

Timber Durability Performance and Design



Content

- Performance requirements of a timber element
- “best-practice” to maximise service life
- Estimating service life of timber elements



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Timber element performance requirements



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Element performance requirements

- Consequence of failure
 - Cladding or structural
- Expected service life
 - Short, medium, long.
- Appearance
 - Architectural, structural, envelope
- Ease of maintenance/repair



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Design life variables

- An appropriate design life will depend on ease and cost of replacement and maintenance.
 - An element or finish which is easy to access and cheap to replace may have a short design life.
 - An element or finish which is difficult to access and expensive to replace should have a design life which matches the overall building design life.
- A building which is likely to be frequently refurbished may have elements with a design life to match refurbishment intervals.



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Design life

Table 2.1: BCA Durability Design Life Guideline.

Design life of building (dlf) (years)		Design life of components or sub-systems (years)		
Category	No. of years	Category		
		Readily accessible and economical to replace/repair	Moderate ease of access but difficult or costly to replace or repair	Not accessible or not economical to replace or repair
Short	1 < dlf < 15	5 or dlf (if dlf < 5)	dlf	dlf
Normal	50	5	15	50
Long	100 or more	10	25	100

For normal buildings, the design life for most structural timber members is 50 years and for moderately accessible members 15 years.

- However, the ABCB has published implicit expectations in 'Durability in Buildings – Guideline Document'.

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Element performance requirements



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Element performance requirements



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Design for maintenance/replacement



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Maximising element design life



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Maximising element design life

Material

- Treat or select durable species
- Use correct fasteners

Design

- Understand weathering
- Manage decay
- Manage exposure/drainage



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Maximising element design life

Material

Control moisture & exposure

- Use correct fasteners

Design

- Understand weathering
- Manage decay
- Manage exposure/drainage



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Resisting or managing weathering

Weathering can be resisted with:

- suitable coatings such as stains and water repellants regularly maintained
- detailing that:
 - Provides shading, overhangs and capping.
 - Ensures water shedding and managed drainage.
 - Accommodates shrinkage
 - minimizes shrinkage restraint while ensuring stability.



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Resisting or managing weathering

Weathering can be resisted

Control moisture & exposure as plants regularly maintained

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Decay control

Fungal growth can be prevented if:

- No food
 - Adequate treatment removes the wood's availability.
- No oxygen
- Low moisture
 - Keep the timber below about 20%MC
- Unsuitable temperature
 - Below about 5°C or above about 60°C



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Limiting moisture content

- Keep the timber dry.
 - Don't let it get wet
- Exclude & shed water.
 - Make sure water can run off.
- Ensure the wood can dry out if it gets wet.
 - Ventilate & avoid moisture traps.



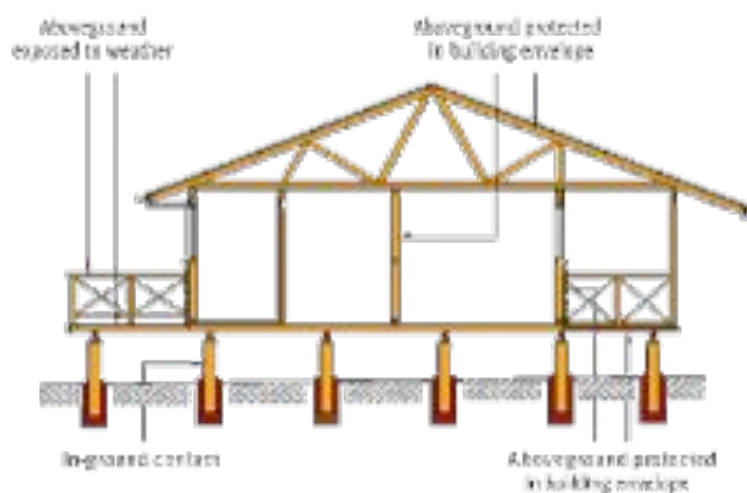
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Managing moisture & exposure



