Seismic performance of brick veneer

Brick veneer is currently popular, being used in about 44% of new houses. Historically, brick veneer houses have not performed well in earthquakes but after recent building changes, how do the modern houses stand up?

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Brick veneer has been used in New Zealand for about 100 years. The system provides good weathertightness and needs little maintenance.

However, historically, brick veneer houses have not performed well in earthquakes. One reason for this was that the ties fixing the veneer to the timber framing were often made from just bent wire, which corroded significantly over the life of the home. During severe earthquakes, discrete panels of veneer fell away as the corroded tie broke. Sometimes, the staples or nails fixing the ties to the timber framing failed, or the ties withdrew from the mortar joints, with the same result.

Ties now screwed, not nailed

About 12 years ago, BRANZ discovered that the vibration caused by nail fixing ties to the timber framing substantially weakened the bond between the tie and the mortar. Nowadays, ties are robustly screwed to the timber framing, and the ties and their fixings must meet stiffness and strength requirements stipulated by standards.

These recent improvements are described in the BRANZ *Masonry veneer – good practice guide.*

Research on clay and concrete bricks

BRANZ recently investigated the earthquake performance of modern brick veneer houses. The research focused on 70 series (70 mm thick) brick veneer attached to a timber frame with a 50 mm gap between the two. The veneer was tied back to the timber framing with steel ties on a grid not greater than 600 mm horizontally by 400 mm vertically.

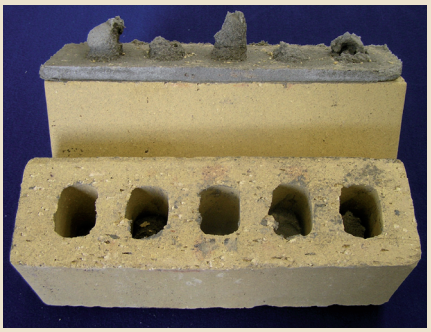

Figure 1: Clay bricks used showing mortar dowels.

Figure 2: Clay brick veneer building after cyclic racking tests.

Figure 3: Building before shake table tests.

Figure 4: Building during shake table tests.

By itself, the veneer is weak under face load wind and earthquake forces and relies on the timber framing to give it stability.

The clay bricks used in the investigation had five vertical holes for the full brick depth that were partially filled with mortar (Figure 1). This formed mortar dowels that provided a mechanical connection between the individual bricks, improving resistance to earthquake forces. The concrete bricks tested did not have these holes.

Slow cyclic racking tests were performed on two small, single-storey clay brick veneer buildings (see Figure 2). Cyclic racking means the building was pushed and pulled backwards and forwards in a manner simulating a real earthquake.

Shake table tests were also performed on another two small buildings (see Figures 3 and 4). Shake table testing simulates the speed and displacements caused by real earthquakes. A large concrete mass was attached to the roof to model the weight of a tile roof of a real house. One of the buildings used clay bricks and the other used concrete bricks.

Damage low

Both the clay and concrete brick constructions performed well at the strength of earthquake that houses are designed for. Once the

Figure 5: Damage to concrete brick veneer after *extreme* levels of shake table testing.

shaking had stopped, the cracks almost closed and the brick veneer returned close to its original position. Any remaining cracks could be easily and cheaply repaired by re-pointing.

At extreme levels of shaking, more than three times the design level, the clay brick veneer remained intact (Figure 4). However, at twice the design earthquake, the concrete brick veneer began to disintegrate into separate bricks after 10 seconds of shaking (Figure 5). After a further 10 seconds at this shaking, partial collapse had occurred in some areas.

Damage to modern New Zealand single-storey, brick veneer houses is expected to be low from earthquake intensities for which the houses are designed. More damage is likely for concrete brick veneer than for clay brick. The veneer is likely to crack but can be repaired by re-pointing, with little loss of function or appearance. The brick veneer is actually expected to provide a useful bracing resistance that will result in less damage to the house interior.

BRANZ will shortly be testing 2-storey brick veneer construction.

This work was funded by the Building Research Levy. Various companies also donated wall linings, bricks and brick ties used in the testing.