AUSTRALIAN

HARDWOOD & CYPRESS

TECHNICAL & DETAILING GUIDE

TECHNICAL & DETAILING GUIDE

…quality you can build on!

TECHNICAL & DETAILING GUIDE

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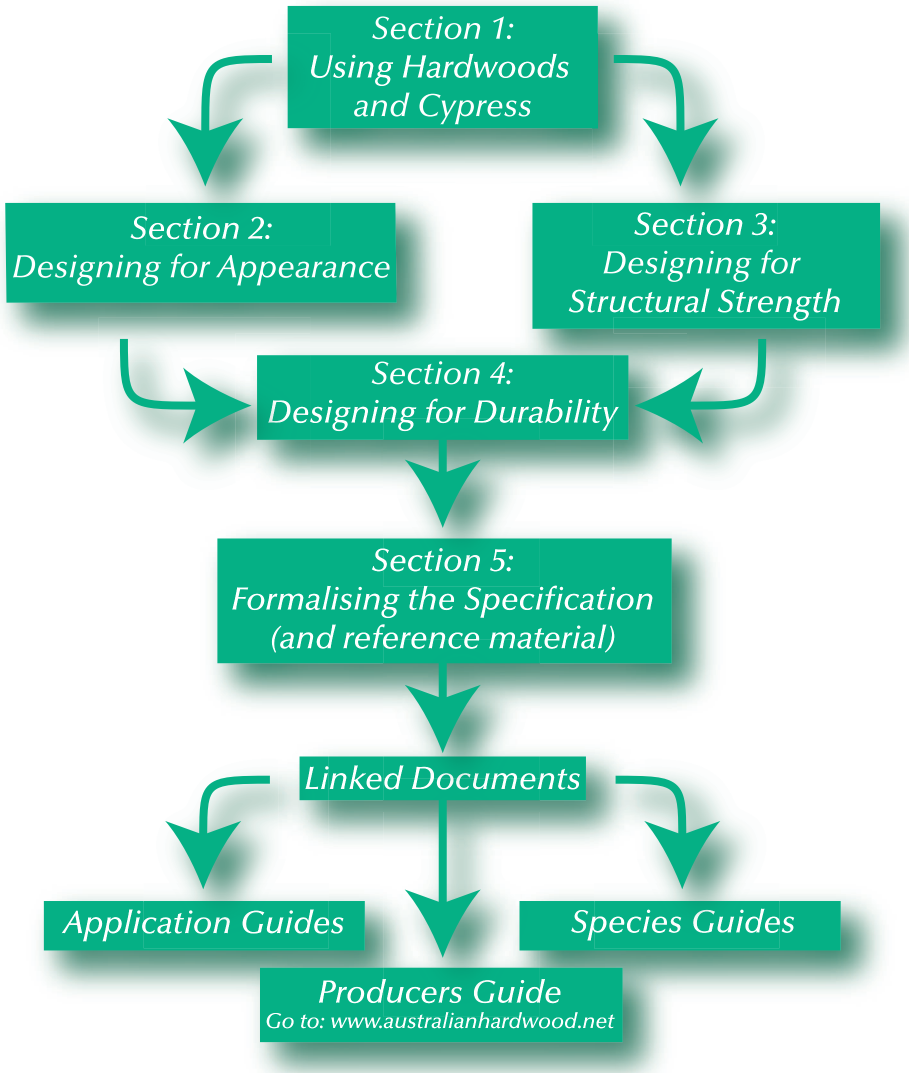
Introduction

Wood begins as a natural resource and passes along the production chain until it is converted into end user products. This guide describes common principles for specifiers to use in converting hardwoods and Cypress into appropriate end products. The content conveys themes that can be applied to building construction, interior design, fit-out, civil structures and landscaping. It will also benefit those who simply wish to learn more about the correct use of timber.

This guide acts as an over arching document which is to be read in conjunction with a series of linked technical guides for specific applications, such as flooring, decks, stairs and handrails, piles and poles, cladding, fit-out and furniture. It also links to information on different hardwood and Cypress species, and related timber producers.

The guide starts with basic principles of timber usage, then breaks into three streams. One dealing with using timber for its appearance, another dealing with structural applications, while the third deals with durability issues. The guide ends by detailing how to prepare a timber specification, and also contains regulatory references, a glossary of terms and a list of the previously mentioned link documents. The overall document structure is shown in Figure 1.

Figure 1: Information flow



1 Section One

Using Hardwoods & Cypress

Since timber is a natural material it is best to work with it, rather than against it.

This section looks at a few basic principles when using hardwoods and Cypress.

WHAT DO THE TERMS HARDWOOD & CYPRESS INCLUDE?

Hardwood and Cypress take in a huge range of species. Some are more commercially available than others, and in addition, some are only used in certain parts of Australia. Table 1 defines the main species, source and common applications.

Table 1: Types of Hardwoods and Cypress

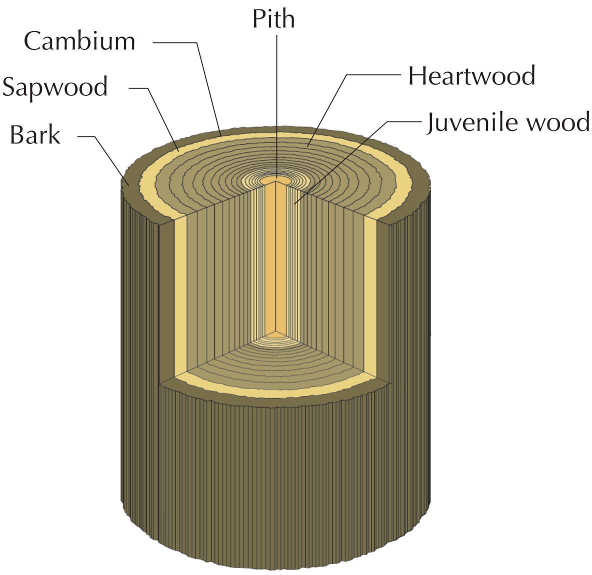
Common Name	Source	Common Applications
Ash, Alpine/Mountain	NSW, Tas, Vic	General framing, flooring, and panelling, joinery, furniture
Blackbutt	NSW, Qld	Poles, sleepers, general framing, decking, flooring, furniture
Brushbox	NSW, Qld	Heavy engineering, panelling, cladding and flooring
Coastal species (Bloodwood, Grey Box, Grey Gum, Yellow Stringybark, Red Mahogany)	NSW, Qld , Vic	Heavy engineering, marine structures, general framing , panelling, cladding, flooring, decking, poles, sleepers, piles, cross arms (refer to Species Guide referenced in Section 5 for specific details).
Cypress (softwood)	NSW, Qld	General framing, flooring, panelling, joinery, furniture
Flooded Gum	NSW, Qld	General framing, flooring, panelling, joinery, furniture
Ironbarks (Grey, Red)	NSW, Qld	Heavy engineering, marine structures, poles, boat building, general framing, flooring, decking, sleepers
Jarrah	WA	Flooring, joinery, panelling, sleepers, poles and piles, heavy engineering, general framing
Karri	WA	Flooring, joinery, panelling, plywood, sleepers, shipbuilding, heavy engineering, general framing
New England Blackbutt	NSW, Qld	Flooring, building general framing, joinery
River Red Gum	NSW, Vic, Qld	Heavy engineering, general framing, sleepers, flooring, panelling, joinery, furniture
Spotted Gum	NSW, Qld	Flooring, joinery, heavy engineering, general framing, piles, poles, sleepers, plywood, tool handles.
Sydney Blue Gum	NSW, Qld	Flooring, joinery, furniture, general framing and heavy engineering, cladding, panelling and boat building.
Tableland species (Brown Barrel, Manna Gum, Messmate, Silvertop Stringybark)	NSW, Vic, Qld	Protected construction applications, general framing, flooring, panelling, tool handles, joinery, furniture (refer to Species Guide referenced in Section 5 for species specific details)
Turpentine	NSW, Qld	Heavy engineering, marine structures and piling, ship building, sleepers, poles, general framing, panelling, cladding, flooring, decking
Tallowwood	NSW, Qld	Decking, flooring, general framing, heavy engineering, sleepers, marine structures, poles, piles, bridges
White Mahogany	NSW, Qld	Heavy engineering, poles, marine structures, boat building, general framing, panelling, cladding, flooring, decking

Note: For further information refer to the 'Species Guides' referenced in Section 5 of this document.

PARTS OF THE TREE

For any species, each passing year brings new growth rings in the tree trunk (refer to Figure 2). The centre of the tree is often referred to as the 'pith' and is rarely used except in poles, piles and where very large sections are required, e.g., girders. The heartwood (or truewood) is usually darker in colour, and extends from the centre (or pith) in the tree out to the sapwood. The sapwood is usually lighter in colour, and extends from the heartwood to the cambium layer. The sapwood is the living part of the wood, and conducts water and nutrients upwards from the roots to the leaves, and also acts as a storage area for sugars and starches. As the tree grows, the inner sapwood is converted to heartwood. Each has different properties relevant to construction applications.

Figure 2: Tree cross section



- Sapwood has lower natural decay resistance than heartwood, but where necessary can be boosted by adding preservative treatments,
- Sapwood and heartwood have similar strength and dimensional stability,
- Both heartwood and sapwood may co-occur in timber used for appearance and structural purposes, but in some applications sapwood may be removed or limited in content.

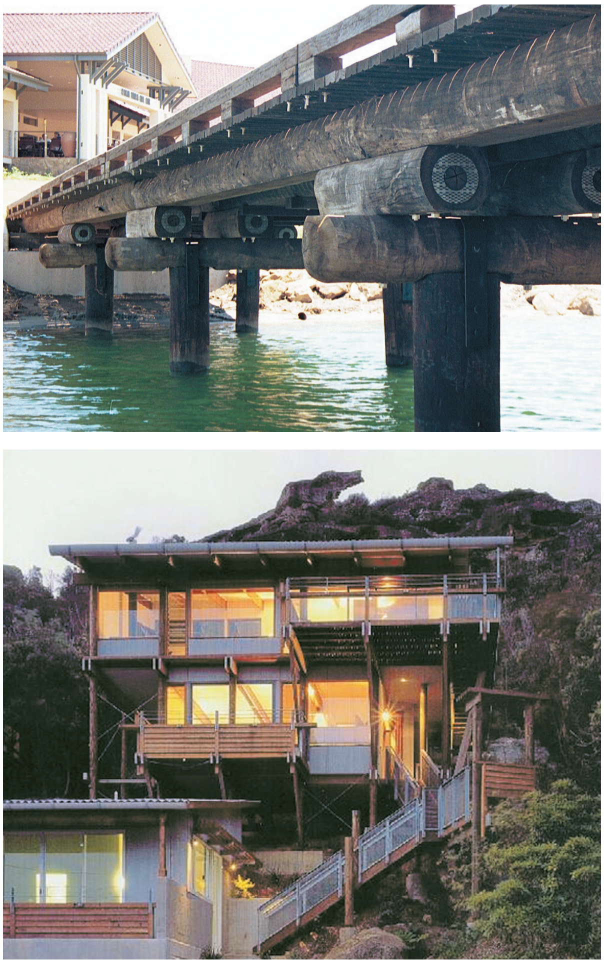
PROCESSING THE TREE INTO TIMBER PRODUCTS

The natural characteristics of timber place constraints on how it is used and offered to specifiers. Issues include sawing, milling, grading and quality control constraints.

