Next Generation Façade Technology

British Manufacturing
BRICKSPAN®
Next Generation Façade Technology

20 August, 2015

Test Report

Hygrothermal Performance of Two Facade Systems Incorporating Brickspan Sheets to ETAG 004:2013

Tested by:

LUCIDEON
insight creating advantage

Lucideon, independent material testing and technology laboratory.

www.lucideon.com

Brickspan Developments Limited
Unit C4, Mamhilad Park Estate,
Pontypool, Torfaen, NP4 0HZ
E: info@brickspan.co.uk | www.brickspan.co.uk

CONTENTS

EXECUTIVE SUMMARY

System One – External Thermal Insulation Composite System with BRICKSPAN Finish

Test	ETAG 004 Clause	Requirement	Pass/Fail
Bond Strength Control	6.1.4.1.1	≥ 0.08 N/mm^2 or cohesive failure of insulation	Pass
Hygrothermal Performance	6.1.3.2.1	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	6.1.4.1.1	≥ 0.08 N/mm^2 or cohesive failure of insulation	Pass
Impact Resistance – Wall	6.1.3.3	Category I, II, or III	Category I

System Two – Lightweight Frame System with BRICKSPAN Finish

Test	ETAG 004 Clause	Requirement	Pass/Fail
Bond Strength Control	6.1.4.1.1	≥ 0.08 N/mm^2 or cohesive failure of insulation	Pass
Hygrothermal Performance	6.1.3.2.1	No cracking, blistering, peeling or delamination	Pass
Bond Strength – Wall	6.1.4.1.1	≥ 0.08 N/mm^2 or cohesive failure of insulation	Pass
Impact Resistance – Wall	6.1.3.3	Category I, II, or III	Category I

1 INTRODUCTION

Paul James Bishop IP Holdings Ltd has developed a façade system incorporating Brickspan Sheets on which will be potentially used in conjunction with External Thermal Insulation Composite Systems and Timber Frame Systems. In order to establish the performance of the brick faced panel, Paul James Bishop IP holdings Ltd requires testing of two systems incorporating Brickspan Sheets in accordance with ETAG 004:2013 Guideline for European Technical Approval of External Thermal Insulation Composite Systems with Rendering.

2 TEST SAMPLES

System One incorporates the following components:

- 90 mm thick EPS Insulation
- MAPEI Mapetherm AR1 GG Basecoat/Adhesive
- MAPEI Mapetherm Net
- 135 mm SPIT Fixings
- MAPEI Fix & Grout Brick Adhesive
- BRICKSPAN Sheet
- BRICKSPAN Pointing Mortar

System Two incorporates the following components:

- Timber Frame
- FERMACELL Powerpanel H_2O
- FERMACELL Screws
- MAPEI Mapetherm AR1 GG Adhesive
- MAPEI Mapetherm Net
- MAPEI Fix & Grout Brick Adhesive
- BRICKSPAN Sheet
- BRICKSPAN Pointing Mortar

3 TEST PROGRAMME

- **Hygrothermal performance in accordance with Clause 5.1.3.2.1 of ETAG 004.** A full size wall 2.6 m tall x 3.2 m long was tested.
- **Bond strength in accordance with Clause 5.1.4.1.1.** Small scale specimens nominally 500 x 500 mm were constructed in order subjected to pull-off tests to determine the bond strength of the base coat to insulation for System One and the bond strength of the cement board to the adhesive for System Two.

- **Bond strength in accordance with Clause 5.1.4.1.1.** On completion of the test the wall was subjected to pull-off tests to determine the bond strength of the base coat to insulation for System One and the bond strength of the cement board to the adhesive for System Two.
- **Hard body impact tests in accordance with Clause 5.1.3.3.1.** These were carried out at energy levels of 3 joules and 10 joules.

4 RESULTS

4.1 Hygrothermal Wall

According to Section 6.1.3.2.1 of ETAG 004, the performance requirements of the large scale hygrothermal test is that neither the base coat nor render finish should show evidence of any of the following defects:

- Blistering or peeling of any paint finish.
- Failure or cracking associated with joints between insulation products or profiles fitted within the system.
- Detachment of the render coat.
- Cracking allowing water penetration to the insulating layer (normally ≤ 2 mm).

Results

System One	No defects
System Two	No defects

The wall was thoroughly examined for defects with particular note taken at the corners of the window openings where cracking would be more likely to occur.

