ewpaa

Plywood Manufacture

An introduction in the manufacture of plywood, including veneer manufacture, plywood fabrication and LVL.

Table of Contents

Manufacture of Plywood

Plywood is an engineered panel, typically composed of an odd number of thin layers of wood veneers, called plies, bonded together with a rigid adhesive and with the grain direction of adjacent layers perpendicular to each other.

History

Plywood has it origins in laminating veneers around 3,500 years ago in Egypt during the days of the Pharoahs. The early Greeks and Romans also used veneers and plywood mainly for furniture. From the mid 1800's 'modern' plywoods were utilised in pianos, furniture and tea chests. Plywood came of age as a versatile construction material in the 1930's when water resistant resins were used as glues giving plywood longevity and integrity.

Australian plywood manufacture commenced in Melbourne in 1911 but the two plants closed after a few years of operation. Around 1914 plywood manufacture commenced in Woolloongabba, Brisbane. Thereafter Brisbane became the main centre of plywood manufacturing activity with the 10 mills producing about two thirds of all Australian production, thus making this city the logical base for the Plywood Association of Australia.

The Australian industry expanded around the country after the second World War to the stage where in 1960 there were 63 mills. Around this time the local industry was under threat from imports, and other panel products, so the industry invested heavily in CSIRO research to better understand the manufacturing process and improve productivity. In 1960 the mills used timber from indigenous forests with around 80% of the production being for interior use. Today, the nine, on average much larger mills use mainly plantation timber with around 90% of the plywood produced being for structural applications.

As Australasian plywood can be used in critical structural applications where the costs of failure can be high, there is a requirement for high reliability combined with consistent quality. This is provided by the Plywood Association of Australia's third party audited, process control based, industry wide quality control program. Thus the PAA quality brand permits easy identification and assures the customer the plywood is a quality product and meets the relevant Standard.

Why We Make Plywood

Timber is around thirty times weaker across the grain than along its grain direction. This is obvious when we split wood with an axe. Thus by bonding adjacent timber veneers at right angles using a rigid adhesive as happens in the cross laminated construction of plywood, we utilise this superior strength and stiffness along the grain to overcome this weakness. Put another way, plywood has no natural line of cleavage. Plywood maintains the integrity of the timber and finds a huge range of applications which utilise the enhanced properties mentioned below.

Dimensional Stability

Timber expands and contracts across its grain as it takes in and loses moisture to the atmosphere. The change in length along the grain due to changes in moisture is 1/100 of that across the grain. This factor, combined with timber's much greater strength along the grain, in the cross laminated structure of plywood locks up this movement. This gives plywood excellent two way dimensional stability which is advantageous in applications such as large areas of flooring or concrete formwork.

Strength And Stiffness/Weight Ratio

The cross laminated structure further enhances timber's high strength and stiffness to weight which is a major reason plywood is used in such applications as formwork, flooring, fabricated beams, road transport and

materials handling. For example, the strength to weight ratio of F11 structural plywood is close to 4½ times the ratio for Grade 250 steel.

Split Resistance

The cross lamination controls any tendency for splitting along the grain and thus enables nailing or screwing very close to all panel edges. Additionally, plywood is highly resistant to edge damage when compared to other panels. These two properties combine to make plywood a rugged building panel.

Panel Shear or Shear Through Thickness Capacity

Panel shear capacity is the ability to resist loads in the plane of the panel. As plywood's cross laminated structure prevents the tendency to split along the grain it has double the panel shear capacity of timber. This makes plywood an excellent material for bracing for residential wall framing, floor, wall and roof diaphragms, the webs in box, C or I-beams, and for gusset plates in timber portal frames.

Resistance To Concentrated Loads

Plywood's cross lamination spreads loads sideways and gives plywood its excellent ability to carry high concentrated and impact loads that would break or shatter many other materials.

Resilience, Impact And Fatigue Resistance

As the structure of the timber is maintained and the fibres not smashed during plywood manufacture these closely related properties are all derived from the parent wood. Timber has high short term load capacity, and is able to elastically spring back or recover its original shape after shock or impact loads. Plywood's structure further enhances this high resilience and impact resistance.

Plywood, being an organic cellulose material is not subject to the fatigue failure of crystalline materials, e.g. metals and plastics. Plywood thus can endure cyclic stresses much longer than these crystalline materials which means it is able to maintain its strength under repeated loading.

Thermal Insulation With Low Thermal Mass

Plywood, like its parent wood is a good thermal insulator plus it has a relatively low specific heat when compared to other building materials. These two properties can be utilised for thermally efficient floor, wall and roof construction.