Log Products

Log products involve the minimum amount of processing, and are commonly used for pole, pile or landscape applications. The sapwood of log products may be preservative treated to help meet durability requirements. This involves leaving the sapwood in place to accept preservatives, while in other instances – such as in power poles – sapwood is purposely removed (i.e 'de-sapped'). Basic types of log products are shown in Figure 3.

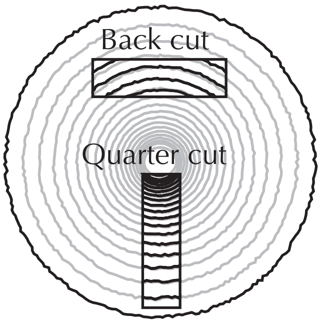
Figure 3: Types of log products



Sawn Products

Sawn products are produced by cutting logs into large slabs, then re-sawing these into smaller sections. There are two main categories – back-sawn and quarter-sawn sections (refer Figure 4) as well as a hybrid of the two. Each has a different effect on the way growth rings appear in the cut timber. As discussed later, this affects the appearance and manner of shrinkage in the timber. After sawing, joinery and visually exposed structural timbers are usually kiln dried and dressed to actual size. The same is true for lintel, truss and other framing elements requiring dimensional stability. Other framing timbers and certain types of cladding only require a 'sawn finish' (off the saw), and are generally unseasoned and nominally sized. Exceptions occasionally occur. Some unseasoned hardwoods and Cypress may be dressed when only partly seasoned. It is best to enquire with suppliers for specific products for intended applications.

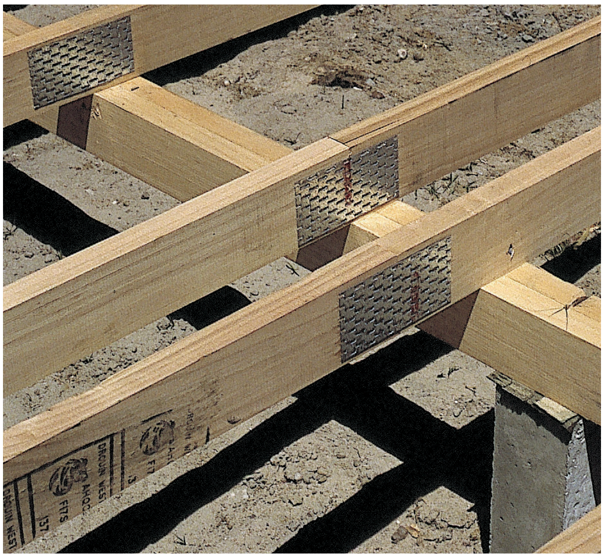
Figure 4: Types of sawn products



Nail Plated Timber

Nail plated timber makes greater use of small and short timber sections. They are mechanically joined to provide increased length or depth. The timber pieces are generally kiln dried and machined to size before plating. The process is carried out as a manufacturing operation to ensure the quality of jointing. As the nail plates are exposed, these elements are usually used for structures that are concealed from view. The nail plates may be affected by exposure to weather and should only be used in protected locations.

Figure 5:
Nail plated kiln dried, dressed products



Engineered Timber Products

Engineered timber products offer the most advanced usage of raw timber. A common example is glue laminated beams which use small timber sections glued together as shown in Figure 6. The benefit of this approach is that natural imperfections in the timber can be significantly reduced – creating a stronger, straighter, and more stable product – compared to sawn timber. In addition, large beams can be produced to suit standard or customised structural situations. For instance, beams can be produced with curves, tapers and cambers to suit specific needs. Advanced elements include portal frames and arches.

Figure 6: Glue laminated engineered timber products

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Sheet Timber Products & Veneers

Sheet timber products and veneers take a different approach to utilising the raw material. Plywood and decorative veneers are made by peeling or slicing logs. Peeling is usually for structural purposes and slicing for decorative applications. Plywood production involves gluing layers on top of each other until the desired thickness is achieved. The knots and other imperfections are isolated into single veneers rather than continuous as per a solid product. The grain of each veneer is run in a perpendicular direction to adjacent layers. This creates strength in both length and width. Uses are mainly for formwork and decorative flooring. Decorative veneers have multiple fit-out and furniture uses, and are often overlaid on plywood or medium density fibre board.

Another sheet application is hardboard. It is made of fine hardwood fibres held together with natural lignin from the wood – applied under heat and pressure. It is commonly used for cladding, bracing and is also used for linings (especially where sheets are perforated to reduce noise).

MANAGING MOISTURE, SEASONING AND SHRINKAGE

Moisture management is used to minimise shrinkage and movement in the timber. For instance, when wood comes from a newly felled tree it is virtually saturated with water. As moisture leaves the wood it influences strength, dimensional stability, stiffness, hardness, abrasion resistance, machineability, insulation value, resistance to decay and nail holding ability.

Measuring Moisture

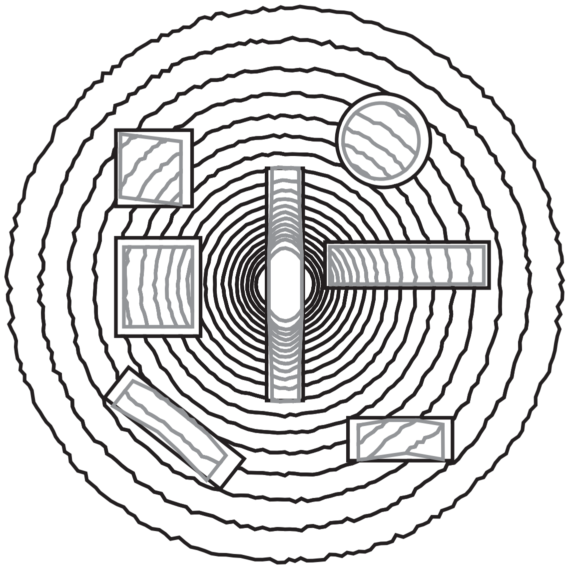
In managing moisture it is necessary to be able to measure moisture levels. Moisture content is described in terms of the weight of water contained in the wood expressed as a percentage of oven-dried wood weight. Key levels of moisture content are linked to simplified terms such as 'seasoned' and 'unseasoned' timber. Seasoned timber relates to low levels of moisture content, less than or equal to 15%. This approximates the equilibrium moisture content (EMC) of most timber. EMC is the moisture level that the timber wants to stay at once it has dried out and acclimatised to its environment. Timber with a moisture content higher than 15% is regarded as unseasoned or green.

Shrinkage and Seasoning

Timber should be specified as being seasoned or unseasoned for installation purposes. This decision is very important since seasoned timber is generally stronger than unseasoned timber – all other things being equal. Unseasoned timber is also less dimensionally stable due to the effects of potential shrinkage. Shrinkage is where wood fibres move closer together causing distortion of the three dimensional features of timber. This only occurs once the timber dries out to fibre saturation point – a point between 25–35% moisture content that varies for each species. Longitudinal shrinkage is very small and generally disregarded; radial shrinkage is about 2 to 7%; while tangential shrinkage is generally up to twice this amount, at 4 to 14%. When this amount of shrinkage takes place in an uncontrolled way, the risk of splitting in timber increases significantly. In addition, there is the risk of shape distortion, as shown for typical cuts of timber in Figure 7.

Figure 7:

Effects of shrinkage on common cuts of timber



Timber species with high shrinkage (e.g. New England Blackbutt, Messmate, Mountain Ash, Silvertop Ash and Turpentine) require greater care if being used in an unseasoned state. Applications where any radial and tangential shrinkage may have significant impact such as flooring, panelling, some cladding, mouldings, furniture and joinery, require timber to be seasoned prior to use. Unseasoned timbers can be used in other applications but this involves a value judgement and creates the need for careful detailing and attention to expected shrinkage rates.

Detailing Unseasoned Timber

Show care where:

- materials with different shrinkage characteristics are combined, e.g. unseasoned timber next to seasoned timber or non-timber products, end grain next to cross grain;
- large timber sections are involved;
- multiple stacked timber members e.g. joists on top of bearers;
- large timber areas are involved e.g. flooring, cladding;
- clearance needs to be provided relative to brick veneer walls i.e. at lintels, eaves lining, window sills and floor framing;
- multi-storey construction causes combined shrinkage i.e. where each floor may add to the overall effect;
- shrinkage affects fire resistant construction e.g. at gaps in walls.

Further perspective of the effects of shrinkage on unseasoned timber is shown by the figures in Table 2.

Seasoning Issues

The seasoning process also requires care to manage the effects of shrinkage. The surface dries first while the interior remains wet and above fibre saturation point. As a result, the interior remains in its expanded shape while the surface shrinks – causing checks and cracks. Large sections are most affected. In addition, ends offer the highest risk as water can enter and leave the timber more readily, which may result in large amounts of differential shrinkage. The problem is increased where the addition of some water borne preservative treatments create the need for secondary seasoning. The problem can be remedied or minimised by good seasoning practices, however there is a concurrent need for designers to acquaint themselves with what is realistic – especially where large, treated sections are concerned.

Statutory and Regulatory Seasoning Requirements

Timber producers are obliged to meet standards and statutory seasoning requirements. If nothing is specified, then statutory requirements take precedence e.g. the 'NSW Timber Marketing Act' and the 'Queensland Timber and Utilisation Marketing Act'. In the absence of a specified moisture content, these acts require seasoned timber to fall within a moisture content range of 10 – 15%. If building standards or architectural requirements are written into specifications, then less rigid requirements may prevail (i.e. as per provisions in respective Acts). For instance AS2082 calls for 90% of a parcel of timber to be 15% moisture content or less, but no individual piece can be more than 18%. In addition, moisture content is specified for specific applications, as detailed in Table 3.

