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Timber in Internal Design

Technical Design Guide issued by Forest and Wood Products Australia

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Introduction

Timber is a renewable material that is both beautiful and durable. It is specified for a broad range of design applications throughout Australia and overseas. Light and versatile, it is used in interior and exterior applications including framing, roofing, lining, cladding, flooring, fit out and joinery for all building types. It can be used in its original shape, rough sawn or hewn to size, dressed to a smooth finish, machined into a variety of shapes or sliced into sheets of veneer. Timber can be machined to realise patterns, filigrees and geometrically complex forms.

Different species possess different basic properties and, therefore, provide a natural variety of aesthetic and structural options. Wood can be transformed into manufactured, reassembled products, including glue-laminated timber, particleboard, plywood and laminated veneer lumber. Each engineered product has its own structural and aesthetic properties and qualities in building.

Timber is easy to work and handle, is a store for carbon and has a low embodied energy.

Pump house, Longford, Tasmania, 1841.

Queenscliff Residence by John Wardell Photographer - Trevor Mein

Timber is easy to work and handle, is a store for carbon and has a low embodied energy. While the trees are growing, they are home to a variety of flora and fauna. Biodiversity is maintained through the forestry cycle as the trees are regrown. The manufacturing process for timber produces fewer pollutants for the air and water than many of its alternatives. Timber is also reusable, recyclable and biodegradable.

A comprehensive understanding of the natural growth characteristics and material behaviour of timber is essential in successfully designing, specifying and constructing with timber. This document aims to present an overview of timber as a material and provide detail for timber in interior applications.

The guide combines information about species, material capability and assembly with an interior design approach to colour, pattern and performance with the full range of wood products.

Denton Crocker Marshall's Melbourne Museum.

1 Visual Palette

Timber is a natural, grown material and as such is susceptible to variation. This variation, when well detailed and considered, adds a richness and texture to surfaces, joinery and furniture. The key visual characteristics of timber are described in detail below.

1.1 Colour

Colour, colour consistency, and its combination with grain pattern are critical aspects of visual appeal. However, Australian Standards do not contain any requirements for colour or colour consistency. In the Australian Standards, colour is held to be a variable characteristic of the species. Industry standards and designer specifications regularly place restrictions on the variability of colour. Usually, boards that are significantly outside a mean average colour range are excluded as being too light or too dark. Occasionally, boards are sorted into colour groups between agreed boundary colours.

Particular species are associated with particular colours, even though only a proportion of the timber from the species may match this expectation. An example of this is Tasmanian Myrtle, *Nothofaguscunninghamii*. In the market, myrtle is perceived as a red to red-orange timber, yet in the forest the colour of myrtle wood varies from nearly white, through pink to red. Only the red timber is regularly milled. Species information sheets are available through the WoodSolutions website which include an indication of possible colour range within a species. Designers must ensure that if a colour range is to be specified, it is clearly agreed within the supply chain.

An analysis of available colours suggests that while wood is generally brownish, most timber can be sorted into one of five main groups of brown shown in Figure 7: yellow, pinks, browns, red-oranges, blacks. Each of those groups can then be graduated from light to dark or pale to intense.

While individual species may produce timber of one major colour group, it is quite common for timber of a particular species to fall in two or three groups. Blackwood is an example, falling into groupings of both browns and blacks.

Yellows Huon Pine, Radiata

Grey-Blacks Walnut, Blackwood

Pinks Tas Oak, Vic Ash

Browns Blackwood, Blackbutt

Red-Oranges Myrtle, Cedar xxxx distorted

Figure 7: Common colour groups in timber.

1.1.1 Colour Variegation

Almost all timber has some variegation in the colour of the wood, generally as the result of growth rings. Other variation of colour can also occur due to the age of various parts of the wood and changing growing conditions. The level of variegation acceptable in a piece depends on the application and the base colour. Variegation is much more noticeable in pale colour timber. Examples are shown in Figure 8.

Silver Wattle ***Radiata Pine*** ***Blackwood***

Figure 8: Colour variegation within timber.

1.1.2 Colour Matching

Timber is generally too variable to match pieces to a particular colour. The best case achievable is matching the timber within agreed colour boundaries. The closer together the boundaries of a particular group, the more consistent the colour match will be. It also means that there will be less timber from any group of boards or veneer accepted into a particular group. Even when matched, the timber still needs to be blended during assembly or installation to ensure that there is a good mix of colour and tone throughout the project area.

1.1.3 'Colourfast' Considerations

Like many materials, no wood, wood finish or stain is completely 'colourfast' if that is defined as 'no change of colour over time'. Raw wood, without a stain or finish, will change colour in reaction to ambient conditions. The addition of stains and/or topcoats will slow the rate at which the transformation will occur, but not stop it.

John Wardle Architects: Flinders House.

1.2 Grain, Texture and Figure

1.2.1 Grain

Visually, grain is the direction, size, appearance, or quality of the fibres in timber. The most common grain variation is the pattern of the growth rings on the surface manifested from cutting timber at varying angles to the tree growth.

Grain pattern

Hardwood

Softwood

Board sawing grain

Quartersawn

Timber sawn with the average inclination of the growth rings to the wide face is not less than 45°.

Backsawn

Timber sawn so that the growth rings are inclined at less than 45° to the wide face.

1.2.2 Texture

Texture is specifically a description of the size and quality of the wood elements of grain. Texture can be coarse, fine, even or uneven. Softwoods are normally considered to be fine textured, whereas hardwoods may span the range from coarse to fine. Mountain ash, ***Eucalyptus regnans***, is an example of a coarse textured hardwood, but Brushbox, ***Lophostemanconfertus*** – also a hardwood – is considered to have a fine texture.

Fine → ***Coarse***

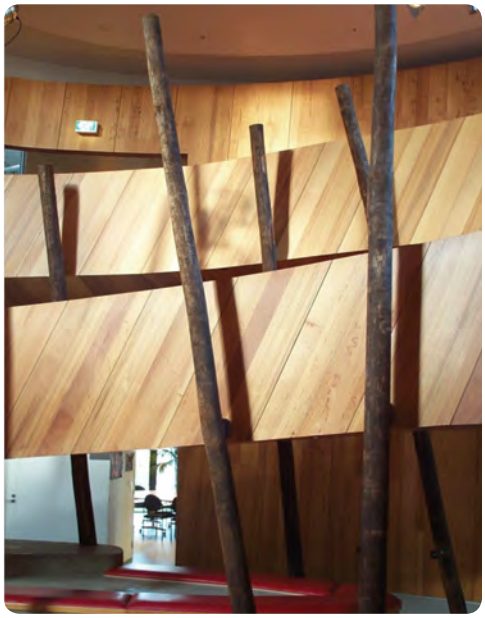
Softwood

Hardwood

Surface texture of the timber varies with sawing and machining. Timber rough sawn by circular blade may have arc-shaped ridges across its surface, or have a rough fibrous surface. Bandsawn timber can often have vertical ridges across the surface. Split timber surface will have an uneven surface which follows grain fibres. Planed or 'dressed' timber will have a smooth surface, with texture only present from grain fibres. Structural framing timber is often machined with a series of longitudinal ribs.

Rough sawn (circular saw).

Planed.



Denton Cocker Marshall's Melbourne Museum.

1.2.3 Figure

Figure is the pattern produced on the cut surface of wood by annual growth rings, rays, knots, deviations from regular grain such as interlocked and wavy grain, and irregular colouration.

Figure is natural visual characteristics in the timber caused by:

- growth patterns
- fire or mechanical damage
- insect marks
- stain and bacterial infection.

Knots
are a portion of a branch or limb that has been surrounded by subsequent growth of the stem. The shape of the knot as it appears on a cut surface depends on the angle of the cut in relation to the long axis of the knot.

Burl or burr:
This is a large abnormal growth or protuberance on either the trunk or branches, and is formed by local development of numerous dormant buds, often caused by injury to the tree. The interwoven mass of wood elements gives an attractive and unusual figure whichever way it is cut.

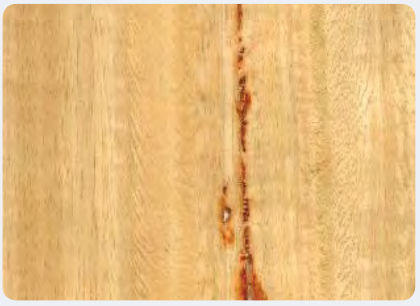
Wavy grain and fiddle-back:
When quarterly sliced, logs with wavy grains produce beautiful veneer with wavy patterns. Light is reflected at varying angles from the surfaces because the individual elements are cut across at varying angles. Figures with large undulations are described as 'wavy', while those with small, regular undulations are 'fiddleback'.

Commonly found in such species as Red Gum (***Eucalyptus camaldulensis***), Blackwood, Mountain Ash, Alpine Ash, Jarrah (***E. marginata***) and others.

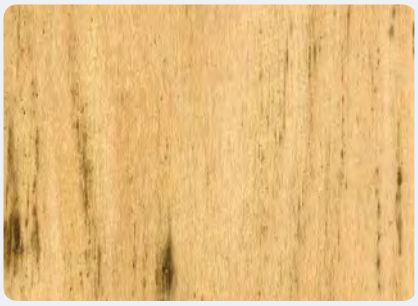
Bird's eye:
This figure can be seen on back-cut surfaces of certain species as numerous rounded areas resembling small eyes. It is caused by small conical depressions of the fibres.

Pommele:
This figure resembles a puddle surface during a light rain: a dense pattern of small rings enveloping one another. Some say this has a ‘suede’ or ‘furry’ look.

Gum vein:
A ribbon of gum between growth rings, which may be bridged radially by wood tissue at intervals. Gum is also known as kino.



Black speck:
Black speck is a fungal stain in the timber caused by the attack of certain insects leaving pinholes in the wood.



Gum cluster:
Clusters of small or short gum veins between growth rings, corresponding to damage or other event.

Black heart:
Various fungi and bacteria can stain or colour the timber either in the standing tree, or as it is milled and dried. Some stains are desirable, such as the ‘blackheart’ feature found in Sassafras, while others, such as the blue stain found in slow-drying hardwood, are not.

Hobnail:
The pattern of pinholes or streak marks that occur along a growth ring in quartersawn timber caused by some insect attack.

Lyctid borer:
Sometimes known as the powder post borer, this is the larval stage of lyctid beetle. The borer consumes the starch-rich sapwood of some hardwoods, leaving behind a sawdust-filled honeycomb of wood.

Australian Standards limit the use of lyctid susceptible sapwood throughout Australia.

Surface check:
A separation of fibres along the grain forming a fissure, but not extending through the piece from face to face. Checks commonly resulting from stresses built up during seasoning. Surface checks affect the integrity of veneers and provide a trap for moisture in solid timber sections.

Pin hole:
Small, regularly sized but irregularly spaced holes on the surface of the wood caused by insect attack in the tree or the timber. They are often accompanied by discoloration around the hole.

1.3 Combinations and Patterns

Adjacent slices or leaves of veneer typically have similar patterning because the changes in grain and features/figuring vary gradually through the timber. Similar veneers can be placed in varying arrangements with striking effects. Similar patterns can also be achieved with high appearance grade solid timber. This process is termed 'matching'.

When two sheets of veneer are matched, the 'tight' and 'loose' faces may alternate in adjacent leaves. They reflect light and accept stain differently, and this may result in a noticeable colour variation in some species.

It is essential that the veneers are balanced on either face when laid on a panel; an unbalanced panel would warp as it gains moisture unevenly. Veneers are laid with grain perpendicular to the grain of the board. Generally, the same species and thickness of veneer should be applied to both sides of the board. If differing species are required on the face and back, it is essential that both veneers have similar strength properties and dimensional behaviour characteristics. The grain of the veneer should be generally parallel to the long edges of the panel.

It is common for veneered engineered boards to have veneers of varying width between boards. i.e. three, four or five strips of veneer per 1,200 mm wide board. Procuring a number of boards with the species of veneer with the same matching pattern from an individual supplier may not result in a set of boards that can be matched end-to-end. In such cases, a random match pattern can be adopted or the procurement should be managed carefully.

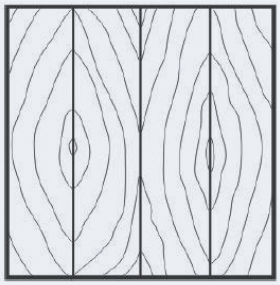
It is essential that the veneers are balanced on either face when laid on a panel; an unbalanced panel would warp as it gains moisture unevenly.

Bates Smart: Sydney Water.

Patterns

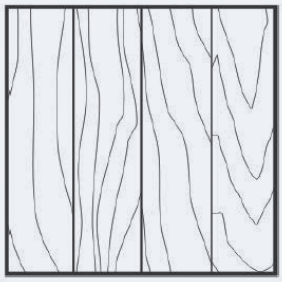
Book matching

Book matching is based on the principle of creating a mirror image. Successive veneer leaves in a flitch are turned over like the pages in a book, and edge-joined in this manner. Since the reverse side of one leaf is the mirror image of the succeeding leaf, the result is a series of pairs. Book matching may be used with plain, quarter or crown sliced veneers.



Random matching

Individual leaves are randomly matched together with the intention of dispersing characteristics such as knots or gum veins more evenly across the sheet. In this way, veneers from several logs may be used in the manufacture of a set of panels.



