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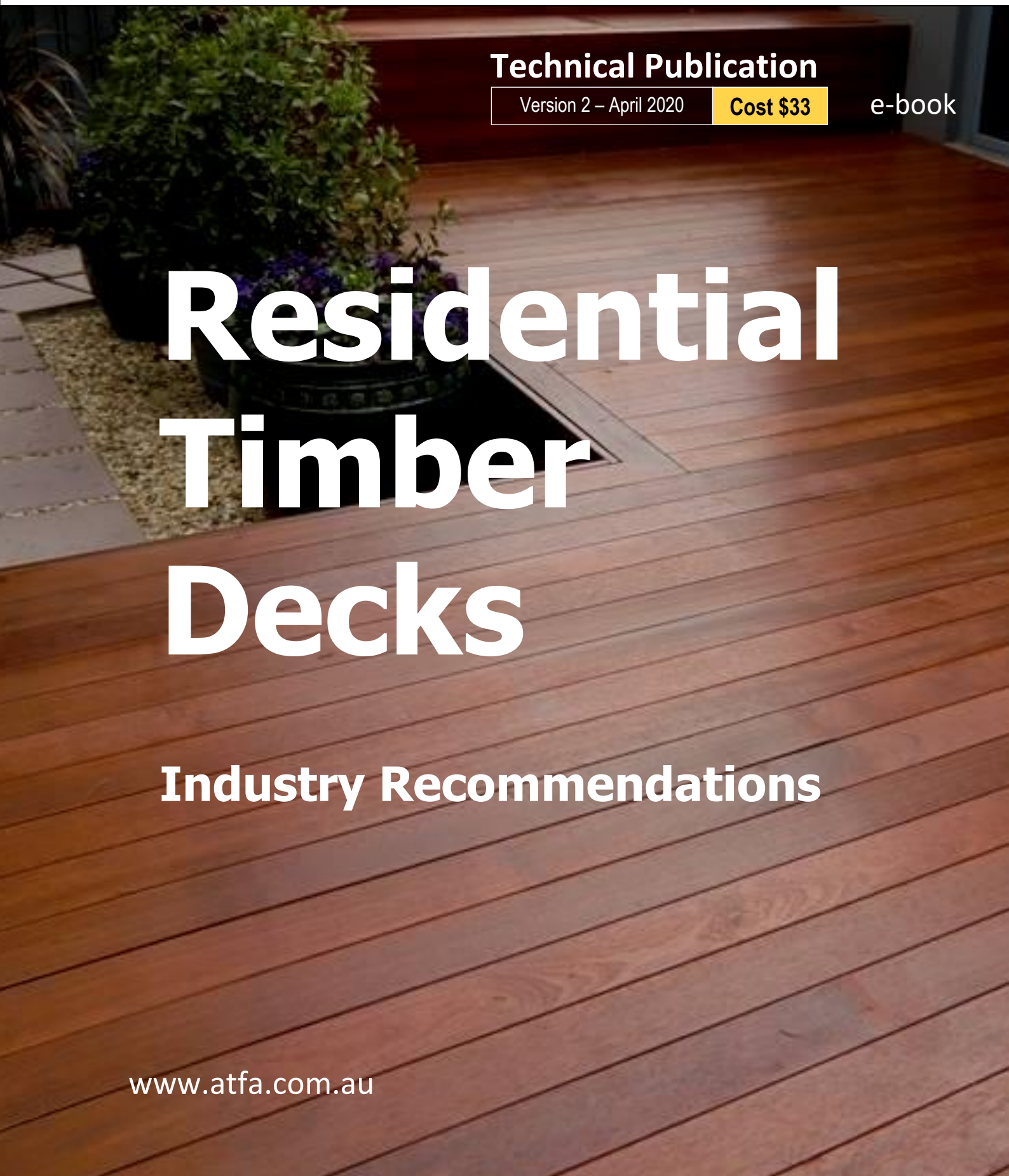

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Residential Timber Decks

Industry Recommendations

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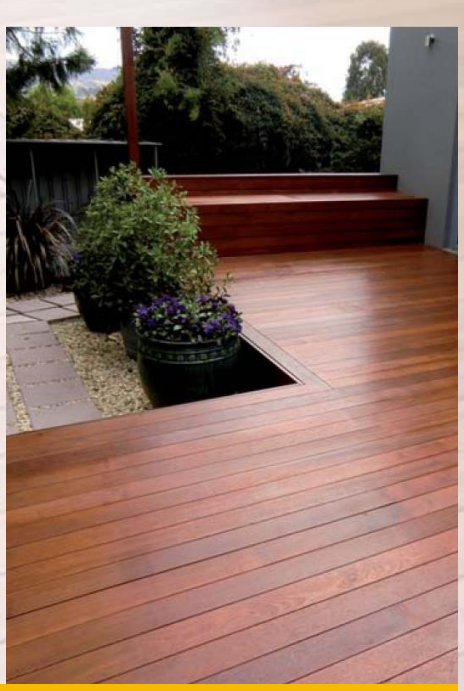

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Prepared by

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Australasian Timber Flooring Association

with the assistance of 'atfa' member companies and organizations who provided information and photographs.

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Introduction

Scope

This publication covers the construction of residential decks suitable for weather-exposed applications with timber decking boards to timber sub-frames and either timber or steel posts. With this class of building the deck is designed for a uniformly distributed load of 2.0 kPa, a point load of 1.5kN and line loads. In addition to this the mass of decking supported by the framing is limited to 20kg/m^2. In situations where treated timber (including CCA, ACQ and Copper azole) remains at more than 20% moisture content for extended periods these applications require greater consideration of the treatment level, fixings and fasteners used in such environments. It should also be noted that local government authorities generally have specific requirements relating to deck construction that must be adhered to, including building approval. The need for building approval relates to aspects such as the size of the deck, its elevation above ground and whether the deck is attached to the dwelling.

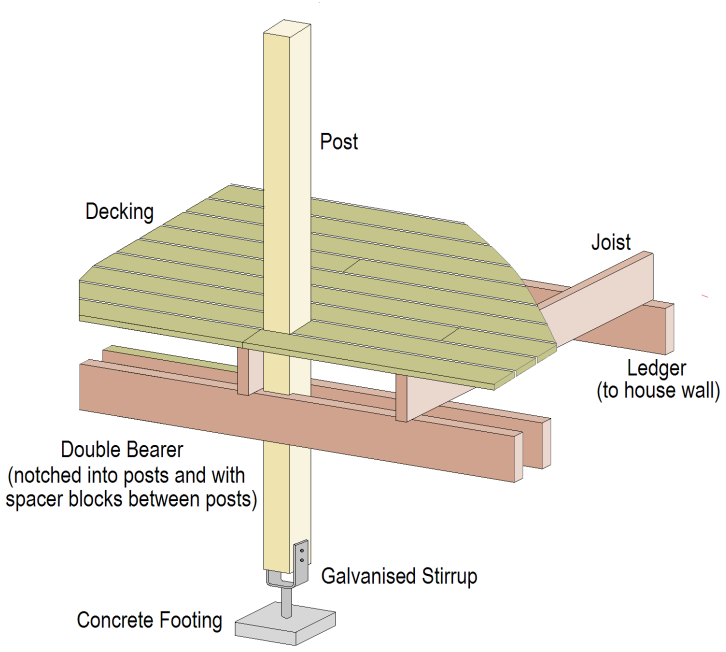
The customer's choice

When considering a timber deck, there will a range of aspects that need to be considered as out outlined below:-

- Decking material – this will require assessment of product stability, board width, ongoing maintenance and durability.
- Sub-frame materials – with consideration of such aspects as durability.
- Appearance – aspects of colour, texture and overall look which is affected by fixing method and coating choice.
- Ease of use – this will be partly governed by whether it is owner installed or professionally installed. Also aspects of site accessibility must be considered. Owners considering installing a timber deck themselves also need to consider their level of skills to obtain a professional installation.
- Budget – it is important to include all costs relating to the options available and understand that the cost will vary depending on the option chosen. The desired appearance and ongoing maintenance are also important considerations.
- Product and installation warranties – generally with natural products warranties are minimal but the performance of these products is well established. Manufactured products often come with warranties.
- Local building codes – all local councils and governments will have guidelines for the construction of decks so be sure to investigate before starting.
- Long term care and maintenance – all products should come with manufacturer or industry recommended guidelines with respect to ongoing care and maintenance. It would be prudent to evaluate these at the beginning of the project.

Deck terminology

Provided below in the diagram are terms regarding the main structural elements used with decks. A more complete terminology section, including many other terms used with timber decks is provided in section 9.



1 Properties of timber decking

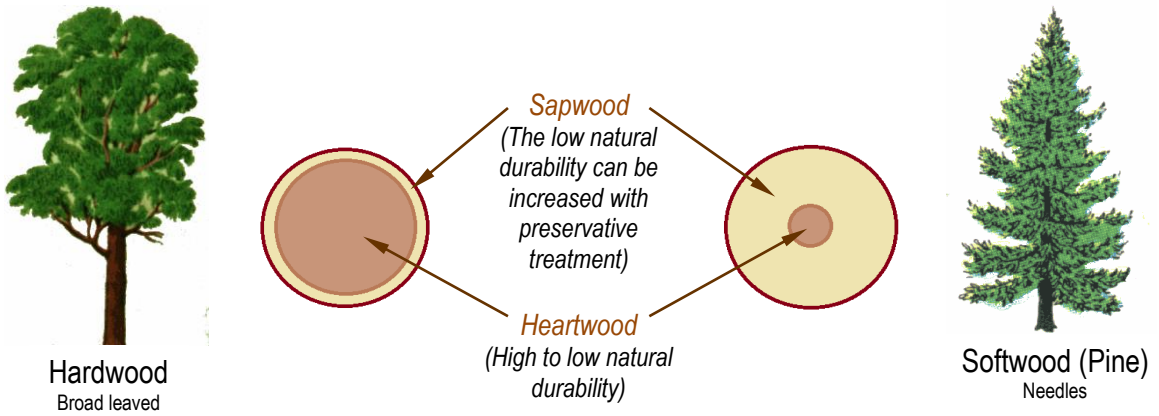
1.1 Timber Decking

Timber decking has a long-established history in Australia with both hardwood and softwood decks complementing many homes. When using timber in exterior applications there are some important aspects to understand and be considered and these are outlined below.

1.1.1 Performance of weather exposed timber

When timber is used in external exposed applications there are a number of considerations to ensure that it gives lasting performance. Timber must be able to withstand the hazards associated with exposure to sun and rain, termite activity and decay fungi. Durability refers to the ability of the timber to withstand these hazards. The severity of these hazards varies throughout the country with more severe conditions in the tropical north and less severe inland and in the cooler southern regions. Requirements for Queensland are provided in 'Construction Timbers in Queensland' which is called up by the 'Building Code of Australia' (BCA) and in other states guidance can be obtained from a software package through the Forest and Wood Products Australia (FWPA) website. Further details on these are provided at the end of section 1.1.2.

Some timber species are naturally more durable than others and it is important that we have an understanding of this. Firstly, however it is necessary to know the differences between the natural durability of hardwoods (broad leafed trees) and softwoods (conifers or pines). All trees contain heartwood and sapwood and in softwoods the sapwood band is much larger than in hardwoods. The sapwood is the timber beneath the bark and is often lighter in colour than the heartwood further in and to the core of the tree. Concerning natural durability, the heartwood of some hardwoods is very durable and in other hardwoods it has low durability. However, in softwoods the heartwood of most species is of low durability. The sapwood is of low durability in both hardwoods and softwoods but in many species the durability of the sapwood can be increased to be highly durable through preservative treatment. These concepts are outlined in the diagram below.



Therefore when hardwoods are used externally it is necessary to ensure that the heartwood is suitably durable and that any sapwood present has been preservative treated to cater for the hazards. Similarly, in softwoods it is necessary to ensure that the sapwood is treated to withstand the hazards and then to limit or encase with preservative the low durability heartwood. There is one special exception to this which is White Cypress. In this softwood the natural chemicals in the heartwood provide natural resistance to both termite attack and decay and its use is discussed in the next section.

Common decking timbers are rated in terms of the natural durability of their heartwood and are given separate ratings for use in ground and above ground. Timbers are therefore allocated both in-ground and above ground durability classes. The conditions in-ground being much more severe due to moisture, presence of termites and the possibility of warm conditions which promote decay. There are four classes with class 1 having the highest durability and class 4 the lowest.

In addition to natural durability being rated, the environmental hazards are also rated. Of relevance to timber deck installations are hazard classes H3, H4 and H5. Hazard class H3 represents a hazard where timbers are not in contact with the ground but still weather exposed, in the presence of termites and conditions to decay are moderate. This therefore relates to the likes of decking boards and posts in stirrups. The hazard H4 relates to in-ground conditions and where decay conditions are more severe such as framing timbers for decks close to the ground. For

posts in-ground H5 treated posts are to be used in Queensland and are recommended in NSW. In Victoria and Tasmania H4 and H5 treated posts are used. It should be noted that H5 treated posts are generally not available off the shelf and usually need to be ordered. 'AS 1684 – Residential Timber Framed Construction' recommends in an informative appendix that posts in-ground should be treated to H5.

For decking applications we therefore need to consider the natural durability of the heartwood to withstand the hazard, the level of preservative treatment of the sapwood to withstand the hazard and also the hazard itself in terms of where the timber is being used. In addition to this when decks are close to the ground in termite prone areas then only termite resistant hardwoods should be used. This is outlined in the table.

Elevated decks (more than 400mm off the ground)	
Decking, joists, bearers, stairs, fascia and posts not in-ground.	Hardwoods of above-ground durability class 1 and sapwood treated to H3. Softwoods with sapwood treated to H3 and heartwood limited. Cypress (requires water repellant preservative prior to installation).
Posts in-ground.	Hardwoods with in-ground durability class 1 and sapwood treated to H4 or H5 (depending on the state). Softwoods with sapwood treated to H4 or H5 (depending on the state) and heartwood limited.
Decks close to the ground (less than 400 mm off the ground)	
Decking, fascia and framing more than 150mm above the ground.	Hardwoods# of above-ground durability class 1 and sapwood treated to H3. Softwoods with sapwood treated to H3 and heartwood limited. Cypress (note requires water repellant preservative prior to installation).
Posts and framing less than 150mm above the ground.	Hardwoods# with in-ground durability class 1 and sapwood treated to H4 or H5 (depending on the state). Softwoods with sapwood treated to H4 or H5 (depending on the state) and heartwood limited.

