House framing – present and future durability issues

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Coming out of the present furore over leaking buildings is the issue of treated framing; the need for it and how much of it. The write up in the media is variously presented as a crisis or a leaky building syndrome depending on your part of the country. The *NZ Herald* from Auckland is the self-proclaimed discoverer/owner of the print issue and continues to reveal further shock/horror aspects.

From a timber viewpoint, the word rotting keeps coming back and with an implication that the treatment we used to have would have prevented that situation. Time has moved on. We will not be going back to the simple two options Boric/CCA treatment.

At the time of writing the situation has a number of possibilities and the way forward is not clear.

Where did treated pine come from?

I researched the evolution of treated building framing in New Zealand and the introduction of a managed timber treatment regime. I am probably the only recent reader of submissions to the 1952 Committee of Enquiry whose report accepted borax-based treatment and recommended what became the Timber Preservation Authority.

The committee was set up to resolve what was then a dispute between the State Advances Corporation and the DSIR and Forest Service. The issue was insect attack in indigenous timber and the "NZ borer complex". SAC wanted a broad spectrum preservative and the others, plus industry interests, advocated a system targeted at *Anobium* and *Lyctus*. The committee recommended acceptance of targeted (narrow spectrum) preservatives and the establishment of a statutory authority to control timber preservation.

Out of all this, the new Authority set up a specification (1958) for insect hazards which later evolved into the H1 hazard rating. This specification was brought into building standards in NZS3602:1975 but had been a requirement of State Advances Corporation and other specifications before this. The specification was not constant and the boron retention was reduced in 1972 and again in 1992 (Table 1), and presumably still met the insect resistance requirements.

Prior to 1990 most building was done using wet framing and builders left framing to come down to an acceptable moisture level or used heaters and dehumidifiers to achieve this. With pressure for both faster building time and higher standards of internal finish, demand arrived for increasing amounts of kiln dried framing.

The change to untreated framing

At the same time as the market was seeking greater amounts of dry framing, the H1 requirement was called into question. Contrary to what some commentators have said, the relativity with the use of untreated dry framing in Australia was not a significant part of the debate.

Table 1: Change in boron retention requirements over time.

Period	Boron Retention C8 and H1 Specifications	
	Minimum Core Loading % m/m BAE	Typical Retention Used Kg/m³ BAE
1958-1972	0.20	5.8
1972-1992	0.18	3.2
1992 onwards	0.05* *(timber less than 28% mc)	0.8

The key aspect of the H1/untreated framing debate in 1994-95 was the lack of integrity in the H1 specification. Two reasons exist for this,

- The specification is for insect resistance. The vast quantities of untreated pine in regular, exposed use showed no significant insect attack, therefore why were we treating framing for insect resistance?
- At the original C8 loading there was fungal decay protection although this was not the intent of that specification. The 1992 boron loading was at a level that Butcher and Drysdale (1991) had indicated there was little or no reliable decay resistance and a high proportion of the boron was driven out in kiln drying. The alternative that had come in by then was H1 LOSP where the preservative was permethrin, which had no decay resistance.

This lack of decay resistance at the 1992 H1 boron level is borne out by the failures that are presently being publicised. Many are failures in pre 1997 or 1996 buildings. These will be almost certainly H1 boric or Douglas fir framed. Probably all of the problem Auckland terrace houses date after this and are of untreated pine.

In the early 1990s fungal decay was unusual and hardly talked about. Reasons for this were the high proportion of houses built with claddings that were of a drained nature, i.e. bricks and weatherboards (various) and the low proportion of designs that would today be considered high risk. Couple these with the pre-1992 boron loading and decay problems were rare.

The outcome of the 1995 revision to NZS3602 Timber and Wood-Based Products for Use in Building was, in brief:

- In interior, dry conditions untreated radiata pine was accepted for building framing "w*ith in-service moisture limit up to 18%*".
- In interior dry conditions H1 treated radiata pine and Douglas fir was accepted for building framing "*with*

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in-service moisture limit up to 20%".

- By implication, if the in-service moisture exceeds 20% the framing should be H3.

In 1998 the NZ Building Code B2 Durability was amended to include NZS3602 as an acceptable solution for the durability requirements of building elements.

