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TEST REPORT

Ceram Reference:	125602 (Email)/Ref 1.0
Project Title:	Structural Testing of GRP Building Products Ltd Pre-Fabricated Chimney Systems
Client:	GRP Building Products Ltd Unit 2A Ham Lane Kingswinford West Midlands DY6 7JU
For the Attention of:	Mr John Banbury
Author(s):	Mr Peng He
Report Date:	21 November, 2012
Purchase Order No.:	659972
Work Location:	Ceram UK

Miss Lisa Cobden
Consultancy Team
Reviewer

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Project Manager

CONTENTS

1. INTRODUCTION

GRP Building Products Ltd supplied Ceram with three types of their pre-fabricated GRP Chimney systems, the Mid Ridge Chimney, the Mono Pitch Chimney and the Gable End Chimney to be subjected to several types of strength tests and soak coat water testing to determine the product's performance.

2. TEST PROGRAMME

Programme of Work

Test Type	Description
Wind Resistance	Applying a serviceability UDL of 1.8kN/m^2 to adjacent faces of each of the Chimneys and taking one face to failure to determine the whole unit wind resistance
Soak Coat Water Test	A controlled spray of water to cover each of the Chimneys whilst installed on a mock roof set-up and ran for three days to determine whether any water ingress is occurring
Hygrothermal Test	A 1000x1000mm GRP panel subjected to heat, rain and freeze-thaw cycles. The other panel used as a control panel, the results then compared to establish any difference in performance

3. SAMPLE DESCRIPTION

3.1 Mid Ridge Chimney

A general view of the Mid Ridge Chimney can be seen in Figure 1.

3.2 Mono Pitch Chimney

A general view of the Mono Pitch Chimney can be seen in Figure 2.

3.3 Gable End Chimney

A general view of the Gable End Chimney type can be seen in Figure 3.

3.4 GRP Test Panels

Two GRP test panels were supplied, one to be a control panel and one to be conditioned prior to testing.

One panel was tested for simulated accelerated weathering in accordance with ETAG004. Each panel comprised of nominal dimensions of 1000mm x 1000mm.

4. TEST ARRANGEMENT

4.1 Wind Resistance

All Chimney types were installed on a roof mock-up module in accordance with GRP Building Products Ltd Installation specification. A steel portal frame was positioned and fixed to the structures strong floor providing a framework for two hydraulic rams with pivoting loading feet and connected via a common manifold, to supply a load reaction.

A steel reaction frame was fixed to the structures strong floor preventing each roof module being moved due to loading.

A cable linear voltage displacement transducer (LVDT) was used to measure deflection and was fixed to the top centre of the opposite chimney face to that which was being loaded. A second cable LVDT was fixed to the roof module itself, to take into account the overall movement of the roof module. Load pressure was measured via a calibrated manometer and recorded via a calibrated data logger.

Load was measured via a calibrated load cell and recorded via a calibrated data logger.

A general view of each Wind Resistance test arrangement can be seen in Plates 1 – 3.

4.2 Soak Coat Water Test

All Chimney types were installed on a roof truss mock-up module in accordance with GRP Building Products Ltd Installation specification. A scaffold framework was erected enabling a water spray system to be arranged around each chimney such that the coverage of water was focused on any suspected weak points, the chimney sealant and lead flashing.

A general view for Soak Coat Water Test arrangement can be seen in Plates 4 – 6.

4.3 Accelerated Weathering Test

A 1000x1000mm GRP panel was placed vertically in a large scale hygrothermal test chamber such that the GRP face of the panel was subjected to the accelerated weathering test conditions.

5. TEST METHODS

5.1 Wind Resistance

Two adjacent faces of each chimney type were loaded to the serviceability load of 1.8kN/m^2 and held for 5 minutes, then inspected for any sign of damage.

One face of each chimney was loaded until failure occurred; the loading rate was such that failure occurred between 5-10 minutes.