Chemical Resistance

Plywood reacts to chemical exposure much the same as wood, in that it has reasonable resistance to acid (pH 2) and alkaline (pH 10) conditions. Thus it can safely be used in most areas exposed to chemicals, for example in heated indoor swimming pool enclosures.

Plywood performs very well in seaside applications under exposure to salt mist, thus preservative treated plywood makes an excellent external cladding for beachside housing. The preservation being to protect the wood from fungal attack. In fact, plywood cladding has a low vapour permeance thus it is also a good vapour barrier.

Sound Reflectance

Plywood's ability to reflect sound is used to reflect traffic noise from highways, and in theatres as a lining to enhance the room acoustics.

Workability

Plywood can be worked with the same ease as timber. Sawing, gluing, nailing or screwing pose no problems

Aesthetics

Timber and plywood look great!

Plywood Is Timber Made Better!

Timber is a precious resource and the fact low quality, fast-grown timber can be used for the manufacture of plywoods means maximum value adding. Plywood from plantation timber, is an environmentally correct material. The modern structural plywoods have all the above advantages and can be used both aesthetically and structurally.

Veneer Manufacture

Log Preparation

The logs are first 'debarked' after delivery from the plantation. This is achieved by a machine which mechanically scrapes the bark from the log.

It is good practice to 'condition' the log before peeling. This can be achieved by water sprays, immersing in cold or heated water, or by steam treatment. This ensures the log is at a high and consistent moisture content throughout which facilitates peeling and helps yield smooth veneer with less tendency to split or tear. Heating the log softens the timber fibres and further improves veneer quality and yield.

Before peeling the logs need to be 'docked' or cut into 'blocks' or 'billets' around 100mm longer than the finished plywood panel, i.e. usually 2½ metres. The log is now ready to be conveyed into the plant for peeling.

Peeling

The initial process in peeling is to load and centre the peeler block in the spindles of the veneer lathe. The peeler block must be centred with the axis of the log along the centre line of the lathe spindles to obtain maximum veneer recovery. This can be done manually, but is best achieved by an 'x - y charging system'. This system uses a laser scanner to measure the block three dimensionally and uses a computer to calculate the largest perfect cylinder within the block. The system then locates the block in the best position for the lathe.

The lathe effectively rotates the block against the lathe blade or 'knife' which peels the veneer off in long continuous veneer ribbon of consistent thickness.

Clipping

The ribbon of veneer passes from the lathe through manual or automated clipping machines which cut or 'clip' the veneer to size, or into smaller strips if defective material has been removed. In some mills producing high quality thin veneer, clipping is done after the continuous ribbons of veneer have been dried so as to maximise the number of full sheets obtained.

Drying

The wet veneer is fed through a drier to reduce its moisture content to about 8% from the 'green' moisture content of between 40-140%. The optimum moisture content for gluing depends on the species and density of the veneer, and the adhesive and gluing procedures being used. In mechanical driers the veneer is conveyed through a long chamber in which hot air is circulated Driers can have one, or as many as five separate conveyors, one above the other. The drying time is regulated by adjusting the speed of the conveyors and/or the temperature of the hot air.

Jointing or Veneer Repair

Small strips of veneer may be jointed into full size sheets by edge gluing, stitching or using perforated tape. Open defects may be repaired by using plugs to upgrade the veneer.

Crossbands

The core veneers that run across the panels at right angles to the face veneers are termed 'crossbands'. In a 2400mm x 1200mm panel the crossbands can be produced by a smaller lathe, or by cutting full sheets of veneer into two.

Grading

The dried, clipped and perhaps jointed or repaired veneers are graded in preparation for use in plywood manufacture.

Sliced Veneer

In general plywood manufacture the veneer is rotary peeled. It is used because of its lower cost and higher yield. However, sliced veneer can be produced by a 'slicer', the strips of veneer being cut in a straight line action. Sliced veneers are generally used for decorative faces to highlight the natural timber grain pattern or 'figure'. This pattern can be varied depending on the angle of the slice through the log.

Plywood Fabrication

Lay-up

The dried, graded veneers are usually assembled in two bundles in preparation for the spreading operation. In one bundle the graded faces and long bands are assembled and the other consists of the crossbands or in the case of three ply, the cores. It is these crossbands or cores which are run through the glue spreader. Different grades of plywood are made from various grades of faces, backs, crossbands and cores. In a three ply construction only the centre veneer passes through the glue spreader. The glue is transferred to the adjacent veneers in the pressing operations.

