Timber Sub-floors, Floors, Stairs and Verandas

This training package details sub-floor post and bracing systems, floors, stairs and verandas including piers, posts, bearers, joists and bracing for village infrastructure and houses common in South-East Asia and the South Pacific region.

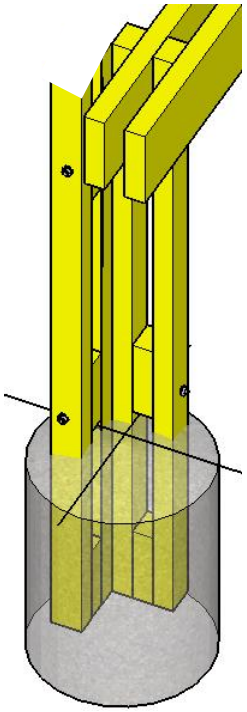
Subfloor of Elevated Timber Houses

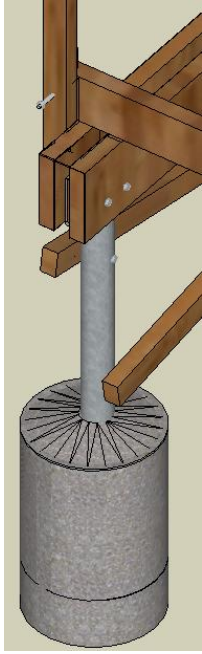
This training module discusses three types of footing, posts and bracing.

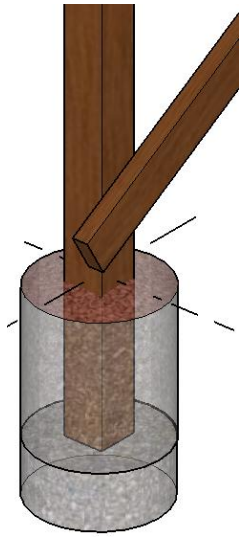
1. **Steel Posts with Timber Diagonal Bracing** are suitable for the Direct Anchorage System or for Conventional Framing. In the system described herein for houses, steel posts are set in concrete footings or piers. For larger structures, steel posts are fitted with base plates and are fixed to holding down bolts embedded in concrete footings or piers.

2. **Fabricated Timber Posts with Timber Diagonal Bracing** are suitable for the Direct Anchorage System designed to AS 1720.1. Roof purlins and trusses are bolted directly to the principal (anchorage) wall studs, which are in turn fixed to joists, bearers or fabricated timber posts. In low-termite-risk areas, the posts may be set in concrete piers. In high-termite-risk areas, the posts should be fixed to steel termite-resistant feet, anchored to the piers and braced.

3. **Solid Timber Posts with Timber Diagonal Bracing** are suitable for Conventional Framing houses designed to AS 1684, where the roof, upper wall and floor framing are separate from, but fixed to, the sub-floor structure by screwed rods or the like. In low-termite-risk areas, the posts may be set in concrete piers. In high-termite-risk areas, the posts should be fixed to steel termite-resistant feet, anchored to the piers and braced.







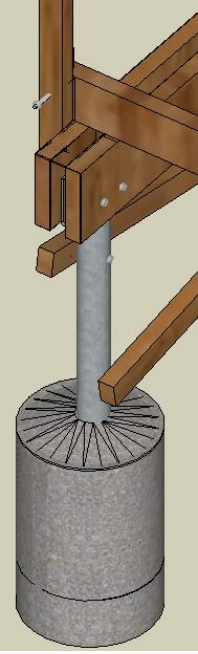
"Pole-houses", in which long continuous timber poles form the sub-floor posts and the vertical structural members of the walls of the upper storey are a special case of a Direct Anchorage System, but are not included here.

Steel Posts

Steel Posts with timber diagonal bracing are suitable for the Direct Anchorage System or for Conventional Framing.

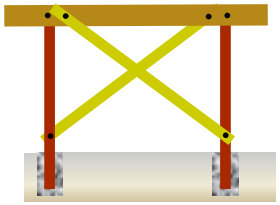
In the system described herein for houses, steel posts are set in concrete footings or piers.

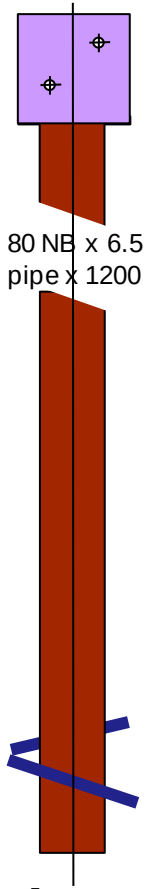
For larger structures, steel posts are fitted with base plates and are fixed to holding down bolts embedded in concrete footings or piers.



Steel Posts

Direct Anchorage Detail
Fix diagonal braces at the top directly to the bearers or joists (as appropriate), to provide a direct load path to the ground

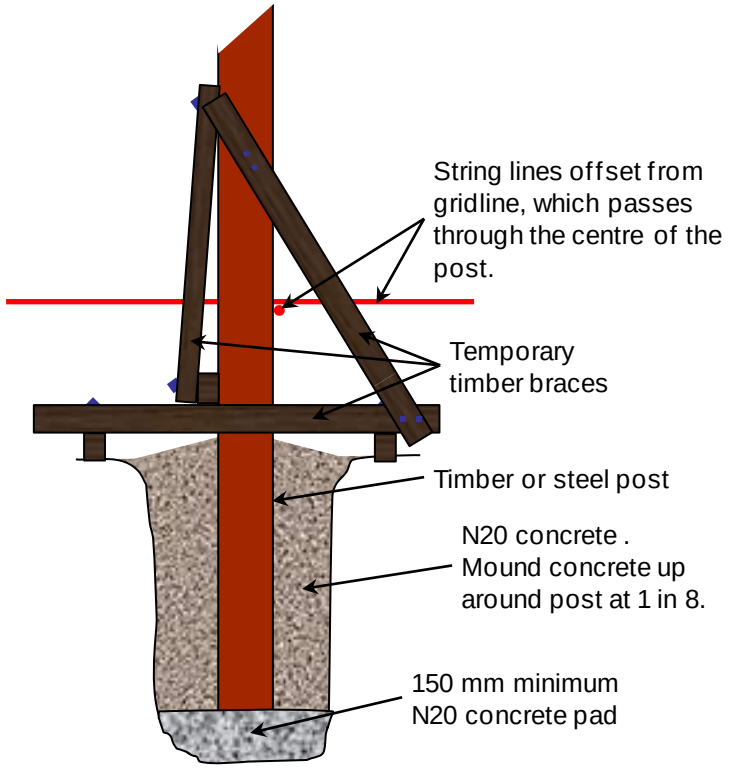


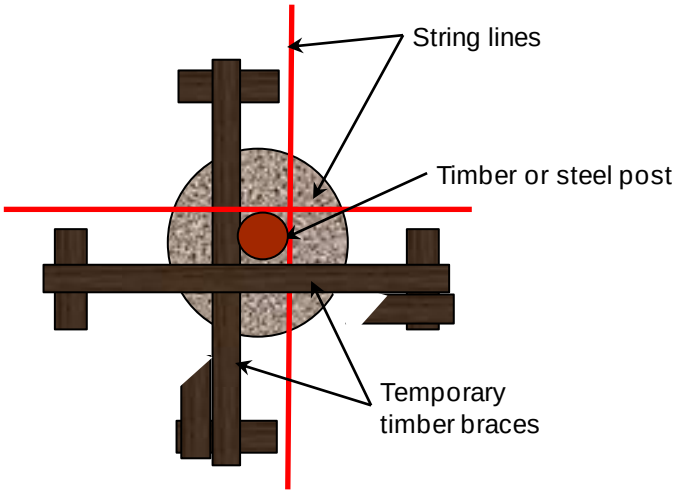


Steel posts ex stock

Steel Posts Embedded in Concrete Piers - Construction

1. Excavate the post holes to the specified diameter and depth. (A square hole of side equal to the specified diameter may be excavated).
2. Remove or thoroughly compact all loose soil.
3. Place sufficient N20 concrete in the bottom of each hole to form pads on which the posts will sit at the specified levels. This thickness shall be not less than 150 mm
4. Treat all posts for termite resistance.
5. Place posts in position, using string lines offset by half the post diameter. Using a spirit level, check for vertical in both directions, and temporarily brace the posts.
6. Erect and bolt in position the bearers, and sufficient joists to establish the correct plan position and heights of the subfloor.
7. When all posts have been checked for vertical, bearers have been checked for height, and bearers/joists checked for position and square, fix four pairs of sub-floor bracing (one set on each side).
8. Place and compact N20 concrete or soil fill (as specified on the drawings).





Concrete in piers, footings & slab-on-ground

Approximate mix (by volume) 1 : 2 : 4

For 1 cubic metre of 20 MPa concrete, the mix should be:

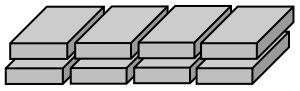
- **8 bags (40 kg each) of GP or GB portland cement**

  OR 16 bags (20 kg each)

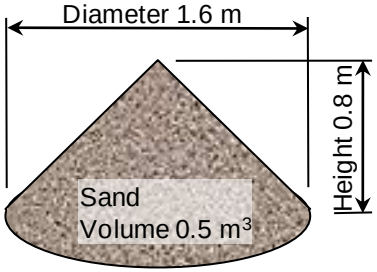
- **0.5 m^3 of sand** - Sand should be clean sharp sand, NOT brickies sand or plasters sand.

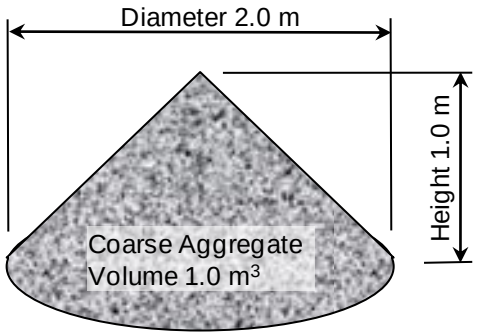
- **1.0 m^3 of 20 mm coarse aggregate** - Aggregate should be clean 20 mm river gravel, crushed aggregate or similar.

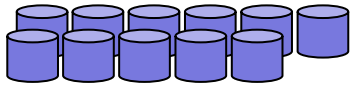
- **200 – 220 litres of water** – Approximately 12 20 litre buckets (300 mm diameter x 290 mm deep). Less water should be used if sand or aggregate are damp.



Cement 8 – 40 kg bags







Water 11 – 20 litre buckets

Basis of calculation:
Density of cement , dry sand and dry aggregate 1,500 kg/m^3
Includes 5% allowance for wastage.

Source: Cement Concrete & Aggregates Australia

Braced Post

Braced Post in Concrete Backfill
Capacity 16 kN

Based on AS 1684.3 Table 8.7. For other diameters, depths and corresponding capacities, refer to the standard.

Application:

Wind classification up to AS 4055 "cyclonic" C1.

For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**

Braced Post in Compacted Soil Backfill
Capacity 9.5 kN

Based on AS 1684.3 Table 8.8. For other dimensions, depths and corresponding capacities, refer to the standard.

Application:

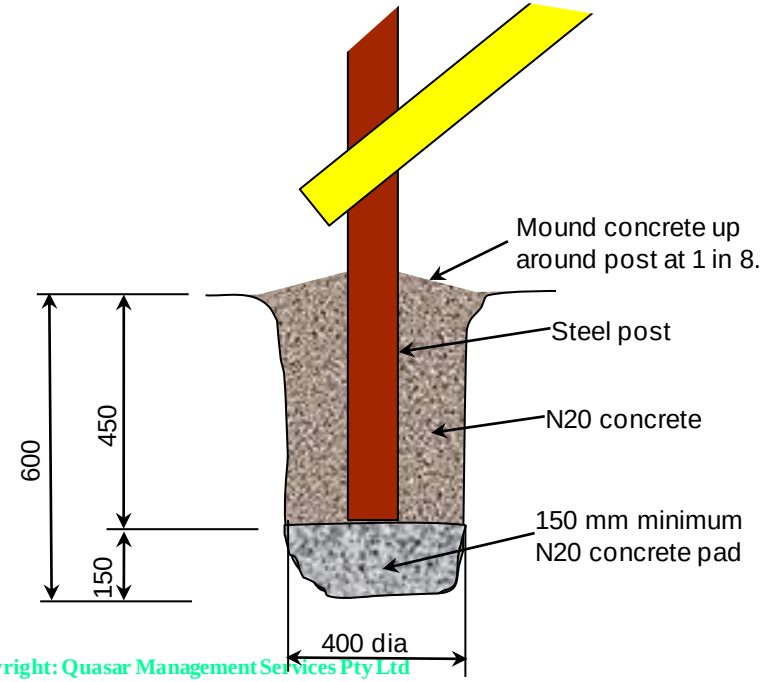
Wind classification up to AS 4055 "cyclonic" C1.

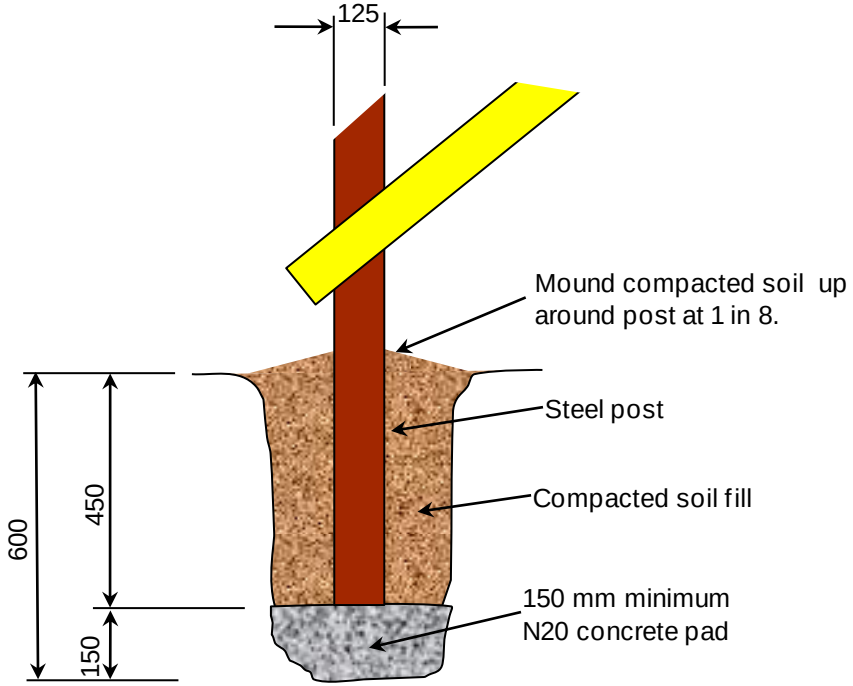
For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**

Preferred Detail





Unbraced Post

Unbraced Post in Concrete Backfill

Capacity 2.4 kN Underside of bearers 1.2 m above ground

Capacity 1.7 kN Underside of bearers 1.8 m above ground

Based on AS 1684.3 Table 8.10. For other diameters, depths and corresponding capacities, refer to the standard.

Application:

Wind classification up to AS 4055 "cyclonic" C1.

