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A serviceability level racking test on a Rockcote AAC panel wall cavity system

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A serviceability level racking test on a Rockcote AAC panel wall cavity system

1. CLIENT

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2. OBJECTIVE

The test was performed to examine the damage to the nominal 50 mm thick autoclaved aerated concrete (AAC) Rockcote cavity wall system when the wall was subjected to both serviceability level and ultimate level seismic racking deflections. These were taken to be ±8 mm and ±36 mm respectively. Three cycles were also imposed at ±55 mm to examine the performance at extreme displacements.

3. DESCRIPTION OF SPECIMENS

This report pertains to the wall tested only. This was a timber framed wall clad with 12 lightweight panels screwed to the timber framing through polystyrene battens on the face of the studs.

The nominally 2.4 m x 2.4 m test specimen was made by the client. General photographs and photographs at various stages of testing are given in Figures 1 to 6.

The studs were at 600 mm centres and nogs at 800 mm centres. All framing timber was 90 x 45 grade MSG 8 Radiata Pine assembled using normal trade practice. The end studs were fixed to the bottom plate with a 25 mm x 1 mm thick steel strap wrapped under the timber plate and nailed to the stud and plate with hot dipped galvanised flat head nails of nominal length 30 mm and 2.5 mm shank diameter. Six nails were installed into each side of the stud and three into the side faces of the plate.

Polystyrene battens of cross-section dimensions 50 x 20 were used between wall framing and panels.

The galvanised steel screws used to fix the panels were 100 mm long and had a 14 mm diameter head. The anchor had a shank of 5.0 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.

The panels were made from autoclaved aerated concrete with a measured density of 622 kg/m^3 and contained a steel mesh with 3.2 mm diameter bars at nominal spacing of 180 mm in both directions. The panels were nominally 50 mm thick, 600 mm height and 600 or 900 mm long. Screws described in the paragraph above were used to fix each panel to the studs at mid-height and 50 mm from the top and bottom of the panel. The screws were countersunk into the panels so that the top of the head of each screw finished slightly indented into each panel. All panel joints were filled with a cement based mortar. Finally, a 3 mm thick surface plaster coating containing an unidentified blue fibreglass mesh was applied on the front surface of the panels.

The panels extended 30 mm past the bottom of the bottom plate as can be seen in Figure 3.

4. DESCRIPTION OF TESTS

4.1 Date and Location of Tests

The test was carried out in September 2009 at the Structural Engineering Laboratory of BRANZ Ltd, Judgeford, New Zealand.

4.2 Test Arrangement and Equipment

The racking test specimen was installed in a rigid steel loading frame. P21 end restraints were installed in accordance with the recommendations of BRANZ P21:1988. “A Wall Bracing Test and Evaluation Procedure”.

The bottom plate was fixed through a strip of 20 mm thick particle board floor and the timber foundation beam to the steel test rig using M12 threaded rods at 100 mm from the outside face of the end studs and at 100 mm from one side of the middle studs. A 50 mm x 50 mm x 3 mm washer was installed between the nut on each rod and the bottom plate.

Horizontal load was applied to the centre of the specimen top plate with a 30 kN closed loop electro-hydraulic ram and measured with a 25 kN load cell.

Nylon rollers were used to prevent out-of-plane movement of the top plate as close as possible to the ends of the specimen.

A linear potentiometer was used to measure the horizontal displacement of the top plate.

The test load and displacement measurements were recorded using a PC running a software program to record the data. The load cell was calibrated to International Standard EN ISO 7500-1 1999 Grade 1 accuracy and the linear potentiometers were calibrated to an accuracy of 0.2 mm.

4.3 Test Procedure

The loading sequence consisted of 3 displacement controlled cycles of the specimen top plate displacements of approximately ±8, ±16, ±36 and ±55 mm.

5. OBSERVATIONS

No damage was observed during the ±8 mm cycling.