Note that in termite prone areas only termite resistant hardwoods are to be used.

1.1.2 Suitable timbers

Provided in the table is information on species or species groups used for decking installations. For the Australian hardwoods, in addition to information on how the timber is being used (application), both the heartwood durability class (above and in-ground) and termite resistance is also provided. Note that hardwood decking boards need to be either Select Grade (having minimal feature) or Standard Grade (having moderate feature), or as is often sold, a mix of these two grades termed 'Standard and Better'. The proportion in this grade mix will differ between suppliers. Near equivalent manufacturer grades to Select and Standard grade are also produced. For details on the type and size of features permitted in Select and Standard grade refer to 'AS 2796 – Timber – Hardwood –Sawn and milled products'. For fully weather exposed applications either 'Standard or Better' or Select Grade decking should be used to provide better performance.

Australian Hardwood species or species group	Application			Durability class		Termite resistance
	Posts (in ground in drier locations only) Framing (within 150mm of the ground and sapwood H4 treated)	Posts (above ground) Framing (above 150mm of the ground and sapwood H3 treated)	Decking boards (Sapwood H3 treated)	In-ground	Above ground	
Blackbutt	See note	Yes	Yes	2	1	Yes
Forest Red Gum	Yes	Yes	Yes	1	1	Yes
Gympie Messmate	Yes	Yes	Yes	1	1	Yes
Grey Box	Yes	Yes	Yes	1	1	Yes
Grey Gum	Yes	Yes	Yes	1	1	No
Ironbark (Red & Grey)	Yes	Yes	Yes	1	1	Yes
Jarrah	See note	Yes	Yes	2	2	Yes
New England Blackbutt	See note	Yes	Yes	2	2	Yes
Red Mahogany	See note	Yes	Yes	2	1	Yes
River Red Gum	See note	Yes	Yes	2	1	Yes
Silvertop Ash	See note	Yes	Yes	3	2	No
Spotted Gum	See note	Yes	Yes	2	1	Yes
Rose Gum (River Reds)	See note	Yes	Yes	3	2	No

Tallowwood	Yes	Yes	Yes	1	1	Yes
Turpentine	Yes	Yes	Yes	1	1	Yes
WA Blackbutt	See note	Yes	Yes	2	1	No
White Mahogany	Yes	Yes	Yes	1	1	Yes
White Stringybark	See note	Yes	Yes	2	2	Yes
Yellow Stringybark	See note	Yes	Yes	3	2	Yes
Mixed Hardwoods Forest Reds (NSW & QLD open forest)	See note	Yes	Yes	1	2	No

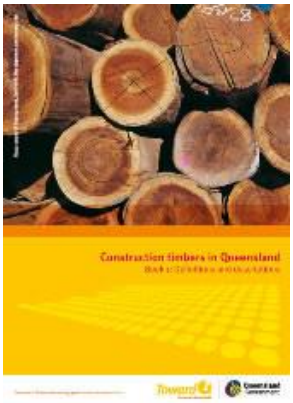
Note: Insufficient service life if used as an in-ground post but may be used for framing close to the ground.

Hardwood decking boards may be from imported species and provided in the table is a list of common imported hardwood decking species together with their durability class and termite resistance. These products are often free of feature and in such cases, they would meet Select Grade (Refer to AS 2796). Additional information on imported hardwood may be available from the Australian Timber Importers Federation. Their website is http://www.atif.asn.au/.

Imported hardwood decking species	Durability class		Termite resistance
	In-ground	Above ground	
Belian	1	1	No
Hopea	2	2	No
Kapur	3	2	No
Kwila or Merbau	3	1	Yes
Pacific Crows Ash (Apuleia Ferrea)	2	1	Yes
Pacific Jarrah (Manilkara Bidentata)	1	1	Yes
Pelawan (Northern Box / Northern Red)	2	1	No
Southern Spotted (Dipteryx Odorata)	1	1	Yes
Yellow Balau (Selangan Batu)	2	1	No

As outlined above the heartwood of White Cypress has natural durability properties and now a limited number of sawmills can treat the sapwood whereas previously it was not possible to treat effectively. Untreated Cypress framing should contain no more sapwood than 25% of the width and 25% of the adjacent thickness. On installation untreated sapwood should not be on the top edge and not occur at joints or fixing locations. With Cypress decking it is also necessary for it to have smaller features, particularly knots (Grade 1 in 'AS 1810 – Timber – Seasoned cypress pine – Milled products') and when not preservative treated decking boards should also be installed with any sapwood facing down. Also note that recommendations are that Cypress should be coated with a water repellant preservative at the time of installation and this includes all joints. Final finishing after installation is also required. Cypress with sapwood is not suitable for decks that have framing members on the ground or generally in areas where prolonged wet and damp conditions can prevail for long periods (e.g. a bushy gully).

Pine posts and framing may include species such as Radiata Pine, Hoop Pine, Carribean and Slash Pine. When posts are used in-ground or framing is within 150mm of the ground, they are to be preservative treated to H4 or H5 (for Queensland and NSW). Framing within 150mm of the ground is to be treated to H4. Posts above ground and framing greater than 150 mm above the ground is to be preservative treated to H3. Radiata Pine decking is available throughout Australia with Hoop Pine also available in Queensland and both require preservative treatment to H3. With pine decking it is generally available in grades that are free of knots and a grade containing tight knots and other features. If of a grade containing knots and other features, then lesser performance such as tendency to twist is more likely.



In Queensland the use of timber is governed by the publication 'Construction Timbers in Queensland' which is called up by the 'National Construction Code' (NCC). This is available to be downloaded at the website:

https://www.publications.qld.gov.au/dataset/construction-timbers-in-queensland

Regarding this publication all decking boards in coastal and tropical Queensland need to be above ground durability class 1 hardwoods with sapwood treated to H3, softwoods treated to H3 or Cypress.

For further information on durability aspects around Australia information is available on the Forest and Wood Products Australia (FWPA) website as a software package called 'TimberLife'. It may be downloaded from this address.

http://www.woodsolutions.com.au/Resources/TimberLife-Educational-Software-Program

1.1.3 Timber treatments

The treatment of timber is covered by 'AS 1604 Timber – Preservative treated – Sawn and round' which outlines the levels of preservative and cross sectional area that needs to be treated in order to resist decay and insect attack for the various hazard classes.

Structural members are often treated with the water-based treatments ACQ, Copper Azole and CCA which can provide treatments to resist H3, H4 and H5 hazards. Decking is treated to resist an H3 hazard with ACQ and Copper Azole but not CCA due to possible frequent close contact with children on un-coated decking boards.

Products requiring H3 treatment, may also be Light Organic Solvent Preservative (LOSP) treated. This includes framing, handrails, balusters and structural members. It has the benefit that timber can be profiled prior to treatment (e.g. handrail and balusters). Manufacturer advice needs to be sought with H3 LOSP treated timber that is pre-primed as additional requirements may be necessary. This can include light sanding and re-priming of some pre-primed painted products with a high quality solvent base primer prior to further painting.

All treated timber requires cut ends, notches, bolt holes and check outs to have supplementary preservative applied (e.g. the products 'XJ Clear', 'Endseal Clear' or 'Ecoseal' respectively from the companies Osmose Protim Solignum and Tanalised). This is necessary to protect exposed untreated heartwood of low durability species and avoid early failure of the piece.

Treated timber, like all timber should be appropriately coated and maintained.

Product hazard class can be identified by a brand on each piece of timber. This brand includes: identification of manufacturer; two-digit preservative code number; and hazard class rating. For best performance, it is very important that the hazard class rating is matched to the conditions to which a timber piece will be exposed. Detailed information on the hazard class rating system may be obtained from, AS1604, the TPAA website, various supplier websites and the preservative company websites.

1.1.4 Timber moisture content

Concerning moisture content, framing members are often unseasoned and due to this shrinkage in the bearers and joists may need consideration if the deck is to abut another surface to be walked on. In such instances seasoned bearers and joists should be considered but can be more difficult to obtain. Decking boards require drying to reduce shrinkage movement and warping after installation. The recommended moisture content range is 10% to 15% for all species types even though the Australian standard for hardwoods permits up to 18%. Note that in many well ventilated decks board moisture contents may average about 12% and boards with moisture contents significantly higher will be much more prone to shrinkage, checking (surface splits) and warping (cupping and twisting).

1.1.5 Board profiles and sizes

The most common decking profiles are the reeded surface profile and pencil round profile although decking can at times be a plain or square edged profile. These are shown below.

Reeded | Pencil Round | Plain or Shot edge

The pencil round profile provides a softer appearance with edges that are smooth and less prone to splintering. The same can be achieved when the reeded profile is fixed with the reeded face down. It is the owner's choice whether they want the reeded face up or down. However, when laid with the reeded face up to achieve a more 'non-slip surface', then regular maintenance is necessary as both dirt and mould in the grooves can result in a more slippery surface that is also more prone to decay. It should also be considered that coatings flow off the reeds and such decks are harder to keep clean.

Boards for residential decking are generally 19mm thick for hardwoods, 21mm thick for Cypress and 22mm for other softwoods. These thicknesses permit spanning of joists at 450 mm centers. Widths for Australian hardwood species vary between manufactures but include 42mm, 64mm, 86mm, 130mm and 136mm. Imported hardwood species are often 90mm wide but with narrower and wider widths available from some suppliers. Softwood decking is often 70mm, 90mm and 120mm wide and Cypress 68mm.

2 Deck design and foundation considerations

2.1 Elevated timber decks

Elevated decks refer to any deck where there is more than 400mm between the ground level and bottom of the sub-deck framing. Decks below this fall into the category of 'decks close to the ground' as covered in section 2.2. For elevated decks with the deck surface at any point 1m or greater above natural ground level there are a number of requirements that do not apply to decks lower than this or designated as being 'close to the ground'. This includes handrails that must be at least 1 m high and with balustrade spacing not greater than 125mm. If a deck is more than 4m above ground level then handrails must not have any climbable elements between 150mm and 760 mm above deck level. As such building approval is also necessary for these decks and requirements can differ between councils.

2.1.1 Ground preparation and foundations

When considering the location of the deck, be aware of the possibility of underground services and also services on the dwelling, access to which may be obstructed due to the deck. Once a deck is in place it can be difficult to access the area beneath it and this too should be considered.

The site needs to be cleared of vegetation and the ground conditions need to be suitable for the deck foundations. Aspects that need to be considered relate to any back filling and settlement that may occur with, for example, tree stumps being removed. In some areas soils can also be reactive and potentially subject to greater movement unless catered for at the design stage.

The ground beneath a deck also needs to be graded with the fall away from any buildings as it is important that water does not pond beneath the deck. As such a proper drainage system may need to be incorporated. A 'sock' covered 'aggie' pipe can often remove surface water when there is minimal ground fall. Where the deck is elevated but still relatively close to the ground, partly enclosed or in a damp environment, either the laying of builder's plastic or geo-textile fabric over the ground and held in place with gravel or stones can be beneficial. This significantly reduces the soil evaporation from beneath the deck that can cause both cupping and closure of expansion gaps between boards.

Decks with supporting posts must meet the requirements of the 'AS 1684 – Residential Timber Framed Construction' and 'AS 2870 – Residential slabs and footings'. This includes initial classification of the site in order to determine the size of the footings and may require a structural engineer to assist.

Concrete footings with galvanized steel post brackets or stirrups are preferred. The bottom of the post needs to be at least 75mm above the concrete footing to provide good ventilation beneath the post and also the necessary gap for termite inspection purposes.

Timber posts can be embedded in the ground however the durability of the timber also needs more careful consideration as does the ease with which the post could be replaced should decay occur some years in the future. Alternatively, steel posts that are hot dipped galvanized may be used.

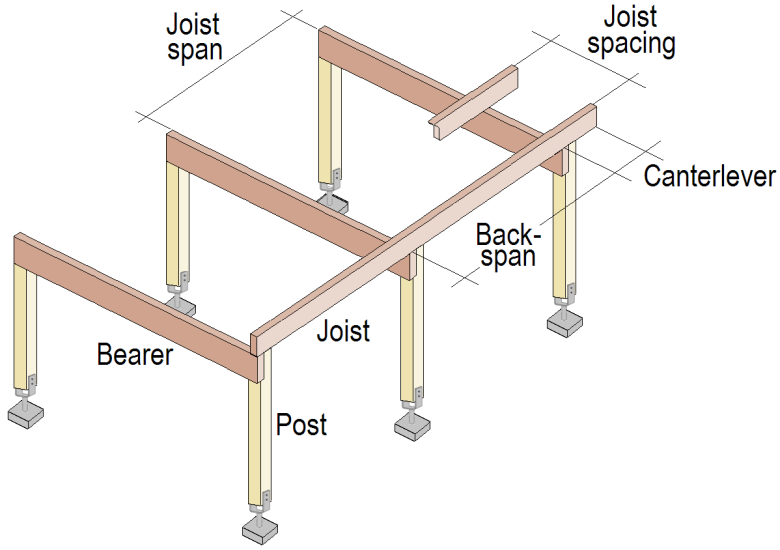
2.1.2 Timber post, bearer and joist selection

The design of timber decks is contained in 'AS 1684 – Residential Timber Framed Construction' and requirements differ depending on whether the deck is up to 1m above the ground or higher. Similarly, some deck posts may also support covered verandahs and need to support the combined weight of the deck and roof. Therefore, other than for simpler decks, some more in-depth design work is required and may need the services of a designer or builder.

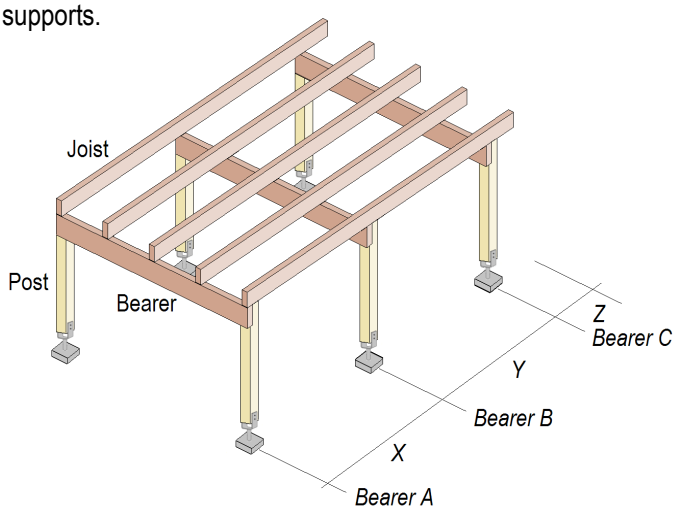
Note that some timber suppliers also provide services for sizing deck framing and posts, but it is nevertheless also important to have an understanding of the sizing of members for simple decks.