For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- A – sand and rock sites
- S – slightly reactive clay sites
- M – moderately reactive clay sites

Unbraced Post in Compacted Soil Backfill

Capacity 0.7 kN Underside of bearers 1.2 m above ground

Capacity 0.5 kN Underside of bearers 1.8 m above ground

Based on AS 1684.3 Table 8.#. For other dimensions, depths and corresponding capacities, refer to the standard.

Application:

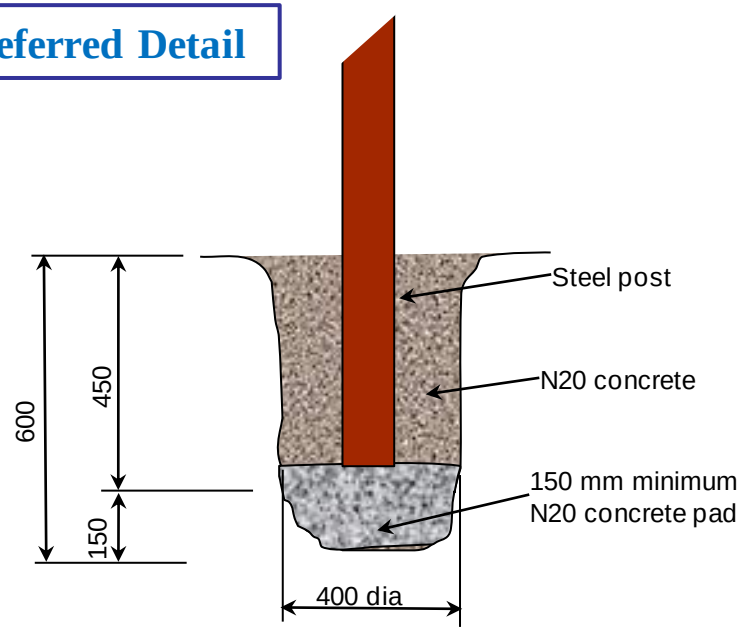
Wind classification up to AS 4055 "cyclonic" C1.

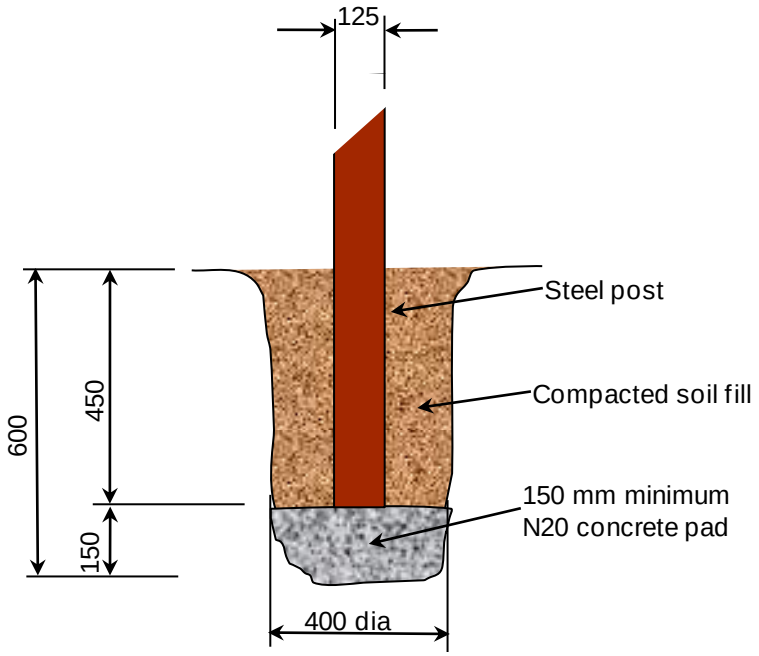
For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- A – sand and rock sites
- S – slightly reactive clay sites
- M – moderately reactive clay sites

Preferred Detail





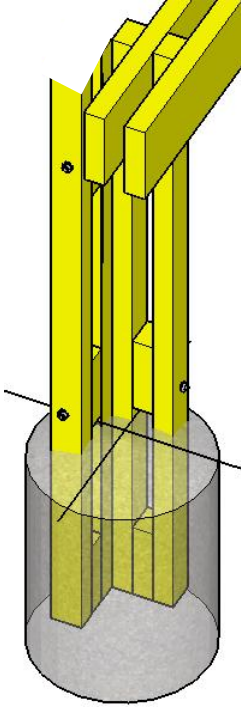
Fabricated Timber Posts

Fabricated Timber Posts with timber diagonal bracing are suitable for the Direct Anchorage System designed to AS 1720.1.

Roof purlins and trusses are bolted directly to the principal (anchorage) wall studs, which are in turn fixed to joists, bearers or fabricated timber posts.

In low-termite-risk areas, the posts may be set in concrete piers.

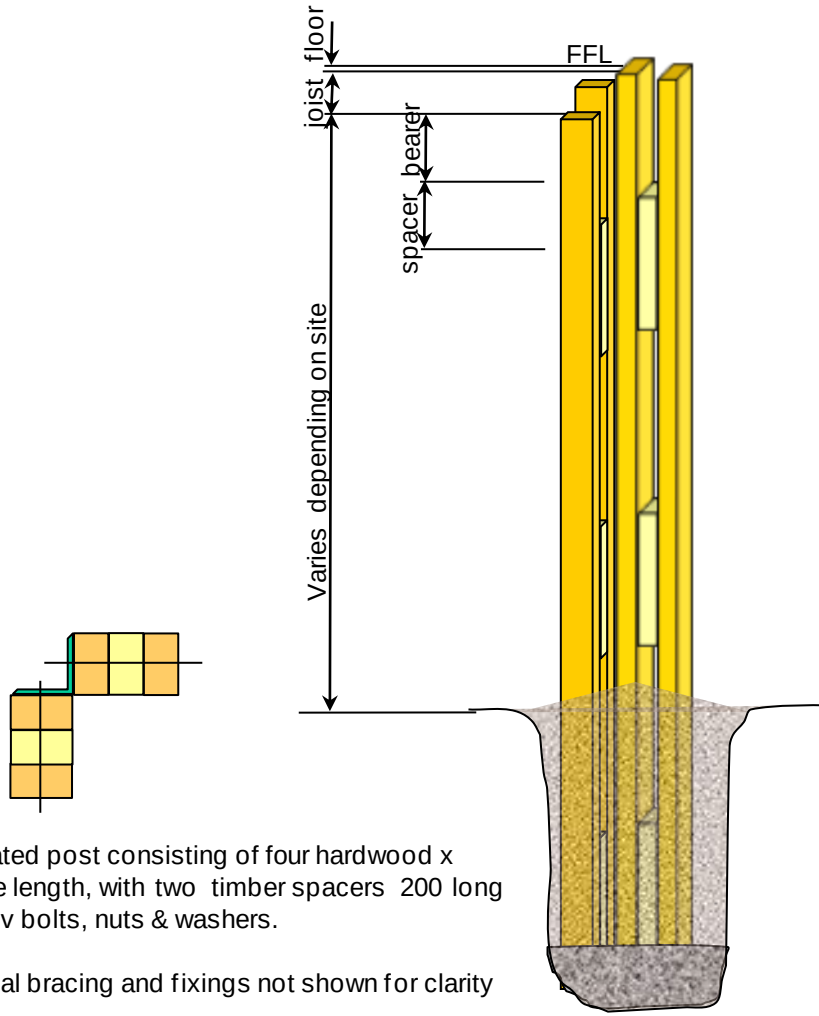
In high-termite-risk areas, the posts should be fixed to steel termite-resistant feet, anchored to the piers and braced.



Fabricated Post Embedded in Concrete Piers

In low termite risk areas, it may be satisfactory to embed the fabricated timber posts directly in the concrete piers. However, this should only be done in the following circumstances:

1. Where there is very low risk of termite attack; and
2. The timber is a hardwood with known resistance to termite attack; and
3. The part of the timber posts that are to be embedded are coated with a termite resisting paint; and
4. The timber is fully surrounded by the concrete, with a cover of at least 50 mm all round; and
5. The top surface of the concrete piers and the surrounding soil are sloped to shed water away from the piers.



Fabricated post consisting of four hardwood x variable length, with two timber spacers 200 long and galv bolts, nuts & washers.

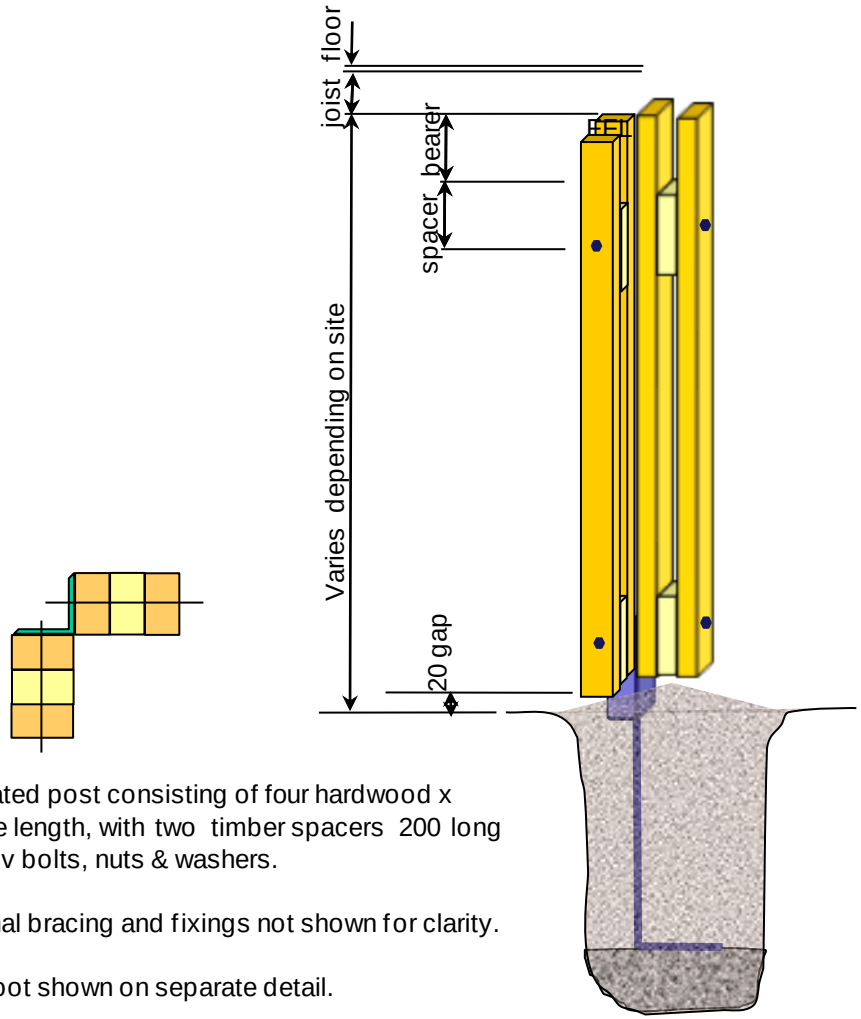
Diagonal bracing and fixings not shown for clarity

Fabricated Post with Steel Feet

In high termite risk areas, fabricated timber posts should not be embedded in the concrete piers, but should be supported on steel feet as detailed.

In addition,

1. The timber should be a hardwood with known resistance to termite attack; and
2. The top surface of the concrete piers and the surrounding soil should be sloped to shed water away from the piers.
3. This system must be diagonally braced.



Fabricated post consisting of four hardwood x variable length, with two timber spacers 200 long and galv bolts, nuts & washers.

Diagonal bracing and fixings not shown for clarity.

Steel foot shown on separate detail.

Direct Anchorage Steel Feet for 4 x 75 Fabricated Posts

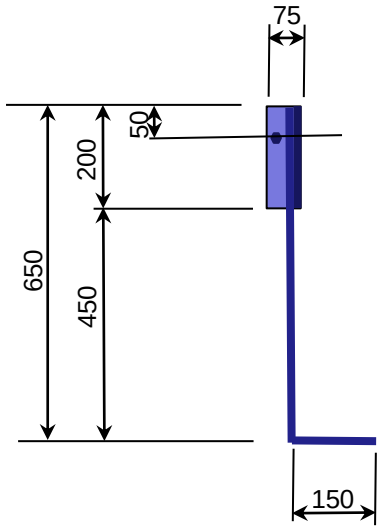
Steel feet, galvanized (or painted with corrosion resisting paint), consisting of a

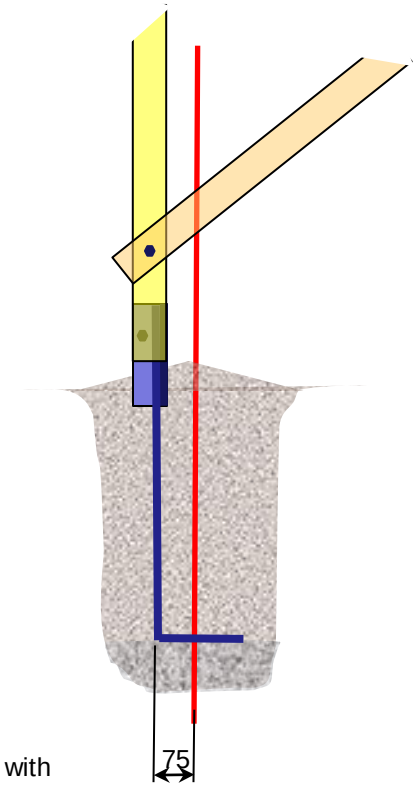
- 75 x 75 x 5 L x 200 mm long
- with 2 / 14 mm holes drilled 50 mm from the top end and
- an M12 x 800 mm reinforcing bar welded to the top and bent to a 150 mm cog at the bottom.

These are bolted to the bottom of each post (consisting of 4 / 75 x 50 F11 timber with spacers) and positioned in the post holes (on a 150 mm concrete pad).

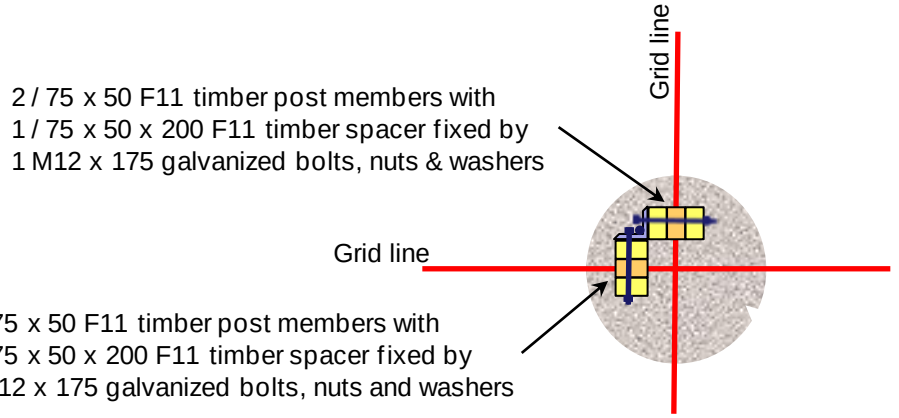
The heels of the angles are positioned 75 mm from the grid lines.

