



# Timber Handrails and Balustrades

➤➤➤ This information bulletin provides general guidance on member sizes, connections and suitable materials for the construction of timber handrails and balustrades. The information provided herein does not preclude the use of manufacturers' proprietary information where this satisfies the requirements of the regulatory authority.

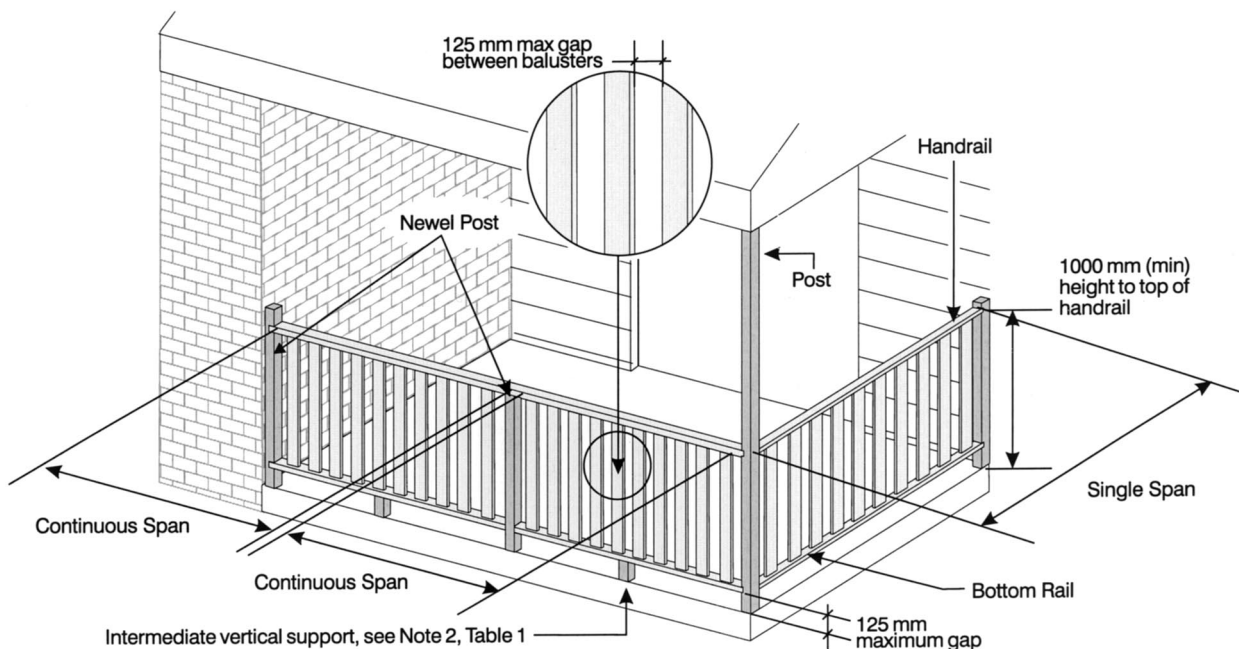
For all buildings, handrails and balustrades are required to comply with the Building Code of Australia (BCA). The BCA is primarily concerned with the safety of building users and occupants. Design and construction must therefore take into consideration both the strength and durability of materials and components as well as the "geometric" constraints prescribed by the BCA to prevent people from accidentally falling through, under or over the balustrade.

The BCA requirements include design and construction provisions for the various components including compliance with the loading provisions of AS 1170.1 SAA Loading Code – Dead and Live Loads. The BCA should also be consulted for specific details regarding handrails for stairs, geometric limitations and other criteria.

## Loads

AS 1170.1 requires balustrades and railings together with members and connections which provide structural support to be able to resist the following limit state loads – 0.9 kN inward, outward and downward load at any point. It also requires balustrades and handrails to be able to resist an inward, outward or downward uniform load of 0.6 kN/m for single occupancy private dwellings and 1.13 kN/m for all other Classes. Infill, including balusters, should be capable of resisting 0.75 kN in any direction.

Note: In addition, where required to restrain crowds or people under panic conditions, AS 1170 recommends design to resist a uniform load of 4.5 kN/m. For these conditions, handrail and balustrade systems should be specifically designed and are not covered in this publication.



>Figure 1 – Balustrade terminology and dimensions

With the compliments of:



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## Materials

In weather exposed applications or, where subjected to other sources of moisture, handrails, posts, newels, balusters, and infill should be either naturally durable Class 1 or Class 2 species such as blackbutt, spotted gum, ironbark, jarrah, merbau or kwila with any sapwood present or treated to H3. Alternatively, preservative treated softwood treated to H3 or higher and shall comply with AS 1604.