As such we will consider a timber deck with posts, bearers fixed to the posts and supporting the deck joists onto which the decking is fixed.

Initially, it is important to understand what is meant by 'simple span' and 'continuous span' as this can affect the sizes of timber bearers and joists that can be used. The span is the distance between where bearers or joists are supported and differs from the spacing which is from centerlines. A 'simple span' is where the bearer or joist only has two supports. In the diagram below this is the case for the bearers that are supported by two posts. With 'continuous span' the bearer or joist has more than two supports and in the diagram below this is the case for the joists that are each supported by the three bearers. One other term to be considered is what is known as a 'cantilever' and this relates to a bearer or joist that extends past a support. The 'backspan' is a term also used. With cantilevered joists this refers to distance to the next bearer behind which the joist is cantilevered. Regarding a cantilevered joist it may be up to 25% of the allowable joist span provided that the backspan is at least twice the cantilever. The meaning of these terms is diagrammatically shown below.



Next it is necessary to be able to calculate the 'floor load width' and from this the bearers can be selected based on the desired post spacing and then the size of the joists determined. The floor load width is the width of floor that the bearer needs to support, and it differs between bearers so the bearer size, is selected based on the bearer with the greatest floor load width. The diagram below outlines the building elements and how the floor load width would be calculated for the three bearers involved. This is sometimes thought of as the length of joist that the bearer supports.



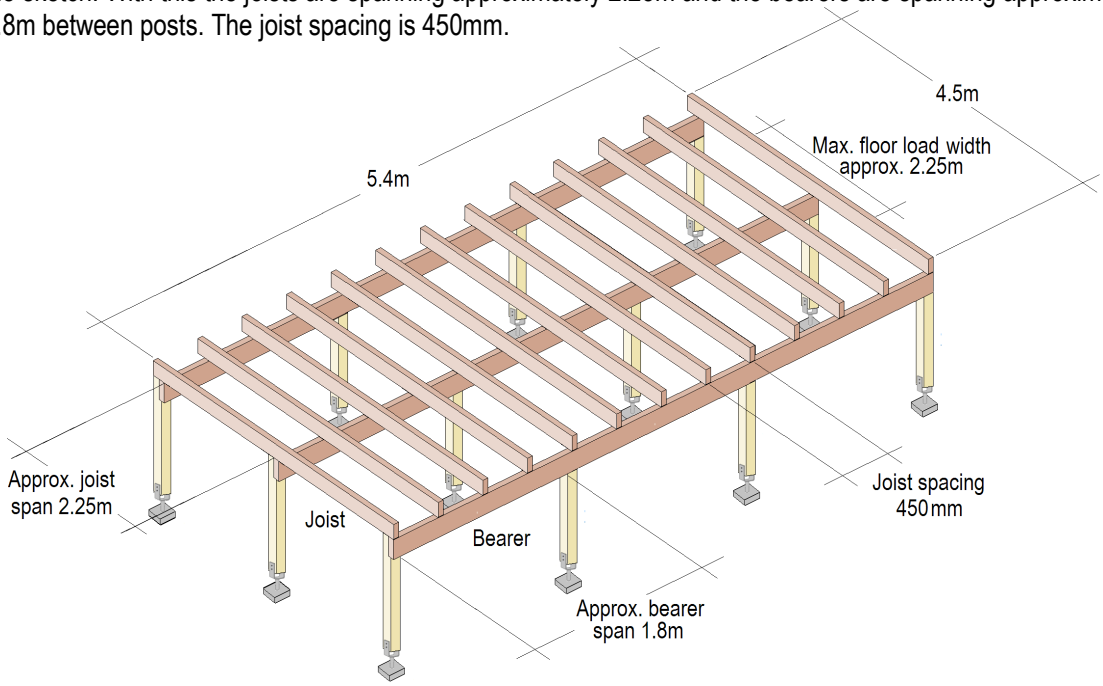
Bearer	Floor Load Width
A	= *X*/2
B	= (*X* + *Y*) / 2
C	= *Y*/2 + *Z*

For a deck to carry a live load such as people walking on it, what is termed the 'strength' and 'stiffness' of the bearers and joists are important. The strength is a measure of the weight or mass that can be carried safely, and the stiffness relates to how much the bearer or joist deflects when under load. Both these aspects are important

with one or other dictating the design of the member. At times you may have walked into a house and considered that the floor is quite bouncy. In this case although the strength may not have been an issue the lower stiffness is causing the sensation of a bouncy floor. The concept of reducing the span or increasing bearer or joist size to increase stiffness and reduce the bounce is just as relevant to timber decks as it is to internal floors.

With any deck there is often a choice of how the posts will be spaced noting that the wider the post spacing the larger the bearers and joists will be. Span tables are available which provide the options linking post spacing, floor load width and bearer size. The following provides an example of designing a simple deck and for this tables are used either from 'AS 1684 – Residential Timber Framed Construction' or other published tables generated from it. *N.B. The tables used below are for example purposes on how to use the tables and are not be used for actual design because the assumptions relating to these tables have not been provided.* Many different span tables are available covering hardwood, softwood and cypress of various stress grades for decks up to and above 1m high.

Consider the following where a deck is 4.5m in width and 5.4m long. As such we may want to lay it out as shown in the sketch. With this the joists are spanning approximately 2.25m and the bearers are spanning approximately 1.8m between posts. The joist spacing is 450mm.



A table for bearer sizing based on floor load widths for unseasoned stress grade F14 hardwood is provided. Hence with the posts 2.25m apart across the width of the deck the maximum floor load width in this case is also 2.25m. From the table it indicates that for a floor load width of 2.4m we could choose 125 x 75mm bearers to span 1.8m with bearers 5.4m long (continuous span). Two 100 x 50mm sections nail laminated together may also be an option however if bearers 5.4m long were unavailable and it was decided to use some at 3.6m and others at 1.8m to make up the 5.4m length, then the single span tables would govern the design. In this instance it can be seen from the table that the size would not change if using 125 x 75mm, but the other possible option of 2/100 x 50mm would no longer work. It should also be noted that the next largest dimension above what we are looking for is chosen in the tables. The arrows show the process.

MAXIMUM BEARER SPANS (mm)
Unseasoned hardwood F14 stress grade

Bearer Size (mm) Depth x Thickness	Single Span Floor Load Width (mm)			Continuous Span Floor Load Width (mm)		
	1800	2400	3000	1800	2400	3000
100 x 75	1700	1400	1300	1700	1400	1300
2/100 x 50	1900	1700	1600	2100	1800	1600
125 x 75	2100	1800	1600	2100	1800	1600
150 x 75	2500	2200	1900	2500	2200	1900
175 x 75	2900	2600	2300	2900	2600	2300
2/150 x 50	2900	2600	2400	3100	2700	2400
200 x 75	3400	2900	2600	3400	2900	2600

Similarly, when it comes to joists other tables are used and the example this time will be for seasoned treated pine stress grade F7continuous span joists. Therefore, with the joists at 450mm spacing and in our example the joists spanning about 2.25m, then a joist size of 140 x 45mm would be required. Note that in this case the single span and continuous span sizes are the same. Again, there are many tables with many combinations of timber species group and stress grade as well as joist spacing.

MAXIMUM JOIST SPANS (mm) Seasoned Treated pine F7 stress grade, joist spacing 450mm		
Joist size (mm) **Depth x Thickness**	**Single Span**	**Continuous Span**
90 x 45	1300	1700
120 x 45	2200	2200
140 x 45	2600	2600
190 x 45	3600	3600
240 x45	4500	4500

Note that by choosing joists that span 2.6 m rather than say 2.2 m we are providing a stiffer deck structure which is also beneficial. For more flexible decking materials (pine versus hardwood decking) we may choose narrower joist spacing or for stronger thicker decking a joist spacing of greater than 450mm may be appropriate. Although tables may indicate sizes for 35mm thick pine joists or 38mm thick hardwood joists, thickness of 45mm or wider are recommended for nailed decking as the additional width alleviates concerns with splitting of the joists particularly when fixing decking board butt joints over the joists.

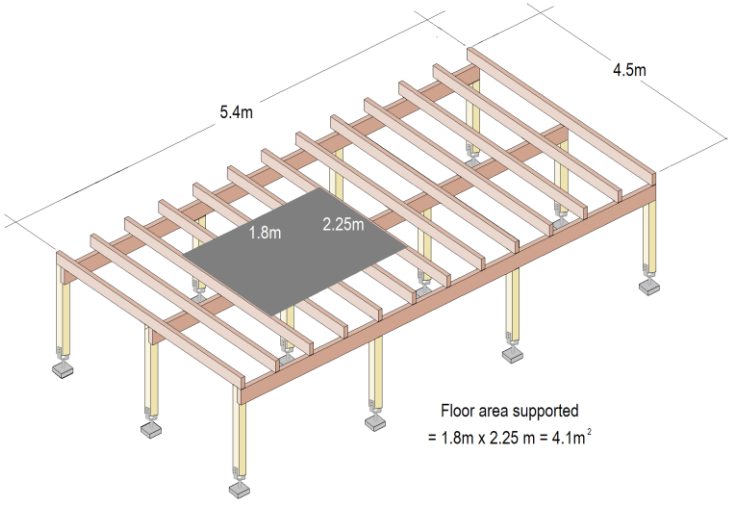
Once you interpret these tables which are based on engineering formulas, the design of the deck is somewhat simplified. Various tables are available from various sources including timber organizations, companies selling decking material and from 'AS 1684 – Residential Timber Framed Construction'. In addition to this design computer software incorporating the principles above is available and links to such software can be found on the national timber website at:-

https://www.woodsolutions.com.au/articles/span-tables-and-software

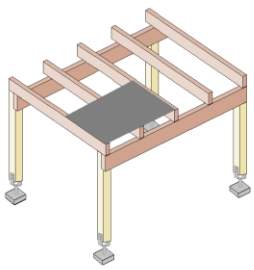
Finally, we need to consider the deck posts. Timber posts may be either hardwood or softwood. The cross sectional size is typically 75 x 75mm or 100 x 100mm for unseasoned hardwood posts (stress grade F11, F14 and F17 are common), seasoned laminated hardwood posts 90 x 90mm and larger (grade GL 13), unseasoned Cypress (stress grade F5) and 70 x 70mm or 90 x 90mm for seasoned treated pine (stress grade F7).

The required post size will depend on the floor area supported and whether the post is also supporting a covered verandah, the roof area being supported and roofing material. These factors will also govern the allowable post height. For posts supporting roof loads further guidance on design is covered by 'AS 1684 – Residential Timber Framed Construction' or a building designer may be consulted.

Another term has been introduced and this is the 'floor area supported'. This is the maximum area of decking that the post will have to support. With reference to the two diagrams below, the maximum 'floor area supported' can be visualized and also provides the calculation for the example above.



Example deck



Deck with 4 posts

With decks not supporting roof loads as in our example above, the table below is an example of the type of table that would be used, but also be aware that there can be additional size and span requirements with newel posts for handrails (refer to section 5).

MAXIMUM POST HEIGHT (mm)			
Post type	**Post size**	**Floor area supported Up to 5 m^2**	**Floor area supported 5 to 10 m^2**
Unseasoned Hardwood F14	75 x 75	2900	2000
	100 x 100	4800	3500
Seasoned Treated Pine F7	70 x 70	2400	1700
	90 x 90	4100	2900
Unseasoned Cypress F5	75 x 75	2000	1400
	100 x 100	3600	2500

In addition to the above all decks require diagonal bracing when attached to a dwelling. If freestanding and the posts are embedded in concrete in the ground, then no bracing is necessary provided no post exceeds 1800mm above the ground. In this case the embedded post provides sufficient restraint to lateral movement. However, all freestanding decks with posts in stirrups will require bracing. Bracing requirements are covered in section 3.2.5.

It is apparent that the choice of materials will affect the size of framing members and their spacing and that a balance needs to be achieved between what is structurally adequate and most economical. Material availability is also a consideration as at times deep bearers or long lengths may be difficult to obtain. An abridged set of span tables is provided in Appendix 1 however this is only a small subset of what is available when using the tables in 'AS 1684 - Residential Timber Framed Construction' or the design software that is available.

2.1.3 Steel posts

As an alternative to timber posts, steel post may be used. The specification, in terms of the size of post required, is provided by the post manufacturer. Typical posts will be 75 x 75mm with a 4mm wall thickness and will be hot dipped galvanised. Recommendations may also warn against their use within 300m of the sea or near salt pools. The posts are usually available with flat or angle plates at the top and posts are generally concreted in place.

2.2 Decks close to the ground

'Decks close to the ground' refers to any deck where there is no more than 400 mm between the ground level and bottom of the sub-deck framing. With these decks the deck framing bearers may be on the ground or raised above it with footings and foundations as indicated in section 2.1 on elevated decks.

2.2.1 Ground preparation and supports

When timber decks are located close to the ground conditions can often become very wet for extended periods of time if not attended to at the design and construction stage. It is therefore necessary to give due consideration to aspects of surface drainage and ventilation, as well as selecting the appropriate timbers and ensuring future access to the termite protection and future maintenance.

Prior to construction it is important that water cannot pond beneath the deck, therefore the ground beneath the deck needs to be sloped and a drainage system may need to be added. To provide a clean weed free environment beneath the deck, black 'builders' plastic membrane or geotextile fabric over the soil that is the covered with stones or gravel, can provide a good solution with rapid drainage and negate the effects of soil moisture evaporation having a potentially adverse effect on the deck.

2.2.2 Subfloor framing and decking timbers

For decks that are very low to the ground and within 150mm of the ground, the framing timbers used should be suitable for in-ground use, i.e. in-ground durability class 1 hardwoods with sapwood treated to H4 and softwoods treated to H4.

With framing timbers more than 150mm above the ground then above ground durability class 1 hardwoods with sapwood treated to H3 and softwoods treated to H3 will be necessary.

With regard to decking boards, above ground durability class 1 hardwoods with sapwood treated to H3 and softwoods treated to H3 should be used. Due to the harsher nature of this installation environment, board widths in standard thickness boards, should be not more than 90mm. Refer to section 1.1.2 for suitable species.

2.2.3 Fixings used with framing members

Due to the harsher conditions that these decks experience all fixings need to be hot dipped galvanized steel or be made from stainless steel. Note that zinc electro plated fixings do not provide adequate protection and can corrode prematurely. Therefore, all bolts, screws, nails, brackets or framing anchors need to be of high durability and when within 1m of swimming pools or near the sea, stainless steel is recommended.