Limit of fabricated post height is 2.0 m





75 x 75 x 5 L x 200 long (galvanized), with
2 / 14 dia hole s 50 mm from the top
M12 x 800 mm long reinforcing bar.
Top of bar continuously welded for 200 mm on both sides to 75 x 75 x 5 L (6 cfw)
Bottom of bar bent to provide a 150 mm cog



Direct Anchorage Steel Feet for 4 x 100 Fabricated Posts

Steel feet, galvanized (or painted with corrosion resisting paint), consisting of a

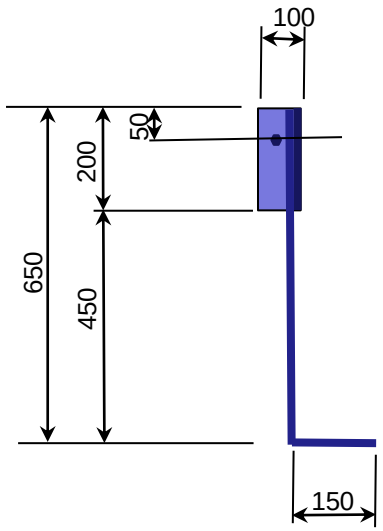
- 100 x 100 x 5 L x 200 mm long
- with 2 / 18 mm holes drilled 50 mm from the top end and
- an M12 x 800 mm reinforcing bar welded to the top and bent to a 150 mm cog at the bottom.

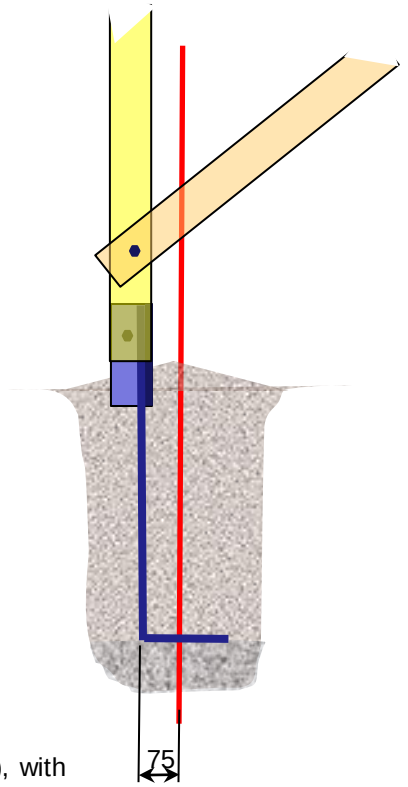
These are bolted to the bottom of each post (consisting of 4 / 100 x 50 F11 timber with spacers) and positioned in the post holes (on a 150 mm concrete pad).

The heels of the angles are positioned 75 mm from the grid lines.

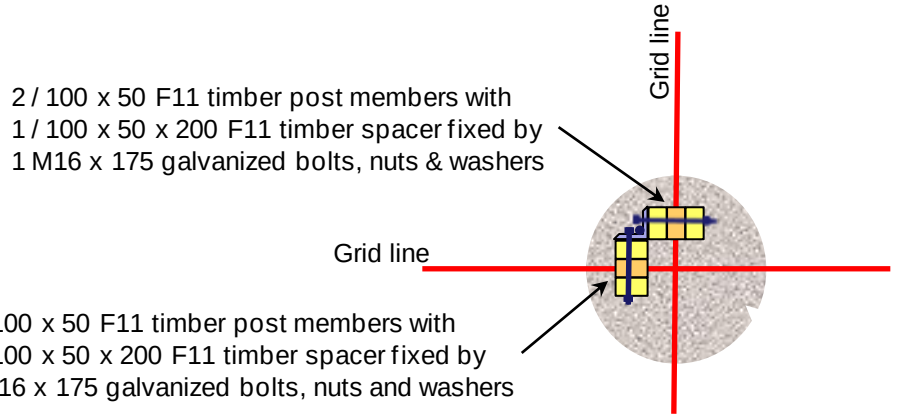
Limit of fabricated post height is 4.0 m.

For heights in the range 3.0 to 4.0 m, horizontal mid height braces must be installed.





100 x 100 x 5 L x 200 long (galvanized), with
2 / 18 dia holes 50 mm from the top
M12 x 800 mm long reinforcing bar.
Top of bar continuously welded for 200 mm on both sides to 100 x 100 x 5 L (6 cfw)
Bottom of bar bent to provide a 150 mm cog



Fabricated Timber Posts with Steel Feet - Construction

1. Excavate the post holes to the specified diameter and depth. (A square hole of side equal to the specified diameter may be excavated).

2. Remove or thoroughly compact all loose soil.

3. Place sufficient N20 concrete in the bottom of each hole to form pads on which the steel feet will sit at the specified levels. This thickness shall be not less than 150 mm

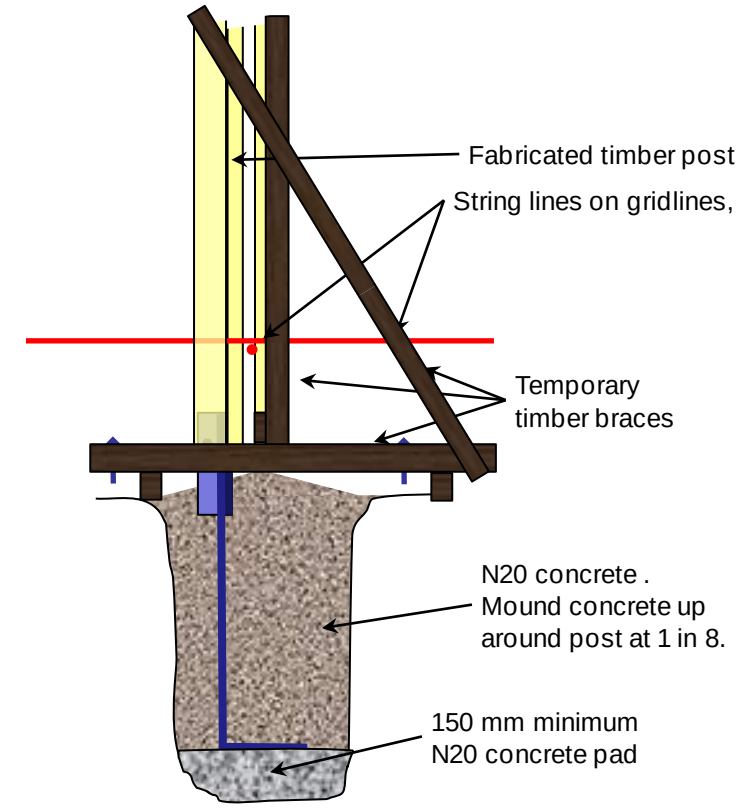
4. Bolt the steel feet to the bottom of the fabricated timber posts (consisting of four timber members with timber spacers).

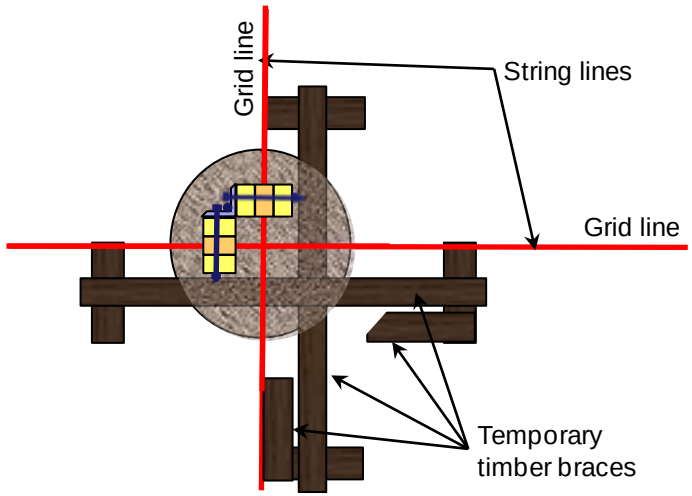
5. Positioned the feet in the post holes. The heels of the angles are positioned 75 mm from the grid lines. Using a spirit level, check for vertical in both directions, and temporarily brace the posts.

6. Erect and bolt in position the bearers, and sufficient joists to establish the correct plan position and heights of the subfloor.

7. When all posts have been checked for vertical, bearers have been checked for height, and bearers/joists checked for position and square, fix four pairs of sub-floor bracing (one set on each side).

8. Place and compact N20 concrete or soil fill (as specified on





Concrete in piers, footings & slab-on-ground

Approximate mix (by volume) 1 : 2 : 4

For 1 cubic metre of 20 MPa concrete, the mix should be:

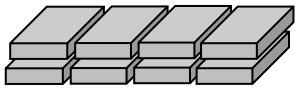
- **8 bags (40 kg each) of GP or GB portland cement**

  OR 16 bags (20 kg each)

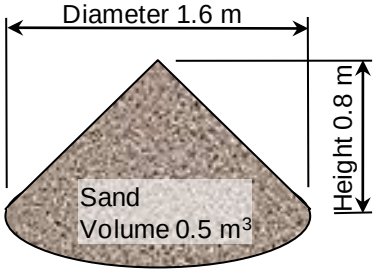
- **0.5 m^3 of sand** - Sand should be clean sharp sand, NOT brickies sand or plasters sand.

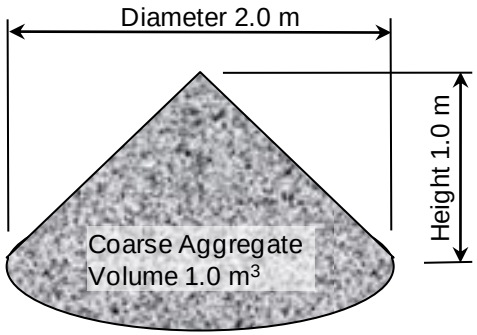
- **1.0 m^3 of 20 mm coarse aggregate** - Aggregate should be clean 20 mm river gravel, crushed aggregate or similar.

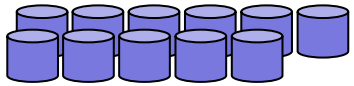
- **200 – 220 litres of water** – Approximately 12 20 litre buckets (300 mm diameter x 290 mm deep). Less water should be used if sand or aggregate are damp.



Cement 8 – 40 kg bags







Water 11 – 20 litre buckets

Basis of calculation:
Density of cement , dry sand and dry aggregate 1,500 kg/m^3
Includes 5% allowance for wastage.

Source: Cement Concrete & Aggregates Australia

Braced Fabricated 4 x 75 HW Post in Concrete

Braced Fabricated 4 x 75 F11 HW Post in Concrete Capacity 11 kN

Adapted from AS 1684.3 Table 8.7. For other diameters, depths and corresponding capacities, refer to the standard.

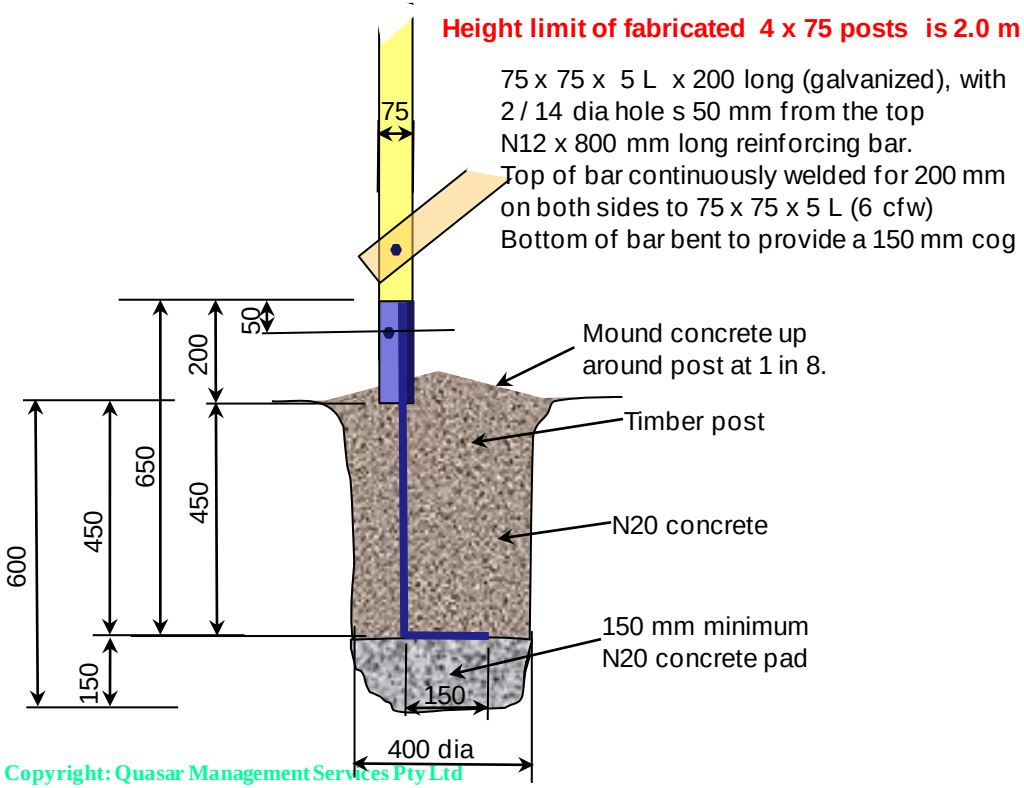
Application:

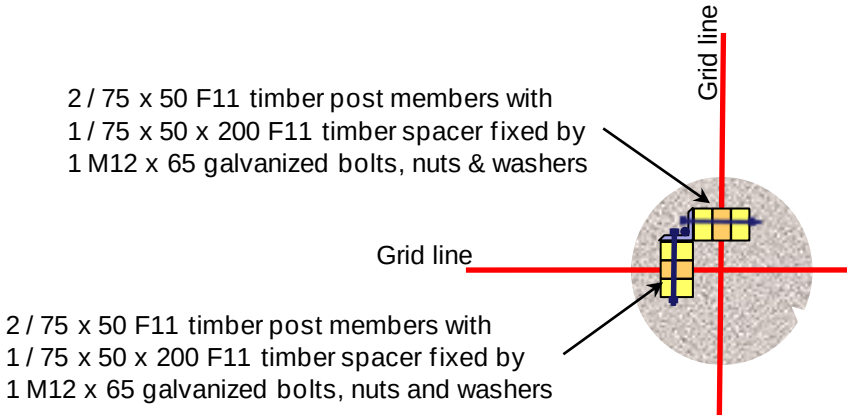
Wind classification up to AS 4055 "cyclonic "C1

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**

Height limit of fabricated 4 x 75 posts is 2.0 m





Braced Fabricated 4 x 100 HW Post in Concrete

Braced Fabricated 4 x 100 F11 HW Post in Concrete Capacity 15 kN

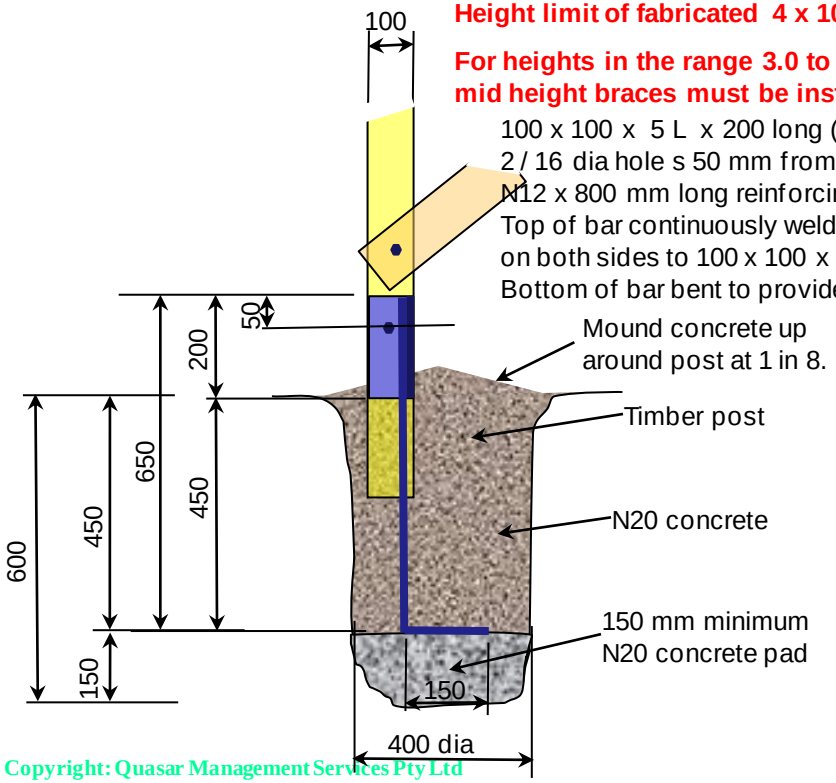
Adapted from AS 1684.3 Table 8.7. For other diameters, depths and corresponding capacities, refer to the standard.

