National Association of Forest Industries

Timber Manual
Datafile P1

Timber Species and Properties

Revised Edition
2004

Contents

Cover Photo: Whether it be structural or decorative, timber selection must take into account the properties and appearance characteristics of species.

National Association of Forest Industries

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Introduction

Timber is one of man's oldest building materials. It is a renewable, naturally occurring organic polymer, unique in a world of synthetic and composite building materials.

Today, timber is derived from sustainably managed forests and is one of our most environmentally friendly building materials. The wide distribution of timber, its ready availability, variety of uses and relative ease of handling and conversion, have all contributed to its wide acceptance in the building industry.

The small tubular cells that are the fundamental structural elements of solid wood give timber its good properties for sound, electrical and heat insulation, for engineering requirements, and strong aesthetic appeal.

Because of its wide range of properties, it is essential that for a particular application, the most suitable timber species is selected.

A sound understanding of tree growth and timber properties, combined with skilful forest management, ensures that we can reliably plan to meet these future timber demands, while building a world-competitive forest and forest products resource.

An essential first step in generating fit-for-purpose timber products is the selection of appropriate timber species. There are more than 30,000 tree species throughout the world, producing timber with a wide range of properties. In its natural solid form, or in reconstituted or engineered products, timber has properties that will meet the specified requirements for a wide range of applications.

Pages 10 to 17 of this Datafile present the Timber Species Properties Schedule, a full listing of the poperties of the timber from over 60 species of tree.

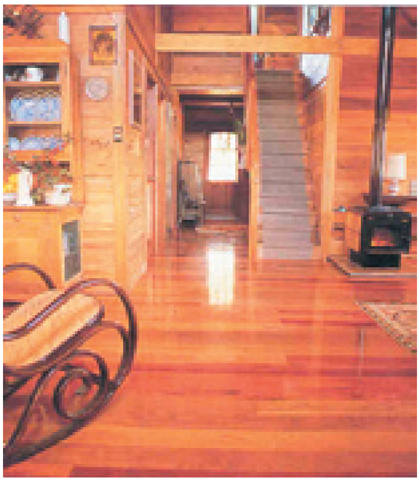
Species properties may also be modified by special treatments that, for example, increase the decay resistance, surface hardness and dimensional stability of timber products.

The wide range of properties available from timber provides the designer with an almost unlimited choice for both structural and decorative applications.

The timber industry has a network of advisory services throughout Australia to help timber users, specifiers/ architects, builders and regulators make the most appropriate selection of timber products.

These services are listed at the end of this Datafile.

Weather exposed applications require selection of suitable, durable species such as in this outdoor restaurant deck and pergola



Natural grain and colour of timber enhances building interior.

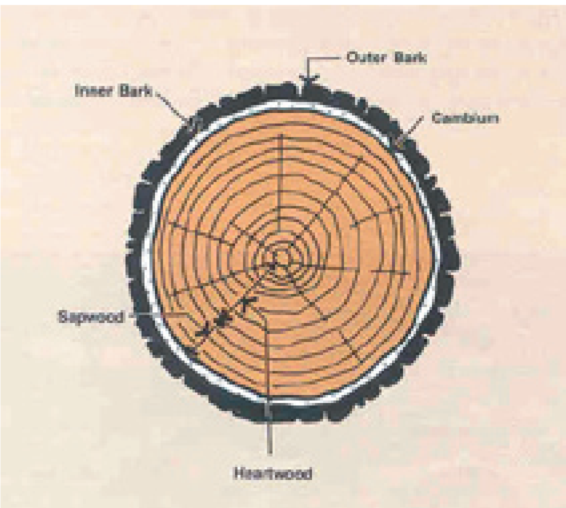
Wood Structure

Sapwood and Heartwood

The structure of a tree stem can be broadly divided into two main zones. When viewing the end-section of a log or cross-section of a tree stem, the central wood zone, is usually considerably darker than the portion adjacent to the bark. Generally, the light coloured wood is the sapwood remainder. (See Figure 1) The discolouration or darkening of the heartwood zone is due to the production and secretion of substances that are by-products of the living processes in the tree.

The tree grows in thickness by producing new wood, or outer sapwood just under the bark, while the inner sapwood, adjacent to the heartwood, is in the process of being converted into heartwood. This means that once a tree reaches a steady stage in its growth pattern, the thickness of the sapwood remains fairly constant. The by-products that cause the darkening of the heartwood are termed extractives and these are laid down by the tree as the inner sapwood cells die and are converted into heartwood. The heartwood itself can be divided into inner- and outer-heartwood. The extractives have a marked influence on timber properties, particularly durability. The proportion of sapwood to heartwood varies depending on species and growth conditions. In softwoods (see below), like radiata pine, the sapwood constitutes a considerable portion of the log volume, while in hardwoods (see below), like the eucalypts, the sapwood thickness is only about 2-5 cm in radial width.

Figure 1: Tree cross-section



Comparisons of sapwood and heartwood show that:

- sapwood and heartwood, at equivalent moisture contents, are equally strong and weigh about the same.
- sapwood has lower natural decay resistance (durability) than heartwood, but generally accepts preservatives more readily.
- sapwood is usually lighter in colour than heartwood, however, in some species, there is little difference.

(Note: The durability ratings of a species published in this Datafile is based on that of the outer heartwood.)

The wood cells of a tree can be divided into those that give the timber its strength and general structure, and those that conduct liquids, such as water and nutrients, through the tree during its growth.

Fibres are the structural elements that make up 30-80% of the volume of timber in hardwoods, and *tracheids* are the structural elements that constitute about 90% of the volume of timber in softwoods.

The conductive cells in hardwoods are vessels (also called pores) and rays, while softwoods possess rays but not vessels. Vessels allow liquid flow longitudinally up and down the tree while rays facilitate lateral flow across the tree stem. The arrangements of the various wood cells in the overall structure of timber vary from one species to another and define the various properties and characteristics of the final timber products.

Softwoods and Hardwoods

The terms "softwood" and "hardwood" do not indicate softness or hardness of particular timbers. The softwoods come from the coniferous (cone-bearing) species such as the pines, spruces and Douglas fir (Oregon). The hardwoods come from the broadleaved group of species such as the eucalypts, oaks, and meranti. Many hardwoods are softer and lighter than some softwoods, e.g., balsa, paulownia.

