

INFORMATION SHEET

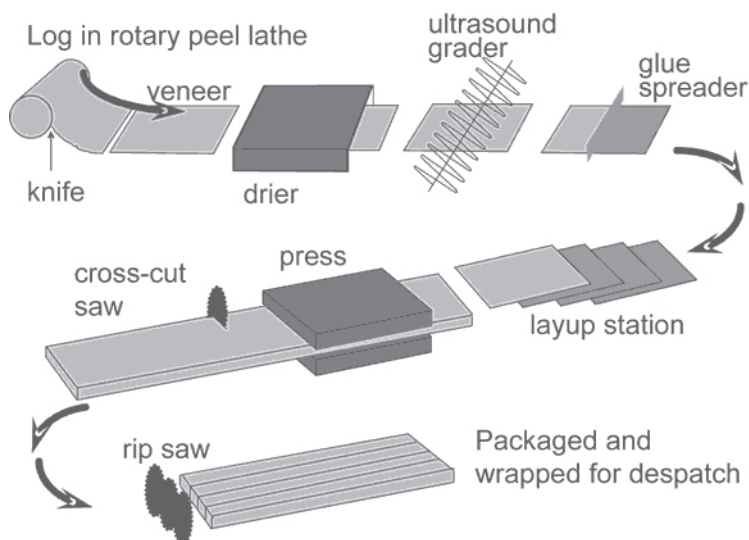
STRUCTURAL MATERIALS

LVL MANUFACTURING PROCESS

The information provided below has been taken from the New Zealand Timber Design Guide 2007, published by the Timber Industry Federation and edited by Professor A H Buchanan. To purchase a copy of the Timber Design Guide, visit www.nztif.co.nz

LVL is manufactured by laminating wood veneer (typically 3mm thick), using a phenolic adhesive, in a continuous process, as shown below.

Diagram 1: Schematic view of LVL manufacturing process.



The grain direction of all veneers is usually in the longitudinal direction. The process begins with logs selected for appropriate quality that are debarked, cut to length and heated by soaking or spraying with hot water to enhance “peel-ability” prior to peeling in a rotary lathe. The ribbon of green veneer is clipped to width and segregated into moisture classes for drying. In the dryer, jets of hot dry air perpendicular to the veneer surface dry the veneer in about 10 minutes to a target moisture content of approximately 6%. Veneers are then sonically measured for stiffness, and graded for width, moisture content and visual appearance. A combination of grades allows manufacturers to produce LVL of specific properties for specific purposes.

Veneers may then be bevelled on the ends prior to pressing. The bevels form a lapped scarf joint in the press to enhance strength by reducing stress concentrations where the veneers overlap. Half of the veneers are turned over with alternate tight and loose face veneer orientations to assist product stability.

Veneers are delivered to the press in a pre-determined sequence, passed through a glue applicator and are then positioned to form a continuous “slab” that is subjected to heat and pressure to cure the structural phenol formaldehyde resin.

The cured “billets” of LVL, usually 1200 to 1250mm wide by 8 to 18 m long are then ripped and cross cut for further processing or customer requirements.

LVL leaves the factory with moisture content in the range of 8% to 15%.

ADHESIVES

The adhesive used in LVL manufacture is phenol formaldehyde (PF). The bond is fully waterproof (Structural exterior Type A or Marine Bond, in accordance with AS 2754.1 –1985). Phenol formaldehyde is a thermosetting adhesive and once cured is unaffected by temperature. In its uncured state phenol formaldehyde emits little formaldehyde and after curing in the final product it gives off as little as $0.03ppm$ of formaldehyde which is a smaller amount than given off by a fruit orchard.

CROSS BANDED LVL

Veneers laid across the line of the slab (cross band veneers) can be introduced into the LVL lay-up, to help control cupping in deeper sections, or where strength is required in a perpendicular to grain orientation. The uses for cross-banded LVL vary widely and include applications like floor and ceiling panels, rim board, concrete form boards and gussets for portal frames. Cross band veneers will enhance LVL properties across the panel but will reduce the longitudinal strength and stiffness. Cross-banded LVL is more costly and is only available on special order for very specific applications. Cost and availability should improve with the development of new applications.

SPECIFICATION

Structural LVL is manufactured to conform with AS/NZS 4357 Structural Laminated Veneer Lumber. This performance standard outlines structural and bond testing to confirm performance, and requires manufacturers to publish properties or span tables for the LVL products made from their particular resource and process. Each piece of structural LVL is required by AS/NZS 4357 to be identified by its brand. Structural properties are determined in accordance with AS/NZS 4063:1992. Quality control for Australasian LVL is independently third-party audited by the Plywood Association of Australasia (PAA). The PAA's product certification scheme is accredited under the Joint Accreditation Scheme of Australia and New Zealand (JAS-ANZ).