2.3 Timber decks over concrete slabs

It may be desired that a timber deck be laid over a concrete slab and with this many of the principles of laying timber decks close to the ground apply and applicable sections in this publication should be referred to. In these decks the decking boards will be fixed to battens over the slab and the concrete surface beneath provides an impervious surface beneath the deck. It is necessary that the concrete has a fall to drain away rainwater and the surface is without hollows that could result in ponding. By simply hosing the concrete slab both the fall and flatness can be evaluated and if necessary, attended to by grinding high points or using an external leveling compound in low points to create a flat slab with sufficient fall for drainage.

The battens used over the slab are often timber although wood-plastic composite battens are also being used. If timber battens are used, then they need to be raised at least 5 mm above the concrete slab. As such they need to be fixed to the slab through plastic or similar packers. This enables the lower surface of the batten to dry and water to pass beneath the batten particularly if laid across the fall. With composite battens laid with the fall no packers are necessary. The battens need to raise the decking board surface a minimum of 95mm above the slab and for this the recommended minimum batten size is 70 x 45mm on edge. Timber battens need to be above ground durability class 1 hardwoods with sapwood treated to H4 or softwoods that have been treated to H4.

The battens need to be fixed with mechanical anchors to the slab within 100mm of batten ends and at spacings of no more than 900mm. Packers must be spaced at no more than 450mm centers and where not fixed through by the mechanical anchors they are to be fixed to the bottom of the batten.

Ventilation beneath the deck is particularly important and the deck needs to be designed to facilitate this. Similarly, timber board widths should be restricted to a maximum of 90mm and gaps between board edges should be a minimum of 5mm. For the fixing of decking boards refer to section 4.1.

2.4 Timber decks adjacent to pools and near the ocean

When installing timber decks adjacent to swimming pools or where ocean air contains salt, special care is needed with the fixings to prevent corrosion. Within one meter of swimming pools, stainless steel or silicon bronze fixings are recommended. It should also be noted that some local authorities require stainless steel fixings within a certain distance of the coast. With proprietary steel fixings their suitability should be checked with the manufacturer.

2.5 Timber decks in bushfire prone areas

With new home construction and additions timber decks must meet the requirements of Australian Standard ‘AS 3959 – Construction of Buildings in Bushfire Prone Areas’. This standard provides a range of Bushfire Attack

Levels that assess the threat and as the threat increases so do the restrictions on what building materials can be used. Timber of specific species can be used in locations where there is a lower level of threat.
Although the standard provides for fire retardant treated timber (not generally available in Australia), it also acknowledges that some timber species are capable of meeting requirements without such treatment. Note that all other building standards also have to be met when using these timbers. The timber species that meets the requirements for use in bushfire prone areas and that are also suitable for timber decks are:-
Blackbutt, Kwila (Merbau), Red Ironbark, River Red Gum, Silver Top Ash, Spotted Gum and Turpentine

However, even with the suitability of these timbers, there are additional specific requirements for decks in these areas. These can include such things as keeping the space beneath the deck open, the width of the gaps between boards, requirements for the posts and keeping the deck separated from the dwelling.

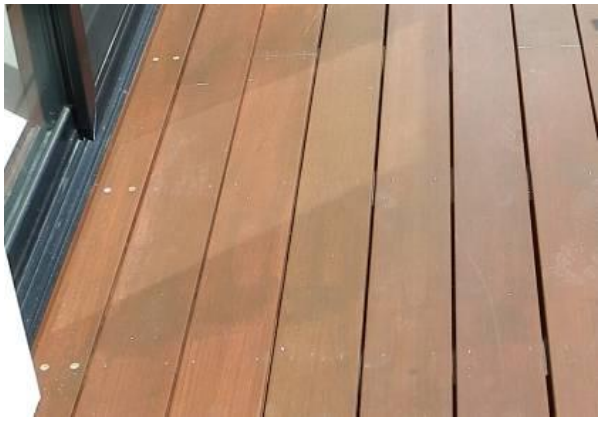
When a local authority declares an area to be a bushfire prone area the use of timber externally is controlled by Building Code of Australia that requires compliance to Australian Standard 'AS 3959 - Construction of buildings in bushfire-prone areas', which is 'deemed to satisfy' the BCA requirements for Class 1 buildings (residential).

In addition to this the Wood Solutions website has substantial information on the deign and use of timber in bush fire prone areas. Refer to https://www.woodsolutions.com.au/articles/design-fire .

2.6 Termite management systems and ventilation

For elevated decks barriers may be physical (metal caps), chemical or a combination of both (and in accordance with AS 3660.1 Termite management – New building work) to protect the deck and also to ensure termites do not use the structure to facilitate passage to the adjoining dwelling. Where the termite management systems require regular inspection, this may necessitate inspection panels to be built into the deck. If this cannot be achieved, then it is necessary to isolate the deck from the dwelling. Inspection zones for the ends of posts in stirrups need a 75mm clearance to the concrete footing. When connecting to a dwelling the local authority should also be referred to regarding the termite management system.

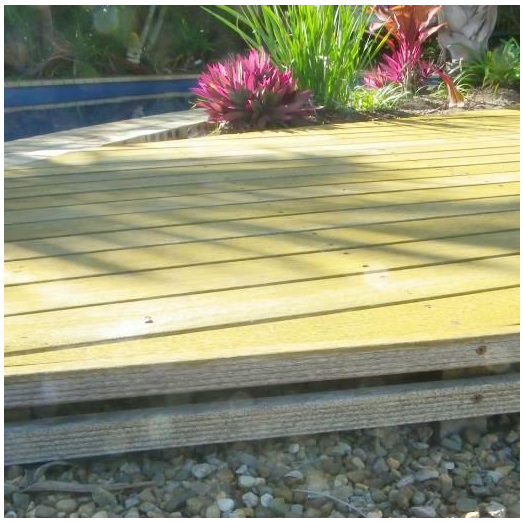
For decks close to the ground only termite resistant timbers (which include preservative treated timbers) should be used. Although this protects the deck it is still necessary to ensure that the deck does not facilitate passage to the dwelling. This can be achieved by isolating the deck from the dwelling with a minimum gap of 40mm or by inspection panels to view physical barriers or by additional chemical treatment (and in accordance with AS 3660.1).



Where posts are used in-ground and there is a risk of termite attack then termite management needs to include 'Termimesh socks', post caps or have a chemical treatment system in place.

Ventilation is an important aspect to all decks, helping to ensure that they perform to expectations. Even though decks close to the ground are designed for more adverse conditions they, too, will benefit from as much ventilation as can be provided (refer to the photo, below left). Inadequate ventilation can have a number of negative effects. The most severe is when the decking boards expand to the point of closing the gaps between the boards. This further exacerbates the moist conditions beneath the deck and inevitably severe cupping and tenting occurs (adjacent board edges lifting). Moreover, it should also be considered that through lack of ventilation you could also

be changing the hazard class to be greater than that allowed for by the treatment. Therefore, this can promote conditions for greater decay and termite activity. Note the photo below left shows a deck close to the ground but the edging timber allows for good ventilation resulting in flat decking boards. Decks are not to be boxed in. In some applications where it is difficult to provide ventilation fans have been used with success including the solar fans available for house subfloor ventilation purposes. In the photo to the right there are no longer gaps at board edges and the decking board has decayed.

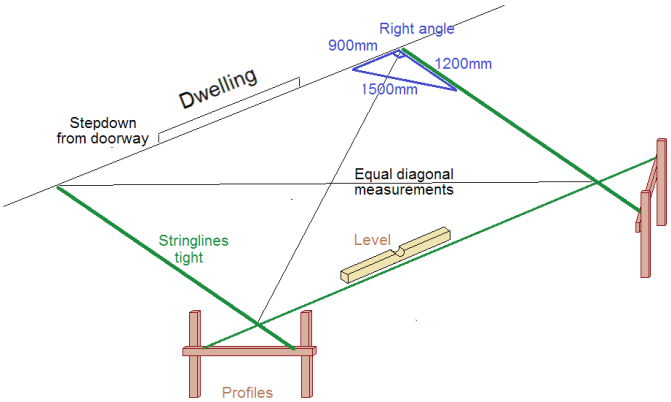


3 Installation of the sub-frame

3.1 Installation Setout

Decks are generally set out in the traditional fashion as used with other buildings noting that accuracy at this stage is important to achieve a professional finish and ease when building the deck. That is, it is important to get the heights correct, angles square and the platform level.

Decide on the position of the deck and the profiles can then be set with string lines at the correct height. Note that if the deck is adjoining a dwelling then the top surface of the decking boards should be at least 50 mm lower than doorways to reduce the risk of possible rain entry. Right angles can be created by using the '3-4-5' rule and diagonals should be checked that they have near the same measurement. Guidance on this is provided in the adjacent sketch.



3.2 Elevated Decks

3.2.1 Freestanding decks

Although many decks are attached to dwellings, many are also free standing, and this includes decks adjacent to dwellings where the cladding on the dwelling is not suitable for the deck to be directly attached. When decks are free standing it is important to note bracing requirements (refer section 3.3.5)

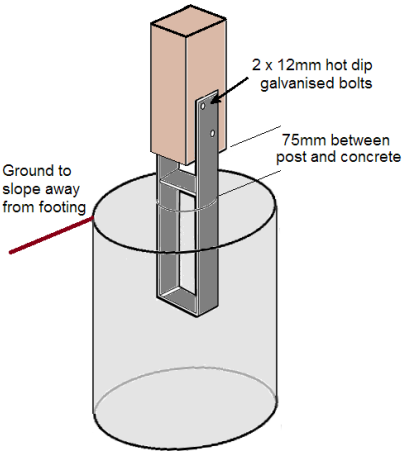
3.2.2 Decks attached to a dwelling

When decks are attached to a dwelling the timber member attached to the dwelling that will support joists is known as a ledger. The minimum recommended size is 90 x 45mm and may be in either H3 treated softwood, H3 treated above ground durability class 1 hardwood or Cypress with limited sapwood.

Where the dwelling is timber framed and the ledger will be fixed through the cladding to the timber house frame 12mm hot dipped galvanised, bolts or coach screws at not more than 600mm centers are required.

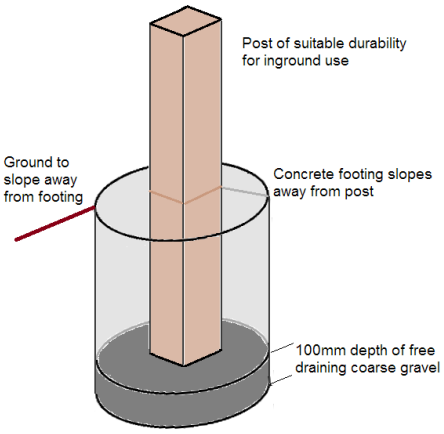
Where the dwelling is structural brick or block, the ledger is attached in accordance with fixing manufacturer instructions. It should be noted that with single skin brick veneer dwellings and similar, the brickwork may not be structurally adequate and may require additional free standing posts to support the deck adjacent to the dwelling, making it a freestanding deck that is independently braced.

3.2.3 Installing timber posts



Post holes about 450 to 600mm deep and 350mm in diameter are often suitable for many lower decks, however the size of footing is dependent on the height of the deck and the soil type. As such local council requirements need to be met along with guidance from 'AS 2870 – Residential slabs and footings' and also 'AS 1684 – Residential timber-framed construction'.

When hot dip galvanized stirrups are used to support the post a clearance between the bottom of the post and the top of the concrete footing of 75mm needs to be provided which assists with the durability requirements of the post and provides the necessary inspection zone for termites. Posts are bolted to the stirrups with two 12mm diameter hot dipped galvanized bolts. Posts in stirrups provide little resistance to lateral movement and therefore cross bracing is important (refer section 3.2.5). The concrete needs to be compacted to remove air pockets and to firmly embed the stirrup while ensuring that it remains vertical, to the correct height and correctly orientated. The footing should be allowed to cure a minimum of 4 days with standard 20MPa concrete before further work commences.

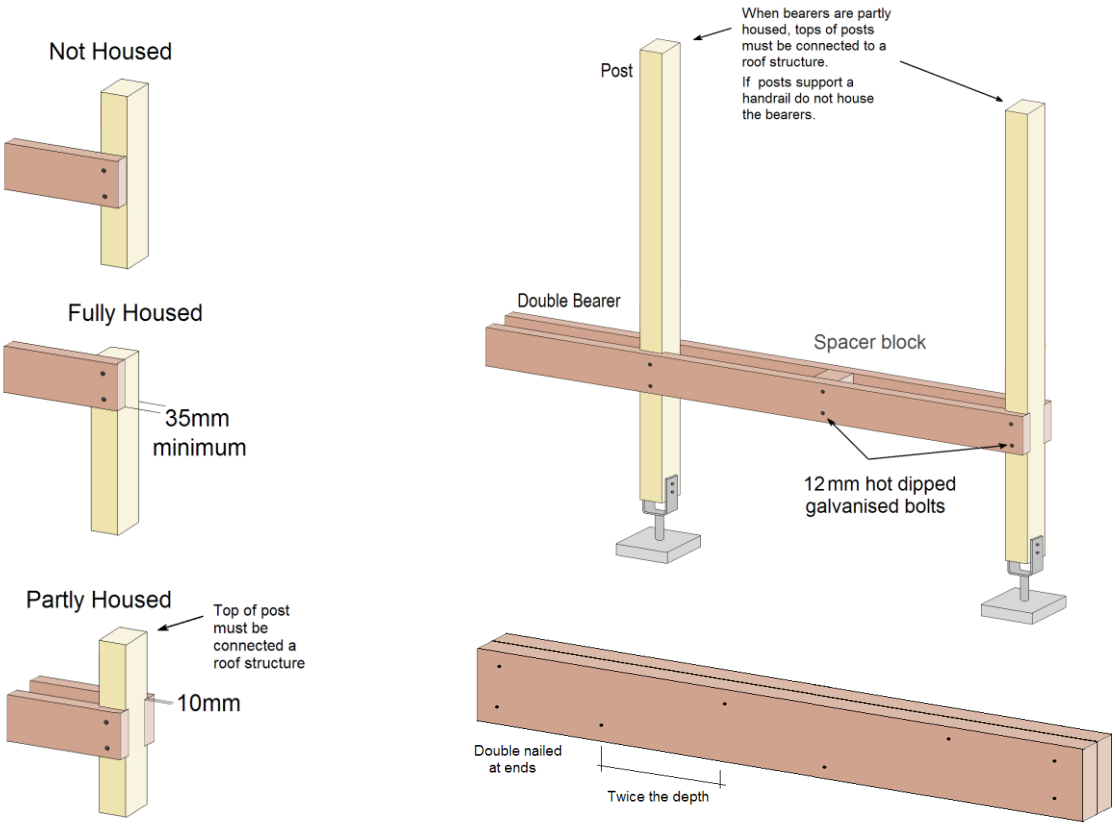


Posts may also be embedded in the concrete as an alternative. This has disadvantages in that posts are difficult to replace in the future if the need arrises, they need to be of high durability and extra precautions are necessary with termite management systems (refer section 2.6). However, for decks up to 1.8m high, with appropriate design, they can be self bracing. Posts in this instance need to be in-ground durability class 1 hardwoods with sapwood treated to H5 or softwoods treated to H5. This method should only be considered in drier locations and where possible post replacement in the future is considered viable, should degradation with time occur. When posts are embedded, coarse gravel approximately 100mm deep should be placed in the bottom of the hole to facilitate drainage and with hardwood posts, 'no fines' concrete is recommended. The concrete needs to be compacted to remove air pockets and the posts need to be supported to ensure they remain vertical and correctly orientated while the concrete sets. Again, a minimum of 4 days curing with standard 20MPa concrete is required before further work is undertaken.