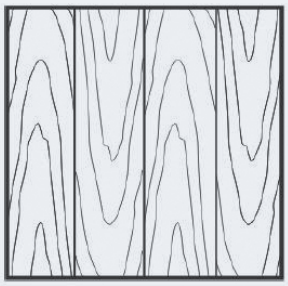
Herringbone matching

Veneer strips are used and matched to both sides of a centre line, at an angle to it. This can produce a downward or upward 'V'.

Slip matching

Successive veneer leaves in a flitch are 'slipped' one alongside the other and edge-glued in this manner. The result is a series of grain repeats, but no pairs. This method gives the veneer uniformity of colour because all faces have the same light refraction.

Reverse slip matching
This method is generally used with crown cut veneers. Veneer leaves are slip matched, then every second leaf is turned end-to-end. The method is used to balance crowns in the leaves so that not all the crowns appear at one end.



Diamond and reverse diamond matching

Sheets are cut on an angle and quarter-matched to produce a diamond figure. Reverse diamond matching uses the same principle with the same kind of veneers, but the grains are matched to produce an 'X' pattern rather than a closed diamond.

Other combinations

The above methods are frequently used for matching veneers. However, other individually designed matching methods can be used to develop beautiful unique patterns by utilising different patterns and colours of veneers.

Inlay

Cabinetmakers often frame a highly decorative wood grain with a plainer grain to accent it. To delineate it, a narrow strip or dark or patterned veneer is cut in along the joint line. This technique is called inlay. It has also come to mean cutting patterns into the basic veneer.

Marquetry

Veneer faces of various kinds are made up with small segments of veneer cut into patterns and fitted together. Often many different species and grain patterns, including many of the most exotic grains, are used in marquetry work. Beautiful effects can be obtained using the marquetry technique. It is generally applied in furniture manufacture and can be quite ornate.

2

Connecting Timber Elements - Joint Types, Fixing and Connections

The following section discusses options available to the designer for connecting stick and panel type elements.

2.1 Joint Types

Timber is relatively easy to shape and work into connecting joints, such as dovetails, with readily available equipment. Timber can be prefabricated by machine or hand, or can be worked on-site to suit particular scenarios. Connections between timber elements, whether stick type framing or panels, can be achieved with carpentry joints, metal fasteners or glue, or as a combination.

2.1.1 Carpentry Connections

Carpentry type connections involve the machining of the intersecting elements to create a joint such as housing, halving or dovetailing. Such connections are typically used in visually expressed applications or applications where locating elements relative to each other is required, ensuring good fit, before using a mechanical fastener for the connection.

David Travalia: Hollybank Training Centre.

Chris Connell Design: Brimar Court.

2.1.2 Metallic Fasteners

Metallic fasteners such as nails, screws and bolts, or specialist proprietary products such as hangers and cleats, are used to secure elements. Fasteners can be machine or manually fixed. Size, form, number and spacing of fasteners required in structural applications is defined in *AS 1720.1 – 1997 Timber Structures: Design Methods* or *AS 1684.2/3/4 – 2010 Residential Timber Framed Construction* but for smaller scale applications the fasteners are specified by the designer or builder. Fasteners may require pre-drilling to prevent splitting of timber on fixing. Fasteners of certain materials, such as ferrous metals, may react with extractives in some timber species resulting in accelerated corrosion of the fastener and staining of the timber in damp environments.

The visual characteristics of different fasteners vary significantly. Careful specification of fasteners and design of the fastener array is essential in order to maintain control over the appearance of the finished article.

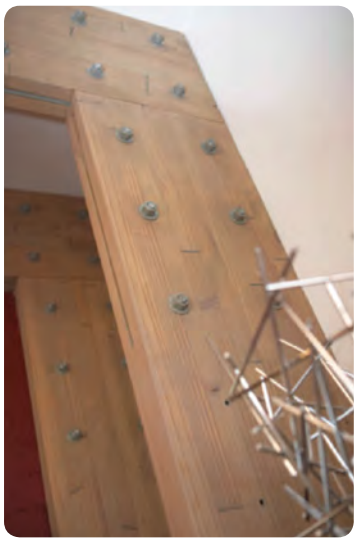
Careful specification of fasteners and design of the fastener array is essential in order to maintain control over the appearance of the finished article.

Counter-sunk screws: cross, square and hex drive.

Raised hex-head: roofing, machine, bolt.

Nails: machine & hand driven.

Figure 6: Screw, bolt and nail head types



Justin Mallia: East St Kilda house extension.

Johnson Pilton Walker: National Portrait Gallery.

Jorge Hrdina: Lilypad House.

2.1.3 Adhesives

Gluing is often used as a connection in conjunction with metallic fasteners, such as screws, which provide a temporary clamping force for the glue to cure, and provide redundancy in the event of glue failure. Glues or 'adhesives' can either be factory or site applied. Factory-applied adhesives can typically offer a higher performance because of the availability of skilled labour and controlled environmental conditions.

Adhesives are used in internal applications to make wood products such as glue-laminated members, or to create joinery and carpentry elements. Timber glue-laminated for general structural applications is manufactured to the requirements of *AS 1328 - 1998: Glued-laminated structural timber*. Commercially produced glue-laminated timber made to this standard generally feature Type A waterproof phenolic bonds with a distinct dark brown glue-line.

Timber laminated in the joinery for non-load-bearing elements does not need to meet the requirements in *AS 1328 - 1998: Glued-laminated structural timber.* It can be glued with adhesives that comply with, or are at least equivalent in performance with adhesives complying with, *AS 2754.2 Adhesives for timber and timber products – Polymer emulsion adhesives* and achieving at least a Type B bond to *AS/NZS 2098.2:2006: Methods of test for veneer and plywood – Bond quality of plywood (chisel test).* Joints made with adhesives that do not give this performance should be held together by other means in the event that the glue fails.

Two glues commonly used in joinery are polyurethanes and PVA emulsions. Polyurethanes glues are thermosetting glues that react with the moisture in the wood to produce a clear polyurethane resin. They have good strength and some gap-filling capabilities, though their performance is improving with further research.

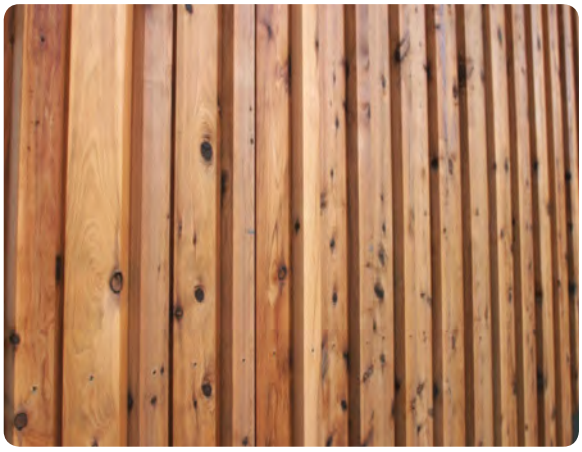
Poly Vinyl Acetate (PVA) is a thermoplastic glue made by polymerising vinyl acetate alone or with other polymers. Most cure at room temperature and set rapidly. They are easy to use, result in a clear glue-line and have good gap-filling properties, though steady pressure on the joint is required. Cross-linked glues have better moisture resistance than other types.

Timber craftsmen and builders or glue manufacturers are typically the best source of information for the specification of glues.

2.1.4 Joint Arrangements

Seven basic timber-to-timber framing connections can be seen below. These connection types are used in various scales from furniture and joinery to structural frames. Connection performance should consider the key points listed below:

- Buildability: The connection should be designed such that it is relatively simple to implement in the relevant scenario whether on-site in an awkward position or in a factory. A well-designed jointing detail provides scope to on-site tolerance in the fixing of the elements.
- Visual characteristics: In cases where the junction between timber elements is visually expressed, the type and form of the connection and fixing will be key. For example, a housed joint allows the grain of the one intersecting element to be visually continuous past the connection. Other types of hidden connections can be achieved with mechanical fasteners or dowels.
- Moisture movement: As described in Section 3.1.4, timber moves differentially between the radial, tangential and longitudinal directions with changing moisture content. Such differential movements can lead to problems with visual and structural fit of joined members. For example, in the case of a housed joint the housed member will shrink across the grain under lower moisture content more than the housing member along the grain leading to a gap opening. This gap may then make the joint flexible and unfit for purpose structurally, expose the connection to moisture ingress or be visually unacceptable. Connections should be detailed carefully considering potential for such movement.



Billard Leece Partnership Pty Ltd: Kardinia Health Super Clinic

Daryl Jackson Sinclair Knight Mertz Lyons: Victorian County Court

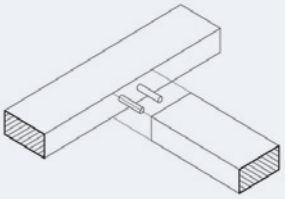
Joint	Description	Joint	Description

Mortice and tenon

Visually expressed furniture, cabinetry, doors and windows. Can be a short tenon in a blind hole. May be pegged, wedged, or interference fit.

Ease of Construction ★☆☆

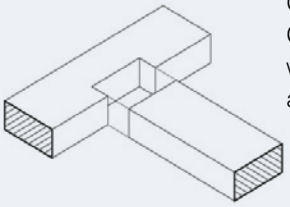
Dowel



Furniture, joinery, windows and doors to make concealed connections. Joint typically glued.

Ease of Construction ★☆☆

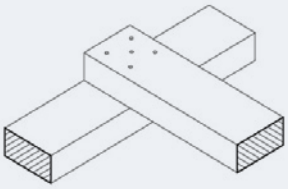
Housed



General joinery. Can be fastened with nails or screws and/or glued.

Ease of Construction ★★☆

Screws/nails in overlap



Internal framing and carcassing. Many options for screws and nails.

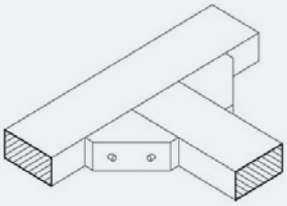
Ease of Construction ★★★

Half housed

General joinery. Can be fastened with nails or screws and/or glued.

Ease of Construction ★★☆

Fixing blocks



Internal framing and carcassing.. Many options for screws and nails.

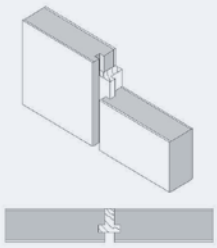
Ease of Construction ★★★

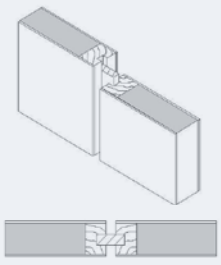
Biscuit

Biscuit cutter and glue required. Furniture, joinery, windows & doors. Concealed connections.

Ease of Construction ★★☆

Loose tongue

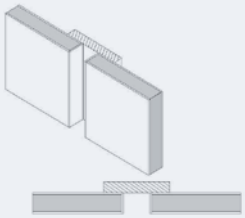




Loose tongue of varying form between two rebated panels. Tongue size, gap size and material can vary.

Ease of Construction ★☆☆

Backing strip

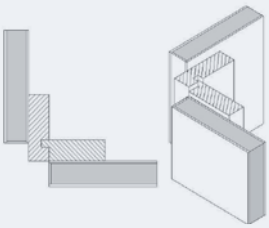


Visually expressed furniture, cabinetry, doors and windows. Can be a short tenon in a blind hole. May be pegged, wedged, or interference fit.

Ease of Construction ★☆☆

Joint	Description	Joint	Description

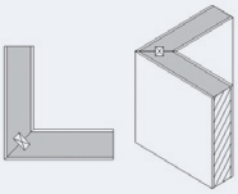
Backing strip corner



Backing strip of contrasting of similar timber used to join panels. Backing strip may be jointed panels of larger block continuous along join.

Ease of Construction ★★☆

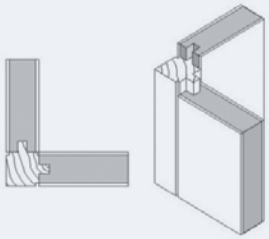
Mitre loose tongue corner



Mitre joint to preserve continuation of face veneer of adjoining elements. Loose tongue used to join elements.

Ease of Construction ★☆☆

Loose T&G corner



Solid timber tongued element usually matching face veneers of adjoining elements.

Ease of Construction ★☆☆

Tongue & groove mitred corner

Mitre joint to preserve continuation of face veneer of adjoining elements.

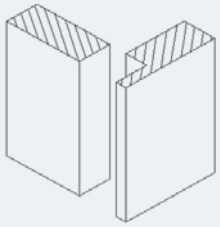
Ease of Construction ★☆☆

Longitudinal Notch

One or both intersecting pieces profiled to create a male and female junction.

Ease of Construction ★★☆

Longitudinal Lap



One or both intersecting pieces profiled to create a male and female junction.

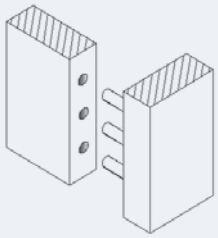
Ease of Construction ★★☆

Dovetail

Traditional connection in cabinetry, though less common in joinery. Complex to make by hand and difficult to machine.

Ease of Construction ☆☆☆

Dowel



Common in modern furniture, especially self-assembly items. Concealed and relatively simple to fabricate.

Ease of Construction ★★☆

3

Coatings and Finishes

The following section presents a summary of different types of coatings and finishes relevant to the interior use of timber. The field of coatings and finishes is a rapidly evolving sector with advancing technology, and growing concerns over public health and ecological issues leading to a significant increase in the use of water-based products. As such, more detailed information on products and product types for the development of project specifications should be sourced through coating manufacturers and suppliers and through reference to *AS/NZS 2311 Guide to the Painting of Buildings*.