Table 2: Typical shrinkage in Hardwood and Cypress framing

Member	Depth (mm)	Typical Shrinkage (mm)		
		Unseasoned Hardwood	Unseasoned Cypress	Seasoned Hardwood/Cypress
Lintel	1 at 250	20	10	0
Plates (top and bottom)	2 at 45	7.2	3.6	0
Floor Joists	1 at 100	8	4	0
Floor Bearer	1 at 100	8	4	0
Total shrinkage		**43.2**	**21.6**	**0**

Notes: 1. Shrinkage rates = 8% for unseasoned Hardwood; 4% for unseasoned Cypress (source: AS1684).

Table 3: Moisture content for different applications

Application	MC Range Hardwoods	MC Range Cypress
Strip flooring	9 to 14%	10 – 15
Parquet flooring	8 to 13%	10 – 15
Light decking	10 to 18%	10 – 15
Lining boards	9 to 14%	10 – 15
Dressed boards, joinery and Moulding	9 to 14%	10 – 15
Cladding, Fascia and Barge Boards	10 to 14%	10 – 15

Notes: 1. Cladding may have higher moisture content where the profile allows for shrinkage.
2. Source: AS2796.1/AS1310.

Seasoning Requirements for Specific Service Environment

Seasoning requirements only approximate the equilibrium moisture content on-site. Each environment is different and so some adjustment may be necessary to get the best result – especially where appearance is important. In such instances conditioning of the timber before installation to limit the chances of movement may be necessary. Different service environments should also be considered – especially air humidity. Humidity changes for coastal and arid environments, interior and exterior environments, air conditioned or heated environments. Each of these will change the stability of moisture in the timber.

Generally the moisture content of timber products such as flooring should be approximately suited to 'normal' environments. If they are not suited to normal conditions or the conditions on-site are unusual, then they should be acclimatised to the expected in-service equilibrium moisture content level before installation. This may mean that timber products are conditioned on-site before fixing. For instance, it is not uncommon for floor fixers to leave timber appropriately stacked on-site for three or more weeks prior to fixing.

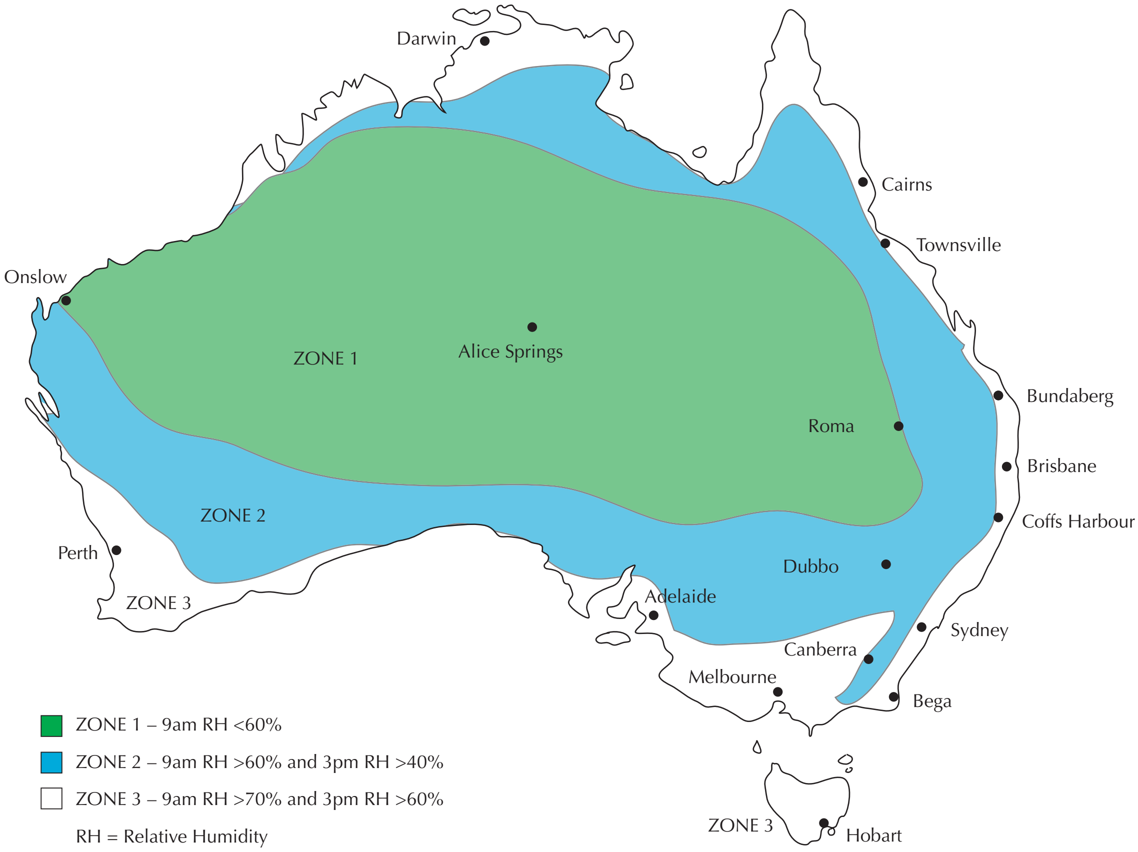
Another approach, although rare, is to predict the EMC prior to taking the timber to site (e.g. condition it at the timber manufacturer's premises). To assist, Table 4 provides the average moisture content for coastal, inland and air-conditioned environments. In order to determine which applies to your situation refer to Figure 8 which shows three climate zones. 'Inland' refers to Zones 1 and 2, while 'coastal' refers to Zone 3. Specifiers must be mindful that the figures derived from Table 4 are still approximate because humidity is constantly changing in the distinct micro-climate of each service environment. Some degree of moisture induced shrinkage (or swelling) is hard to avoid – even if only due to seasonal climate change. The only tool for dealing with such movement is to limit restraint of the timber in-situ – thus allowing freer movement. Movement joints or specialist connectors can be integrated into the construction to achieve this result.

Table 4: Seasoning for specific environments

Zone	Outdoor Av. E.M.C. (%)	Indoor Av. E.M.C. (%)
Coastal	14	12
Inland	11	9
Air-conditioned	–	9

Notes: 1. The moisture content values for air-conditioned and heated situations are appropriate regardless of the zone location.
2. E.M.C. zones do not bear the same significance to farming timbers as appearance or feature products.

Figure 8: Climate Zones based on relative humidity



2 Section Two

Designing for Appearance

Timber has natural appeal that makes it a sought after material – especially for joinery, furniture and interior design purposes. Australian hardwood and Cypress offer a truly unique, interesting and beautiful appearance. This section of the guide helps designers utilise colour, grain, texture, knots, sawing patterns, natural features and decorative finishes.

COLOUR

Colour is arguably the first thing to consider when selecting timber for appearance. It is best to think in terms of basic colour groups such as blond, brown, red and yellow, then choose an individual species that meets these criteria. Table 5 shows common species grouped according to basic colour categories. These categories are based on common heartwood colours rather than the lighter and less used sapwood. Some degree of variation still exists within the heartwood and so Table 5 is a guide only. Variation can be balanced by grading timber during installation. This provides a more consistent overall appearance compared to randomly placed pieces but requires greater attention to workmanship. Another issue is that timber changes colour slightly on the surface during its serviceable life. Sunlight has a bleaching effect on dark colours and a yellowing effect on blond colours. Weathering has an additional effect on unprotected external timbers causing them to ultimately turn silvery grey in colour. Care should be taken in the selection of applied timber finishes to manage these effects.

GRAIN AND TEXTURE

Grain refers to the direction, size and arrangement of fibres in the timber. Different species have different grain patterns and this can transform appearance. In generic terms, grains can be described as: straight, sloping, spiral, interlocking, irregular and wavy grains, and may be accentuated by the type of cut used when sawing the timber (i.e. back sawing or quarter sawing).

Texture is associated with grain, and refers to whether the wood is coarse, fine, even or uneven. Much of this is related to the size and arrangement of the wood cells. Such features tend to be important when viewing the timber at close range. For details on grain and texture of individual species, refer to the Species Guide as referenced in Section 5 of this document.

Table 5: Species colours

Colour	Species
Blond	Ash (Silvertop, Mountain and Alpine), Blackbutt, Messmate, White Mahogany
Brown	Brown Barrel, Brushbox, Grey Box, Manna Gum, New England Blackbutt, Spotted Gum, Stringybark (Yellow, Red, Silvertop), Grey Ironbark
Yellow	Cypress, Tallowwood
Red	Forest Red Gum, Flooded Gum, Grey Gum, Red Ironbark, River Red Gum, Sydney Blue Gum, Turpentine, Red Mahogany, Bloodwood

NATURAL FEATURES

Natural features come from branches and irregularities in the tree, and affect the finished appearance of timber. They include things like knots, gum veins, checks and pin holes. If there is a desire to limit or control natural features, then the appropriate grade of timber should be specified. For hardwoods, this includes options such as: select, medium feature and high feature grades – as defined by AS2796.2. For Cypress this includes Grade 1 and 2 – as defined in AS1810. These grades objectively define the number, type and spacing of knots and imperfections. As an example, variation in grades for hardwoods are shown in Figure 9 and summarised below:

Select Grade – (SEL)

- permissible features: small holes and small tight knots,
- not permitted: enclosed termite galleries, shakes, splits, decay, loose knots, gum pocket, narrow gum veins, want, wane or mechanical damage and non natural stains or sticker marks.

Medium Feature Grade – Standard (MF)

- permissible features: tight knots, small holes, tight and loose gum veins, limited gum pocket and checks,
- not permitted: enclosed termite galleries, shakes, splits, decay, want, wane or mechanical damage and non natural stains or sticker marks,

High Feature Grade – (HF)

- permissible features: knots, holes, tight and loose gum veins, limited gum pocket and checks,
- not permitted: enclosed termite galleries, shakes, splits, decay, want, wane or mechanical damage and non natural stains or sticker marks.

Before selecting a grade it is useful to compare the relative features expected in each species. Some are more prone to knots, holes, gum veins and insect attack, than others. This can be explored by referring to the Species Guide referenced in Section 5.