For internal use, timber of any durability class is suitable.

The timber should be free from any major strength reducing features, be straight grained and be in accordance with the following:-

- **Hardwood AS 2796:** Timber – Hardwood – Sawn and milled products, Clear or select grade
- **Softwood AS 1786:** Joinery timber milled from conifers – Clear grade

Note: Finger jointed timber shall comply with AS 1491 – ‘Finger jointed structural timber’ and laminated timber

shall comply with AS 1328 – ‘Glued laminated structural timber’.

## > Structural Properties

### Handrails

The handrail sizes and spans given in Table 2 are based on the assumption that the materials have mechanical properties as follows:-

- **Hardwood** – Stress Grade F22, (characteristic bending strength  $f'b = 65$  MPa, Modulus of elasticity  $E = 16000$  MPa) and Joint Group JD2. Examples - spotted gum, ironbark, blackbutt, kwila and merbau
- **Meranti** – (characteristic bending strength  $f'b = 25$  MPa, Modulus of elasticity  $E = 9100$  MPa) and Joint Group JD4.
- **Softwood** – (characteristic bending strength  $f'b = 25$  MPa, Modulus of elasticity  $E = 6900$  MPa) and Joint Group JD4. Examples - radiata pine.

### Posts/Newels

Posts and Newels shall have a minimum Stress Grade of F5. Where supporting handrails/balustrades only, the minimum

size of posts and newels shall be 80x80 mm (maximum post spacing 3600 mm and height of 2700 mm).

**Where supporting roof and or floor loads, refer to AS 1684 – Residential Timber Frame Construction Standard to determine minimum size but not less than 80x80 mm.**

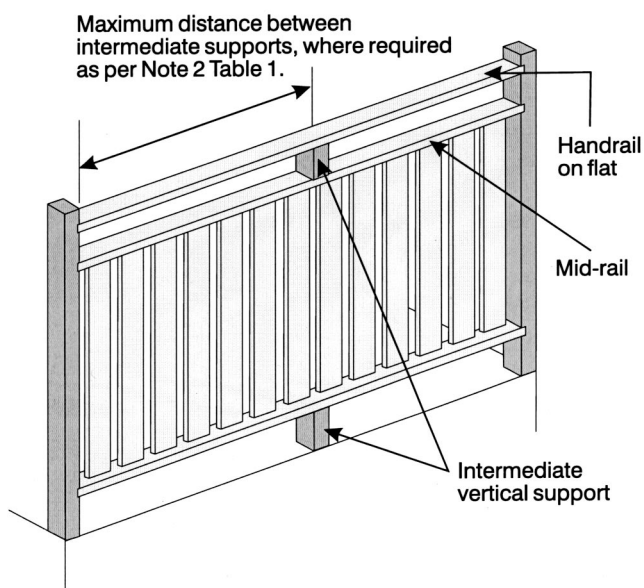
### Infill/Balusters

The minimum size of infill/balusters should be as follows:-

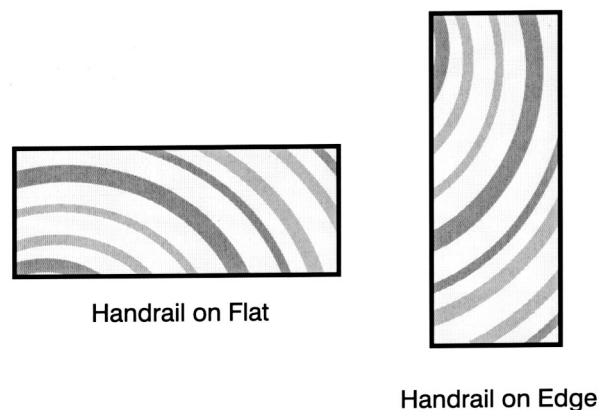
- **Hardwood** – 19x19 mm or 21 mm diameter
- **Softwood** – 19x42 or 25 mm diameter

## Corrosion Resistance

For weather exposed applications all metal connectors including nails, screws, bolts and brackets should be a minimum of hot dipped galvanised or for screws, Class 3 corrosion resistance as per AS3566. For coastal environments subjected to airborne salts deposition, stainless steel or equivalent corrosion resistance metal connections should be used.



>Figure 2 – Intermediate Vertical Support



**Note:** To improve durability / performance it is beneficial to slope the top surface of the handrail. Refer the ATIF brochure “Timber, Durability & External Applications”

>Figure 3 – Handrails: on flat / on edge

## Painting and Finishing – External

### > Unprimed Timber

Nail holes should be stopped with an exterior grade wood filler.