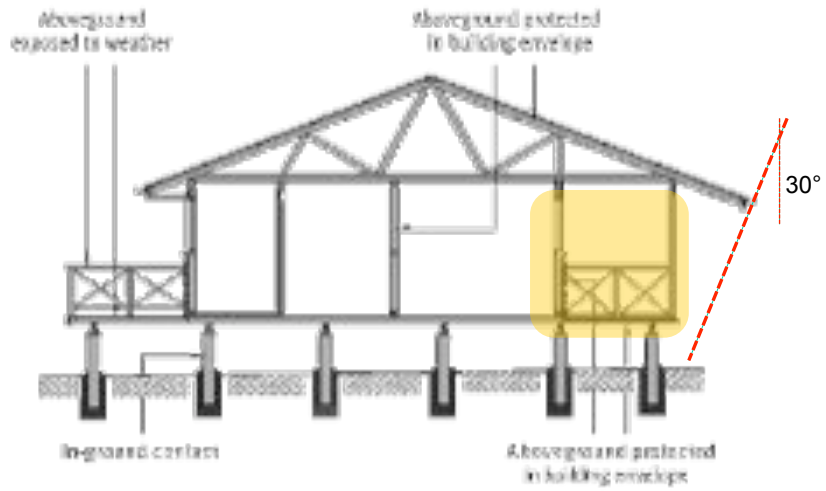
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Managing moisture & exposure



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Managing moisture & exposure

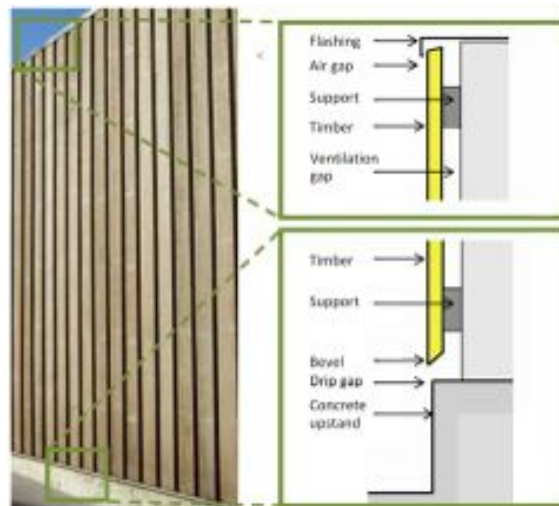


Figure 15 – Detailing to avoid standing water

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Managing moisture & exposure



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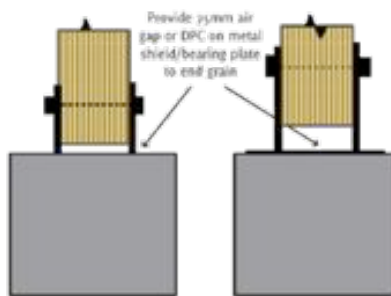
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Managing moisture & exposure



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Managing moisture & exposure



A well-ventilated, free-draining post support.

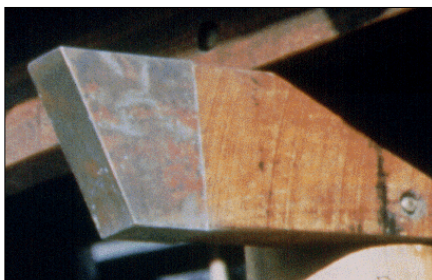
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Managing moisture & exposure



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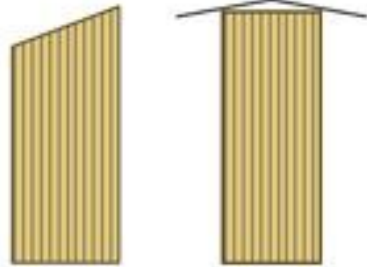
Managing moisture & exposure



Capping protects top and end grain of projected beam.

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Managing moisture & exposure



Provide capping or sloping cuts to posts



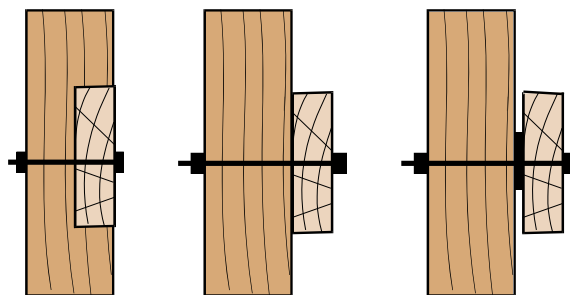
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Managing moisture & exposure



X

Better

Best



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Managing moisture & exposure



Use timber caps and bitumen strips with particular care.