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

No visible damage was noted to the face of the render finish or base coat during the test regime or on completion of the test regime.

No water ingress was noted at the position of the render finish or base coat.

4.2 Hard Body Impact Testing

The results of the hard body impact testing carried out at both 3 joules and 10 joules energy are given in the Tables.

According to Table 9 of Section 6.1.3.3 of ETAG 004 the systems can be categorised as follows:

System One	Category I
System Two	Category I

Category I definition is as follows:

"A zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use."

4.3 Bond Strength - Full Wall

The results of the bond strength testing carried out on the wall are given in the Tables.

According to Section 6.1.4.1.1:

"The minimum failure resistance after the hygrothermal test 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".

The mean failure load of the bond strength test after hygrothermal test for System One was above the 0.08 N/mm^2 value required hence the test is deemed to have passed.

The mean failure load of the bond strength test after hygrothermal test for System Two was above the 0.08 N/mm^2 value required hence the test is deemed to have passed.

4.4 Bond Strength - Small Scale Samples

The method for assessing the performance of the small scale bond strength test specimens is the same as the full scale wall listed above.

The results of the small scale control bond strength tests carried out on the samples are given in the Tables.

The mean failure load of the bond strength control test for System One was above the 0.08 N/mm^2 value required hence the test is deemed to have passed.

The mean failure load of the bond strength control test for System Two was above the 0.08 N/mm^2 value required hence the test is deemed to have passed.

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

END OF REPORT

RESULTS TABLES

System One

Table 1 - Results of Impact Tests Carried out on System One

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking
1	-	No Damage	-	Slight Indentation
2	-	No Damage	-	Indentation with slight cracking around the perimeter of the brickslip in the pointing mortar
3	-	No Damage	-	Slight Indentation

Table 2 - Results of Bond Strength Tests Carried Out on System One after Subjecting to Hygrothermal Action

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.15	Failure within insulation Body
2	0.07	Failure within insulation Body
3	0.09	Failure within insulation Body
4	0.19	Failure within insulation Body
5	0.06	Failure within insulation Body
Mean	**0.11**	**-**

Table 3 - Results of Bond Strength Control Tests Carried Out on System One - Small Scale Sample

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.11	Failure within insulation body
2	0.11	Failure within insulation body
3	0.11	Failure within insulation body
4	0.11	Failure within insulation body
5	0.11	Failure within insulation body
Mean	**0.11**	**-**

System Two

Table 4 - Results of Impact Tests Carried out on System Two

Location	Diameter Under 3 Joules Impact Energy (mm)	Cracking	Diameter Under 10 Joules Impact Energy (mm)	Cracking
1	-	No Cracks	-	Slight Indentation
2	-	No Cracks	-	No Damage
3	-	No Cracks	-	Slight Indentation

Table 5 - Results of Bond Strength Tests Carried Out on System Two after Subjecting to Hygrothermal Action

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.81	Failure within Cement Board
2	0.65	Failure within Cement Board
3	0.92	Failure within Brickslip
4	0.33	Failure between Adhesive Layer and Cement Board
5	0.47	Failure within Cement Board
Mean	**0.64**	**-**

Table 6 - Results of Bond Strength Control Tests Carried Out on System Two - Small Scale Sample

Location	Pull-Off Strength (N/mm^2)	Mode of Failure
1	0.30	Partial failure between Adhesive Layer and Cement Board and partial failure within Cement Board.
2	0.32	Failure within Brickslip
3	0.32	Partial failure between Adhesive Layer and Cement Board and partial failure within Cement Board.
4	0.23	Failure between Adhesive Layer and Cement Board
5	0.29	Failure between Adhesive Layer and Cement Board with minimum failure within Cement Board
Mean	**0.31**	**-**

APPENDIX 1 - Sample Construction

(i) Hygrothermal Wall

The systems were fitted both by an external contractor and by the technical team from Brickspan.

An AAC block wall was constructed in a rigid 2.6 m long x 3.2 m high steel test frame using designation (iii) mortar. The wall was allowed to cure for 28 days.

System One (Left Hand Side of the Wall)

A base track was installed at the foot of the left hand side of the wall above the second course of blockwork with fixings at nominally 300 mm centres. The base coat was mixed with water (Rate: 25 Kg of MAPEI AR1 GG with 5-6 Lt of water) using a paddle mixer for nominally 3 minutes and allowed to stand for 5 minutes before remixing to a smooth consistency.

