TEST REPORT

Lucideon Reference:	184360 (QT50784/2/GMB)/Ref. 1
Project Title:	Testing of Forterra Brick Slip Cladding System in Accordance with ETAG 034:2012 Guideline for Technical Approval of Kits for External Wall Cladding
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1 INTRODUCTION

Forterra submitted their SureBrick Cladding System for testing using two brick slip types the first being Dark Multi Smooth and the second being Chelsea Smoked Red. The system was tested in accordance with ETAG 034:2012 “Guideline for European Technical Approval of Kits for External Wall Cladding”, ETAG 017:2005 “Guideline for European Technical Approval of Veture Kits Prefabricated Units for External Wall Insulation” and ISO 7892:1988 “Vertical building elements Impact resistance tests – Impact bodies and general test procedures”.

2 TEST PROGRAMME

The Cladding System was subjected to the tests listed in the Table below.

Table 1 -Test Programme

Sample	Test	Standard	Clause	No. of Tests
Full Size Wall 3.2 m x 2.6 m (w x h)	Hygrothermal Behaviour	ETAG 034:2012	5.4.6 6.4.6	1
	Freeze-Thaw	ETAG 017:2005	5.7.2.2 6.7.2.2	1
	Hard Body Impact	ETAG 004:2013	5.1.3.3	6
	Soft Body Impact	ISO 7892:1988	-	3
	Bond-Strength (After Hygrothermal and Freeze/Thaw Testing)	NA	-	5

3 TEST SAMPLE

The Cladding Systems, installed onto 2.6 m high x 3.2 m long steel test frames incorporated the following components:

- Galvanised Metal Frame.
- EJOT Stainless Fixings.
- Cement Particle Board.
- tremco illbruck Breather Membrane.
- tremco illbruck Adhesive Tape.
- Walker Steel ZED Rails.
- Ejot ZED Rail Fixings.
- SureBrick Metal Cladding Rails (comprising S220GD + ZM310 hot dip zinc-magnesium coating to BS EN 10346.
- SureBrick Stainless Steel Cladding Rails.
- Hilti SureBrick Rail Fixings.

- Visqueen DPC.
- Forterra Dark Multi Smooth Brick Slips.
- Forterra Chelsea Smoked Red Brick Slips.
- Forterra Oakthorpe Red Multi Brick Slips.
- Parex Historic KL Mortar.

The sample construction together with the construction detail plates are shown in Appendix 1 and 2.

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 Clause 5.4.6 of ETAG 034:2012. The testing involved subjecting a panel 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 panel was 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 temp 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 50ºC ± 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 test panel was inspected every 4 heat rain cycles and daily under the heat cold cycles to observe changes in the visual characteristics of the panel.

4.2 Freeze/Thaw Test

After Hygrothermal Testing the panel was subjected to Freeze Thaw Testing in accordance with Clause 5.7.2.2 of ETAG 017:2005. The test involved subjecting a panel to repeated freeze thaw cycles as follows:

4.2.1 Freeze Thaw – 30 Cycles

Exposure to water for 8 hours at (+ 23 ± 2°C).

Freezing to (- 20 ± 2°C) (fall for 2 hours) for 14 hours (total 16 hours). At periods of every three cycles during freeze thaw cycles, observations relating to a change in characteristics of the surface or to the behaviour of the entire kit were recorded.

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

4.3 Soft Body Impact Test

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

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

The distance from the face of the wall that the front edge of the impactor for each impact energy was calculated and can be seen in the table below:

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 2 m steel wire swung from differing drop heights, as stated in the table above, 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.

Testing was conducted on both the Dark Multi Smooth and Chelsea Smoked Red panels. Test positions were chosen taking into account various modes of behaviour of the cladding system. The presence of any cracks at the impact point were noted.

4.4 Hard Body Impact Test

Testing was carried out in accordance with ETAG 004:2013.

The system was held in 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 a 1000 g steel ball was released from a drop height 1020 mm.

