TEST REPORT

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Project Title:	Tensile Testing and Accelerated Ageing of Brick-Fix A2 Firebond on a Stainless Steel Lintel. Tested in Accordance with EAD 090062-00-0404 and DD CEN/TS 772-22:2006
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1 INTRODUCTION

Urban Surface Protection Ltd wish to demonstrate the structural performance of their Brick-Fix A2 Firebond structural adhesive on a stainless-steel lintel following a programme of accelerated weathering. Urban Surface Protection Ltd wish to determine the bond strength of the brick slips adhered using A2 rated adhesive. The lintel was subjected to hygrothermal conditioning in accordance with EAD 90062-00-0404[1] and accelerated freeze/thaw cycling in accordance with TS EN 772-22[2].

Lucideon Limited determined the bond strength of the samples by undertaking pull-off tests based on the test method described BS EN 1015-12[3].

2 TEST SPECIMEN

1 No. 210 mm x 1565 mm (W x L) A2 Firebond, bonded brick slip clad steel lintel was submitted for bond strength testing after weathering.

3 TEST PROGRAMME

Testing involved subjecting the lintel to repeated hygrothermal cycles to simulate accelerated weathering.

3.1 Hygrothermal Testing

Testing was carried out in accordance with the method described for Hygrothermal Performance in EAD 090062-00-0404 Guideline for Technical Approval Kits for External Wall Cladding, Mechanical Fixing. The testing involved subjecting the lintel to repeated heat/rain cycles followed by repeated freeze/thaw cycles at controlled humidity conditions, designed to simulate naturally occurring conditions.

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

3.1.1 Heat/Rain – 80 Cycles

Heating to 70°C, rising over one hour and maintaining at 70°C (±5) at 10-15% RH for a further two hours. Followed by spraying with water [water temperature 15°C (±5)] at 1 l/m^2/minute for one hour. Then draining for two 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%.

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[1] EAD 090062-00-0404 Guideline for European technical approval of kits for external wall cladding, mechanically fixed

[2] DD CEN/TS 772-22:2006 Methods of Test for Masonry Units. Determination of Freeze/Thaw Resistance of Clay Masonry Units

[3] BS EN 1015-12:2000 Methods of Test for Mortar for Masonry. Determination of Adhesive Strength of Hardened Rendering and Plastering Mortars on Substrates

3.1.2 Heat/Cold – 5 Cycles

Exposure to 50ºC (±5) with a rise of one hour and maximum 10% RH for seven hours.

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

The test panel was inspected every four heat/rain cycles and daily, under the heat/cold cycles to observe changes in the visual characteristics of the panel.

3.2 Freeze/Thaw TS EN 722-22

After at least 48 hours of subsequent conditioning at temperatures between 10 and 25°C and a minimum relative humidity of 50%, the same test rig being exposed to a series of 100 cycles comprising of the following phases:

- Exposure to 20 (±3)°C for 20 minutes.
- Spraying for two minutes.
- Exposure to -15 (±3)°C for two hours.

Visual observation was carried out after 25 and 100 freeze/thaw cycles.

3.3 Tensile Testing BS EN 1015-12

On completion of the accelerated weathering, the A2 Firebond, bonded lintel was tested to determine tensile strength.

The lintel was tested using a steel reaction frame, which was positioned over the samples, so that the centre of the top clamp was in line with the centre of the brick slips.

A calibrated load cell and hydraulic pull-through ram were positioned on top of the reaction frame. A M12 threaded bar was guided vertically through the whole system and screwed into a spreader plate which was adhered to the brick slip using the A2 firebond two-part epoxy resin system. The opposite end of the threaded bar clamped the whole system via a M12 nut and washer.

A tensile load was applied to the samples at a rate such that failure occurred within 1-2 minutes. A hydraulic pump was used to apply the load via the hydraulic pull-through ram. Load was recorded via a calibrated data logger.

Bond strength of the samples σ_B was determined using the tensile load at failure f and the area of the Plate A, according to the equation below:

$$\sigma_B = f/A$$

4 RESULTS

4.1 Hygrothermal Testing

The requirements of the hygrothermal testing are that there should be no:

- Failure or cracking associated with the mortar joints.
- Cracking of the brick slips.
- De-bonding of the brick slips.

The lintel was thoroughly visually examined for defects with no damage or discolouration noted and in addition, an auditory tapping test was undertaken to identify any loose, or de-bonding brick slips and this indicated that all were still well adhered.

4.2 Tensile Testing BS EN 1015-12

The failure loads and tensile strengths for each of the samples are recorded in Table 2.

The mean values are given in Table 1. Plates 2 and 3 show the failure mode of the brick slips. In all instances, failure occurred within the body of the brick slip. This indicates that the bond between the brick slip and substrate is stronger than the brick slip itself.

Table 1 - Mean Tensile Strength

	Mean Tensile Strength (N/mm^2)
Weathered A2 Firebond Lintel	0.39

5 CONCLUSIONS

The failure mode for the A2 Firebond, bonded brick slip lintel in all cases was found to be tensile failure within the brick-slip without fracture of the adhesive layer between the brick-slip and the steel substrate. In all instances, the adhesive bond strength was deemed to be far greater than the test values.

Design to resist wind load is a complex subject and every location is unique. However, it has been calculated that in the North of Scotland an event once in 50 years will result in a gust of wind reaching approximately 56 m/s (125 mph). This equates to a force of approximately 0.0019 N/mm^2. A safety factor of 10 is then incorporated based on values obtained from ETAG 004 which is used for EWI systems giving a value of 0.019 N/mm^2. The values obtained for weathered lintel were in excess of this.

TABLE

Table 2 - Tensile Strength A2 Firebond Steel Lintel

Specimen	Sample No.	Maximum Failure Load (kN)	Tensile Strength (N/mm^2)	Failure Mode
Control	1	9.26	0.45	Within the body of the brick slip
	2	8.31	0.41	Within the body of the brick slip
	3	6.62	0.32	Within the body of the brick slip
Mean	**-**	**8.06**	**0.39**	**-**

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

END OF REPORT