The adhesive was trowel applied to the insulation slabs before adhesively fixing the insulation boards to the substrate.

The insulation slabs were positioned horizontally (stack bond) and vertically staggered in a stretcher bond pattern.

The base coat was applied around the window opening. The corner beadings with mesh incorporated were then applied over the base coat and the mesh were embedded into the coat.

The insulation boards were then mechanically fixed with SPIT fixings to the face of the masonry substrate.

The base coat was applied on the external corners of the opening before fitting the mesh (cut into 300 x 300 mm squares) around the window, setting it at an angle of 45 degrees and embedding into the coat.

The base coat was trowel applied to the left hand side of the wall. A notched trowel was used to streak the base coat.

The mesh was applied (overlap of 100 mm) and embedded into the base coat.

The technical team trowel applied an additional layer of base coat, which was then levelled with a wide levelling trowel.

The base coat was applied to a total thickness of 5 mm and it was allowed to dry for two days.

The Brickspan sheets were then adhesively applied over the base coat using the MAPEI Fix & Grout Brick Adhesive.

After one day the bricks were pointed with the Brickspan pointing mortar.

System Two (Right Hand Side of the Wall)

A timber system was installed on the right hand side of the wall over the masonry substrate with studs at nominally 600 mm centres.

The FERMACELL Powerpanel H_2O cement boards were fixed into the framed system.

The base coat was mixed with water (Rate: 25 Kg of MAPEI AR1 GG with 5-6 Lt of water) using a paddle mixer for nominally 3 minutes and allowed to stand for 5 minutes before remixing to a smooth consistency.

The base coat was applied around the window opening. The corner beadings with mesh incorporated were then applied over the MAPEI AR1 GG and the mesh were embedded into the coat.

The MAPEI AR1 GG was applied over the cement board joints before embedding the mesh into the coat.

The wall was allowed to cure for two days before adhesively applying on the right hand side of the wall the Brickspan sheets using the MAPEI Fix & Grout Brick Adhesive.

After one day the bricks were pointed with the Brickspan pointing mortar.

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

(ii) Small Scale Specimens

Bond Strength Control

Small scale specimens for each system were prepared in the same way and at the same time as the full test wall on 500 x 500 mm samples as follows:

1 No. System One
1 No. System Two

The samples were cured for 28 days in the same conditions as the full test wall.

APPENDIX 2 - Test Method

(i) Hygrothermal Wall

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

Testing was carried out in accordance with the method described for Hygrothermal Performance in ETAG 004:2013 Guideline for Technical Approval of External Thermal Insulation Composite Systems with Rendering. 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:

Weathering Cycles

The panel was subjected to cyclic heat-rain conditions followed by heat-cold cycles according to the following programme.

Heat Rain - 80 Cycles

Heating to 70°C rising over 1 hour and maintaining at 70^{o}C $\pm$ 5 at 10-15% RH for a further 2 hours.

Followed by spraying with water (water temp $\pm$15°C) at 1l/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%.

Heat Cold – 5 Cycles

Exposure to 50^{o}C $\pm$ 5 with a rise of 1 hour and maximum 10% RH for 7 hours.

Exposure to -20°C $\pm$ 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.

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

(ii) Hard Body Impact Testing

Testing was carried out in accordance with ISO 7982 Vertical building elements - impact resistance tests – impact bodies and general test procedures.

The wall was laid down in the structures laboratory. A 1 Kg steel ball was allowed to impact the face of the panel at a height of 1020 mm to give an impact energy of 10 joules. A 0.5 Kg ball was allowed to impact the face of the panel from a height of 610 mm to give an impact energy of 3 joules respectively. Care was taken during the test not to allow the ball to impact the same spot more than once.

Test positions were chosen as to be the most onerous and representing the two finishes. On completion of each impact using digital callipers, the diameter of the impact area was measured and recorded. The presence of any micro-cracks, cracks at the impact point and at the circumference was noted.

(iii) Bond Strength - Full Wall

Five No. 50 mm squares for each system were cut through the base coat and the insulation (System One) and through the cement board (System Two). A steel plate was bonded to the area 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 studded bar attached to a hydraulic ram and load cell arrangement.

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.

$\sigma_B = f/A$

(iv) Bond Strength - Small Scale Samples

Five No. 50 mm squares for each system were cut through the base coat and the insulation (System One) and through the cement board (System Two) to a nominal depth of 10 mm. A steel plate was bonded to the area 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 an Instron tensile load machine.