- Ventilation is needed around the protected timber.



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Managing moisture & exposure

- Keep surface exposure consistent or understand the inconsistency.
- Provide adequate ventilation.
- Use vertical rather than horizontal cladding on exposed surface.
- Manage the splash zone from surrounding surfaces.
- Bevel upper surfaces of elements.
 - Round arrises
- Project drip flashings over doors and windows.
- Minimise joins in horizontal cladding likely to retain moisture.
- Use the recommended size, pattern and quality of fixings.



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Project specific solutions

The type and level of finish in a project should vary to suit the species, exposure and application.



Unfinished Durability Class 1 sun screens



Painted timber windows in the same building



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Summary

- Select appropriate species
- Use treatment if required
- Select appropriate fasteners
- Keep the timber dry
- Exclude & shed water
- Ensure the wood can dry out if it gets wet



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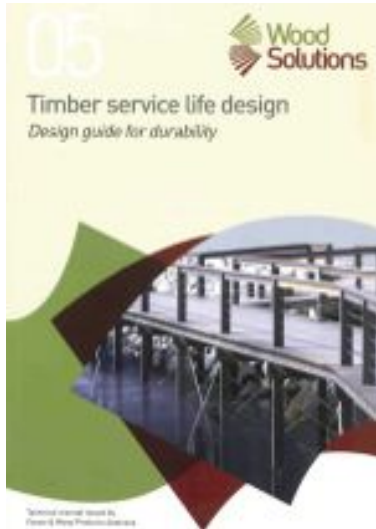
Estimating service life

Available resources

- Timber Service Life Design Guide
 - Available for free download at:
www.woodsolutions.com.au
- ‘TimberLife’ educational software
 - Available for free download at:
www.woodsolutions.com.au

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Timber Service Life Design Guide



- Introduction
- Standards and Codes
- Selection and Specification of Durability
- Decay of Timber In-Ground Contact
- Decay of Timber Above-Ground Exposed to the Weather
- Weathering, Finishing, Good Practice, Maintenance etc
- Insect Attack
- Corrosion of Fasteners
- Marine Borers
 - Appendix 1 - Exposed corrosion
 - Appendix 2 - Termites


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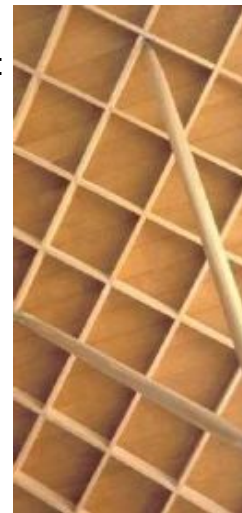
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Estimating timber service life

To estimate the service life a timber species has use the following procedure:

1. Determine the species' natural durability class
2. Determine the structure location zone
3. Determine the typical service life for various applications and combinations of timber, cross sections, treatments and natural durability
4. For round poles, add on the extra service life afforded by maintenance treatments


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Decay Above Ground–Decking example

To estimate the typical service life of a timber member, use the following procedure:

1. Determine the natural durability class for the species above ground from *Table 5.1*
2. Determine the decay hazard zone for the application from *Figure 5.2*.
3. Determine the service life for various applications (*Figures 5.3 to 5.7*) and combinations of timber, cross sections, treatments and natural durability from *Tables 5.2 to 5.11*



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Decking example - Criteria

Location	Hobart
Application	Timber decking assume <ul style="list-style-type: none"> • decking ~ 20mm thick • Spotted gum • either free of sapwood or sapwood treated to H3



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Decay above ground-Exposed

Trade name	Botanical name	Above-ground durability
Gum, spotted	<i>Corymbia maculata</i> (incl. <i>acuminata</i> & <i>diversa</i>)	1
Gum, sugar	<i>Eucalyptus cladocalyx</i>	1
Gum, yellow	<i>Eucalyptus tasopyrena</i>	2
Hardwood, white/red	<i>Eucalyptus nitens</i> (E)	2
Hardwood, western	<i>Trochodendron araliifolium</i>	4
Ironbark, grey	<i>Eucalyptus cinerea</i>	1
Ironbark, red	<i>Eucalyptus poliochlamys</i>	1
Ironbark, red (blackbutt)	<i>Eucalyptus dielsii</i>	1
Ironbark, red (greybutt)	<i>Eucalyptus crebra</i>	1
Ironwood, red-crown	<i>Mythophyllum albertianum</i>	1
Gum, raspberry	<i>Myrtalea asplenifolia</i>	1
Parah	<i>Eucalyptus marginata</i>	3
Kapur	<i>Dysoxylum spp.</i>	3