Application:

Wind classification up to AS 4055 "cyclonic "C1

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**



Height limit of fabricated 4 x 100 posts is 4.0 m.

For heights in the range 3.0 to 4.0 m, horizontal mid height braces must be installed.

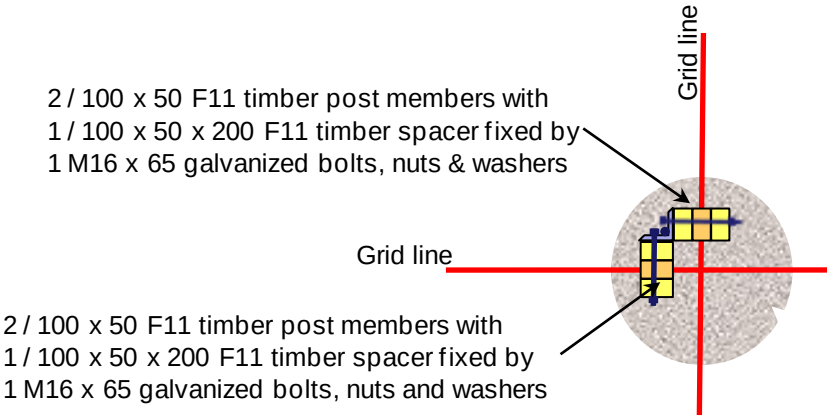
100 x 100 x 5 L x 200 long (galvanized), with
2 / 16 dia hole s 50 mm from the top
N12 x 800 mm long reinforcing bar.
Top of bar continuously welded for 200 mm
on both sides to 100 x 100 x 5 L (6 cfw)
Bottom of bar bent to provide a 150 mm cog

Mound concrete up around post at 1 in 8.

Timber post

N20 concrete

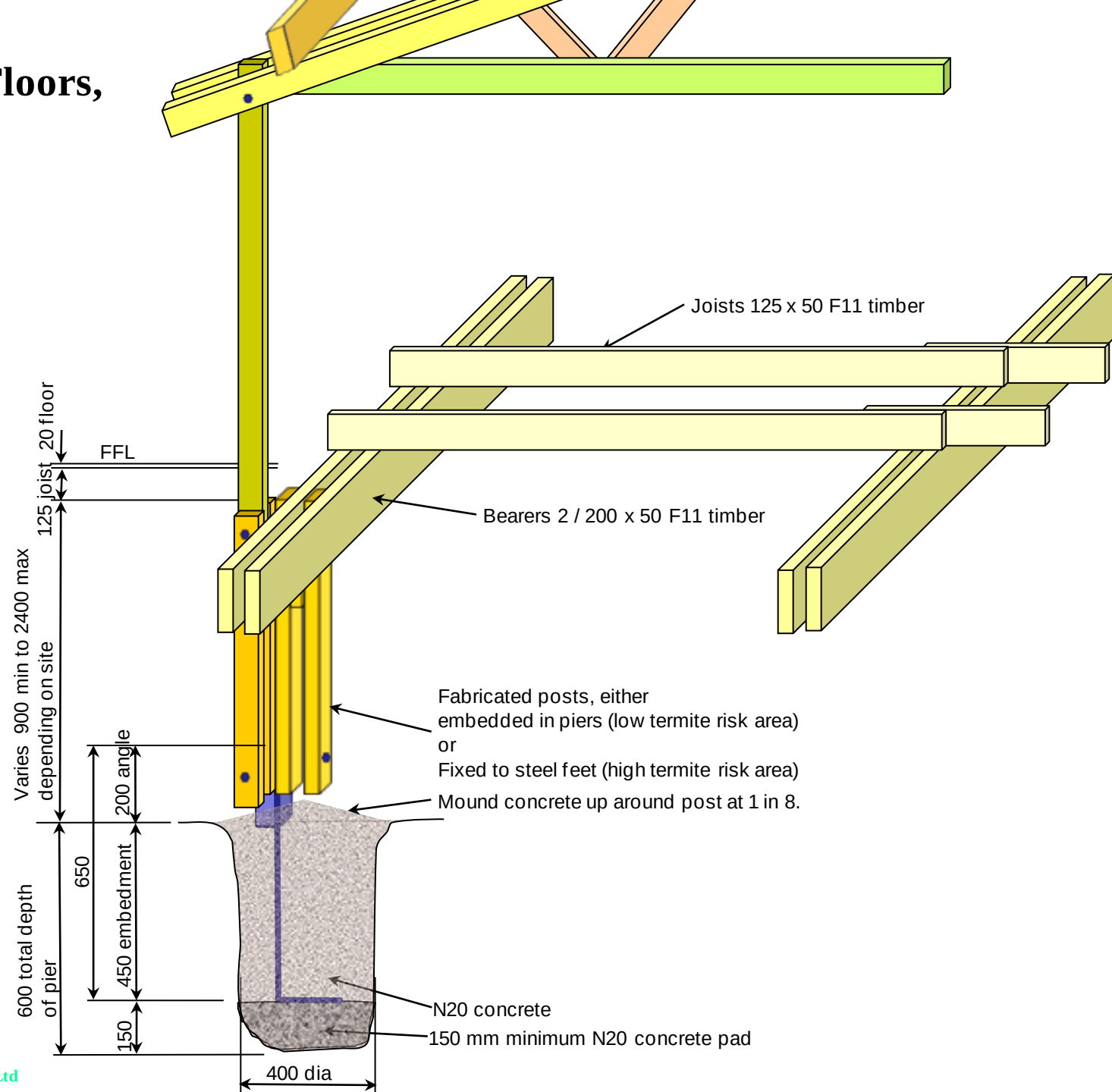
150 mm minimum N20 concrete pad



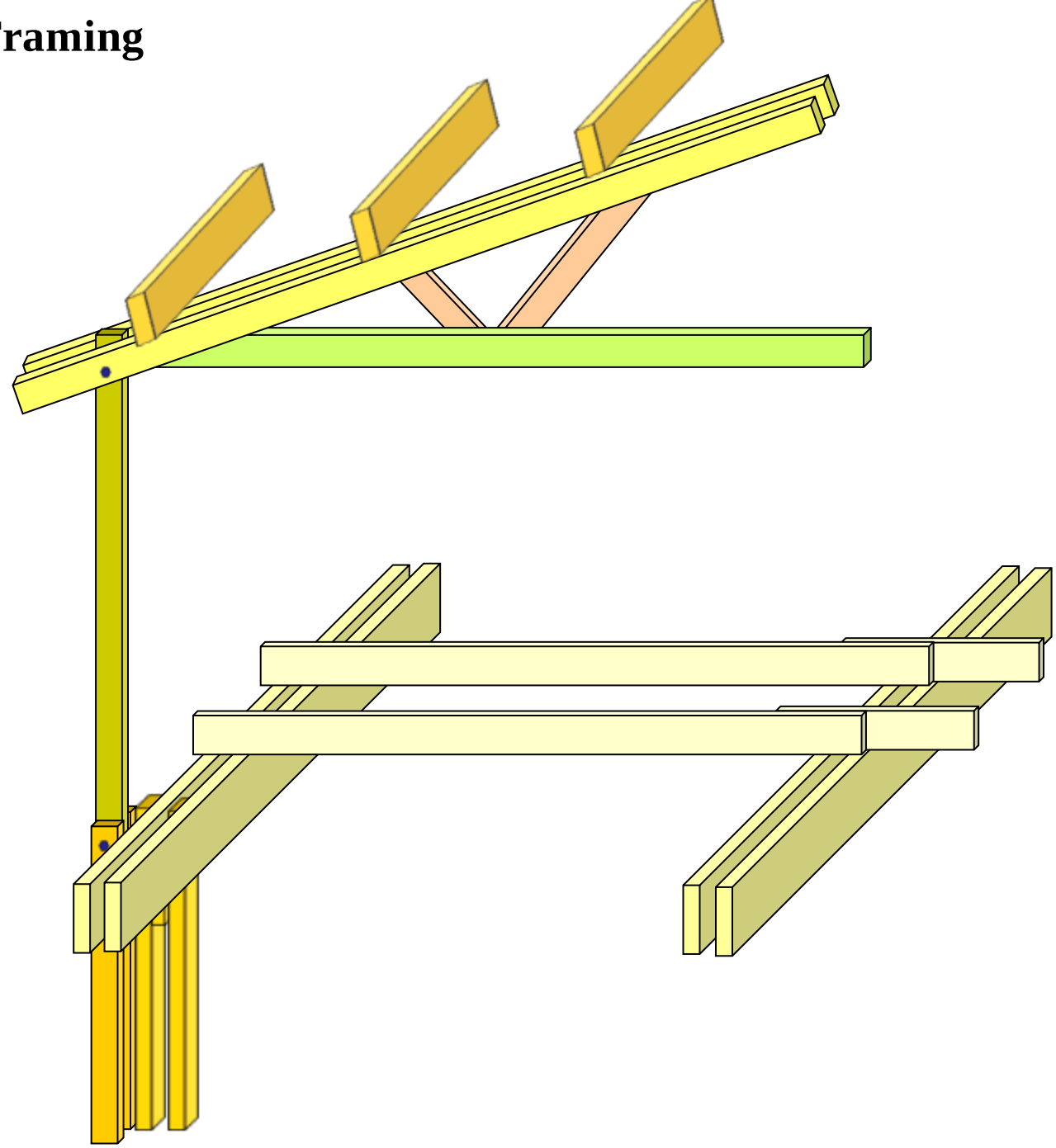
2 / 100 x 50 F11 timber post members with
1 / 100 x 50 x 200 F11 timber spacer fixed by
1 M16 x 65 galvanized bolts, nuts & washers

2 / 100 x 50 F11 timber post members with
1 / 100 x 50 x 200 F11 timber spacer fixed by
1 M16 x 65 galvanized bolts, nuts and washers

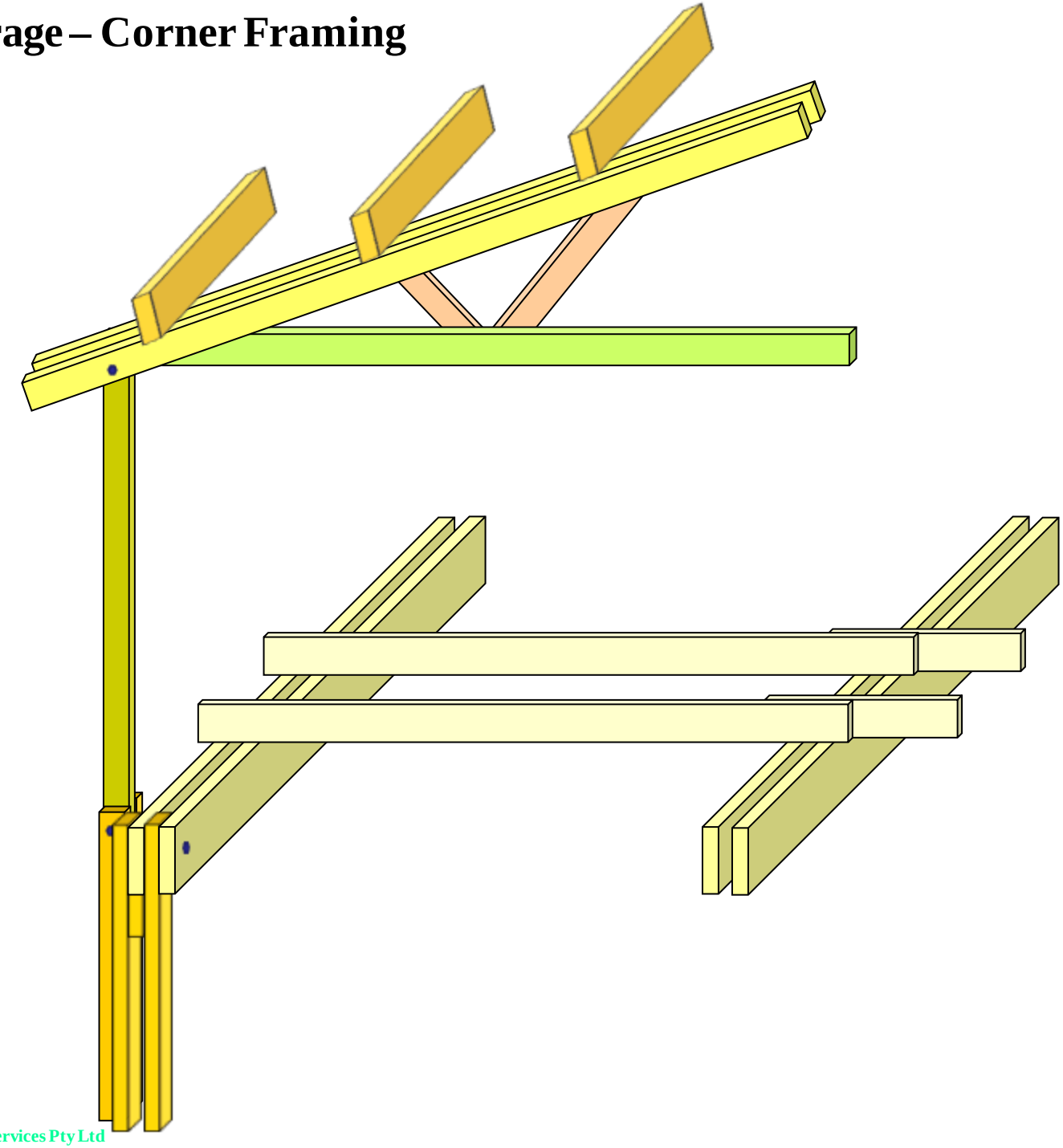
Direct Anchorage - Fabricated Posts, Floors, Walls and Trusses



Direct Anchorage – Side Framing



Direct Anchorage – Corner Framing

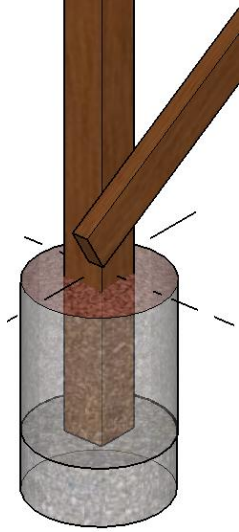


Solid Timber Posts

Solid Timber Posts with Timber Diagonal Bracing are suitable for Conventional Framing houses designed to AS 1684, where the upper wall and floor framing are separate from, but fixed to, the sub-floor structure by screwed rods or the like.