Dirt or any loose material should be removed prior to coating.

All surfaces, ends and joints should be primed prior to assembly with a quality solvent based alkyd primer or stain, in accordance with manufacturers' recommendations.

Final top coats of exterior paint or stain should then be applied in accordance with manufacturers' recommendations.

### > Protective Coated LOSP

**Treated Timber** (see Timber Users Guide (TUG) 2)

Pink pre-coated handrail and balustrade components should be sanded back and dusted off to remove any loose or powdery coatings prior to finishing. Nail

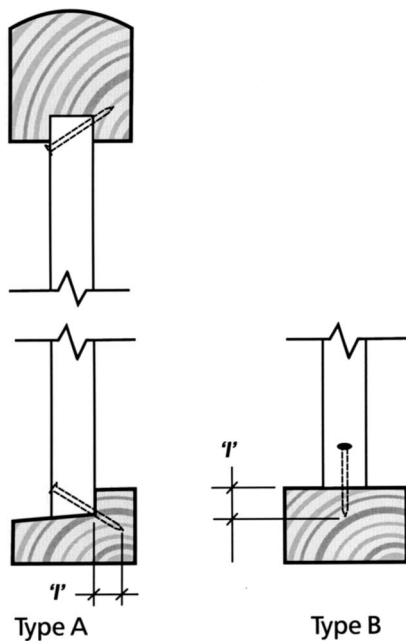
holes should be stopped with an exterior grade wood filler. Timber-to-timber interfaces for all joints should have a seal coating of preservative formulation and all surfaces, ends and joints should be primed prior to assembly with a quality, solvent based alkyd primer.

When the primer has dried in accordance with the manufacturers recommendations, apply two full coats of premium 100% acrylic exterior topcoat in accordance with manufacturers' recommendations.

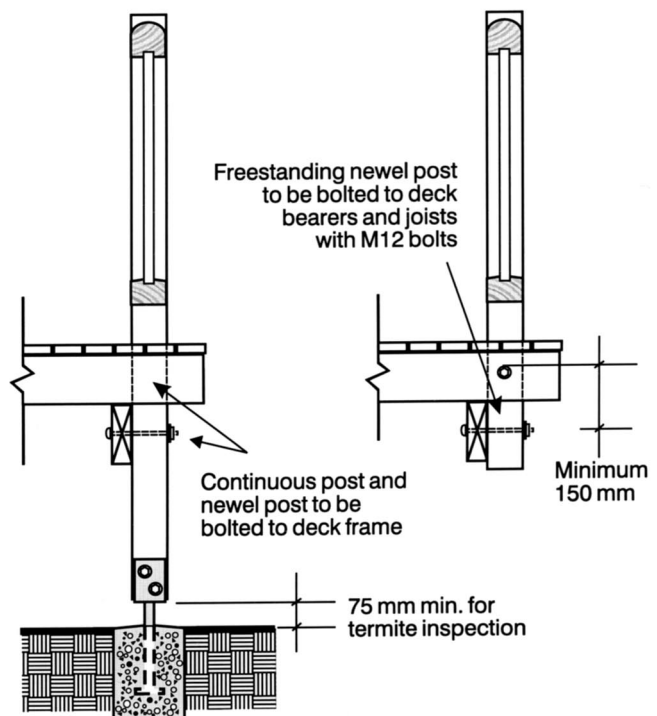
**Table 1 – Connectors for Balusters / Infill**

Timber	Type A – Minimum Nail / Screw Penetration 'l' (mm)				Type B – Nail in shear minimum penetration 'l' (mm)
	Nails		Screws		
	2/2.5 dia	2/2.8 dia	1/No. 8	1/No. 10	
Hardwood (JD2)	22	20	15	15	1 / 2.5 dia x 25 penetration
Softwood and Meranti (JD4)	53	47	15	15	1 / 2.5 dia x 25 penetration

**Notes:** Where the balusters / infill are slotted into a groove or a dowel into a hole (i.e. top connection in Figure 4 Type A) that restrains both inward and outward forces, the above nail /screw fixing requirements are not applicable.