Table 5.1 Timber classification for above-ground decay

From Table 5.1, Spotted gum is above ground durability class 1



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Decay Above Ground–Decking



Figure 5.2 Above ground decay hazard zones for Australia (Zone D has the greatest decay hazard potential)

From Figure 5.2, Hobart is in above ground decay Hazard Zone C



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Decay Above Ground – Decking

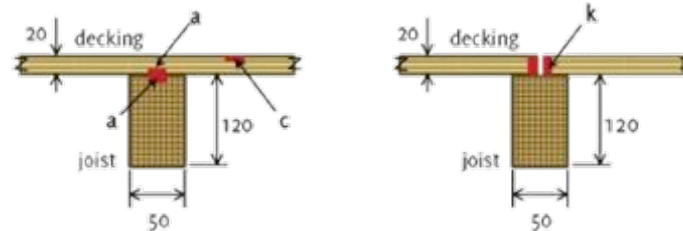


Figure 5.4 Typical dimensions of decking and locations of interest for service lives

- Decay in decking has the potential to occur at a number of places such as butt joints, the top of boards or the interface between the decking and the joists.
- Each may need to be considered separately.

Decay Above Ground – Decking

Climate zone	Timber type	Above-ground durability class ⁽¹⁾	Treatment ⁽²⁾	Typical service life (years)		
				a	c	k
C	Treated sapwood	all	H ₃	40	50	40
		1	—	20	25	20
	Untreated heartwood	2	—	15	20	15
		3	—	9	10	9
		4	—	5	7	5
Untreated sapwood	all	—	2	3	2	

Table 5.4 Typical service life for *onset of decay* in decking

- For Above Ground Decay Hazard Zone C, the predicted service life for onset of decay is
 - 20 years at the butt joint and interface of decking and joist and
 - 25 years for the top of the decking.

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Decay Above Ground – Decking

- For Above Ground Decay Hazard Zone C, the predicted service life for Replacement due to decay is
 - 45 years at the butt joint and interface of decking and joist and
 - 60 years for the top of the decking.

Climate zone	Timber type	Above-ground durability class ⁽¹⁾	Treatment ⁽²⁾	Typical service life (years)		
				a	c	k
C	Treated sapwood	all	H3	90	>100	90
		1	—	45	60	45
	Untreated heartwood	2	—	35	50	35
		3	—	20	25	20
		4	—	10	15	10
	Untreated sapwood	all	—	4	5	4

Table 5.5 Typical service life for *replacement* of timber in decking



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Corrosion of fasteners

Corrosion of fastener is affected by:

- Timber pH
- Moisture
- Type of timber treatment (copper)
- Salt
- Pollutants, etc



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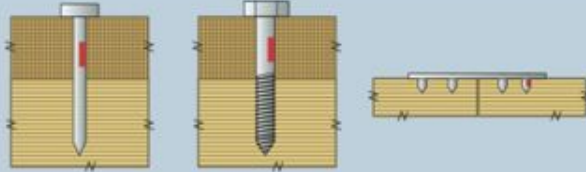
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Corrosion of fasteners

There are two types of corrosion:

Embedded

Figure 8.1 Typical installation of fasteners embedded in wood subjected to corrosion (red marks denote where corrosion is considered)



Atmospheric

Figure 8.2 Typical fastener installation subjected to atmospheric corrosion (red marks denote where corrosion is considered)



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Corrosion of fasteners

- In addition to embedded and atmospheric corrosion, a special case occurs with bolts fitted into pre-drilled holes that allow moisture and other pollutants to enter.
- The worst corrosion occurs near the neck of the bolt and will be due to the worst case of either embedded or atmospheric corrosion.

