PENTARCH FORESTRY

SPECIFYING DECORATIVE HARDWOOD TIMBER PRODUCTS

This course will take approximately 1 hour to complete and attract 1 formal CPD Point

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Learning Outcomes

In this course, you will learn about the physical and mechanical characteristics of timber and the role they play in the timber selection process.

You will be assessed on the main points presented, and at the end of the course you will receive your overall score and obtain a certificate of participation.

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Chain of Responsibility

The keystone to good design is selecting the right building materials with clarity and certainty knowing they will perform as intended. Good design is also about people - ensuring everyone in the community is safe.

Before we begin looking at timber products and their characteristics, it is important to first address the subject of **Non-conforming Building Products.**

Non-conforming Building Products are defined as:

- Not deemed to be safe or will not be safe in their application
- Do not comply with relevant regulatory provisions; or
- Do not perform, or are not capable of performing for their intended use

Chain of Responsibility is a policy that makes sure everyone in the supply chain shares responsibility to ensure breaches of the *National Construction Code* (NCC), relevant technical standards, and local laws does not occur.

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Chain of Responsibility

"Building work in Australia must conform and comply with the *National Construction Code* (NCC), relevant technical standards, and local laws. This ensures our buildings are safe, healthy and durable. The products and materials you choose and how they are used must also be 'fit for purpose'. In recent years, there has been concerns about the risks of using substandard ('non-conforming') building products or materials or using them incorrectly ('non-complying'). The use of these products can cause significant costs – from repairing and replacing products, to risks to safety, or even building failure."

NSW Government Fair Trading, 2021 <https://www.fairtrading.nsw.gov.au/trades-and-businesses/construction-and-trade-essentials/building-products/non-conforming-building-products>

Everyone in the supply chain is responsible for ensuring the right product is used and is deemed fit for purpose. This includes, manufacturers, importers, wholesalers, distributors, retailers, architects & designers, engineers, approvers & certifiers, developers & builders and other trade specialists.

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Chain of Responsibility

Review

What defines a non-conforming building product?

Choose one answer.

A One that is not safe

B One that does not comply with regulatory provisions

C One that does not or will not perform under for its intended use

D All of the above

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Chain of Responsibility

Review

Who in the supply chain is responsible for ensuring the right product is deemed fit for purpose?

Choose one answer.

A Specifiers such as architects and designers

B Manufacturers who produce building products

C Certifiers

D Everyone in the supply chain

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The Timber Design Framework

Specifying decorative timber products follows a simple timber design framework, outlined below:

Step One: Determine the product and its intended use

- How will it be used?
- Is it designed for aesthetics, structural or amenity?
- Will it be used internally or externally?
- What are the costs?
- Is the product sustainably sourced?

Step Two: Assess the product's performance

- What is the timber products life expectancy and reliability?
- What is the strength or aesthetic nature of the product?
- Is ongoing maintenance required?

Step Three: Consider the potential hazards and impacts

- Are preservative treatments required to increase longevity?
- Will the product be subjected to potential hazards such as fire, pests or decay?
- What are the environmental impacts such as weathering?

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Timber and Sustainability

We live in an expanding, environmentally conscious society that demands more from our building products than just being fit for purpose. Homeowners and developers alike are becoming increasingly aware of the importance of using sustainable, natural products for domestic and commercial applications.

Timber combines performance, wellbeing and environmental advantages and unlike other building materials, it can be harvested, re-grown and re-harvested in an average person's lifetime. The production of timber products also uses less energy than most other building materials (that are typically sourced from fossil fuels) making it the ultimate renewable.[1]

Australian Forests are protected by strict Federal and State controls and regulations ensuring that there is a healthy balance between long term conservation and sustainable forestry management. Australia's 134 million hectares of forest cover approximately 17% of Australia's total land area. This represents almost 3% of the world's forest area.[2]

In Australia, the native forest area is 132 million hectares. Of this area, only 28% is available for harvesting and only 1% is harvested each year.[2]

21% (26.4 million hectares) of Australia's forest are part of Australia's network of protected areas where nature conservation is the primary management intent.[3]

Timber The Ultimate Renewable

[1] 'Carbon and Environment" www.naturallybetter.com.au

[2] ABARES 2018. Australia's State of the Forests Report 2018

[3] ABARES 2017. Australia's Forests at a Glance 2017

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Chain of Custody

Chain of Custody is the process by which a product can be traced from its origin right through all its processes to the end user.

