From the

TECHNICAL DESK

with Richard Schaffner, WESPINE Senior Engineer and Dave Evans , WESPINE Management Systems Coordinator.

Fixing plasterboard to CCA H2 treated structural timber

When concerns regarding the fixing of plasterboard to CCA treated timber recently surfaced, Boral Plasterboard immediately took the matter in hand and discussed the issue with adhesive manufacturer HB Fuller and timber supplier WESPINE.

CCA structural timber is treated to provide protection against timber rot and attack by insects. The treatment process involves impregnating timber under pressure and then redrying it to 15 per cent or less moisture content.

The level of treatment is marked on each piece of timber. CCA H2 treated timber is increasingly being used for internal wall framing and ceiling components in areas susceptible to termites. WESPINE CCA H2 treated timber is clearly marked "Dried After Treatment" as an assurance of the product's structural performance.

In response to the concerns, Boral Plasterboard and HB Fuller jointly devised a series of tests to observe the effect of CCA solution as well as CCA H2 timber on a range of screws and nails.

Although neither Boral Plasterboard or HB Fuller manufacture mechanical fasteners, the tests were considered important, as a fastener/adhesive system requires the performance of both securing mechanisms to be completely successful.

Samples of CCA H2 treated structural timber were provided by WESPINE, in addition to samples of the chemical used in the CCA H2 treatment process. The aim of the adhesion tests were to determine if there was any detectable difference in the bonding performance of Boral New Acrylic Stud Adhesive when used on untreated radiata pine compared to the CCA H2 treated pine.

To conduct the tests, identical assemblies were made with untreated and CCA H2 treated pine and Boral plasterboard. Samples were then tested in accordance with AS 2753 (Mastic Adhesive for bonding Gypsum Plaster Lining to Framing Members), which is the standard used to determine suitability of stud adhesives in Australia.

Half of each were bonded using Boral New Acrylic Stud Adhesive and the balance fastened with a selection of hot dipped galvanised Golden Zinc plated and Zincalume-coated steel mechanical fasteners.

The assemblies were then put through an exhaustive cycling process of high (60°C) and low (3°C) temperatures and high and low humidity.

When the tests were completed, the bonded assemblies were pulled apart and the results of untreated and treated CCA H2 timber compared. Significantly, the results showed no difference in adhesion levels between treated and untreated timber, with the bonds to timber proving far stronger than the strength of the plasterboard in all cases.

The nails and screws in the fastened assemblies were also removed after cyclical testing and closely examined. None of the fasteners showed any form of corrosion or discolouration and, interestingly, were identical to a new unused fastener.

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Orientation key to solar gain and ventilation

A striking timber framed addition to an old workers' cottage in Fremantle keeps the owners warm in winter and cool in summer - thanks to excellent site orientation and window placement.

Designed by Colin Armstrong, of Kornweibel Armstrong Architects, the 125 square metre addition proves that seamlessness between the original 80 year-old cottage and its extension is not always the answer to a stylish renovation.

Mr Armstrong said that solar gain and good ventilation were the key components of the brief for this extension.

Solar gain in particular, was achieved by the careful use of glass in the design.

"In winter for example, lots of glass on the north side of the building provides good solar penetration and this, combined with well-insulated walls, keeps the house warm during the cooler months," he said.

"The timber framed walls are well-insulated, so that the only heat penetration is directly through the windows. As a consequence, as soon as the windows are opened, the heat is dispelled due to good cross ventilation, which provides access to the relieving sea breezes." This has proved so effective that sun-shading originally designed for the upper floor is now a low priority for the owners.

Mr Armstrong said that when designing the addition he made special effort to ensure the extension did not create excessive shade in the neighbouring property, graduating the height of the structural walls on the southern side of the building to optimise northern light into the neighbour's property without compromising the design.

The striking extension to the 80 year-old workers' cottage that features WESPINE structural framing.

