# DURABILITY OF BORON-TREATED RADIATA

## An independent trial of boron-treated radiata framing found that the treatment was still working against brown rot after 6 years, but that soft rot infected the wettest components.

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Since 2001, small simulated wall units have been used to test the durability of treated and untreated *Pinus radiata* framing at Forest Research (Scion). Most trials were established to determine the effectiveness of commercial formulations in preventing decay in framing subjected to intermittent wetting. Test results have been used to develop suitable preservative formulations and retentions for Hazard Class H1.2 for inclusion in NZS 3640: 2003 *Chemical preservation of round and sawn timber*.

### Framing treated and built into units

In an independent trial (funded through Forest Research Capability Funding), radiata pine sapwood 90 × 45 mm framing was treated as 2.4 m lengths in a 6.8% solution of boric acid in water using a low pressure process. After treatment, boards were selected to provide two sets of samples with a mean retention of 0.30% boric acid equivalent (BAE) m/m (0.25–0.35%) or 0.40% BAE m/m (0.36–0.45%).

Model frame units consisting of 500 mm studs, top and bottom plates and a central dwang were assembled from samples cut from these boards. Seven units per retention were assembled. Pre-wetted units (~40% moisture content), plus untreated controls, were inoculated with two decay fungi at four locations within each frame. Wet fibreglass insulation was then packed into the wall cavity before attaching black polythene to the back face, to retain any trapped moisture, and a fibre-cement sheet to the front face, with building paper underneath to simulate monolithic cladding construction.

### Controlled moist environment

Frames were then stored in a controlled environment maintained at 25°C and 95% relative humidity (Figure 1). Frames were periodically hosed with water to maintain moisture contents high enough to promote decay and to simulate severe rain leak events.

Frames were disassembled and assessed for decay after the first 12 weeks, then at 6-monthly intervals (see Table 1). The 'index of condition', an international scoring system to quantify decay progression, was used. The average decay rating is recorded for all five components in a set of units. All ratings relate

Figure 1: Exposed frames in controlled environment. Fibre centre cover and building paper removed from one frame.

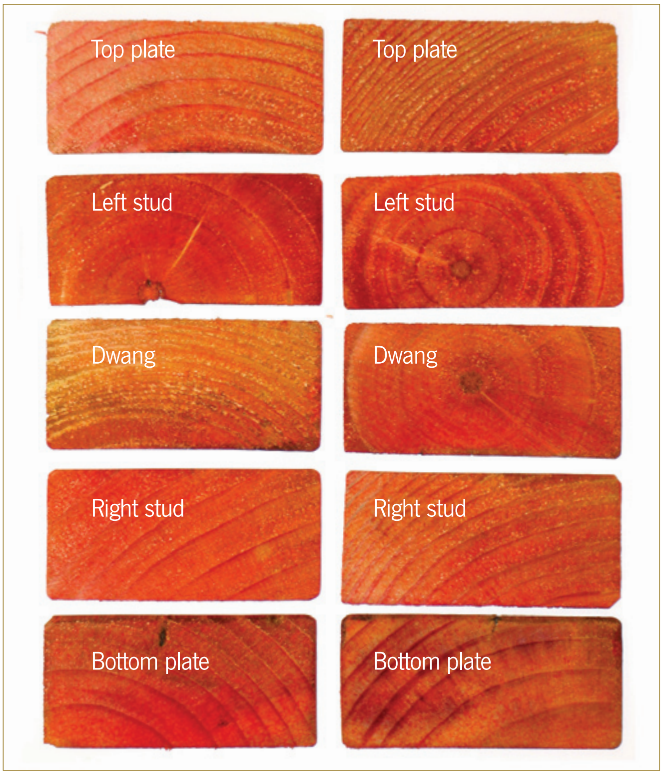


Figure 2: Typical spot test results for each frame component at 6 years' exposure.

to soft rot rather than brown rot decay, since no brown rot was present.

## The timber decay resistance

At 78 weeks' exposure, all untreated radiata pine frames had failed (total loss of structural integrity due to decay).