Colour variations between sapwood and heartwood add character to ceiling panelling

Light coloured sapwood contrasts with heartwood in cypress pine flooring

All unfinished timber turns grey if exposed to weather

Natural figure enhances veneer panelled walls in public places such as restaurant

Appearance

Colour

Most timbers show variation in colour between species and within species. Colour descriptions usually relate to the heartwood of the species and may be significantly different from that of the sapwood. Colour may also vary during use and can be influenced by the application of different finishes. Timber exposed to light will change colour and unprotected timber, exposed to the weather, will eventually become silvery grey in colour.

Grain

Grain refers to the general direction, size and arrangement of the wood cells (discussed above), and may be used to broadly describe the timber's appearance. However, the word "grain" when used alone may not be sufficiently specific. It is more appropriate to use such descriptive terms as straight grain, sloping grain, spiral grain, irregular grain, wavy grain, and the like, which describe some specific characteristics of the timber grain.

Texture

The timber's texture may be described as being coarse, fine, even or uneven. This differentiation between coarse and fine texture is made on the basis of the size and arrangement of the wood cells. Softwoods are normally considered to be fine textured, whereas hardwoods may span the range from coarse to fine. Mountain ash is an example of a coarse textured hardwood but brush box, also a hardwood, is considered to have a fine texture.

Figure

Figure means the patterns produced on the surface of timber, and is influenced by the arrangement and dimensions of the wood cells, the nature of the grain, and colour variations in the heartwood and sapwood.

Figure may also depend on whether logs are quarter sawn or back sawn. Interlocked and wavy grain create a striking figure, due to the manner in which light is absorbed or reflected at differing angles by the wood cells.

Properties

Density

Density of timber at a specific moisture content is the amount (mass) of wood substance in a given volume, expressed as kilograms per cubic metre.

Density is influenced by the amount of wood cell wall relative to the amount of void space in and between the cells. The density of the wood cell wall (fibres, tracheids, vessels, or rays) is constant in all timber species at 1400-1500 kg/m^3 Thus, the main factors affecting density are the size of the cells (including cell wall thickness), the amount of void spaces, and the proportions and distribution of the different cell types.

In general terms, density is one of the most reliable indicators of strength, as well as several other properties, such as stiffness, joint strength, hardness, ease of machining, fire resistance and drying characteristics. Density can be given in at least one of three forms.

Density is greatly influenced by the amount of moisture contained in the timber at the time of measurement. For that reason, density values are normally quoted at a standard moisture content of 12 per cent. This is referred to as the air-dry density. Sometimes the term basic density may also be used. It is defined as the mass of oven-dry wood divided by its green volume. In this case, it is a green density value. Approximate densities for unseasoned timber are set out in the Timber Species Properties Schedule at the end of this Datafile.

Moisture Movement

As wood dries below its fibre-saturation point, it shrinks. However, the loss in dimension is not the same in all directions. The longitudinal shrinkage, that is, the length of timber of product, is very small and usually may be disregarded.

In the radial direction, (across a piece of timber) depending on species, shrinkage is around 3% to 6% when drying down to 12% moisture content. In the direction of the growth rings, ie: tangentially, the shrinkage is generally about twice this amount, 6% to12%.

Moisture Content

Because living trees contain sap, newly felled timber usually has a high moisture content. Moisture content (MC) is the mass of water contained in the wood, expressed as a percentage of the mass of oven-dry wood. When the moisture content is between zero and about

25%, moisture is totally contained within the cell walls, but in the range from 25% MC to 35% MC (depending on the species), the cell walls become saturated; and this is called the fibre-saturation point (FSP). Above the fibre-saturation point, additional moisture is held as free water in the cell cavities.

Timber releases or absorbs moisture in response to changes in relative humidity until the moisture content of the timber has stabilised at an equilibrium moisture content (EMC). Assuming a constant temperature, the ultimate moisture content that a given piece of timber will attain, expressed as a percentage of its oven-dry weight, depends upon the relative humidity of the surrounding atmosphere. (See Figure 2.)

Moisture content within living trees varies greatly. Moisture content may range from 30% in the heartwood of some hardwoods and Douglas fir, to 200% in the sapwood of some low density timbers. Generally, timber which has a moisture content exceeding 15% is regarded as unseasoned.

The effect of shrinkage on timber sections cut from various sections of a log, is shown in Figure 3. This effect may only be of major significance to the end-user when unseasoned timber is used and is allowed to dry in place.

Figure 2: Equilibrium moisture content (emc)

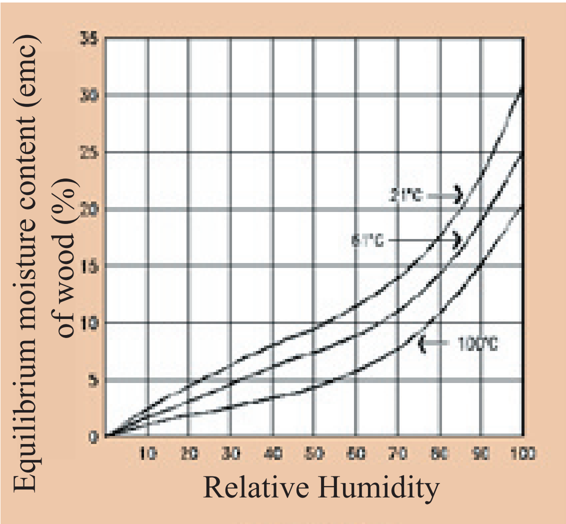
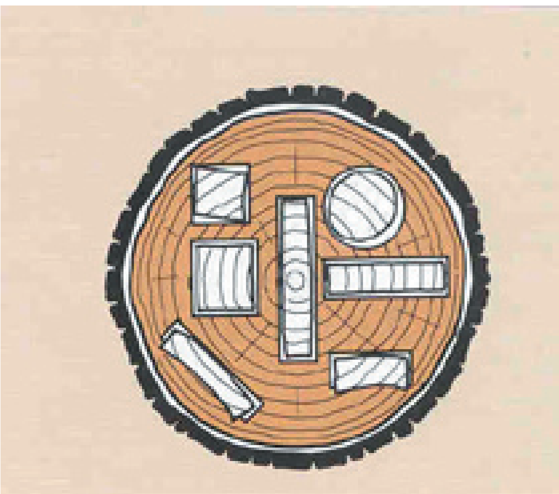


Figure 3: Effect of shrinkage



If seasoned timber is used, the direction of cut is usually not as important since there should be no large subsequent change in dimension.