Design and construction materials

Over the past 10 years or so building designs have changed to produce a significant group of buildings that, in combination with inappropriate construction materials, are resulting in buildings that leak.

Design changes include,

- 2, 3, 4 storey terrace or townhouse developments;
- risky add-ons, in particular balconies;
- complex roof shapes, difficult if not impossible to flash;
- dry climate features in a high rainfall country;
- penetrations either decorative or for services;
- loss of roof overhangs.

A construction material change in the same period is the trend to a significant proportion of face sealed claddings without roof overhangs. This combination resulted in a reliance on a waterproof building envelope for exclusion of water, but also an inability of ingressed moisture to exit. To make matters worse, where such claddings were fixed directly to framing, there is a tendency for moisture to spread laterally as well as going vertically down. Moisture built up in the wall assembly which could neither drain nor breathe. Decay has resulted in H1 and untreated pine framing and in Douglas fir.

Putting this into perspective, the problem that has developed exists dominantly in the monolithic clad buildings, not in those with self-draining envelope systems, i.e. cavity masonry and weatherboards. Cavity masonry has over 50% of the residential cladding market. The monolithic market share is less than 40%. Differences in performance of these claddings is recognised by the BIA and the Territorial Authorities, and their reactions are showing this in requirements for treated framing for monolithic cladding. However, Territorial Authorities are currently making quite variable requirements for framing 'alternative solution' exterior walls including monolithic cladding.

The Building Act

The 1991 Building Act brought in the concept of performance of buildings and put accountability for this on "the owner" at all stages. Who "the owner" is at various stages after a consent is given and during building is outside the scope of this paper. In brief, with large-scale developments and speculative building, it is the developer. With single house building on contract, it depends on the contractual arrangements and who obtains the building consent. This accountability results in the liquidation of many development entities immediately after the buildings are sold. The new "owner" then has all responsibility, i.e. it moves with ownership change.

The documents that flowed from the Act incorporate a performance requirement that buildings should not admit moisture to the detriment of the building or its occupants. Prior to the changes in design and construction noted above, this rarely happened. That it is happening now is plainly non-compliance and is the current "crisis".

The issues of accountability and liability and the position of various advisory and regulatory bodies have not so far been tested in Court. There are certain determinations by the Building Industry Authority, but no High Court judgements. The Act may soon be tested.

There is a glaring gap in the Building Act that can only be remedied by Parliament and this needs Government action. The gap is the lack of any simple system to remedy failure of performance. Presumably its authors assumed an action in Court between parties in dispute would be the ultimate remedy in a performance failure. This has two major weaknesses. Firstly, the party that created the building failure may have disappeared and secondly Court action to remedy is very slow and costly, and meanwhile the effects of the failure are worsening.

Where to from here?

The way ahead is not transparent. In framing usage, in crude volumes, about one third goes into roof and mid-floor framing, one third into interior wall framing and one third into exterior wall framing. Of that exterior wall framing at least half is associated with exterior cladding system, which are not associated with the present "crisis".

Some demands are being made for all exterior wall bottom plates or all bottom plates to be treated. Where this stops is hard to see. In a country dependent on urea formaldehyde bonded, non-decay resistant flooring, the logic of treating all bottom plates is obscure. Urea formaldehyde is not water resistant over extended periods and the wood flakes in the board are just as likely to decay.

The reaction from Territorial Authorities is currently to require selective treatment of framing associated with high-risk claddings or situations. (How it is expressed varies). The expectation of the design and supply industries is that this will continue. The extent to which this carries over into the NZ Building Code and Building Standards remains to be seen.

Treatment – wth what?

For building designs deemed high risk and for monolithic claddings, why and what to treat with is currently being studied. There is a theory about a modest level of fungicide so that leaks can be discovered and repairs made. The problem is that some leaks persist for very long periods before discovery. What sort of assurances should be given is a serious issue in an era

of performance standards. At a time when *Stachybotrys* moulds are causing excitement because of health concerns (it is a popular basis for suing in the USA and people are showing concern about it here), how mould resistant should timber be? Most timber treatments here do not contain mouldicides unless specifically added.