During the ±16 mm cycling a single fine crack near both the top and bottom of the wall could be seen in the AAC panels at both wall ends (i.e., four cracks in total) (see Figure 3 and 4). Some differential vertical movement was observed between the frame and battens and between the battens and panels. The top plate was slipping significantly relative to the panels.

During the ±36 mm cycling the damage and slippage noted at ±16 mm cycling was accentuated. The wall studs lifted slightly from the bottom plate. The top plate was slipping on the end studs.

During the ±55 mm cycling 75% of the applied deflection was being taken up by slippage of the top plate relative to the cladding although there was little increase in differential movement frame-to-battens and battens-to-panels. It was noted that some screws from the cladding to the top plate were largely ineffective as they were located near the junction of the stud to the top plate. Portions of the panels were spalling at the ends at the top of the wall.

The plaster system on the front face did not crack or show signs of damage for the entire test program. The connection between AAC panels and the framing appeared to still be robust except that at the top of the wall as the fasteners were largely ineffective as discussed in the paragraph above.

6. CONCLUSIONS

In an earthquake, the AAC Rockcote cavity wall system is expected to “ride out” the expected deflections of the light timber frame to which it is attached with no observable damage at Serviceability Limit State deflections. Any slight cracking of the panels is not expected to be visible due to the plaster surface coating and would be of negligible consequence.

This conclusion does not apply at building corners which was not investigated in this study. Any damage here is expected to be repairable.

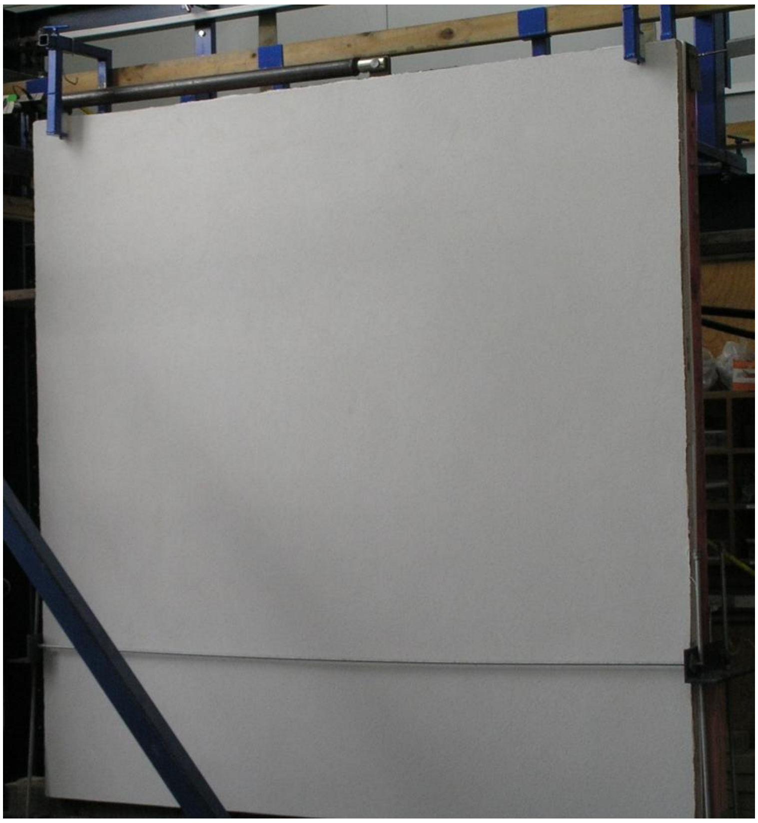

Figure 1. Front face of wall in the test rig prior to test

Figure 2. Rear face of wall construction

Figure 3. Bottom and top of panel south end after ±16 mm cycling

Figure 4. Top and bottom of panel north end after ±16 mm cycling

Figure 5. Top and bottom of panel north end after ±36 mm cycling

Figure 6. Top of panels at both ends after ±55 mm cycling