

Non-Domestic Decks, Boardwalks & Light Vehicular Traffic Structures

SCOPE

This application guide provides details on the design, specification and construction of timber decks for non-domestic applications such as board walks, viewing platforms and light vehicle traffic structures.

Load scenarios are taken from AS1170.1[®] and include: light pedestrian loads (4.5kN concentrated load), heavy pedestrian traffic (9.0kN concentrated load) and light vehicular traffic (13kN concentrated load). In all instances an allowance has been made for uniformly distributed loads of up to 5.0kPa. For heavier loads refer to AS1720.1 and seek engineering assistance.

CONSTRUCTION SYSTEMS

Deck structures usually involve posts or piles that support bearers, joists and decking.

Two systems are commonly used. The first uses a single bearer housed into the pole or pile. The second uses a double headstock system utilising thinner bearers housed into opposite sides of the pole or pile. This method does not require extra bolts and reduces the depth of the rebating. Refer to Figure 1.

Wide decking boards (e.g. greater than 120mm) are commonly used to reduce rattles and improve vehicle ride. Boards laid with a slight diagonal set-out will also help to distribute wheel loads across multiple boards.

The need for handrail and kerbing is dependent on usage requirements, height above ground and type of traffic. For assistance with handrail design, refer to the application guide on Stairs, Handrails and Balustrades - as referenced at the end of this document. Kerbing design requirements emphasise vertical loads and should be determined by a structural engineer – a 75 x 75mm cross-sectional area is the minimum kerb recommended.



TIMBER DURABILITY

Specifying durable timber is paramount in harsh external environments - all timber must be class 1 or 2 durability. These classes are readily available and have a proven performance record. Species of this durability include Blackbutt, Cypress, Ironbark (grey & red), Mahogany (white), Spotted Gum and Tallowwood. Specifying a single species may increase supply costs or time, so it is generally preferable to include a suitable substitution species. In many cases, given a period of natural weathering, variations in species may not be recognisable. Further details can be obtained in the Hardwood & Cypress Species Guide referenced at the end of this document.

CONNECTOR SELECTION

When selecting connectors to assemble components, primary considerations are timber movement, prevention of splitting and corrosion resistance:

- As a minimum, connectors should be hot-dip galvanised, however environments such as splash zones around pools, coastal regions or industrial corrosive environments require stainless steel or silicon bronze connectors.

[®] AS1170 Structural design actions– Permanent, imposed and other actions, Standards Australia, Sydney

- Use of brackets to connect bearers and joists is not recommended for exterior applications, but where necessary, stainless steel should be used.
- All bolts and coach screws should utilise washers.
- Bolt holes placed across the grain of wide unseasoned elements should be drilled 10% larger than shank diameters to avoid timber shrinkage stresses.
- Nailing and screwing trials should be used to determine splitting tendencies – if pre-drilling is required, holes should be approximately 80% of the shank diameter.
- Some preservative treatments (e.g. CCA) react with galvanised coatings in continually

moist environments. Problems can be managed by coating bolts and similar fixings in heavy grease.

- Where retightening of bolts on large unseasoned members is not possible, a volute coiled stainless steel spring washer should be used to maintain tightness.
- Fasteners should be set-in 25mm minimum from sides and ends.

CONNECTOR SIZING

Connector sizes for fixing decking are given in Table 1, and further details can be obtained in the Hardwoods & Cypress Technical & Detailing Guide referenced at the end of this document.