For some structural applications, it may be necessary to use large sections of unseasoned timber. In these cases, it is essential to limit the effects of shrinkage by careful design. The possibility of differential shrinkage between adjacent members should be avoided. (Refer to *Datafile P4 - Timber – Design for Durability* for additional information.)

Additional techniques considered to be good practice to minimise the movement effects due to moisture changes, are:

- select timbers with low movement characteristics.
- protect against excessive drying or wetting.
- apply a coating to the timber that will retard rapid moisture absorption or loss.
- use smaller rather than larger cross-sections.

The term "movement" is used to describe the periodic small dimensional changes that occur in seasoned timber due to environmental changes. This movement may be either shrinkage or swelling and its basic cause is a change in the moisture content of wood occurring below the fibre saturation point.

The usual way of minimising the likelihood of any adverse effects is to ensure that the timber member when first installed is at a moisture content approximately mid-way between the extremes of the equilibrium moisture content it is likely to attain in service. Internal flooring, for example, would probably need to be installed with its moisture content at around 12%.

Seasoned timber has a moisture content between 10% and 15%, and its use has several advantages including:

- cross-section dimensions remain almost constant.
- weight is reduced.
- strength is improved.
- electrical resistance is increased.
- gluing and nail holding properties are improved.
- joint strength is increased.

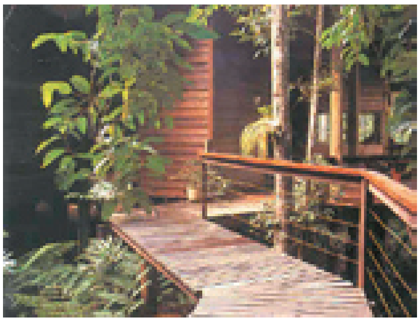
Durability of Heartwood

In general, there are two main factors, which influence a timber's in-service performance. The first is the natural durability of the particular species, while the other relates to the type and degree of hazard to which the timber is exposed.

Durability is expressed in terms of one of four classes, which have been based on a combination of field trials for untreated heartwood both in the ground and above the ground (when ventilation and drainage are adequate), expert opinion, and experience of timber in service.

Class 1 timbers have the highest level of natural durability and are expected to be resistant to decay and termite attack for at least 25 years.

The durability rating reflecting natural durability, relates to the resistance of outer heartwood of the species to fungal and insect (termite) attack. Note that sapwood is deemed not to be durable unless it has been treated with some form of preservation material.



Durable timber selected for exposed tropical environment.

The Classes are only a guide to expected performance; they should not be used as definitive prescriptions. (For durability of Australian timbers see the Timber Species Properties Schedule.)

The serviceability of timber may also be affected by borers, termites, or marine borers. Note that termite resistance may not be the same as decay resistance and this is listed separately in national Standards for timbers that are used inside and above the ground. AS5604-2003 *Timber – Natural Durability Ratings*, lists both in-ground and above-ground life expectancies and the termite resistance of timbers when used inside.

Good design workmanship, finishing and maintenance are helpful, together with the selection of species of high natural durability where necessary. An alternative is the use of timber that has been treated with some form of preservative. (Further discussion about durability can be found in *Datafile P4 - Design for Durability*.)

Strength

The strength of timber is described in terms of "stress grades". A stress grade is defined in the AS1720 SAA *Timber Strutures Code*, as the classification of timber for structural purposes. It is based on either visual or machine grading, which indicates the basic working stresses and stiffnesses that apply to timber products used for structural design purposes. The stress grade is designated in a form such as F7, which indicates that for such a grade of timber , the basic working stress in bending is approximately 7 MPa.

When timber is graded by visual means the resulting stress grade is influenced by both the inherent strength of the species concerned and the quality (or grade) of the particular parcel of timber. Grade descriptions are listed in Australian Standard specifications for structural timber, which places limits on the size or extent of strength reducing characteristics, such as knots or sloping grain. The two main Standards are AS 2082 *Timber – Hardwood - Visually Stress-Graded for Structural Purposes* and AS 2858 *Timber - Softwood – Visually Stress-Graded for Structural Purposes*.

The inherent strength of timber species (strength group) is scheduled in Appendix A. There are seven strength groups (S1 to S7, with S1 being the strongest) for unseasoned timber and eight (SD1 to SD8) for seasoned timber.

The relationship between these strength groups, the visual grades and the resulting stress grades is illustrated in Table 1.

An exception to the general rule is cypress pine. The appropriate stress grades for cypress pine are F4, F5 and F7. For further information refer to AS2858.

Stress grades may also be determined by mechanical grading to deliver:

- machine stress grading; and
- proof grading

Machine stress grading utilises a computer-controlled machine which is usually limited to production centres with large throughputs. The basis of the technique is that stiffness can be directly correlated to strength.

Table 1: Strength group/stress grade/visual grade relationship

Strength Group	Stress Grade				
	Structural No.1	Structural No.2	Structural No.3	Structural No.4	Structural No. 5
Unseasoned Timber					
S1	F22	F22	F17	F14	F11
S2	F27	F17	F14	F11	F8
S3	F17	F14	F11	F8	F7
S4	F14	F11	F8	F7	F5
S5	F11	F8	F7	F5	F4
S6	F8	F7	F5	F4	
S7	F7	F5	F4		
Seasoned Timber					
SD1	F34	F34	F27	F22	F17
SD2	F34	F27	F22	F17	F14
SD3	F27	F22	F17	F14	F11
SD4	F22	F17	F14	F11	F8
SD5	F17	F14	F11	F8	F7
SD6	F14	F11	F8	F7	F5
SD7	F11	F8	F7	F5	F4
SD8	F8	F7	F5	F4	

Note: Structural grade no.5 applies to softwood only - as specified in AS2825

Stress grading permits engineered truss design using small member sizes.

Timber structures and cladding perform well in a cold alpine environments.

Individual pieces are fed into the machine in a longitudinal direction and continually deflected in the narrow dimension by a given load. A coloured spray indicates the stress grade of the piece, based on a measure of the resulting deflection.

Machine Graded Pine (MGP), used to designate stress grades for seasoned softwoods like radiata, slash, hoop, and other pines, is now widely available in the framing grades MGP10, 12, and 15. These grades satisfy the requirements of stress grades F5, F8 and F11 seasoned timber, respectively.

Proof grading allocates a stress grade to a piece of timber if it demonstrates its ability to sustain a specific proof bending stress. The proof stress applied is generally from 2.2 to 2.4 times the actual design stress. The load is applied on edge to simulate the usual loading method in service.