The neighbourly gesture has been returned with many residents of the same street affectionately referring to the steeply gabled roof of the structure - which can be seen behind the old cottage from the road - as 'the church'.

"The extension really does accentuate the distinction between the old and the new and you can also see how the two structures relate to each other," Mr Armstrong said.

Materials used in the extension included WESPINE structural framing and Profile 404 weatherboard cladding.

Energy efficiency using timber

A new Federal Government strategy designed to reduce greenhouse gas emissions has pushed energy efficiency to the top of the agenda for people building a new home. This strategy is reflected in the recent Energy Efficiency Measures of the Building Code of Australia (BCA), due to be adopted in Western Australia on July 1, 2003.

Thermal Mass

Because of the dominance of double brick cavity walls and concrete slab floors in the Perth residential housing market, there is a general assumption that thermal mass (provided by these materials) is the solution to building an energy efficient house. In actual fact, thermal mass is no substitute for good design.

A recent article published in the Australian Timber Design journal stated that although thermal mass can even out large temperature swings indoors as well as store solar warmth in winter, it cannot be incorporated into a building in isolation. It will only 'work' if it is part of a building package, which includes:

- Correct design of windows and window shading to permit entry of winter sun and prevent entry of summer sun.
- Exposed concrete floors
  (i.e. the floor should not be covered by carpet).

> "Mass or lightweight only works when accompanied by good design"

Author, Peter Llewellyn, Executive Director of the Timber Development Association of South Australia cited research by the University of Adelaide's Department of Architecture* which clearly highlighted how sensitive thermal mass was to (poor) "design". For example, if the following (common) design faults occurred:

- the house faced 15 degrees east of north
- cavity brick wall insulation was omitted (seldom used in practice anyway)
- the garden included screen planting of trees and shrubs (north side - stopping winter sun)
- and large rugs were included in the main living areas rather than bare concrete/tiles

then energy used (to heat and cool the house) would be greater than in a "conventional" house under the same conditions. In this case a conventional house is a timber frame with an outer covering of face bricks.

This energy efficient award winning house, designed by **Paul Trotter**, uses good design (including large overhangs and louvres) to combat the solar overheating problems presented by an east-west aspect. Provision of separate summer and winter living spaces allows comfort conditions to be optimised for best seasonal performance. All this was achieved with a lightweight timber structure.

Even if the ideal scenario of correct orientation, large windows and absorbent (uncarpeted) floors could be achieved, the thermal mass model would not work in all climatic regions of Australia, or for all modes of heating and cooling.

For example, the research showed that the temperature of a concrete slab-on-ground floor was likely to fall below the comfort level (20°C) during winter in southern regions of Australia (like Albany). Consequently, heating would be required to lift not only the room temperature but also warm up the concrete (i.e. in this case the thermal mass is acting to keep the room uncomfortably cold).

Even when all the conditions are met for a "solar efficient house" using thermal mass, when embodied energy is taken into account - i.e. the energy used in the manufacture and transport of building materials - little will have been gained. In some cases, it could take years for the lower energy consumption in the thermal mass house to cancel out the greater embodied energy required to build it, Mr Llewellyn explained, concluding clearly that using thermal mass materials was only part of the answer.

Lightweight timber-framed construction

The research also highlighted very positive aspects regarding thermal performance of well-designed, insulated timber-framed housing, including brick veneer houses with timber floors - historically the most popular form of construction in all states of Australia, except Western Australia.

The findings indicated that an insulated timber-framed building responded quicker to temperature changes, meaning that it cooled down to the desired temperature faster and maintained that temperature longer. This was a distinct advantage during hot Perth summers when the thermal lag of heavyweight construction could result in unfavourably high temperatures indoors in the evening - despite it being cool outdoors.

Insulated lightweight design provides better thermal response

Interestingly, these results were echoed in a recent study commissioned by WESPINE that focused on a proposed two storey BGC display home.

