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ST0758/2 Rev. 1

Pull-through tests of Ezpanel Anchors between Ezpanels and timber framing in the Ezpanel wall cavity system

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      - The date when the service should have been completed in the event of any alleged non-performance.

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   ii. any misstatement or misrepresentation of the Outputs, including Public Outputs;

   iii. any defects in the Products the subject of the Services; or

   iv. any changes, modifications or alterations to the Products the subject of the Services.

Pull-through tests of Ezpanel Anchors between Ezpanels and timber framing in the Ezpanel wall cavity system

1. CLIENT

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2. OBJECTIVE

To determine the characteristic pull-through strength of Ezpanel Anchors in nominal 50 mm thick autoclaved aerated concrete (AAC) for the Ezpanel cavity wall system.

This Report ST0758/2 Rev. 1 replaces ST0758/2 (Date of issue of 8 July 2008).

3. DESCRIPTION OF SPECIMENS

3.1 Product Description

The products used are shown in a drawing of the test setup in Figure 1 and a photograph in Figure 2. These were supplied by the client already assembled for the tests. The screw was drilled through the Ezpanel and batten and then screwed to the stud. The batten was not otherwise attached to the stud.

This report pertains to the products tested only. The products used for each test are described below.

- A 100 mm long, stainless steel screw with an 14 mm diameter head. The screw had a shank of 5.1 mm diameter, with the bottom 50 mm threaded with an outside thread diameter of 6.4 mm and it was designed to be self drilling in timber.
- An autoclaved aerated concrete panel with a measured density of 690 kg/m^3 and nominal dimensions 300 x 300 x 50 mm thick. A steel mesh with bars at nominal spacing of 150 mm in both directions and bar diameter of 3.2 mm was embedded in the lightweight concrete.
- A polystyrene batten of dimensions 55 x 20 x 100 mm long.
- A radiata pine kiln dried timber stud of dimensions 91 x 46 x 100 mm long.

4. DESCRIPTION OF TESTS

4.1 Date and Location of Tests

The tests were carried out in July 2008 at the Structural Engineering Laboratory of BRANZ Ltd, Judgeford, New Zealand.