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.

$\sigma_B = f/A$

APPENDIX 3 - Construction Detail (plates**)**

Installation of System One

Plate 1 – Attaching the Base Track to the Wall

Plate 2 – Applying the Adhesive to the Insulation Slab

Plate 3 – Adhesively Attaching the Insulation Slab to the Left Hand Side of the Wall

Plate 4 – Application of the Base Coat Around the Window Opening (Left); Applying of the Beading with Mesh Incorporated over the Base Coat (Centre); Flanges Embedded into the Base Coat (Right)

Plate 5 – Insulation Adhesively and Mechanically Fixed to the Wall

Plate 6 – Stress Patches Applied Around Window Opening

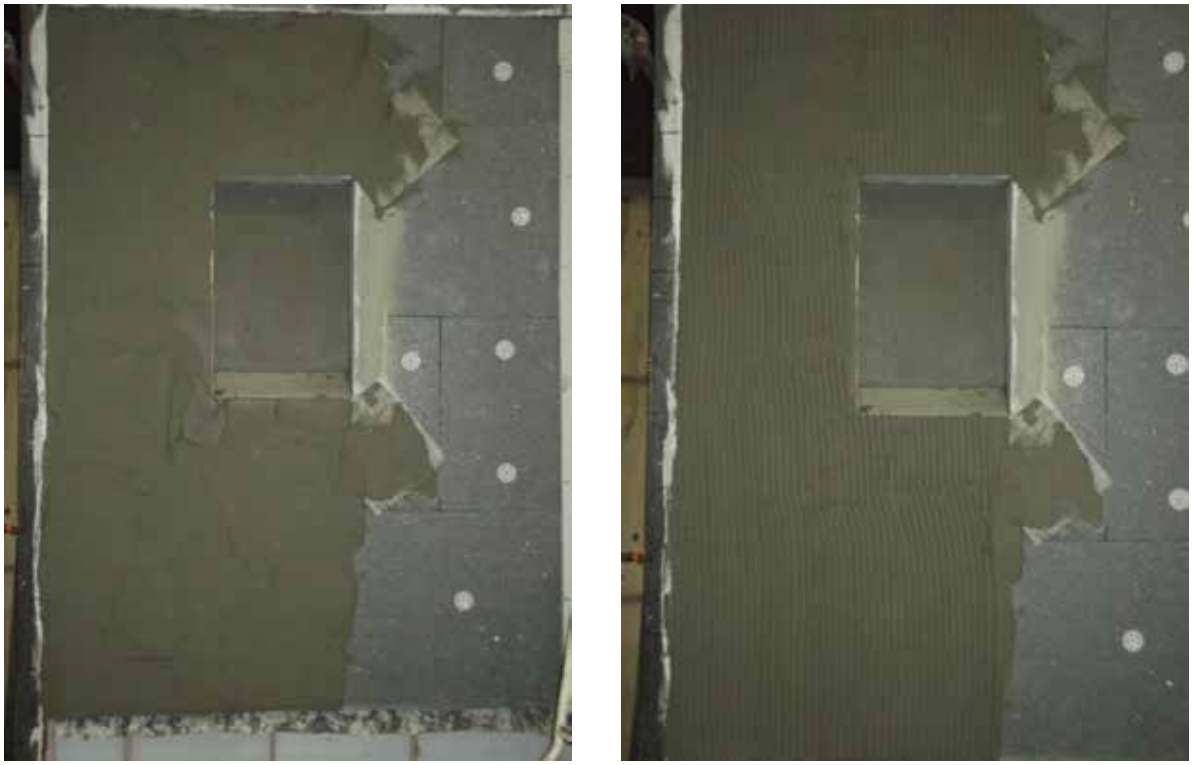


Plate 7 – Base Coat Applied over the Insulation (Left) and Base Coat Streaked with a Notched Trowel (Right)