Figure 1: Deck structure with double headstock and handrails

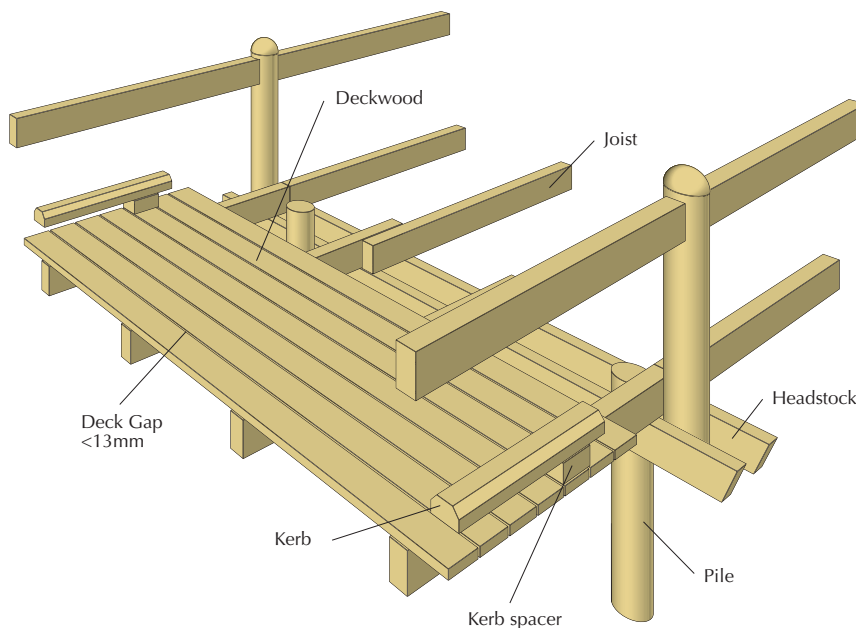


Table 1: Connector sizes for decking

	Timber Thickness	Connector Type and Size	Comment
Nailing	30 to 35	100 x 3.4mm Flat Head	Gun nailing possible
		100 x 3.75mm Flat Head	May require pre-drilling
	40 to 45	125 x 5.6mm Dome head decking spike	Should be pre-drilled
	70	200 x 9.0mm Decking spike	N/A
Screws	30 to 35	75mm No 14 Type 17 screw	May require countersinking
	40 to 45	90 or 100mm No 14 Type 17 screw	May require countersinking

Note: One fastener is required per joist for board up to 70mm wide, and above that, two fasteners.

DECKING BOARD SELECTION

Common sizes for seasoned boards include 90,120 and 140mm widths, and 35 or 45mm thicknesses. Grades included F17 and F27. Unseasoned board sizes include 75, 100, 125 & 150 widths, and 38 or 50mm thicknesses. Grades include F14 and F17, with some F11 available on a limited basis. Details of spans achievable with these grades and sizes are given in Table 2.

Decking profiles may be dressed, rough sawn or reeded. Edges may be square, rounded or arrised - as shown in Figure 2. Selection issues include:

- Rough sawn or reeded boards offer varying degrees of slip resistance. Reeded boards only provides increased slip resistance when travelling perpendicular to the grooves. Reeded boards will also tend to collect and hold dirt in the grooves.

- Arrised and rounded edge boards reduce splintering and improve the performance of coating systems as there is reduced risk of peel.
- The degree of cupping in decking can be minimised if the section ratio does not exceed 1:3 depth to width (approximately).
- The effects of weathering are not as obvious on rough sawn decking as they are on dressed material.
- To increase service life, boards should be laid with the concave growth rings facing downwards, as shown in Figure 2. This reduces or limits checking and hence consequential water retention.
- The closer the joist spacing the better the restraint for decking boards, thus reducing distortion.
- Unseasoned boards may shrink and should be laid with the in-service life moisture content in mind.

Figure 2: Common decking profiles



Table 2: Decking span tables

(concentrated loads of 4.5kN or 13.0kN, uniformly distributed loads 5kPa)

		Point Loads	Unseasoned Grades			Seasoned Grades		
Light Pedestrian Traffic	4.5kN	Board Size	F11	F14	F17	Board Size	F17	F17
		38 x 75	300	360	470	35 x 70	420	730
		38 x 100	410	480	620	35 x 90	570	950
		38 x 125	540	620	800	35 x 120	780	1290
		38 x 150	660	760	970	35 x 140	920	1520
		50 x 75	610	710	910	45 x 70	750	1240
		50 x 100	800	920	1170	45 x 90	990	1620
		50 x 125	1020	1180	1480	45 x 120	1340	1800
		50 x 150	1240	1430	1800	45 x 140	1570	1800
Light Vehicular Traffic	13kN	38 x 75	NS	NS	NS	35 x 70	NS	480
		38 x 100	NS	NS	320	35 x 90	370	640
		38 x 125	NS	330	430	35 x 120	520	870
		38 x 150	350	410	530	35 x 140	620	1030
		50 x 75	300	360	470	45 x 70	500	840
		50 x 100	410	480	620	45 x 90	660	1100
		50 x 125	530	620	790	45 x 120	900	1490
		50 x 150	660	760	970	45 x 140	1070	1740