3.2.4 Installing timber bearers and joists

The bearer is fixed to the post and for this there are a number of options available. The bearer can be fixed by housing it into the side of the post and bolted on, or it may be fixed to the top of the post with proprietary metal brackets in accordance with manufacturer instructions.

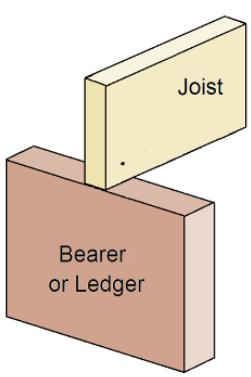
Bearers may also be fixed to posts without being housed. When fully housed to the top of the post there needs to be a minimum of 35mm of the post remaining. If double bearers are used, they can be housed if desired by 10mm, but this is only applicable to posts that continue up to be connected to a roof structure. The bolts are to be 12mm diameter, hot dipped galvanized and two bolts at each bearer connection. It is also recommended that housed joints be primed with an oil-based primer or water repellant preservative. Also, when double bearers are used then solid timber spacing blocks are to be bolted between the joists at mid span.



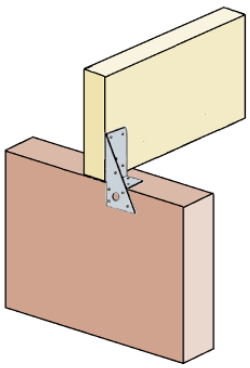
A further alternative is to use nail-laminated bearers from seasoned timber. The ends are double nailed and intermediate nails are staggered at a spacing that is twice the depth of the timber being used.

With the joists, they may be fixed to the top of either the bearer or ledger as applicable or if joist hangers are used the top of the joist may be fixed level with the top of the bearer.

When fixing to the top of the bearer two 75 x 3.15mm hot dipped galvanized nails are skew nailed from either side of the joist into the bearer. Alternately, proprietary brackets or framing anchors can be used to manufacturer instructions. Note that joist hangers need to be screw fixed to the bearer.

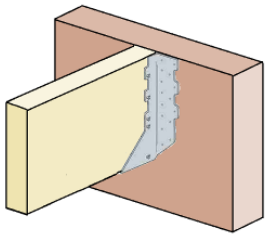


Screw nailing



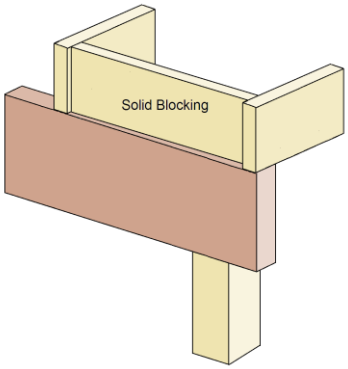
Framing anchor

Must be screw fixed to face of bearer or ledger. Refer to hanger manufacturer for screw size.



Joist hanger

When nail-fixing boards to joists, a joist thickness of 45mm for 'dry after treatment' softwood joists or 50mm for un-seasoned hardwood joists is recommended. The thicker joists provide a greater bearing surface and will be less prone to splitting when decking boards are nailed to them. Softwood joists 35mm thick and hardwood joists 38mm thick can also be structurally adequate and with care over deck fixing practices or with alternate deck fixing methods, these thicknesses are also used.



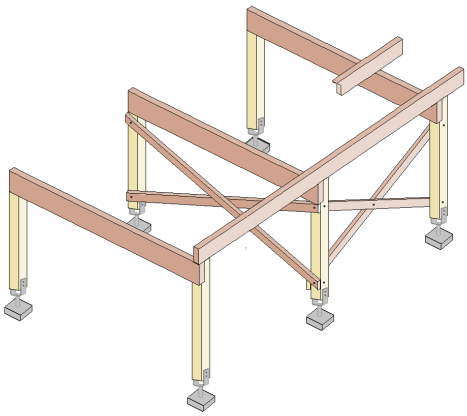
With very deep joists where the depth of the joist is four or more times the thickness (e.g. 190 x 45mm) provision must be made for the stability of the joist under load. When joists are on laid on top of the bearer, solid blocking between the joists at the supporting posts is required. Also, when joists span more than 3m and up to 4.2m then a full row of blocking midway is to be provided. With joist spans over 4.2m two additional rows equally spaced are required.

3.2.5 Bracing

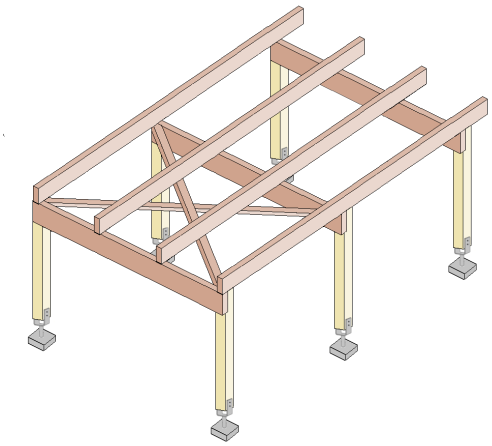
Bracing in accordance with BCA and regulatory requirements is necessary to prevent lateral movement of the deck.

When decks are attached to the dwelling cross bracing (double diagonal) is required and suitable timber sizes are 90 x 45mm pine with a minimum stress grade of F5 or MGP 10, or 100 x 38 mm hardwood with a minimum stress grade of F14. Again, durability class 1 hardwoods with H3 treated sapwood or H3 treated softwood is to be used.

For decks up to 1.8m above ground the bracing can be fixed in a horizontal plane to the underside of the joists with 75mm long No. 14 Type 17 hot dipped galvanized batten screws. The battens are to be screwed to the joists at each joist crossing. Alternatively and also when the deck height is above 1.8m the cross bracing is fixed in the vertical plane between posts and parallel with the wall of the dwelling if a ledger is used and in both directions if the deck is freestanding. In this arrangement the bracing is fixed to the posts with 12mm diameter hot dipped galvanized bolts near post ends and where they cross. As an alternative, vertical cross bracing with M12 hot dipped galvanized steel rods may be used.



Cross bracing between posts



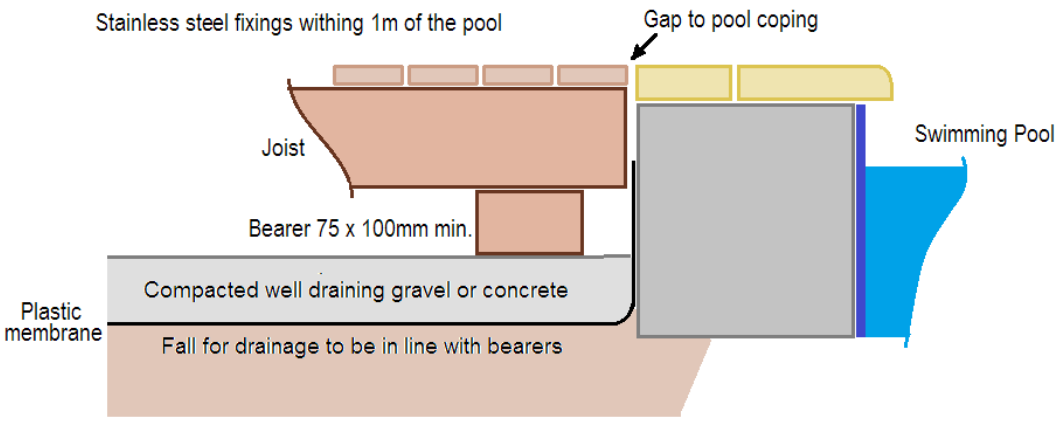
Cross bracing under joists

3.3 Decks close to the ground

3.3.1 General considerations

The deck framing may be supported by timber or concrete foundations or in situations where decks are very close to the ground, bearers laid with their face on compacted free draining gravel may be used. In both options joists are fixed to these bearers. Also note that even with very low decks, airflow beneath the deck is still important in order for the deck to perform. Therefore, the edges of the deck need to provide for adequate ventilation. Similarly, it is important that all cut ends have either an oil-based primer applied of water repellant preservative (copper or zinc napthenate based).

The diagram below shows a section through a deck very close to the ground adjacent to a swimming pool. It is necessary to ensure that the bearers do not impede free drainage and therefore a fall is necessary parallel or in line with them. A gap also needs to be maintained between the deck and the coping. If a freestanding deck is adjacent to a dwelling, a gap of 40mm is recommended between the deck and the wall of the house for termite inspection.



3.3.2 Sub-frame recommendations

If the bearer is to laid on flat and supported by the ground then a minimum bearer size of 75 x 100mm is recommended. For bearers that are supported off the ground and for joists, the sizes are determined as outlined in section 2.

Requirements regarding the durability of fixings are outlined in section 2.2.3 and the sizes of fixings to be used with framing members are provided in section 3.2.

4 Decking Installation

4.1 Installing decking boards

4.1.1 Joist protection

Prior to fixing the decking boards it is necessary to protect the tops of the joists to enhance their service life. This may be achieved through use of a water repellant preservative products or oil-based paint primer followed by a paint, or with stain finish. Alternatively, there are various joist protective capping products that are available which are placed between the joists and decking boards as shown in the photo.

4.1.2 Coating decking prior to installation

In addition to coating the tops of joists or providing a protective cap, decking boards can also benefit from being coated prior to installation, although it is not mandatory that this is done. Coating the decking boards all round can enhance the performance of the deck by reducing (although not preventing) the effects of moisture uptake and loss and the swelling and shrinking that can result in checking and movement such as twist and cupping. If the final finish is oil-based stain then water-repellant preservatives (copper or zinc napthenate based) can be applied followed by one coat of the stain. The water-repellant preservative will also enhance the durability of the timber. With painted decks the boards should be primed all round and then one coat of paint applied. With other types of finish (refer to 6.1.2 Finish Options) recommendations should be sought from the finish manufacturer. It should be noted that water repellant preservatives may not be compatible under water-based coatings. Also note that many finish systems often recommend that the timber be weathered for periods of 4 to 6 weeks and then cleaned prior to application of the finish system (refer section 6). Although such coating can reduce the tendency for a board to cup it cannot be expected to prevent it.

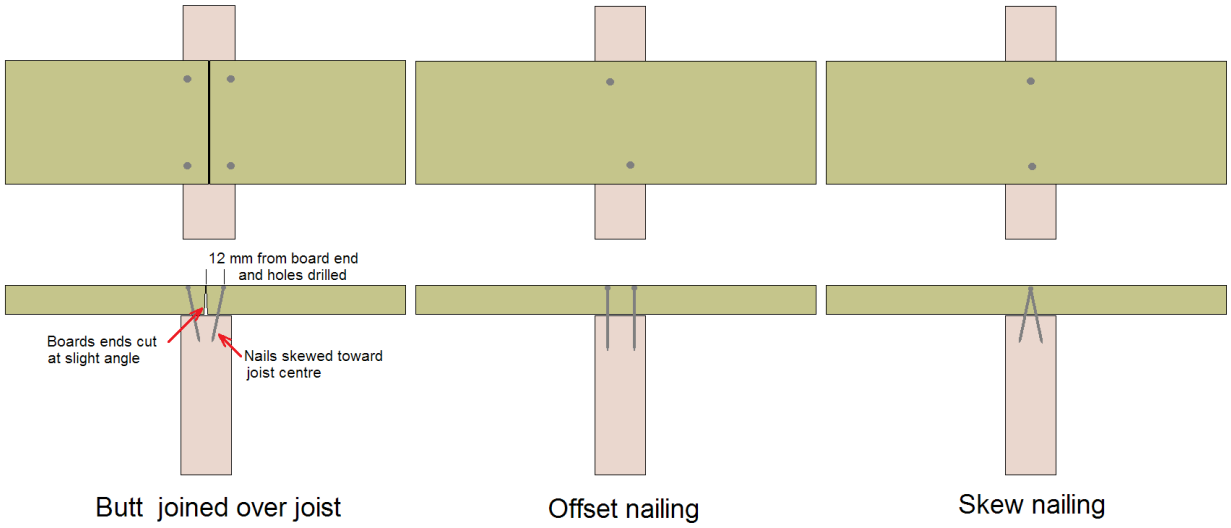
4.1.3 Decking board layout

With hardwood and Cypress decking boards, up to 90mm wide and where the deck is not close to the ground, the boards require spacing to achieve a 3mm gap between adjacent board edges. For softwood decks and 130mm wide hardwood decking the spacing should achieve 5mm gaps between boards. For decks close to the ground it is recommended that boards no wider than 90mm be used and spaced to achieve a minimum 5mm gap between boards.

The boards are to be cut to length as necessary to allow butt joining over the joists. The end joints are to be staggered to ensure that there are no neighboring butt joints on a joist. Acceptable end joint spacing is illustrated in the adjacent photo. Cutting the boards at a slight angle can help to ensure that ends fit tightly (see diagram below). The cut is to be clean and square. It is also necessary for boards to span at least two joists and therefore if the joists are spaced 450mm centers, this means that the shortest board will be about 900mm long.