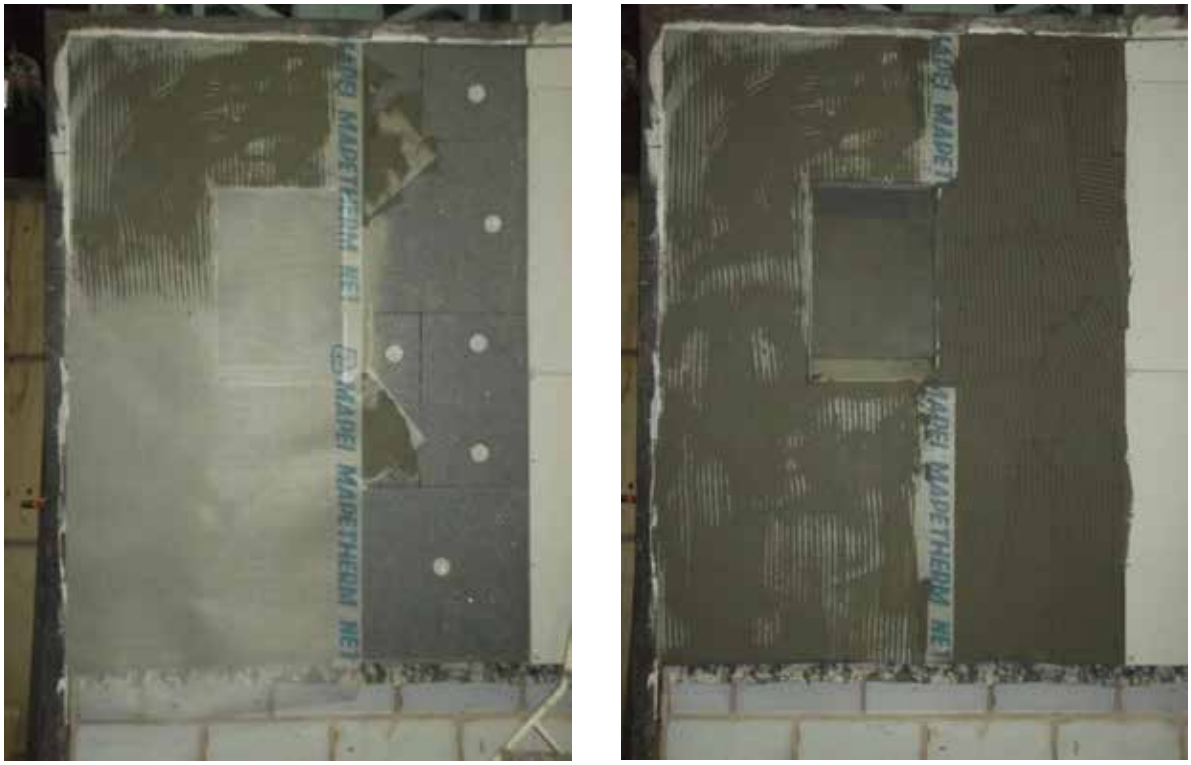


Plate 8 – Mesh Applied over the Base Coat (Left) and Mesh Embedded into the Base Coat (Right)

Plate 9 – Additional Layer of Base Coat Applied to the Left Hand Side of the Wall

Plate 10 – Brickspan Corner Sheet Adhesively Applied Around the Window Opening (Left) and Briskspan Sheet Fully Applied to the Left Hand Side of the Wall (Right)