Coating timber used in interior applications allows the timber to be cleaned and wiped free of potentially staining substances, thus improving its service life.

McBride Charles Ryan: Letterbox House

3.1 General

Coating timber with a well-maintained paint or a high-build translucent finish can increase the service life of the element by improving resistance to wear and abrasion, reduce colour change in the timber associated with exposure to UV, enhance the colour, grain and feature of the timber, and reduce decay in exposed elements. Coatings shed water off the surface of the timber and slow the uptake of moisture, particularly for the relatively porous end-grain of the timber. Providing a coating to timber used in interior applications allows the timber to be cleaned and wiped free of potentially staining substances, thus improving its service life.

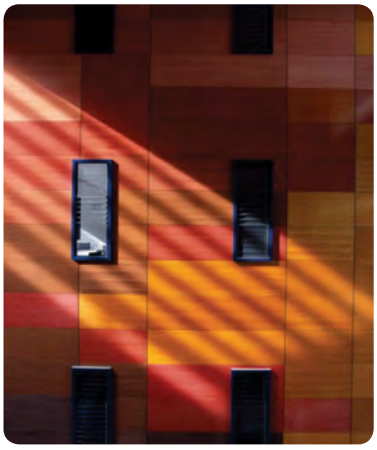
Good-quality paint systems provide a water-resistant and generally long-lasting finish. Stains and water repellents do not last as long and require more frequent reapplication than paints. Factory-coated finishes tend to have significantly longer service lives than site-applied finishes, as factory finishing allows superior coatings to be applied in controlled conditions. The coating on factory-finished elements is highly durable and should not require refinishing for many years. The coating should be protected during storage, installation and subsequent construction. Factory-finished coatings often require special repair. Non-compatible coating will often not adhere to the surface properly. If the finish is damaged, consult the supplier.

Finished timber can often be seen to ‘yellow’ over time as a result of using amber binders or vehicles for the stains and/or topcoats. To avoid yellowing, specify ‘non-yellowing’ finishing materials. The addition of an ultraviolet (UV) inhibitor will slow, but not prevent, the gradual colour change of the wood, the stain and the finish system.

The expected life of paint or other finishes depends on the quality and type of coating, the care taken in application and the condition of the underlying timber. Timber characteristics which effect the performance of the applied finish includes:

- **Species** – The performance of different finishes varies with the species and density of the timber onto which the finish is applied. Finish manufacturers should be consulted for detailed information on the varying performance with changing species.
- **Surface texture** – Smooth surfaces offer better substrates for painting than rough surfaces, therefore dressed timber offers a better performance than sawn timber for conventional paint systems. Rough sawn timber can be used with oils and stains.
- **Moisture content** – Seasoned timber (10 to 15% MC) provides a more stable substrate than green timber, thus reducing problems of cracking associated with movement under a coating. Moisture egress associated with drying in-situ of green timber can lead to blistering of finishes with low vapour permeability such as paint, so stains and oils are best adopted if the timber is green or with a high MC.
- **Section profile** – Section edges should be arrissed or rounded to prevent concentration in coating stress for paint finishes. For surface coating systems such as paint, sections adopted should be as dimensionally stable as possible such as quartersawn rather than backsawn.
- **Material features** – Heartwood has a higher natural durability than sapwood but is harder to treat with impregnated treatments. Timber features or 'defects' will affect the finish performance. Gum pockets can lead to resin exudation and staining unless pre-treated and sealed. Aromatic oils can lead to drying retardation and staining if surface oils are not removed. Knots can cause premature cracking, staining and resin exudation can occur unless treated with knotting varnish or manufacturers recommend treatment. Bark can lead to premature failure of all film-forming finishes if not removed. Extractives may cause topcoat discolouration or blistering unless surface extractives are removed with a solvent wash prior to priming.

Barwon Heads by Inarc Architecture. Photographer – Peter Clarke



H2o Architects: Deakin University International Centre & Business Buildings.

Finishes	Transparency	Typical use	Approx VOX	Colour range / appearance
Untreated, 'bare'	High transparency	Linings Furniture Joinery Carcassing	None	Colour by species & level of weathering
Oil		Linings Furniture Joinery	<455g/L	Looks like wet timber
Clear varnish		Linings Furniture Floors Joinery	<15g/L	Matt, satin or gloss finish. Grain visible.
Pigmented varnish		Linings Furniture Floors Joinery	<155g/L	Matt, satin or gloss finish. Toned grain visible. Colour range by manuf.
Stain		Linings Furniture Floors Joinery	<10g/L	Coloured grain visible. Matt, satin or gloss finish. Colour range by manuf.
Paint	Opaque	Linings Furniture Floors Joinery Carcassing	<5g/L	Opaque smooth surface. Vast colour range available.

Campbell Drake: Dusk Bar.

4

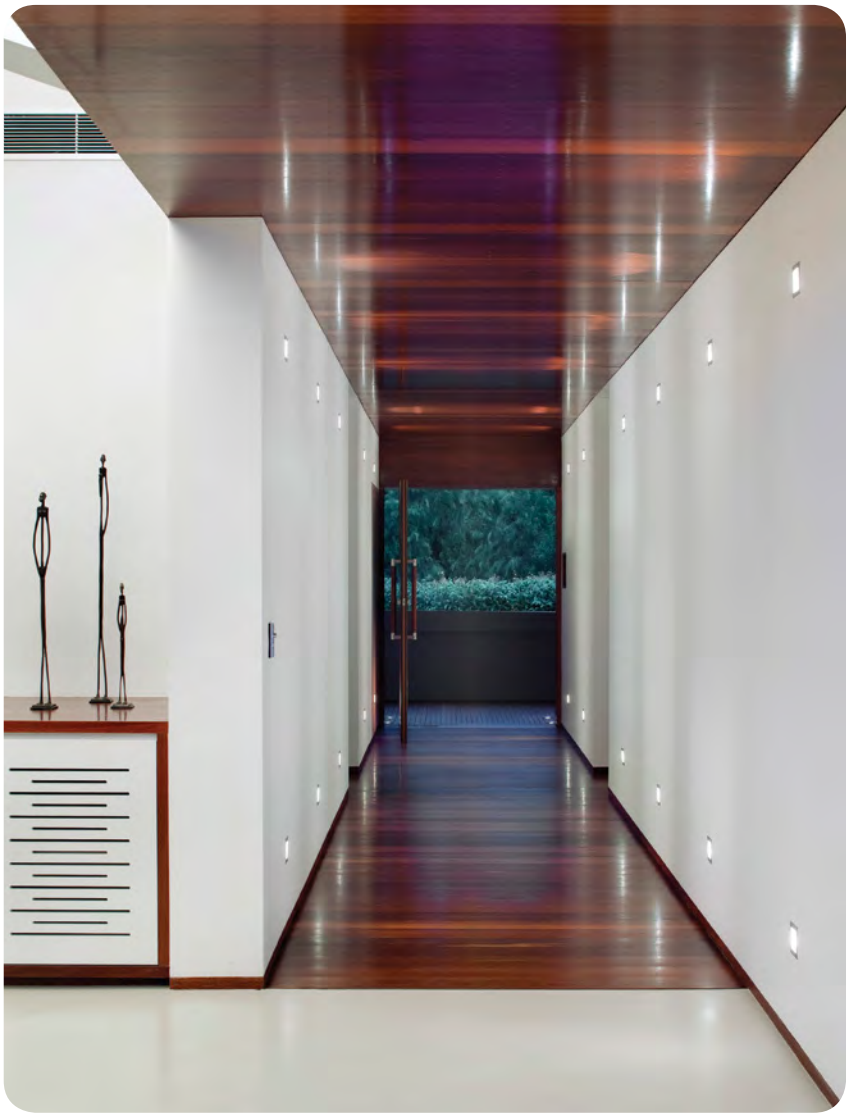
Timber Products

Timber is available in a wide range of products, from unprocessed natural rounds, to more highly processed laminated veneer products. Each product has its own properties and uses in internal design.

Commonly available products include:

- solid sawn and moulded timber for structural elements, furniture, screens and panels, skirtings and architraves (new or recycled timber);
- glue laminated timber (glulam) for structural elements, and bench tops;
- veneer for decorative wall panels, furniture, and joinery;
- plywood and laminated veneer lumber (LVL) for cladding, furniture, joinery, structural elements, etc; and
- engineered wood panels, such as medium density fibreboard (MDF) and particleboard for cupboard carcassing, and veneer substrate.

This section presents information on each of the key timber product types as summary tables for reference.



CplusC Design Construct: Queens Park Residence.

4.1 Solid Timber: Local hardwoods

Left: Matt Chan, Scale Architecture, with Katie Hepworth and Isabel Cordeiro: Infinity Forest.

Right: Peter O'Gorman and Brit Andressen, Mooloomba House. Photo by John Gollings.

Description

Solid sections timber converted from native Australian hardwood species.

Uses

- Flooring
- Internal lining
- Furniture and joinery
- Stairs and handrails
- Windows, doors and screens
- Architectural and concealed structures
- External cladding

Comments

- Available in many species from certified sources
- Local variation in species
- Broad colour range from light brown to dark reds
- Dry density from approximately 600 to 1100kg/m3
- Available rough sawn, dressed or moulded
- Natural features and figure
- Can be durable

Grades

Appearance grades to AS 2796

Select-Low feature Standard- Medium Feature High Feature

Milling requirements are consistent across the three grades.

Structural grades: seasoned

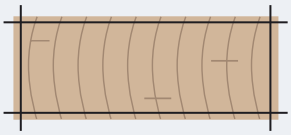
Visually graded to AS 2082:

F8 → **F27**

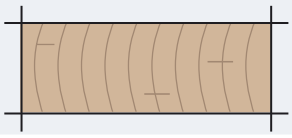
Increasing strength & stiffness

Typical Sizes

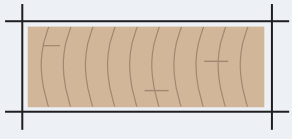
Sawn
Size off the saw overcut to allow for shrinkage during drying to the nominal dimensions.



Nominal
Dry, rough sawn size. Thickness of 25, 38 & 50 mm.
Widths of 75, 100, 125, 150, 175, 200+.

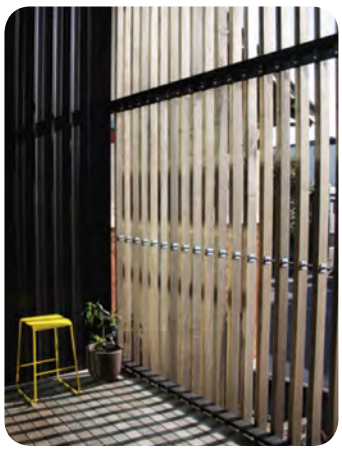


Machined
Dry, milled size will vary with producer and products.
Common sizes are: Thicknesses of 19, 32, 35 & 45 mm
Widths of 65, 70, 85, 90, 115, 135, 140, 165, 185+



Hardwoods are the dominant species group in Australia's native forests. Local hardwoods have been used widely in Australia since European colonisation for internal finishes and lining, envelope elements such as windows and doors, and external structures and cladding. In recent years, local hardwood production has increasingly focused on seasoned appearance material for applications such as floors, joinery and furniture. At the same time, designers are increasingly exploiting the timber's grain and feature.

NH Architecture and Woods Bagot: Hilton Convention Centre, Southbank.



Chris Tate Architecture: Slat House.

Bligh Voller Neild: GOA Image House.

Squillace Nicholas Architects: Black Stump Restaurant.

Smith + Tracey: Olinda Tea House.
Interior wall panelling in service and during construction.

4.2 Solid Timber: Local softwoods

Left: Lecturn, St Patricks Cathedral

Right: David Boyle Architect: Burridge Read Residence

Description

Solid sections timber converted from native Australian and introduced softwood species

Uses

- Flooring
- Internal lining
- Furniture and joinery
- Stairs and handrails
- Windows, doors and screens
- Architectural and concealed structures
- External cladding

Comments

- Available in many species from certified sources
- Local variation in species
- Colour range from creams to medium browns
- Dry density from approximately 350 to 550 kg/m^3
- Available rough sawn, dressed or moulded
- Natural features and figure
- Can be durable but generally less durable than local hardwoods

Grades

Appearance grades from clear to utility

Select grade celery top pine at Saffire resort, Tasmania

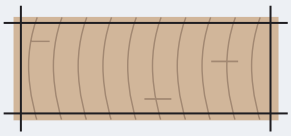
Structural grades: seasoned

Visually graded to AS 2082:
F8 → **F27**
Increasing strength & stiffness

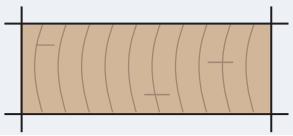
Machine graded to AS 3519:
MGP10 → **MGP15**
Increasing strength & stiffness

Typical Sizes

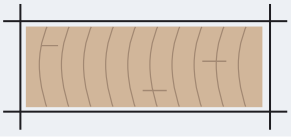
Sawn
Size off the saw overcut to allow for shrinkage during drying to the nominal dimensions.