Chain of Custody certification is becoming more widely used and recognised, so more consumers are requesting manufacturers validate their claims that the products they supply are from sustainably managed resources.

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Chain of Custody

Sustainable Forest Management Certification (AS 4708)

The area of certified forests and plantation in Australia has grown to about 26.7 million hectares.[1] This includes most of the native forests managed for timber production. Sustainable Forest Management certification provides assurance that forests are conserved and managed responsibly to ensure they deliver social, environmental and economic benefits now and in the future – balancing people, profit and the planet.

PEFC Responsible Wood Chain of Custody Certification (AS 4707)

Chain of Custody tracks a forest or wood product from its origin in a certified forest through to its end use by the consumer. Responsible Wood Chain of Custody certification verifies that timber manufacturers of solid hardwood products are produced from certified, legal and sustainable resources. Chain of Custody is a tracking process that provides an environmental assurance standard for the sustainable use of Australia's forest resources.

Responsible Wood is endorsed by PEFC (Programme for Endorsements of Forest Certification) and is the national governing body for PEFC in Australia.

Look for these logos to ensure sourced timber products have certification.

[1] ABARES 2017. Australia's Forests at a Glance 2017

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Sustainability and Chain of Custody

Review

Responsible Wood Chain of Custody (AS 4707) validates that manufacturers of hardwood timber products produce or source certified, legal and sustainable resources.

Choose one answer.

A True

B False

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Characteristics of Australian Hardwood Timber

Let's begin by looking at some of the major characteristics of hardwood timber with the intent of providing an understanding of how they impact the decisions you make to achieve good design and fitness for purpose.

In the remainder of this course, we will cover how timber behaves and how it is categorised. This will include:

- Timber hardness and durability
- Structural grading of timber
- Appearance grading of timber
- Bushfire ratings
- Timber's relationship with moisture

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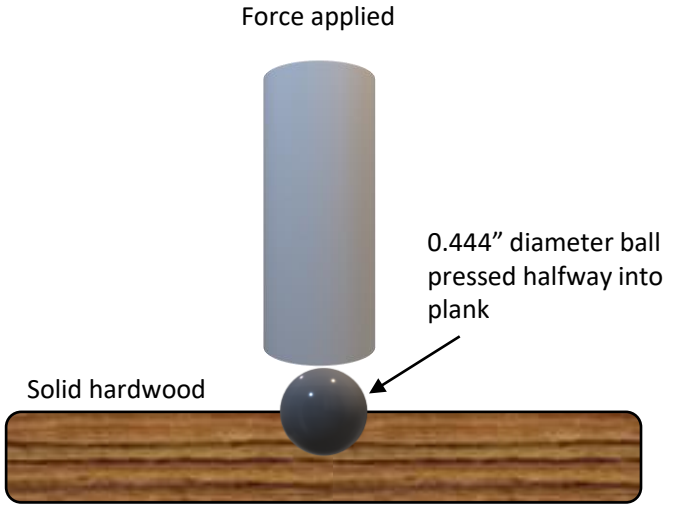
Characteristics of Australian Hardwood Timber

Timber Hardness

Australian hardwood timber species are measured for their hardness with what is known as a Janka Test. Janka (hardness) tests measures a timber species resistance to indentation and abrasion.

A steel ball is driven into a sample piece of heartwood (denser inner part of a tree) and the force used is measured in Kilonewtons (kN). A rating is then assigned based on the results – the higher the number the greater the hardness.

Hardness of a timber species maybe important when selecting timber flooring for a project.