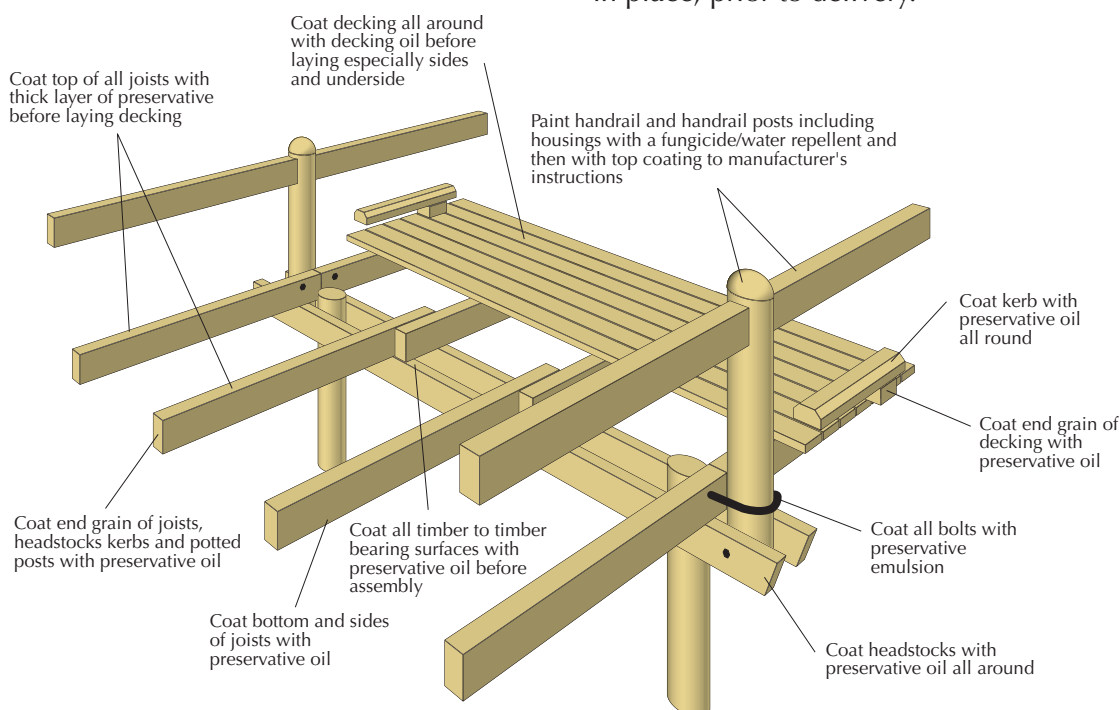
Notes: Concentrated loads generally override uniformly distributed loads in determining deck board capacity.
NS = Not Suitable

TIMBER COATINGS

Before laying decking the top surface and ends of joists and all sides and ends of decking boards should be treated with water repellent preservative or oil based primer – as detailed in Figure 3. An alternative for joists, is to flash the top surface. For further information on applied finishes contact proprietary manufacturers or for general information refer to the Hardwoods & Cypress Technical Specifier's Guide (referenced at the end of the document).

Deck maintenance is required to prevent leaf litter and other debris from affecting long term durability. To improve service life, use widely gapped boards (10mm gaps) and kerbs spaced well above deck level. This lets the debris pass through – often under wind assistance. Another problem can be brown staining from hardwood leachate. This can be minimised by sealing the timber or providing protection to relevant structures. Another approach is to use cleaning agents to manage the problem. In all cases severity of the problem reduces over time.

Figure 3: Pre-deck laying treatment of timber



BEARERS AND JOISTS

Sizes and grades for bearers and joists are shown in the left hand column of Tables 3, 4 and 5. Sections of greater size omitted from the tables may still be available upon enquiry with individual producers. This includes sections wider than 100mm wide and F22 stress grades (seasoned or unseasoned). Producer's names can be sourced in the Producers Guide referenced at the end of this document.