The properties of LVL are specific to the layups used by each individual manufacturer. Some LVL products are designed with special veneer placement to enable use with nail plates, others as formwork beams and others as general structural members. The design properties are therefore specific to a brand identifier, and there are no generic grades. Specification of the LVL brand name is required by local building authorities (building inspectors) for building consent purposes.

It is important for designers to understand that different brands of LVL will perform differently under the same loading conditions according to their specific properties.

LOW VARIABILITY

Because of its low variability LVL is a reliable engineering material.

The veneers are graded by sonic and resonance methods before being arranged in predetermined “recipes” to be glued and pressed to form a “slab” or “billet” of LVL characteristics such as density and fibre strength are randomised so that the finished product has lower variability than clear solid timber and any defects (such as knots) are randomly distributed to a point where they do not influence the structural properties.

The lowest modulus of elasticity values (E-values) for a given LVL recipe are usually within 10% of the target average whereas values for sawn timber can be plus or minus 40% depending on the method of grading. The code requirement for LVL is that no individual piece may have an E-value of less than 0.85 times the claimed average. As a comparison of variability, Diagram 2 shows graphs of probability density function (p.d.f.) for the modulus of elasticity of MSG8 machine graded timber and two LVL products (hyCHORD and hySPAN LVL). The solid vertical lines give the target average E-values for each material, and the dotted vertical line shows the 5th percentile target E-value E_{lb} for MSG8 timber.

Diagram 2: Plots of modulus of elasticity for machine graded timber (MSG8) and two LVL recipes. Target average E-value 8 GPa (timber), 11 GPa and 13.2 GPa (LVL)

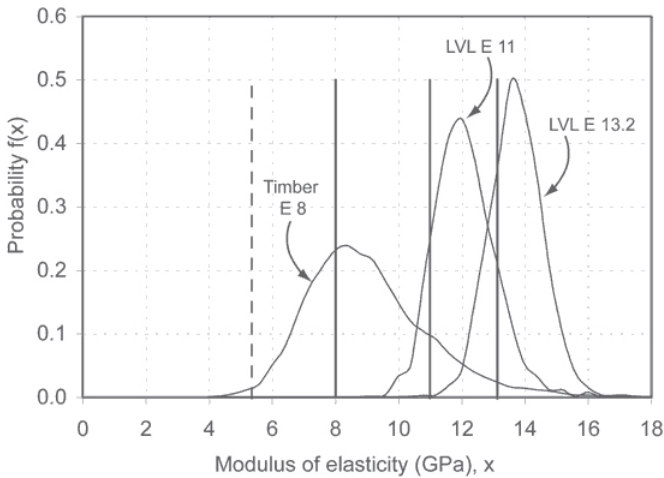
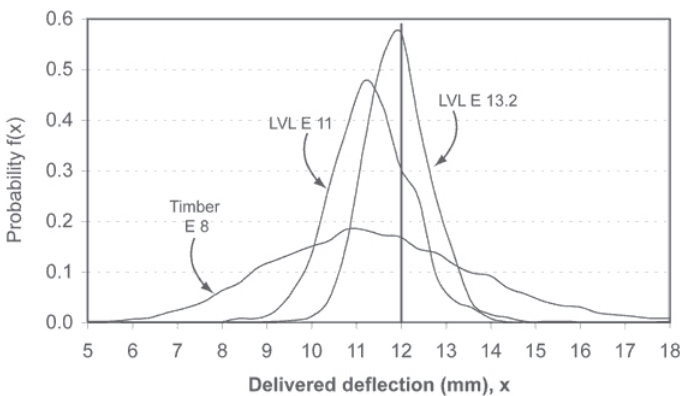


Diagram 3: Range of deflections for the materials shown in diagram 1 designed for a deflection of 12.0 mm (vertical solid line) using target average E-values.



The lower variability of LVL made from randomised sorted veneer means that tighter deflection control is possible. This is important because most timber beam designs are governed by stiffness. The low variability of LVL enables engineers to predict deflection with more confidence than with other wood based materials.

Diagram 3 shows the statistical range of deflections that would occur when materials with the actual range of E-values shown in diagram 2 are designed for a 12.0 mm deflection limit using the target average E-values for each material, also shown in diagram 2. Because of the narrower range of E-values of LVL compared with sawn timber, LVL members in a floor or ceiling system will ensure a more uniform surface for plaster finishes or finished flooring. For individual beams like lintels or widely spaced beams like bearers, the range of deflections for LVL is acceptable because most of the higher deflections are less than about one millimetre (-10%) more than the calculated deflection. However, diagram 3 shows that for the machine graded sawn timber, the higher variability results in a much wider range of deflections. This is why a lower bound (fifth percentile) E-value has been introduced into NZS 3603 for sawn timber, but is not required for LVL. For sawn timber, design to a lower bound E-value results in the use of a greater volume of wood to carry the load, so the use of LVL leads to more efficient use of the wood material.