5.2 Soak Coat Water Test

The water spray system applied a soak coat of water, covering the complete chimney and relevant connections continuously for a duration of 3 days and monitored via visual inspection for any signs of water ingress on the inside of the roof structure.

The chimney was deemed to pass if no water ingress occurred and classed as failed if water leakage due to the chimney and its connections was present within the roof structure.

5.3 Accelerated Weathering Test

Testing was carried out in accordance with the method described for Hygrothermal Performance in ETAG004 March 2000 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:

5.3.1 Weathering Cycles

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

Heat Rain - 80 cycles
Heating to 70^{o}C rising over 1 hour and maintaining at 70^{o}C ± 5 at 10-15% Relative Humidity (RH) for a further 2 hrs.

Followed by spraying with water (water temp ± 15^{o}C) at 1l/m2/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^{o}C with a minimum RH of 50%.

Heat Cold – 5 cycles
Exposure to 50^{o}C ± 5 with a rise of 1 hour and maximum 10% RH for 7 hours.

Exposure to -20^{o}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.

6. RESULTS

6.1 Wind Resistance

Wind Resistance Results

Chimney Type	Chimney Face	Serviceability Load – 1.8kN/m^2	Serviceability Deflection (mm)	Maximum Load (kN/m^2)	Failure Deflection (mm)
Mid Ridge	Parallel	Pass	0.81	5.40	3.27
	Perpendicular	Pass	1.51	5.40	5.95
Mono Pitch	Parallel	Pass	1.57	5.40	4.86
	Perpendicular	Pass	2.18	5.40	8.20
Gable End	Parallel	Pass	0.68	5.40	1.73
	Perpendicular	Pass	1.68	5.40	6.75

All chimney types withstood the serviceability load of 1.8kN/m^2 and showed no sign of damage. Design to resist wind load is a complex subject and every location is unique. However, 1.8kN/m^2 is a very high load which would only be reached in very exposed circumstances in the windiest areas of the UK. The serviceability deflection did not exceed $^1/_{500}$ of the loaded height, which is extremely small.

The Mid Ridge, Mono Pitch and Gable End Chimneys showed no sign of damage under maximum load as the test was stopped prior to failure of the chimney with the roof timber structure failing under load rather then the chimney. The load to cause failure was at least 3.0 times the serviceability load.

6.2 Soak Coat Water Test

Soak Coat Water Test Results

Chimney Type	Day 1	Day 2	Day 3
Mid Ridge	Pass	Pass	Pass
Mono Pitch	Pass	Pass	Pass
Gable End	Pass	Pass	Pass

All Chimneys successfully passed the soak coat water test and showed no signs of water ingress throughout test.

6.3 Accelerated Weathering Test

On completing the full heat rain and heat cold test regime the panel was examined for visual signs of deterioration. No deterioration was noted.

The GRP control panel and the conditioning panel after accelerated weathering test are shown in Plate 7.

7. SUMMARY

GRP Building Products Ltd Chimney Overall Results

Chimney Type	Wind Resistance Serviceability Load	Soak Coat Water Test	Accelerated Weathering Test
Mid Ridge	Pass	Pass	Pass
Mono Pitch	Pass	Pass	Pass
Gable End	Pass	Pass	Pass

All GRP Building Products Ltd chimney types tested under this test programme would be deemed to have passed the testing requirements for CGMA entry.