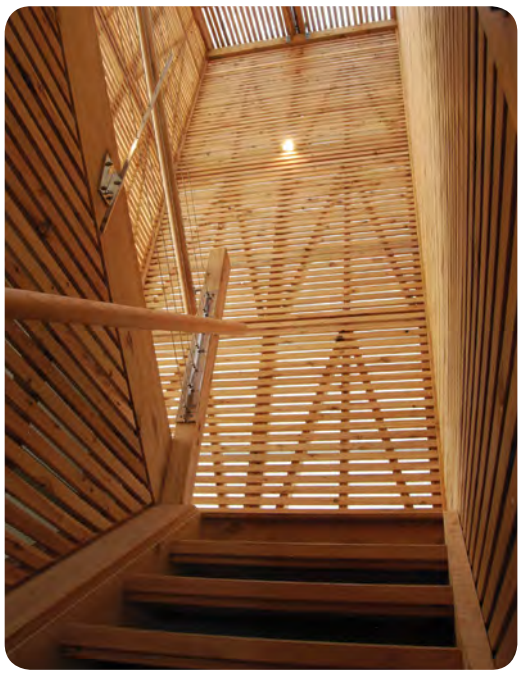
Nominal
Dry, rough sawn size. Thickness of 25, 38 & 50 mm.
Widths of 75, 100, 125, 150, 175, 200+.



Machined
Dry, milled size will vary with producer and products.
Common sizes are: Thicknesses of 18, 19, 21, 32, 35, 45 mm
Widths of 66, 92, 110, 116, 138 , 170, 190+.

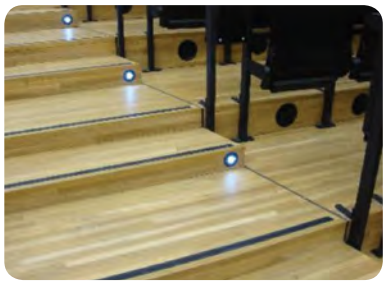


Grant Amon Architects Pty Ltd: Svarmisk Resort Centre, NZ.



Troppo Architects, SA: Whale of a Beach House.

4.3 Solid Timber: Imported



Left: American White Oak

Right: American Oak

Description

Solid timber sections imported from overseas. Major sources include Europe, North America, and south-east Asia.

Uses

- Flooring
- Internal lining
- Furniture and joinery
- Stairs and handrails
- Windows, doors and screens
- Architectural structures
- External cladding

Comments

- Many species available from international sources
- Procure from certified sources, especially species from high-risk countries
- Usually high quality appearance and finishing material in a variety of colours
- Most commonly available in seasoned and unseasoned rough sawn boards and less frequently in seasoned dressed boards
- Regional species supply and application preferences exist

Grades

Appearance grades from clear to utility

Appearance grades and terminology vary with the timber's origin but often include a low feature or premium grade and grades with higher feature.

Structural grades: seasoned

Visually graded to AS 2082 (hardwood) and AS 2858 (softwood):

F5 → **F27**

Increasing strength & stiffness

Softwoods machine graded to AS 3519:

MGP10 → **MGP15**

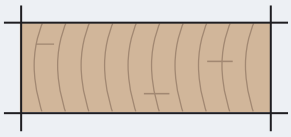
Increasing strength & stiffness

Typical Sizes

Sizes vary with the country of original production.

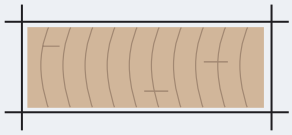
Nominal

Common dry, rough sawn sizes are:
Thickness of 25, 38, 50, 65 & 75 mm
Widths of 63, 75, 100, 125, 150, 200+

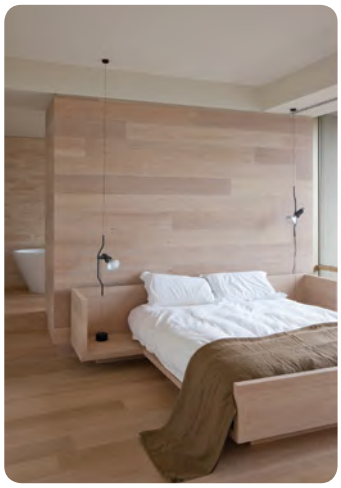


Machined

Dry, milled size will vary with producer and products.
Common sizes are: Thicknesses of 19, 32, 42, 54, 65 mm
Widths of 54,65, 90, 110, 140 , 190+



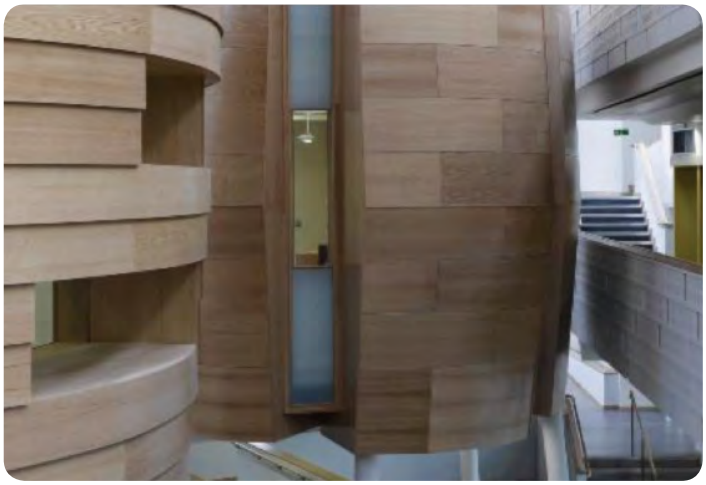
Britton Timbers: Cambia Ash Lining.



Jolson: Albert Road Apartment.

Jackson Clements Burrows: Henley Street.

Jolson: Albert Road Apartment.



Britton Timbers: American Red Oak.

4.4 Glue-laminated Timber

Description

Glue-laminated timber (glulam) is assembled by gluing together small pieces of timber, known as laminates, to produce large sizes and long lengths. The individual laminates are usually finger-jointed into continuous lengths, removing significant defects, and then assembled into the final piece.

Uses

- Stairs and handrails elements
- Top and slab elements in joinery and furniture
- Wind posts for windows and glazed walls
- Beam and column elements in architectural and concealed structures

Comments

- Can be curved or straight
- Large section sizes and long lengths can be manufactured
- Stronger than solid timber of the same size
- Dimensionally stable
- Works easily with all the usual carpentry tools
- Both standard and customs sections can be made

Grades

Appearance grades
(by structural grade and quality of fabrication/finish)

Structural grades

Graded to:

GL8 → **GL18**

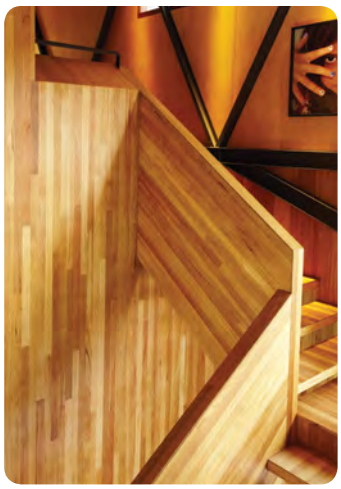
Increasing strength & stiffness

Typical Sizes

Radiata pine	
Width	**Depth**
65mm	130, 165, 195, 230, 260, 295, 330, 360, 395, 425mm
85mm	130, 165, 195, 230, 260, 295, 330, 360, 395, 425, 460+mm
135mm	130, 165, 195, 230, 260, 295, 330, 360, 395, 425, 460+mm

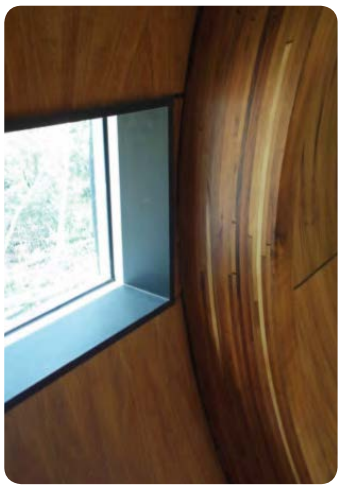
Hardwood	
Width	**Depth**
45mm	120, 140, 170, 190, 222, 240, 290mm
65mm	120, 155, 185, 215, 245, 270, 300, 330, 360, 390, 420, 450, 480mm
85mm	120, 155, 185, 215, 245, 270, 300, 330, 360, 390, 420, 450, 480mm
135mm	120, 155, 185, 215, 245, 270, 300, 330, 360, 390, 420, 450, 480mm

2011 Timber Awards: The St Kilda West Project.



Bureau SRH: The Birdcage.

David Luck Architecture: Cloud Chamber.



Dismal Swamp.

Berlina Projects: Lilypad.

4.5 Decorative Veneers

Left: Veneer leaf.

Right: Andrew Macdonald: Stirling St Residence.

Description

Decorative veneer is a thin slice of wood cut from the wood. It can be peeled from logs or sliced from flitches into sheets or leaves at a predetermined thickness and grain orientation. Veneer is available in leaf or adhered to a substrate or backing.

Uses

- Internal lining
- Stair handrails
- Furniture and joinery
- Doors and screens

Comments

- Available in many local and imported, softwood and hardwood species in a wide variety of colours and grain patterns
- Efficient use of feature wood
- Veneer has a tight and loose side and should be laid with the tight side outwards
- Can be glued up into flat, bent and curved panels
- Substrate must be dry at 8 to 10% MC at gluing

Appearance grade

Veneers are usually graded into face and backing grade veneers. Generally, face grades have strict limits on natural features.

Typical Sizes

Veneer leaf is often about 2.5 m long, with varying widths between bundles of leaf. Leaf is often assembled into layons that match the length and width of board substrates.

The size of specialist and high-feature veneer is limited by the occurrence of the feature in the log.

4.6 Plywood

Right: Ashton Raggatt McDougall (ARM) – Vos Construction: Melbourne Recital Centre

Description

Plywood is a timber panel product assembled from veneers of timber glued together so that the grain of alternate layers is at right angles to each other.

Uses

- Flooring
- Internal wall and ceiling lining
- Substrate for appearance veneers
- Furniture, fittings and joinery
- Stairs and handrails
- Doors and screens
- Architectural structures
- Concealed bracing panels and shear skins
- External cladding

Comments

- Dimensionally stable
- Available from softwoods and hardwood
- The numbers and thickness of veneers varies with the quality and intended use of the product. There is always an odd number of veneers.
- Large variation in visual and structural quality available – see manufacturers
- Appearance grade veneers can be applied to the surface

Grades

Appearance grade To AS 2270

Highest quality → **Lowest quality**

A grade.

B grade.

C grade.

D grade.

Bond type
A - dark colour. Internal or external use
B - colourless. Internal or external use
C & D - light colour. Internal use only

Structural grades To use with AS1720

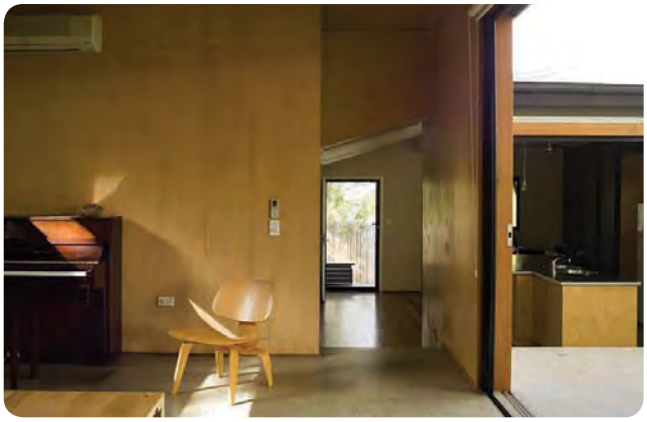
Graded to:

F7 → **F34**

Increasing strength & stiffness

Typical Sizes

Lengths: 1800 mm, 2100 mm
Widths: 900 mm, 1200 mm
Thicknesses: 3, 4, 6, 12, 15, 17 mm



Casey Brown Architecture: Bungan Beach House.

Dale Jones Evans Architecture with Marchese & Partners: M Central.

Plus Architecture: Office.

Wood Solutions – Internal stairs.

4.7 Laminated Veneer Lumber

Tim Hill: Office Development Surrey Hills.

Description

Laminated veneer lumber (LVL) is a structural wood product manufactured from peeled veneers laminated into a panel with the grain of most veneers running parallel to each other along the board for structural strength. The few cross veneers increase section dimensional stability.

Uses

- Bench tops and slabs
- Stairs and handrails
- Structural beam and column elements in architectural and concealed structures

Comments

- Dimensionally stable
- Large variation in visual and structural quality available – see manufacturers
- Generally manufactured from softwood, mainly Radiata Pine
- Not available in appearance grades but can accept an appearance veneer

Grades

Appearance (by structural grade)

End/edge grain

Structural grades

By manufacturer to AS/NZS 4357

Typical Sizes

45 mm x depths in mm* 150, 200, 245, 300, 360
63 mm x depths in mm* 150, 200, 245, 300, 360
Potentially available up to 13 m long x 1.2 m wide x 75 mm thick
45 mm lengths (m) 3.0 to 8.4 in 0.3 increments then 9.0 m, 9.6 m, 10.2 m, 12.0 m
63 mm lengths (m) 3.0 to 6.0 in 0.3 increments then 6.6 m, 12.0 m in 0.6 m increments

Seeley Architects: Citriodora

Spowers Architects:
Williamstown High School.

Bureau SRH: The Birdcage.

4.8 Engineered Fibre/Chip/Strand Board

Matt Gibson Architecture and Design.