Testing was conducted on both the Dark Multi Smooth and Chelsea Smoked Red brick slips. Test positions were chosen taking into account various modes of behaviour of the cladding 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

4.5.1 After Hygrothermal and Freeze/Thaw Testing

The test was undertaken on the wall after being subjected to hygrothermal, freeze/thaw cycles and weathertightness testing (reported separately in Lucideon report Reference 184360 Ref. 2.)

5 No. (215 mm x 64 mm) rectangles were cut through the mortar joints. A steel plate was bonded to the face of the brick tile 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 to 10 mm/minute through a tensile load machine. Tests were undertaken on both the Dark Multi Smooth and Chelsea Smoked Red brick slip systems.

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 Section 6.4.6 of ETAG 034:2012, the performance requirements of the large scale hygrothermal test is that the test sample should not show evidence of any of the following defects during nor at the end of the test programme:

- Deterioration such as 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.

*SureBrick is designed to be used outbound of a drained and ventilated cavity, and as such some water may access the cavity/insulation zone. The primary weather-tightness

line is normally the external face of the sheathing board, but should be defined in the wall design.

5.1.1 Results

Forterra Dark Multi Smooth Brick Slips	No defects
Forterra Chelsea Smoked Red Brick Slips	No defects
Forterra Oakthorpe Red Brick Slips	No defects

The surface finish was thoroughly examined to establish whether any deterioration or cracking had occurred.

No damage was noted to the face of either of the panels after the 28 days cure period prior to installing in the test apparatus.

No visible damage was noted to the face either of the panels during the test regime or on completion of the test regime.

5.2 Wet Freeze Thaw Testing

According to Section 8 of BS EN 16383:2016 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

Forterra Dark Multi Smooth Brick Slips	No defects*
Forterra Chelsea Smoked Red Brick Slips	No defects*
Forterra Oakthorpe Red Brick Slips	No defects*

* Although there were no defects as noted in the list above, there was some water penetration noted at the window reveal, which on deconstruction was found to be caused by a wooden batten detailing which carried a soldier course around the window. The waterproofing around the window did not extend sufficiently over the timber batten. The timber batten became saturated which led to some wetting of the sheathing board.

*SureBrick is designed to be used outbound of a drained and ventilated cavity, and as such some water may access the cavity/insulation zone. The primary weather-tightness line is normally the external face of the sheathing board, but should be defined in the wall design.

5.3 Soft Body Impact Test

The results of the soft body impact testing carried out at 10, 60, 300 and 400 Joules are given in the Table Section (Tables 2 and 3).

5.3.1 Results

Forterra Dark Multi Smooth Brick Slips	No defects
Forterra Chelsea Smoked Red Brick Slips	No defects
Forterra Oakthorpe Red Brick Slips	No defects

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 Table Section (Tables 4 and 5).

Forterra Dark Multi Smooth Brick Slips	Vertical Crack
Forterra Chelsea Smoked Red Brick Slips	No Damage

5.5 Bond Strength Test

5.5.1 After Hygrothermal Freeze/Thaw and Water Tightness Testing

The results of the bond strength testing carried out on the wall after being subjected to hygrothermal and freeze/thaw cycles are given in the Table Section (Tables 6 and 7).

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

END OF REPORT

TABLES

Table 2 – Results of the Soft Body Impact Tests Forterra Chelsea Smoked Red Brick Slips

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

Table 3 – Results of the Soft Body Impact Tests Forterra Dark Multi Smooth Brick Slips

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

Table 4 – Results of the Hard Body Impact Tests Chelsea Smoked Red Brick Slips

Location	Under 3 Joules Impact Energy (mm)	Under 10 Joules Impact Energy (mm)
1	No damage recorded	No damage recorded
2	No damage recorded	No damage recorded
3	No damage recorded	No damage recorded

Table 5 – Results of the Hard Body Impact Tests Dark Multi Smooth Brick Slips

Location	Under 3 Joules Impact Energy (mm)	Under 10 Joules Impact Energy (mm)
1	No damage recorded	Vertical Hairline Crack Through Brick Slip
2	No damage recorded	Vertical Hairline Crack Through Brick Slip
3	No damage recorded	Vertical Hairline Crack Through Brick Slip