Plate 1: Mid Ridge Chimney under UDL

Plate 2: Mono Pitch Chimney under UDL

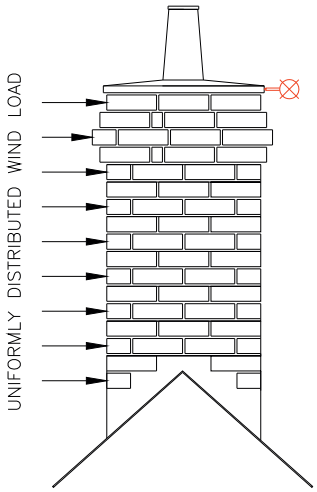
Plate 3: Gable End Chimney under UDL

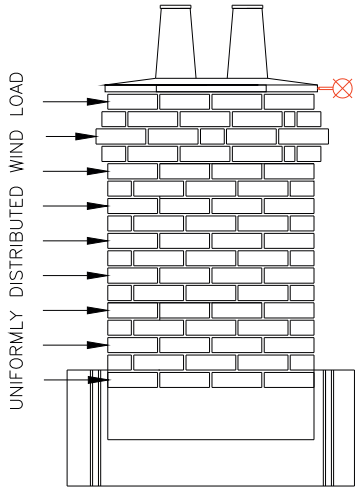
Plate 4: Mid Ridge Chimney under Soak Coat Water Test

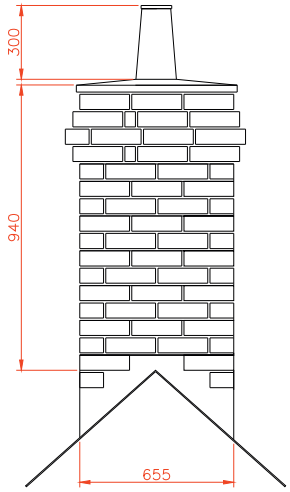
Plate 5: Mono Pitch Chimney under Soak Coat Water Test

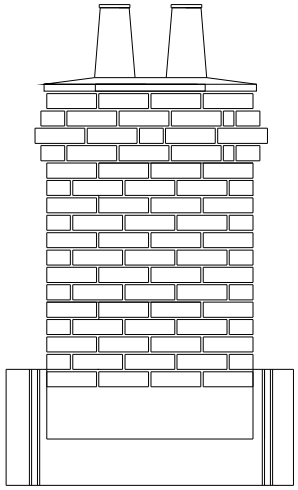
Plate 6: Gable End Chimney under Soak Coat Water Test

Plate 7: GRP Control Panel and Conditioning Panel after Accelerated Weathering Test









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DWG. N°.	SCALE:	DATE:	DRAWN BY:
Figure 1	NOT TO SCALE	14/11/2012	A. BELLAMY

TITLE: Detail and dimensions for tests on mid-ridge chimney

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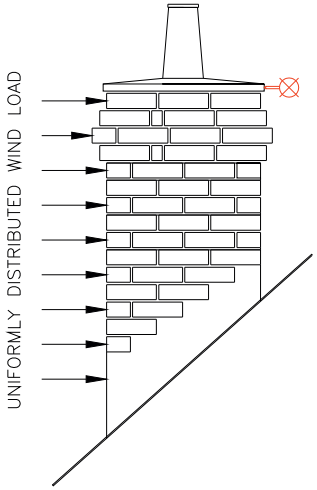

