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TEST REPORT

ST1065 R1

FACE LOAD TESTING OF EUROBORD CLADDING SYSTEM

CLIENT
Flashman Flashing Systems Ltd.
New Zealand

LIMITATIONS

The results reported here relate only to the items tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

REVISION STATUS

This report, ST1065 R1 is a more current version of the report ST1065. The original report was revised to more accurately reflect the aims of the test programme and the obtained results. The only changes are to the wording and do not include any changes to the previously obtained results.

SIGNATORIES

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1. OBJECTIVE

The purpose of this testing was to determine the design level of differential pressure able to be resisted by the Eurobord wall system using stud spacing of 600 mm. Based on these test results, maximum allowable design wind speeds and wind pressures were calculated for the following:

(a) The wind zones of the New Zealand timber framed building standard NZS 3604 [1];

(b) The wind speed classifications N1 to N4 applicable to the non-cyclonic wind regions A and B specified in the Australian residential timber-framed construction standards, AS1684.2 [2] and AS 1684.4 [3]. The ultimate limit state design gust wind speeds (m/sec) applicable to the wind speed classifications N1 to N4 are specified in AS 4055 [4].

2. DESCRIPTION OF TEST SPECIMEN

A single Eurobord specimen was provided by the client for testing with studs at 600 mm centres and dwangs at 800 mm centres. The specimen covered a nominal area of 2.4 m x 2.4 m, a size selected to fit within the opening of the laboratory pressure chamber at BRANZ. The test specimen consisted of approximately 400 mm wide by 2400 mm long aluminium panels running vertically, that clipped together and were secured to the timber frame through 18 mm x 45 mm horizontal battens into the framing. The timber frame was constructed using 140 mm x 45 mm SG8 timber and included studs on 600 mm centres, top and bottom plates, and horizontal dwangs on 800 mm centres. The attachment of the aluminium panels to the timber frame was made with 6.2 mm x 65 mm galvanised hex-head self-drilling screws on vertical 800 mm centres. The screws were installed through horizontally running battens into the dwangs or studs. Strong-backs were included at the top and bottom plate and dwang locations to strengthen the frame. These strong-backs were horizontally orientated 140 mm x 45 mm SG8 timber members that were screwed to the plates and studs as shown in Figure 1. In order to help prevent failure of the top plate connection to the inside of the pressure box, short lengths of dummy stud were fixed to the top of each stud. These extended past the top of the pressure box and thus frame shear load was partially transferred to the top of the pressure box via these dummy studs. These modifications were not considered to prejudice the conclusions reached in this report as the tests were intended to test the cladding and cladding fixings and not the framing.

The specimen had a loose fitting sheet of black 250 µm plastic installed between the inside face of the aluminium panels and the timber battens to maintain air tightness without affecting specimen strength. This plastic sheeting was included as part of the specimen construction done by the client.

Figure 1. Eurobord Face Load Specimen Installed in Pressure Box

3. DESCRIPTION OF TESTING

3.1 Date and Location of Testing

Face load pressure box testing was carried out in the Structures Testing Laboratory of BRANZ, Judgeford, New Zealand during August 2015.

3.2 Test Equipment

The specimen was secured in an upright position within the front opening of an airtight pressure chamber with the Eurobord exterior cladding positioned on the inside of the pressure box. The top and bottom plates were securely fixed to the perimeter of the chamber with Tek screws with additional dummy studs sharing the load as previously described. The sides of the specimen were not fixed to the chamber, but were sealed all around using the polythene sheet and adhesive tape so that the studs of the test construction could deflect without restraint from the side of the chamber.

Negative pressure (suction) was applied to the chamber using a centrifugal air pump. The fan speed was manually controlled during testing to create the target pressure as required by the cyclic loading regime. The test pressure was monitored with a manometer and all test pressures and deflections of the centre of the specimen were recorded manually throughout testing.

3.3 Testing Procedure

The test procedure used for face load testing is based on AS 4040.2:1992 [5]. The specimens were tested under negative pressure applied to the chamber shown in Figure 1 corresponding to "suction" on a building. The pressure was applied with an initial level of 1.0 kPa, then 2.0 kPa and then in increasing steps of 0.2 kPa. Each pressure step was held for one minute then released back to zero for 15 seconds before the next level of pressure was applied to the specimen. The maximum pressure resisted by the specimen was the greatest pressure that could be resisted for one minute.

4. OBSERVATIONS, RESULTS AND ANALYSIS

4.1 Observations and Results

The maximum pressure resisted by the Eurobord specimen for at least one minute was 6.2 kPa. The test was stopped at this stage as it was close to the limit of the test equipment. No damage was observed on the test specimen during testing and therefore the testing was continued to the limits of the testing apparatus. At the maximum pressure, the deflection of the specimen at the centre height and width was 24.9 mm. Upon unloading of the specimen there was 2.7 mm of residual deflection at that location.

4.2 Analysis

The Ultimate Limit State (ULS) design differential pressure has been derived from the test data using the k_t values described in Appendix B of AS/NZS1170.0 [6] for 10% assumed parent population variability for a single specimen. This resulted in a k_t value of 1.46.

The design capacity is the value of each single test result divided by the appropriate factor for variability (k_t). The ULS design differential pressure, p_d, is therefore given by p_d = 6.2/1.46 = 4.3 kPa for the tested Eurobord specimen.

5. DESIGN WIND SPEEDS

The analysis given below is only applicable to the exterior walls of buildings which fall within the scope of NZS 3604 [1], AS1684.2 [2] and AS 1684.4[3]. These standards assume:

- The interior of walls are fully lined and consequently wall cavity internal pressures are taken as zero in this analysis.
- The framing is separately designed for the design wind speeds calculated below.