Description

Board elements made from: timber fibres bonded together in a dry process such as medium density fibre board (MDF) to AS/NZS 1859.2-2004; fibres bonded in a wet process such as softboard or hardboard to AS 1859.4; chips such as chipboard (particleboard) to AS/NZS 1859.1-2004; or strands such as oriented strand board (OSB).

Uses

- Internal lining
- Carcassing
- Not available with appearance grades
- Structural bracing (hardboard and OSB)

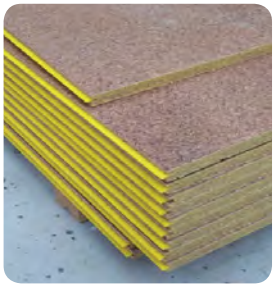
Comments

- Typically bonded with adhesive except Masonite hardboard
- Available in water resistant boards
- Easily machined
- Smooth/good surface integrity
- Uniform thickness and properties
- Very stable (little risk of warping)
- Edges not suitable for coating

Grades

Appearance

Medium density fibreboard.



Particleboard.

Structural grades

By manufacturer, if applicable

Typical Sizes

Board Type	Width	Length	Thickness
Softboard	900, 1200 mm	2400, 3200 mm	12, 15, 18 mm
Hardboard	900, 1200 mm	2400, 3200 mm	3, 6, 9, 12 mm
Medium Density Fibreboard (MDF)*	900, 1200 mm	2400, 3200 mm	3 to 25 mm
OSB/Particleboard	900, 1200 mm	2400, 3200 mm	12, 15, 19 mm

*Moisture Resistant (MR)

Matt Gibson Architecture and Design: The Coop - structure and cladding constructed from LVL Beams and OSB Panelling.

Morris-Nunn and Associate: Scottsdale Forest EcoCentre.

David Boyle Architect: Burridge Read Residence.

5

Interior Design Elements

This chapter presents information tables on the use of timber internally by application type, ordered in decreasing size.

Architectural structures feature the architectural expression of structure within an internal space. Expression of structural elements can be the key to a successful holistic design solution in many projects, with visual character of a space being influenced by the structural form required.

Lining is the finishing material on the internal wall or ceiling surfaces of a room or space. While linings can be utilitarian or merely a substrate for paint, as is plasterboard, they can also be significant elements in an architectural design or an interior fit out.

As a lining material, timber in one of its various forms and arrangements can:

- enhance appearance and visual interest
- improve acoustic and thermal performance
- reduce maintenance.

Flooring is visually significant part of any interior space. With an extensive range of colours, textures and forms, the architectural potential for timber flooring is extensive. To achieve this potential and create long lasting and stable timber flooring, the main design and specification requirements are:

- selecting species hard enough for the intended use;
- ensuring adequate insulation and sound separation;
- determining the correct moisture content for the project;
- keeping moisture away from the timber in application; and
- choosing the correct finish for the floor.

Stairs and handrails are visually significant vertical elements in any building design, defining the flow of space and movement between different levels. The inherent risks in their uses and their function as means of escape in a fire building regulations limit the general parameters of the stair design.

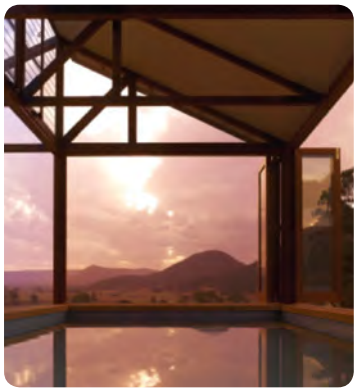
Windows and doors are special elements in any building design. Windows and doors are often visible internally and externally. Their form and proportion are fundamental to the appreciation of the elevation and massing outside, and perceptions of spatial arrangement inside. Windows affect the comfort and amenity of inhabitants significantly, controlling ventilation, introducing natural light and influencing thermal performance.

Furniture and joinery are some of the most intricate and valuable uses of timber in any aspect of building. Both share the demand for a high quality of finish and visual appeal, tactility, and functionality. Furniture has the extra requirement of portability.

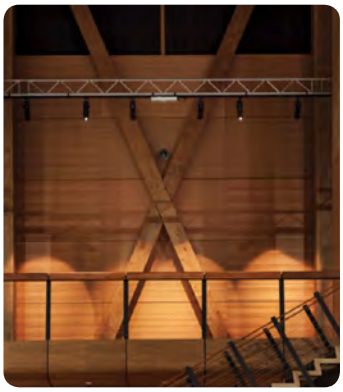
External elements associated with interior design are typically spaces where the inside seamlessly transitions to the outside. Timber used externally requires very careful specification and detailing.

Mouldings were traditionally used as functional yet ornate elements such as picture and dado rails, to protect plaster in areas susceptible to damage such as skirtings, or to cover construction tolerance and junctions such as architraves around doors. Contemporary mouldings tend to simpler than ornate historic mouldings.

5.1 Architectural Structures



Turner and Associates Architects: Wolgan Valley Resort and Spa.



Studio Pacific Architecture: Holmes Consulting Group.

Berlina Projects: LilyPad.

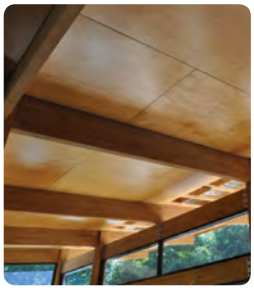
Description

Skilled use of timber in architectural structures leads to unrivalled interior spaces. There is a large range of structural options available which can be expressed internally. The following examples relate to the main types and forms. Consult a structural engineer for more information.

Timber is used in exposed architectural structures because it provides:

- **Design versatility**. A wide range of timber materials and solutions are available for spans up to and over 100 m.
- **Ease of construction.** There are a wide range of simple and effective jointing systems. Timber solutions are also light, simplifying erection.
- **Honesty of expression.** As a natural material, the varying strength characteristics in timber often force a direct and honest expression of force and load. This can establish a clear structural expression.
- **High strength-to-weight ratio.** Timber is very light for its strength. This makes for efficient structures and easier construction.
- **Economy.** Due to materials cost, workability and ease of construction, timber structures have historically been cheaper to build and vary than comparable steel and concrete buildings.

Design options



Post and beam is a relatively simple but very useful structural system suitable for general multi-storey construction.

Rafters - In addition to sitting on posts, beams can span between walls. This can be as a single span or continuous over more than one span.

Trusses are frames of members, typically in a single plane, joined only at their end and interconnected to form triangles. They are generally deeper than solid members, and they place material efficiently in the form.

Domes/grids are complex surfaces with double curvature divided into a triangular grid. The triangular grid is then formed using straight timber elements connected at nodes. Timber elements tend to be glulam or LVL.

5.2 Internal Lining: Stick elements

Volker Haug and Maddison Architects: Ludlow Foundation.

Description

Solid sawn timber cut into regularly sized and generally rectangular pieces or profiled into tongue and groove boards.

Uses

Residential, commercial, industrial walling or ceilings

Comments

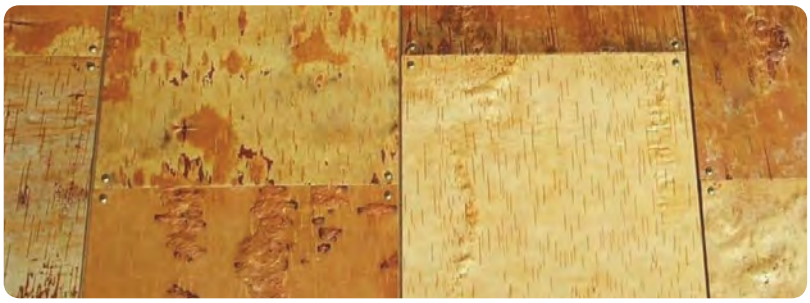
- Can be rough sawn or dressed to a smooth finish.
- Appearance products are sorted into visual grades, such as Select or Standard grade.

Design options

Solid timber boards fixed to frame or battens, butted, lapped, or slatted (vertical or horizontal or diagonal). Boards can vary in, size, proportion, species, finish and texture. Manipulating the ratio of board to gap and the backing colour can add another level of articulation.

Woods Bagot and NH Architecture: Hilton Convention Centre.

5.3 Internal Lining: Panel elements



Description

Engineered timber panels or selected decorative veneers laid on a sheet substrate and mounted onto battens on a wall or ceiling.

- Interior plywood: non-structural appearance product suitable for internal wall panelling, furniture and fittings, interior door skins and ceiling lining. Bending plywood is relatively simple. Plywood can be cut or have its surface machined with computer-controlled routing equipment allowing complex patterns to be realised.
- Particleboard: smooth, good surface integrity, uniform thickness, uniform properties and good dimensional stability, and excellent substrate for high grade veneer.
- Medium density fibreboard (MDF): widely used as a substrate material due its smooth surface and edge-finishing qualities. Good substrate for high grade veneer.
- Hardboard: typically used in the backing of cabinetry. Hardboard tends to have a very smooth side and a side textured with lines around 3 mm long.

Uses

- Residential
- Commercial
- Industrial
- Walling or ceilings

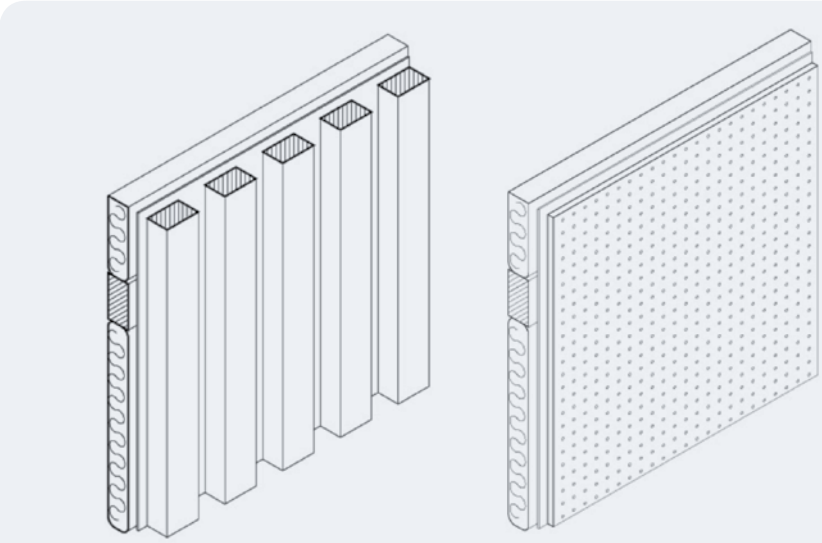
Design options

- Fixed to frame
- Fixings concealed or exposed
- Joints flush, lapped or with shadow ‘gap’
- Hung on sub-frame fixed to frame; for prefabrication of high quality panels
- Book matched, slip matched or random veneer options

Jaime Kleinert Architects: Persephone Investments.

Campbell Drake: Dusk Bar.

5.4 Internal Lining: Sound control



Description

A system of visually expressed timber elements with perforations or gaps with acoustic absorbing material behind.

Uses

- Offices
- Auditoria
- Industrial

Design options

- Sound absorbing lining, in combination with stick or panel elements, alter the reverberation time in a space, improving sound quality.
- Perforated sheet materials: veneered plasterboard, veneered particleboard, plywood or MDF requires about 10% perforation to perform efficiently with the acoustic absorber. The size of the perforations can be adjusted to manipulate the acoustic properties.
- Slatted boards as an acoustic panel: boards spaced on frame with fabric backing/insulation for sound absorption.

5.5 Internal Lining: Partitions and screens

2010 Timber Award Australia Post

Description

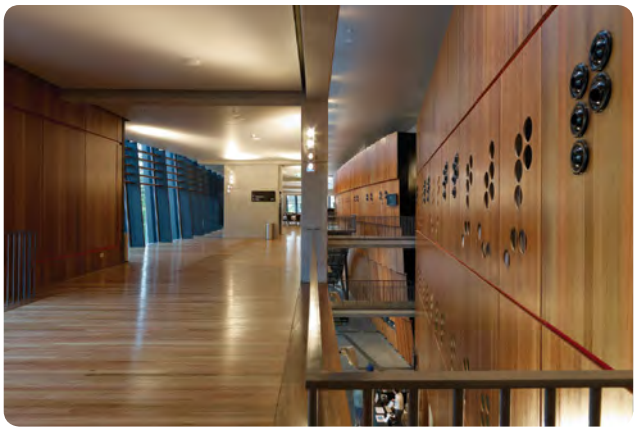
Solid timber elements or engineered timber products arranged to create screens or partitions which may be floor to ceiling part-storey height.

Uses

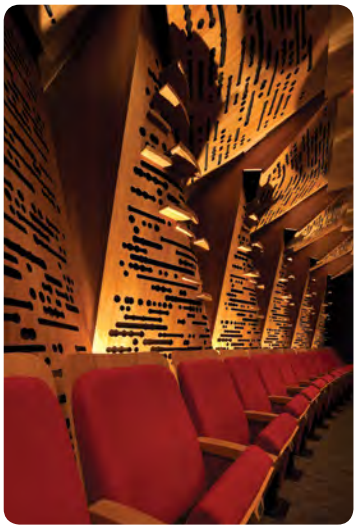
- Offices
- Auditoria
- Industrial
- Residential

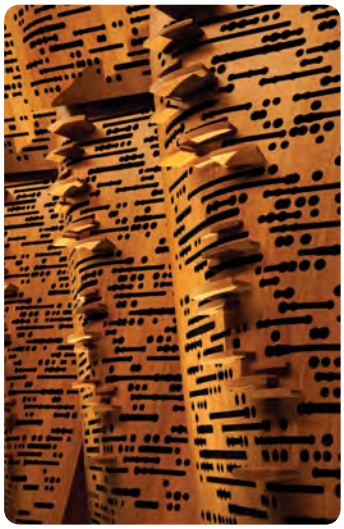
Design options

- Can incorporate storage space with shelves and cupboards Sound absorbing lining in combination with stick or panel elements can be provided.
- May be opaque or provide borrowed light between spaces.



