

# Lateral stability of boundary walls

A BRANZ research project investigated the lateral stability of boundary walls for simple residential structures in the event of a fire.

**DESIGNERS** of fire-rated boundary walls for simple residential structures are often requested to show the wall can resist 'a uniformly distributed horizontal face load of 0.5 kPa in any direction' after the fire. This has been questioned by industry experts (for example, see *Build 146, Boundary walls*, page 8) and is currently under review by MBIE (Fire Review Project 10: *Structural stability in fire*).

## Code requirements

New Zealand Building Code Acceptable Solution C/AS1 requires external walls within 1 m of and at angles less than 90° to a property boundary to have a minimum 30-minute fire resistance rating (FRR). The Verification Method B1/VM1 requires structural building systems to remain stable during and after fire. For single-storey buildings, it is common practice to assess the lateral stability performance of external fire-rated walls against a 0.5 kPa face load criterion.

## Two full-scale fire experiments

As part of a BRANZ research project, *Limiting fire spread by design*, the lateral stability of boundary walls for simple residential structures was investigated. Two full-scale fire experiments were conducted at BRANZ on a small timber-framed compartment with 10 mm standard plasterboard internal linings and a representative typical roof truss structure.

The purpose was to determine whether the laterally loaded fire-rated wall could be designed to remain laterally stable in fire without the need for providing moment-resisting fixity at the base of the wall.

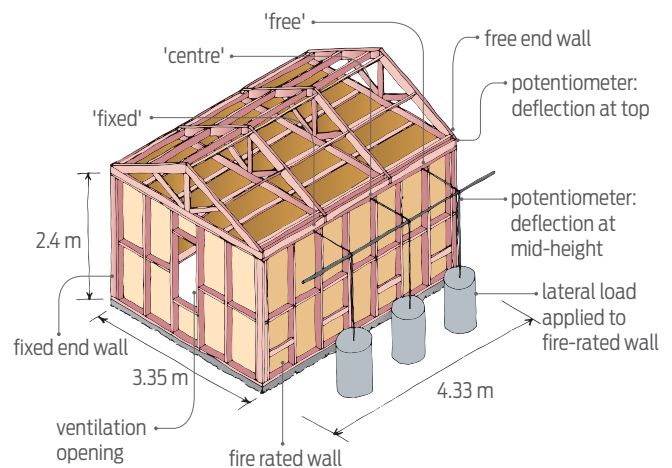


Figure 1: Compartment and lateral loading arrangement used for outdoor experiment – external cladding not shown for clarity.

## One inside, one outdoors

The first experiment was conducted by placing a test compartment on the BRANZ fire resistance furnace. This involved exposing the inside surfaces of the compartment to a fire environment like a standard fire resistance test.

The second experiment was conducted outdoors, burning wood cribs inside the test compartment.

Both compartments had the same dimensions and similar construction, but the second included openings in both end walls to provide ventilation for the fire. ➤



Figure 2: Near the end of the furnace experiment.

In each case, the boundary wall was constructed using a proprietary plasterboard system to achieve a minimum 30-minute FRR. The remaining walls and roof were of standard light timber-frame plasterboard-lined construction.

### Lateral load applied

A roof truss system spanned between the fire-rated wall and the opposite non-rated wall, and a lateral load was applied to the fire-rated wall.

This was achieved using water-filled drums suspended by a pulley system and cables fixed to the top plate of the boundary wall in line with the trusses (see Figure 1). The lateral load determined for the fire-rated wall was based on the Building Code B1/VM1 option to resist a uniformly distributed horizontal face load of 0.5 kPa in any direction.

### Some details different to normal

The scale of the two experiments meant that some construction details were not able to be fully replicated. One important example was the span of the roof trusses. In an actual building, the bottom chord of the roof trusses may be longer and have a spliced connection - typically using nail plates - that is a point of weakness in fire.

The roof truss in the experiments was designed, therefore, with a nail plate splice in the middle of the bottom chord to simulate trusses spanning longer distances. The underside of the trusses had standard plasterboard lining in the experiments.

### Splice unprotected in one, protected in other

There was a key difference between the two experiments. The splice in the bottom chord of the trusses was unprotected in the



Figure 3: During the outdoor fire experiment with fire-rated boundary wall on the right side.

furnace experiment, whereas in the compartment experiment, it was protected with timber blocking.

In the furnace experiment (see Figure 2), the bottom chord of the roof truss failed at the spliced connection in tension after 30.5 minutes (14.5 minutes after the ceiling failed).

For the compartment experiment (Figure 3), the bottom chord of the roof truss failed in tension after 28 minutes (16 minutes after the ceiling failed).

The fire severity in the compartment experiment was calculated as being more severe than the standard fire time-temperature curve at the time of bottom chord failure. After correcting for the variance in fire severity, the bottom chord failure time in the compartment experiment was estimated to be 33.5 minutes if exposed to the temperatures in a standard fire resistance test.

### Results will inform Building Code

The results suggest a truss system without a splice or with a protected splice connection provides sufficient lateral support to an external 30-minute FRR fire-rated wall to resist a 0.5 kPa face load.

This conclusion applies only to single-storey light timber-framed buildings lined internally on the walls and ceiling with standard 10 mm gypsum plasterboard. It can be achieved without providing moment-resisting fixity at the base of the fire-rated wall. The results of the research will inform potential future changes to the Building Code compliance documents. ◀

**Note** This work was carried out by Daniel Jessop at the University of Canterbury and funded by the Building Research Levy. For further information, visit <https://ir.canterbury.ac.nz/handle/10092/12157>.