Table 6 – Results of Bond Strength Tests Chelsea Smoked Red Brick Slips - After Hygrothermal Freeze/Thaw and Water Tightness Test

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.046	Pull Out From Rail
2	0.078	Pull Out From Rail
3	0.031	Pull Out From Rail
4	0.088	Pull Out From Rail
5	0.050	Pull Out From Rail
Mean	**0.059**	**-**

Table 7 – Results of Bond Strength Tests Dark Multi Smooth Brick Slips- After Hygrothermal Freeze/Thaw and Water Tightness Test

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.243	Pull Out From Rail
2	0.126	Pull Out From Rail
3	0.164	Pull Out From Rail
4	0.195	Pull Out From Rail
5	0.081	Pull Out From Rail
Mean	**0.162**	**-**

APPENDIX 1 - Sample Construction

(i) Full Scale Wall

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

The galvanised metal frame was installed into the steel test frame at centres in Figure 1 included in Appendix 7.

The system was fitted by an external contractor.

2400 x 1200 x 10 mm RCM Cement Particle Board was fixed to the galvanised metal frame at 300 mm vertical centres. Joints in the board were taped using tremco illbruck ME315 Contractors adhesive tape.

The wall was split vertically down the centre and a window opening (Height = 600 mm; Width = 400 mm) was incorporated into either side of the panel located 400 mm down from the top of the panel and 400 mm in from the side of the panel.

The window was fixed back to the frame using aluminium window straps. tremco illbruck ME501 Duo Membrane HD was installed using tremco illbruck SP525 adhesive to the exposed edge around the perimeter of the window. The window was sealed back to the cement particle board using ME501

tremco illbruck ME 011 breather membrane UV was dab fixed to the cement particle board using tremco illbruck SP525 adhesive.

Walker Steel Zed rails were fixed through the breather membrane and cement particle board into the galvanised steel frame. The zed rails were fixed to give 600 mm centres in the centre of the frame and 280 mm at either end. The rails were fixed using EJOT JT3 4.9 mm x 35 mm fixings at 300 mm vertical centres.

A timber frame constructed from 48 mm x 48 mm treated timber was fixed using EJOT TKE 4.8 mm x 100 mm to the wall above the window to enable vertical fixing of the brick slips to incorporate a soldier course detail above the window.

SureBrick stainless steel cladding rails were fixed to the Zed rails at a maximum of 106 mm vertical centres with EJOT JT3 5.5 mm x 25 mm fixings.

SureBrick Rails were fixed with butt joints located between the vertical zed rails. The maximum distance from a zed rail to a joint i.e. the end of a cantilevered SureBrick rail was 500 mm.

The wall was split vertically with Forterra Dark Multi Smooth brick slips used on one side of the installation and Forterra Chelsea Smoked Red used on the other. The brick slips were located in the metal cladding rails using a rubber mallet.

Multiple rows of projecting brick slips (up to 78 mm projections) were incorporated across the panel using Oakthorpe Red Multi and Dark Multi smooth brick slips.

25 Kg of mortar was mixed with 3.75 litres of water with a paddle mixer to produce a mortar with a consistency of finishing plaster. It was allowed to stand for 5 minutes and then remixed.

The brick slips were then pointed using a pointing gun. The mortar was allowed to cure for several hours and then finished by scraping with a spatula.

The wall was allowed to cure at a temperature of 20°C and 55% Relative Humidity for at least 28 days and was monitored daily for any signs of distress including blistering, cracking and detachment.