Tonkin Zulaikha Greer: Glasshouse – Arts, Conference and Entertainment Centre.

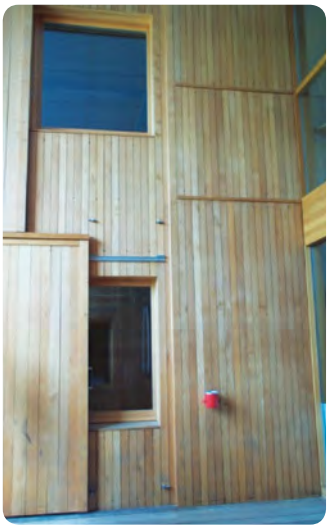




Tonkin Zulaikha Greer: Glasshouse – Arts, Conference and Entertainment Centre.

Bureau SRH: The Birdcage.

Studio Pacific Architecture with Warren and Mahoney: The Rock



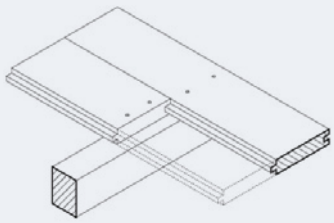
School of Architecture, Wood and Civil Engineering, Biel, Switzerland

Sibelius Centre, Lathi, Finland

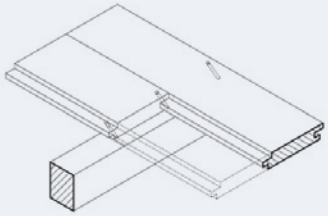
Siren Design: AGL Headquarters

5.6 Flooring: Standard strip

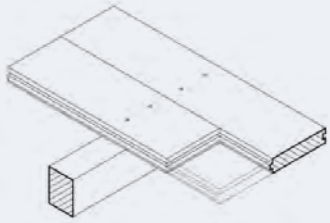
Installation methods



Surface nailed:
face or exposed nailed.



Secret nailed: nails to be hidden as they are driven through the extended tongue of the board as the individual boards are laid.



End matched: tongue or groove on all four sides of the board to eliminate the necessity to locate joints directly over floor joists.

Description

Interlocking tongue and groove (also known as T&G) boards assembled into a structural floor over joists or battens. Timber boards available in many species, typically hardwood. Janka hardness required >5 kN for domestic and >7 kN for commercial. More information is available in *WoodSolutions Guide #9 Timber Flooring – Design guide for installation* or from the Australian Timber Floor Association (ATFA).

Uses

- Residential
- Commercial
- Industrial

Comments

- Detail to allow for movement with changing moisture content.
  See *WoodSolutions Guide #9 Timber Flooring – Design guide for installation*
- Can be re-finished and repaired, ensuring longevity.

Typical size

- Width 65 – 133 mm
- Thickness 19 mm min (450 mm joist span)

Installation

- Joist level deviation to be less than 3 mm per 3 m
- Boards should span at least three joists
- Cramp <800 mm
- Machine driven nails 50 x 2.8 mm for softwood joists, 50 x 2.8 mm for hardwood joists (AS 1684)

5.7 Flooring: Overlay strip

Description

Interlocking tongue and groove (T&G) assembled as a finish over a structural substrate. Boards are available in many solid timber species or engineered from species such as bamboo or from fibre or chipboard. Janka hardness required >5 kN for domestic and >7 kN for commercial. More information is available in ***Wood Solutions Guide #9 Timber Flooring – Design guide for installation.*** Overlay strip flooring can be:

- floating floor, where the floor is held down by the skirtings;
- nail only floor, where the boards are nailed to a plywood or wood product substrate; or
- glued floor, in which the boards are glued with specialist elastomeric adhesive, and possibly nailed to the substrate.

Uses

- Residential, commercial & industrial
- Floating floors in gymnasia
- Acoustically resilient layers for sound separation

Substrate options

- Plywood
- Chipboard
- Plywood underlay on concrete
- Concrete

Typical size

- Width up to 85 mm
- Thickness 12-15 mm

Comments

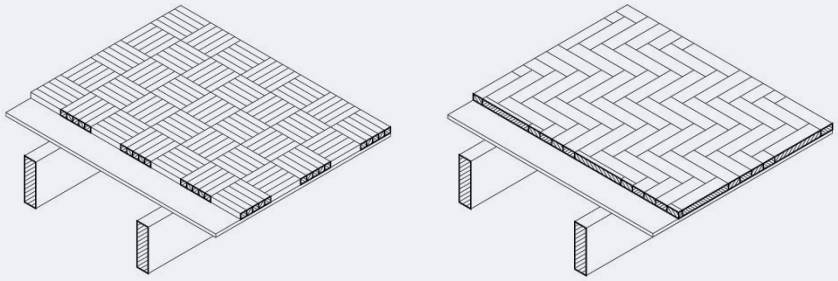
- Floating or bonded.
- Boards are available for use in any of the T&G profiles described above.
- Overlay flooring can be fixed either by nailing, gluing, or gluing and nailing.
- Detailed to allow expansion at the edges – 10 mm per 6 m width of flooring.

5.8 Flooring: Overlay parquetry

Description

Small pieces of timber, known as fingers, glued as a finish onto a suitable structural substrate, such as a sheet material (plywood or chipboard) or concrete.

- Mosaic parquetry: panels of small thin timber pieces arranged in a selected pattern, glued to a backing material.
- Block parquetry: individual pieces thicker than parquetry pieces.
- End grain parquetry: trafficked surface is end-grain, i.e. the end of the 'bundle of straws' faces upwards.



Uses

- Residential
- Commercial
- Industrial

Substrate options

- Plywood
- Chipboard
- Plywood underlay on concrete

Typical size

- Mosaic: approximately 130 x 20 x 10 mm
- Block: range from 340 x 85 x 20 mm to 260 x 65 x 20 mm

Comments

- Available with surface embossing that improves traction underfoot.
- Purchased as a pre-arranged pattern adhered to a backing sheet or as loose pieces that can be arranged into a pattern on site.
- Compatible species or grade of the pieces can also vary or be mixed to create patterns of colours or tones.

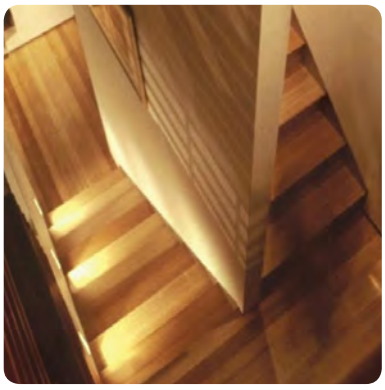
Seeley Architects: Citriodora.

Seeley Architects: 13th House.

Marsh Cashman Koolhoos Architects: MG House.

BMW Edge Theatre, Federation Square.

5.9 Stairs and Handrails



Lincolne-Lomax: Studio and Gallery

Walter Barda Design: The Boatshed.

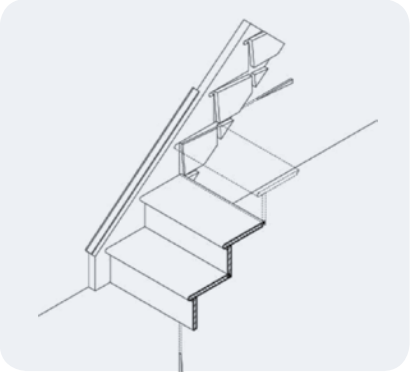
Description

Solid timber elements or engineered wood products crafted into structures which tend to be visually significant in interior spaces. The requirements for stairs and handrails can be found in the National Construction Code Building Code of Australia (BCA). Typically, the size of risers and goings are limited and there is restriction on the relationship between the two. A single step in a floor is prohibited. A flight of stairs must have a minimum of two risers and a maximum of 18 before a landing is included. The riser height must not change in a flight. The diameter and tread sizes in circular stairs are also restricted. Handrails are required. Gaps between the treads of any open stair and balusters in any handrail are restricted to reduce injury to small children. More information can be found in the *Wood Solutions Guide #8 Stairs, Balustrades and Handrails.*

Uses

- Inside to outside
- Residential
- Commercial
- Fire (means of escape)

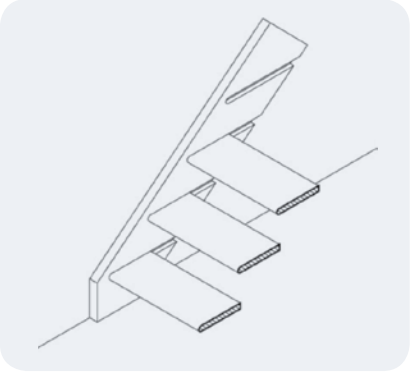
Design options



Enclosed

Treads and risers rebated into stringer

Treads and risers supported on additional framing

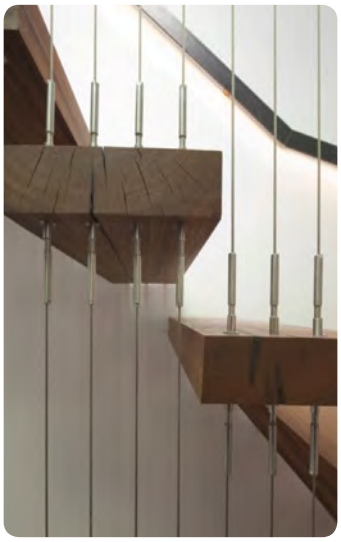


Open

Treads and risers rebated into stringer

Treads and risers supported on additional framing

Mark Pearse Architect.



Sam Crawford Architects: Newtown Terrace.

Woodhead: Pernod Ricard Corporate Office.

Phillips/Pilkington Architects: MADEC Wesley Centre.

Scale Architecture: Milis Salem House.

5.10 Windows and Doors

School of Forestry, Lyss, Switzerland, Clinton Cole.

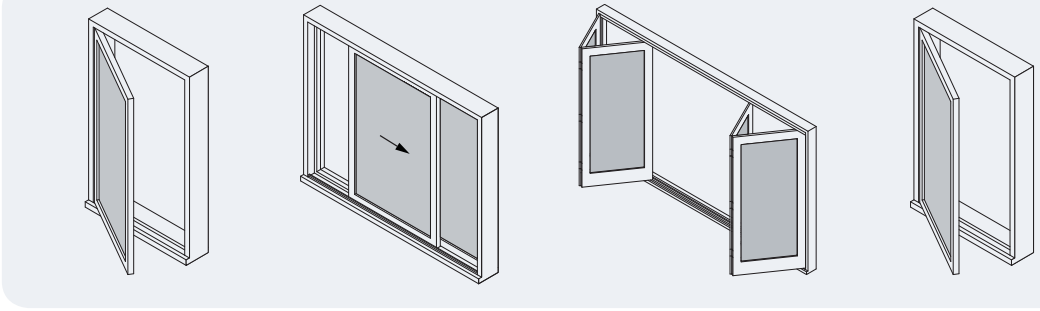
Description

The detailed design and specification of windows and doors includes externally exposed timber elements.

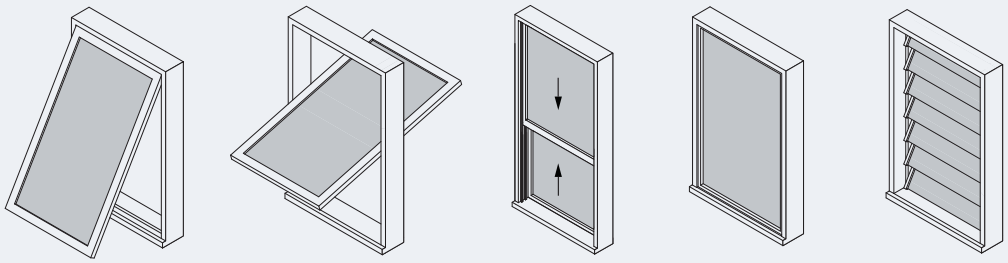
The use of timber externally is a vast and detailed topic covered elsewhere in documents such as *Wood Solutions Guide #10 Timber Windows and Doors*. As a summary, the key considerations in the design and specification of windows and doors are:

- Durability of the timber elements: timber species and/or treatment should be appropriately selected to have required durability for the exposure anticipated for different parts of the window or door.
- Stability of the window frame: timber species, timber cut and or wood product should be selected to minimise movement and distortion of the window frame with changes of moisture content in manufacture and service.