Fatigue Effect

Unlike most structural materials, timber is very resistant to cyclic loading, as occurs with structures subjected to high wind loads or vibrating machinery. Allowable working stresses for loads of long duration are safe for most structures subjected to impact or cyclic loading, but designers should determine the magnitude and frequency of cyclic loading and consider them in design. Sustained loading produces a time-dependent behaviour of timber known as creep, and allowance for this effect is made in AS1720 SAA *Timber Structures Code*.

Standard static tests show that wood subjected to 30 million cycles of stress in tension parallel to the grain retains 40% of its static strength. In joints, consideration must be given to cyclic effects on metal connectors.

Temperature Effect

The strength of timber is affected by temperature. In general, the mechanical properties of wood decrease when it is heated and increase when it is cooled. At below freezing temperatures, strength values for bending and compression, and for resistance to shock, are slightly higher than for values at normal temperatures. Timber subjected to very high temperatures can be weakened, but allowable working stresses are safe for timber exposed to temperatures up to approximately 40°C. Above that, stresses should be reduced.

The combination of high temperature and high humidity in structures such as indoor swimming pools will need to be considered. Reference should be made to Clauses 2.5.2 and 2.5.3 of AS 1720.1 SAA *Timber Structures Code.*

Preservative Treatment Effect

Current commercial preservative treatments have little effect on the strength of timber. Allowable working stresses are the same as for untreated timber. It should be noted that timber treated with water-borne preservatives that has not been re-dried after treatment should be regarded as unseasoned timber for grading purposes. Where the timber is re-seasoned after treatment it may need to be re-graded.

Joint Strength

For the purpose of joint design, all species have been classified into six 'joint groups' - J1 to J6 - for the unseasoned condition, and six groups JD1 to JD6 for the seasoned condition. The Timber Properties Schedule at the end of this Datafile shows the joint groups for individual species.

Where test data is not available for a particular species, a joint group may be established in relationship to a species density. Table 2 provides minimum average densities appropriate to each joint group.

Hardness

Hardness of wood refers to its resistance to wear or abrasion and it's resistance to indentation. It is also reflected in the difficulty of sawing and planing the timber. Hardness is measured by the load required to embed a defined-sized ball to one half its diameter into the wood. The figures given in the Timber Properties Schedule refer to this resistance to indentation, which generally is considered to be an indicator of the other hardness factors.

Table 2: Density/joint group relationship

Unseasoned Timber						
Joint Group	J1	J2	J3	J4	J5	J6
Basic Density kg/m3	750	600	475	380	300	240
Seasoned Timber						
Joint Group	JD1	JD2	JD3	JD4	JD5	JD6
Air-dry Density at 12% mc kg/m3	940	750	600	475	380	300

NOTE: Basic density is the mass of an oven-dry specimen divided by its volume when unseasoned.

Thermal Properties

Completely dry wood expands with heat and contracts on cooling. The thermal expansion of wood is generally insignificant. When thermal expansion does occur, it is about 5 to 10 times greater across the grain than along it. Consequently, thermal expansion in timber structures is seldom a consideration.

For very long spans, such as in bridges or large floor areas, expansion should be calculated, taking the offsetting effect of shrinkage into account. Expansion joints should be provided if warranted.

The thermal conductivity of wood is low, so timber can be viewed as a natural insulator. Air pockets within the wood's cellular structure make it a natural barrier to heat and cold. Since thermal conductivity increases with density, light-weight timber is a better insulator than dense timber. Thermal conductivity varies slightly with moisture content, residual deposits in the timber such as the extractives, and natural characteristics, such as checks, knots and grain direction.

An advantage of timber-framed construction is that additional insulating materials can be placed in the spaces between framing members without increasing wall, ceiling, roof or floor thickness.

Some preservative treatments, e.g. copper chromium arsenic (CCA), in the presence of moisture can corrode unprotected fittings and fixings such as mild or bright steel nails and screws. It is important under these conditions to ensure that the fittings and fixings are of resistant materials, such as hot-dipped galvanised nails and screws. Further information on this can be found in *Datafile P4 - Timber - Design for Durability.*

Aluminium, copper, brass, bronze and galvanised steel are much more resistant than bright steel to wood acids such as acetic acid. When the pH of wood is below 4.3 the rate of corrosion of steel increases considerably. Table 3 provides pH values for a range of species. A more comprehensive list may be found in *Wood in Australia* by K.R. Bootle.

Electrical Conductivity

The electrical resistance of timber varies greatly with its moisture content, from many thousands of megohms when very dry to near zero at the fibre-saturation point; electric moisture metres utilise this properly to measure the moisture content of timber.

In the moisture ranges where timber is a good insulator (poor conductor), moisture metres are reasonably accurate. However, timber becomes a good conductor at and above the fibre-saturation point, meaning that resistance moisture metres cannot be used in this range with accuracy. Other metres, based on electric capacitance, can be used in these cases.

As a conductor, timber can be heated by subjecting it to a high-frequency electrical field. Some adhesives can be heat-cured by this process during laminated timber or plywood manufacture.

Seasoned timber is normally regarded as a non-conductor for most practical purposes. Note however, that timber containing high levels of water-soluble salts from some preservatives and fire-retardants or through prolonged contact with seawater, may undergo an increase in conductivity when the moisture content exceeds about 12%.

Timber structures are ideal for indoor swimming pools.

Chemical Resistance

Timber offers considerable resistance to building attack by a wide variety of chemicals including organic materials, hot or cold solutions of acids or neutral salts, and dilute organic and mineral acids. Direct contact with caustic soda should be avoided. Strong acids and alkalies will destroy timber in time but the action is not rapid, with alkaline chemicals more likely to cause cellular degradation than acidic ones.

In general, heartwood is more resistant to chemical attack than sapwood, because of its relative resistance to liquid penetration. Resistance to chemical attack is greater in softwoods than in hardwoods due to softwoods usually having a lower hemicellulose and higher lignin content.

Resin in some softwoods, such as Douglas fir and slash pine, shows good resistance to chemicals if free of sapwood. The benefit of resisting chemical attack should be balanced against the practical difficulties of having preservation material penetration into softwoods.

Because of the properties identified above, timber is commonly used to manufacture vats and tanks for chemical storage or for structural members in factories where corrosive vapours are present.

Further information can be found in *Datafile P4 - Timber - Design for Durability*.

