Report prepared on behalf of
UNSW Global Pty Limited

Testing of Penny Panels

for

Penny World Pty Ltd

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7 November 2008

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1. Introduction:

On behalf of New South Global (the consulting arm of the University of new South Wales) the author undertook tests of "Penny Panels", lightweight concrete wall panels imported by Penny World Manufacture Pty Ltd. It is envisaged that the panels would find a role as load-bearing walls in general building applications. Specimen panels were tested for structural behaviour in compression and bending as described in the American Standard Test Method covering panels for building construction, ASTM E72 2000. .

The tests were undertaken at a storage facility in Artarmon NSW leased by the client under the supervision of the author, John Carrick, consulting engineer to New South Global. Compression tests were carried out on the 21st and 28th of August 2008. Bending tests were carried out on the 21st of October 2008.

2. Specimens:

2.1 Specimens:

"Penny Panel" wall panels are a sandwich consisting of outer layers of 4.5mm fibre-cement sheet each side of a layer of light concrete in which the coarsest aggregate consists of small styrene spheres (Photo 2). The panels tested in this programme of testing had an overall thickness of 75mm, were 600mm wide and of varying heights to approximately three metres. A shallow groove runs down both vertical edges of each panel to facilitate the formation of a vertical joint. Specimens tested in bending contained two 6mm steel rods embedded at mid depth approximately 120mm in from each edge. Specimens tested in compression were un-reinforced.

3. Test methods:

3.1 Compression Tests:

Three specimens each consisting of a pair of 75mm x 600mm x 2.8m high panels assembled side by side to form a 1.2m wide x 3m high section of wall were tested in vertical axial compression as required by Section 9 of ASTM E72-2005. Each specimen was set up vertically and loaded by a downward force at the midpoint of a steel beam placed centrally on the specimen's 75mm wide top face (Photo 1). The panels' adjoining vertical edges were simply butted together - no adhesive or aligning dowel was used. Vertical axial force was applied using a hydraulic ram reacting against the top beam of a self-reacting frame. The force was quantified by an electronic load cell and an amplifier unit with peak hold. Deflection transducers or dial indicators were mounted over a gauge length of 2.4metres on the front and back faces to assess axial strain. Lateral deflection (and buckling tendency) was assessed by a horizontal scale and level telescope. As the load was gradually increased, readings were taken of axial force and deflection. Generally, each specimen was tested until load drop-off and the rate of lateral deflection suggested incipient failure. In the case of the third specimen, the test was continued up to a clear and dramatic buckling failure. Deflection transducers were removed at a load of approximately 150kN. Generally, the level scale was read until ultimate load was reached.

3.2 Bending test:

The bending resistance of the panels was examined by applying bending action to a series of single-panel (600 wide x 75mm thick x 3m long) specimens arranged horizontally and supported over a span of 2.8 metres (Photo 3). A hydraulic ram and load cell were used to apply and quantify load to the outer quarter-points of the span as described in ASTM E72. Deflection was measured using dial indicators, one each side at mid-span and one at a support. Net central deflection was obtained by subtracting any downward support deflection from that of the mid-span of the loaded panel. Five replicate specimens were tested. In each case, the load was increased to failure in bending.

4. Results and Observations:

4.1 Compression tests:

The ultimate loads of the three specimen panel pairs are presented in Table 4.1. Large mid level deflections and decreasing load indicated incipient failure in Specimens 1 and 2. Specimen 3 was tested to destruction

Specimen Pair	Date Tested	Ultimate load (kN)
1	21.08.2008	218
2	28.08.2008	226
3	28.08.2008	201

Table 4.1

Plots of load against horizontal mid-height horizontal deflection are shown in Figure 4.1 below. An increase in lateral instability is generally evident after150kN in all three specimens.

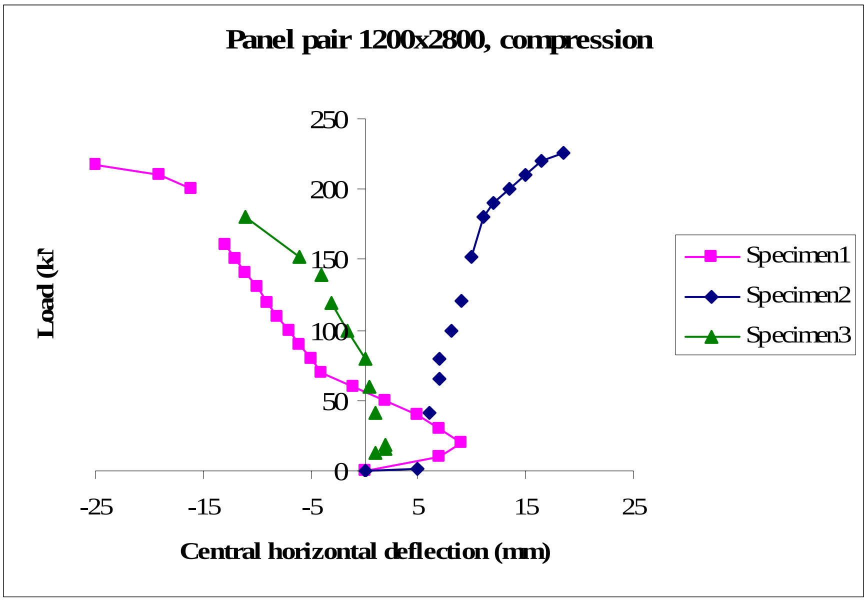


Figure 4.1

Figure 4.2 below plots the vertical shortening of the wall specimens against axial compression load. Consistent with the pattern observed for mid-height lateral deflection, a decrease in stiffness is evident for loads greater than approximately 150kN.