>Figure 4 – Balusters/Infill



>Figure 5 – Post and Newel Post Connections



**Table 2 – Handrail Sizes and Spans**

Timber	Size/ Description	Maximum Span of Handrail (mm)			
		Single Occupancy Buildings		Other Building Classes	
		No Intermediate Vertical Supports (1)	With Intermediate Vertical Supports (2)	No Intermediate Vertical Supports (1)	With Intermediate Vertical Supports (2)
Hardwood (except Meranti)	65x65 (profiled)	3000	3000	3000	3000
	42x65 (profiled)	2200	2700	2200	2700
	42x85 (profiled)	2400	3400	2400	3400
	35x70	2100	3000	2100	3000
	35x90	2200	3600	2200	3600
	35x120	2400	3600	2400	3600
	45x70	2500	3200	2500	3200
	45x90	2700	3600	2700	3600
	45x120	2900	3600	2900	3600
	70x70	3500	3500	3500	3500
	70x90	3600	3600	3600	3600
Meranti	65x65 (profiled)	2700	2700	2200	2200
	42x65 (profiled)	1400	2000	1400	1800
	42x85 (profiled)	1800	3000	1700	2400
	35x70	1200	2400	1200	2000
	35x90	1600	3200	1600	2500
	35x120	2100	3600	1800	3400
	45x70	2000	2800	1800	2200
	45x90	2400	3400	2000	2900
	45x120	2600	4300	2400	3600
	70x70	3200	3200	2800	2800
	70x90	3400	3600	3200	3600
Softwood	65x65 (profiled)	2400	2400	2200	2200
	42x65 (profiled)	1400	2000	1400	1800
	42x85 (profiled)	1800	2700	1700	2400
	35x70	1200	2400	1200	2000
	35x90	1600	2900	1600	2500
	35x120	1900	3600	1800	3400
	45x70	2000	2600	1800	2200
	45x90	2200	3100	2000	2900
	45x120	2300	3600	2300	3600
	70x70	2900	2900	2800	2800
	70x90	3000	3400	3000	3400

- Notes**
- 1 Handrails with no intermediate vertical supports may be used on flat or on edge. See Figure 3.
  - 2 Handrails with intermediate vertical supports shall be installed on flat with intermediate vertical supports spaced not greater than the allowable spans given for the same handrail with no intermediate vertical supports. See Figures 2 and 3.
  - 3 Where a mid-rail (minimum size 42x65) is within 150 mm of the main handrail and is rigidly fixed to it (using blocks, or balusters or dowels that pass through the mid rail and are fixed to the top rail) at least once at mid span, the allowable span of the handrail may be increased by 300 mm.
  - 4 Handrail spans have been limited to 3600 mm maximum.
  - 5 Profiled sections typically include bread loaf, ladies waist and colonial profiles.
  - 6 There is no negative tolerance permitted on the breadth or depth dimensions (overall outside dimensions of profiled shapes) given in the above table.