Janka Test measures force needed to embed steel ball

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Characteristics of Australian Hardwood Timber

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Timber Hardness

This table lists the Janka rating of some common species:

Species	Janka Rating (Dry)
Grey Ironbark	14.0 (Very Hard)
Red Mahogany	12.0
Turpentine	11.6
Spotted Gum	10.1
Brushbox	9.1
Blackbutt	8.9
Tallowwood	8.6
Tasmanian Oak	4.9 (Moderately Hard)

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Characteristics of Australian Hardwood Timber

Durability (AS 5604)

Durability is the term used to describe timber's propensity to perform its intended task over a required period when exposed to hazards. For example, if a deck is expected to last 40 years in a tropical environment, perhaps a timber species with a naturally higher durability needs to be considered. The deck may need to perform when exposed to hazards such as, but not limited to, insects like borers and termites or decay.

Some timber species are naturally more durable than others which makes it an important factor to understand to ensure the anticipated build's longevity is achieved.

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Durability

Hardwood timber species are each given a durability rating from 1 to 4, derived from their expected service life ‘in the ground’ and ‘outside above the ground’ when exposed to hazards.

Class	Rating	Expected Service Life (years)	
		In Ground	Outside Above Ground
1	High	>25	>40
2	Reasonably High	15 to 25	15 to 40
3	Moderate	5 to 15	7 to 15
4	Low	<5	<7

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Characteristics of Australian Hardwood Timber

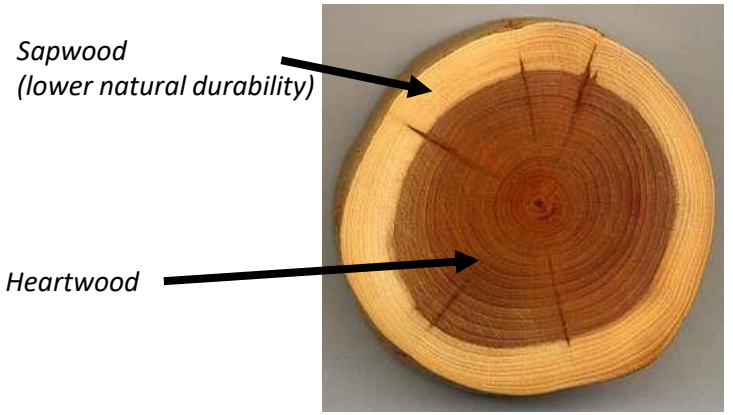
Durability

It is important to note, durability classifications will only apply to what is referred to as the 'heartwood' portion of a timber member.

Heartwood is the central part of a tree which is usually much darker in colour and mechanically stronger than the tree's sapwood. Heartwood is also naturally more resistant to hazards such as decay.

Sapwood present in any timber species is not considered durable and therefore given the classification of durability class 4. Sapwood durability can be improved though, by impregnating it with chemicals, however, this will not change its durability classification.

The heartwood cannot be impregnated with chemicals, so a timber species durability classification will not change.



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Characteristics of Australian Hardwood Timber

Improving Durability

As already mentioned, the durability of sapwood can be improved when impregnated with chemical treatments. AS 1604.1 specifies the requirement for preservative treatment to protect timber from decay, insect or marine borer attack.

Preservative treatment is given a Hazard Class (H1 to H6) which indicates the service conditions which the timber product will be exposed to and the level of protection that needs to be applied. In accordance with AS1604 any timber containing lyctid[1] susceptible sapwood be treated to a minimum H1 level.

