FEATURE

It is always reassuring to customers to see a company willing to use its own products. The first story of this feature examines the construction of Carter Holt Harvey's new laminated veneer lumber plant in northern New Zealand, using the same material that it will manufacture. Other stories of the feature look at the refurbishment of one of Sydney's finger wharves, the Australian recipient of an international forestry prize and UNSW's new ceremonial building.

Practising what you preach

by Bruce Hutchings

WHAT BETTER PLACE to use laminated veneer lumber (LVL) than for the portal frame of an LVL factory. This is the rationale with the construction of Carter Holt Harvey's new LVL plant at Marsden Point in the north of New Zealand's North Island.

The plant's recently completed main building covers more than 2ha. Its structural frame is principally of LVL. This 96m-wide by 209m-long facility will house the assembly, pressing, finishing and dispatch functions of LVL manufacture.

The structural design of the buildings and the fabrication of the LVL beams has been carried out by Melbourne-based Timberbuilt Pty Ltd. The construction of the plant has been undertaken by Mainzeal Construction. The LVL itself has been manufactured at Carter Holt Harvey's Nagwarry plant near Mount Gambier in South Australia.

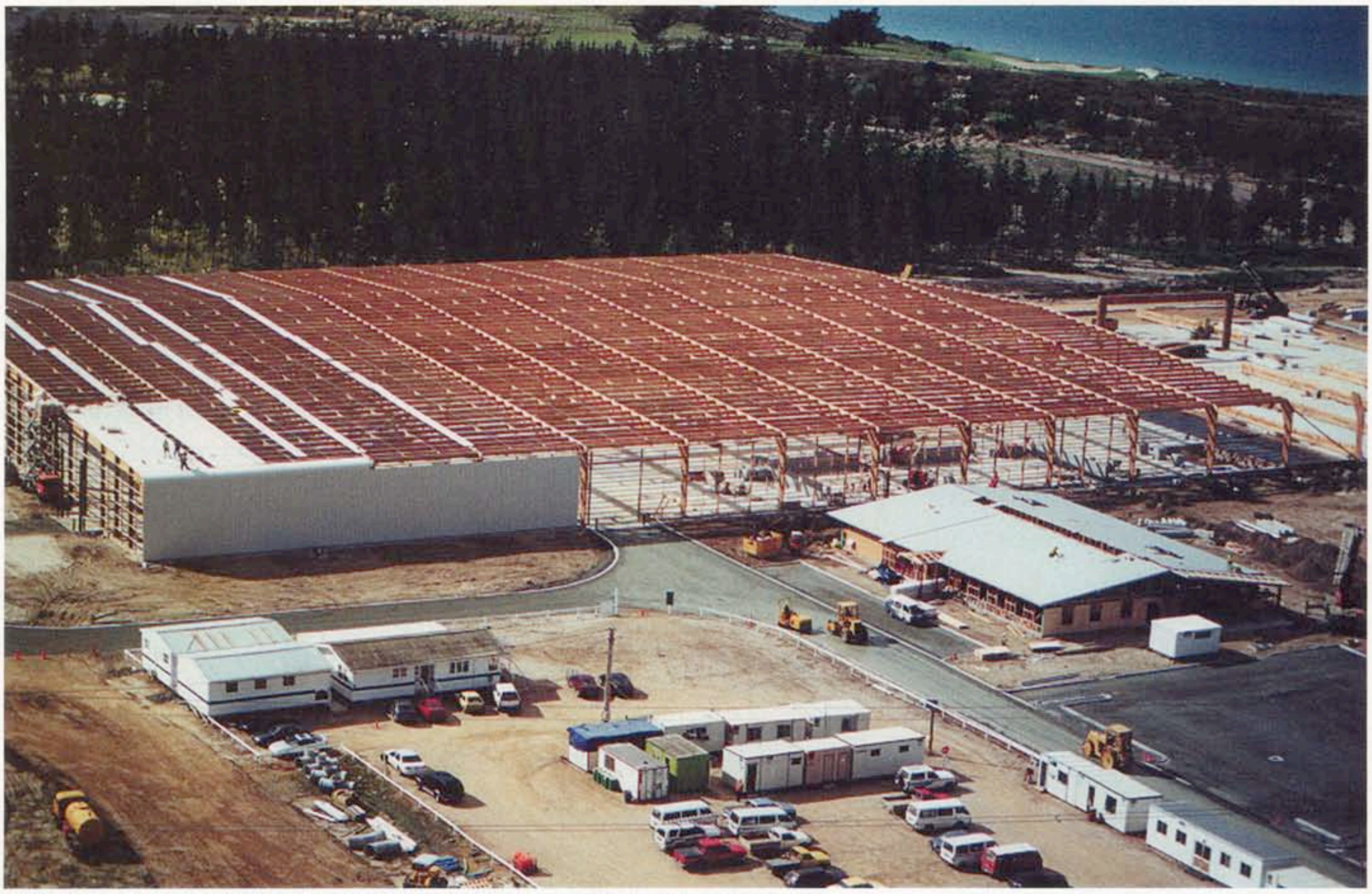
A further stage of the development, due to begin next March, will house the veneer peeling and drying operations. This building will also have an LVL frame and will cover 0.6ha.

The main building's roof has a three degree pitch gable shape. At its southern end it rises from an eaves height of 7.7m on both the eastern and western sides to a central ridge. To provide additional height over the press, the ridge line for 11 of the 19 bays at the northern end is offset to the east of centre to create a step in the roof on the eastern side.