In low-termite-risk areas, the posts may be set in concrete piers.

In high-termite-risk areas, the posts should be fixed to steel termite-resistant feet, anchored to the piers and braced.



Braced Post

Braced Post in Concrete Backfill
Capacity 16 kN

Based on AS 1684.3 Table 8.7. For other diameters, depths and corresponding capacities, refer to the standard.

Application:

Wind classification up to AS 4055 "cyclonic" C1.

For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**

Braced Post in Compacted Soil Backfill
Capacity 9.5 kN

Based on AS 1684.3 Table 8.8. For other dimensions, depths and corresponding capacities, refer to the standard.

Application:

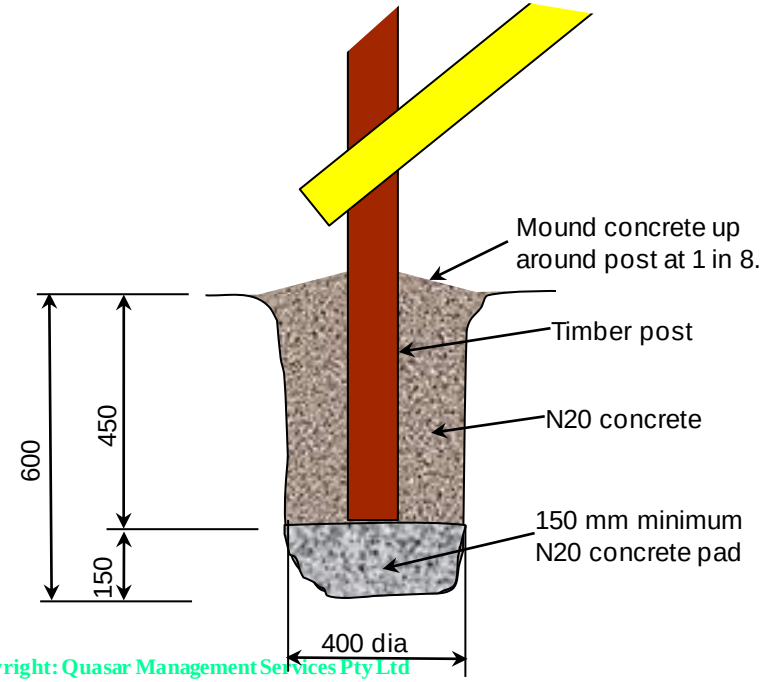
Wind classification up to AS 4055 "cyclonic" C1.

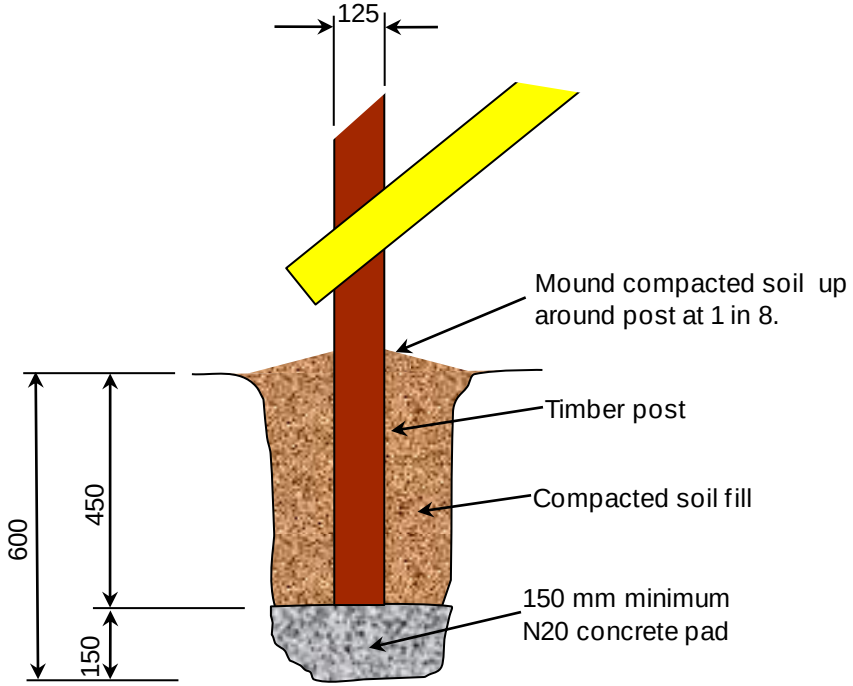
For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- **A – sand and rock sites**
- **S – slightly reactive clay sites**
- **M – moderately reactive clay sites**

Preferred Detail





Unbraced Post

Unbraced Post in Concrete Backfill

Capacity 2.4 kN Underside of bearers 1.2 m above ground

Capacity 1.7 kN Underside of bearers 1.8 m above ground

Based on AS 1684.3 Table 8.10. For other diameters, depths and corresponding capacities, refer to the standard.

Application:

Wind classification up to AS 4055 "cyclonic" C1.

For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- A – sand and rock sites
- S – slightly reactive clay sites
- M – moderately reactive clay sites

Unbraced Post in Compacted Soil Backfill

Capacity 0.7 kN Underside of bearers 1.2 m above ground

Capacity 0.5 kN Underside of bearers 1.8 m above ground

Based on AS 1684.3 Table 8.#. For other dimensions, depths and corresponding capacities, refer to the standard.

Application:

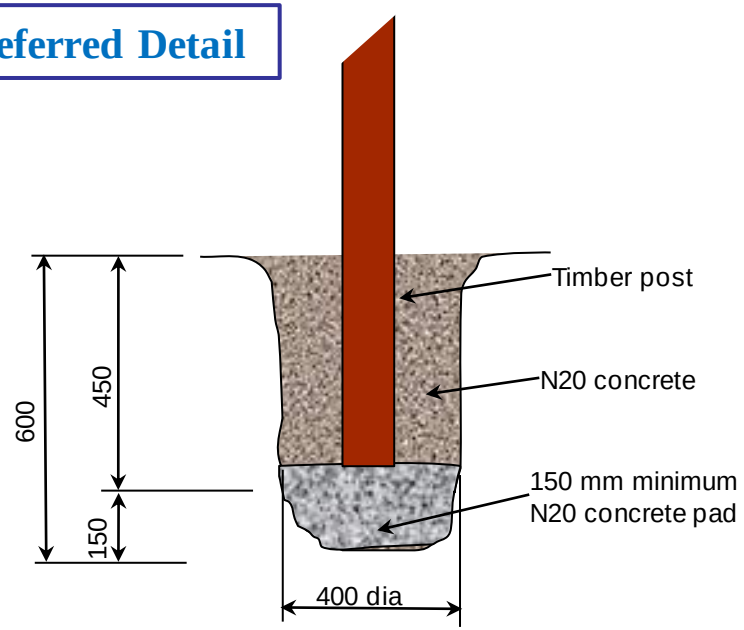
Wind classification up to AS 4055 "cyclonic" C1.

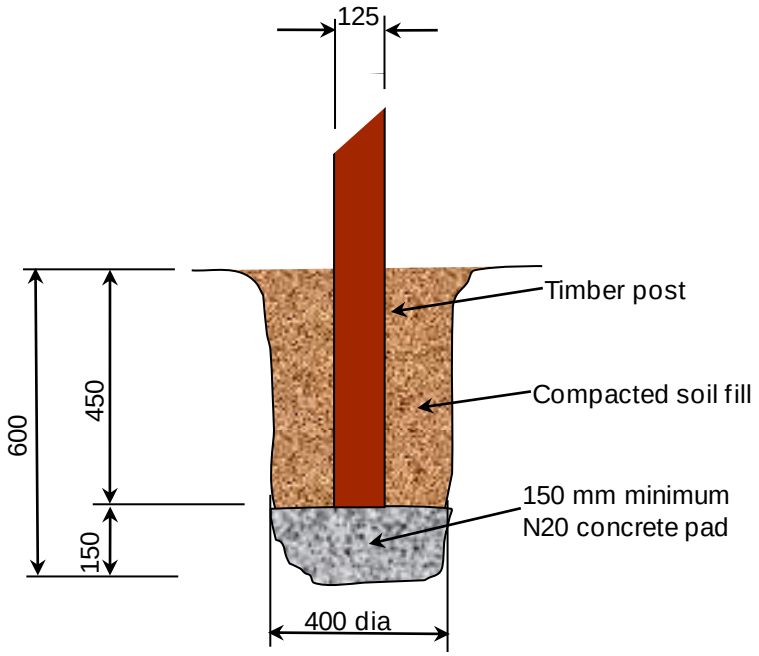
For stronger winds, reduced capacities must be calculated using AS 2870.

Soil classification to AS 2870

- A – sand and rock sites
- S – slightly reactive clay sites
- M – moderately reactive clay sites

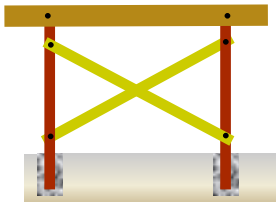
Preferred Detail



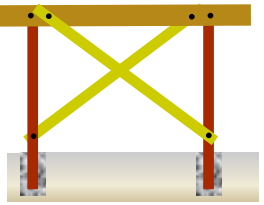


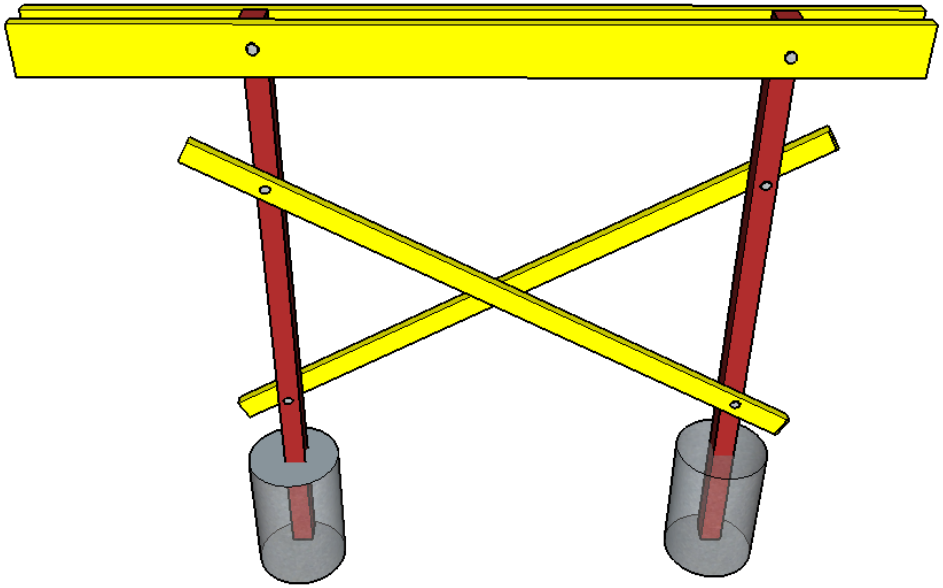
Sub-floor Tension Bracing

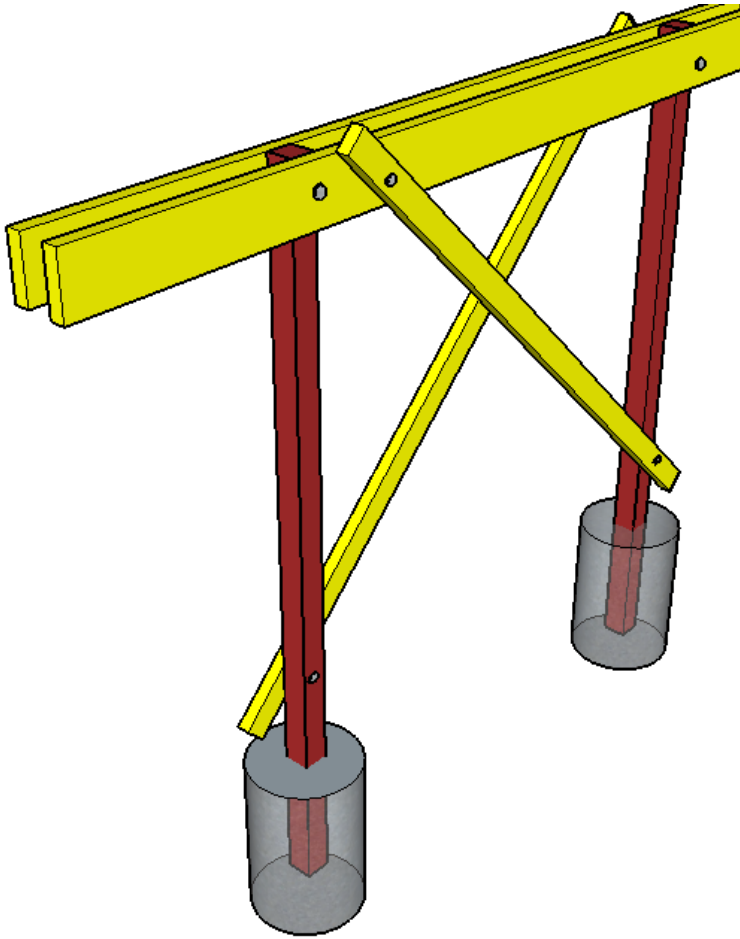
Conventional Detail
Fix diagonal braces to the posts



Direct Anchorage Detail
Fix diagonal braces at the top directly to the bearers or joists (as appropriate), to provide a direct load path to the ground

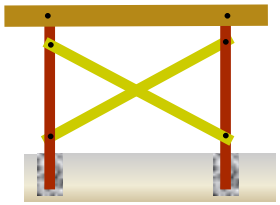




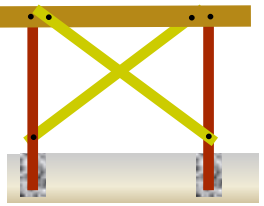


Sub-floor Tension Bracing

Conventional Detail
Fix diagonal braces to the posts



Direct Anchorage Detail
Fix diagonal braces at the top directly to the bearers or joists (as appropriate), to provide a direct load path to the ground

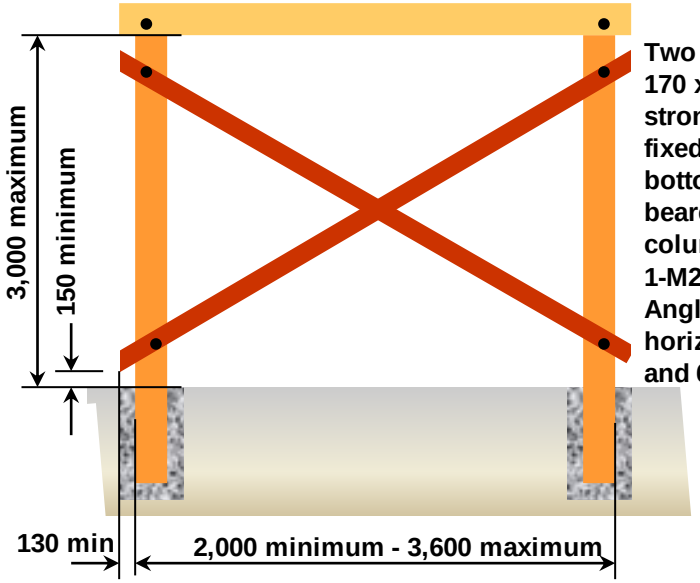


Capacity 22 kN
Based on AS 1684.3 Table 8.9

Columns, of dimensions not less than:

- **90 x 90 mm F11 (or stronger) hardwood**
- **90 x 90 mm N20 (or stronger) concrete with 1 N12 reinforcing bar**
- **190 x 190 mm 15 MPa reinforced concrete masonry with 1 N12 reinforcing bar**
- **90 OD x 3 mm CHS galvanised steel hollow section**

Bearers fixed to columns with 1-M12 bolt or 2-M10 bolts



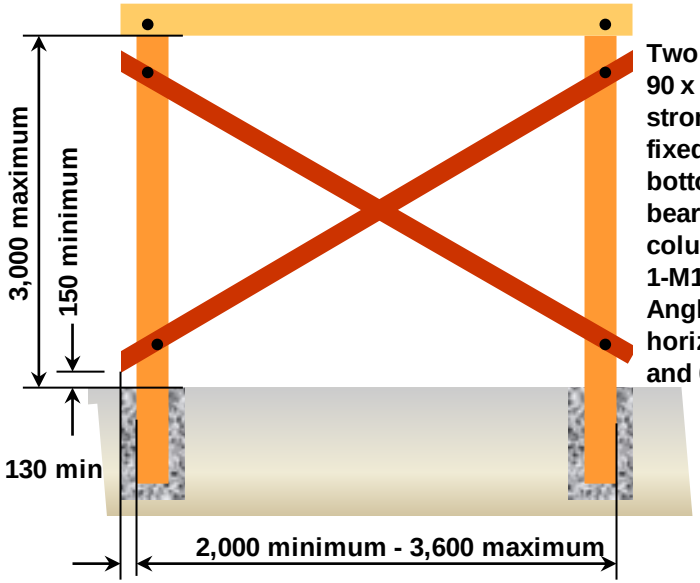
Two diagonal braces, 170 x 45 mm F11 (or stronger) hardwood, fixed to columns at the bottom and to the bearer (preferred) or column at the top by 1-M20 bolt (or stronger) Angle of braces from horizontal between 30° and 60°.