Preservative treatments do not permanently prevent weathering, so exposed timber, may over overtime:

-Discolour

-Surface check and/or develop cracks

-Develop a rough surface

[1] Lyctid – a wood boring beetle

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Characteristics of Australian Hardwood Timber

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Hazard Class Selection Guide

Hazard Class	Exposure	Specific Service Conditions	Biological Hazard	Typical Uses
H1	Inside, above ground	Completely protected from the weather and well ventilated, and protected from termites	Lyctid borers	Susceptible framing, flooring, furniture, interior joinery
H2	Inside, above ground	Protected from wetting. Nil leaching	Borers & termites	Framing, flooring, and similar, used in dry situations
H3	Outside, above ground	Subject to periodic moderate wetting and leaching	Moderate decay, borers & termites	Weatherboard, fascia, pergolas (above ground), window joinery, framing and decking
H4	Outside, in ground	Subject to severe wetting and leaching	Severe decay, borers and termites	Fence posts, garden wall less than 1m high, greenhouses, pergolas (in ground) and landscaping timbers
H5	Outside in ground contact with or in freshwater	Subject to extreme wetting and leaching and/or where the critical use requires a higher degree of protection	Very severe decay, borers and termites	Retaining walls, piling, house stumps, building poles, cooling tower fill
H6	Marine waters	Subject in prolonged immersion in sea water	Marine wood borers and decay	Boat hulls, marine piles, jetty cross bracing, landing steps and similar

AS 1604.1 2010 Specification for preservative treatment Part 1: Sawn and round timber

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Characteristics of Australian Hardwood Timber

Improving Durability

So, when should preservative treated timber be used? Consider the following:

1. Presence of hazards
   - moisture
   - decay
   - insects
2. Structural integrity required
   - load sharing/bearing capacity
   - cost of failure if it occurs
   - Impact on health and safety
3. Service life expectancy
4. Natural durability of the timber being used
5. Presence of sapwood

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Hardness and Durability

Review

A Janka test measures a timber species resistance to indentation and abrasion.

Choose one answer.

A True

B False

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Hardness and Durability

Review

Kiln dried, Spotted Gum has a Janka rating of 10.1 whereas Grey Ironbark has a Janka rating of 14. Which Australian hardwood species is considered harder?

Choose one answer.

A Spotted Gum

B Grey Ironbark

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Hardness and Durability

Review

A timber member that contains sapwood has been impregnated with a preservative treatment. Which of the following statements is true?

Choose one answer.

A Preservative treated hardwood will have a higher durability rating than it did prior to treatment

B Preservative treatment improves the durability of sapwood present in a timber member

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Characteristics of Australian Hardwood Timber

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Structural Hardwood Grading

The grading of timber ensures that all timber can perform to a minimum performance requirement and to provide a reliable standard against which a designer/architect can create a design and specification.[1]

Grading is the term used to describe the process of sorting individual pieces of timber into groups based on their appearance or structural capability measured against a set criteria listed in Australian Standards.

In Australia, two of the main structural hardwood grading methods are:

- Visual stress grading (AS2082)
- Machine stress grading

Visual Stress Grading is done in accordance with Australian Standards and undertaken by a trained grader who examines every piece of timber produced. An inspection of the characteristic types (e.g., knot, gum vein, etc.), their size and position is performed and then measured against those allowed in the grading classifications. Timber members with fewer and smaller characteristics will achieve a higher grade.

Machine Stress Grading uses a machine to bend timber members where the stiffness and strength is measured and given a grade rating. Grades can be found in AS 1702.1

[1] https://www.woodsolutions.com.au/articles/specification, 2020

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Characteristics of Australian Hardwood Timber

Structural F-Grading

We mentioned earlier, that grading is the process of sorting individual pieces of timber into groups, and in the case of structural hardwoods, F-grades are used. The F-grade allocated to a piece of timber indicates the structural design strength – the higher the F-grade number the higher the strength.

F-grades range from F4 to F34. F14 for example, tells us the timber's working stress in bending is approximately 14MPA (Megapascals).

It is a common misconceptions that ordering a higher structural grade of timber, F27 for instance, will provide you with a product that is considered higher in appearance grade. The number and size of characters such as knots, sloping grain, etc., may be less extensive, but they still may be unacceptable for appearance grade.