Plate 11 –Brickspan Sheets Pointed with Pointing Mortar

Installation of System Two

Plate 12 – Timber Frame Installed

Plate 13 – Cement Board Fixed to the Timber Frame

Plate 14 – Beading with Mesh Incorporated Applied Around the Window Opening

Plate 15 – Base Coat and Mesh Applied over Cement Board Joints

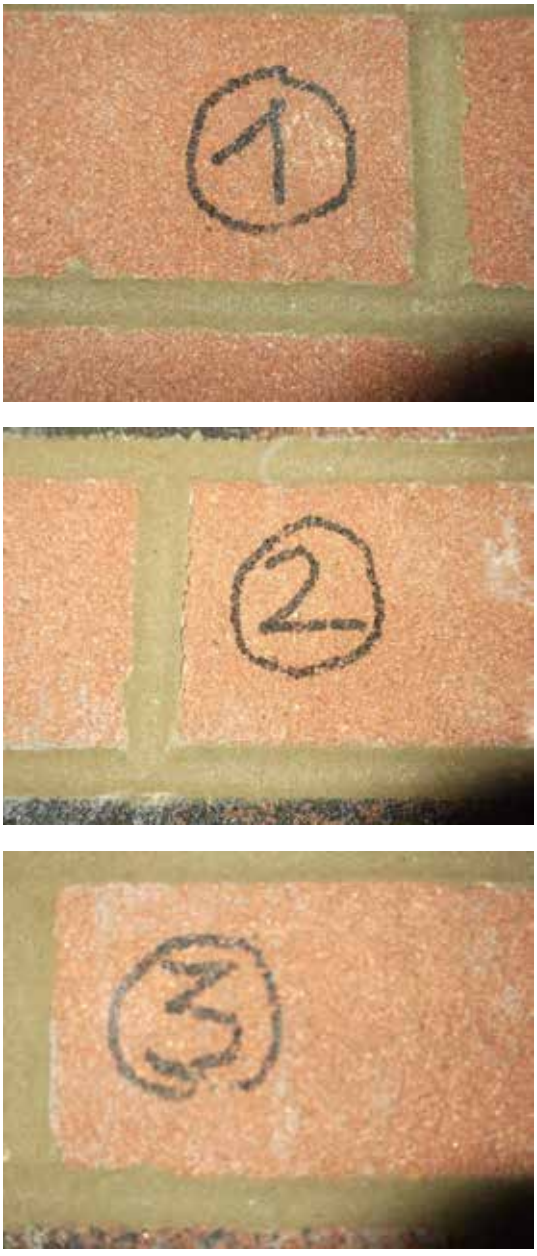
Plate 16 – Brickspan Corner Sheet Adhesively Applied Around the Window Opening (Left) and Briskspan Sheet Fully Applied to the Right Hand Side of the Wall (Right)

Plate 17 –Brickspan Sheets Pointed with Pointing Mortar

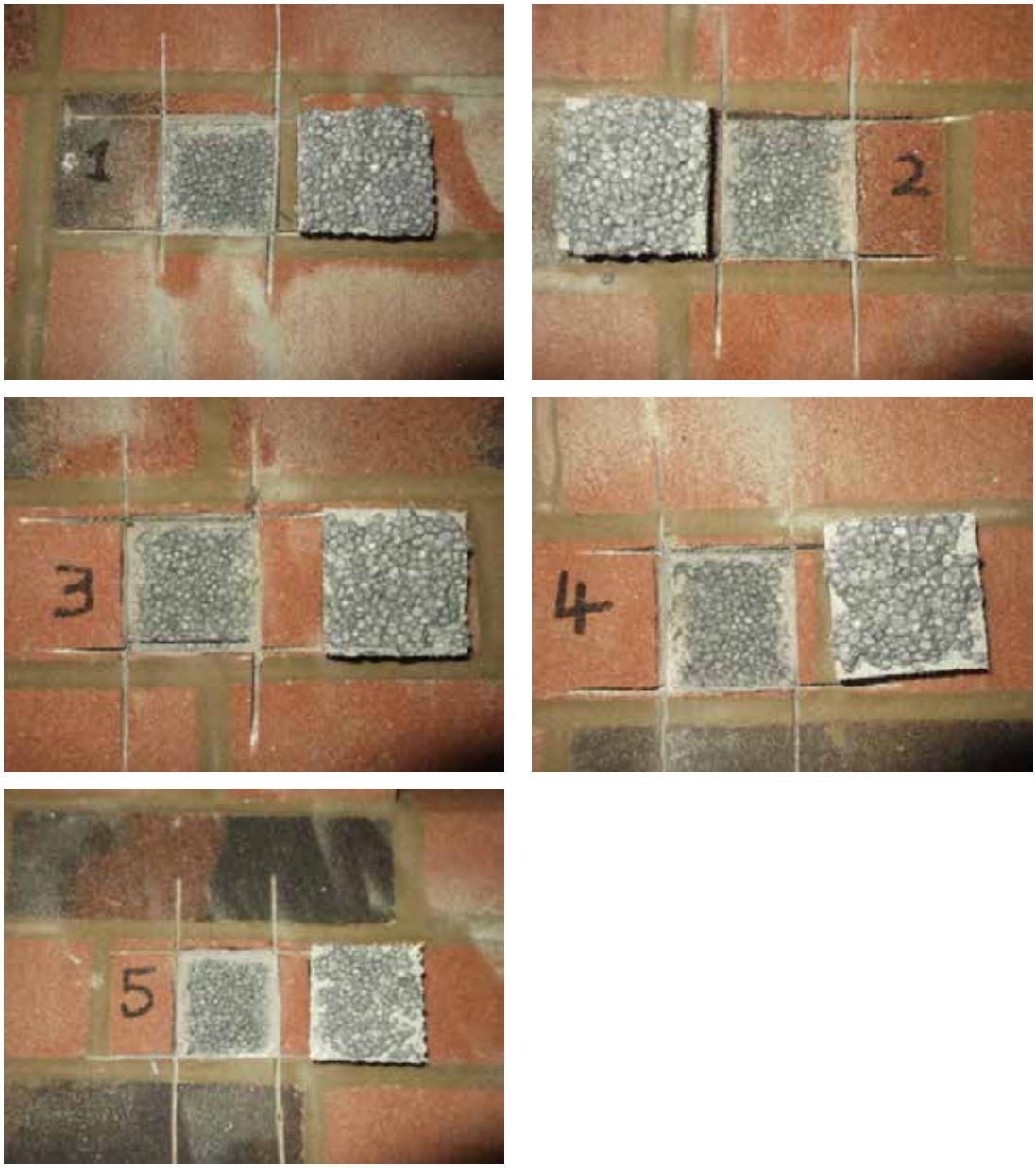
Plate 18 –View of the Wall at the End of the Installation