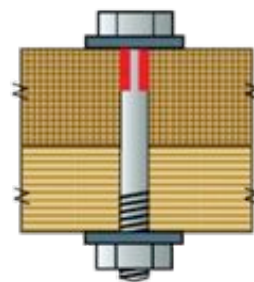


Figure 8.5 A typical bolt embedded in wood (red marks denote where corrosion is considered)



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Corrosion of fasteners

- Embedded example (Shanks of nails, screws etc)
- The typical service life estimates are taken as the estimate of the mean time taken for the fastener to lose 30% of their initial tension or bending strength.



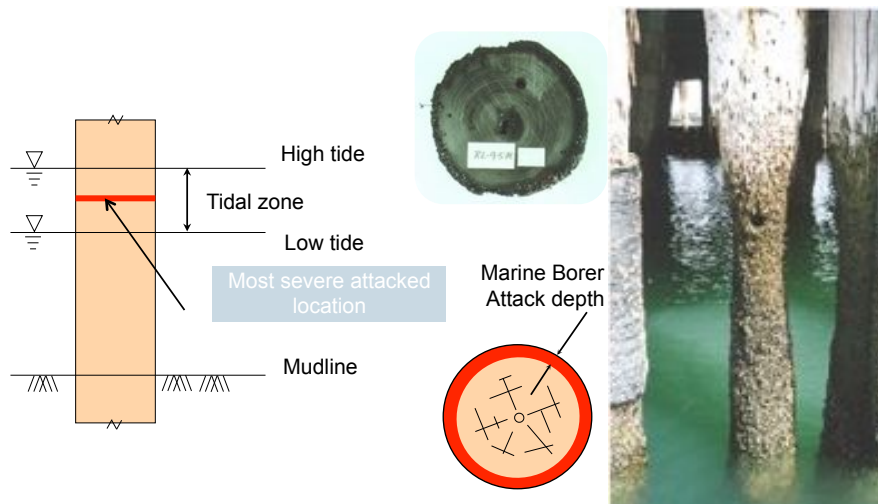
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Marine Borers



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'TimberLife' – Educational software



TimberLife can be downloaded free from:

www.woodsolutions.com.au



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TimberLife - Opening screen



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TimberLife – Main Menu

- There are seven discrete programs covering a range of hazards and predictions.
- Each is stand alone.
- Many screens have a help button that provides additional information and advice to guide users in their decision making.



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Example – round pole in Vic



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TimberLife – Select Location

Input all data under each tab as shown. The data you input will be saved and can be changed later.

Step 1: Enter pole location.

The pole house is located in Decay Hazard Zone B

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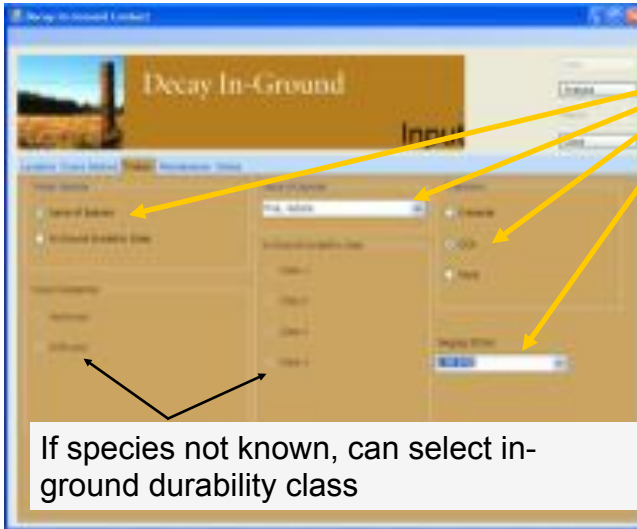
TimberLife – Select Cross-section

Assume the pole will be H5 treated plantation softwood with a diameter of 350 mm and approximately 70 mm sapwood band width typical of plantation pine poles.

Select circular and enter dia.. And sapwood thickness.

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TimberLife – Select Timber



The next step is to define the timber natural durability class or species if known and the hazard treatment level if treated. For this example, assume the pole is radiata pine, treated to H5 with CCA in accordance with AS 1604.1 as a building pole.



TimberLife – Define maintenance if any



This option allows users to select additional preservative maintenance that can be applied at the time of installation of the pole or at specified intervals, such as external diffusing paste applied to the pole 15 years after installation.

Users also have the option to add notes to the file being created. These may relate to the specific job being considered and any other information relevant and important to the user.