Figure 9: Various appearance grades in hardwood

Select

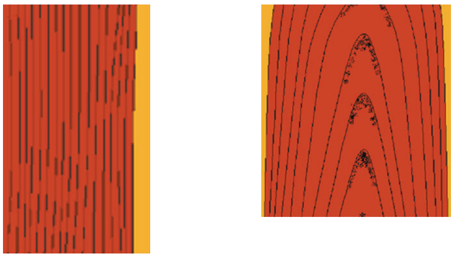
Medium Feature

High Feature

SAWING PATTERNS

Sawing patterns represent another factor influencing appearance. Logs are sawn according to practical and economic necessity. Though this tends to dictate what is available in the market, each sawing pattern adds a different appearance to the grain. For instance back sawing expresses growth rings in the wide face of the wood, while quarter sawing shows growth rings in the narrow face (refer Figure 10). If necessary inquire with suppliers about what to expect for different species

Figure 10: Features attainable via different saw cut methods



Quarter sawn   Back sawn

SIZES AND AVAILABILITY

Sizes of dressed timber are influenced by availability. Many are derived from structural or rough sawn sizes which are then re-processed for dressed timber usage (Note: stress grade branding is usually lost during re-processing, which is permitted by State regulations as long as appropriate arrangements have been made between the supplier and purchaser).

Machined thicknesses include 20, 35 and 45mm options. The latter is limited in supply due to the time and difficulty in seasoning high density hardwoods. Lamination offers a practical alternative. Widths include 65, 90, 140, 190, 235 and 285mm (depending on species). Widths greater than 140mm are also limited in supply because of the lack of appropriate quality logs. Tolerances for thicknesses and widths vary depending on shrinkage and recovery rates from rough sawn sections – sizes 1–2mm smaller than the above may occur. Lengths are available in 300mm increments but 100mm increments may be available for short lengths (e.g. less than 2.4m).

Large orders require lead time for preparation. Special runs may also be possible for unusual or large section sizes. In addition, sheet veneer products are available to use in conjunction with the above from specialist stockists. It is recommended that producers be contacted for details about sizes and availability (refer to the Producers Guide referenced in Section 5).

INTERNAL TIMBER FINISHES

Timber finishes provide the final influencing factor to the finished timber appearance. Finishes for internal uses can be classified as clear polyurethanes, oils and stains.

Polyurethanes create a clear film over the timber in satin, semi gloss and gloss sheen levels. Lower levels of sheen (satin) help hide imperfections in the flatness of large areas such as floor boards. In contrast high gloss has the opposite effect due to increased reflectivity. Even so it allows easier cleaning and there is less likelihood of mould growth caused by the condensation of steam, fats and oils which occur in kitchens and wet areas. All gloss levels can be formulated to have anti-yellowing agents to prevent the discolouring brought about by long term exposure to ultra-violet light. (Note: only light coloured timber species are noticeably affected). Clear finishes can also be formulated to provide various levels of impact resistance and therefore some are more applicable than others where high traffic usage is involved (e.g. floors).

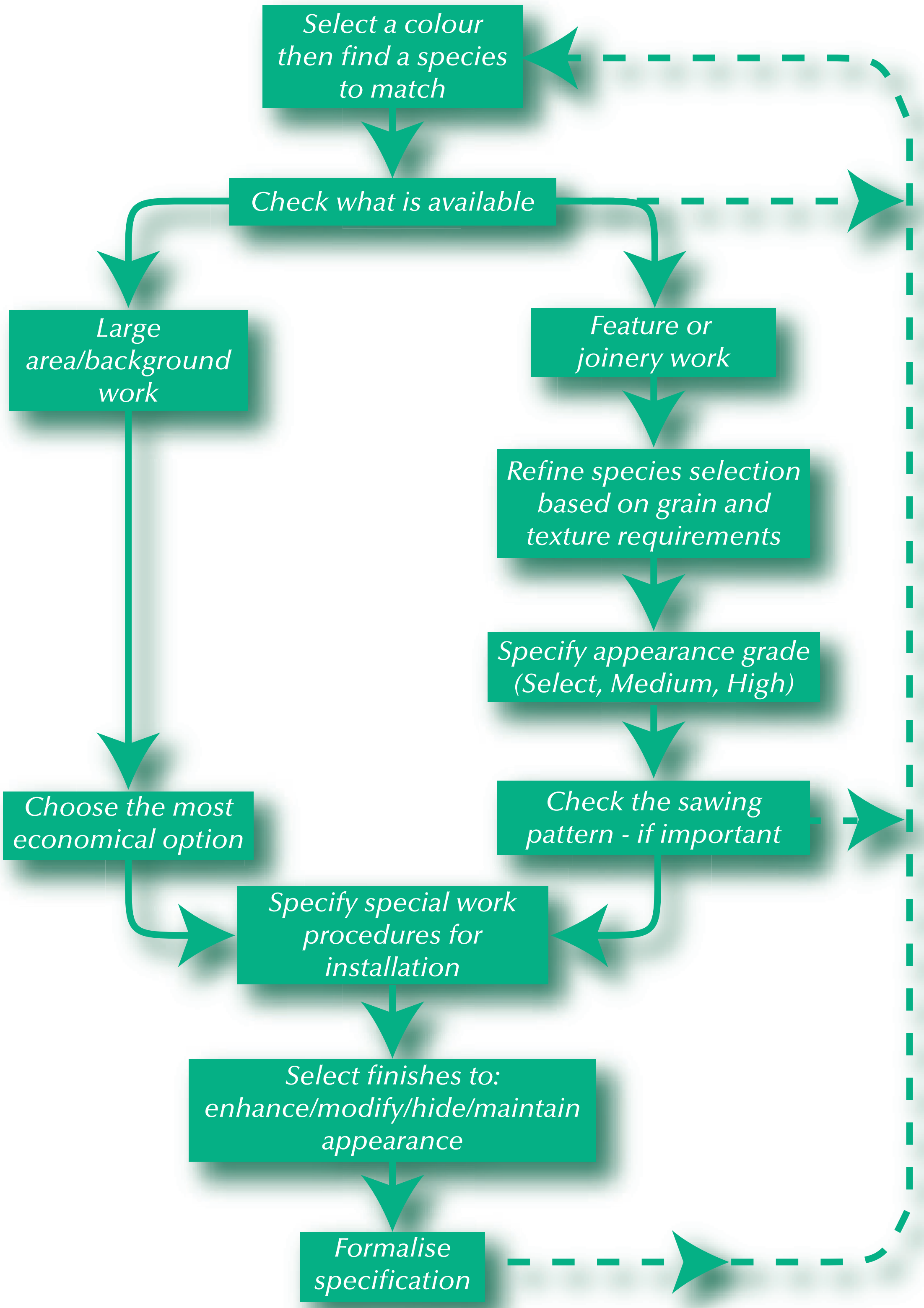
Oils differ from clear finishes as they soak into the timber and therefore lose the features associated with a protective film. They also tend to create a different appearance by looking more natural and creating a flat lustre.

Stains are similar to oils in the way they soak into the timber and provide a relatively flat, unsealed appearance. Perhaps the main difference is that stains have a colouring agent that aims to tint the natural timber to provide an altered appearance. It is also possible to use stains in conjunction with clear finishes where the latter is used to provide gloss and a protective film over the stain.

CHECKING YOUR APPEARANCE SELECTION

Checking the previously discussed timber selection factors is perhaps best summarised in the flow chart shown in Figure 11. Its aims is to ensure all appropriate factors are taken into account for different specification scenarios.

Figure 11: Process for selecting timber for appearance



3 Section Three

Designing for Structural Strength

Hardwoods and Cypress have been used since early settlement in Australia for all types of structures. They have proven to be sustainable and readily available resources. Design principles have now developed to deliver highly adapted products. Hardwoods and Cypress offer strength, fire resistance and natural durability. Careful design and detailing can optimise these properties in structures as discussed in this section of the guide.

STRUCTURAL PROPERTIES AND GRADING

When considering structural properties it is important to realise there are many commercially available species. Strength varies for each depending on whether it is tested in the longitudinal, tangential or radial axes. The timber industry has simplified these variables by developing a system of timber stress grading. Stress grades give an indication of strength 'in bending'. The process of grading begins by identifying a timbers 'strength group' which clusters species of similar strength together (e.g. based on modules of rupture and elasticity). 'Structural grades' separate the strength groups into smaller groups to deal with reduced strength through natural imperfections in the tree. From this, a stress grade is assigned (signified by an 'F' for sawn timber or 'GL' for glue laminated timber). Twelve grades exist, and those relating to hardwoods and Cypress are shown in Table 9. These grades are utilised by structural designers to assess the capacity of elements to perform in given applications (with the assistance of AS1720.1).

Approaches to Stress Grading

Grading can be carried out at any stage in the chain of production, e.g. on logs, unseasoned or seasoned sawn timber. It can be carried out in any one of the following three ways, according to need and circumstance.

Visual grading

Visual grading involves a trained 'grader' who first identifies the timber strength group, then looks for characteristics that influence structural grade, then assigns a stress grade. The two main guiding documents for this are: AS2082 (for hardwood) and AS2858 (for Cypress).

Machine Grading

Machine grading utilises a computer controlled machine that measures the stiffness of timber. This can be directly correlated to strength where upon a grade is assigned. Individual pieces are fed into the machine in a longitudinal direction, which continually deflects the timber by a given load. Stress grades are assigned based on the measured stiffness. The main guiding document for this method is AS1748.

Proof Grading

Proof grading allocates a stress grade based on a piece of timber being able to sustain a specific proof bending stress. The proof stress is generally 2.2 to 2.4 times the actual design stress. The main guiding document for this method is AS3519.

Grading in Practice

Machine grading is useful where economies of scale and the characteristics of the timber permit. It allows grading to take place as an in-line part of the milling process and is less reliant on human error. Even so, machine grading is sometimes hard to undertake on high strength hardwoods – the machines have difficulty bending the timber. In addition, machines cannot check for decay and susceptibility to the Lyctus borer. As such it is not necessarily the most efficient approach and so visual grading is still common. Table 8 provides an account of common methods and commonly available stress grades for Cypress and hardwoods (seasoned and unseasoned).

Table 6: Stress grades for hardwoods and Cypress

	Seasoned Hardwoods	Unseasoned Hardwoods	Cypress
Common stress grades	F17 and F27	F14 and F17	F4 and F5
Occasional achievable stress grades	F34	F8, F11 and F22	F7
Common grading method	Visual	Visual and Proof	Visual and Proof

SIZES AND AVAILABILITY

There are standardised sizes for structural timber which serve to assist design, production, pricing and quality control requirements – sizes are presented in Tables 7, 8 and 9.