Table 3: Timber – pH values

Species	pH Value
ash, alpine	3.6
blackbutt	3.4
box, brush	3.9-4.6
fir, Douglas	3.1-4.4
gum, spotted	4.6-5.0
ironbark	3.7
jarrah	3.0-3.7
kapur	3.2-3.7
meranti, red, light	4.3-6.1
merbau	4.3
pine, cypress, white	5.7
pine, hoop	5.2
pine, radiata	4.0-4.8

Corrosive Action

Corrosion of metals by wood can sometimes occur when the wood is wet or is used unseasoned. This is related to the timber's conductivity (see previous page for more details on this subject). Examples may be seen where the extractives in moist wood have reacted with bright steel nails and caused dark coloured corrosion products to be deposited around the nail heads.

Acoustic Properties

Acoustics is the science of all audible sounds, wanted or unwanted. Control of wanted sounds within a room is called room acoustics; control of unwanted sounds within a building is called acoustic separation or sound insulation.

Timber as a construction material plays a large part in both room acoustics and acoustic separation.

An important acoustical property of timber is its ability to dampen vibrations. Its network of minute interlocking wood cells converts sound energy into heat energy by frictional and viscous resistance within these cells and by vibrations within their sub-structure.

Because of this internal friction, wood has more damping capacity than most structural materials. This damping reduces the tendency of structures to transmit vibrations long distances. It also reduces the magnitude of resonant vibrations, improving the performance of wood panelling as a reflective surface.

Further information can be found in *Datafile P6 - Timber - Sound Control*.

Weathering

Unprotected timber can physically deteriorate if exposed to extremes of atmospheric change over a period of time. For example, timber will respond to cyclical variations of sun, rain, wind, and frost, by the wood cells swelling and shrinking. These movements may in the long term lead to a gradual disintegration of the wood structure.

Some preservatives effective against decay and insects may also be used to improve resistance to weathering. Sometimes, the weathering will actually enhance the appearance of timber for exterior applications, as in natural finished cladding and decking.

Weathering is essentially a surface effect and most properties, apart from surface abrasion resistance, are hardly changed by its effects. For this reason, weathering of unprotected timber is a slow process. Studies suggest that the average rate of wood substance erosion is about 6mm/100 years.

Weathering is not to be confused with decay which is the result of fungi attacking the wood cells in the presence of excess moisture and air for an extended period.

Weathering protection may be provided by the application of coatings such as paints, water repellents, water repellent preservatives and pigmented penetrating stains. The main objective in applying the coatings is to prevent or retard the uptake of moisture, change the rate at which water is absorbed and desorbed, and/or resist the absorption of ultraviolet light which causes chemical changes in the wood cell components, especially the lignin.

Further information can be found in *Datafile P4 - Timber - Design for Durability*.

Utilisation

Grading

Timber grading is a system of classification to provide material for specific end uses.

In general terms, there are three categories of grading:

- structural
- structural appearance
- appearance

Within each of these categories, there is a range of grades, e.g., in structural grading the structural grades, 1, 2, 3, etc. define various strength levels. For more information refer to the "Strength" section under "Properties" in the Timber Properties Schedule. You will also find a full schedule of Australian Standard grading rules included in *Datafile SP2 - Timber Standards and Quality Assurance.*

Where structural timber is to be used for decorative or "exposed" applications, it may be appropriate to specify the structural grade (or stress grade) with overriding appearance grade requirements. Both structural grading standards (AS 2082 and AS 2858) include provisions for "appearance grades".

For milled products, such as panelling, flooring and mouldings, the grading standards generally provide for a range of graded quality. At the lower end of the grades, the products are generally more suitable for covered or painted applications.

The Timber Species Properties Schedule

The schedule set out on the following six pages of this Datafile (together with two pages of notes) includes a range of the most common timber species available in Australia.

For information on other species, reference should be made to the Timber Advisory Services listed on the back page of this Datafile.

Timber Species Properties Schedule

1	2	3		4		5		6	7		8	9
Standard Trade Name	Botanical Name	Strength Group		Joint Group		Density		Hardness (seasoned)	Toughness		Tangential Shrinkage	% Unit Tangential Movement
		Unseasoned	Seasoned	Unseasoned	Seasoned	Unseasoned	Seasoned		Unseasoned	Seasoned		
ash, alpine	Eucalyptus delegatensis	S4	SD4	J3	JD3	1050	650	5	M	M	8.5	0.35
ash, crows	Flindersia australis	S2	SD3	J1	JD1	1050	950	11	M	M	4.2	
ash, mountain	Eucalyptus regnans	S	SD3	J3	JD3	1050	650	4.9	M	M	13.3	0.36
ash, silvertop	Eucalyptus sieberi	S3	SD3	J2	JD2	1100	850	9.8	M	M	10.6	0.36
balau (selangan batu)	Shorea spp.	S2	SD3	J2	JD2	1150	900				7	
bangkirai	Shorea laevifolia	/	SD3				850				5	
beech, myrtle	Nothofagus cunninghamii	S4	SD5	J3	JD3	1100	700	5.9			4.7	0.32
blackbutt	Eucalyptus pilularis	S2	SD2	J2	JD2	1150	900	8.9	M	M	7.3	0.37
blackbutt, New England	Eucalyptus andrewsii	S3	SD3	J2	JD2	1150	850	9.2	M	M	11.4	0.36
blackbutt, W.A.	Eucalyptus patens	S4	SD5	J2	JD2	1100	850	6.9	L	L	10	
blackwood	Acacia melanoxylon	S4	SD4	J3	JD3	1050	650	4.9			3.9	0.27
box, brush	Lophostemon confertus	S3	SD3	J2	JD2	1100	900	9.1	M	M	9.7	0.38
box, grey coast	Eucalyptus bosistoana	S1	SD1	J1	JD1	1200	1100	13.1	H	H	8.2	0.42
brownbarrel	Eucalyptus fastigata	S4	SD4	J3	JD3	1100	750	5.5	M	M	11.8	0.34
calantas (kalantas)	Toona calantas	S6	SD7		JD4		500		L	L	7	
candlebark	Eucalyptus rubida	S5	SD5	J3	JD3	1100	750	5.9	M	L	12.2	0.34
cedar, western red	Thuja plicata	S7	SD8		JD6		350		L	L	3	
erima	Octomeles sumatrana	S7	SD8		JD5		400				7	
fir, Douglas (oregon)	Pseudotsuga menziesii	S5	SD5	J4	JD4	710	550	3	L	L	4	
gum, blue southern	Eucalyptus globulus	S3	SD2	J2	JD2	1150	1000	11.5	M	H	7.7	0.4
gum, blue Sydney	Eucalyptus saligna	S3	SD3	J2	JD2	1100	850	8.1	M	M	9.5	0.35
gum, grey	Eucalyptus propinqua	S1	SD2	J1	JD1	1250	1050	14	M	M	7	