APPENDIX 2 - Construction Details (Plates)

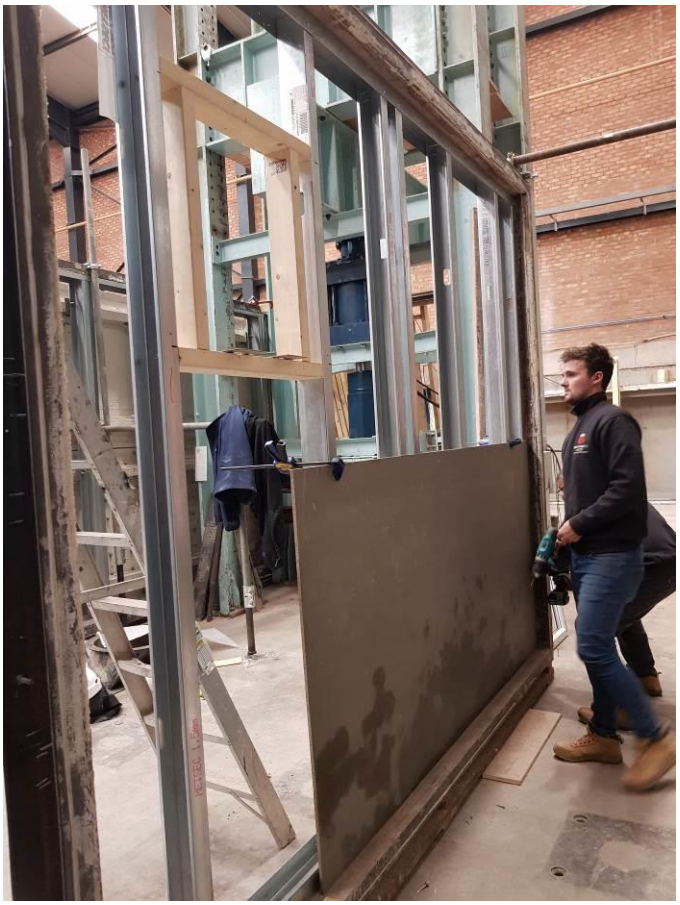


Plate 1 – Mechanically Fixing of the Cement Particle Board onto the Galvanised Metal Frame Previously Installed

Plate 2 – View of Joint Taping Cement Particle Board

Plate 3 – View of the 'DPC Installed to Window Perimeter

Plate 4 – View of the 'DPC Installed to Window Perimeter and Cement Particle Board