Table 7: Sizes for seasoned hardwood

Dimension mm	70	90	120	140	170	190	240
35	✓	✓	✓	✓	✓	✓	✓
45	✓	✓	✓	✓	✓	✓	✓

Notes: 1. Commonly available sizes – marked ✓.
2. Lengths are generally available in 0.3 m increments, up to 6 m; Longer lengths may be available where structurally joined with nail plates.
3. Tolerances +2, -0mm.
4. 70 and 90mm widths are generally made up by vertically nail laminating. Structural and ????? applicable.
5. Preservative treatment branding on each piece of timber.
6. 270 and 290mm limited availability.
7. 45mm is of lower availability.

Table 8: Sizes for unseasoned hardwood

Dimension mm	50	75	100	125	150	175	200	225	250	275	300
25	✗	✗	✗	✗	✗	✓	✗	✓	✓	✓	✓
38	✗	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗
50	✗	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗
75	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
100	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗

Notes: 1. Commonly available sizes – marked ✓;
Additional sizes usually available on order – marked ✗.
2. Lengths are generally available in 0.3m increments, up to 6m readily available; 6 to 6.9m frequently available; 6.9m and over – check with supplier.
3. Tolerances for lengths up to 6 m long and up to 200mm in width: ±3mm. For lengths over 6m long, increase tolerances by one-third.
4. Posts – 125 x 125mm and 150 x 150mm are also available.
5. Sized or gauged timber tolerances: +2, -0mm.
6. Preservative treatment branding on each piece of timber where applicable.

TECHNICAL & DETAILING GUIDE

Table 9: Sizes for unseasoned Cypress

Width mm	75	100	125	150	175	200	225	250
38	✓	✓	✓	✓	✗	✗	–	–
50	✓	✓	✓	✓	✓	✗	✗	✗
75	✓	✓	✓	✓	✓	✗	✗	✗
100	✓	✓	✗	✗	✗	✗	✗	✗

Notes: 1. Commonly available sizes – marked ✓
Additional sizes usually available on order – marked ✗.
2. Lengths are generally available in 0.3m increments, up to 6m readily available; over 6m – check with supplier.
3. Tolerances for lengths up to 6m long and up to 200mm in width: ±3mm; up to 6m long and over 200m in width: +9, -3mm; over 6m long tolerance increased by one-third.

SPAN TABLES

Stress grades and timber sizes combine to determine the spanning ability of load carrying members. Span tables allow users to choose an appropriate size and stress grade to achieve spanning needs. For simple construction – such as domestic construction – this can be determined from span table supplements in AS1684.2 and AS1684.3. For multi-unit residential construction, span tables can be down loaded from the National Timber Development Council web site www.timber.org.au/mrtfc. For decks, stairs, handrails and balustrades, refer to the application guides referenced in Section 5 of this document, to obtain specific span tables. For other load conditions, spans can be determined from proprietary computer programs commonly used by timber producers.

TIMBER JOINTS & CONNECTORS

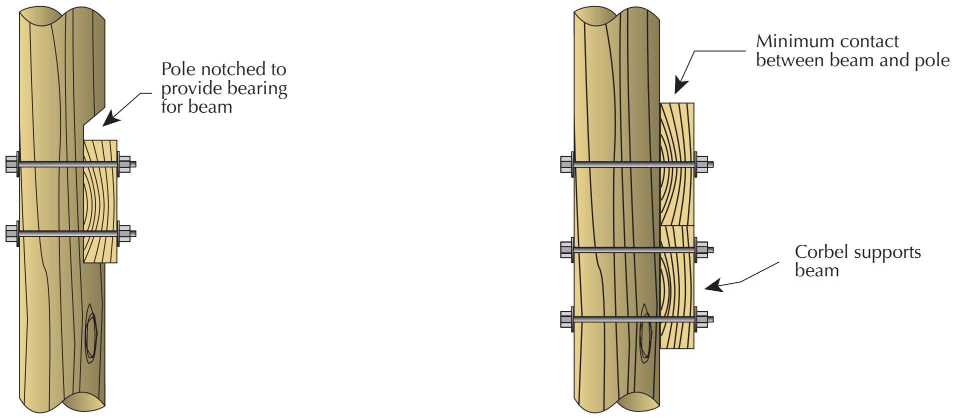
Timber must be able to make strong joints as well as having strong spanning ability. This is determined by strength developed parallel or perpendicular to grain. If one direction is weaker than the other then joint strength is reduced. Splitting may occur if connectors are placed too close to the edge or too close to each other. The Species Guide referenced in Section 5 of this document advises on the 'joint group' to which each species belongs. This is a measure of the timbers ability to hold fasteners and bear joint loads. For domestic construction AS1684 advises on connector arrangements for various joint groups in standard framing situations. In other instances, joint group information must be used in conjunction with AS1720.1 and structural engineering principles, to confirm jointing and connector requirements.

Choosing an Efficient Connector between Timber Members

An efficient connector maximises structural performance, minimises cost, and minimises installation effort. Many small connectors spaced close together – such as nails – are generally more efficient than fewer large connectors spaced further apart – such as bolts. In addition, nails have the added benefit of being fast to install, especially when used with a nail gun and nailing template.

Connector efficiency can also be aided by the design of the timber joint. For instance, beams that bear directly onto columns are more efficient than cleat joints. If a cleat joint can not be entirely avoided then the derivation shown using a corbel support is preferable (refer Figure 12).

Figure 12: Typical structural connections



Types of Connectors

An advantage of timber is its ability to make use of a wide range of connectors, including nails, spikes, screws, bolts and nail plates.

Nails

Nails are the most common form of mechanical fasteners used in construction. There are many types, sizes and forms. When using nails, the number, spacing, depth of penetration, pull out strength, and resistance to lateral movement, influences overall connection strength. Nail options include bullet head, flat head, hardboard, wallboard, fibre cement, clout and plasterboard nails – as shown in Table 10. Different types of corrosion resistant materials can be matched with certain nail types including stainless steel, silicon bronze, monel and galvanised coating. Nails have a tendency to split timber when being driven, and the use of blunt or chisel headed nails may alleviate the problem, as will pre-drilling of kiln dried timber. The metal in some nails can react with the extract from timbers, forming stains. For instance, uncoated steel nails can cause black stains while copper can produce green stains. To avoid this problem, galvanised nails are recommended.

Screws

Screws are commonly classified by head type and by the method of drive. They are mainly used for light to medium scale structural situations. They offer superior pull-out strength compared to nails but take longer to install. In recent years self drilling screws – especially Type 17 screws – have made installation faster. Types include countersunk, raised counter sunk, round head hexagon, washer head – as shown in Table 11.

Screws are manufactured from low-carbon steel, brass and stainless steel. The latter two are often used for highly corrosive environments. An alternative is to make use of hot-dip galvanising. Yet another alternative – for low corrosion risk situations – is electroplating in either zinc, zinc–chrome, cadmium nickel or chromium.

Bolts

Bolts function by bearing on the surface of the timber and the shearing action within the bolt itself. Common types are shown in Tables 12, and in most instances should be accompanied with washers. Common washer sizes for timber are shown in Table 13.

Bolts are commonly used to fix large timber members together, or timber to steel. Coach screws are used for slightly lower strength situations and are essentially heavy duty screws but are sized similar to bolts. They are useful where nuts cannot be placed onto bolts and are only suitable for timber to timber joints, or steel to timber joints.

Bolts can also be used to attach timber to concrete or masonry. This is typically through the use of special masonry or chemical anchors. Here no nuts are used on the end in the concrete or masonry. Instead the bolts rely on friction or adhesion to the substrate. Care is required to make sure the anchor strength is sufficient to resist pull out loads. In addition, washers at the bolt heads must be large enough to prevent timber fibres from crushing when exposed to pull-out loads.

In general, bolts and coach screws are made from low-carbon steel, and in some instances brass or stainless steel. The choice is often driven by the need for corrosion resistance. Where steel is used, this can be improved using hot-dip galvanising and electro-plating.

Table 10: Nail selection guide

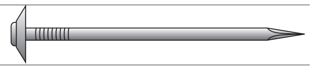
Type	Application	Illustration
Bullet Head Nail	Timber framing and general finishing	
Flat Head Nail	Metal connectors, containers and softwood framing	
Hardboard Nail	Hardboard fixing	
WallBoard Nail	Wallboard fixing	
Cement Sheet Nail	Cement sheeting	
Flex Sheet Nail	Galvanised sheeting, other flexible sheeting	
Soft Sheet Nail	Low density materials, e.g Plastics	
Clout	General fixing of thin sheets, not recommended for structural connectors such as framing anchors	
Plasterboard Nail	Plasterboard fixing	
Decking Spike	Timber deck fixing	
Duplex Nail	Concrete framework can be withdrawn	
Roofing Nail	Fix galvanised roof or wall sheeting (non-cyclonic areas only)	
Fencing Staple	Fix fencing wire	

Table 11: Screw selection guide

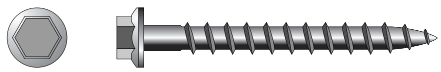
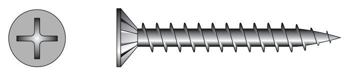
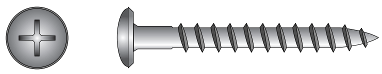
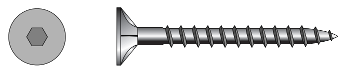
Type	Application	Illustration
Hexagon Washer Head external hexagon drive	Roof sheet fixing. Used with neoprene washer under head	
Countersunk Head cross-recessed drive	General fixing in wood to wood connections	
Wafer Head cross-recessed drive	General fixing of proprietary metal fastener to wood connections, where roof sheeting rests on fasteners	
Bugle Head cross-recessed and hexagonal recessed head	General fixing in wood to wood connections where uplift may be severe	

Table 12: Bolt selection guide

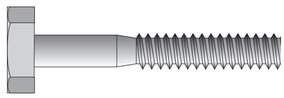
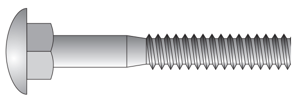
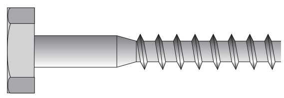
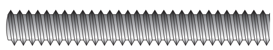
Type	Application	Illustration
Hexagon Head Bolt	General structural purposes	
Cup Head Bolt	Occasional structural purposes where head must be flush with surface	
Coach Screw	Used to replace bolts where nut is inaccessible or to improve appearance	
Threaded Rod	Applications where it is difficult to specify bolt length beforehand, e.g tie-down rods, pole construction and cross-bracing	

Table 13: Washer selection guide

Bolt	Washer Size		
	Thickness (mm)	Round Washer Minimum Dia. (mm)	Square Washer Min. Side Length (mm)
M8	2.0	36	36
M10	2.5	45	45
M12	3.0	55	55
M16	4.0	65	65
M20	5.0	75	75

Note: Source: AS1720.1

ADDING TIMBER SIZE TO INSULATE AGAINST FIRE

Fire confronts the performance attributes of any structure. Many people do not realise that large solid timber sections perform well in fires – even better than steel. Timber chars slowly which has an insulating effect on the unburnt timber beneath. This makes it possible to design timber to resist burning or collapse for a given period of time. For instance, the rate of charring and hence the rate of reduction of load carrying capacity due to loss of cross section, can be calculated. As a result it is possible to design slightly larger members in order to resist fire. The need for this depends on the class of building as defined in the Building Code of Australia (it tends to be unnecessary for many residential buildings). The means for establishing the additional size required for charring is determined using AS1720.4 which addresses fire resistance for structural timber members. For instance, by substituting appropriate values into the equations below, the residual cross section for construction elements can be calculated with sufficient accuracy to meet the compliance requirements of the BCA (refer Specification A2.3 Clause 3).