10	11	12	13	14			15	16									17
				Fire Hazard				Common Uses									
Durability Class	Above-ground Durability Class	Termite Resistance	Lyctid Sustainability	Ignitibility	Spread of Flame	Smoke Developed	Colour	In Ground	Framing Above Ground -Exposed	Framing Above Ground-Protected	Decking	Cladding	Intenal Flooring	Panelling	External joinery	Internal Joinery	Availability
4	3	NR	S (NS in Vic.)	14	8	3	W			S			O	O		O	R
1	1	R	S				W						O				L
4	3	NR	NS	14	8	3	W						O	O		O	R
3	2	NR	NS				W-P			O							L
2	1	NR	S				R		O	O	O	O	O	O			L
2			S				W	P	O		O		O	O			L
4	3	NR	S				P			O		O	O	O		O	L
2	1	R	NS	13	7	3	W		O	O	O	O	O	O			R
2	1	R	S				W		O	O							L
2	1	R	S				B			S	O	O	O	O			L
3			S	13	9	3	B			O	O	O	O	O		O	R
3	3	R	NS	14	7	3	B			O	O	O	O	O			R
1	1	R	S				W	O									R
4	3	NR	S				W			O							L
2			S				R							O	O	O	L
3	3	NR	S				P			O							L
3	2	R	NS	15	10	4	W-B					O		O	O	O	R
4			S				W							O		O	L
4	4	NR	NS	14	9	3	W			O				O		O	R
3	2	NR	S				W			O							L
2	2	NR	S				P			O	O		O	O			R
1	1	R	NS				R	O	O								R

Timber Species Properties Schedule

1	2	3		4		5		6	7		8	9
Standard Trade Name	Botanical Name	Strength Group		Joint Group		Density		Hardness (seasoned)	Toughness		Tangential Shrinkage	% Unit Tangential Movement
		Unseasoned	Seasoned	Unseasoned	Seasoned	Unseasoned	Seasoned		Unseasoned	Seasoned		
gum, grey mountain	Eucalyptus cypellocarpa	S3	SD2	J2	JD2	1100	900	10.3	M	M	11.9	0.39
gum, manna	Eucalyptus viminalis	S4	SD4	J3	JD2	1100	800	5.8	M	M	12	0.34
gum, mountain	Eucalyptus dalrympleana	S4	SD5	J3	JD3	1100	700	5.7	M	M	11.5	0.35
gum, red, forest	Eucalyptus tereticornis	S3	SD4	J1	JD1	1150	1000	11.3	M	M	8.6	0.34
gum, river, red	Eucalyptus camaldulensis	S5	SD5	J2	JD2	1150	900	9.7	M	L	8.9	0.31
gum, rose	Eucalyptus grandis	S3	SD4	J2	JD2	1100	750	7.3	M	M	7.5	0.3
gum, shining	Eucalyptus nitens	S4	SD4	J3	JD3	1100	700	5.8	M	M	9.4	0.33
gum, spotted	Corymbia maculata	S2	SD2	J1	JD1	1200	1100	10.1	H	H	6.1	0.38
hardwood, Johnston River	Backhousia bancroftii	S2	SD3	J1	JD1	1150	950				6.4	0.39
hemlock, western	Tsuga heterophylla	S6	SD6	J4	JD4	800	500	2.7	L	L	5	
ironbark, grey	Eucalyptus paniculata	S1	SD1	J1	JD1	1250	1100	16.3	H	H	7.5	0.39
ironbark, red	Eucalyptus sideroxylon	S2	SD3	J1	JD1	1200	1100	11.9	H	M	6.3	0.37
jarrah	Eucalyptus marginata	S4	SD4	J2	JD2	1100	800	8.5	L	L	7.4	0.3
kapur	Dryobalanops spp.	S3	SD4	J2	JD2	1100	750	5.4	L	M	6	
karri	Eucalyptus diversicolor	S3	SD2	J2	JD2	1150	900	9	M	M	9.9	0.4
keruing	Dipterocarpus spp.	S3	SD3	J2	JD2	950	750	4.6	H	H	9.5	
kwila (merbau)	Intsia bijuga	S2	SD3	J2	JD2	1150	850	8.8	M	M	2.5	
mahogany, Philippine, red, dark	Shorea spp.	S5	SD6		JD3		650	3.2			4	
mahogany, Philippine, red, light	Shorea, Pentacme, Parashorea spp.	S6	SD7		JD4		550	2.6			6.5	
mahogany, red	Eucalyptus resinifera	S2	SD3	J1	JD1	1200	950	12	M	M	6.3	0.34
mahogany, southern	Eucalyptus botryoides	S2	SD3	J2	JD2	1100	900	9.2	M	M	9.8	0.37

10	11	12	13	14			15	16									17
				Fire Hazard				**Common Uses**									
Durability Class	**Above-ground Durability Class**	**Termite Resistance**	**Lyctid Sustainability**	**Ignitibility**	**Spread of Flame**	**Smoke Developed**	**Colour**	**In Ground**	**Framing Above Ground -Exposed**	**Framing Above Ground-Protected**	**Decking**	**Cladding**	**Intenal Flooring**	**Panelling**	**External joinery**	**Internal Joinery**	**Availability**
3	2	NR	S				P						O	O		O	R
4	3	NR	S				P						O	O		O	L
4	3	NR	S				P			O			O			O	L
2	1	R	NS				R	O	O	O		O					L
2	1	R	S				R	O	O	O	O	O	O	O	O		L
3	2	NR	NS				P			O							L
4	3	NR	S				W			O			O				R
2	1	R	S	13	3	3	B		O	O	O	O	O				R
3	2	NR	S				B						O				L
4	4	NR	NS	14	9	3	W			O				O		O	L
1	1	R	NS				WRB	O	O	O	O						R
1	1	R	S				R	O	O		O						L
2	2	R	S	13	6	3	R	P	O	O	O	O	O	O	O	O	R
3	2	NR	NS	13	7	3	WPR			O							L
3	2	NR	NS				P		P	O	P		O	O	O	O	R
3	3	NR	S				R	P	P	O							L
2	3	R	S				R		O	O	O		O	O			L
4	4	NR	S				R								O	O	R
4	4	NR	S				W							O		O	R
2	1	R	S				R		O	O							L
4	4	R	NS				R			O			O				L