Design options



Casement window/ hinged door ***Sliding window/door*** ***Bi-fold window/door*** ***Pivot window/door***



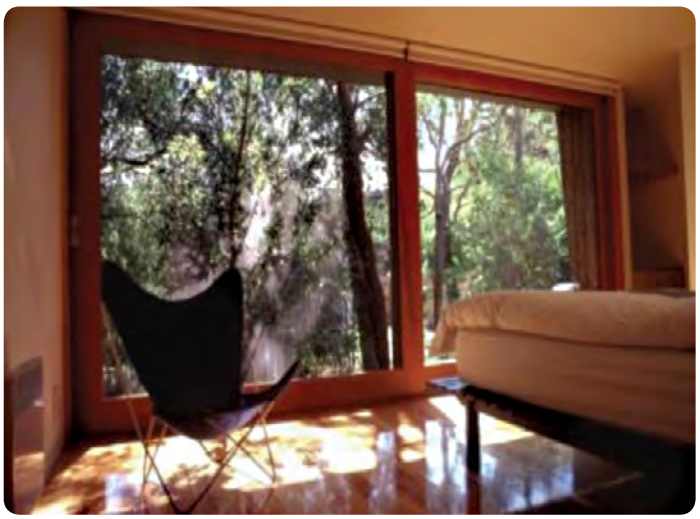
Awning window ***Pivot window*** ***Sash window*** ***Fixed window*** ***Louvre window***

Virginia Kerridge Architect: House in country NSW.

Architects EAT: Linear House.

Richard Cole Architects: Cottage Point.

MCK Architects: Flipped House.



John Wardle Architects: Isaacson/Davis Beach House.

Brewster Hjorth: Freshwater House.

5.11 Furniture and Joinery

Britton Timbers

Timber Award: Cottage Point House.

Description

Furniture and joinery is subject to close inspection by the eye and touch of the hand. It generally demands a higher level of finish and connection than other elements of internal design. The quality of the material, design and assembly must match these demands.

Joinery is the detailed functional elements of a building such as benches, cupboards and doors which are fixed to the building's structure. The required quality of assembly and finish in joinery ranges from simple and utilitarian to levels rivalling fine furniture.

Design options (by material)

Solid timber

Bentwood

Glue-laminated

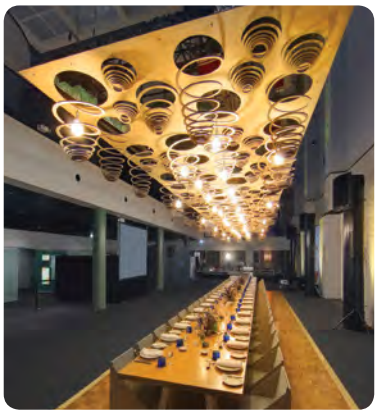
Plywood

Particle/fibre board

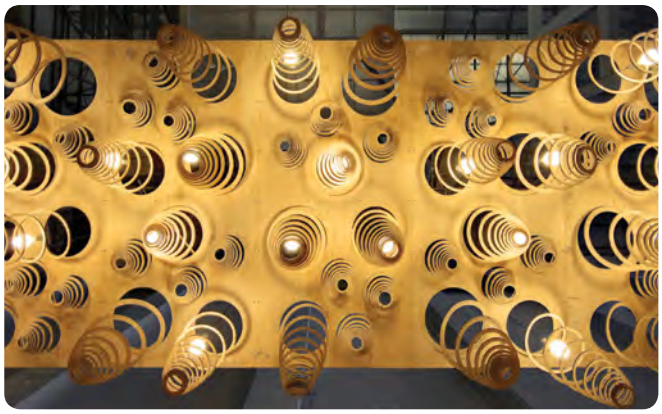
Veneer

Bovis Lend Lease offices, Melbourne.

Facet Studio - Habitat Antique



Tribe Studio: Eat Green Design



Tribe Studio: Eat Green Design

MCK Architects: The Flipped House.

Architects: Citriodora.

5.12 External Elements

John Wardle Architects: Queenscliff Residence.

Description

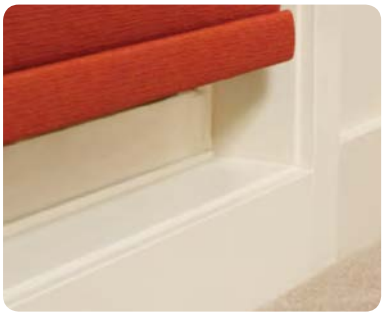
The use of timber in external structures is a vast and complex topic covered elsewhere in great detail in many documents including ***Wood Solutions Guide #5 Timber Service Life Design – Design guide for durability*** and ***Wood Solutions Guide #13 Finishing Timber Externally***. In summary, external elements must be designed for durability of structural and visual characteristics through appropriate selection of species, finishes and connection details. Key considerations are durability of timber, coating/treatment of timber, connection design to shed water, discoloration under UV exposure, and differential colour change with weathering under non-uniform exposure.

Design options

Internal External

David Boyle Architect: Burridge Read Residence.

5.13 Mouldings



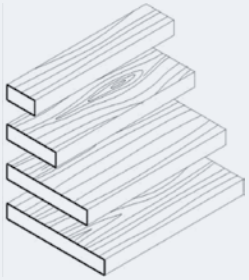
Description

Timber mouldings were traditionally used in areas prone to damage, such as skirtings, or areas to take tolerance in building, such as architraves and cornices. Elements are typically solid timber but can be from engineered timber such as MDF. Many standard profiles are available, though any prismatic section can be made if required.

Design options

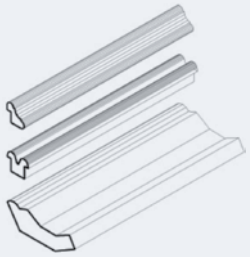
Rectangular timber sections

Used often as contemporary skirting and architraves.



Specialty/ornate mouldings

These are moulded to almost any shape for use as cornices, picture rails, trims, etc.



Splayed boards

Splayed material is widely used in architraves, skirtings and trims.

6

Material Basics

This chapter provides a basic understanding of how the natural characteristics of wood can influence timber end-products for use in internal applications.

6.1 Wood Structure

The structure of wood at a cellular level, and the way in which the cells are grown in succession, give the visual character to a piece of timber. The cells which form the grain of the wood are like long hollow tubes that run up the trunk of the tree. This can be seen in the:

- **Grain:** the pattern and orientation of the cells along the length of a piece.
- **Growth rings:** the radial patterns of wood of varying density laid down in each season and most visible on a cut end.

The physical properties of wood vary, whether along the grain fibres or across them, radial to the log centre or tangential with a growth ring. The variation in physical properties governs the way in which timber is orientated in application. For example, the strength parallel to the grain fibres is around 10 times that perpendicular to the fibres, which is why column (post) elements are loaded parallel to the grain.

As well as varying with direction relative to grain, the character of timber obtained from a tree varies with:

- **Species and genetics:** trees come from various species and the character of each species is different. This includes differences in colour, hardness, durability, grain and feature. These features make unique timber products regarded as a valuable commodity and highly sought after material.
- **Climate and arrangement:** trees of the same species and genetic background grown in different climates and arrangements produce timber with different character. This provides variety in the same species which is a natural quality and characteristic of timber.
- **Location within tree**: the properties and visual characteristics of timber obtained vary within individual trees with the age of the wood and whether the wood grew under stress.

Commercial timbers are normally broadly classified into two main groups: hardwoods and softwoods. Species such as eucalypts and oaks are hardwoods. Softwood includes pines, spruces, firs and other conifers. The terms ‘softwood’ and ‘hardwood’ do not always indicate the softness or hardness of the timber. In fact, many hardwoods are softer and lighter than some softwoods. For example, balsa is botanically classified as a hardwood, but is well known to be soft and lightweight. Generally, hardwoods are adopted in applications requiring harder-wearing surfaces, increased durability, strength or stiffness.

The differences between the cell structures of hardwoods and softwoods influence their aesthetic qualities.

Flowering angioperms.

Open seeded gymnosperms.

The differences between the cell structures of hardwoods and softwoods influence their aesthetic qualities. Hardwoods have vessels. Vessels are large cells used to transport water within the plant. Softwoods have a more uniform structure than hardwoods. The visual characteristics of each are described in Section 2.2.

6.1.1 Moisture

It is critical to understand the relationship between water and timber to successfully specify and use timber in interior applications. Under ordinary conditions, all wood contains some water. The amount of water contained in wood at a particular time – its moisture content (MC). The moisture content of a piece of timber is defined as the weight of water contained in the piece expressed as a percentage of its oven dry weight.

Drying splits in a log.

Drying kiln.

Moisture meter.

Moisture content at conversion

When the timber has been freshly converted from a tree it is termed 'green'. Typically, the timber would then be dried or 'seasoned' to a moisture content aligned with that anticipated in-service – generally between 9% and 18% MC. Drying timber increases its value and versatility by improving its dimensional stability, strength, stiffness, durability, insulating characteristics, and workability.

As timber dries from green to its in-service moisture content, it shrinks. Shrinkage occurs on a predictable basis, with a uniform change in dimension in each of its three principal directions (longitudinal, tangential and radial) per percentage point change in moisture content. Timber sections can be distorted because timber shrinks at different rates as it dries whether tangential and radial to growth rings or parallel to grain.

The term 'unit shrinkage' is defined as the percentage change in dimension following a moisture content change of 1%. Unit shrinkage (or movement) is an important property for timber in high-value applications. It gives an indication of the dimensional changes that may be expected in timber in response to environmental changes, such as the movement in floorboards between summer and winter. Shrinkage characteristics of some commonly used species are found in Table 2. More species information can be found through the WoodSolutions website.

Table 2: Shrinkage rates.

Shrinkage	Shrinkage from FSP to 12% MC	Species and Unit Shrinkage
Very High	Tangential >8.0% Radial >5.0%	Brush box (0.38) Vic ash (0.36) Forest red gum(0.34) Sydney blue gum(0.35) Tas Oak (0.36)
High	Tangential 6.5% - 8.0% Radial 4.0% - 5.0%	Blackbutt (0.37) Jarrah (0.30) Rose gum (0.30)
Medium	Tangential 5.0% - 6.5% Radial 3.0% - 4.0%	Radiata pine (0.27) Spotted gum (0.38) Tallowwood (0.37) Red ironbark (0.37)
Low	Tangential 3.5% - 5.0% Radial 2% - 3.0%	Hoop pine (0.23) Slash pine (0.30) Blackwood (0.27)
Very Low	Tangential 0% - 3.5% Radial 0% - 2.0%	White cypress (0.26)

Moisture content in application

After initially drying from 'green', timber will continue to lose moisture and shrink, or gain moisture and expand, to be in equilibrium with its surrounding environment. The moisture content at equilibrium is known as the equilibrium moisture content (EMC). The equilibrium moisture content will vary with the internal environment in which the timber is placed. For an air-conditioned space the EMC will be around 9%, though will vary with species. More typically timber in an internal space will reach EMC at about 12%.

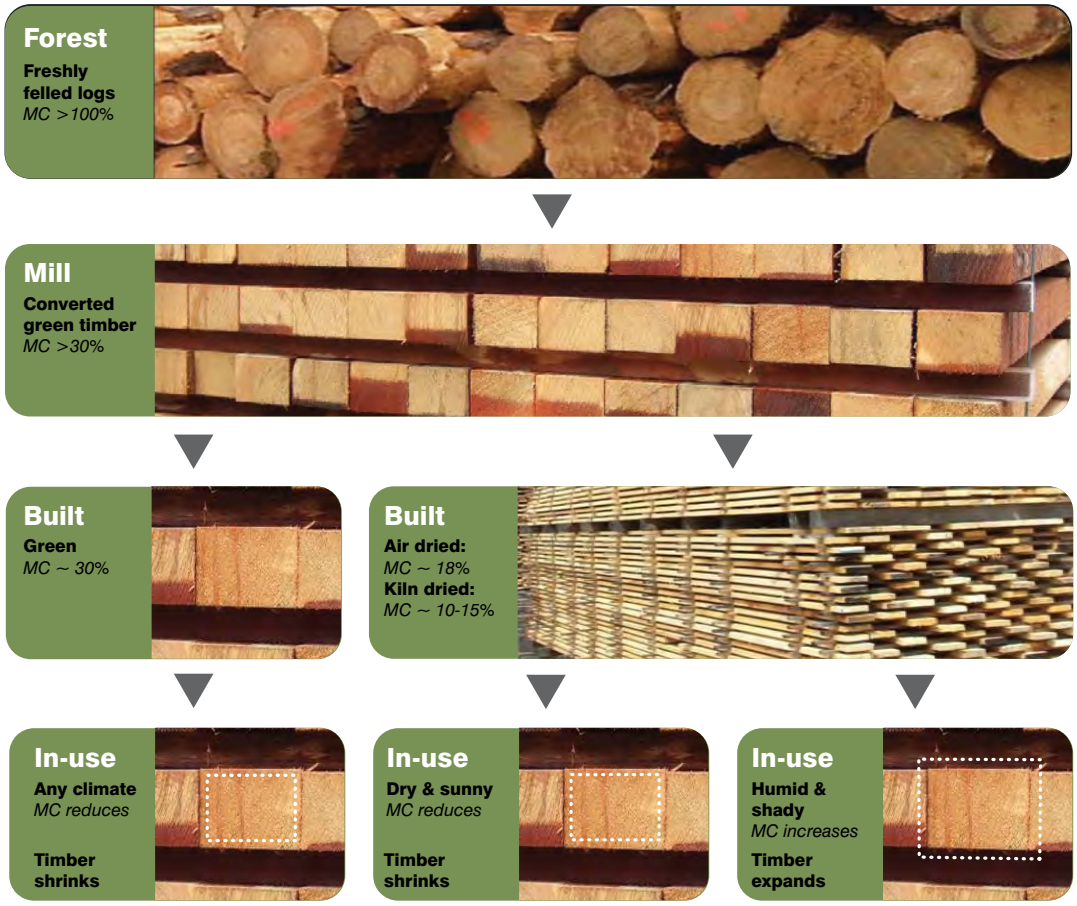


Figure 5: Changing moisture content through production and use.