Glue Mixing

The adhesives currently used for plywood manufacture are based on synthetic resins and are all thermo-setting, i.e. they are cured by heat and are not replasticised by subsequent heating. The adhesives have a defined series of bond tests and are grouped as shown below on the basis of their durability.

A Bond	Phenol, Resorcinol or Tannin Formaldehyde	Fully weather resistant
B Bond	Melamine fortified Urea Formaldehyde	Partially weather resistant (2-5 years exposed)
C Bond	Urea Formaldehyde	Interior glue - high humidity applications
D Bond	Extended Urea formaldehyde	Interior glue - low humidity applications

In glue mixing, fillers, a little water and perhaps some caustic soda are added and thoroughly mixed with the synthetic resin. The fillers normally used are nutshell and/or wheatflour and are used to bulk up the glue, improve the initial tack of the glue, improve the transfer of the glue from the spread to the unspread veneer, and lower the glue costs by reducing the amount of resin required.

Glue Spreading

In the glue spreading operation it is usual to spread glue on both sides of the crossbands simultaneously by passing them through the glue spreader rollers. The plywood sheet is then assembled with the spread crossbands between the longbands and/or the face veneers. The resultant assembly is known as the lay-up.

Prepressing

The packs of spread veneers are now ready for the pressing operation. They can either go directly to the hot press or more usually they first undergo a prepressing operation. The prepressing is carried out in a cold press which has one large daylight (or opening). A pack of spread veneers, usually enough for two or three hot press loads, is placed under pressure at normal atmospheric conditions. The aims of this process are to transfer the adhesive from the spread to the unspread surface of the veneer to obtain a better glue bond and to develop some strength (using the initial tack) in individual panels to make subsequent loading of the hot press easier. This decreases the amount of degrade due to handling between spreading and hot pressing.

Hot Pressing

The spread assemblies are bonded together under high temperature and pressure in a large multi-opening hydraulic hot press. The normal hot press has from six to fifty daylights, operating at a press temperature around 140°C and a pressure of around 1MPa. The packs remain under the prescribed conditions of temperature and pressure until curing of the glue takes place.

Smaller presses are loaded manually while the larger presses have automatic loading and unloading equipment. After exiting the hot press the panels are flood sprayed with water, stacked and allowed to cool. This final process brings the plywood close to normal moisture content and improves the panel's flatness and stability.

Trimming, Filling and Sanding

Finally the plywood is trimmed to size. Those panels requiring it may be filled or repaired and most plywood is then sanded. After stamping with the required brands the plywood is packed ready for despatch.

Quality Assurance

The PAA quality brand stamp ensures the product has been manufactured under the PAA third party audited industry wide quality control program. This program is a combination of process quality control and end product testing carried out within each mill, and independent end product testing of samples from every production shift and regular mill inspections by the PAA.

Laminated Veneer Lumber

Laminated veneer lumber (LVL) is primarily used as a structural beam, rather than as a panel as in the case of plywood. Structural LVL is manufactured in a similar manner as plywood, the main difference being all (or most) of the veneers have their grain aligned longitudinally, rather than alternating perpendicular and parallel to the length. Structural LVL is manufactured with A bond gluelines and to a quality controlled manufacturing specification or 'recipe'!

The significant advantage of the parallel veneers is the naturally occurring strength defects in solid wood are evenly distributed thus minimising their effects.

Structural LVL manufactured to AS/NZS 4357.0 has known, consistent and reliable structural properties.

Advantages of LVL

The naturally occurring defects in sawn timber limit its structural properties, and as the trend in the available timber resource shows a decline in size, quality and volume, reconstituted products like LVL are subject to a fast growing demand.

Superior Strength and Stiffness

The randomising of the naturally occurring strength defects in timber, such as knots and sloping grain, makes LVL much stronger and stiffer than the parent material. In fact, the tensile strength can be tripled, a very useful property for tension chords of trusses and the outer laminate in glue laminated beams.

Long Lengths

As the diameter of the available logs is decreasing, LVL offers large sections of long lengths, 12m being a standard length. Additionally, LVL is available in widths up to 1.2m.

Dimensional Accuracy and Straightness

LVL offers material of consistent and accurate dimension plus exceptional straightness. These properties offer large labour savings in construction, and less call back problems on completion.

Stability

As the material is already 'seasoned', there is no need to allow for shrinkage - LVL is a stable material.

LVL Manufacturing Process

LVL can be manufactured in a plywood press in a 2400mm x 1200mm 'biscuit'. After rip sawing into beams these can be joined with special nail plates to make longer beams.