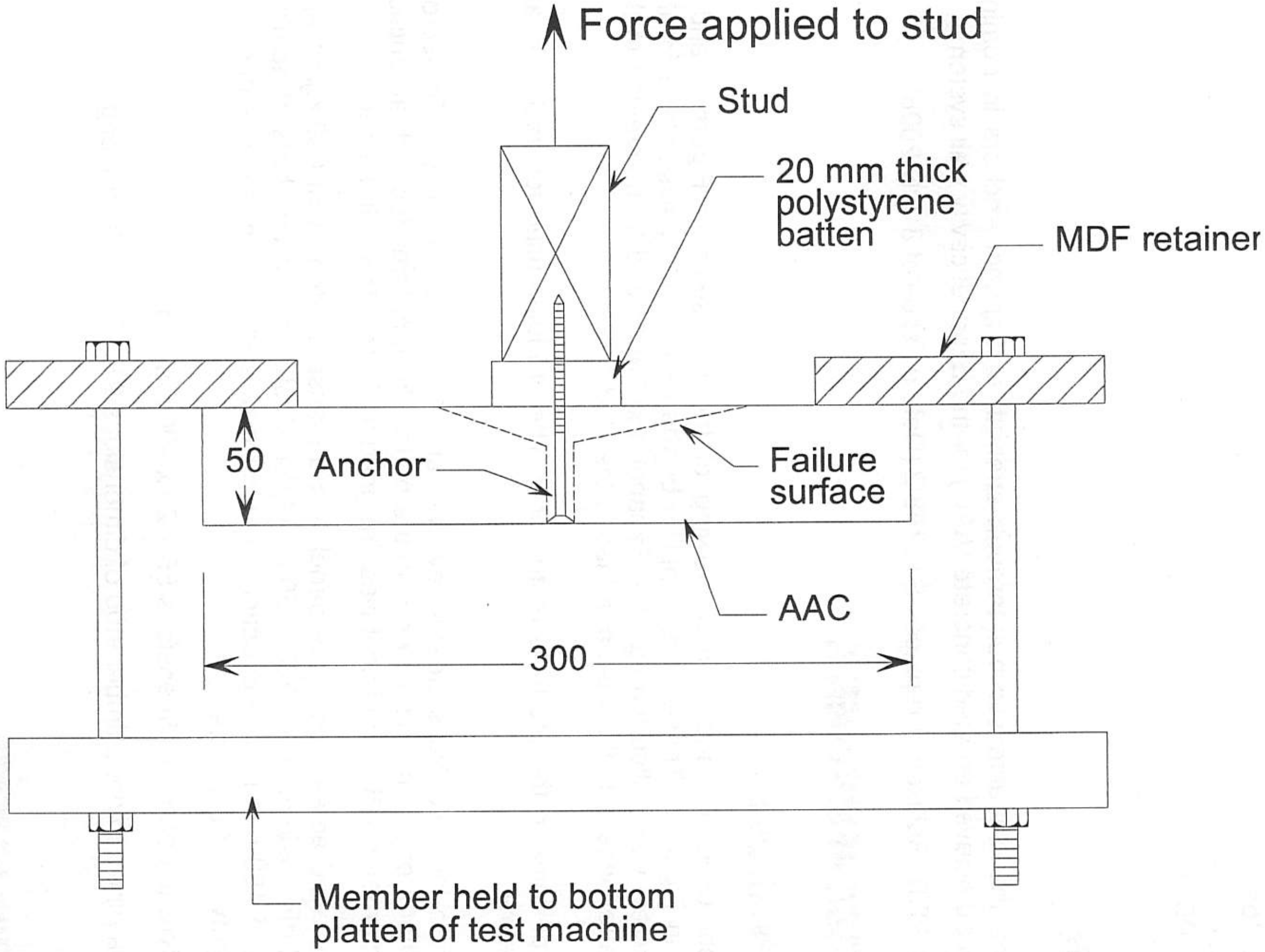

Figure 1. Cross section showing a schematic view of test setup, specimen construction and failure surface in the polystyrene

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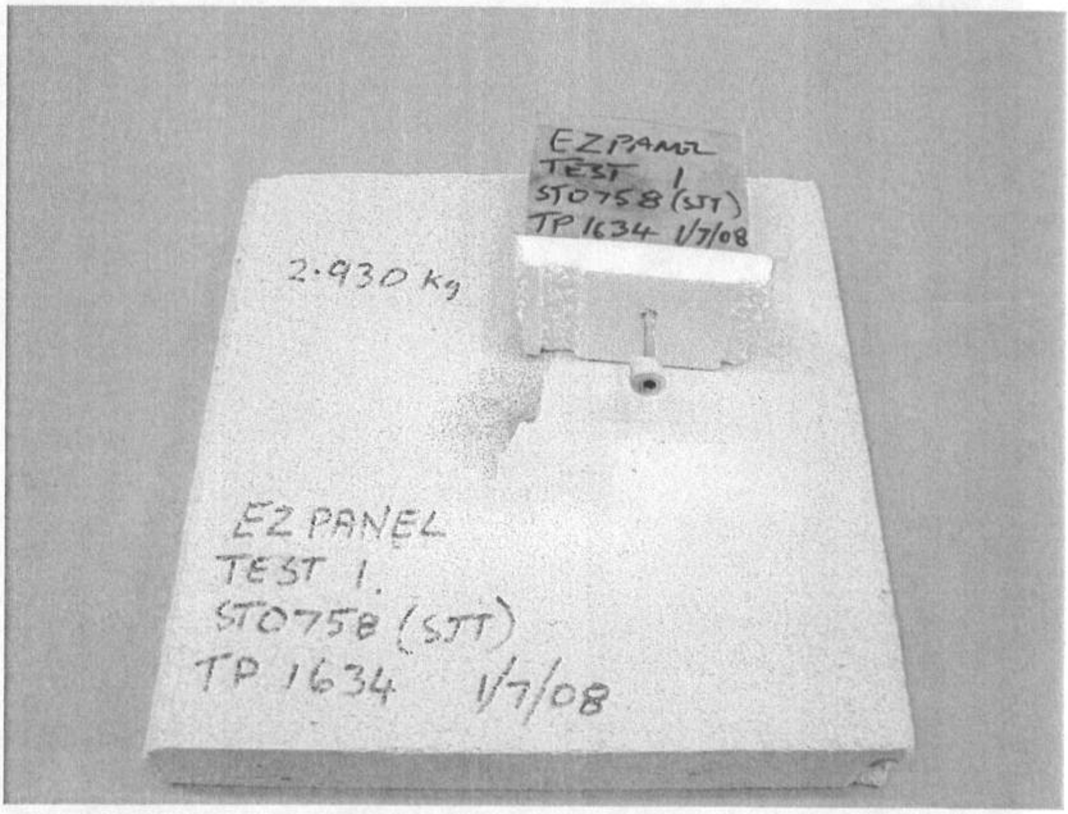

Figure 2 Products used

4.2 Test Arrangement and Equipment

The tests were undertaken in a Dartec Universal testing machine. A view of the test setup is given in Figure 1 and Figure 3.