Timber Species Properties Schedule

1	2	3		4		5		6	7		8	9
Standard Trade Name	Botanical Name	Strength Group		Joint Group		Density		Hardness (seasoned)	Toughness		Tangential Shrinkage	% Unit Tangential Movement
		Unseasoned	Seasoned	Unseasoned	Seasoned	Unseasoned	Seasoned		Unseasoned	Seasoned		
mahogany, white	Eucalyptus acmenoides	S2	SD3	J1	JD2	1150	1000	10.1	M	M	5.4	
marri	Corymbia calophylla	S3	SD3	J2	JD2	1150	850	7.1	M	M	6.6	0.34
meranti, dark-red	Shorea spp.	S5	SD6	J4	JD4	1100	650	3.5			5	
meranti, light-red	Shorea spp.	S6	SD7		JD5		400	2.4			4.4	
messmate	Eucalyptus obliqua	S3	SD3	J3	JD3	1100	750	7.4	M	M	11.3	0.36
messmate, Gympie	Eucalyptus cloeziana	S2	SD3	J1	JD1		955				6	
oak, American	Quercus spp.	S6	SD6				750				5	
peppermint, narrow-leaved	Eucalyptus australiana	S4	SD4	J3	JD2	1100	800	7.5	L	L	13.2	0.36
pine, Caribbean	Pinus caribaea	S6	SD6	J4	JD4		550				3.6	
pine, celery top	Phyllocladus asplenifolius	S4	SD5	J3	JD3	1050	650	4.5			3.1	0.19
pine, cypress, white	Callitris glaucophylla	S5	SD6	J3	JD3	850	700	6.1	L	L	2.5	0.26
pine, hoop	Araucaria cunninghamii	S6	SD5	J4	JD4	800	550	3.4	L	L	3.8	0.23
pine, radiata	Pinus radiata	S6	SD6	J4	JD4	800	550	3.3	M	L	5.1	0.27
pine, slash	Pinus elliottii	S5	SD5	J3	JD3	850	650	3.4	L	L	4.2	0.3
ramin	Gonystylus spp.	S4	SD4		JD3		650	5.8			5.5	
satinay	Syncarpia hillii	S3	SD3	J2	JD2	1100	800	8.3	M	L	10	0.35
stringybark, Blackdown	Eucalyptus sphaerocarpa	S3	SD3	J1	JD2		1000				7	
stringybark, brown	Eucalyptus baxteri	S3	SD3	J2	JD2	1100	850	7.5	M	M	10.4	0.33
stringybark, white	Eucalyptus eugenioides	S3	SD3	J2	JD2	1100	1000	9	M	M	10.6	0.36
stringybark, yellow	Eucalyptus muellerana	S3	SD3	J2	JD2	1150	900	8.6	M	M	7.5	0.37
tallowwood	Eucalyptus microcorys	S2	SD2	J1	JD2	1200	1000	8.6	M	M	6.1	0.37
taun	Pometia spp.	S4	SD4		JD3		700				5.5	
turpentine	Syncarpia glomulifera	S3	SD3	J2	JD2	1050	950	11.6	M	M	13	0.35

10	11	12	13	14			15	16									17
				Fire Hazard				Common Uses									
Durability Class	Above-ground Durability Class	Termite Resistance	Lyctid Sustainability	Ignitibility	Spread of Flame	Smoke Developed	Colour	In Ground	Framing Above Ground -Exposed	Framing Above Ground-Protected	Decking	Cladding	Intenal Flooring	Panelling	External joinery	Internal Joinery	Availability
1	1	R	NS				W		O	O	O						R
3	3	NR	S				W			O			O				L
4	2	NR	S	14	9	4	R							O			R
4	3	NR	S	14	9	4	P						O	O		O	R
3	3	NR	S	13	5	3	W			O						O	R
1	1	R	NS				W	O	O	O	O		O		O		L
2			S				W							O		O	L
4	3	NR	S				P			O							L
4	4	R	NS				W	P	P	S	P	P	O	O			R
4	2	R	NS				W	O	O		O	O		O		O	L
2	1	R	NS	13	8	3	WB		O	O	O	O	O	O			R
4	4	NR	NS	14	7	2	W	P	P	S	P	P	O	O	P	O	R
4	4	NR	NS	14	8	3	W	P	P	S	P	P	O	O	P	O	R
4	4	R	NS				W	P	P	S	P	P	O	O	P	O	R
4		NR	S	14	7	3	W						O	O		O	L
2	2	R	NS				R				O		O				L
2	1	R	NS				B		O	O							L
3	2	NR	NS				B			O							L
3	2	R	NS				P		O	O	O						L
3	2	R	NS				W		O	O	O						L
1	1	R	S	12	5	4	W	O	O	O	O	O	O				R
3	2	NR	S				R			O			O				R
1	1	R	NS				PB				O		O				L

Timber Species Properties Schedule

Notes

** General note: Where a species group has been included, the properties outlined are based on that of the lowest rated species in the group.*

Column 1 ***Preferred Common Name/Standard Trade Name****: The names listed are those defined in AS/NZS 1148-2001 Timber - Nomenclature – Australian, New Zealand, and Imported Species.*

Column 2 ***Botanical Name****: These names are also defined in AS/NZS 1148-2001*

Column 3 ***Strength Group****: Strength groups are given unseasoned (U/S) and seasoned (S) timber in accordance with AS 22878-2000, Timber - Classification into Strength Groups.*

The relationship between strength group, visual grade and stress grades is given in Table 1.

Column 4 ***Joint Group****: The joint group is a classification of the strength of a species in joint design. A relationship between species density and joint group is given in Table 2.*

Column 5 ***Density****: Density is given for unseasoned (U/S) and seasoned (S) timber. The seasoned density is based on a moisture content of 12%. The unseasoned density is an approximation as it will depend on the moisture content at the time of measurement. It has been provided only as a guide to determine the weight of an unseasoned timber member.*

Column 6 ***Hardness****: Hardness is measure of a species resistance to indentation. It is measured in kN and is determined by the Janka hardness test.*

Column 7 ***Toughness****: Toughness is a measure of timbers ability to resist shocks and blows, and is synonymous with impact strength. It is measured in Nm but for the purpose of this schedule, the following simplified classifications have been adopted:*

L = up to 15 Nm

M = 15 to 25 Nm

H = 25 Nm and above

Specific toughness classifications are scheduled in AS1720.2 SAA Timber Structures Code Part 2: Timber Properties.