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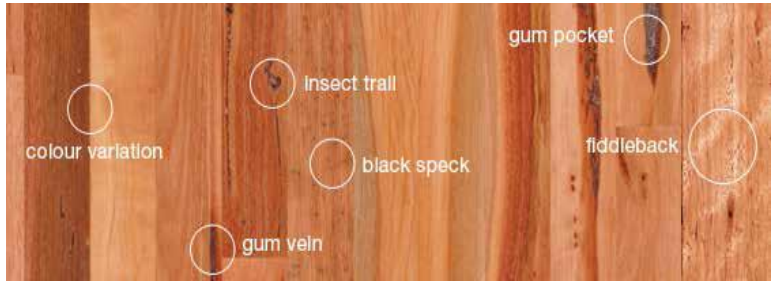
Decorative Hardwood Grading

Grading of decorative hardwood products such as flooring, decking, cladding and linings is used to describe the amount of feature present and aesthetic appearance of timber. It does not indicate the level of quality.

Timber grading provides a way to describe and identify the look and feel of a product and assists with the timber specification process. Some common features present in decorative timber products are, gum vein, insect trail, fiddleback, gum pocket.



AS 2796.2 is used to describe how decorative timber products are classified, using the following grading terms:

- Select Grade
- Medium Feature Grade (Standard)
- High Feature Grade

Many timber manufacturers use the standards outlined in AS 2796.2 but market their products under different grading names.

It is imperative to note that a timber species colour variation is not used to determine its grading classification. Timber is a natural product that includes naturally occurring colour variations and is not included in the AS 2796.2 grading rules.

Timber pieces with more frequent and larger features will be sorted into a different grade than those with less frequent and smaller features.

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Hardwood Timber Flooring Grades

The character present in a floor is affected by a timber species' endemic features or individual signature, and as a result will also affects its grade. Age and the growing region also has an influence.

An overview of what can be expected in each of the three grades is listed here. For a detailed explanation of what timber features are permissible, please consult AS 2796.1 and AS 2796.2.

Select Grade is a subtle feature grade of timber flooring that provides a low level of natural features. The low levels of natural feature provide the floor with a more uniform look.

Medium Feature Grade (Standard) includes a moderate number of natural features allowable under Australian Standards.

High Feature Grade displays a high level of natural features providing the floor with a more rustic look & feel.

The grade you specify will affect the character of the floor but will not impact on the floors fitness for purpose.

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Characteristics of Australian Hardwood Timber

Below is an excerpt from AS 2796.2 which exemplifies how permissible features are detailed:

SUMMARY OF PERMISSABLE FEATURES IN HARDWOOD PRODUCTS

Feature	SELECT GRADE (SEL)	MEDIUM FEATURE GRADE – Standard (MF)	HIGH FEATURE GRADE (HF)
Tight knots and any associated voids; individually or in aggregate in any 1m of board length	• Not exceeding 15mm or ¼ of the surface area on which it occurs	• Not exceeding 40mm or 1/3 of the surface on which it occurs	• Not exceeding 50mm or 3/8 of the surface on which it occurs
Loose knots	• Not permitted	• Not permitted	• As for holds
Holes (borer, non-enclosed termite galleries and other)			
a. Length	• Not exceeding the lesser of 15mm or ¼ of the surface on which it occurs	• Not exceeding the lesser of 40mm or 1/3 of the surface on which it occurs	• Not exceeding the lesser of 50mm or3/8 of the surface on which it occurs

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Characteristics of Australian Hardwood Timber

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Colour

Australian hardwoods are available in a wide range of rich tones and colours and while some species will present with relatively consistent tones, others will display a varied range of colour. Some factors that affect colour variation within a species are:

- Presence of sapwood (outer living rings of a tree) which is often considerably lighter than the heartwood
- Age of the tree - less mature trees are generally paler in colour
- Growing region

Colour variation within a single species is naturally occurring and considered normal. Here are some examples:

Blackbutt – cream to pale brown with an occasional tinge of subtle pink

Spotted Gum – pale, grey browns and soft creams to rich, chocolate brown

Sydney Blue Gum – soft pinks to dark pinks and red toned browns

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Grading

Review

The higher the structural stress grade of a timber member, the better it's appearance.