The test load was measured with a 5 kN loadcell calibrated to International Standard EN ISO 7500-1 1999 Grade 1 accuracy. The loadcell output was monitored on a strain bridge which captured the peak load.

4.3 Test Procedure

The Ezpanel was supplied fixed to the stud through the batten with a screw. One end of an eyebolt was screwed into the stud and the other end was pinned to the load cell screwed into the upper platen of the test machine. The Ezpanel was retained against the underside of a plate with a 210 mm diameter hole at its centre. This plate was fixed to the bottom platen of the test machine (see Figure 3).

The top platen was raised at a cross head displacement rate of 20 mm per minute until failure, and the peak load registered by a strain bridge.

5. OBSERVATIONS

At peak load the screw head crushed the Ezpanel beneath leaving a cylindrical hole of the same diameter as the screw head for most of the thickness of the Ezpanel until a shallow cone broke out of the inside face as shown in Figure 1 and Figure 2.

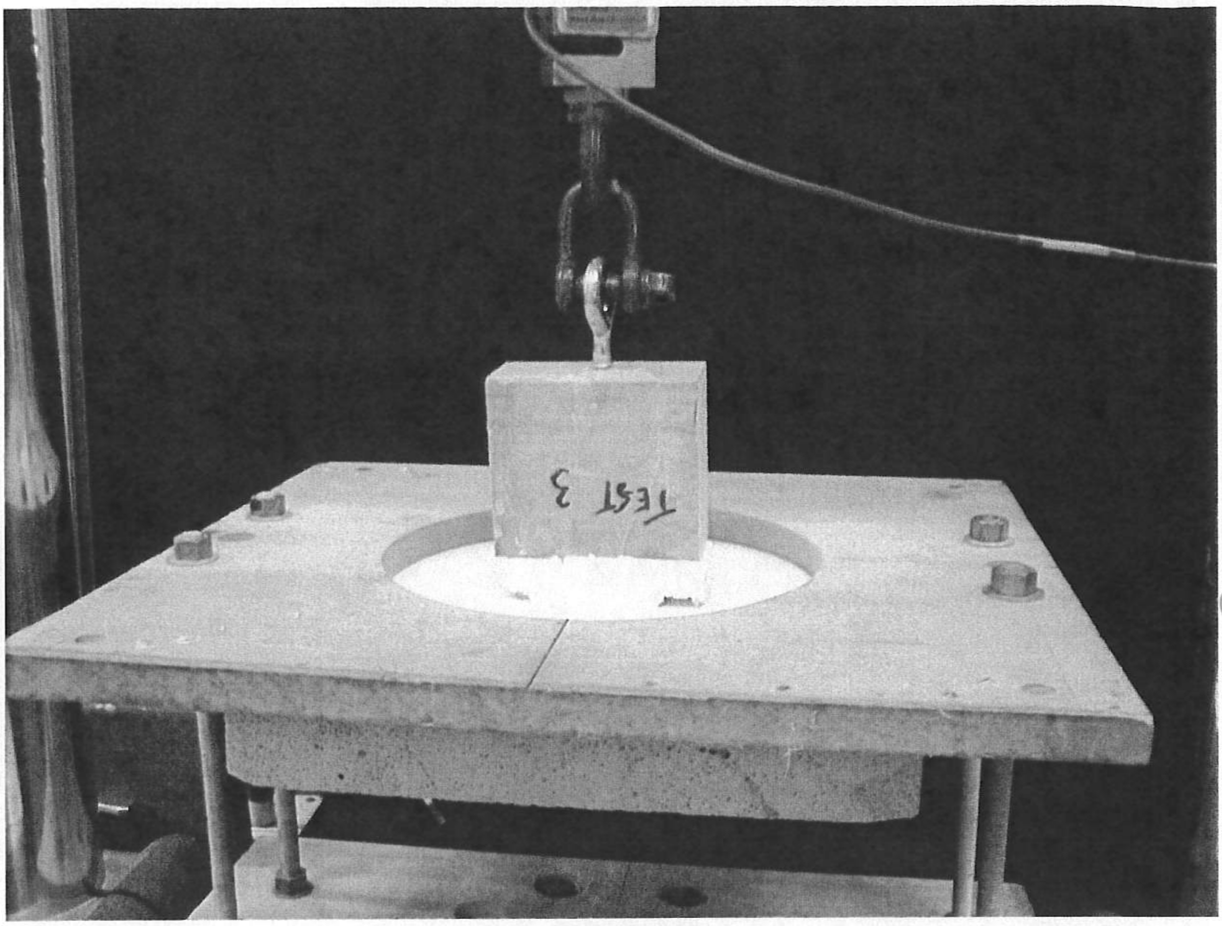

Figure 3 Test setup

6. RESULTS

The characteristic strength, determined using the procedure outlined in BRANZ Evaluation method EM1 [4] as shown in Appendix A, was 1.095 kN. The design strength of the Ezpanel anchor fixing is taken as 0.7 times the characteristic strength = 0.7 x 1.095 = 0.766 kN where 0.7 is the strength reduction factor. For screw spacing of 300 mm and a stud spacing of 600 mm, this gives a design differential pressure of 0.706/(0.6 x 0.3) = **3.92 kPa**. Note, this only considers the fixing strength and not the ability of the sheet to span between fixings or the stud strength nor the required stud strength.

A typical load deflection plot from the pullout tests is given in Figure 4.

7. 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]. It assumes:

- The interior of walls are fully lined and consequently wall cavity internal pressures are taken as zero in this analysis.