The structural system involves rafters extending across the full 96m width and supported at four points over three 32m spans. The outer columns are rigidly connected to the rafters to form portal frames. The internal supports merely serve to prop the rafters. The rafter or bay spacing is a uniform 11m.

Rafters are 1200mm- or 1265mm-deep fabricated LVL I-sections. Outer column sections are similar but are tapered to 800mm depth at their base. I-sections were chosen for material efficiency, speed and ease of fabrication, simplicity of splice detail and for shipping efficiency.

The rafters are each spliced at six locations with the longest segment being 16.2m, including the projecting splice elements.



Construction of Carter Holt Harvey's laminated veneer lumber (LVL) plant at Marsden Point in the north of New Zealand's North Island. The structure of the 96m x 209m facility uses principally LVL.

Mainzeal Construction used 620m³ of LVL, 50m³ of plywood timber and 15m³ of sawn and dressed timber to build the structural frame of the main building.

Splices are arranged to correspond to points where the moment actions under the various load combinations are low and are less than the moment capacity of either the webs or flanges of the I-section acting alone.

Internal supports for the rafters are mostly prop columns made up of four pieces of 300mm x 45mm LVL fabricated into box sections. Elsewhere, where column free areas are required, rectangular lintel frames, orientated in the longitudinal direction and spanning over two bays, support the rafters. Large 1200mm deep LVL box section beams rigidly connected to 900mm deep box columns were used to keep the deflection profile of the supported rafter as close as possible to that of the adjacent rafters.

Longitudinal forces on the building are transferred via two sets of bracing, each comprising roof bracing and vertical plane bracing in the outer longitudinal walls and along the internal column lines. Two sets of bracing were used to avoid the need to transfer longitudinal force across the step in the roof on the eastern side of the building and to minimise the extent of force transfer. Bracing was also arranged to minimise force transfer between roof, wall and internal column braces. This together with functional requirements for the building determined the location of each bracing set. Braces are fabricated LVL sections connected with dowel jointed steel fin plates and bolted brackets.

At the southern end of the main building the framing has been designed to allow for the addition of the next building. This new building will be designed as a gable roofed portal frame structure with the portal frames orientated at right angles to the end wall of the main building. The supports for the southern end wall rafter are arranged to coincide with the column locations of the portal frames for the new building. The prop columns along this wall and prop columns throughout the main building are supported on 1m-high reinforced concrete pedestals to provide protection from potential forklift impact.

Composite plywood and LVL I-beam purlins span just under 11m between the rafters. Except for one row of purlins at the expansion joint near the eaves, all purlins are 450mm deep. Two flange sizes are used and flange size together with spacing is used to cater for the varied wind pressures across the roof. In some locations double purlins have been installed to support higher service loads. Purlins are laterally restrained along their bottom edge at third points for the strength-critical wind uplift case.

The structural design of this building was prepared in accordance with the New Zealand loading and relevant material design standards. The similarity between the Australian standards, with which the designers were familiar, and the corresponding New Zealand standards facilitated the process. The trend toward development of joint AS/NZS Standards and other outcomes from the Closer Economic Relations (CER) Agreement between Australia and New Zealand will progressively open up markets for trade in engineering design and structural systems across the Tasman such as has occurred in this instance.

The structural design for both buildings was generally critical for wind. The Northland province has basic wind speeds corresponding to Region A in Australia but the assumption of Terrain Category 2 wind exposure for all directions ensured wind loads were high in comparison with all other load conditions.

Repetition of design elements was also an important factor in the economical construction of the buildings as it reduces the set-up time for manufacture of each component and reduces costs through faster assembly and reduction of error.

Another factor that can be critical to cost, particularly for portal frame buildings, is building height. Clearance heights inside must meet the anticipated functional requirements. In the main building the necessary clearance height in the area of the press is significantly greater than for any other requirement. This was provided for by offsetting the ridge for part of the building.

Another consideration affecting height was the intersection of the main building with the later addition. The higher clearance requirements for the new building meant that its side wall height would be sufficient to contain the gable end of the main building provided the ridge height was kept to a minimum. This is the basis for the step in the roof and the adoption of a symmetrical gable shape at the southern end.

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Approximate volumes of the timber materials used for the structural frame of the main building are:

- laminated veneer lumber, 620m^3
- structural plywood, 50m^3
- sawn and dressed timber, 15m^3.

The total volume corresponds to a transfer ratio (Nicholls, PTEC 1984) of 0.034m^3/m^2 of floor area, which is an efficient use of material given the spans and the loading conditions.

The decision to go with an LVL may seem automatic given a timber products company has embarked on a project to house an LVL manufacturing plant. However, there are many LVL plants around the world and with the exception of the Carter Holt Harvey South Australian plant, very few of these are housed in structures built using LVL.

Carter Holt Harvey believe LVL is ideal because of:

- its structural reliability demonstrated with other large span buildings constructed in Australasia during the past 14 years
- the availability of a fully prefabricated system from a specialist supplier (Timberbuilt)
- cost competitiveness with alternative materials especially given the use of I-beam purlins to allow wide bay spacings and reduced numbers of internal columns
- speed of construction.

For a design team experienced in timber engineering, designing this type of building using LVL is little different from what designing a steel building would be for engineers experienced in steel design. However, design solutions with LVL are not as established and their creation is both challenging and satisfying. ■

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