After 6 years of continuous exposure in a warm and wet environment, all treated frames at both retentions had resisted attack by the inoculated brown rot fungi, one of which, *Oligoporus placenta*, is frequently found in decaying treated/untreated framing timber in New Zealand. Soft rot decay, associated with high timber moisture content, was principally present in dwangs and bottom plates of most units, and the depth of decay (2–5 mm) was greater in the low retention set.

In the boron-treated units, soft rot decay was in the low uptake units within 78 weeks, initially in the wet sections of bottom plates and dwangs. This progressed slowly throughout the trial period and spread to the studs and top plates when moisture content was above 40%.

After 6 years, soft rot had progressed to 2–5 mm deep in places across the upper face of most of the bottom plates and dwangs, plus the bottom ends of the studs in the low retention group (0.30% BAE m/m). In the high retention group (0.40% BAE m/m), soft rot was present but relatively shallow (<2 mm) and only in the wettest sections of components. The apparent slight increase in index of condition at 312 weeks illustrates the difficulty in accurately assessing the superficial extent of this decay.

**Table 1: Progressive deterioration of units (index of condition).**

| Timber type | Number of weeks in test | | | | | |
|---|---|---|---|---|---|---|
| | 52 | 104 | 156 | 209 | 260 | 312 |
| **Untreated** | 2.5 | All failed after 78 weeks | | | | |
| **Low (0.30% BAE)** | 10.0 | 9.7 | 9.2 | 8.8 | 8.3 | 8.6 |
| **High (0.40% BAE)** | 10.0 | 9.9 | 9.7 | 9.3 | 9.3 | 9.3 |

Average decay rating: 10 = no decay, 7 = moderate decay, 4 = severe decay and 0 = failure through decay.

**Table 2: Mean preservative retention before and after exposure.**

| Component | Preservative uptake (L/m³) | Calculated x-section retention (% BAE m/m)* | Analysed x-section retention 6 years | % loss from x-sect | Analysed core retention 6 years |
|---|---|---|---|---|---|
| **High retention** | | | | | |
| Top plate | 27.40 | 0.41 | 0.23 | 34 | 0.19 |
| Left stud | 22.34 | 0.41 | 0.19 | 54 | 0.16 |
| Dwang | 35.39 | 0.37 | 0.14 | 62 | 0.16 |
| Right stud | 26.88 | 0.44 | 0.25 | 43 | 0.22 |
| Bottom plate | 29.45 | 0.42 | 0.28 | 33 | 0.13 |
| **Mean** | | **0.41** | **0.22** | **44** | **0.16** |
| **Low retention** | | | | | |
| Top plate | 20.77 | 0.31 | 0.08 | 74 | 0.05 |
| Left stud | 17.64 | 0.33 | 0.09 | 73 | 0.09 |
| Dwang | 22.29 | 0.32 | 0.13 | 59 | 0.12 |
| Right stud | 18.89 | 0.29 | 0.15 | 48 | 0.11 |
| Bottom plate | 16.03 | 0.28 | 0.10 | 64 | 0.09 |
| **Mean** | | **0.31** | **0.11** | **64** | **0.09** |

*Based on solution concentration (6.8% BAE m/m), solution uptake and wood basic density of individual samples.

## Substantial boron after 6 years

Sections of samples of two high and two low retention units were taken from each component for core and cross-section analysis. For one unit, two samples were taken from each component (see Table 2).

Although substantial boron leaching had occurred, particularly in the low retention group, this resulted in little increase in decay susceptibility except by soft rot fungi. Spot test results taken from representative components of each frame clearly showed substantial amounts of residual boron, even within heartwood samples (see Figure 2).

After 6 years, the boron preservative (boric acid) had prevented brown rot decay at both 0.30% and 0.40% BAE m/m retentions. For all components, boron losses were lower from the high retention group (44%) than from the low retention group (64%) (see Table 2).

There was no consistency in leaching rates from particular components. Bottom plates might be expected to be more susceptible to leaching, being in the wettest areas of the test set-up. Presence of soft rot in bottom plates confirms this excessive wetness, but component location does not seem to have promoted greater leaching.