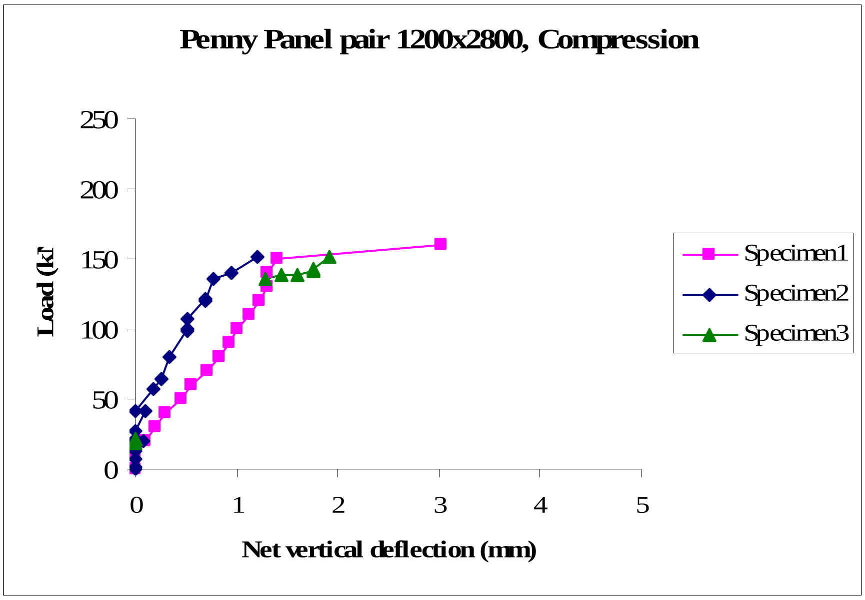


Figure 4.2

4.2 Bending tests:

Table 4.2 below shows the ultimate loads and calculated ultimate bending moments for the bending tests of 600 wide x 75mm thick panels loaded at outer quarter points and spanning 2.8metres. The ultimate bending moments ranged between 1.37kN.m and 1.95kN.m.

Specimen	Ultimate load (kN)	Ultimate Bending Moment (kN.m)
1	3.90	1.37
2	4.43	1.38
3	6.25	1.95
4	3.60	1.13
5	5.50	1.72
Mean:	4.74	**1.66**
Stdevn.	1.11	
Coef. of Vn.	0.2351	

Table 4.2

Figure 4.3 below shows load deflection curves for the bending tests. The curves show a linear response up to central deflections of about 14mm with a loss of stiffness preceding failure at central deflections between 20 and 28mm. In all cases the failure was brittle (Photo 4). Some cracking was observed in the tension side fibre reinforced sheet immediately prior to failure.

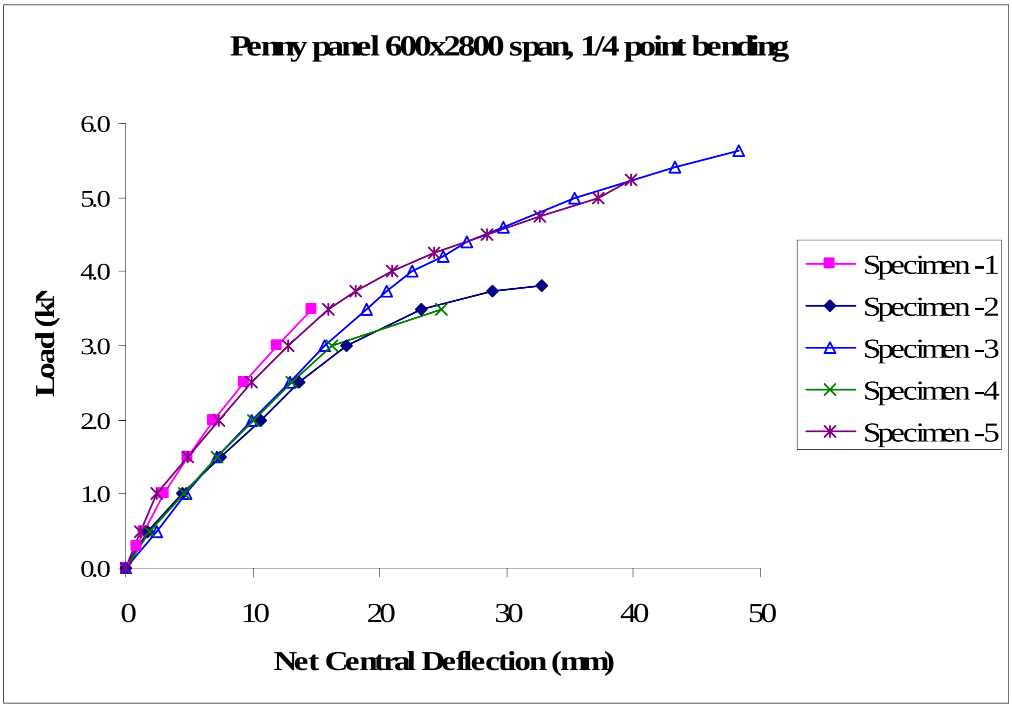
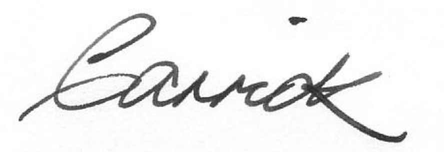


Figure 4.3



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