The wind loadings are based on AS/NZS 1170.2:2011[7]. The design wind pressure, p, is given by Eq 2.4(1) of AS/NZS 1170.2 as:

$$p = 0.6V_{des}^2 \times C_{fig} \times C_{dyn} \quad (Pa),$$

where:

V_{des} is the design wind speed applicable to the relevant wind zone.

C_{fig} is the aerodynamic shape factor

C_{dyn} is the dynamic response factor = 1.0 for walls of a building within the scope of application described above.

The aerodynamic shape factor from Eq 5.2 of AS/NZS 1170.2 is given by:

$C_{fig} = C_{pe}K_aK_cK_LK_p$ for external pressures and $C_{fig} = C_{pi}K_aK_c$ for internal pressures.

For houses within the scope on NZS 3604 and AS 1684 the maximum C_{pe} = -0.65 suction, K_a = 1.0, K_L = 2.0 within 0.5a of a corner and 1.5 within 1.0a of a corner, (where 'a' = minimum of 0.2 times the length or width of the house and apex height), K_c = 1 for a single wall and generally K_p = 1.0.

Generally the width of New Zealand and Australian houses does not exceed 12 m. Hence, 'a' is taken as 0.2 x 12 = 2.4 m. Thus, within 1.2 m of a corner this report has used K_L = 2.0 and elsewhere it has used K_L = 1.5. For areas beyond 2.4 m from the corner this is a slightly conservative assumption.

Substituting these values gives the external pressure, p_e, on a wall as:

$p_e = 0.6V_{des}^2 \times 0.65 \times 1 \times 1 \times 2 \times 1 = 0.78V_{des}^2$ within 1200 mm of a corner; and

$p_e = 0.6V_{des}^2 \times 0.65 \times 1 \times 1 \times 1.5 \times 1 = 0.585V_{des}^2$ at more than 1200 mm from a corner.

As discussed in the assumptions above, the internal pressure coefficient, C_{pi}, has been taken to be zero and thus the internal pressure, p_i, on a wall = 0.

Thus, the demand differential pressure, p_z, to be resisted by cladding within a specified wind zone is given by:

$p_z = (p_i + p_e) = (0 + p_e) = p_e = 0.78V_{des}^2$ within 1200 mm of a corner and;

$p_z = (p_i + p_e) = (0 + p_e) = p_e = 0.585V_{des}^2$ at more than 1200 mm from a corner.

The demand differential pressures which are listed in Table 1 were derived using these equations.

Table 1. Demand Differential Pressures across a Wall Cladding on Lined Buildings Complying with the Scope of NZS 3604 and AS 1684.2

NZS 3604 or AS4055 wind zone	Wind speed m/s	Basic pressure (kPa)	Differential pressure Cpe = -0.65 (kPa)	
			KL=1.5	KL=2.0
L	32	0.614	0.599	0.799
N1	34	0.694	0.676	0.902
M	37	0.821	0.801	1.068
N2	40	0.960	0.936	1.248
H	44	1.162	1.133	1.510
VH or N3	50	1.500	1.463	1.950
EH	55	1.815	1.770	2.360
N4	61	2.233	2.177	2.902

From data in Table 1 and the determined design differential pressure of 4.3 kPa it can be seen that the tested Eurobord cladding system is suitable for wind zones up to EH and N4 when studs are on 600 mm centres and dwangs/nogs are at maximum 800 mm centres. This applies within 1200 mm of a corner as well as at more than 1200 mm from a corner. These results also indicate that the tested system has the ability to resist design differential pressures up to 4.3 kPa for specifically designed structures with the same framing layout.

6. CONCLUSIONS

Conclusions provided in this report are only applicable to wall systems constructed utilising the same components, fasteners, spacing and construction methods as the tested specimen. The conclusions below assume that the framing is separately designed for the design wind loading and the construction is as described in this report with the exception of the strong-backs and dummy stud extensions previously described. It applies to timber-framed construction, fully lined internally, which falls within the scope of NZS 3604, AS1684.2 or AS 1684.4.

The Eurobord system described may be used on non-specifically designed buildings in Wind Zones up to and including EH in New Zealand and N4 in Australia, and specifically designed buildings subjected to design differential wind pressures up to and including 4.3 kPa where the Eurobord weatherboards are fixed to studs or dwangs at maximum 800 mm centres, and the attachments are identical to those for the tested system.

7. REFERENCES

[1]. Standards New Zealand. NZS 3604:2011. Timber Framed Buildings. SNZ, Wellington, New Zealand.

[2]. Standards Australia. AS 1684.2 – 2010. Residential timber-framed construction – Non-cyclonic areas. SA, Sydney, Australia.

[3]. Standards Australia. AS 1684.4 – 2010. Residential timber-framed construction – Simplified - Non-cyclonic areas. SA, Sydney, Australia.

[4]. Standards Australia. AS 4055 – 2006. Wind loads for housing. SA, Sydney, Australia.

[5]. Standards Australia. AS 4040.2 – 1992. Method of testing roof and wall cladding. Method 2: Resistance to wind pressures for non-cyclone regions. SA, Sydney, Australia.

[6]. Standards New Zealand. AS/NZS 1170.0:2011. Structural design actions. Part 0: General Principles. SNZ, Wellington, New Zealand.

[7]. Standards New Zealand. AS/NZS 1170.2:2011. Structural design actions. Part 2: Wind actions. SNZ, Wellington, New Zealand.