Column 8 ***Tangential Shrinkage****: Average percentage shrinkage values for the tangential direction only are given as these are normally about double that of the radial shrinkage. Shrinkage is the measure of the percentage reduction in timber product dimensions from the unseasoned to 12% moisture content condition.*

Column 9 ***Unit Tangential Movement*** *(%): This is the percentage dimensional change for each 1% moisture content change between about 3% moisture content and the fibre saturation point moisture content for the particular species.*

Column 10 ***In-ground Durability Class****: Durability is expressed as one of four classes based on a combination of field trials of untreated heartwood in the ground, expert opinion, and experience of timber in service.*

Class 1: *Timbers of the highest natural durability which may be expected to resist both decay and termite attack for at least 25 years in the ground.*

Class 2: *Timbers of high natural durability which may be expected to have a life of about 15 to 25 years in the ground.*

Class 3: *Timbers of only moderate durability which may be expected to have a life of about 8 to 15 years in the ground.*

Class 4: *Timbers of low durability which may last from about 1 to 8 years in the ground. These timber have about the same durability as untreated sapwood which is generally regarded as Class 4, irrespective of species.*

Column 11 ***Above-ground Durability Class****: Durability is expressed by one of four classes based on a combination of field trials of untreated heartwood above the ground (when ventilation and drainage are adequate), expert opinion, and experience of timber in service.*

Class 1: *Timbers of the highest natural durability which may be expected to resist decay for more than 40 years above the ground.*

Class 2: Timbers of high natural durability which may be expected to have a life of about 15 to 40 years above the ground.

Class 3: Timbers of only moderate durability which may be expected to have a life of about 7 to 15 years above the ground

Class 4: Timbers of low durability which may last from about 1 to 7 years above the ground.

Column 12 ***Termite Resistance:*** *This refers to heartwood exposed inside and/or above the ground:*

R – resistant

NR – not resistant

Column 13 ***Lyctid Susceptibility:*** *The susceptibility of the sapwood of individual species to attack by lyctid borers is classified as follows:*

S = Susceptible

RS = Rarely Susceptible

NS = Not Susceptible

In Queensland and New South Wales, there is specific legislation covers the sale and use of lyctid susceptible timber.

Column 14 ***Early Fire Hazard Indices:***

Ignitibility index (scale 0-20)

Spread of flame index (0-10)

Smoke developed index (0-10)

Column 15 ***Colour:*** *The colour of seasoned heartwood can vary between species and often within a species. The information here should be used as a general guide only.*

In most cases, the colour of sapwood is either a lighter shade of the heartwood colour or a white/cream colour.

W = white, yellow, pale straw to light brown

P = pink, to pink brown

R = light to dark red

B = brown, chocolate, mottled or streaky

Column 16 ***Common Uses****: The schedule lists common uses of species and not necessarily all uses for which a species is suitable. The listing does not include uses where an individual species is used in a species mix. It assumes that normal good design, workmanship, finishing and maintenance practices will be followed.*

(i) In Ground: Conditions of use include in or on the ground, or in persistantly damp or badly ventilated situations, e.g., embedded poles or posts, landscaping timber.

(ii) Framing above Ground – Exposed: Conditions of use include framing exposed to the weather (or not fully protected), but clear of the ground and well ventilated, e.g., sub-floor framing to decks.

(iii) Framing Above Ground - Protected: Fully protected from the weather and other dampness, and well ventilated, e.g., wall framing with waterproof cladding.

(iv) Decking: Exposed to weather, clear of the ground and well ventilated, e.g., verandah, flooring, boardwalks, wharves.

(v) Cladding: Exposed to the weather and clear of the ground.

(vi) Internal Flooring: Fully protected from the weather. Consideration may need to be given to species hardness and toughness relative to the specific application.

(vii) Panelling: Fully protected from the weather.

(viii) External Joinery: Exposed to the weather (or not fully protected), e.g., external joint linings, joinery frames, window sills.

(ix) Internal Joinery: Fully protected from the weather, e.g., door jambs, mouldings, stair case material, railings.

Uses are indicated as follows:

O = commonly used

P = commonly used but preservative treated

S = commonly used but should be seasoned

Column 17 ***Availability****: This schedule provides guidance on availability. This will vary in local areas and with time. Specific advice should be sought from local Timber Advisory Services or timber suppliers.*

R = regular

L = limited

Preservative treatment of low durability species can make them suitable for weather exposed applications.

Other References

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8. *Wood and Wood Preservation*, A Complete Guide to the AS/NZS1604 Standards Series, Greaves, H., Standards Australia Handbook HB164-2002

For further information contact these timber organisations:

NATIONAL

National Association of Forest Industries
Forest Industries House
24 Napier Close
Deakin ACT 2600
Tel: 02 6162 9000
Fax: 02 6285 3855
Internet: www.nafi.com.au
Email: enquiries@nafi.com.au

Australian Plantation Products and
Paper Industry Council (A3P)
Level 3, Tourism House
40 Blackall Street
Barton ACT 2600
Tel: 02 6273 8111
Fax: 02 6273 8011

QUEENSLAND

Timber Queensland
500 Brunswick Street
Fortitude Valley QLD 4006
Tel: 07-3254 1989
Fax: 07-3358 1411
Email: admin@timberqueensland.com.au

NEW SOUTH WALES

Timber Development Association NSW Ltd
13-29 Nichols Street
Surry Hills NSW 2010
Tel: 02-9360 3088
Fax: 02-9360 3464
Email: showroom@tdansw.asn.au

VICTORIA

Timber Promotion Council of Victoria
320 Russell Street
Melbourne VIC 3000
Tel: 03-9665 9255
Fax: 03-9255 9266
Email: tpcvic@tpcvic.org.au

TASMANIA

Tasmanian Timber Promotion Board
Suite 22/11 Morrison Street
Hobart TAS 7000
Tel: 03-6224 1033
Fax: 03-6224 1030
Email: fiat@southcom.com.au

SOUTH AUSTRALIA

Timber Development Association of SA
113 Anzac Highway
Ashford SA 5035
Tel: 08-8297 0044
Fax: 08-8297 2772
Email: peter.llewellyn@bigpond.com

WESTERN AUSTRALIA

Timber Advisory Centre (WA)
Homebase Expo
55 Salvado Road
Subiaco WA 6008
Tel: 08-9380 4411
Fax: 08-9380 4477
Email: i.hearn@fifwa.asn.au