The second method of manufacture is in a continuous purpose built press which produces 'slabs' of any length. The joints in the outer veneers can be scarfed, or lapped and are staggered throughout the cross section. The inner veneers are also staggered and may be butt joined, thus providing an effective means for the steam to escape while the slab is in the long hot press, thus avoiding any 'blows'. Blows are when the glueline is blown

apart by steam pressure before the bonding has been completed. After exiting the press the continuous LVL is cross cut to the desired length, and later rip sawn to standard widths.

High Structural Reliability

As a result of the wide and even distribution of the timber characteristics in the reconstitution process there is very little variation in the material properties along each length or from piece to piece of LVL. Its structural properties are consistent and can be used by designers with confidence.

GLUED LVL AND PLYWOOD I-BEAMS

Glued I-beams utilising LVL's high tensile and compressive strengths in their flanges, and plywood's high panel shear capacity in their webs, provide a structurally efficient beam. These beams are extremely light, very stable and have exceptional strength and stiffness. Holes for services are able to be made through the web, the maximum size and location depending on the support locations and loading.

Revision History

Revision	Changes	Date	Who
3	• Updated logos and member list	07-02-12	MB
2.0	• Reformatted. • Added various photos	03-03-09	MB
1.0	• Initial Release		

EWPAA Members

Plywood and Laminated Veneer Lumber (LVL)

Member Name	Location	Phone	Fax	Web
Ausply	NSW	+61 2 6926 7300	+61 2 6922 7824	www.ausply.com
Austral Plywoods Pty Ltd	QLD	+61 7 3426 8600	+61 7 3848 0646	www.australply.com.au
Big River Group Pty Ltd	NSW	+61 2 6644 0900	+61 2 6643 3328	www.bigrivergroup.com.au
Carter Holt Harvey Woodproducts Australia (Plywood) – Myrtleford	VIC	+61 3 5751 9201	+61 3 5751 9296	www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts Australia – Nangwarry LVL	SA	+61 8 8739 7011		www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts - Marsden Point LVL	NZ	+64 9 432 8800	+64 9 432 8830	www.chhfuturebuild.co.nz
Carter Holt Harvey Woodproducts (Plywood) - Tokoroa	NZ	+64 7 885 5999	+64 7 885 5614	www.chhwoodproducts.co.nz
Fiji Forest Industries	Fiji	+67 9 881 1088	+67 9 881 3088	
IPL (West Coast) Ltd	NZ	+64 3 762 6759	+64 3 762 6789	
Juken New Zealand Ltd (Gisborne)	NZ	+64 6 869 1100	+64 6 869 1130	www.jnl.co.nz
Juken New Zealand Ltd (Wairarapa)	NZ	+64 6 370 0650	+64 6 370 0653	www.jnl.co.nz
Nelson Pine Industries Ltd	NZ	+64 3 543 8800	+64 3 543 8890	www.nelsonpine.co.nz
PNG Forest Products Ltd	PNG	+67 5 472 4944	+67 5 472 6017	www.pngfp.com
RH (PNG) Ltd	PNG	+67 5 325 5600	+67 5 325 6165	www.rhpng.com.pg
Valebasoga Tropikboards Ltd	FIJI	+67 9 881 4286	+67 9 881 4154	
Wesbeam Pty Ltd	WA	+61 8 9306 0400	+61 8 9306 0444	www.wesbeam.com

Particleboard and MDF

Member Name	Location	Phone	Fax	Web
Alpine MDF Industries Pty Ltd	VIC	+61 3 5721 3522	+61 3 5721 3588	www.alpinemdf.com.au
Borg Panels Pty Ltd	NSW	+61 2 6339 6111	+61 2 6339 6220	www.borgs.com.au
Carter Holt Harvey Woodproducts Australia	NSW	1800 891 881	+61 2 9468 5793	www.chhwoodproducts.com.au
D & R Henderson Pty Ltd	NSW	+61 2 4577 4033	+61 2 4577 4759	www.drhenderson.com.au
Laminex	VIC	+61 3 9848 4811		www.thelaminexgroup.com.au
Tasmanian Wood Panels (Aust)	TAS	+61 3 9460 7766	+61 3 9460 7268	
Weathertex Pty Ltd	NSW	1800 040 080		www.weathertex.com.au

PRODUCT CERTIFIED

paa ENGINEERED WOOD

JAS-ANZ

Visit the EWPAA Website to get the latest information. www.ewp.asn.au

Visit www.ewp.asn.au/register to ensure your products carry genuine EWPAA certification