Plate 5 – View of Installation of Breather Membrane

Plate 6 – Installation of Frame for Soldier Detail

Plate 7 – Wall after Installation of Breather Membrane

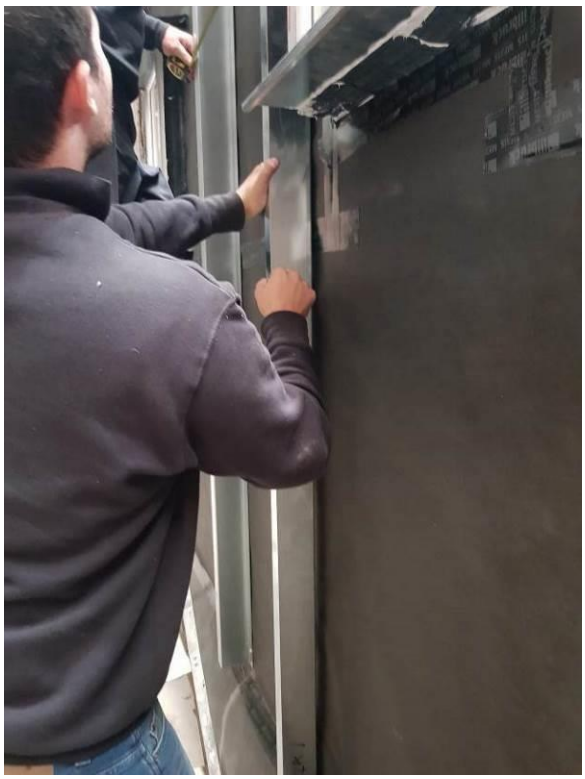


Plate 8 – Installation of Zed Rails

Plate 9 – Wall on Completion of Zed Rail Install

Plate 10 – Installation of Brick Rail

Plate 11 – Installation of Brick Slips

Plate 12 – Application of Pointing Mortar

Plate 13 – Finishing of Mortar Joint

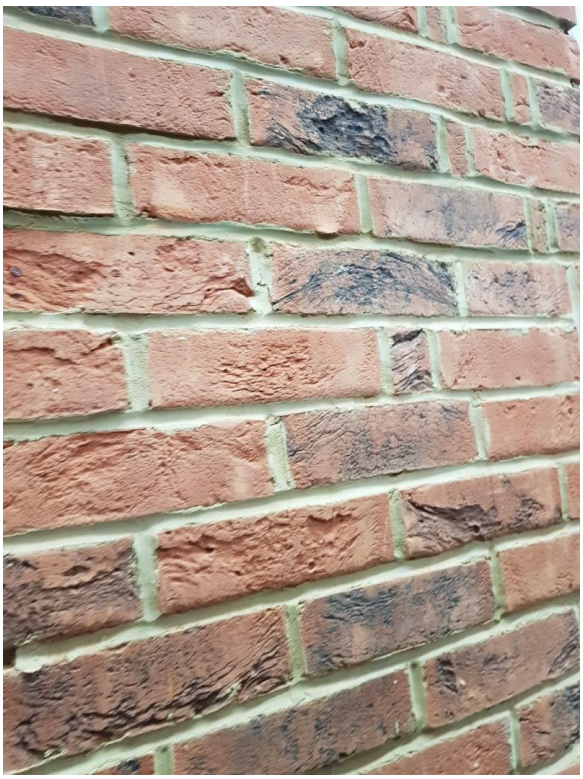


Plate 14 – Finished of Joints

Plate 15 – Finished Wall

APPENDIX 3 – Hard Body Impact Testing (Plates)

Plate 16 – Dark Multi Smooth Brick Slip Hard Body Impact Tests (10 Joules)

Plate 17 – Chelsea Smoked Red Brick Slip Hard Body Impact Tests (10 Joules)

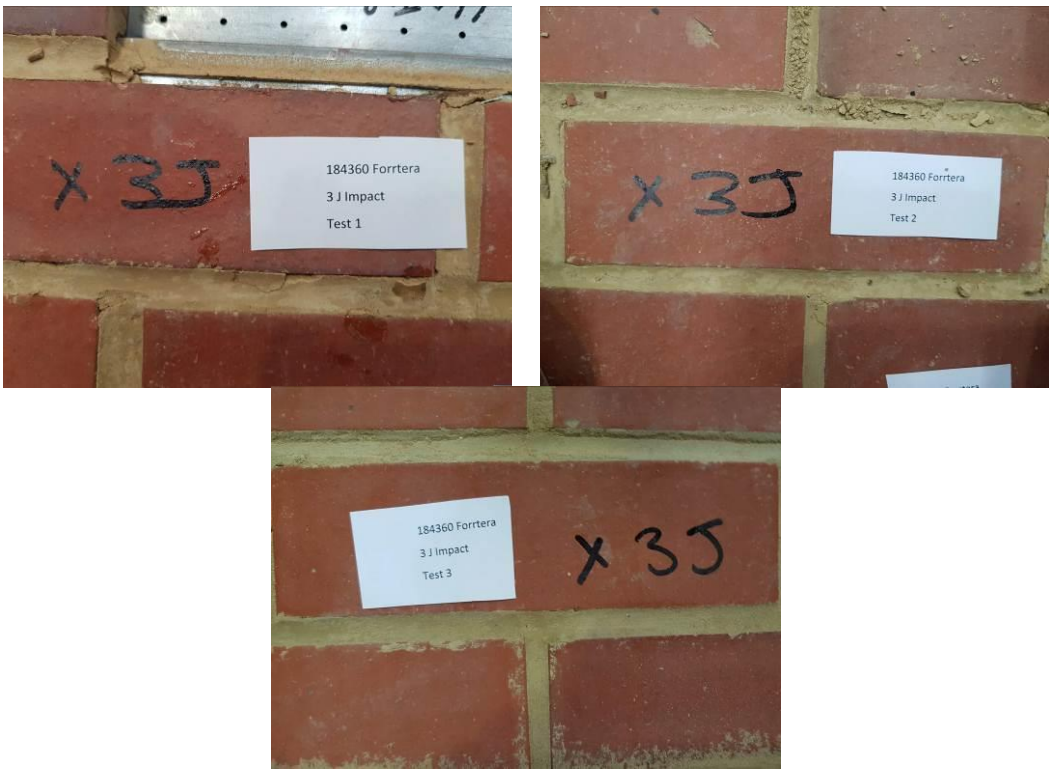


Plate 18 – Dark Multi Smooth Brick Slip Hard Body Impact Tests (3 Joules)