4.1.4 Top or face nailing

When top or face nailing, each board is to be fixed at each joist crossing with two nails. The nails should be kept a minimum of 12mm from the edges and ends of boards and at board ends, holes need to be drilled to prevent splitting. With high density timber, holes may also need to be drilled to minimise splitting or assist with nailing. The hole size is to be about 80% of the nail diameter. At butt joints the nailing should be slightly skewed toward the centre of the joist. At intermediate fixing points the nails may be offset, or if fixed in-line, the nails should be skewed at opposing angles. This is required to reduce the tendency for the joist to split along the top surface, which can in time reduce fixing integrity. These aspects are illustrated in the diagram below.



When nailing decking boards there are many nail types and sizes that can be used. All nails are to be either hot dip galvanized (meeting Corrosion Resistant Class 3) or if close to salt water (within 1m of swimming pools or 300m of the sea) then stainless steel nails are required. The holding ability of the nail is dependent on the diameter of the nail, the depth of penetration into the joist, whether the joist is hardwood or softwood and most importantly the 'roughness' of the nail shank. Spiral and ring shank nails can increase the surface roughness, but hot dip galvanizing also produces a rough surface. Some stainless steel nails have a spiral shank that appears 'rough' but can act as a relatively smooth surface in terms of fixing. High density decking boards of some species can be more prone to twist and cupping when installed and in some instances the nail fixing has not been able to restrain this.

Both gun and hand nailing may be used to fix decking boards however due consideration of the decking species is needed to minimise the degree of splitting including the need to pre-drill at butt joints or if the decking timber has a tendency to split when being nailed. With reference to the photo below the two nails to the left are stainless steel and the others hot dip galvanized. All nails except for the nail to the right have a dome head and the nail on the right has a bullet head. The three nails to the right show in sequence a spiral shank, ring shank and plain shank. Also notice the differences in diameter.

Many decks are nailed with dome head nails and while this has the benefit of 'sealing' the nail penetration through the board and can enhance durability, it must also be considered that refurbishment of the deck becomes much more difficult if it is desired to re-sand the deck at some future date. For this reason, bullet head nails (nail on the right in the photo) which permits punching just below the board surface to enable easy re-sanding may be preferred. The table below outlines recommended fixings for hand nailed domestic decks. If using nails that differ from these then it is suggested that withdrawal tests, comparing the recommended nail with the proposed nail, be undertaken. To implement this, hammer in five or so nails of each type into the joist and then evaluate the ease with which each can be withdrawn. Similar or greater withdrawal force is needed with the proposed nail.

Decking Timber	Joist Timber	Nail Type	Nail Size
Hardwood	Hardwood or Cypess	Bullet Head (plain shank)	50 x 2.8 mm
	Treated Pine	Bullet Head (ring shank)	50 x 2.8 mm
	Treated Pine	Bullet Head (plain shank)	65 x 2.8 mm
Treated Pine (dried after treatment)	Hardwood or Cypess	Flat or Dome Head (plain shank)	50 x 2.8 mm
	Treated Pine	Flat or Dome Head (ring shank)	50 x 2.8 mm
	Treated Pine	Bullet Head (plain shank)	65 x 2.8 mm
Cypress	Hardwood or Cypess	Bullet Head (plain shank)	50 x 2.8 mm
	Treated Pine	Bullet Head (ring shank)	50 x 2.8 mm
	Treated Pine	Bullet Head (plain shank)	65 x 2.8 mm

4.1.5 Screwing

Screwing provides another option for deck fixing and screws provide significantly more holding strength than nails. As such they can provide greater restraint to board movement such as cupping but will not necessarily prevent it. Each board is to be fixed with two screws at each joist crossing and no closer than 12mm from board edges or ends. Screwing generally requires boards to be drilled with holes countersunk and is therefore a more expensive option than nailing. Screws for deck fixing are available in a variety of materials (meeting Corrosion Resistant Class 3) including those with specific coatings to resist corrosion when used with treated pine decking boards or joists. Stainless steel screws are also available which can include self-drilling varieties. Stainless steel screws are available in grade 304 for general use and grade 316 if close to salt water. Decking screws are usually 10 gauge (approx. 5mm diameter)

but 8 gauge (approx. 4.5mm diameter) is sometimes used. The screw head is often a 'Philips' head but particularly with stainless steel screws a 'square drive' head is also available (refer to photo). For decking boards 19 or 20mm thick a screw length of 50mm is sufficient into either hardwood or softwood joists. If thicker boards are used then 65mm long screws may be used. To provide a neat appearance, a countersinking bit should be used and the boards screwed off so that the head is just below the timber surface. Screwing with the heads just below the surface enables a light sand to be undertaken in the future for deck refurbishment.

4.1.6 Secret fixing

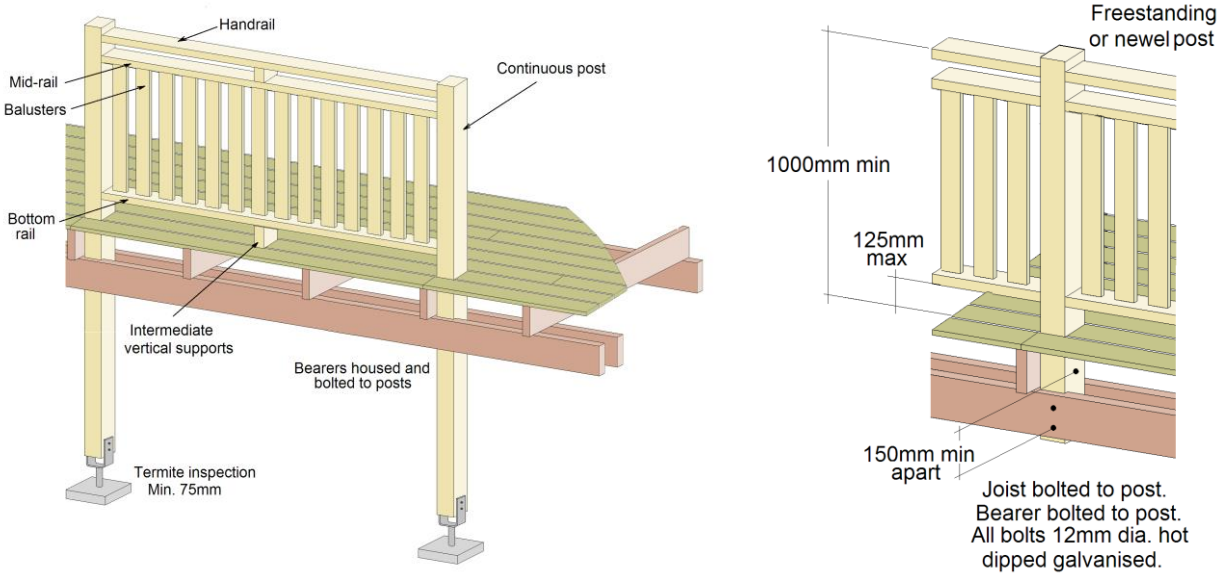
To provide a very clean looking deck, options are available that allow decking boards to be secretly fixed. This also makes future maintenance easy, including sanding if desired but there are also a number of other advantages that can include a reduced number of mechanical fixings on installation, no possible splits as can occur with nails and greater restraint against possible cupping. However, this option is more expensive than a nail down deck.

With secret fixing there are a variety of proprietary systems available. These include jointing systems with specifically profiled boards, galvanized pressed steel strips on the joists that grip board edges and the secret screwing through the edge of the board and into the joists. With some of these systems there are preferred timber species and board tolerances necessary and as such it is important to follow manufacturer instructions closely. The first of the photos below shows a deck with galvanized pressed steel strips over the joists and the second photo a system with the jointing system in recessed board edges.

5 Handrails and stairs

5.1 Handrails

Decks more than one meter above ground require handrails that meet the requirements of the 'Building Code of Australia' and this is primarily concerned with safety. However, it may also be a sensible safety precaution with some decks less than a meter high. Also, with decks four meters above the ground or higher there are additional requirements to exclude climbable elements. In external applications strength, durability and the geometry are all of prime importance. Provided below in the diagrams are terms relating to handrails for timber decks.



With regard to the geometry, it is required that the handrail stands a minimum of 1m above the deck surface with the clearance to the deck under the bottom rail no more than 125mm to prevent large objects falling off the deck. Similarly, the gap between the balusters must also be less than 125mm. If the deck is more than 4m above ground then any horizontal members between 150mm and 760mm above the deck surface cannot be climbable. In addition to this there are loading requirements associated with the strength of the rails and balusters.

With weather-exposed decks it is again necessary to use above ground durability class 1 hardwood with H3 treated sapwood or H3 treated softwood. In terms of the grade, handrails should be free of significant strength reducing features or characteristics and preferably the timber should be clear and straight grained. Hardwoods, both Australian and imported, need to meet the Select Grade requirements of 'AS 2796 – Timber – Hardwood – Sawn and milled products'. Similarly, softwoods, both Australian and imported need to meet Clear Grade as provided in 'AS 4785 - Timber - Softwood – sawn and milled products. In compliance with these standards all material needs to have been kiln dried. Material sold specifically for handrails should meet these criteria. Although deck posts are covered in section 2.1.2 any freestanding newel posts need to be minimum stress grade of F5. Regarding the balusters (or infill to the balustrade) minimum sizes apply and for hardwood it is 25 x 19mm, or 25mm diameter if round and for softwood 62 x 19mm or 25mm diameter if round.

When it come to the fixings, corrosion resistance is again important. Therefore, all bolts, screws, nails and brackets that may be used need as a minimum to be hot dipped galvanized (HDG) with screw type fixings meeting Corrosion Resistance Class 3. Similarly, in the more corrosive environments near the sea or by saltwater pools the stainless steel or other high corrosion resistant fixings need to be used.

From a durability perspective all timber joints need to be pre-primed before assembly with final finishing using stains or paints. Similarly, nails are to be punched and nail holes filled with exterior filler. Pre-primed H3 LOSP treated pine requires additional consideration with the primer coat lightly sanded back to remove any powdery coating. Any cut ends, notches or holes are to have a water-repellant preservative applied and then be primed with a solvent based paint primer. Following this, two full coats of acrylic paint should be applied to these areas before assembly and final finishing.

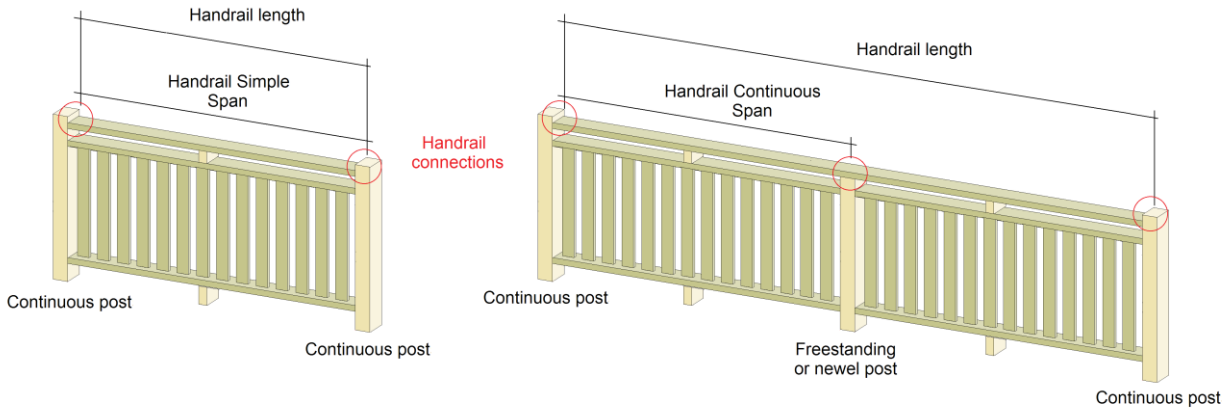
Provided in the diagram are a range of common handrail shapes and also mid and bottom rail profiles.

Concerning the design of the handrails it is a similar process to that outlined in section 2 and for terms used such as 'span' then section 2 or the glossary in section 9 can be referred to. Again, it is important to understand the design concepts and both timber organizations and product suppliers can assist in determining final sizing.

MAXIMUM HANDRAIL SPAN (mm)				
Handrail end section size	HARDWOOD		SOFTWOOD	
	Intermediate vertical support		Intermediate vertical support	
	Not provided	Provided	Not provided	Provided
35 x 70	2100	3000	1200	2000
35 x 90	2200	3600	1600	2500
35 x 120	2400	3600	1800	3400
45 x 70	2500	3200	1800	2200
45 x 90	2700	3600	2000	2900
45 x 120	2900	3600	2300	3600
Profiled 65 x 65	3000	3000	2200	2200
Profiled 42 x 65	2200	2700	1400	1800
Profiled 42 x 85	2400	3400	1700	2400

Notes:
- Handrails with intermediate vertical supports are installed on flat. Without supports they may be installed on flat or edge.
- Intermediate support spacing must not exceed the unsupported handrail span.
- Profiled sections include bread loaf and lady's waist profiles. The width and depth dimensions represent the outside dimensions of the profile.

Next it is necessary to consider the distance that the handrail is spanning. As with joist and bearer design in Section 2, some handrails will be simple span if supported by only two posts while others will be continuous span when supported by more than two posts. This is shown in the diagram.



With handrails up to a meter in height, newel posts (see diagram above) need to be of a certain size and the spacing of these posts also has restrictions. The minimum size for an F8 softwood newel post is 88 x 88mm with a maximum spacing of 1.3m. If the post is full height (up to 2.7m) and restrained by the roof frame the spacing can be increased to 2.3m. In hardwood the minimum size is 90 x 90mm and if F17 the maximum spacing is 2.7m and for F27 it is 3.6m. For both stress grades if full height and restrained as indicated above, the maximum spacing is 3.6m. This may influence the choice of deck posts as outlined in section 2.1.2.

When connecting the handrail to the posts the connection needs to be sufficient to take the load of people leaning on the handrail. To assist with this and determining the types of connectors that are suitable, the table indicates the loads to be taken by the connections.

Depending on the style of handrail some fixings will be more appropriate than others. The type of fixing includes cup head bolts, Type 17 screws, nails, screws and proprietary fixings.

HANDRAIL CONNECTION LOADS (kN)		
Handrail span	Simple Span	Continuous Span
1800	1.0	2.5
2100	1.2	3.0
2400	1.4	3.4
2700	1.5	3.8
3000	1.7	-
3300	1.9	-
3600	2.0	-

The strength of the connection is also dependent on the number of fixings used and the strength of the material being fixed into, i.e. a fixing into denser hardwood will be stronger than into softwood. For this timbers are allocated joint groups and for the timbers outlined in these guidelines, the hardwoods meet joint group JD2 and the softwoods JD4.