APPENDIX 4 - Test Photos

System One



Plates 1 – Impact Test – System One



Plates 2 - Bond Strength After Hygrothermal Test – System One

Plates 3 - Bond Strength Control – System One

System Two

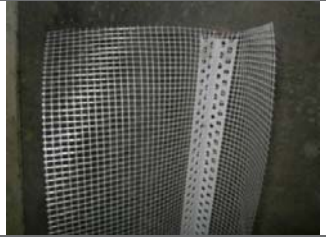
Plates 4 – Impact Test – System Two

Plates 5 - Bond Strength After Hygrothermal Test – System Two

Plates 6 - Bond Strength Control – System Two

APPENDIX 5 - Batch Details

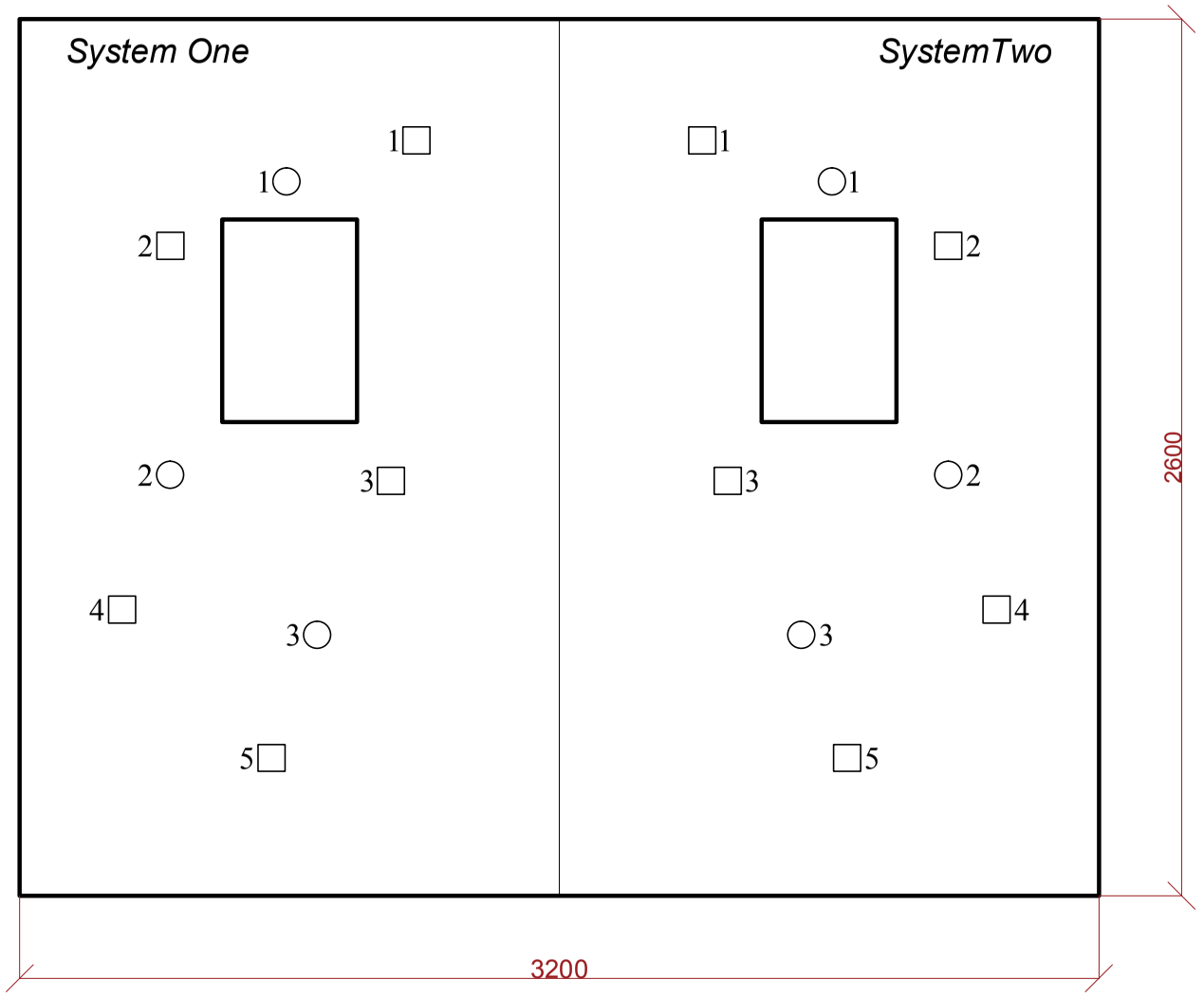
Product	Description	Batch Reference	Image of Label
Insulation (System 1)	EPS Insulation Thickness = 90mm Length = 1200 mm Width = 600 mm	No B.N. or D.O.B.	–
Cement board (System 2)	FERMACELL Powerpanel H_2O boards	No B.N. or D.O.B.	–
Base Coat/ Adhesive (for Insulation)	MAPEI Mapetherm AR1 GG Grey 25kg	D.O.B. – 28/11/2014 19:52:44 39	
Adhesive	MAPEI Fix & Grout Brick	B.N. – 958802 D.O.B. – 5/7/2014	
Finish	BRICKSPAN Brickspan Sheet 17.5 bricks per sheet Brick size: Length x Width = 215 x 65 mm	B.N. – 00197100 D.O.B. – 7/7/2015	
	BRICKSPAN Brickspan Corner Sheet 8 bricks per sheet Brick size: Length x Width = 215 x 65 mm	B.N. – 00197100 D.O.B. – 26/5/2015	–