Notional Charring Rate

$$C = 0.4 + (280/D)^2$$

where **C** = notional charring rate, in millimetres per minute (mm/min)

and **D** = timber density at a moisture content of 12% in kilograms per cubic metre (kg/m^3)

Note: species of higher density char more slowly (i.e. reduction in charring is roughly inversely proportional to increase in density)

Effective Depth of Charring (in millimetres)

$$dc = Ct + 7.5$$

where **dc** = calculated effective depth of charring in millimetres (mm)

and **C** = notional charring rate in millimetres per minute(mm/min) as calculated

and **t** = period of time, in minutes (min)

Note: The effective depth of charring will depend on the number of faces of the member exposed to the fire – 1, 2, 3, or 4. If all faces are exposed, then charring depth must be added to all faces of the structurally required cross section size.

Sample: Calculation to determine the size of a 60/–/– FRL Blackbutt post

Step 1: Determine the size of the post required to support the floor using timber design methods in AS1720.1. Reference to AS1720.4 (Clause 2.8) may also be useful as it defines 'fire limit state' load conditions. This state may allow lower load conditions than when a fire is absent. As a result, the increase in timber size for charring may go part/full way to meeting sizes requirements for normal load conditions. Say a 55 x 55mm post is required for the example.

Step 2: Determine the notional rate of char for Blackbutt.

Species: Blackbutt – Density @ 12% M.C. = $900 kg/m^3$

$$\text{Notional charring rate } C = 0.4 + \frac{(280)^2}{(\text{Density})}$$

$$= 0.4 + \frac{(280)^2}{(900\ )}$$

$$= 0.5 mm/min$$

Step 3:

Charring depth for 60 minutes. = $Ct + 7.5$

$= (0.5 \times 60) + 7.5$

$= 0.4 + (280)^2$

$= 30 + 7.5$

= 37.5mm each side (assume all sides effected).

Step 4:

Size of column required = 55 + 37.5 + 37.5

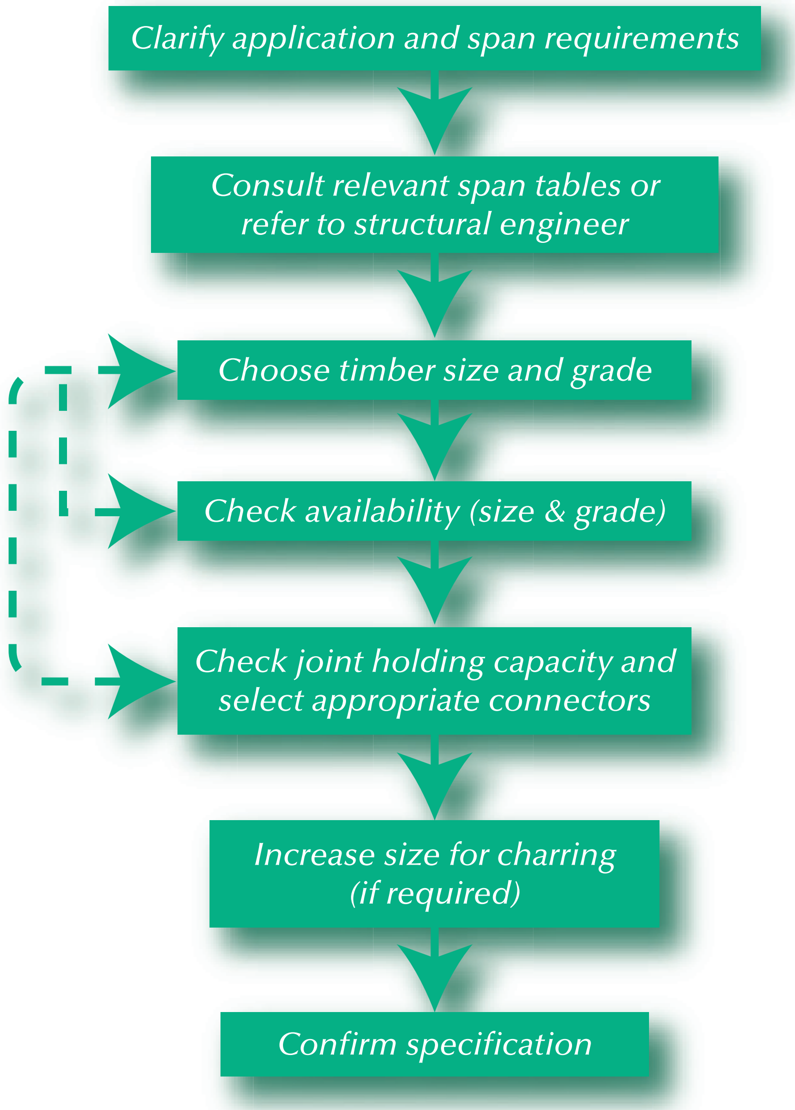
= 130 x 130mm

Thus for a Blackbutt post with an FRL of 60/ – / –, the most practical size is probably 150 x 150mm unseasoned timber which will season in-situ (i.e. this is being selected as a substitute for seasoned Blackbutt, which is hard to obtain). Another option is a glue-laminated Blackbutt post at least 130 x 130mm.

CHECKING YOUR STRUCTURAL SELECTION

As with appearance needs, it is a good idea to check your structural selection by using the decision flow chart shown in Figure 13. Its aims is to ensure all appropriate factors are taken into account for different specification scenarios.

Figure 13: Process for selecting timber in structurally oriented situations



4 Section Four

Designing for Durability

Irrespective of structural or appearance requirements, durability has overriding importance. This section systematically deals with durability issues. It starts by setting-up performance criteria for durability and then suggests ways of addressing these criteria. This includes the use of naturally durable timber, preservative treatments, detailing construction to protect timber, protective coatings and maintenance strategies

PERFORMANCE CRITERIA FOR DURABILITY

Durability considerations are important in ensuring the service life of all timber products. Designers need to choose timber and details that suit the service environment. The main factors include weathering, fungal decay, and termite or borer attack. These issues have been combined into hazard classes, as shown in Table 14.

These service conditions can be accommodated by one or more of the following:

- select naturally durable timbers,
- use timber that has been preservative treated,
- detail construction to provide protection,
- use protective coatings,
- uphold an appropriate maintenance strategy.

NATURAL TIMBER DURABILITY

Cypress and many hardwoods show great natural durability. For instance, Turpentine has a proven track record in tough marine environments such as wharf construction. Timber species are divided into four durability classes as shown in Table 15. The tabulated data indicates how long each species will resist decay and termite attack under different hazard conditions. These classifications relate specifically to untreated heartwood rather than the less durable sapwood (which is generally regarded as Class 4 durability).

Table 14: Durability hazard classes

Hazard Class	Exposure/Service Condition	Biological Hazard	Typical Example
H1	Inside, above ground. Completely protected from the weather , well ventilated and protected from termites	Lyctid borers	Framing, flooring, interior fit-out, furniture
H2	Inside, above ground Protected from wetting, nil leaching	Borers and termites	Termite resistant framing
H3	Outside above ground i.e. periodic wetting and leaching, borers and termites	Moderate decay, borers and termites	Pergolas, decks, fences, weatherboards, window joinery
H4	Outside, in-ground Subject to severe wetting and leaching	Severe decay, borers and termites	Fence posts, garden edging, landscaping timbers
H5	Outside, in-ground contact with or in fresh water. Subject to extreme wetting and leaching and/or where the critical use requires a higher degree of protection.	Very severe decay, borers and termites	Building poles constantly exposed to fresh water, retaining walls, piles, stumps, cooling towers
H6	Marine waters Subject to prolonged immersion in sea water	Marine wood borers and decay	Boat hulls, marine piles; jetty cross bracing, landing steps and similar

Table 15: Service life of naturally durable timbers in different hazard classes

Durability Class heartwood only	Species	H5 In ground	H3 Above ground Exposed	H1 Protected
Class 1 – Highly Durable	Bloodwood, Cypress, Grey Box, Grey Gum, Ironbark, White Mahogany, Tallowwood, Turpentine,	25+	45+	50+
Class 2 – Durable	Blackbutt, Jarrah, New England Blackbutt, Red Mahogany, River Red Gum, Spotted gum, Yellow Stringybark	15 to 25	30	50+
Class 3 – Moderately Durable	Brushbox, Flooded Gum, Karri, Messmate	8 to 25	15	50+
Class 4 – Non-durable	Brown barrel, Mountain and Alpine Ash, Manna Gum	less than 8	5	50+

USE OF PRESERVATIVE TREATMENTS TO INCREASE DURABILITY

The durability of timbers with low natural durability can be enhanced by the use of preservative treatments. Preservatives are added to the timber to meet the previously described hazard classes.

The use of preservatives involves the introduction of stable chemicals into the cellular structure of the timber. This protects it from wood destroying organisms such as fungi and insects. Preservatives are mainly used in sapwood as heartwood contains resins and other extracts that prevent the uptake of preservative solutions. Timbers such as Cypress cannot be treated.

There are many types of preservatives, each with individual advantages. These include three main groups: Oil-borne, Water-borne and Light Organic Solvent borne.

Oil-borne Preservatives

Oil-borne preservatives include creosote or mixtures of creosote, petroleum oil and insecticides. These chemicals are generally limited to heavy engineering structures such as road bridges and power poles. They are sometimes added as a double treatment to marine piles e.g. with CCA treatment.

Water-borne Preservatives

Water borne preservatives include Copper Chrome Arsenic (CCA), Ammonia Copper Quaternary (ACQ) and Boron compounds.

