception of austenitic grades, which make for easy separation from the recycling stream.

Overall, the processing of stainless steel does not emit a substantial amount of carbon dioxide, besides it has a much lower carbon footprint than aluminium and magnesium. Moreover, stainless steel is considered a highly durable and long-lasting element in the world.

DURABILITY AND LIFE EXPECTANCY FOR STAINLESS STEELS IN EXTERNAL ENVIRONMENTS

Introduction

The most important corrosion consideration with stainless steels is pitting.
Micro pitting is manifested as surface rust staining and is generally considered unacceptable for a material basically selected for its aesthetic appearance and corrosion resistance.

Analysis and extrapolation of pit depth data gathered from atmospheric exposure test programs can be used as a durability/longevity guide. (This work was done by Corus, (British Steel), Technical)
It must be borne in mind that staining from micro pitting may result in rejection of the steel on aesthetic grounds, long before pitting has perforated it.

Factors affecting durability

The durability/longevity of the stainless steel depends on: –

steel grade

environment

surface finish

Chloride ions are the most aggressive environmental hazard when assessing the pitting corrosion risk. Marine sites tend to be the most aggressive and so give the lowest projected durability.
Acid conditions, sometimes found in industrialised atmospheres, are also aggressive.

It is also important to consider the effects of local 'micro climates' that may influence how aggressive the environment is.

Estimated pit penetration times

The pitting life predictions shown in the table are based on a linear pit growth rate model.

Location	Estimated Time to Penetrate 1mm (Years) by steel type		
	430, (1.4016)	304, (1.4301)	316, (1.4401)
Marine	N/A	145	260
Semi-industrial	85	135	525
Rural	250	770	1200

The marine and rural site samples had 'mill' finishes and the semi-industrial site results had dull polished finishes.

APPENDIX F - Name Change Evidence

ti dynamic facades

be different. be recognised. be innovative

Date: 16/02/2023

VESTING AGREEMENT

Aerolite Monolith

Dear Sirs,

We rebranded the product Aerolite Monolith from Aerolite Ultralite back in October 2020.

Another company challenged the intellectual property rights to the term Ultralite claiming they had preferred rights to use the term in relation to their construction products for conservatories.
As the product had recently undergone development into large format panel sizes, we chose a new product name that would promote this key selling point.

The panel construction, composition, packaging, storage, handling and installation methods are identical to the previously named panel Ultralite, tested at Vinci UK in 2017.

Yours Sincerely,

Signed:

Managing Director
For and on behalf of TI Tiles International Ltd

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