Ecotect is a locally developed building analysis software package (Dr. Andrew Marsh, University of Western Australia) that calculates the effects of heat, light and wind on a building. Utilising this software, the WESPINE commissioned study examined the differences between the energy efficient properties of timber frame and double brick under Perth's climatic conditions.

According to project team member James Melsom, a former student of Dr. Marsh, the two options (i.e. insulated timber frame vs double brick) actually performed similarly in autumn and spring.

However, according to James, timber performed a lot better in winter and brick performed marginally better in summer.

"Therefore, if you have a well-insulated timber framed building, the R-values are extremely good," James said.

"And that is something a lot of people don't realise - that a well-sealed, well-insulated timber -framed building can perform as well, if not better, than brick." In summary, according to Mr Llewellyn, the case for lightweight timber framed construction, hinges on these important factors:-

- Lower embodied energy in a timber-framed structure relative to concrete, masonry or steel;
- Quick thermal response of a lightweight insulated structure to intermittent heating and cooling (the most common heating and cooling mode); and
- Difficulties in the "real world" of complying with all the criteria necessary to make the thermal mass model "work"
- The fact that heavy mass walls can insulate the interior when temperatures fluctuate because the heat does not have time to get through the wall....but:
- When temperatures are more constant, like during an extended hot or cold period, the wall continues to transfer the heat and the result is a very hot or very cold house.

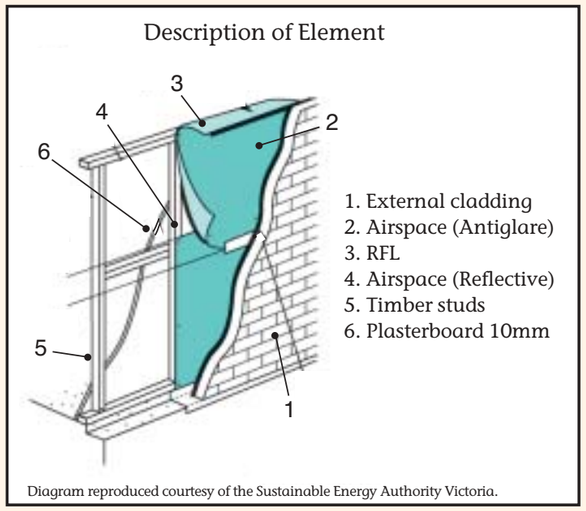

Diagram reproduced courtesy of the Sustainable Energy Authority Victoria.

For more information on thermal performance of timber framed buildings, visit the National Timber Development Program (NTDP) website at - www.timber.org.au. Click on 'Thermal Performance', which will make available to you many resources, including the document entitled "R Values for timber framed building elements". The document addresses the topics of roofs, walls and floors in easy to understand diagrams. This document is a must for designers and builders considering timber construction.

Timber framed construction can easily meet the proposed new thermal performance criteria:

Under the BCA 1996-volume two, amendment 12: Perth and coastal areas (including Geraldton, Mandurah, Bunbury, Busselton, Margaret River) are classed as Zone 5 and require a Minimum total R value of 1.4. Figure 3.12.1.3 notes indicates that a brick veneer wall with RBM (reflective building material-foil sarking), a 25mm brick cavity and a 70 mm timber frame gets an added R of 1.02. An outer skin of brick adds 0.54, therefore, a brick veneer wall achieves 0.54 + 1.02 = 1.56 Albany is zone requiring a minimum R value of 1.7. This can be achieved (in a brick veneer wall) with products such as Air cell (total R 1.9). Using WESPINE standard or CCA H2 treated structural framing is a good way to ensure that your building meets the minimum requirement for thermal performance of walls.

*'Design of Environmentally responsible housing for Australia with emphasis on the use of timber', Adelaide University School of Architecture, Landscape Architecture and Urban Design in collaboration with the National Association of Forest Industries - August 2000. Summary document available as PDF download document at www.timber.org.au.