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- The framing is separately designed for the design wind speeds calculated below.

For design to NZS 3604, serviceability limit state is not a design criteria.

NZS 3604 wind loadings are based on NZS 4203:1992[2]. The basic ultimate wind pressure, q_z, is given by Eq 5.5.1 of NZS 4203 as:

$q_z = 0.6V_u^2$ (pascals)

The ultimate limit state design external wind pressure on the walls of a building, p_e, from Eq 5.6.3 of NZS 4203 is given by:

$p_e = C_{pe}K_aK_LK_pq_z$

For houses 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' = 0.2 times the length of the wall) and generally K_p = 1.0.

Substituting these values gives: $p_e = 1.3q_z$ within 0.5a of a corner.

The internal pressure, p_i, has been taken to be zero as discussed in the assumptions listed above. Thus, the ultimate design wind speed is calculated from:

V_u^2 (pascals) = 3920/(1.3 x 0.6), giving V_u = 70.9 m/sec.

As the design ultimate limit state wind speed for Very High wind zones, as stipulated in NZS 3604, is 50 m/sec the cladding system tested is suitable for lined buildings complying with the scope of NZS 3604 in all NZS 3604 wind zones up to and including Very High for stud spacing up to 600 mm and fastener spacing along the studs not exceeding 300 mm.

If the cladding is used for a fully lined building in a Very High wind zone the basic ultimate limit state wind pressure = 1.50 kPa (from Shelton, [3]). From NZS 4203:1992 the serviceability limit state (SLS) basic wind pressure = $(\frac{0.75}{0.93})^2$ x 1.5 = 0.976 kPa. The corresponding SLS design differential pressure for lined buildings complying with NZS 3604 = 1.3 x 0.976 = 1.27 kPa. For fasteners at 600 x 300 mm spacing, this represents a force of 1.27 x 0.6 x 0.3 = 0.229 kN. From Figure 4 fasteners will displace 0.4 mm at this load. It is possible that slight plaster cracking may occur at this serviceability level wind load displacement.