Large bearers may require 'heart-in' which means the tree pith and surrounding juvenile wood are included in the centre part of the bearer. AS2082[®] permits the heart in the central 1/9th of the cross section, but only on sections 175 x 175mm or greater in size. Caution is required with 'heart' material as it is subject to heart shakes which are longitudinal fissures within the wood which weaken large sections. One option to reduce the problem is to use high density timbers with relatively low shrinkage rates, e.g. red ironbark. These timbers are very strong and create less internal shrinkage stresses, thus reducing heart shakes. Another option is to reduce end-grain splitting and moisture loss by coating the ends with a suitable sealer immediately after sawing. In addition, all sections should be end-plated with multi-toothed plate connectors covering at least 50% of the exposed end sections. Timber should be specified with these features in place, prior to delivery.

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Table 3: Bearer sizes and maximum spans
(concentrated loads 13.0kN, uniformly distributed loads 5kPa)

Bearer Size Depth x Breadth (mm)	Floor Load Width (mm)							
	1800	2400	3600	4800	1800	2400	3600	4800
	Maximum Bearer Span (mm)							
	Single Span Bearer				Bearer Continuous Over 2 or More Spans			
F11 UNSEASONED HARDWOOD								
150 x 75	1300	1300	1200	1200	1700	1500	1100	1000
150 x 100	1700	1600	1400	1300	2000	1700	1400	1300
175 x 75	1800	1700	1500	1400	2100	1800	1300	1200
175 x 100	2200	2000	1700	1600	2400	2000	1700	1500
200 x 75	2300	2100	1700	1600	2400	2100	1500	1400
200 x 100	2700	2300	1900	1800	2700	2300	1900	1800
225 x 75	2700	2300	1900	1800	2700	2300	1700	1600
225 x 100	3000	2600	2100	2000	3000	2600	2100	2000
250 x 75	3000	2600	2100	2000	3000	2600	1900	1700
250 x 100	3400	2900	2400	2300	3400	2900	2400	2200
275 x 75	3300	2900	2300	2200	3300	2900	2100	1900
275 x 100	3700	3200	2600	2500	3700	3200	2600	2400
300 x 75	3600	3100	2600	2400	3600	3100	2300	2100
300 x 100	4100	3500	2900	2700	4100	3500	2900	2700
F14 UNSEASONED HARDWOOD								
150 x 75	1500	1500	1300	1300	1900	1600	1200	1100
150 x 100	1900	1800	1500	1400	2100	1900	1500	1400
175 x 75	2000	1900	1600	1500	2200	1900	1400	1300
175 x 100	2500	2200	1800	1700	2500	2200	1800	1600
200 x 75	2600	2200	1800	1700	2600	2200	1600	1400
200 x 100	2900	2500	2000	1900	2900	2500	2000	1800
225 x 75	2900	2500	2000	1900	2900	2500	1800	1600
225 x 100	3300	2800	2300	2200	3300	2800	2300	2100
250 x 75	3200	2800	2300	2200	3200	2800	2000	1800
250 x 100	3600	3100	2600	2400	3600	3100	2600	2300
275 x 75	3500	3100	2500	2400	3500	3100	2200	2000
275 x 100	4000	3500	2800	2700	4000	3500	2800	2600
300 x 75	3900	3400	2700	2600	3900	3400	2400	2200
300 x 100	4200	3800	3100	2900	4500	3800	3100	2800
F17 UNSEASONED HARDWOOD								
150 x 75	1900	1800	1500	1400	2100	1800	1300	1100
150 x 100	2300	2100	1700	1600	2400	2100	1600	1500
175 x 75	2500	2200	1800	1700	2500	2200	1500	1300
175 x 100	2700	2400	2000	1900	2800	2400	1900	1700
200 x 75	2800	2500	2000	1900	2900	2500	1700	1500
200 x 100	3100	2800	2300	2200	3200	2800	2200	2000
225 x 75	3200	2800	2300	2200	3200	2800	1900	1700
225 x 100	3500	3200	2600	2400	3700	3200	2500	2200
250 x 75	3500	3100	2500	2400	3600	3100	2200	1900
250 x 100	3800	3500	2900	2700	4100	3500	2700	2500
275 x 75	3800	3400	2800	2700	4000	3400	2400	2100
275 x 100	4100	3800	3200	3000	4500	3900	3000	2700
300 x 75	4100	3800	3100	2900	4400	3800	2600	2300
300 x 100	4400	4100	3500	3300	4800	4200	3300	3000
F17 SEASONED HARDWOOD								
2/120 x 35	1200	1200	1100	1000	1500	1400	900	NS
2/120 x 45	1500	1500	1300	1100	1900	1600	1200	900
2/140 x 35	1600	1500	1400	1200	1900	1700	1100	NS
2/140 x 45	2000	1900	1600	1300	2200	1900	1400	1100
2/135 x 35	2200	2000	1700	1400	2400	2000	1300	1000
2/170 x 45	2700	2300	1900	1600	2700	2300	1700	1300
2/190 x 35	2700	2300	1900	1600	2700	2300	1500	1100
2/190 x 45	3000	2600	2100	1800	3000	2600	2000	1500
2/240 x 35	3400	2900	2400	2000	3400	2900	1900	1400
2/240 x 45	3700	3300	2700	2300	3800	3300	2500	1800
2/290 x 45	4200	3900	3300	2800	4600	4000	3000	2200
F27 SEASONED HARDWOOD								
2/120 x 35	1800	1800	1500	1300	2100	1600	1100	NS
2/120 x 45	2300	2100	1700	1500	2400	2100	1400	1000
2/140 x 35	2400	2100	1700	1500	2500	1900	1300	900
2/140 x 45	2600	2400	2000	1700	2800	2400	1600	1200
2/135 x 35	2800	2600	2100	1800	3000	2300	1500	1100
2/170 x 45	3000	2800	2400	2100	3300	3000	2000	1500
2/190 x 35	3100	2900	2400	2000	3400	2600	1700	1300
2/190 x 45	3300	3100	2700	2300	3600	3300	2200	1700
2/240 x 35	3700	3400	3000	2600	4000	3300	2200	1600
2/240 x 45	3900	3700	3300	3000	4300	4000	2800	2100
2/290 x 45	4500	4200	3800	3500	5000	4600	3400	2600