Choose one answer.

A True

B False

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Grading

Review

Which of the following elements is assessed when deciding whether timber is classified, Select Grade, Medium Feature Grade or High Feature Grade?

Choose more than one answer.

A Colour variation

B Gum Vein

C Insect Trails

D Knots

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Characteristics of Australian Hardwood Timber

Bushfire Standard (AS 3956)

An Australian Standard AS 3959 specifically relating to the construction of buildings in bush-fire prone areas applies in all parts of Australia.

AS 3959 describes six levels of risk of bushfire attack; these levels are referred to as Bushfire Attack Levels (BAL). BAL is a means of measuring the severity of a building's potential exposure to a bushfire. The six levels of exposure are BAL Low, BAL 12.5, BAL 19, BAL 29, BAL 40 and BAL-FZ. As the number increases the severity of bushfire attack from embers, radiant heat and direct flame contact also increases.

The number associated with the BAL represents the maximum radiant heat expressed in kilowatts per m^2, the building surface is assumed to be exposed too. Severity of a bushfire or BAL is influenced by the Forest Fire Danger Index, vegetation type, slope of land under the vegetation and distance the building is away from the vegetation.

The standard uses the BAL as the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire.

Bushfire Attack Exposure AS 3959-2009[1]	Description of Predicted Bushfire Attack Levels
BAL - LOW	Low risk of bushfire does not warrant specific construction requirements
BAL - 12.5	Possibility of ember attack
BAL - 19	Increasing level of predicted ember attack and burning debris ignited by windborne embers together with increasing heat flux not greater than 19kW/m^2
BAL - 29	Increasing levels of ember attack and burning debris ignited by windborne embers, together with increasing heat flux not greater than 29kW/m^2
BAL - 40	Increasing levels of ember attack and burning debris ignited by windborne embers, together with increasing heat flux not greater than 40kW/m^2
BAL – FZ	Direct exposure risk to flames from a fire front, ember attack and heat flux over 40kW/m^2

[1] To ascertain which BAL zone a property falls under (outlined in AS 3959-2009) a site assessment should be conducted by an experienced architect, building designer or builder.

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Characteristics of Australian Hardwood Timber

Timber Moisture Content (MC)

Timber is hygroscopic – meaning it is capable of easily absorbing and expelling moisture in response to local environmental conditions. As timber absorbs moisture is expands and as it expels moisture it contracts.

As such, factors such as relative humidity (atmospheric moisture), moisture ingress, direct sunlight, air conditioning and lack of adequate ventilation can cause timber to contract. It is imperative care must be taken to correctly assess the suitability of the site prior to the installation of decorative hardwood products.

Every site requires a climate assessment prior to the installation of timber flooring products. It is important to know the long-term relative humidity (RH) for the area where the floor is be installed. Relative Humidity is the major influence determining whether solid timber flooring products will absorb moisture from the air and swell, or whether it will lose moisture and shrink.

One of the ways Moisture Content (MC) is calculated is by dividing the mass of water present in timber by the kiln dried mass of the timber which is then expressed as a percentage:

$$\frac{\text{mass of water present in timber}}{\text{kiln dried mass (moisture removed)}} \times 100$$

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Characteristics of Australian Hardwood Timber

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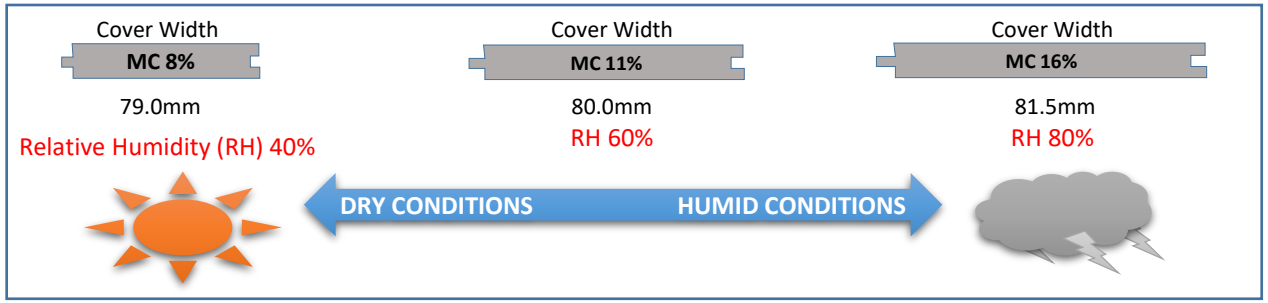
Equilibrium Moisture Content (EMC)