The copper-chrome-arsenic compounds cover a wide biological spectrum and are not subject to significant leaching. The copper is a fungicide and the arsenic is both an insecticide and back-up fungicide. The chrome acts as a fixing agent to render the copper and arsenic chemicals insoluble. CCA treated timber is odourless and can be readily painted or stained once dry. It has a characteristic light green colouring.

ACQ is a newer form of timber treatment that is similar in performance to CCA. The copper and quaternary ammonium compounds provide protection to timber against decay, fungi, termites and wood boring insects. The timber appears green when freshly treated but mellows to a golden brown with exposure to the weather. Boron is used specifically to protect sapwood against borer attack and is aimed predominately at the Lyctid borer in many hardwoods. It remains water soluble after application and is only suitable for interior use where leaching does not occur.

Light Organic Solvent Preservatives (LOSP)

Light Organic Solvent Preservatives (LOSP) actually describes the carrier of the preservative and not the contents. As a result, LOSP's vary greatly according to the preservative chemicals added. In general, LOSP's are solutions of either insecticides or fungicides and insecticides, and may contain additional water repelling agents to develop good weathering characteristics where exposed. They are suitable for interior or exterior, but are limited to above ground situations only. They may also be protected by a coating such as paint or oil based stain in order to extend or enhance the durability.

Irrespective of the type of preservative used the treatment generally forms a protective envelope. As such, cutting and drilling of treated timber should be avoided. Where this is not possible the treatment should be patched on-site using paint-on preservatives.

In general, preservative treatments must comply with stringent statutory requirements, whether treated within the state or imported from other states or overseas. State Acts take precedence over all other documents including Australian Standards (e.g. AS1604). Though State Acts vary, they generally cover:

- The types of preservatives that can be used.
- The minimum penetration of preservative into the timber.
- The minimum retention of preservative in the timber.
- The registered brand that must be applied to the timber.

If necessary further detail on these issues should be sought as required.

COATINGS TO PROTECT TIMBER & CONNECTORS

Finishes provide an extended means of protecting against sun, rain, wind and frost. Without protection, timber colour may be bleached; surface fibres may loosen; boards may cup or warp; cross sectional sizes may slowly erode; continual shrinkage and swelling may cause cracking in the timber. Without protection, structure may prematurely deteriorate.

Protective Coatings for Timber

Protection can be provided by the application of coatings such as paints, water repellents, preservatives and pigmented stains. The main objective is to prevent or retard the uptake of moisture and the absorption of ultraviolet light. This applies to external claddings, posts, beams and decks where there are the following options for protective finishes:

- Clear water repelling treatments – these treatments are site applied and are essentially site based versions of the previously discussed preservative treatments. Commonly they contain an organic solvent medium, with additives such as copper naphthanate or zinc naphthanate. In addition wax or resin is often added. Where fully exposed these types of products have a limited service life and re-application in 6–12 months may be required. In addition, solvent or water based finishes with UV inhibitors are also available and give improved service life. Either way these finishes must not be confused with internal clear finishes.
- Semi transparent stains – these provide a high degree of protection while enhancing the natural beauty of the timber. Pigments provide a UV screen and light colours are best as they absorb less heat. Stains utilising an oil base are also useful in giving good moisture protection. Prior to applying stains all surfaces including ends should be given a coat of water repellent preservative. Ideally, the first coat of stain should be applied prior to installation, with final coat(s) upon completion. A service life of 3–5 years can be expected depending upon degree of exposure to the weather. Re-application is relatively easy e.g. surfaces generally only require cleaning before additional coats are applied.

- Opaque Stains and Paints – when properly applied and maintained, these provide the best protection against weathering. Water borne (acrylic) and solvent borne (oil) paints can provide a film which is substantially impervious to water and gives maximum protection against ultra-violet light. These finishes offer a different appearance to the former options – they hide the timbers natural colour and grain. Getting the most out of them is reliant on applying the recommended number of sealing, priming and finishing coats – as recommended by the manufacturer. If done correctly a service life of between 5 and 10 years can be expected from most opaque finishes.

The above options can be used for most applications except decks. They occupy a special category due to the amount of foot traffic, abrasion and exposure to the weather. As a result products specifically manufactured for this purpose should be used. Semi-transparent oil stains are generally the main option because the oil penetrates into the surface, providing moisture protection. The pigments also filter the sun's ultra-violet rays, thus reducing checking and fading.

Protective Coatings for Connectors

Preventing chemical breakdown and corrosion at connections is another important component of dealing with durability. The key issue is to prevent the interaction of moisture, chemicals and metal, from causing corrosion or a breakdown of the wood fibres around metal fasteners. Most use protective coatings to connectors, though some of the more expensive options use a core corrosion resistant material such as stainless steel. Options are shown in Table 16.

Table 16: Connectors to prevent corrosion and chemical breakdown

Material	Application	Comments
Mild Steel	Fully protected from weather or moisture	Check for compatibility with preservative treated timbers
Plated (Zinc, Cadmium) and Gold Passivated	Exposed head but only where internal or protected from the weather and corrosive environments	Avoid damage during handling and installation
Hot dip Galvanised	External exposed to weather and low corrosive	Bolts: Where in contact with moist CCA treated timber, additional protection using plastic sheaths or bituminous epoxy coatings.
Silicon Bronze, Copper, Brass,	Marine	Nail and Screws: Usually used in boat building or for acidic timbers such as western red cedar. Not for use when in contact with aluminium.
Monel	Marine	Nails and Screws: Used in boat building
Stainless Steel	Chemical, industrial, marine and pool	Grade 316 preferred for marine environments. Additional coatings should be applied to Grade 304

Precautionary note: Many hardwoods have a low pH level (i.e. acidic) therefore increasing corrosion especially where moisture is present. As a result, it is best to err on the side of caution when using the above table. Specify higher rather than lower.

DETAILING CONSTRUCTION TO PROTECT TIMBER

Detailing construction to enhance durability may include one or more of the methods described in Table 17.

Table 17: Strategies to improve timber durability

Strategy	Method	Example
Shedding water	Slope the element enough to allow water run-off.	Handrail and balustrade with 5° slope
Sacrificial Elements	Use protective elements over the top and side of critical elements. Here, sacrificial options such as cladding or cappings, take the direct weathering while the underlying element is protected.	Cladding over beams Caps power poles
Isolating timber from Hazard	Use a barrier to prevent moisture or insect attack.	Damp proof course Post stirrups Termite physical barriers
Easy inspection and maintenance	Detail elements so that they can be inspected or maintained i.e. ensure they are assessable	Post stirrups

MAINTENANCE STRATEGIES

Maintenance of timber is crucial to the long term serviceability of timber structures. Timber protected by an overhanging structure requires little or no maintenance, but where exposed to the weather, some form of maintenance during the life of the structure is important. Design philosophy here gives three options:–

1. Over design the element so it needs no maintenance during its life.
2. Maintain elements as demanded.
3. Design the elements so that they are cyclically maintained.

Of these, strategy one is least preferred, while strategy three is most preferred. Strategy two clearly offers an intermediate option. Having said this, the choice between all three will be influenced by access to the timber and budgetary constraints.

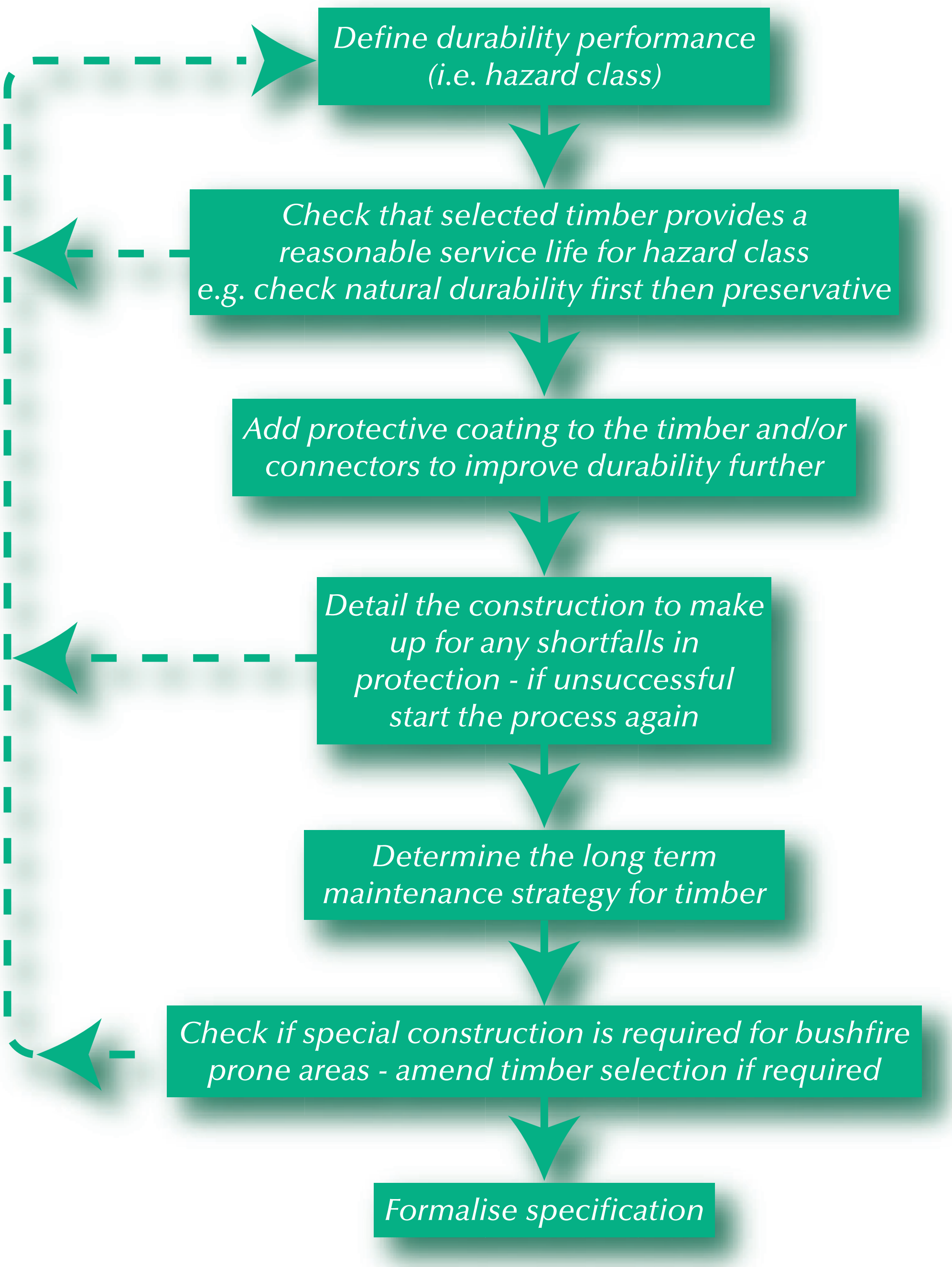
BUSHFIRE PRONE AREAS

Bushfire prone areas require special consideration. These areas are usually defined by local council and require building materials that perform well in fires. Timber species falling into this category include Blackbutt, Red Ironbark, River Red Gum, Silver Top Ash, Spotted Gum and Turpentine. All satisfy the definition of fire retardant timbers (Warrington Fire Research). Reference should also be made to AS3959 for further details on regulatory requirements.