Capacity 15 kN
Based on AS 1684.3 Table 8.9

Columns, of dimensions not less than:

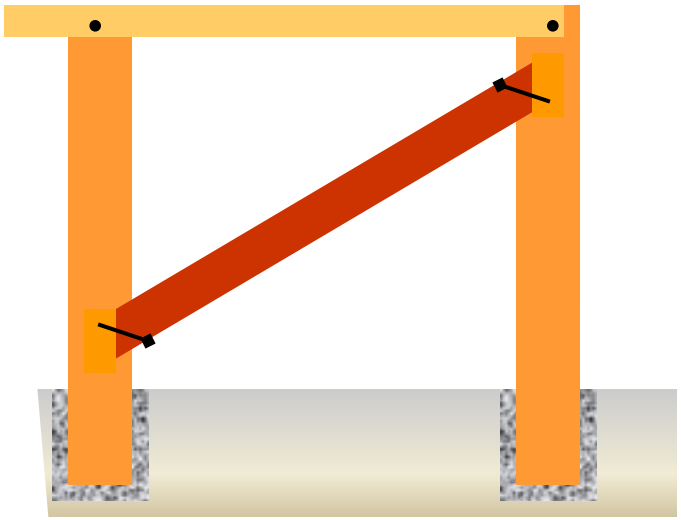
- **90 x 90 mm F11 (or stronger) hardwood**
- **90 x 90 mm N20 (or stronger) concrete with 1 N12 reinforcing bar**
- **190 x 190 mm 15 MPa reinforced concrete masonry with 1 N12 reinforcing bar**
- **90 OD x 3 mm CHS galvanised steel hollow section**

Bearers fixed to columns with 1-M12 bolt or 2-M10 bolts



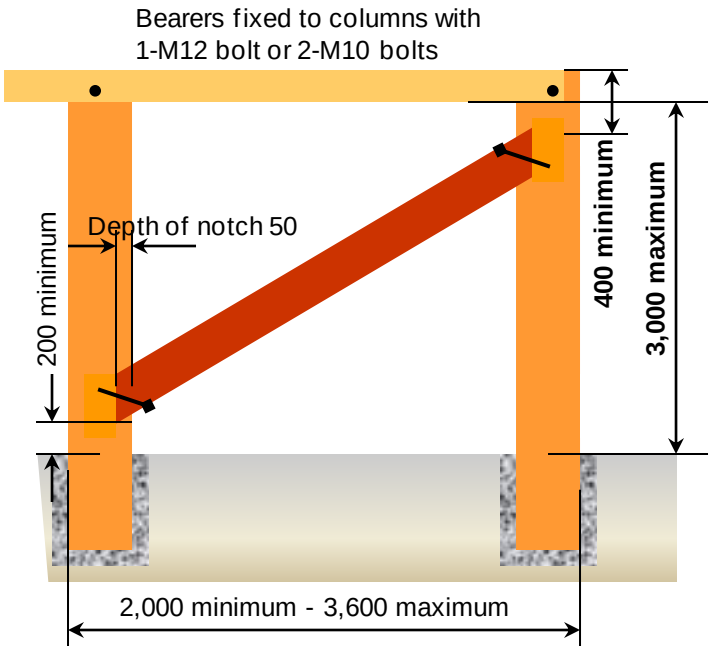
Two diagonal braces, 90 x 45 mm F11 (or stronger) hardwood, fixed to columns at the bottom and to the bearer (preferred) or column at the top by 1-M16 bolt (or stronger) Angle of braces from horizontal between 30° and 60°.

Sub-floor Compression Bracing



Sub-floor Compression Bracing

Capacity 90 kN (Nominal)



Posts, of dimensions not less than:

- 200 x 200 mm or 250 mm diameter F11 (or stronger) hardwood, or
- 150 x 150 mm or 200 mm diameter N20 (or stronger) concrete with 1 N12 reinforcing bar

Two diagonal braces in opposing directions in two bays on each side of building, at least 90 x 900 mm or 150 mm diameter F11 (or stronger) hardwood, notched into the columns to a depth of 50 mm and fixed at the top and bottom by at least 2 – 150 x 3.15 mm ϕ galvanised flat head nails (or stronger) .

Angle of braces from horizontal between 30º and 60º.

Concrete in footings

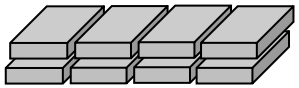
Approximate mix (by volume) 1 : 2 : 4

For 1 cubic metre of 20 MPa concrete, the mix should be:

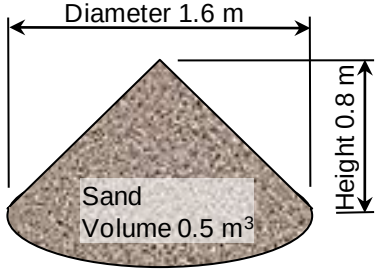
- **8 bags (40 kg each) of GP or GB portland cement**

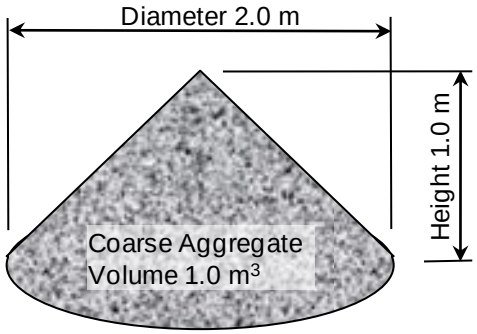
  OR 16 bags (20 kg each)

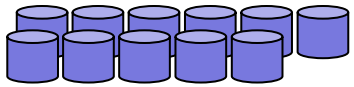
- **0.5 m^3 of sand** - Sand should be clean sharp sand, NOT brickies sand or plasters sand.
- **1.0 m^3 of 20 mm coarse aggregate** - Aggregate should be clean 20 mm river gravel, crushed aggregate or similar.
- **200 – 220 litres of water** – Approximately 12 20 litre buckets (300 mm diameter x 290 mm deep). Less water should be used if sand or aggregate are damp.



Cement 8 – 40 kg bags







Water 11 – 20 litre buckets

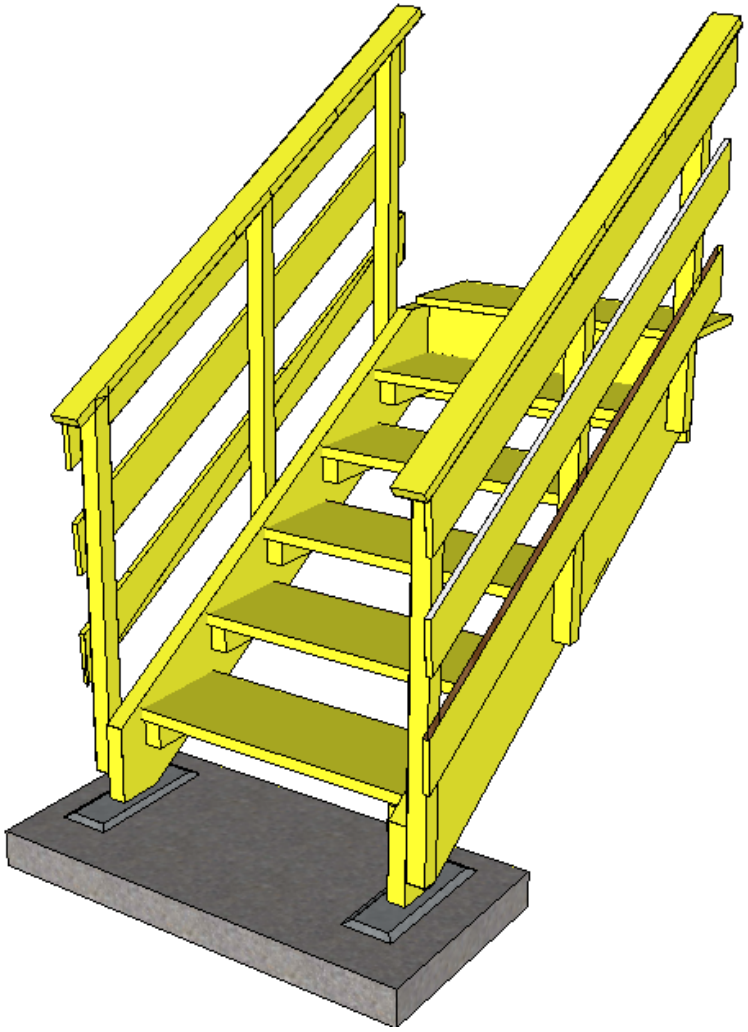
Basis of calculation:

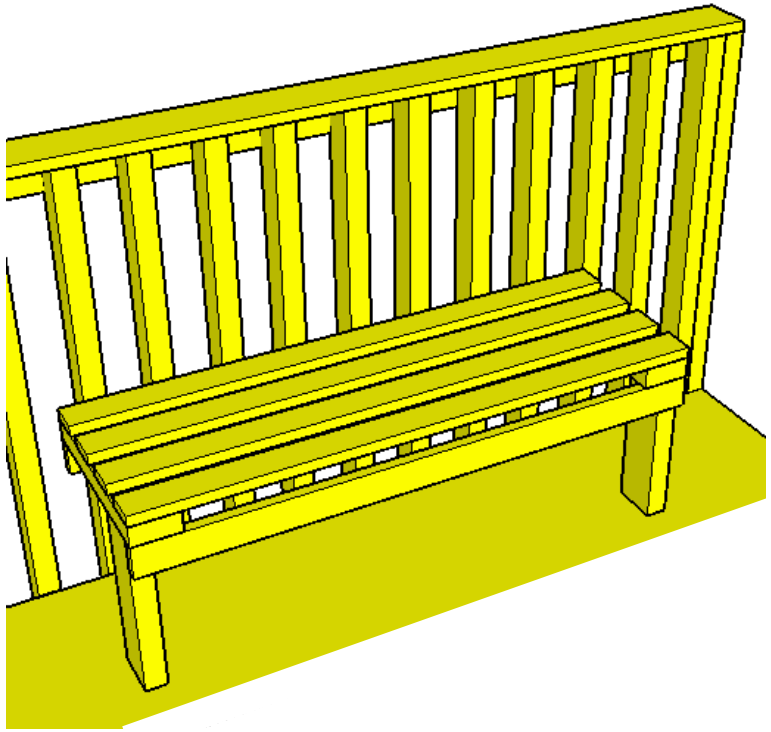
Density of cement , dry sand and dry aggregate 1,500 kg/m^3

Includes 5% allowance for wastage.

Source: Cement Concrete & Aggregates Australia

Stairs, Balustrades, Handrails and Balcony Seats

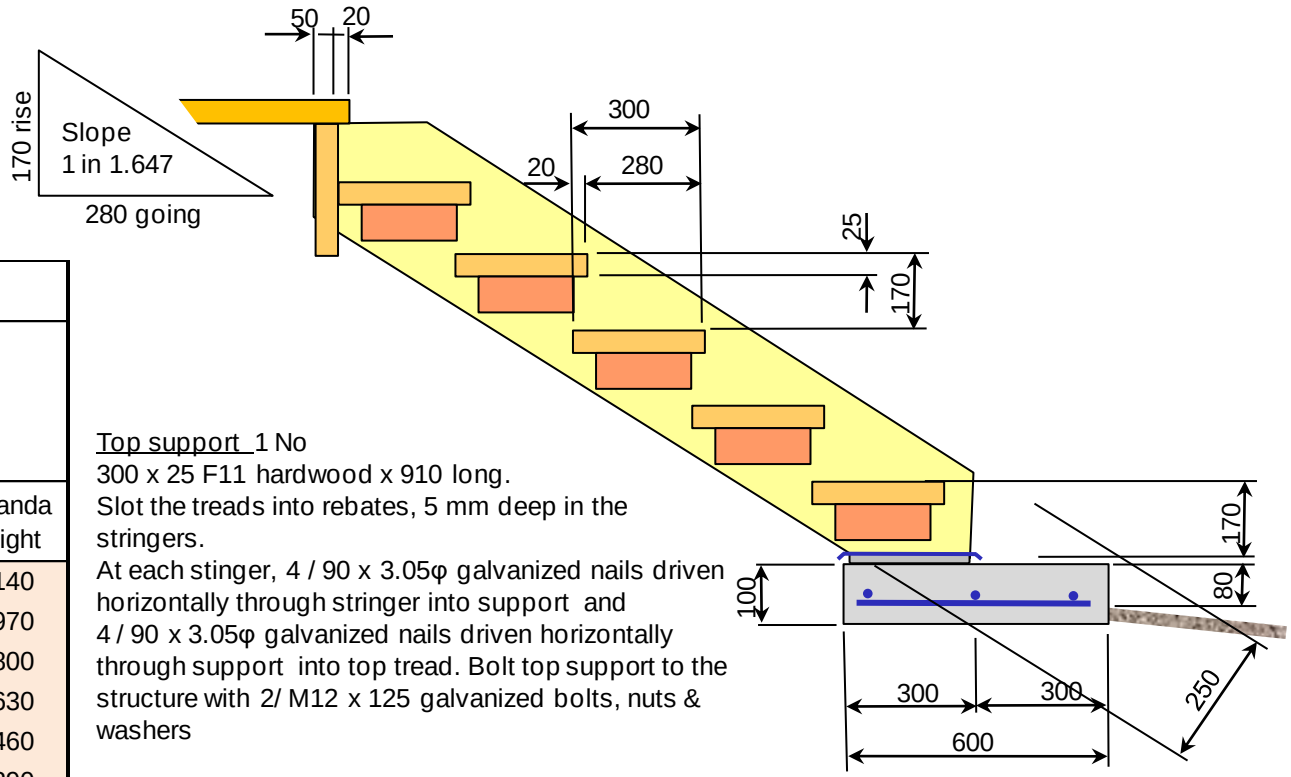




Stairs

Stair Dimensions		
Stair going	280	mm
Stair rise	170	mm
Grout thickness	0	mm
Height of slab above ground	80	mm

No of Rises	No of Goings	Stair Rise	Stair Going	Veranda Height
18	17	3060	4760	3140
17	16	2890	4480	2970
16	15	2720	4200	2800
15	14	2550	3920	2630
14	13	2380	3640	2460
13	12	2210	3360	2290
12	11	2040	3080	2120
11	10	1870	2800	1950
10	9	1700	2520	1780
9	8	1530	2240	1610
8	7	1360	1960	1440
7	6	1190	1680	1270
6	5	1020	1400	1100
5	4	850	1120	930
4	3	680	840	760
3	2	510	560	590
2	1	340	280	420
1	0	170	0	250



Section Through Typical Stair

Top support 1 No
300 x 25 F11 hardwood x 910 long.
Slot the treads into rebates, 5 mm deep in the stringers.
At each stinger, 4 / 90 x 3.05φ galvanized nails driven horizontally through stringer into support and
4 / 90 x 3.05φ galvanized nails driven horizontally through support into top tread. Bolt top support to the structure with 2/ M12 x 125 galvanized bolts, nuts & washers

Stringers 2 No 250 x 50 F11 hardwood
Length of stringers to suit the length of stair.