When trees are harvested the wood will begin to dry, with the free water present, evaporating first. When all the free water has evaporated from the timber, but the cell walls remain completely saturated this is known as the fibre saturation point. These cell walls will continue to lose water to the point where the amount of the water held within the fibre is in equilibrium to the moisture in the air. When this occurs it is known as Equilibrium Moisture Content or EMC and predominately depends on the Relative Humidity in the surrounding air and partially on the temperature.

Timber products are generally not used in completely stable environmental conditions so the amount of the water bound within the timber will change when the relative humidity and temperature change. Seasonal weather changes may affect the way timber products respond in terms of contraction and expansion. The diagram here shows us how a piece of timber flooring may respond:



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Characteristics of Australian Hardwood Timber

Equilibrium Moisture Content (EMC)

Take a look at the example here. We can see in Brisbane where the climate is generally warm and humid and has an average relative humidity of 55% to 65% - this means timber flooring is more like to expand during the summer period. Melbourne, where many homes have winter heating and the summers are dry the timber has the potential to contract. To minimise any movement after installation, the floor must be installed as close to the EMC of the immediate environment. EMC is achieved through a process known as acclimatisation.

Brisbane City
(warm moderately humid summers)

Average RH - 55% to 65%

Expansion

To minimise movement after installation - install flooring close to the average EMC of the environment

AFTER INSTALLATION

Melbourne City
(winter heating & dry summers)

Average RH - 50% to 55%

Contraction

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Characteristics of Australian Hardwood Timber

Acclimatisation

So what have we learned about timber and moisture content so far?

- Equilibrium Moisture Content (EMC), simply put, is the point at which timber neither gains for loses moisture from the surrounding environment/atmosphere
- Timber adjusts its Moisture Content (MC) to be in equilibrium with the humidity and temperature within the building or installation site

Acclimatisation is the process of bringing the MC of a timber floor closer to the expected in-service MC to minimise expansion or contraction after installation. Please note timber expansion and contraction is not considered a fault and forms a part of timber's natural characteristics and behaviour.

In-service environments are affected by:

- Heating and refrigeration air-conditioning
- Full length windows and direct sunlight
- Bodies of water in close proximity to the site
- Variations in climate and prevailing dry or moist winds

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Moisture Content

Review

What does EMC stand for?

Choose one answer.

A Equalised Moisture Content

B Equilibrium Moisture Content

C Equilibrium Moisture Composition

D Expansion Moisture Content

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Moisture Content

Review

If the Relative Humidity (RH) present in the air is 40% in winter and changes to 80% in the height of summer, what affect could this have on the width of timber floorboards?

Choose one answer.

A The moisture content in the timber floor would likely increase, therefore resulting in an increase in the boards overall cover size

B An increase in relative humidity will cause the boards to contract

C No affect as the boards have been acclimatised

D All of the above

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Moisture Content

Review

How is EMC achieved? (choose one answer)

A Drying the timber in a kiln to remove excess moisture

B Through the process of acclimatisation

C By rapidly increasing relative humidity in the surrounding environment

D EMC doesn't need to be achieved- it's a natural product

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Thank you for your attention

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Continuing Professional Development

You have now completed Pentarch Forestry's CPD - **Specifying Decorative Hardwood Timber Products**

Thank you for participating in this formal/informal CPD activity where you have earned 1 point

A certificate of participation will be email to you

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