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Timber Garden Retaining Walls

Up to 1.0 m High



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Contents

1	Introduction	4
1.1	Performance.....	4
1.2	Building Approval and Certification	4
1.3	Ground Conditions	5
2	Materials	6
2.1	New Timber.....	6
2.2	Recycled Timber Railway Sleepers	7
2.3	Steel Posts	8
2.4	Preservative Treatment	9
2.5	Corrosion	10
3	Construction	11
3.1	General.....	11
3.2	Member Sizes and Embedment.....	11
3.3	Drainage.....	14
3.4	Retaining Wall Posts and Garden Edges.....	15
3.5	Steps.....	16
4	Maintenance	18
5	Safe Working and Disposal of Off-cuts	19
6	References	19

1 Introduction

Timber sleepers or round posts and logs can be used to create effective and relatively inexpensive garden edges, steps and walls to terrace sloping sites. Galvanized steel posts can also be used in conjunction with sleepers to achieve satisfactory designs. Timber fences can also be integrated with garden walls to add privacy and character to front yards.

This Guide contains recommendations for the construction of timber garden walls up to 1 metre high.

1.1 Performance

Retaining walls designed and constructed in accordance with this Guide could be expected to achieve a service life of 15 years or greater. Where a longer service life is required, hardwood timber should be limited to In-ground Durability Class 1 and softwood should be treated to H5 level.

For these more durable options, service life in excess of 25 years can be expected.

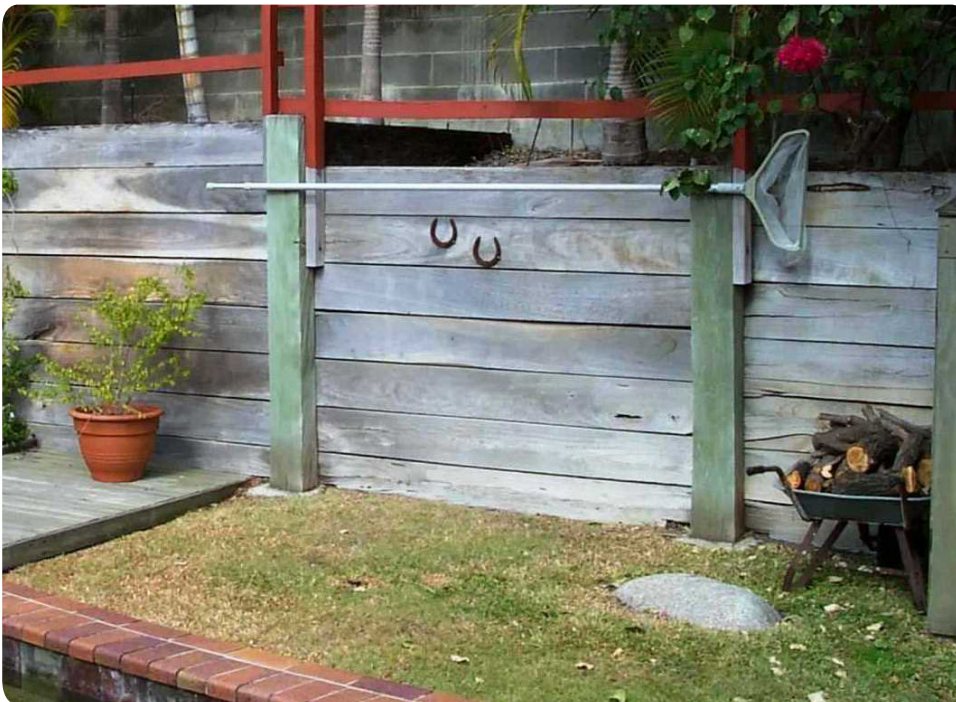


Figure 1.1: 25 year old hardwood retaining wall constructed using treated Class 1 durability posts and Class 1 and Class 2 Wales

1.2 Building Approval and Certification

Local authorities generally do not require building approval or engineer certification for retaining walls up to 1 metre high. Walls (irrespective of height) closer than 1.5 metres to a building, swimming pool, deck etc., and retaining walls greater than 1 metre high will generally require building approval and certification by an engineer.

1.3 Ground Conditions

The sizes and other recommendations in this Guide assume that posts are embedded into firm natural ground (e.g. stiff clay, shale or dense sand), with a maximum ground slope of 1 in 6. Special design may be required for steeper slopes and poor subgrade soil conditions such as uncompacted fill.



Figure 1.2: *It is critical that the footing embedment of posts is adequate to prevent rotation of the posts. The treated pine rounds in this wall are still sound. The wall is failing due to inadequate embedment of posts.*

2 Materials

2.1 New Timber

There is no Australian Standard or other grading requirement for landscaping timber. The quality of sawn 'sleepers' and round logs can vary greatly between different suppliers.

Timber sold for landscaping is likely to contain natural characteristics such as knots, gum veins, heart, insect damage, want, wane etc., and there could be some bow, cupping, twisting etc. Where a higher than normal appearance or performance is required, timber should be selected with limitations on the size and number of these characteristics.