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TimberLife - Analysis

When all data is input hit the Analysis tab. Analysis will be undertaken on the input data and can be displayed as either decay depth or a strength time relationship. Your input information can also be checked at this point

If you wish to change your inputs, return to the input tab and make alterations accordingly. When you are happy with your analysis, you can view, print or save a report of the analysis and input data

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TimberLife – Analysis (Cont.)

This screen shows the Strength vs time analysis option. It can be seen that after a period of 100 yrs, the predicted loss of bending strength in the pole due to decay from the outside is approximately 15%.

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TimberLife – “What if” exercise?

- In the preceding example we have considered a situation that predicts a relatively long life for CCA treated plantation softwood poles.
 - But what if we keep most things the same and just change some of the input variables to:-
 - In-ground Durability Class 2 hardwood e.g. Spotted gum
 - 300 mm dia. and
 - 20 mm, H4 treated sapwood envelope
- What happens to the predictions then



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TimberLife – “What if” example



These changes in some of the input variables result in internal as well as surface decay occurring, a more rapid rate of surface decay and total loss of the 20mm treated sapwood zone at about 70 years where there is a small 'lag' period before the untreated heartwood starts to decay from the outside. Of course, the strength-time predictions also change.



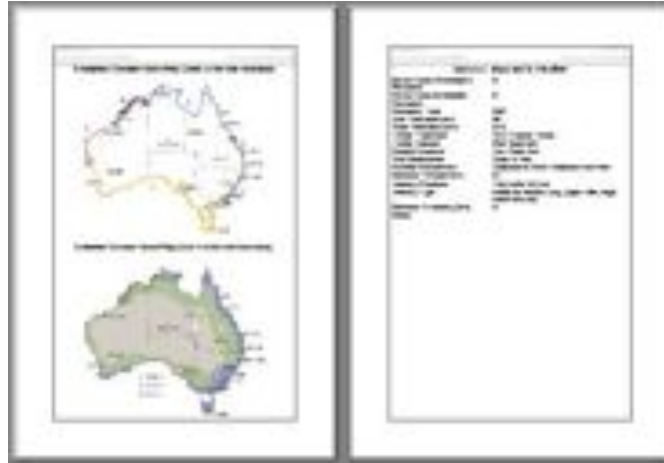
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TimberLife – Reports



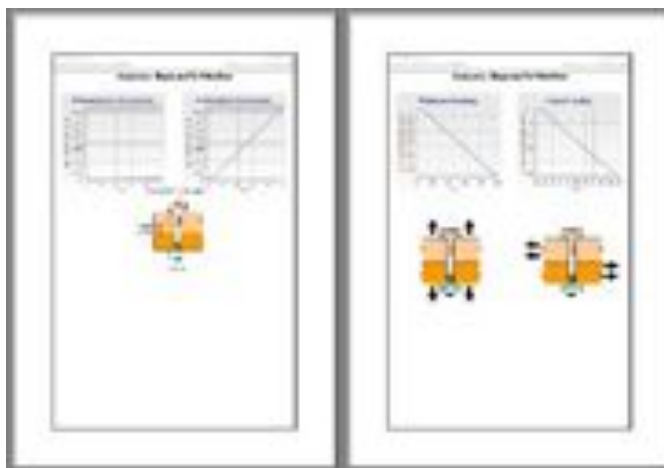
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TimberLife – Reports



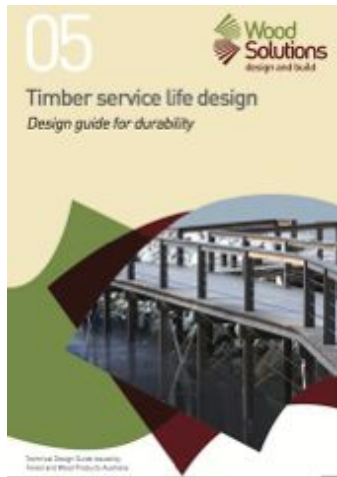
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Summary

- Timber is a biodegradable material
- The hazards to timber can be rated by class (building) and by zone (region)
- It resists biodegradation naturally or through applied treatments
- Weathering is a natural process which can be managed in design
- Avoiding decay requires removing the fungi food source by treatment or design to manage moisture content
- Design guides and software packages allow more reliable prediction of service life



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Summary

Thank you



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