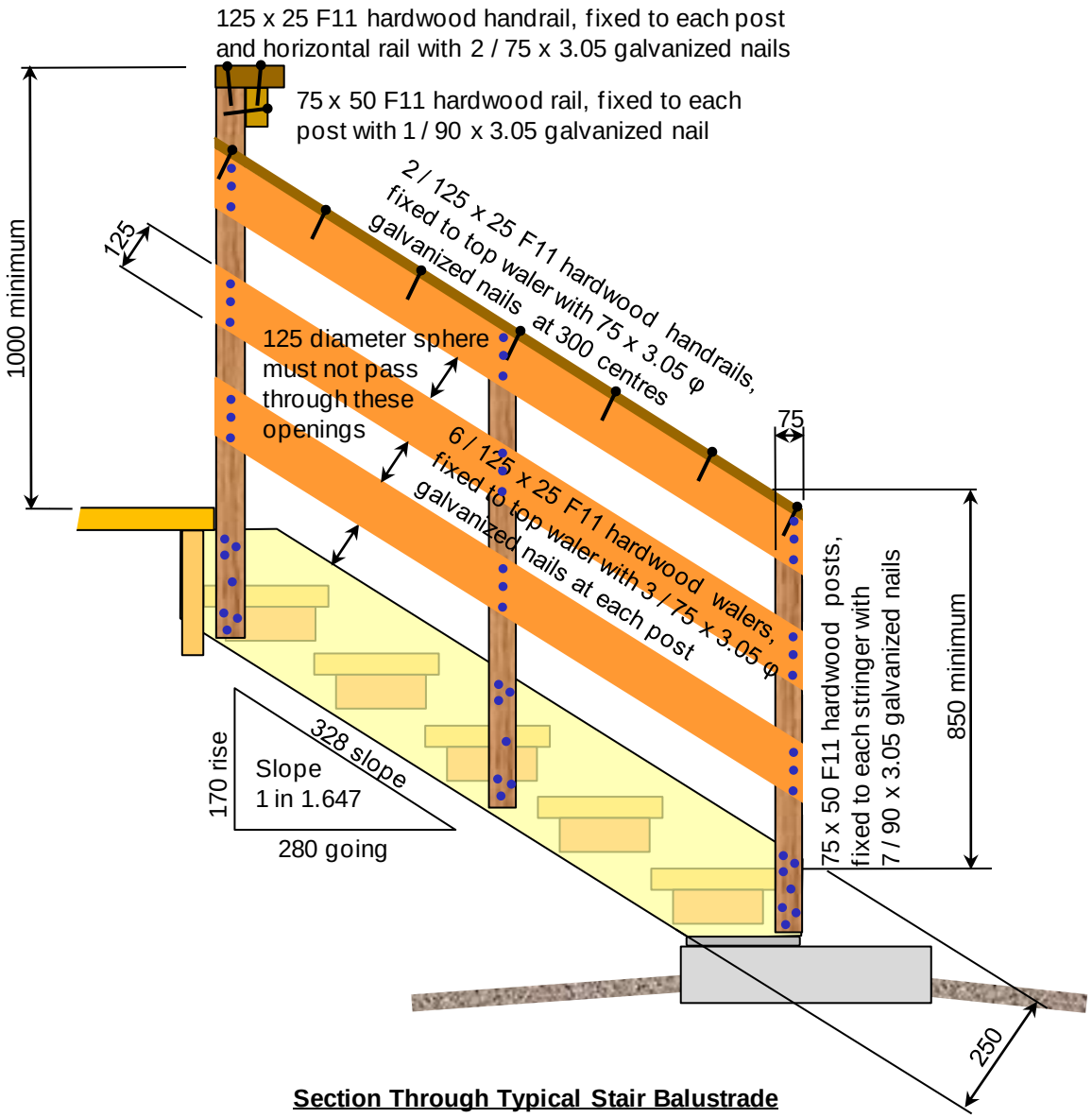
Treads – Number of treads to suit length of stair
300 x 25 F11 hardwood x 910 long. Slot the treads into rebates,
5 mm deep in the stringers. At each stinger,
2 / 90 x 3.05φ galvanized nails driven horizontally through stringer into tread and 2 / 90 x 3.05φ galvanized nails
driven vertically through stringer into support

Tread supports –
2 per tread. 75 x 50 F11 hardwood x 260 long
3 / 90 x 3.05φ galvanized nails driven horizontally through support into stringer

Termite shield – 2 / 100 x 3 x 350 galvanized steel strips, folded down 20 mm around edges, nailed to the underside of the stair stringer and kept clear of debris.

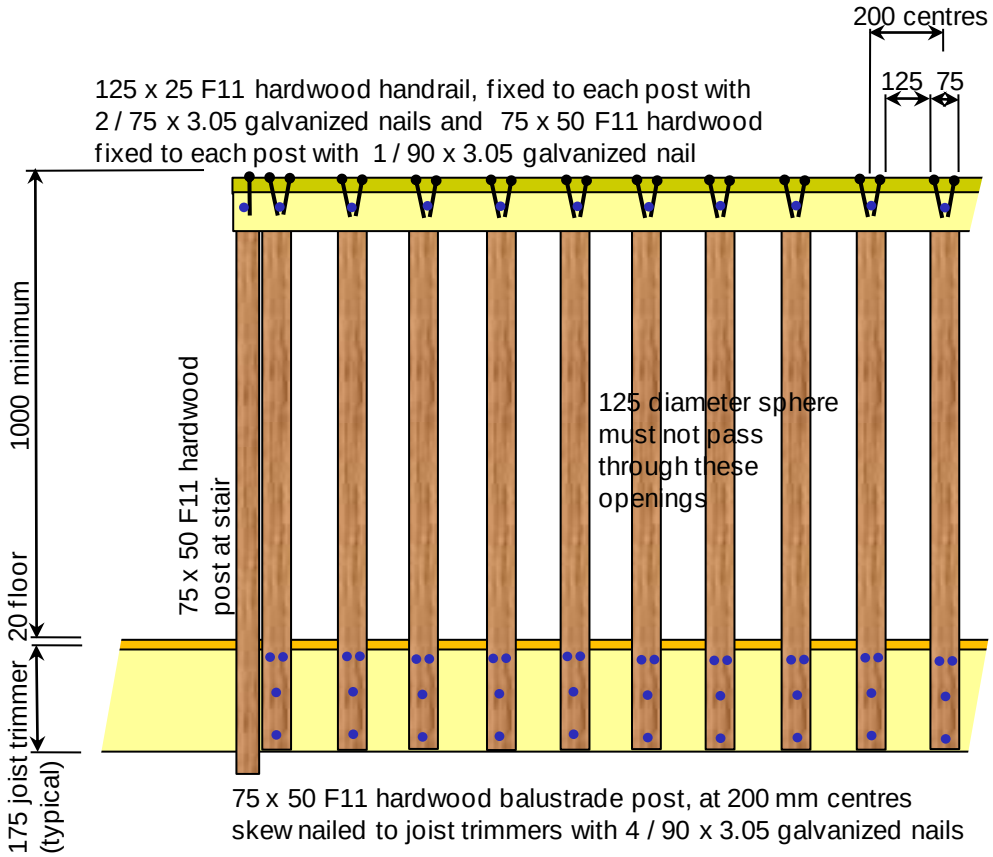
Concrete Pad – 1,200 x 600 x 100 mm thick
3 / N10 x 550 reinforcing bars and
3 / N10 x 950 reinforcing bars
Top surface of slab nominally 80 mm above ground level. If the slab surface is low, grout (up to a maximum thickness of 10 mm) under both stringers to make up required height. If the slab surface is high, trim the bottom surface of the stringers.

Stair Balustrades

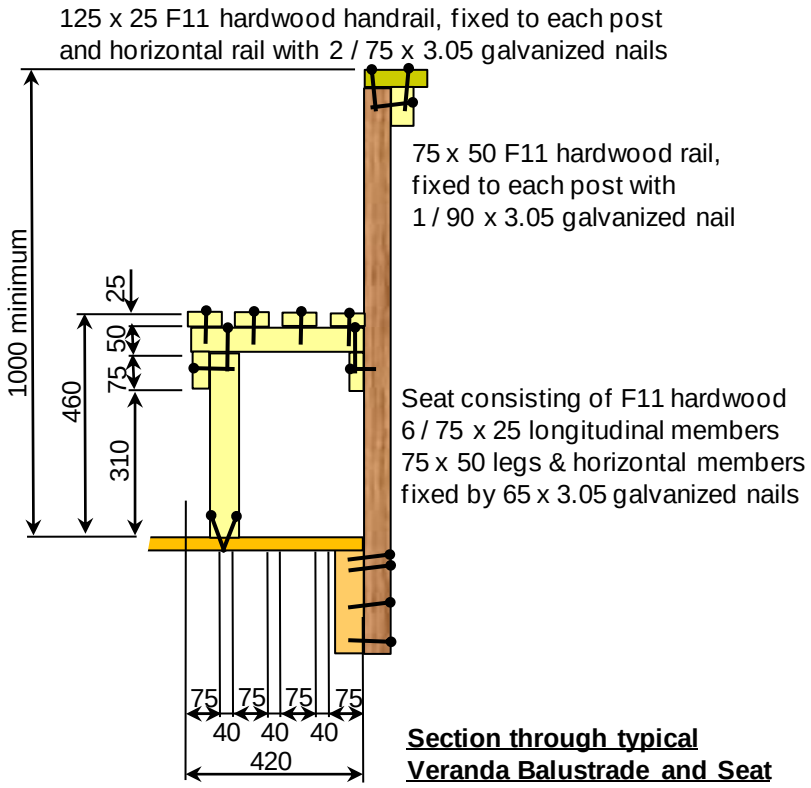


Section Through Typical Stair Balustrade

Veranda Balustrade with Seat



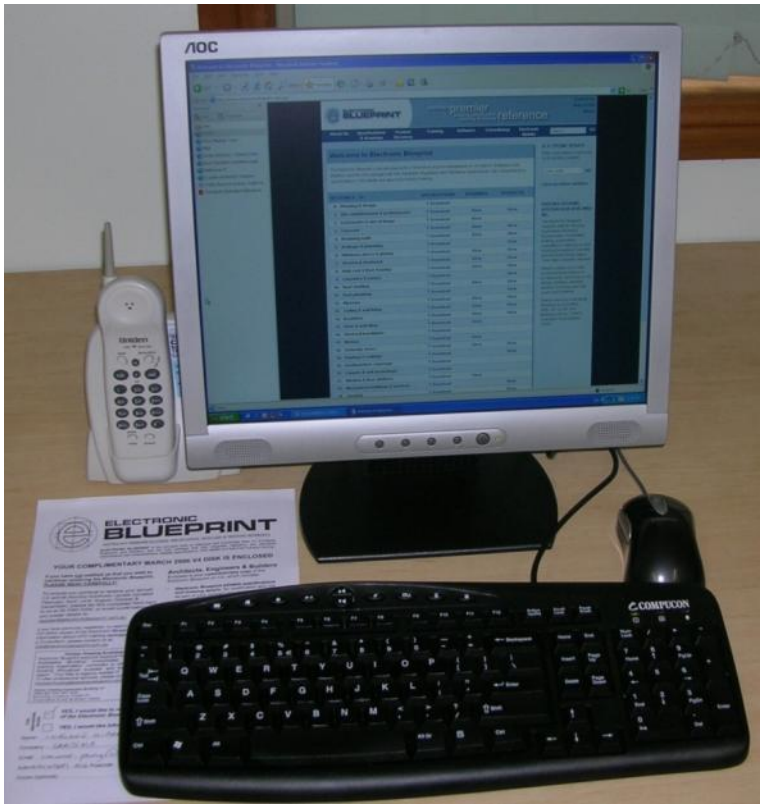
Elevation of typical Veranda Balustrade



Section through typical Veranda Balustrade and Seat

Specifications

This module provides, an example specifications for timber framing and concrete, summarised from the Electronic Blueprint



Specifications

Scope
This section covers timber framing, such as columns, posts, beams, battens, rafters, trusses and the like, consisting of sawn timber, plywood, and glued-laminated timber.

Building Regulations and Standards
All materials and construction shall comply with the most recent version of:

- the relevant parts of the Building Regulations;
- the Standards referred to therein;
- other Standards nominated in this specification; and
- other relevant Regulations.

Relevant Standards

AS 1684.1 *Residential Timber Framed Construction – Design Criteria*
AS 1684.3 *Residential Timber Framed Construction – Cyclonic areas*

Although parts of the region are considered to be non-cyclonic, AS 1684.3 *Residential Timber Framed Construction – Cyclonic areas* has been selected. This provides for maximum flexibility in applying the standard designs across the region.

Specifications

Relevant Standards (continued)

AS 1604 Timber – Preservative treated – Sawn and round
AS 2082 Visually stress-graded hardwood for structural purposes
AS 2858 Visually stress-graded softwood for structural purposes
AS 2878 Timbers – Classification into strength groups
AS 3519 Timber – Machine proof grading

AS 4440 Installation of nail-plated timber roof trusses
AS/NZS 1328 Glued-laminated structural timber
AS/NZS 1748 Timber – Stress graded – Product requirements for mechanically stress-graded timber
AS/NZS 2098 Methods of test for veneer and plywood
AS/NZS 2269 Plywood – Structural
AS/NZS 4063 Timber – Stress graded In-grade strength and stiffness evaluation
AS/NZS 4357 Structural laminated veneer lumber
AS/NZS 4490 Timber – Procedures for monitoring structural properties
AS/NZS 4491 Timber – Glossary of terms in timber related Standards

AS 1111 ISO metric hexagon commercial bolts and screws
AS 1393 Coach screws (metric series) (with ISO hexagon heads)
AS 1397 Steel sheet and strip
AS 2334 Steel nails – Metric series
AS 3566 Screws – Self drilling – For the building and construction industries
AS 3660 Protection of buildings from subterranean termites
BS 1597 Specification of connectors for timber

Specifications

Commencement

Work shall commence as soon as practical after, but not before,

(a) the Builder has issued:

- a written order
- the relevant contract drawings, specifications and schedule of work
- written approval of any details provided by the Contractor

(b) concrete slabs and /or footings that support the frame are in place.