There are seven possible preservative options from H1 to H3 hazard levels. The introduction of the so-called H1 plus systems to fit between H1 and H3 has added three to the four current commercial H1 and H3 systems. A recent article (Cavanagh 2003) outlines these highlighting their status and safety aspects. There is too much material to repeat here. The timber industry, chemical suppliers and the BIA are currently looking at the commercial aspects. The frame and truss industry has significant health and safety concerns about the LOSP systems and the handling of tin based preservatives. These are not resolved.

H3 (whether CCA or tributyl tin in LOSP) seems overkill for house framing. If building is so bad that this level of preservation is required then a radical upgrade of building is required.

The future

The future will probably see two or more types of framing, untreated and one or more variations of treated framing, become common. It will see amendment of NZS3602 and parts of the Building Code. It will see a new timber treatment standard. It should see an amendment to the Building Act. To quote John Sinclair, President of the NZ Institute of Architects, "Just as in 1931 the Napier earthquake changed the way we built with brick there are other materials that cannot stand up to certain environmental conditions. These must be identified and guidelines provided" (NZIA 2002).

References

Butcher, J.A., Drysdale, J.A. 1991: Biodeterioration and natural durability. Chapter 9 in Kininmonth, J.A, Whitehouse, L.J. (Eds.) "Properties and uses of New Zealand radiata pine". Ministry of Forestry, Forest Research Institute, Rotorua.

Cavanagh, G.J. 2003: Treated timber – what, where and why. *Progressive Building*, February-March 2003

NZ Institute of Architects. 2002: Submission to Government Administration Committee, Inquiry into the Weathertightness of Buildings in NZ.

education news

School of Forestry farewelling Karl Schasching

Karl Schasching

The secret is out! Karl Schasching, who has been with the School since 1970, is retiring! A farewell function will be held for Karl on March 20, where much reminiscing will be the order of the day. Many graduates will have fond (?) memories of Karl "rousing" them out of bed, or into vans, supervising the cooking at Hari Hari, and so on. Letters of congratulation, interesting stories, exaggerations, and donations if you wish, will be accepted with appreciation and passed on.

Postgraduate News

The School's Postgraduate programme has attracted 46 students this year, with 3 students doing the new Graduate Diploma, 30 enrolled in the Masters degree, and 13 Ph.D. students, from 16 countries – Argentina Britain, Chile, China, Fiji, Germany, India, Indonesia, Japan, Mexico, New Zealand, Peru, The Philippines, Taiwan, Uruguay and the U.S.A.! Students who have recently completed/submitted their research include the following:

Mariana Cattaneo, MForSc thesis. 2002. Effects of microsite characteristics, competition and grazing on *'Pinus contorta* Dougl.' and *Pesudotsuga menziesii* (Mirb.) Franco' seedlings.

Eykolina De Zwart, MForSc thesis. 2002. Possum resource selection in a fragmented landscape, Cass, New Zealand.

Ingrid Gruner, Ph.D. 2003. Comparative ecology and conservation of rare native broom, Carmichaelia (Fabaceae), South Island, New Zealand.

Sina Hustedt, MForSc thesis. 2002. Ecology and conservation of the threatened shrub *Hebe armstrongii*.

Sarah McElrea, MForSc thesis. 2002. Effects of exotic plantation forest management on indigenous biodiversity values, Canterbury Foothills, New Zealand.

Craig Miller, Ph.D. 2002. Conservation ecology of riparian forest within the agricultural landscape: West Coast, New Zealand.

Clinton Sim, MForSc thesis. 2002. Modelling second log branching characteristics of *Cupressus lusitanica* that affect log quality.

Watt, Michael, Ph.D. 2003. Modeling the influence of weed competition on the growth of *Pinus radiata*.

Jianming Xue, Ph.D. 2002. Effects of biuret addition on soil nitrogen transformations and Douglas fir seedling growth.

Visitors

Dr. Doland Nicholls, from the School of Environmental Science and Management at Southern Cross University in Lismore, New South Wales, visited the School in January. During his four-week stay, Doland discussed curriculum development with the Staff and presented a seminar on "Problems of Establishing Tree Cover on Degraded Pasture Sites in Costa Rica and Eastern Australia".