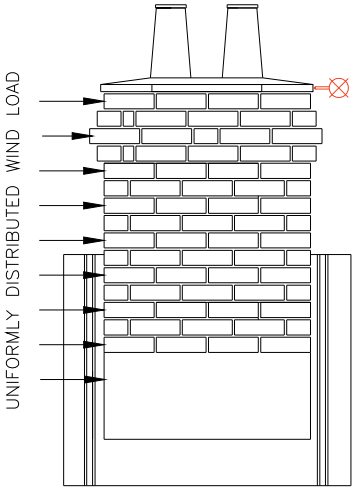

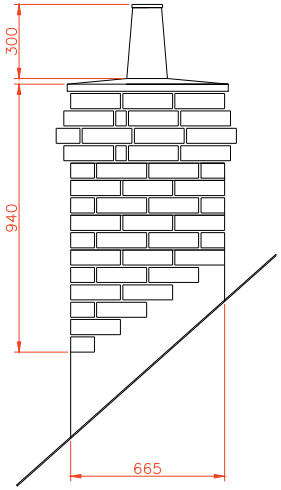

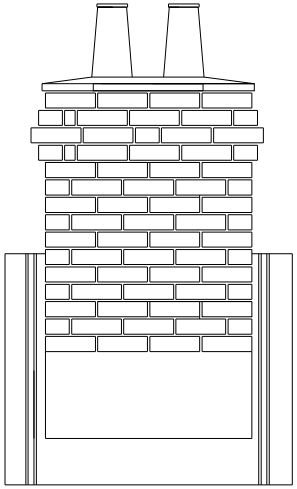

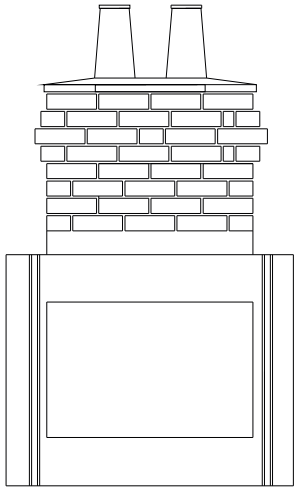

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Figure 2	NOT TO SCALE	14/11/2012	A. BELLAMY

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Detail and dimensions for tests on mono-pitch chimney

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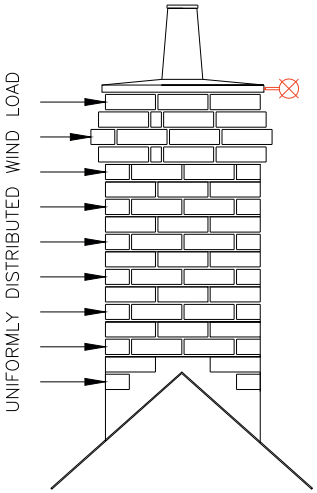

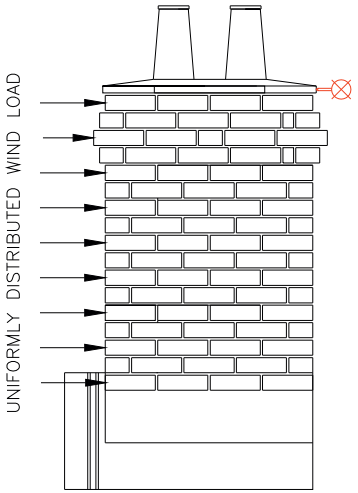

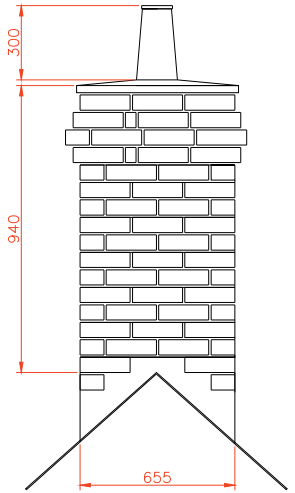

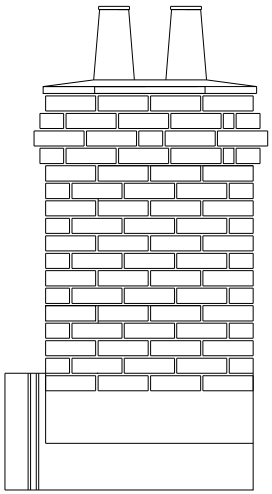

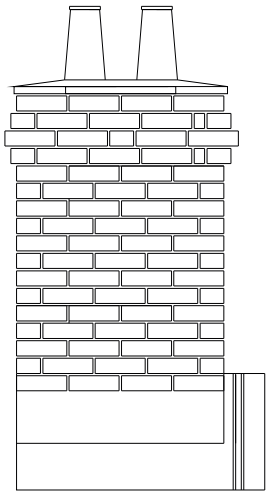

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Figure 3	NOT TO SCALE	14/11/2012	A. BELLAMY

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Detail and dimensions for tests on gable-end chimney

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