HANDRAIL CONNECTION CAPACITY (kN)								
Timber Type	Cuphead bolt		Type 17 screw		Screw (2 used)		Nail (2 used)	
	M10	M12	No. 10	No. 14	No. 10	No. 14	3.15 dia	3.75 dia
Hardwood	13.0	14.0	3.4	4.4	1.9	2.3	1.6	1.8
Softwood	8.0	9.0	2.0	2.6	1.1	1.3	0.9	1.0

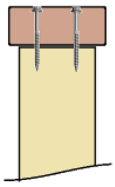
Type 17 hot dipped galvanized wood screw.

Hot dipped galvanized cup head bolt (Use with washer under nut)

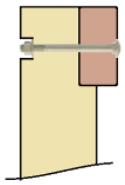
The table indicates the capacity or load carrying ability of a variety of common fixings. Normal nails and screws will always be used in pairs and therefore the numbers as indicated in the table are for 2 nails or 2 screws. Cup head bolts and Type 17 screws may be used individually or in pairs and if used in pairs then the table value is doubled.

As an example, if the handrail is hardwood and has a simple span of 3m then it will require intermediate vertical supports and the loading at the connection points at either end of the handrail is 1.7kN. As can be seen from the table one bolt, one Type 17 screw, two screws or two 3.75mm diameter nails will be adequate. However, if the handrail is pine then the normal screws and nails would not be adequate.

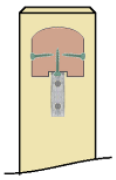
Illustrated here are typical fixing details for handrail to post connections. Note the minimum penetrations into the posts for screws and nails. Mid rails and bottom rails need to be fixed by skew nailing with two 3.15mm diameter hot dipped galvanized nails penetrating the post a minimum of 38mm.



Type 17 HDG
Wood screws
Min. penetration 38mm

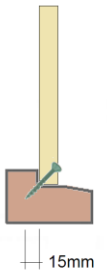


M12 HDG
Cuphead bolts

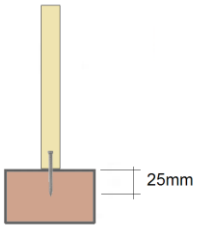


No.10 HDG Screws
75x75x15 3mm thick
HDG bracket
Min penetration 40mm
(38 mm for nails)

When connecting the balusters (infill) of the balustrade they may be either nailed or screwed. Where the balusters are not fully housed (e.g. the rebate beneath the bread loaf profile or similar) the minimum fixing requirements as shown in the diagram apply. If fully housed, then the fixing is to be suitable for location purposes. With nail fixings, 'brads' or finishing nails which are small in diameter are not adequate and not to be used.



One HDG No.8 or N0.10
screw to hardwood or
softwood bottom rail



Two HDG 2.5 dia nails.
Skew fix through both edges
of the baluster for hardwood and
softwood bottom rails.

5.2 Stairs and steps

Staircase construction is quite detailed and as such will not be covered in depth by this publication. There are a number of companies who can manufacture prefabricated steps for external applications and also companies that specialize in staircase construction.

Staircase design requirements are outlined in 'The Building Code of Australia' and similar to handrails safety is of prime concern with strength, durability and geometry being the main factors focused on.

Included in BCA requirements are that:

- Each flight of stairs must not have more than 18 risers and not less than 2.
- The width of goings and height of risers must be constant throughout each flight.
- The riser opening cannot allow a 125mm sphere to pass between treads.
- The slope of the stairs is required to fit within the relationship that twice the rise height plus the going width must be between 550mm and 700mm. E.g. stairs with a rise height of 170mm and a going of 250mm gives:- (2 x 170) + 250 = 590 and thus complies.
- Stair treads are to have a slip-resistant finish or an anti-skid strip near the nose of the thread.

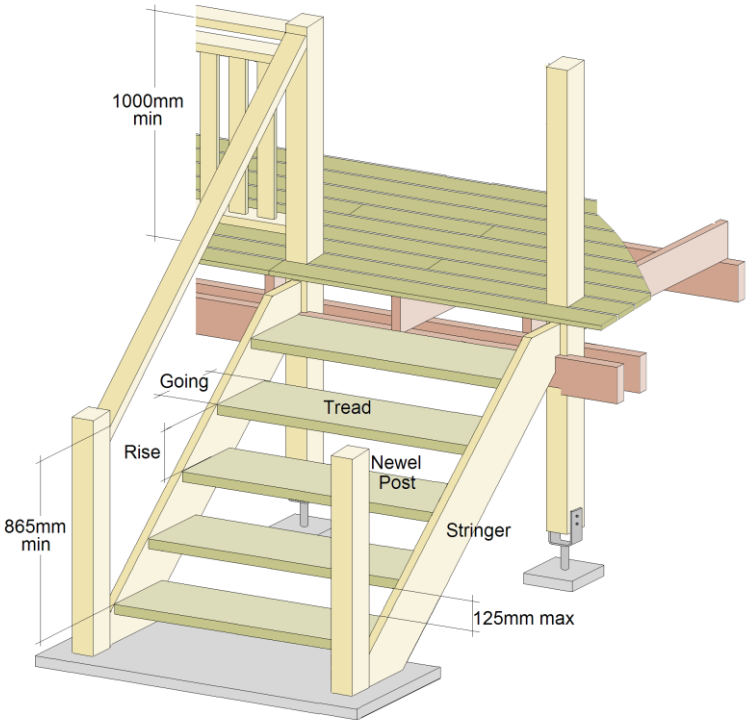
Further details on stair construction are available in Guide 8 from the Wood Solutions website:

https://www.woodsolutions.com.au/publications/installation-guides-0

Provided in the diagram are terms associated with external stairs as well as some dimensions that need to be met when constructing stairs.

With regard to durability aspects of the timber type used, preservative treatment provided and the use of appropriately corrosion resistant fixing, the requirements are the same as outlined for decks and handrails.

Similarly, aspects relating to termite management systems also apply.



6 Finishing after installation

6.1 Finishing systems

Decks perform significantly better when finishes are applied to provide protection from the weather and thereby reduce the effects of exposure to sun and rain and also weathering effects. It is therefore advised that all decks should have a finish applied. The finish also assists in reducing swelling and shrinking that can lead to a higher degree of distortion and surface splits known as checking. Consequently, good finish systems add to the service life of the deck.

6.1.1 Preparation

Finish manufacturers generally indicate that the deck should be left for 4 to 6 weeks prior to applying the finish. In some cases longer is suggested with some timbers to allow the tannins to wash out and oils to leach from the decking prior to the finish being applied. Kwila or Merbau are tannin rich and Spotted Gum has oils that can affect finishes. Depending on the condition of the deck at that time it may first be necessary to clean the deck, and this is also part of some finishing systems. Proprietary deck cleaning products (including Integrain Reviva and Cabots Deck Clean) are generally available from hardware stores that stock deck finishing products. These products should be used in accordance with the manufacturer's instructions. With new decks the use of these cleaning products can also allow coating without the need to wait a number of weeks. If there has been any grinding of steel in the area, then the fine steel particles can react with the tannins in the decking and form black iron tannate spots and stains. Again, these cleaning products can be used to remove such stains. Note also that tropical and more humid localities will be more susceptible to mould and some finish manufacturers have products that can be used to treat the decking at this stage while other manufacturers may include mould inhibiters it in the deck finish product.

Prior to applying the finish, a water repellent preservative can be considered as a base coat. The product has various waxes and resins dissolved in a light organic solvent that inhibit decay. It has the consistency of mineral turpentine and will soak into the timber and particularly cut ends. This enhances the durability of the deck and being a water repellent, the decking is less susceptible to swelling and shrinkage from rain wetting. Compatibility with other finishes needs to be checked and other finishes should generally not be applied over the product within two weeks of application. If the deck is to be painted, then oil-based primers are generally used, and this also adds to the durability of the deck.

6.1.2 Finish options

Commonly available finishes include decking oils, water-based film finishes, stains and paints. When considering colours it must be considered that dark colours absorb heat, not only making the deck very hot to walk on but also making the boards prone to cupping through more rapid loss of moisture from the top board surface. Due to this, light coloured paints and stains are recommended.

Decking oils are a penetrating finish that soak into the decking and provides a natural look to the timber with both the texture and grain showing. Oils may be solvent or water-based and some, in addition to penetrating, provide a protective coating. It is easy to apply and reapply only requiring the deck to be cleaned off prior to reapplication. However, traditional solvent-based products are generally not long lasting and after initial application additional coats may be required six months later and then at yearly intervals. Conversely, water-based systems are generally more durable and require less frequent maintenance. Solvent-based systems will usually darken with time.

Transparent water-based film finishes with UV inhibiters are also available and these maintain the natural timber look often desired. These products require a cleaned decking surface and a primer coat applied to the timber decking first. The primer is an essential part of enhancing the life of the final coating. Multiple final coats are used to provide a thick build that results in a good service life. As it is necessary to achieve a thicker consistent film, application is usually with an applicator rather than a roller and such products are not suited to decking with the reeded face up due to thin film build at the top of the 'reeds'.

Decking Stains either solvent or water-based are available and these can be considered as very thin paints that contain a pigment or colour that can tone in with the colour of the timber or provide a distinct colour to the timber. They often contain mould-inhibiting additives. The pigment in these products tends to hide the grain to an extent yet the texture is not masked. The benefit of the pigment or colour is that it absorbs ultra violet light and therefore provides added protection against weathering. Consequently, stained decks generally require less frequent maintenance than oiled decks. Again preparation for recoating is relatively easy with the deck only needing cleaning prior to reapplication.

To provide an even longer lasting finish, paints can be used. In this instance oil-based primers should be used for both oil and water-based paint systems. The oil-based primer enhances the durability. Although a painted surface will provide the best protection against weathering the colour, grain and texture of the timber will be obscured. The paints that are used are specific for decks enabling them to cater for the added traffic. Light colours should be used as dark colours are very hot underfoot and the heat can also promote timber shrinkage. With such systems recoating may only be necessary every five to seven years although the preparation in terms of sanding and re-priming of areas is also a consideration.

If it is desired to increase the slip resistance, then some manufacturers have additives that can be added to decking oils and stains. Although these additives increase the surface roughness, they should not appreciably affect the durability of the finish.

6.2 Application

Application techniques will vary depending on the product. However, as some products are more specific regarding the method, it is necessary to ensure manufacturer instructions are followed. Products will generally be applied with a roller or an applicator to enable the deck to be coated quickly and with an even finish, with brushes for more difficult to get to areas including board edges and ends where necessary. It is also necessary to adhere to recoat times which can be 2 to 3 hours for water-based products and often 18 to 24 hours for non-water-based oils and stains.

7 Maintenance and care

7.1 Regular maintenance

Weather exposure provides harsh conditions for timber decks and in order to achieve lasting long-term performance then effective regular maintenance is necessary. The frequency of maintenance will vary depending on many factors including the degree of exposure, location of the deck and the finish system that has been applied.

Decks should be kept clean and regular sweeping or use of blowers is preferable to hosing the deck down because decks benefit from being dry whenever possible. There is a also need to ensure that vegetation is not preventing adequate ventilation beneath the deck. Although there is no reason not to have pot plants on a deck they should be elevated off the surface of the deck with pot stands and feet so that the base of the pot is not in contact with the deck. Similarly, saucers should be used under pots and plants should not be overwatered causing the saucer to overflow. Where posts are in stirrups, any debris beneath the post needs to be cleared.

7.2 Safety checks

Checks should be made at least annually as to the condition of the deck, deck structure and fixings. However, there can also be movement of board fixings and boards within the deck at any time and more often with a change in season, therefore regular routine checks of the decking are also necessary. The likes of any protruding nails or screws should be attended to when observed, as should any damaged boards. In addition to this, the structure particularly with elevated decks should be checked for soundness and that fixings are not corroding. Ventilation beneath the deck also needs to be considered and reinstated when necessary, which may include clearing undergrowth from the deck perimeter and clearing the gaps at board edges. For further information on checking decks refer to the link below from the Queensland Building and Construction Commission titled 'Deck, balcony and window safety' which specifically covers assessing decks.

https://www.qbcc.qld.gov.au/sites/default/files/Deck%20inspection%20guide.pdf

7.3 Refurbishment

Prior to refurbishing a deck it is necessary to ensure that it is clean and again that the gaps between board edges are clear. The condition of the deck and previous finish will affect what is required.

The benefit of oiled and stained decks is that the surface film does not need to be removed and it can be as easy as just cleaning off the deck and reapplying the oil or stain. If, however, the deck is in a lesser condition, then a deck cleaning product may be used or sanding may be considered. Deck cleaning products work on moderately affected decks and are designed to restore timber that has some weathering, has stains from tannin or rust and which may be mould affected. (Products include Integrain Reviva and Cabots Deck Clean).

For film forming coatings, either solvent or water-based, in order to achieve the best results, it is necessary to remove the coating and bring the deck back to bare timber. Products (e.g. Integrain Liquid 8) are available for stripping the coating prior to use of a deck cleaning product or sanding. If the decking is more severely weathered and has gone grey or is affected by mould, then irrespective of the previous finish system it is necessary to sand back to bare timber to achieve a good result. The re-sanding of decks is not always a simply task. If the decking has been secretly fixed, traditional sanding machines are fast and easy as you have no nail or screw heads to deal with. Also being introduced are 'sanding machines' that utilize wire brushes which will clean the board surface and pass over dome headed nails. With traditional sanding and particularly when using oils it is important not to over sand the deck as this will inhibit penetration of the oil. With this in mind, some recommend not going finer than an 80 grit paper. Where decks have been nailed with bullet head nails, punching of the nails will also facilitate ease of sanding. In such cases some have found that nail holes can be successfully filled prior to coating.

8 Safe work and waste disposal

8.1 Safe work

Safety standards as provided by Safe Work Australia must be followed. Also, due to dust and other particles that are generated when sawing, planning and sanding timber, appropriate personal protective equipment should be worn. This includes eyes, ears, nose and mouth protection. When using tools refer to the tool manufacturers' safe recommended practices. Similarly, when working with adhesives or coatings containing VOC's, manufacturers' safety recommendations should be followed. Workplaces should be kept clean.

8.2 Waste disposal

When working with preservative treated timber off-cuts, sawdust and shavings need to be disposed of appropriately. These wastes from any preservative treated products should not be burnt but disposed of in a manner approved by the local authority.

9 Terminology

The terminology is provided in several sub-sections (e.g. Corrosion and Durability, Deck types) and within each the listing of the terms is grouped on similarity of theme, rather than alphabetical order. For example - span, spacing, simple span and continuous span, form such a group.