Design and Construction

Timber structures shall comply with the Drawings, Building Regulations and relevant Standard (AS 1684 [residential applications], AS 1720 [general applications]). Timber and timber products shall be graded as follows:

- Visually graded sawn timber – AS 2082 and AS 2858
- Mechanically graded timber – AS 1748
- Proof graded timber – AS 3519
- Structural plywood – AS/NZS 2269
- Laminated veneer lumber – AS/NZS 4357
- Glued laminated timber – AS/NZS 1328
- Round timber – AS 2209.
- Sawn timber, of nominated stress grades, shall have the following characteristic properties.

Specifications

Minimum Timber Properties for Particular Stress Grades

Locally sourced hardwoods shall comply with, or exceed, the following specifications for F11 unseasoned hardwood or better. Imported softwoods shall comply with, or exceed, the following specifications for MGP10 machine graded softwood or better.

Characteristic Properties of Timber							
Stress Grade and Commonly Available Timbers	Characteristic Strength					Characteristic short duration average modulus of elasticity parallel to grain	Characteristic short duration average modulus of rigidity
	Bending	Tension parallel to grain		Shear in beam	Compression parallel to grain		
		Hardwood	Softwood				
	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)
F 11 Unseasoned Hardwood	35	20	17	3.1	25	10 500	700

Characteristic Properties of Timber						
Stress Grade and Commonly Available Timbers	Characteristic Strength				Characteristic short duration average modulus of elasticity parallel to grain	Characteristic short duration average modulus of rigidity
	Bending	Tension parallel to the grain	Shear in beams	Compression parallel to grain		
	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)	MPa (N/m^2)
MGP 10 Seasoned Softwood (e.g. Radiata, Slash, Hoop, Caribbean, Pinaster Pines)	16 19 (45 mm thick)	8.0	5.0	24	10 000	670

Specifications

Durability

Timber shall comply with the durability requirements specified on the drawings for the particular application, Where required to achieve particular resistance to termite and/or borer attack, the species listed herein shall be treated to achieve the hazard levels listed in AS 1684.2, & 3 Table C1, but not less than the following. CCA (copper chrome arsenate) represents a health risk, and shall not be used. Where appropriate, particular health regulations shall apply.

Unless stated otherwise, timber shall comply with the following:

In-ground contact	Durability Class 1 or 2 timbers, with sapwood removed or preservative treated to H5 Softwood preservative treated to H5
External, above-ground, exposed	Durability Class 1 or 2 timbers, with sapwood removed or preservative treated to H3 Softwood preservative treated to H3 (Note: AS 1684 makes provision for the use of some Durability Class 3 and 4 timbers in some applications. These shall only be used with the express approval of the designer)
External, above-ground, protected	Durability Class 1, 2, 3 or 4 timbers
Internal, fully protected and ventilated	Durability Class 1, 2, 3 or 4 timbers (any timber)

Specifications

Timber and Timber Products for In-ground Use

Timber and timber products for in-ground use shall comply with the Drawings, Building Regulations and relevant Standard (AS 1684 [residential applications], AS 1720 [non-residential applications]), and shall be of the nominated stress grade (or strength group), durability class, and (where appropriate) lyctid susceptibility, shrinkage and ignitability.

Standard Trade Name	Preservative Requirement	Availability	Strength Group Seasoned	Durability Class	Lyctid Susceptible	Tangential Shrinkage %	Early Fire Hazard Ignitability
Grey Coast Box	O	R	SD1	1	S	8.2	
Grey Ironbark	O	R	SD1	1	N	7.5	
Grey Gum	O	R	SD2	1	N	7.0	
Tallowwood	O	R	SD2	1	S	6.1	12
Jarrah	O	R	SD4	2	S	7.4	13
Hoop Pine	P	R	SD5	4	N	3.8	14
Slash Pine	P	R	SD5	4	N	4.2	
Caribbean Pine	P	R	SD6	4	N	5.0	
Radiata Pine	P	R	SD6	4	N	5.1	14
Red Ironbark	O	L	SD3	1	S	6.3	
Gympie Messmate	O	L	SD3	1	N	6.0	
Bangkirai	P	L	SD3	2	S	5.0	
Keruing	P	L	SD3	4	S	9.5	
Forest Red Gum	O	L	SD4	1	N	8.6	
Celery Top Pine	O	L	SD5	1	N	3.0	
River Red Gum	O	L	SD5	2	S	8.9	

Notes:

1. This table is based on AS 1684.2 & 3 Table H1. For additional properties and definitions refer to source document.
2. Preservative requirement: P = Should be preservative treated, S = Should be seasoned ,O = Commonly used untreated
3. Availability: R = Readily available, L = Limited Availability
4. Durability Class: 1 = Highest natural durability to 4 = Lowest natural durability.
5. Where required to achieve particular resistance to termite and/or borer attack, the species listed herein shall be treated to achieve the hazard levels listed in AS 1684.2 & 3 Table C1.
   Lyctid Susceptible: S = Susceptible, N = Not susceptible, R = Rarely susceptible

Specifications

Levels, Dimensions, Squareness and Setting Out

The structure upon which the framing is to be constructed shall be within the specified tolerances, with particular attention given to levels, dimensions, squareness and setting out.

Notes

- Levels: It is critical that all floor framing is level. Before commencing the set out, check that slab or timber floor framing is level. It may be necessary to pack the frames in the low areas or to rectify the high areas.
- Dimensions and Squareness: Check the position and squareness of the concrete slab or footings before commencing construction. Measure diagonals to check squareness.
- Setting Out: When setting out the wall framing, a small error in position can lead to misalignment of the other components, such as the roof. Base the set out on the longest side of a building, since this will reduce the likelihood of errors in squareness.
- Prefabricated Trusses or Roof Framing: If there are setting-out errors in the walls, there is a possibility that prefabricated roof trusses or framing may fail to engage the required supports. In complicated buildings, check the position of walls, before constructing the roof. It is critical that all wall framing be fixed and braced plumb.

Specifications

Bracing

All buildings shall be adequately supported against lateral wind loads, as specified in the relevant Standard (AS 1170.2 or AS 4055). In some cases, lateral earthquake loads may be a design criterion. The bracing requirements shall be determined for the appropriate Region, Terrain Category, Topography and Shielding and recorded on the drawings by the design engineer.

Tie Down

All buildings shall be adequately tied down to resist overturning due to wind loads, as specified in the relevant Standard (AS 1170.2 or AS 4055). The tie-down requirements should be determined for the appropriate Region, Terrain Category, Topography and Shielding and recorded on the drawings by the design engineer. Ensure that all tie-down systems are continuous to the footings or to the specified location on the structure.

Nailing

Where architraves are required to be subsequently removed during construction, the nails shall be temporarily left proud. On completion they shall be driven in and punched where appropriate.

Specifications

Timber Shrinkage

Provision shall be made for timber shrinkage. Gaps that result from timber splitting shall be repaired, filled with wood filler and sanded smooth before completion.

Notes

Timber shrinks in cross section, although, due to the grain structure, it remains relatively stable in length. Cover strips should be provided at the edges of timber panelling to allow for shrinkage. The use of kiln-dried timbers will reduce shrinkage.

The following information in drawn from a number of references, including the following:

- Anon (1989), *Introducing Timber – An Introduction to Wood and Timber*, Timber Development Association (NSW) Ltd, Timber Information Leaflet No 1
- Anon (1997), *Decorative Floors – Guide to Decorative Floors of Timber*, Timber Development Association (NSW) Ltd, Timber Information Leaflet No 4
- Anon (1997), *Hardwoods – Native hardwoods of the East Coast*, Timber Development Association (NSW) Ltd, Timber Information Leaflet No 18
- Anon (1974), *Technical Timber Guide - Shrinkage*, TRADAC

As timber dries, it shrinks, and in some circumstances cracks can open. The moisture content varies with type and the degree of seasoning. Seasoned timber has moisture content in the range approximately 10% to 15%, and a variation of up to 2% within any lot of timber. Dense close-grained

Specifications

Preservatives

Timber in exposed applications shall be treated to minimize fungal decay and attack by insects. The following preservatives are available for the treatment of timber, subject to the health warnings below. Copper chrome arsenate (CCA) shall not be used.

- Ammoniacal copper quaternary (ACQ
- Copper azole
- Boron
- Creosote
- Pyrethroid- and metal-based light organic solvent preservatives (LOSPs).

Notes

Copper Chrome Arsenate (CCA) : CCA consists of heavy metals, copper, chromium and arsenic, which may leach from the timber and pose a health risk. CCA should no longer be used; and when timber treatment is required, one of the alternatives listed above may be used. If CCA-treated timber is already in use, the following precautions should be taken:

- Wear protective equipment when handling CCA treated timber.
- Wash hands thoroughly after handling CCA treated timber.
- Do not allow food to come into contact with CCA treated timber.
- Do not burn CCA treated timber in open fires, stoves, fireplaces or the like.

Specifications

Health Warning – Other Preservatives

Creosote: Creosote gives off a vapour that irritates the eyes and skin; and is therefore not recommended.

Pigment Emulsified Creosote (PEC): PEC is a combination of coal tar, with a heavy metal pigment used to stabilize it. PEC is not suitable normal building applications.

Light Organic Solvent Preservative (LOSP): LOSP is a solvent-based treatment, which inhibits fungal invasion of timber. It contains copper naphthenate, zinc naphthenate, tri-butyl tin oxide (TBTO) or pentachlorophenol (PCP), with resin or wax to improve its retention and increase the water repellency. LOSP will release, to the atmosphere, 30-40 litres of hydrocarbon solvent per cubic metre of treated timber. LOSP is suitable for above-ground applications where dimensional-stability is important, is used principally in external applications (e.g. fences, decks and outdoor furniture). LOSP is not suitable for in-ground applications because it does not chemically fix in the wood, and will leach into the soil. LOSP must not be used for food storage, except where LOSP formulation is of very low toxicity. Where LOSP treated timber is exposed, cut or drilled, the exposed surface should be coated with a post-protection treatment.

Pentachlorophenol (PCP): PCP (derived from sodium pentachlorophenate) is an organochlorine family, of the same chemical group as DDT and Agent Orange. PCP can cause fatigue, fever, weight loss and nausea. PCP dioxins can also cause birth defects, allergies or cancer. PCPs can be passed on to successive generations through sperm and breast milk. PCP must be disposed of without special technology and facilities. It is recommended that PCPs should not be used.

Reference: RIC Good Wood Project & the Good Wood Advisory Centre, Victoria, Preservatives

Specifications

Concrete for Piers and Footings

Unreinforced concrete in piers and footings shall comply with AS 2870 and, where relevant AS 3600.

The properties shall be not less than:

- Characteristic compressive strength of 20 MPa (Strength grade N20)
- Maximum aggregate size of 20 mm
- Of sufficient slump to facilitate the nominates means of placement.

For 1 cubic metre of 20 MPa concrete, the mix should be:

- 8 bags (40 kg each) of GP or GB portland cement. Cement is also available in 20 kg bags, in which case 16 would be required.
- 0.5 m^3 of sand Sand should be clean sharp sand, NOT brickies sand or plasters sand.
- 1.0 m3 of 20 mm coarse aggregate - Aggregate should be clean 20 mm river gravel, crushed aggregate or similar.
- 220 – 230 litres of water – Approximately 11 20 litre buckets (300 mm diameter x 290 mm deep). Less water should be used if sand or aggregate are damp.

Pro-forma Inspection Schedules

The close control of construction is critical to the correct function of a building structure.

The following slides provide a sample Inspection Schedule to indicate the type of inspection that may be warranted. These can be adapted to assist in the site control function.

The details of any Inspection Schedule should be developed by the designer to suit the particular requirements of the application.

Design and Construction Checklist

Site

Activity Timber Wall Framing

Item or Product	Required	Acceptance	Hold Witness	Date, Inspector, Comment
Steel Post				
Steel post type	Steel pipe			
Steel post diameter	80 mm			
Anchorage post width	80NB galvanised medium wall pipe,125 x 75 x 6 L x 130,			
Laterally unsupported length, Lsy	930 mm			
Anchorage post bottom fixing	450 mm embedment			
Embedment or clearance (negative	-20 mm			
Steel Post Timber Bracing				
Steel post bracing type	USHWD F11			
Steel post bracing depth	100 mm			
Steel post bracing width	50 mm			
Steel post bracing fixing	Tension Brace 100 x 50 USHWD F11, 1 M12 bolt			
Total no of steel post brace sets	4			
Floor Bearer				
Floor bearer type	USHWD F11			
Floor bearer depth	250 mm			
Floor bearer width	50 mm			
No of bearer components	2			
Floor bearer fixing	1/M12x165 galv bolts, double shear, parallel to grain			
Floor Joist				
Floor joist spacing	0.450 m			
Floor joist type	USHWD F11			
Floor joist depth	150 mm			
Floor joist width	50 mm			
Floor joist fixing	2/90x3.15φ galv nails, shear, side grain			

Flooring			
Floor type	USHWD F11		
Floor thickness	20	mm	
Floor width	100	mm	
Floor fixing			
Stair Stringer			
Stair stringer type	USHWD F11		
Stair stringer depth	250	mm	
Stair stringer width	50	mm	
Stair stringer fixing	1 / M16 bolt1 / M10 HD bolt		
Stair Tread			
Stair tread span	0.900	m	
Stair tread type	USHWD F11		
Stair treadwidth	300	mm	
Stair tread depth	25	mm	
Stair tread fixing	4 / 90 x 3.05 φ gal4 / 90 x 3.05 φ gal		
Veranda Balustrade			
Balustrade type	USHWD F11		
Balustrade width	25	mm	
Balustrade depth	125	mm	
No of components per member	1		
Balustrade fixing	2/75x3.15 φ gal2/75x3.15φ gal		
Veranda Balustrade Post			
Handrail post type	USHWD F11		
Handrail post depth	75	mm	
Handrail post width	50	mm	
No of components per member	1		
Handrail post fixing	2 / M10 bolt		

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This training package covers broad engineering principles and building practices, with particular emphasis on affordable housing and associated village infrastructure in the Asia-Pacific region. These broad principles and practices must be translated into specific requirements for particular projects by professional architects, engineers or builders with the requisite qualifications and experience. Associated sample specifications and drawings are available in electronic format, with the express intention that architects, engineers and builders will edit them to suit the particular requirements of specific projects. The design, construction and costing of structures must be carried out by qualified and experienced architects, engineers and builders, who must make themselves aware of any changes to the applicable standards, building regulations and other relevant regulations. The authors, publishers and distributors of these documents, specifications and associated drawings do not accept any responsibility for incorrect, inappropriate or incomplete use of this information.

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