Humidity and temperature within an internal space may change on a daily basis as well as on a seasonal basis but because of timber's relatively slow response rate it is only influenced by longer cycles such as seasonal. The effects of seasonal changes may be observed in a timber floor or windows. Gaps between adjoining boards in the floor will open and close at different times of the year and a window may jam during a wet season.

The response rate of softwoods such as Hoop Pine or Radiata Pine is more rapid than that of the denser hardwoods such Spotted Gum, Brushbox or Victorian Ash. Even within the hardwood or softwood groups, response rates can also vary quite markedly.

Ongoing dimensional change of an element once installed is an inherent natural property of wood associated with environmental changes on a regular basis. These changes are predictable and the responsibility for accommodating them in internal application rests with:

- the designer/architect/specifier ensuring the material specified is appropriate and that the predicted movement in application has been accounted for;
- the contractor in providing adequate protection to ensure the moisture at the time of installation is as anticipated in application;
- the building user by following best practice maintenance.

7

Satisfying Performance Requirements

Timber and timber products used in internal applications are typically selected for their visual characteristics. As such, it is critical that the visual characteristics are maintained in application throughout the design life of the element. Maintaining this visual character requires:

- **correct specification of timber grade;**
- **resistance to indentation and abrasion;**
- **durability and resistance to bio-deterioration;**
- **structural performance; and**
- **fire performance.**

7.1 Timber Grading

Grading is the production process of sorting products into groups with similar characteristics and properties. Material is graded to agreed standards which can be nationally or internationally recognised standards, or for large orders and specialist projects, developed between producers and customers. The agreed specification between designer and producer can often be more restrictive than Australian or International Standards, defining all facets of the product including colour range or types of natural feature.

Products governed by visual characteristics, which are selected based on appearance, are sorted into visual grades, such as Select or Standard Grade. These are termed 'appearance grades'. Structural sections are graded into 'stress grades', such as F17 or MGP10, by visual or mechanical means. Stress graded timber will in certain interior applications be visually expressed. In such a case, it is prudent for the interior designer to become familiar with the visual characteristics of the different stress grades to assess aesthetic appeal. The designer may also wish to impose an appearance grade requirement on the stress graded timber.

Visual grading.

7.2 Solid Timber Appearance Grading

Solid timber is visually graded into appearance grades to a set of rules established by:

- **Australian Standards**: These cover major commercial products such as flooring, and lining timbers. For example: *AS 2796-1999 Timber – Hardwood – Sawn and milled products, AS 1810-1995 Timber – Seasoned cypress pine – Milled products* and *AS 4785-2002 Timber – Softwood – Sawn and milled products. AS 2082-2007 Timber – Hardwood – Visually stress-graded for structural purposes* and *AS 2858-2008 Timber – Softwood – Visually stress-graded for structural purposes* provide guidance on visually stress grading timber for structural purposes.
- **Industry standards:** These cover furniture stock, joinery, cabinetry and similar material. These are often established between a producer and a major customer. For example, they may set the type and amount of feature required in the timber.
- **Industry service providers:** The *FWPA Interim Industry Standard Recycled Timber – Visually Graded Recycled Decorative Products* and *FWPA PN06.1039 – Recycled Timber – Visually Stress Graded Recycled Timber for Structural Purposes* provide guidance on visually grading reclaimed, recycled timber for various uses from linings to structural elements.
- **Designer specification:** Like industry standards, they are often established between a designer and particular producer for a specific project or group of projects. Such a specification would usually be developed for large orders on large projects.
- **Personal selection:** Defined by the individual on a case-by-case basis.

The solid timber grades are Select, Medium feature and High Feature.

Australian standard AS 2796 defines three major product grades: Select, Medium Feature/Standard, and High Feature, examples of which are presented below and on the solid timber summary sheet in Section 5. The grades are separated by the amount of natural and production-induced characteristics found in each board. Each grade has permissible limits different growth phenomenon, which are described in more detail in Section 8.2. Colour or colour consistency is not a criterion. Allowable tolerance from machining is consistent between grades. Specification of grades with fewer permissible features, such as Select, will lead to lower utilisation of the timber obtained from a tree.

The grades can be summarised as follows:

- **Select:** Straight and even grain timber with fairly uniform texture and limited amounts of natural feature, such as gum, knots and hobnail.
- **Medium Feature/Standard:** Even grain timber with increased amounts of natural feature providing a surface with distinct natural appeal.
- **High Feature:** Timber with regular quantities of natural feature with a distinct rich, lively and vibrant surface.

Select.

Standard.

High feature.

Unlike Select, and to a lesser extent Standard grade material, High Feature boards are really a mixture of several visual sets. This grade can often be re-sorted or industry grade established so that particular features become more prominent on the finished surface.

AS 4785-2002 Timber – Softwood – Sawn and milled products is similar in product requirements and visual grades to AS 2796. AS 4785 has established visual grades of Clear, Appearance, Select, Standard and Utility Grade. For Radiata pine there is a much greater use of industry defined grades with appearance and so the terms for particular visual combinations can vary between companies.

7.3 Plywood Grading

Plywood manufactured to AS 2270 in Australia has either a Type C or Type D bond, which is typically light in colour. Both bonds are durable under fully protected interior environments but are non-durable under full exposure to weather or to wet or damp environments. Type C bonded interior plywood should be used in high humidity areas such as bathrooms, and in the tropics. Type D bonded interior plywood is satisfactory for interior applications under normal humidity conditions. Structural plywood generally has waterproof Type A & B bonds and can be used either internally and externally. Type A bonds are typically dark in colour. Type B bonds are colourless. Images of plywood bond colours can be found in Section 5.

Black bond type A.

Marine grade.

Interior grade.

Structural grade.

Plywood can be ordered and procured with face veneers suitable for the intended application. The face grades available are:

- A – a high quality appearance grade suitable for clear finishing.
- S – a decorative face veneer that permits natural timber characteristics such as knots.
- B – a grade that provides a suitable substrate for high quality painted finishes.
- C – a non-appearance grade with solid surface, i.e. all open defects are filled.
- D – a grade that can have open defects and is normally used as a back veneer.

AD grade plywood, which has one face grade A and one grade D, would be specified for a clear finished aesthetic application requiring one good surface. Structural plywood normally has C and D grade faces, but can be specially ordered with higher quality face veneer. Face quality examples are included below for guidance only.

A grade.

S grade.

B grade.

C grade.

D grade.

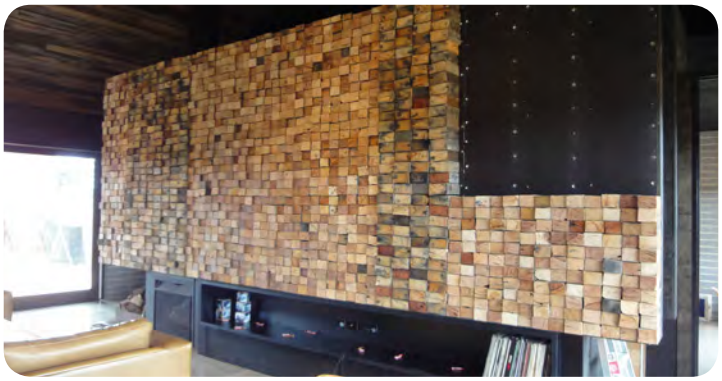
7.4 Veneers Grading

Detailed requirements for veneers used for the manufacture of veneered panels are specified in the Australian/New Zealand Standard AS/NZS 1859-1996 Reconstituted Wood-Based Panels, Part 3: Decorative Overlaid Wood Panels. Grading rules described in this standard have been adopted by the Australian veneer industry and they are widely used when specifying veneered boards.

7.5 Tolerance

An acceptable level of tolerance is codified as an allowable deviation from the sectional dimensions and length, and deviation from straightness and planarity. AS 2796 defines acceptable amounts of bow, spring, cup and the target moisture content for the major product groups in material of different product types. Tolerance limits relate to deviation immediately after machining, and do not relate to movements which may occur in-service.

Tolerances are established for the major product groups including joinery and dressed boards; strip and overlay flooring, mouldings, sawn boards and light decking, lining boards, cladding, fascia and bargeboards.

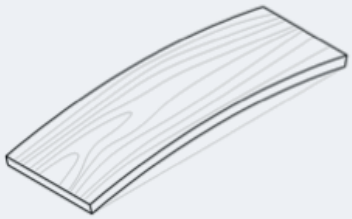


Wolveridge Architects: Hill Plains House.

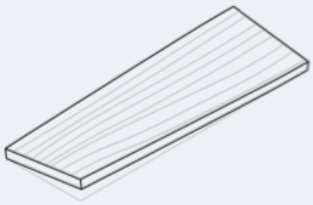
AS 2796 defines acceptable amounts of bow, spring, cup and the target moisture content for the major product groups.

Description

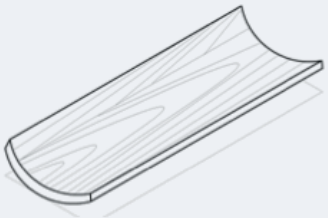
Bow is a curvature in the longitudinal direction of a board causing the wide face to move away from a flat plane. Bow is specified with respect to board thickness.



Twist is spiral distortion along the length of a piece of timber. Twist is specified with separate limits for less or more than 25 mm thick.



Cup is a concave or convex curvature across the grain or width of a piece of timber. Cup is typically limited to less than 1 mm per 100 mm width.



Spring is a longitudinal curvature of the edge of a piece of timber, not affecting the face. Spring is specified with respect to board width.

7.6 Hardness

The ability of a timber species to resist indentation in use is determined by its hardness. Hardness varies between species. Hardness is typically determined by the Janka hardness test and represented in kiloNewtons (kN). Hardness is particularly critical for floors and bench-tops. For example, for all but domestic flooring applications, a hardness of at least the same as Victorian ash (about 5) is required. A hardness of above 7 is preferable for any commercial flooring application.

7.7 Durability

Durability of timber is its natural resistance to bio-deterioration caused by fungi, insects and mechanical breakdown (e.g. weathering, checking and splitting). Durability is species dependent. The heartwood of each species is more durable than the sapwood. Durability in internal applications is not as critical as for external applications. More information on durable species can be found in Australian Standard AS 5604-2003 and *Wood Solutions Guide #5 Timber Service Life Design Guide*.

7.8 Structural performance

Timber elements specified based on structural performance will be designed according to AS 1684 Residential Timber Framed Construction for domestic scale structures or to *AS1720 Timber Structures Part 1: Design Methods for larger structures*. The structural elements will then be specified according to structural grade. Different structural grades have different visual characteristics with higher grade structural material tending to have fewer features, such as knots and sloping grain, than lower grades. Architectural structures will often be designed such that the structural elements are exposed in the internal space. In such a case the designer should review the visual qualities of the proposed structural grade and work with the design team to ensure intended visual qualities are achieved.

Circa Morris-Nunn Walker: Saffire during construction and completion.

7.9 Fire

More fire performance resources are available for download from woodsolutions.com.au

Adequate performance of timber structures and finishes is ensured by following the National Construction Code Building Code of Australia (BCA). Detailed information can be found in *Wood Solutions Guide #3 Timber-framed Construction for Commercial Buildings Class 5, 6, 9a & 9b, #2 Timber-framed Construction for Multi-residential Buildings Class 2, 3 & 9c, #1 Timber-framed Construction for Townhouse Buildings Class 1a* and *#4 Building withTimber in Bushfire-prone Areas.* Visually expressed large section solid timber, glue-laminated timber or laminated veneer lumber can be designed to achieve a required fire resistance level (FRL) in accordance with *AS1720.4-2006 Timber structures Part 4: Fire resistance for structural adequacy of timber members.*

7.10 Resistance to Chemicals

Timber is resistant to all but the strongest alkalis and acids (pH>10 and pH<2). In strong acid and alkali environments, such as science laboratories, the rate of degradation is dependent on many factors such as species, chemical and exposure. Discussions with the client on a project-by-project basis will determine likely risk level.

Adhesives used for wood products, such as glulam and plywood, which rely on a bonding agent for structural capacity, are typically robust enough for the majority of common applications. However, specialist advice should be sought if the environment in which the timber is to be used has an extreme ambient environment.

References

Australian Standards AS/NZS 1859-2005 ***Reconstituted wood-based panels - Specifications - Decorative overlaid wood panels.***

Australian Standards ***AS 1684.2-2010 Residential Timber Framed Construction.***

Australian Standards ***AS 2796-1999 Timber - Hardwood - Sawn and milled products.***

Australian Standards ***AS 2082-2007 Timber - Hardwood - Visually stress-graded for structural purposes.***

Australian Standards ***AS 5604-2005 Timber - Natural durability ratings.***

Australian Standards ***AS 1810-1995 Timber - Seasoned cypress pine - Milled products.***

Australian Standards ***AS 4785-2002 Timber - Softwood – Sawn and milled products.***

Australian Standards ***AS 2858-2008 Timber - Softwood - Visually stress-graded for structural purposes.***

Australian Standards ***AS 1720.1- 2010 Timber Structures Part 1: Design Methods.***

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Wood Solutions Guide #4 Building with Timber in Bushfire-prone Areas, 2011.

Wood Solutions Guide #5 Timber Service Life Design Guide, 2011.

Wood Solutions Guide #8 Stairs, Balustrades and Handrails, 2011.

Wood Solutions Guide #9 Timber Flooring, 2011.

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