Table 4: Joists sizes and maximum spans (unseasoned timber)
(concentrated loads 13.0kN, uniformly distributed loads 5kPa)

Floor joists centres (mm)	Floor joist size (mm)	Maximum Joist Span (mm)					
		Single Span Joist			Joist Continuous Over 2 or More Spans		
		F11	F14	F17	F11	F14	F17
450	100 x 50	NS	NS	NS	NS	NS	NS
	100 x 75	NS	NS	NS	NS	900	1200
	125 x 50	NS	NS	1000	NS	1000	1300
	125 x 75	1000	1200	1600	1300	1500	2000
	150 x 50	1000	1200	1600	1300	1500	2000
	150 x 75	1600	1900	2400	2000	2400	3000
	175 x 50	1500	1700	2200	1900	2200	2800
	175 x 75	2300	2600	2800	2900	3300	4100
	200 x 50	2000	2400	2800	2600	3000	3700
	200 x 75	3000	3100	3300	3800	4300	4600
	225 x 50	2700	3000	3200	3300	3800	4600
	225 x 75	3400	3500	3700	4700	4900	5100
	250 x 50	3200	3400	3600	4100	4700	4900
	250 x 75	3700	3900	4100	5100	5300	5500
	275 x 50	3600	3700	3900	4900	5100	5300
	275 x 75	4100	4300	4500	5500	5700	5900
	300 x 50	3900	4100	4300	5300	5500	5700
300 x 75	4500	4700	5000	5900	6100	6300	
600	100 x 50	NS	NS	NS	NS	NS	NS
	100 x 75	NS	NS	NS	NS	900	1100
	125 x 50	NS	NS	NS	NS	1000	1200
	125 x 75	1000	1100	1500	1300	1500	2000
	150 x 50	1000	1100	1500	1200	1500	1900
	150 x 75	1500	1800	2300	2000	2300	3000
	175 x 50	1400	1700	2200	1800	2200	2800
	175 x 75	2200	2600	2800	2800	3300	3900
	200 x 50	2000	2300	2800	2500	2900	3700
	200 x 75	2900	3100	3300	3800	4100	4300
	225 x 50	2600	2900	3200	3200	3700	4200
	225 x 75	3400	3500	3700	4400	4500	4700
	250 x 50	3200	3400	3600	4100	4400	4600
	250 x 75	3700	3900	4100	4800	4900	5100
	275 x 50	3600	3700	3900	4600	4800	4900
	275 x 75	4100	4300	4500	5100	5300	5500
	300 x 50	3900	4100	4300	4900	5100	5300
300 x 75	4500	4700	5000	5500	5700	5900	
900	100 x 50	NS	NS	NS	NS	NS	NS
	100 x 75	NS	NS	NS	NS	900	1100
	125 x 50	NS	NS	NS	NS	900	1200
	125x75	1000	1100	1400	1200	1400	1800
	150 x 50	1000	1100	1400	1200	1400	1700
	150 x 75	1400	1600	2100	1800	2100	2800
	175 x 50	1300	1500	2000	1700	2000	2600
	175 x 75	2000	2400	2800	2700	3100	3500
	200 x 50	1800	2100	2700	2300	2700	3500
	200 x 75	2800	3100	3300	3600	3700	3900
	225 x 50	2400	2700	3200	3100	3500	3800
	225 x 75	3400	3500	3700	4000	4100	4300
	250 x 50	3000	3400	3600	3800	4000	4200
	250 x 75	3700	3900	4100	4300	4400	4600
	275 x 50	3600	3700	3900	4200	4300	4500
	275 x 75	4100	4300	4500	4600	4800	5000
	300 x 50	3900	4100	4300	4400	4600	4800
300 x 75	4500	4700	4900	4900	5100	5300	