Product	Description	Batch Reference	Image of Label
Pointing Mortar	BRICKSPAN Brickspan Pointing Mortar 15 Kg Colour: Old English	B.N. – 00196800	
Mesh	MAPEI Mapetherm Net	B.N. – 29326 D.O.B. – 8/7/2014	
Fixings (for Insulation)	SPIT ISO 10x135/95-105 T60 Length = 135 mm Diameter head = 60 mm 057630	D.O.B. – 14/01/2015 03:23	
Screws (for Cement Board)	FERMACELL Screws 3.9 X 35 Art Nr 79120	B.N. – 4007548 005531	–
Base Track	Base Track	No B.N. or D.O.B.	
Screws (for Base Track)	SPIT 6 X 55 V S 65046	B.N – 8160/13	
Corner Beading with Mesh Incorporated	Corner Beading with Mesh Incorporated	No B.N. or D.O.B.	

Legenda:

□ Bond Strength Tests

○ Impact Tests (3 Joule and 10 Joule)



DWG No.	SCALE	DATE	DRAWN BY:
Figure 1	Not to scale	19/08/2015	DE ZUANI

Detail and dimensions for Bond Strength Test and Impact Test

UKAS TESTING
0013

LUCIDEON
insight creating advantage

TEST REPORT

Lucideon Reference:	151845 (QT36289/1/SL)/Ref. 1
Project Title:	Hygrothermal Report of Two Facade Systems Incorporating BRICKSPAN Sheets to ETAG 004:2013
Client:	Paul James Bishop IP Holdings Ltd Bradley Hill Farmhouse Bradley Hill near Blakeney Gloucestershire GL15 4AW
For the Attention of:	Mr Paul Bishop
Author(s):	Miss Veronica De Zuani
Report Date:	20 August, 2015
Purchase Order No.:	001 TBS
Work Location:	Lucideon UK

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Miss Joanne Booth
Consultancy Team
Reviewer

Miss Veronica De Zuani
Consultancy Team
Project Manager

Lucideon Limited
Queens Road, Penkhull
Stoke-on-Trent
Staffordshire ST4 7LQ

T +44 (0)1782 764428
enquiries@lucideon.com
www.lucideon.com