APPENDIX 4 - Soft Body Impact Testing (Plates)

Plate 19 – Soft Body Dark Multi Smooth Brick Slip 400 Joules – No Damage

Plate 20 – Soft Body Impact Test Chelsea Smoked Red Brick Slip 400 Joules – No Damage

APPENDIX 5 - Bond Strength Test (Plates)

Plate 21 – Dark Multi Smooth Brick Slips Bond Strength Tests – after Hygrothermal, Freeze/Thaw Testing and Water-Tightness Testing

Plate 22 – Chelsea Smoked Red Brick Slips Bond Strength Tests – after Hygrothermal, Freeze/Thaw Testing and Water-Tightness Testing

APPENDIX 6 - Batch Details

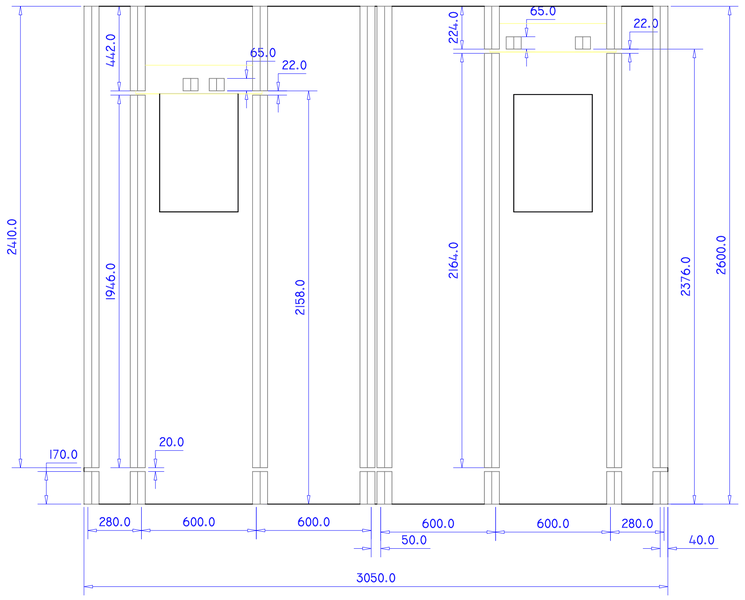
Product	Description	Batch Reference	Image of Label
Pointing Mortar	Parex - Historic KL EA250 Sandstone – 25 kg bag	M/O 87168	
Perpend Weep Vent	Manthorpe - Weep Vent Grey G950GR - Pack	MANG950GR (IN)	
Clay Brick Slips	Forterra Building Products Ltd - Dark Multi Smooth - Pallet	Manufactured to BS EN 771-1	
Clay Brick Slips	Forterra Building Products Ltd - Chelsea Smoked Red - Pallet	Manufactured to BS EN 771-1	
Clay Brick Slips	Forterra Building Products Ltd - Oakthorpe Red Multi - Pallet	Manufactured to BS EN 771-1	

Product	Description	Batch Reference	Image of Label
Clay Plinth Slips	Forterra Building Products Ltd - Smooth Red - Pallet	Manufactured to BS 4729	
Backing Rod	tremco illbruck - AW135 Backing Rod 10 mm x 1150 mm – Box	350593 (IN)	-
External Sealant	tremco illbruck - SP525 600 mL - Box	377887 (IN)	
SureBrick Rail	0.7 mm SureBrick Rails (comprising S220GD + ZM310 hot dip zinc-magnesium coating to BS EN 10346) - Pallet	-	
SureBrick Top Rail	0.7 mm SureBrick Rails (comprising S220GD + ZM310 hot dip zinc-magnesium coating to BS EN 10346) - Pallet	-	
SureBrick Stainless Rail	SureBrick Rails - 0.7 mm, 2.4 m 1.4301 Stainless Steel - Pallet	-	