Note: NS = Not Suitable

APPLICATIONS

Table 5: Joists sizes and maximum spans (seasoned timber)
(concentrated loads 13.0kN, uniformly distributed loads 5kPa)

Floor joists centres (mm)	Floor joist size (mm)	Maximum Joist Span (mm)			
		Single Span Joist		Joist Continuous Over 2 or More Spans	
		F17	F27	F17	F27
450	90 x 45	NS	NS	NS	900
	120 x 45	NS	1400	1000	1800
	140 x 45	1200	2000	1500	2600
	170 x 45	1800	2600	2300	3800
	190 x 45	2400	3000	3000	4300
	240 x 45	3400	3700	4800	5100
600	90 x 45	NS	NS	NS	900
	120 x 45	NS	1300	1000	1800
	140 x 45	1100	2000	1400	2500
	170 x 45	1800	2600	2300	3700
	190 x 45	2300	3000	2900	4000
	240 x 45	3400	3700	4500	4800
900	90 x 45	NS	NS	NS	NS
	120 x 45	NS	1300	1000	1600
	140 x 45	1100	1800	1400	2300
	170 x 45	1600	2600	2100	3300
	190 x 45	2100	3000	2800	3600
	240 x 45	3400	3700	4000	4300
	290 x 45	4100	4500	4600	5000

Note: NS = Not Suitable



NON-DOMESTIC DECKS, BOARDWALKS & LIGHT VEHICLE STRUCTURES

RELATED DOCUMENTS

(From this Series of Timber Development Association Publications)

- Fire Requirements for Non-Domestic Fit-Out (including information on BCA requirements for fire and other issues).
- Technical & Detailing Guide for Hardwoods and Cypress (including information on moisture management, durability, appearance and structural issues).
- Domestic Decks - Hardwoods and Cypress (including span tables and details on key components).
- Stairs, Handrails and Balustrades - Hardwoods and Cypress (including span tables and details on key components).



ACKNOWLEDGMENTS

- Timber Manual, National Association of Forest Industries Ltd., Canberra,
- Timber decks commercial, industrial, marine, Timber Research and Development Advisory Council of Queensland, Brisbane.
- Span tables in this document were prepared using Timber Solutions (structural engineering program), parameters prepared by Project X Consulting Engineers, Rouse Hill, NSW.
- Outdoor Structures Australia, www.outdoorstructures.com.au



For additional assistance please contact the
Timber Advisory Service

1800 044 529

or visit the following websites:

www.timber.net.au

www.australianhardwood.net



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