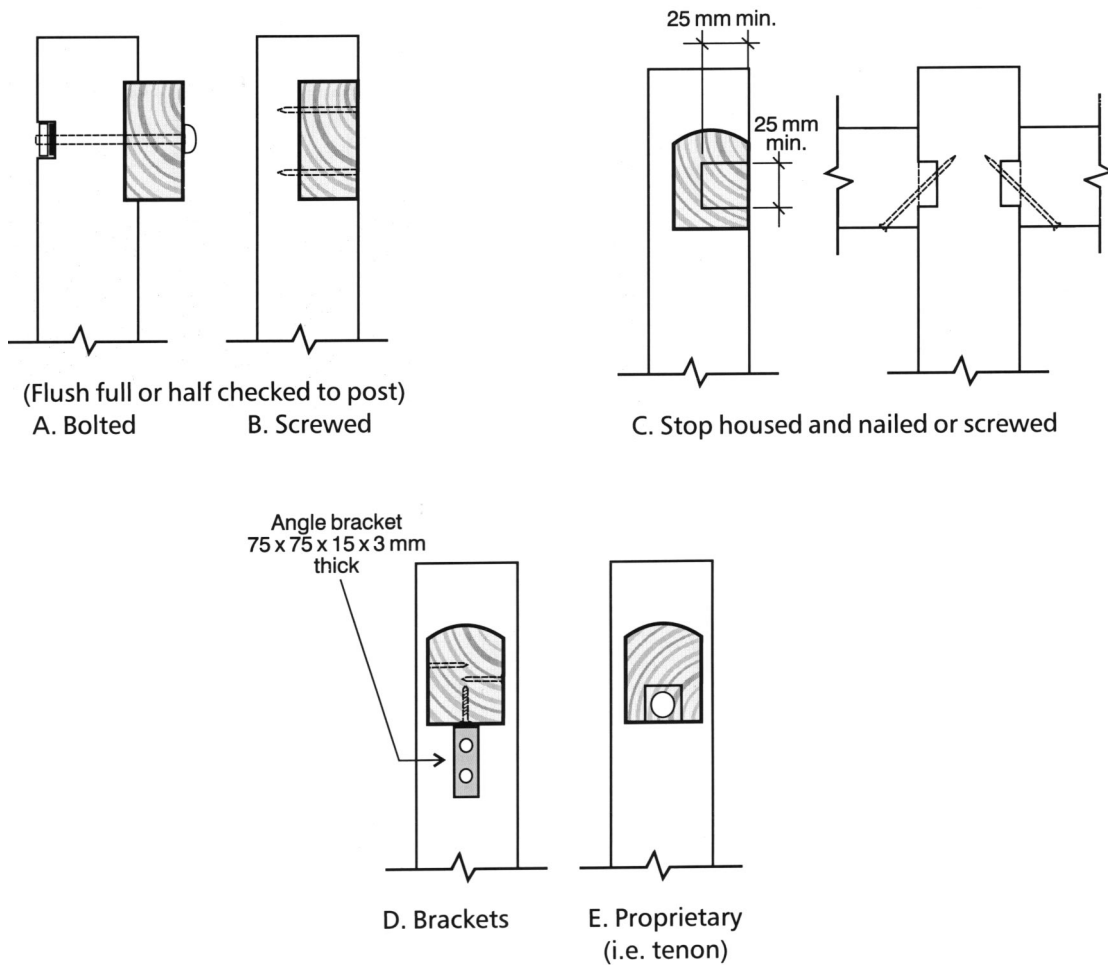


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**Table 3 – Capacity of Handrail Connections**

Timber	Capacity of Connections (kN)											Refer to Manufacturers specifications	
	Type A			Type B			Type C		Type D		Type E		
	No. of Bolts	Bolt Size (Cuphead)		No. of Screws	Screw Size (Type 17)		Screws		Nails		2 Screws per leg of bracket		
M10		M12	No. 10		No. 14	2/No. 10	2/No. 14	2/3 .15 dia	2/3 .75 dia	No. 10	No. 14		
Hardwood (JD2)	1	13	14	1	3.4	4.4	1.9	2.3	2.6	1.8	4.9	7.6	
	2	26	28	2	6.8	8.8							
Softwood and Meranti (JD4)	1	8	9	1	2.0	2.6	1.1	1.3	0.9	1.0	2.8	4.3	
	1	16	18	2	4.0	5.2							

- Notes:**
- 1 For Type B connections, minimum screw penetration into post is 38mm.
  - 2 For Type 2 connections the minimum screw penetration into post is 40mm and the minimum nail penetration into post is 38mm.
  - 3 Midrails and bottom rails shall be fixed with a minimum of 2 / 3.15 dia. skew nails.



> Figure 6 – Handrail Connections



**Table 4 – Loads on Handrails**

Span Type	Handrail Span (mm)	Handrail Connection Loads (kN)	
		Single Occupancy Private Dwellings (Class 1a & 2)	Other Building Classes
Single Span	1800	0.90	1.0
	2100	0.90	1.2
	2400	0.90	1.4
	2700	0.90	1.5
	3000	0.90	1.7
	3300	0.99	1.9
	3600	1.1	2.0
Continuous Span	1800	1.1	2.0
	2100	1.3	2.4
	2400	1.4	2.7
	2700	1.6	3.0
	3000	1.8	3.4
	3300	2.0	3.7
	3600	2.2	4.1

## Example of Determining Handrail Connection

The items highlighted with the magnifier in Tables 3 and 4 provide, as an example, a guide to the selection of an appropriate connection for a Class 3 Building with a continuous span softwood handrail span of 2400mm.

- Step 1** From Table 4 determine the load on the handrail = 2.7 kN
- Step 2** From Table 3 and Figure 6, determine a connection with the capacity to resist 2.7 kN.
- Step 3** Acceptable solutions determined from Table 3 are:
  - Type A connection: 1/M10 bolt; or
  - Type B connection: 2/No. 10 screws; or
  - Type D connection: 2 No. 10 screws per leg of bracket

For further information on this brochure, contact the Timber Advisory Service on free call 1800 044 529 or email [showroom@tdanswasn.au](mailto:showroom@tdanswasn.au) Level 6, 525 Elizabeth Street, Surry Hills NSW 2010. General Information on the use of timber can also be found at the web page [www.timber.net.au](http://www.timber.net.au)  
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