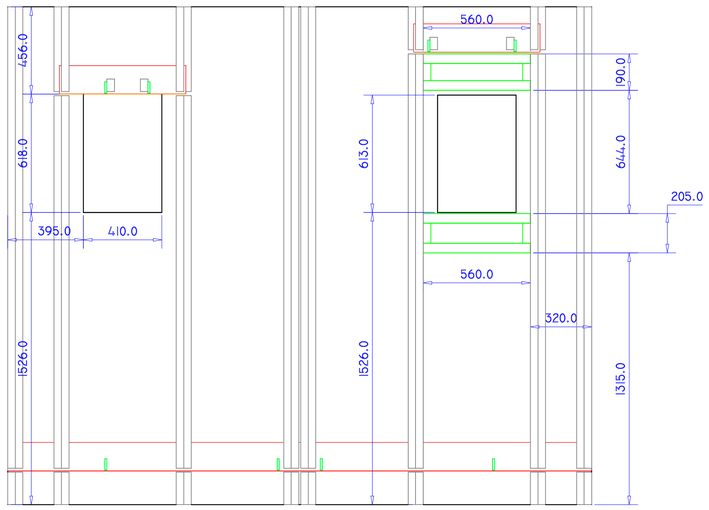
Product	Description	Batch Reference	Image of Label
SureBrick Stainless Top Rail	SureBrick Rail - 0.7 mm, 2.4 m 1.4301 Stainless Steel - Pallet	-	
SureBrick Rail Fixings	EJOT - JT3-LT3-5.5 x 25 - Box	2565975	
SureBrick Rail Fixings	HILTI - S-MD01PS 5.5 x 22 - Box	1099500525	
Timber Batten Fixings	EJOT - TKE 4.8 x 80 mm - Box	0002165209 / 0002187364	
Timber Batten Fixings	EJOT - TKE 4.8 x 100 mm - Box	1852086	

Product	Description	Batch Reference	Image of Label
Timber Battens	Forterra Building Products Ltd – 48 mm Treated Timber – Pallet	N/A	
Zed Rails	Walker Steel - 1.5 mm Profiled Steel - Pallet	N/A	
Total Protection Tape	tremco illbruck - ME315 Contractors Adhesive Tape	398628 (IN)	
Breather Membrane	tremco illbruck - ME011 UV - Box	398873 (IN)	
Adhesive	tremco illbruck - SP525 600 mL - Box	377887 (IN)	

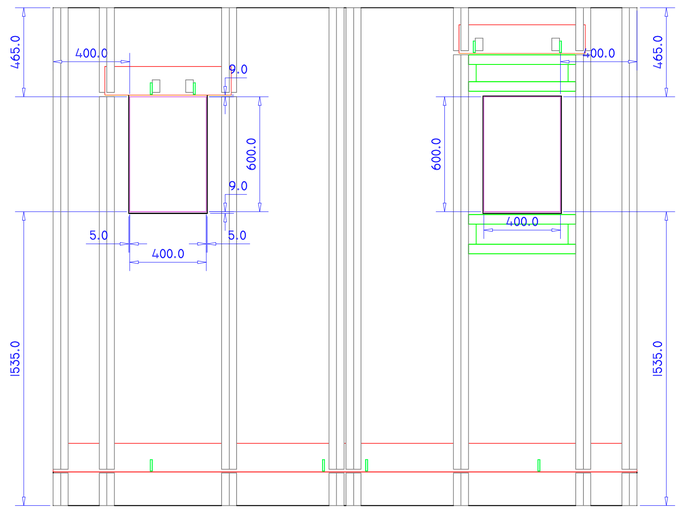
Product	Description	Batch Reference	Image of Label
DPC	Visqueen - Polythene 30 m x 450 mm - Roll	BUPDPC450 (IN)	
Window Primmer	tremco illbruck - AT150 500 mL EN – Box	342049 (IN)	
Window DPC	tremco illbruck - ME501 25 m Roll – Box	396578 (IN)	
Window Sealant	tremco illbruck - SP525 600 mL - Box	377887 (IN)	
Zed Rail Fixings	EJOT - JT3-FR-2-4.9 x 35 - Box	2603402	
Cement Particle Board	RCM - Cemboard 2400 x 1200 x 10 mm – Pallet	ZZ-TRA002P2	