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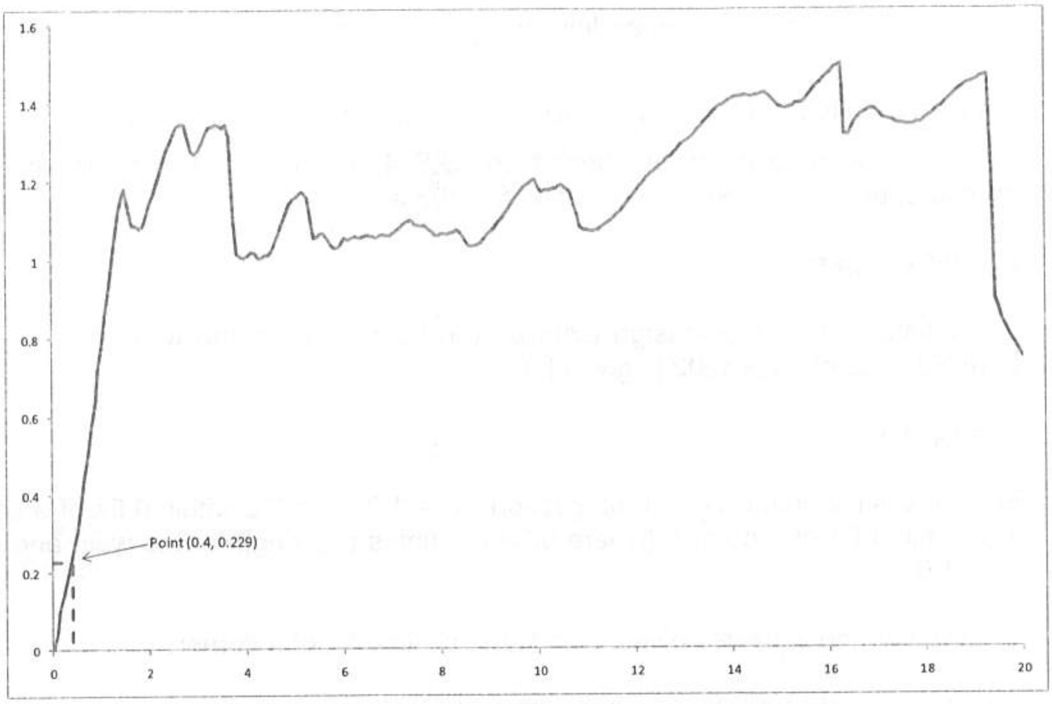

Figure 4. Typical plot of load versus displacement

8. CONCLUSION

BRANZ test report ST0758/3 has shown satisfactory performance of a complete wall panel under face load pressures. This report has considered the strength of the fixings which test report ST0758/3 showed govern the face load strength. Taken together the following conclusions can be drawn.

The conclusions on maximum wind speeds and basic wind pressures summarised below require the wall framing to also be designed for the stipulated wind speeds and pressures. It considers sheet fixing only and does not consider the ability of the cladding to span between fixings. The building must be internally lined. The screw anchors are at a maximum centres of 600 mm in the horizontal direction and 300 mm in the vertical direction.

The Ezpanel Cavity System, when fixed as described herein, may be used as exterior wall cladding in NZS 3604 type construction for all wind zones up to and including "Very High". It can resist an ultimate limit state differential wind pressure across the cladding up to 3.92 kPa for all buildings fixing the cladding as described herein.

9. REFERENCES

(1) Standards New Zealand. NZS 3604:1999. *Timber Framed Buildings.* SNZ, Wellington, New Zealand

(2) Standards New Zealand. NZS 4203:1992. *Loadings standard.* SNZ, Wellington, New Zealand.

(3) Shelton, R H 2007. The engineering basis of NZS 3604. BRANZ study report No 168.

(4) BRANZ, 1990. Evaluation Method No. 1 (1999). Structural joints – strength and stiffness evaluation. BRANZ Evaluation Method No 1.

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Appendix Test results

	Peak load (kN)
Specimen 1	1.481
Specimen 2	1.670
Specimen 3	1.757
Specimen 4	1.960
Specimen 5	1.401
Specimen 6	1.760
Specimen 7	2.022
Specimen 8	1.387
Specimen 9	1.499
Specimen 10	2.044
Specimen 11	1.403
Mean	1.671
Std dev	0.26
CoV (Std dev/mean)	0.1528

Calculation of Characteristic Strength for Ultimate Limit State Design
The characteristic strength determined from BRANZ Evaluation Method EM1

$R_k = (1- 2.7v/n^{0.5})P_{0.05}$
where

$P_{0.05}$ = Fifth percentile of the measured data	1.250
N = number of samples	11
V = coefficient of variation	0.1528

Thus
Rk = Characteristic Strength = **1.095** kN

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