Corrosion and durability

Corrosion resistance class – The corrosion resistance class indicates the conditions that the fixing is suited to. There are four classes with class 4 being the most severe. In class 3 the fixing is suitable for general external use in mild industrial and marine applications and with class 4 for marine and moderately severe corrosive environments, generally within 1 km from the sea.

Durability class above and below ground – Timbers are designated a natural durability class which relates to the durability heartwood (not the sapwood) to resist decay. As the name suggests the above ground rating relates to the likes of decking boards which are above ground and weather exposed. In-ground durability class relates to the use of that timber when used a post that is in-ground and also the framing timbers of decks close to the ground. Therefore, each of the hardwood species is given two classes and for decking applications classes 1 & 2 are applicable with class 1 being of greater durability than class 2.

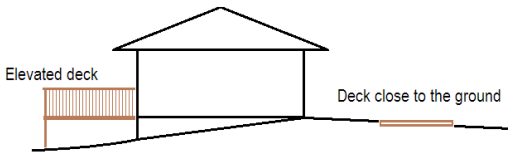
Hazard class – The hazard class describes the environmental hazard that the timber needs to be treated to so that it will perform in that hazard. There are six classes with class H1 being a low hazard environment and H6 being a very severe hazard environment. Above ground weather exposed applications are designated an H3 hazard environment. Therefore, timber with sapwood treated to perform in this environment will be labelled H3.

Preservative treatment – This refers to the treatment of the sapwood in both softwoods and hardwoods. There are various types of treatment processes and chemicals and for decking applications water-based treatments are the most robust (e.g. CCA and ACQ). Although the deck framing may be treated with CCA it is not permitted to treat decking boards with CCA. Timber sapwood is treated to different levels depending on the environmental hazards of decay and termite attack.

Deck types

Deck close to the ground – Decks close to the ground refers to any deck with horizontal framing members less than 400mm above the ground.

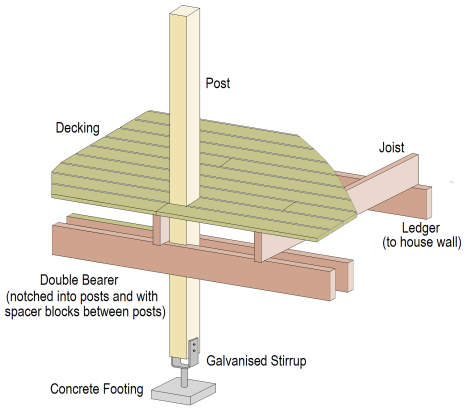
Elevated Deck – When horizontal deck framing members are more than 400mm above the ground they are referred to as elevated decks.



Framing members and terminology used with decks

Post – The post is the vertical member which supports the main horizontal load bearing member which is referred to as the bearer. The post cross sectional size depends on the area of deck (and possibly roof structure) that it is required to support as well as the height of the deck. Timber posts may be concreted in-ground or supported by stirrups with a concrete foundation. Steel posts are generally concreted in-ground.

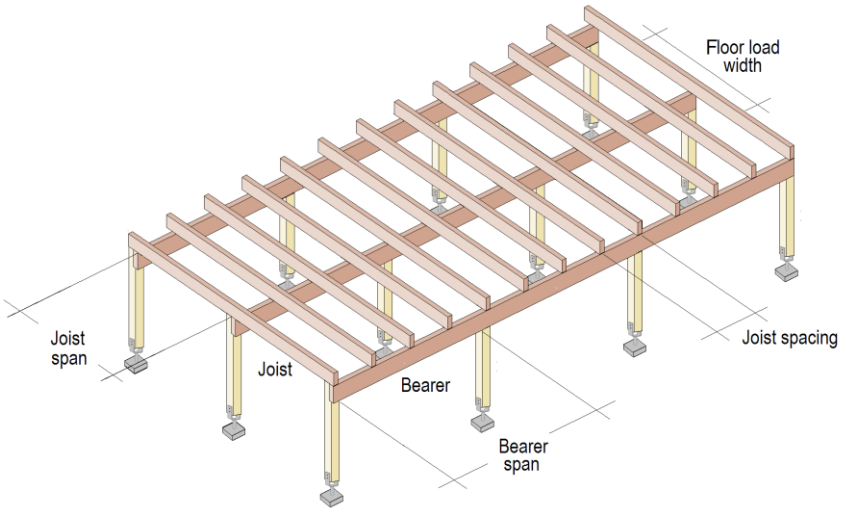
Bearer – The bearer spans between the posts and supports the joists. Generally, bearers need to be housed into the posts (fitted into a notch



in the post) and at times double bearers are used to support the required load and enabling smaller timber sizes to be used.
Joist – The joists are fixed on top of the bearers and are spaced to suit the distance that the decking board can span. Often this is 450mm but at times a closer spacing of say 400 mm may be used or with thicker decking boards say 600mm.
Ledger – With decks that adjoin the dwelling, if the house walls are sufficiently strong, then the deck may be directly fixed to it. The board fixed horizontally to the dwelling and acting as bearer is called a ledger. The deck details need to be able to accommodate access for termite inspection. A small air gap between the ledger and dwelling wall is beneficial to ensure that moisture is not trapped between the two.
Bracing – With elevated decks they will generally need to be braced. These are pieces of timber fixed at an angle between adjacent posts. On one post the bracing piece is fixed near the base and to adjacent post just beneath the bearer. This therefore creates a triangle to prevent lateral movement. When the bracing in bay goes in both directions a 'cross' is formed and this is referred to as cross bracing. As well as bracing between the posts in a vertical plane, cross bracing is also used horizontally when fixed to the underside of the joists. If posts are concreted in ground and the deck is relatively low this will provide sufficient bracing in itself.

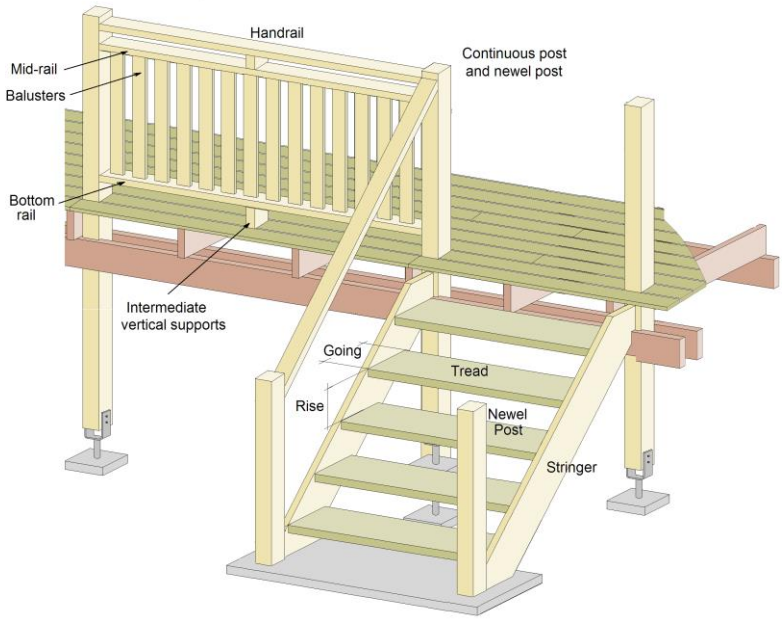
Spacing – The spacing is the distance from centre line to centre line of the framing members. Therefore, when joists are spaced at 450mm centres it is the distance from the centreline of one joist to the next.
Span – The span of a bearer, joist or decking board is the distance between what is supporting each. Therefore, with decking boards it is the distance between the joists.
The span of the decking boards is therefore the joist spacing less the thickness of the joist.
Simple span – When a joist or bearer is only supported by two supports it is said to be simply supported.
Continuous span – When a joist or bearer is supported by three of more supports then it is referred to as continuous span. The member sizes may at times be smaller with continuous span than when simply supported.

Floor load width – The width of floor supported by the bearer.
Floor area supported – The area floor supported by the post.



Framing members and terminology used with handrails and stairs

Handrail – This is the top rail of the balustrade and must be fixed strongly to the post to support the likes of people leaning against it. Handrails need to be at least 1m above the deck surface.
Mid-rail – No all balustrades have mid-rails but it often adds to the aesthetics.
Bottom rail – The bottom rail partly supports the balusters. The bottom rail must be within 125mm of the deck surface.
Balusters – These are sometimes referred to as infill and are fixed between the bottom rail and mid rail or handrail as applicable.
Intermediate vertical supports – In order for handrails to span further intermediate vertical supports can be used.



Newel post – These are the post supporting the ends of a handrail at the top or bottom of a flight of stairs. This also includes posts that are not continuous referred to as free posts.
Continuous post – A continuous post, fixed at ground level that passes through the deck to support handrails and/or roof structures.

Stringer – The structural member that supports the treads.
Going – The dimension from the front of the tread to the front of the next tread.
Rise – The dimension from the top of a tread to the top of the next tread.

Timber related terms

Hardwood – These are trees with broad leaves such as gum trees and those used commercially moderate to high density. The sapwood band is often quite narrow but if sapwood is present it needs to be preservative treated to increase its durability.

Softwood – These trees have needles rather than leaves such as the pines and those used commercially are generally less dense than hardwoods. Softwoods have a wide sapwood band that can often be effectively preservative treated. The heartwood is of low durability.

Sapwood – This is the timber below the bark and is the active growing part of the tree. Sapwood is often lighter in colour than heartwood. Sapwood is not durable in weather exposed applications but in most species, it can be preservative treated to increase its durability.

Heartwood – The heartwood is from the core of the tree out to the sapwood. It is often darker in colour and in number of hardwoods it is sufficiently durable for weather exposed applications.

Tannin – This is a dark coloured compound present in hardwoods to varying degrees and when tannin rich timbers become rain wet the tannins wash out and can leave dark staining on surfaces such as concrete paths beneath a deck. Merbau or Kwila are high in tannins which may make them less desirable in some applications but due to the high stability of this species it also makes it desirable in other applications. Tannins will bleed for a period with rain periods and then diminish and bleed not longer.

Iron tannate – When steel contacts timber in the presence of water a reaction occurs between the steel and the tannins to create iron tannate which black in colour. Galvanised nails prevent iron tannate forming around the nail but the grinding of steel with the grinding dust landing on the deck can create many black spots. Deck cleaners containing oxalic acid can remove the stain.

Stress grade – This refers to the structurally grading of timber and refers to both the strength and stiffness (resistance to deflection under load) and other structural properties. When timber is visually graded it will be marked with the likes of F5 or F7 if it is softwood and often F14 or F17 if it is hardwood. The higher the number the stronger and stiffer the timber and the smaller the timber end section to carry a specific load. Mechanically graded softwood will be marked with the likes of MGP10 or MGP12 and again the higher the number the stronger and stiffer the timber.

Appendix 1 – Selected Span Tables

The following span tables for posts, bearers and joists have been provided by Timber Queensland Ltd.

MAXIMUM POST HEIGHTS
(also note that newel posts have minimum cross-sectional areas and spacing – refer section 5)

MAXIMUM POST HEIGHT (mm)			
Post type	**Post size**	**Floor area supported Up to 5 m^2**	**Floor area supported 5 to 10 m^2**
Unseasoned Hardwood F14	75 x 75	2900	2000
	100 x 100	4800	3500
Seasoned Treated Pine F7	70 x 70	2400	1700
	90 x 90	4100	2900
Unseasoned Cypress F5	75 x 75	2000	1400
	100 x 100	3600	2500

BEARER TABLES

MAXIMUM BEARER SPANS (mm)						
Seasoned Treated pine F7 stress grade						
Bearer Size (mm) Depth x Thickness	**Single Span** Floor Load Width (mm)			**Continuous Span** Floor Load Width (mm)		
	1800	2400	3000	1800	2400	3000
140 x 45	1300	1100	1000	1300	1100	1000
190 x 45	1750	1500	1200	1750	1500	1350
240 x 45	2200	1900	1700	2200	1900	1700
2 /140x45	2000	1700	1500	2000	1700	1500
2 /190x45	2700	2300	2100	2700	2300	2100
2/240x45	3400	2900	2600	3400	2900	2600
Unseasoned Cypress F5						
Bearer Size (mm)	**Single Span** Floor Load Width (mm)			**Continuous Span** Floor Load Width (mm)		
	1800	2400	3000	1800	2400	3000
125 x 75	1300	1100	1000	1300	1100	1000
150 x 75	1600	1300	1200	1600	1300	1200
175 x 75	1800	1600	1400	1800	1600	1400
2 /100x50	1300	1100	900	1300	1100	900
2 /125x50	1600	1400	1300	1600	1400	1300
2/150x50	1950	1650	1500	1950	1650	1500
2/175x50	2200	1900	1700	2200	1900	1700
Unseasoned hardwood F14 stress grade						
Bearer Size (mm)	**Single Span** Floor Load Width (mm)			**Continuous Span** Floor Load Width (mm)		
	1800	2400	3000	1800	2400	3000
100 x 75	1600	1400	1300	1600	1400	1300
125 x 75	2100	1800	1600	2100	1800	1600
150 x 75	2500	2200	1900	2500	2200	1900
175 x 75	2900	2500	2300	2900	2500	2300
200 x 75	3400	2900	2600	3400	2900	2600
2 /100x50	1900	1700	1600	2100	1800	1600
2 /125x50	2400	2100	2000	2600	2200	2000
2/150x50	2800	2600	2400	3100	2700	2400
2/175x50	3300	3000	2800	3700	3200	2800
2/200x50	3700	3400	3200	4200	3600	3200

JOIST TABLES

MAXIMUM JOIST SPANS (mm)		
Seasoned Treated pine F7 stress grade, joist spacing 450mm		
Joist size (mm) Depth x Thickness	**Single Span**	**Continuous Span**
90 x 45	1300	1700
120 x 45	2200	2200
140 x 45	2600	2600
190 x 45	3600	3600
240 x 45	4500	4500
Unseasoned Cypress F5 stress grade, joist spacing 450mm		
Joist size (mm) Depth x Thickness	**Single Span**	**Continuous Span**
100 x 50	1400	1700
125 x 50	2200	2200
150 x50	2600	2600
175 x50	3000	3000
200 x 50	3500	3500
Unseaoned hardwood F14 stress grade, joist spacing 450mm		
Joist size (mm) Depth x Thickness	**Single Span**	**Continuous Span**
100 x 50	2200	2500
125 x 50	2800	3200
150 x50	3400	3800
175 x50	3900	4500
200 x 50	4400	5100