CHECKING YOUR DURABILITY SELECTION

It is appropriate to check your durability decisions before committing to a specification as shown in Figure 14.

Figure 14: Process for selecting timber when designing for durability



5 Section Five
Formalising the Specification

This section gives guidance on writing a timber specification in drawings or documents. It also provides references to underlying regulatory documents, technical application guides and technical terms.

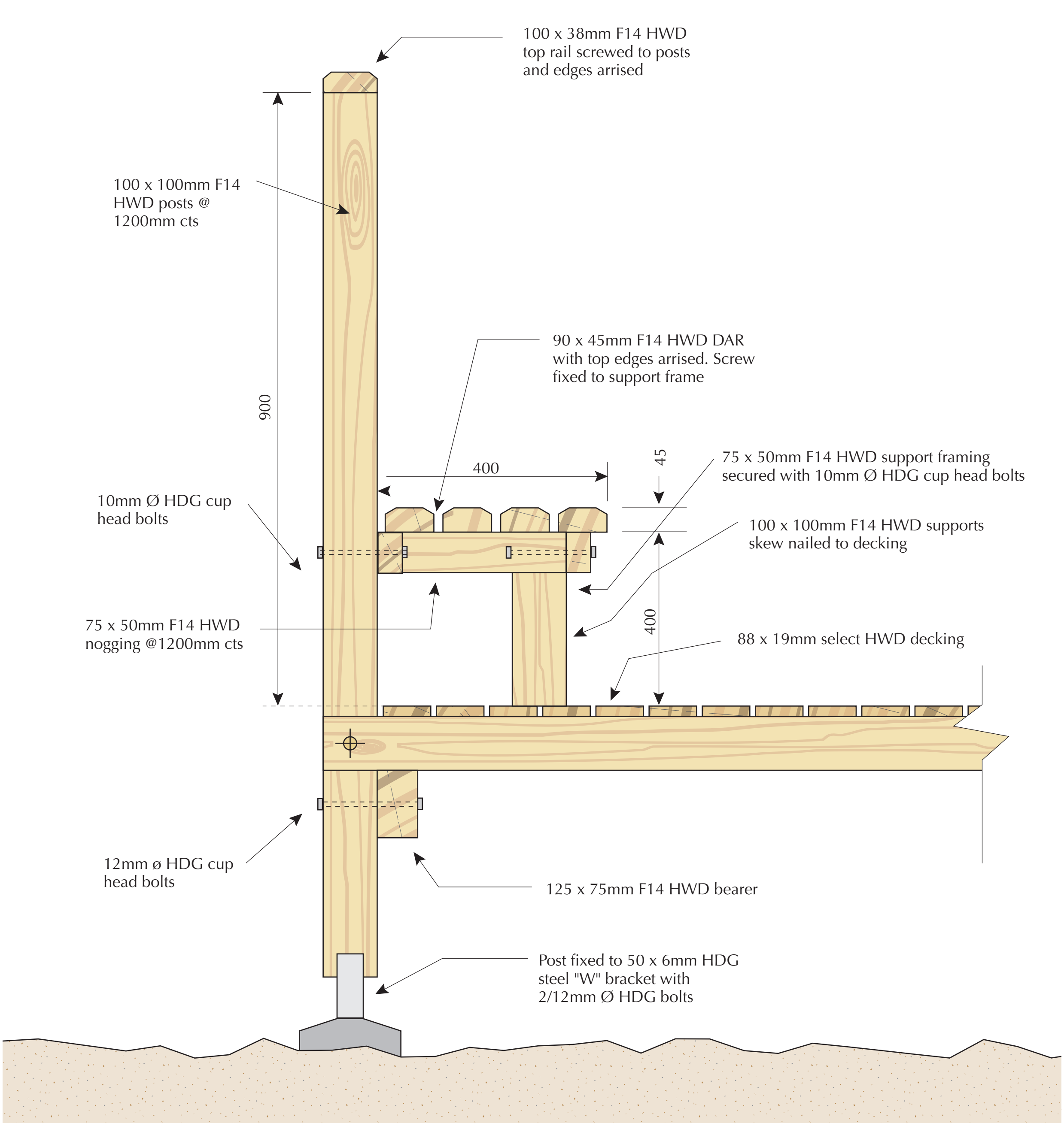
WRITING THE SPECIFICATION

Once selection of timber has been completed it is important that the correct information is presented so that all involved know what is required. This is also an important mechanism to protect the designer from any deviations to specification that may occur during the job. A one line timber specification can be made up of a series of abbreviated words and numbers, each describing a particular characteristic of the timber element. The basic principles are shown in Table 18 and an applied example is shown on Figure 15. Here it is notable that items are usually shown on the side of the drawing with an arrow. Another option is to include the information in a key or table with member sizes. A third option is to write the information in a separate specification document. Under any of these scenarios it is important to ensure that the materials specified are cross referenced with contingent information covering timber durability and workmanship. This may be linked to notes covering regulations, standards, legislation and on-going maintenance regimes.

Table 18: One line specification guidelines

Characteristic	Example of Key Words
Application or Product	Cladding, flooring, rafter, beam, joist, hand rail, etc
Size	Width (mm) x Thickness (mm) x Length (mm or m)
Species or Species group	Mixed hardwood, blackbutt, spotted gum, New England group
Surface Finish	Sawn, dressed, sized, gauged, D.A.R., reeded finish, etc.
Profile	Tongue and Groove (T&G), End matched
Moisture Content	Seasoned or unseasoned
Treatment	Treated H1, H2, H3, H4, H5, H6 or untreated
Durability Class	Durability Class 1, 2, 3 or 4
Structural Grade	F8, F11, F14, F17, F22, F27 etc.
Appearance Grade	Hardwood: Select, Medium feature, High feature Cypress: Grade 1 or 2
Special Features	e.g. density between 600 and 700 kg/m^3
Fixings	Fixed with 2/75 x 3.15mm diameter galvanised nails
Fabrication details	To specific requirements
Finishing details	One flood coat of water repellent preservative

Figure 15: Typical specification on drawings



GLOSSARY OF TERMS

air-dried timber: Timber dried by exposure to air in a yard or shed, without artificial heat (also see seasoning).

arris: The sharp intersection of two surfaces, e.g.. face and edge of a piece of timber.

backcut: Cut so that the wide face of the piece is a tangential plane to the growth rings. Trade practice in Australia is to class timber as backcut when the average inclination of the growth rings to the wide face is less than 45 degrees, and to class veneer as backcut when the growth rings are nominally parallel to the face of the veneer.

boxed heart: The pith and the adjacent wood contained within the four surfaces of a piece of timber anywhere in its length

GLOSSARY OF TERMS (continued)

equilibrium moisture content (EMC): The moisture content at which timber neither gains nor loses moisture from the surrounding atmosphere

fibre saturation point: The point in the seasoning or wetting of timber at which the cell cavities are free from water but cell walls are still saturated with bound water. It is taken as approximately 25–30% moisture content

green timber: Unseasoned, wet, with free water present in the cell

heart: The portion of a log that includes the pith and the associated defective wood

heartwood: The wood making up the centre part of the tree, beneath the sapwood. Cells of heartwood no longer participate in the life processes of the tree. Heartwood may contain phenolic compounds, gums, resins, and other materials that usually make it darker and more decay resistant than sapwood

insitu: In situation

lignin: One of the principal chemical constituents of wood cellular tissue – the binding agent

longitudinal: Generally parallel to the direction of the wood fibres

lyctid borer: Larva of the family *Lyctidae*, commonly the species Lyctus brunneus Steph., which attacks starch sapwood of some seasoned or partially seasoned, pored timbers. The adult beetle makes the flight hole. Syn. Powder-post borer

lyctid susceptibility: Timber is classified according to its susceptibility to attack by lyctid borer. Legislation governs the sale and use of lyctid susceptible timber in NSW and Queensland; Australian Standards limit the use of lyctid susceptible sapwood throughout Australia

moisture content: The weight of moisture contained in a piece of timber expressed as a percentage of the oven dry weight

nominal size: The named size, or ordered size, which may vary from the actual size of the piece because of variations due to sawing, shrinkage and dressing and the tolerances allowed on these operations

quarter sawn timber: Timber in which the average inclination of the growth rings to the wide face is not less that 45 degrees

radial: Coincident with a radius from the axis of the tree or log to the circumference

radially sawn: Timber sawn on the radius from the central axis of the tree or log to the circumference, perpendicular to the growth rings. The resulting pieces are generally triangular in shape

sapwood: Outer layers of wood which, in a growing tree, contain living cells and reserve materials such as starch. Under most conditions the sapwood is paler in colour and more susceptible to decay than heartwood

tangential: Coincident with a tangent at the circumference of a tree or log, or parallel to such a tangent. In practice, it often means roughly coincident with a growth ring

unseasoned timber: Timber in which the average moisture content exceeds 25%

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LINKED GUIDES SUPPORTING THIS DOCUMENT

Hardwood & Cypress Application Guides

- Flooring
- Domestic Decks
- Non-domestic Decks, Boardwalks & Light Vehicular Traffic Structures
- Stairs, Handrails & Balustrades
- Expressed Hardwood Structures
- External Cladding
- Fire Hazard Requirements for Non-domestic Fit-out
- Joinery, Furniture and Fit-out
- Landscape Structures
- Round Timber – Piles, Poles & Girders
- Internal Lining Boards
  (Go to www.australianhardwood.net)

Hardwood and Cypress Species Guides

Hardwood and Cypress Producers Guide
(Go to www.australianhardwood.net)

ACKNOWLEDGED DOCUMENTS

- Timber Manual – National Association of Forest Industries, Canberra

Australian Hardwood Network

For additional assistance please contact the Timber Advisory Service

1800 044 529

or visit the following websites:

www.timber.net.au
www.australianhardwood.net

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