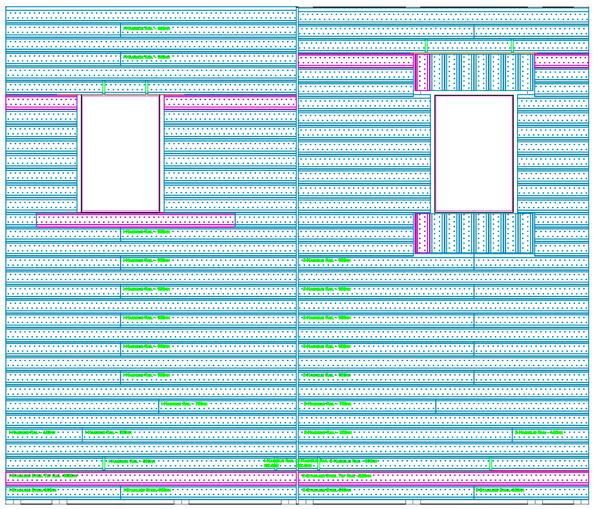
Front Evelation - Secondary Steel Layout



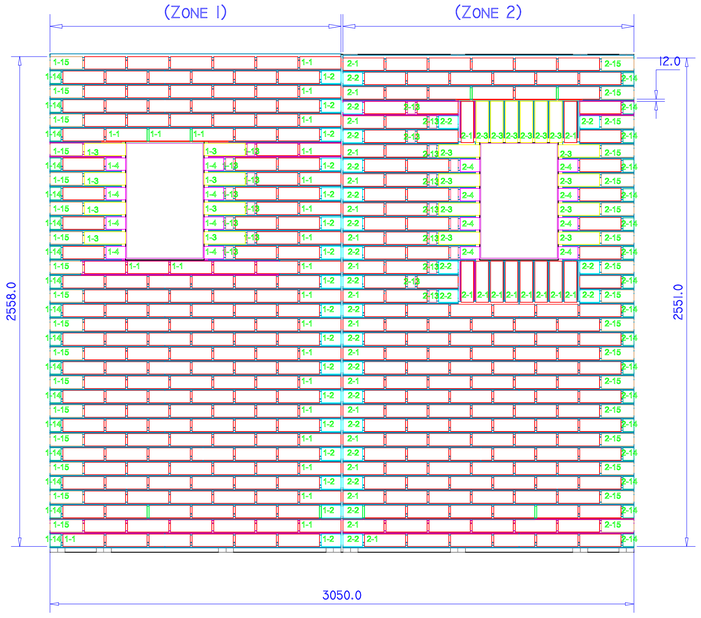
Front Evelation - Timber Batten, DPC & Perpend Vent / Drain Layout



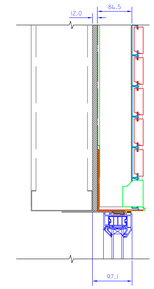
Front Elevation - Window Position



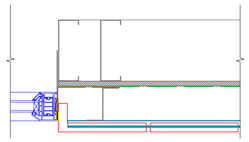
Front Elevation - Rail Layout



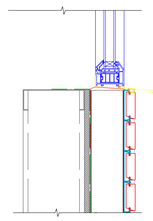
Front Elevation - Brickwork Layout



Section - Head Detail



Section - Jamb Detail



Section - Cill Detail

Rev.	Description.	Date.	By.
-	-	-	-

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Project.
Product Development

Customer.
Forterra Building Products Ltd

Drawing Title.
Test 17 - Basic Panel
Lucideon
SureBrick

Drawn By. GR
Scale. (Paper Size A1)

Date. 18-08-19

Drawing No. 1700098 - 700
Rev. D