Structurally graded timber (e.g. F14 hardwood and F7 treated pine) will have prescribed limits for natural characteristics and will generally be higher quality than 'landscaping' timbers.

Softwood logs and sleepers shall be preservative treated to hazard level H4 or higher.



Figure 2.1: Combination of durable hardwood posts and H4 CCA treated rounds

Hardwood should be In-ground Durability Class 1 or 2 and resistant to termites. Hardwood containing sapwood shall be preservative treated to H4 or better.

Table 2.1 provides a list of some readily available termite resistant hardwood and cypress species and their in-ground durability class.

Table 2.1: Hardwood and Cypress Durability

Species	In-Ground
Blackbutt	2
Blackbutt, Western Australian	2
Bloodwood, red and brown	1
Box, grey and grey coast	1
Cypress, white	2
Gum, red forest	1
Gum, river red	2
Gum, spotted	2
Ironbark, red and grey	1
Ironwood, Cooktown	1
Jarra	2
Mahogany, red	2
Stringybark, Darwin	1
Wandoo	1

**Based on BCA's Provision C2.2 Table C2.2*



Figure 2.2: High quality hardwood sleepers



Figure 2.3: Low quality hardwood sleepers

2.2 Recycled Timber Railway Sleepers

Recycled hardwood railway sleepers provide another viable option for construction of timber retaining walls. When new, these sleepers are usually supplied to rail authorities under stringent specifications including species, durability and preservative treatment. Railway sleepers are much 'heavier' (larger in cross-section) than normal landscaping sleepers so may not suit use with 'off the shelf' steel post systems.

As they will have typically been in use for many decades, some existing degradation due to decay, termites and weathering can be expected. If this has severely degraded the sleepers then they will have a lesser life expectancy than equivalent material when new.

Any recycled sleepers that exhibit significant surface or possible internal degradation caused by decay or termites should be discarded. Sleepers with live termite activity should also be discarded.

Drilling the sleepers with a 4 mm diameter drill where internal degradation is suspected will reveal if any areas of concern. Drills will resist solid timber but easily penetrate decayed or termite damaged timber.



Figure 2.3: Recycled hardwood railway sleepers complete with rail bearing plates.

2.3 Steel Posts

Steel posts should be hot-dip galvanized in accordance with AS/NZ 4680:2006 - Hot-dip galvanized (zinc) coatings on fabricated ferrous articles. A minimum zinc coating thickness of 50 microns is recommended. The specification and design for steel posts should be in accordance with the manufacturer's requirements. Figure 2.4 shows typical design options using steel posts.

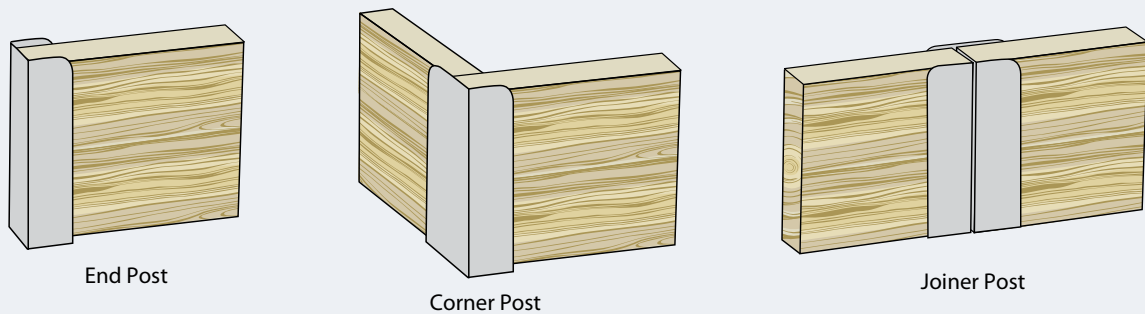


Figure 2.4: Timber Sleepers with Steel Posts



Figure 2.5: Poor quality galvanized steel 'H' section post showing corrosion approximately 8 years after installation

2.4 Preservative Treatment

AS 1604.1 – Specification for preservative treatment, Part 1: Sawn and round timber, specifies the minimum penetration and retention requirements for various preservative treatment types.

Common preservatives used to treat timber for retaining wall applications are CCA, ACQ, copper quaternary and copper azole.

For Hazard Class H4, AS 1604.1 requires the following penetration to be achieved in the timber:-

In-ground Durability Class 1 and 2 timber – The preservative must penetrate all of the sapwood. Penetration of the heartwood is not required.

In-Ground Durability Class 3 and Class 4 timber (Softwood) – For sawn timber, the preservative shall penetrate not less than 10 mm from any surface, or, unpenetrated heartwood shall comprise less than 20% of the cross section and shall not exceed 50% of the width of the face and not extend more than halfway through the piece.

For round timber, penetration shall be not less than 10 mm from the surface.

Figure 2.6 illustrates the minimum penetration requirements in sawn and round in-ground durability Class 3 and 4 timber.

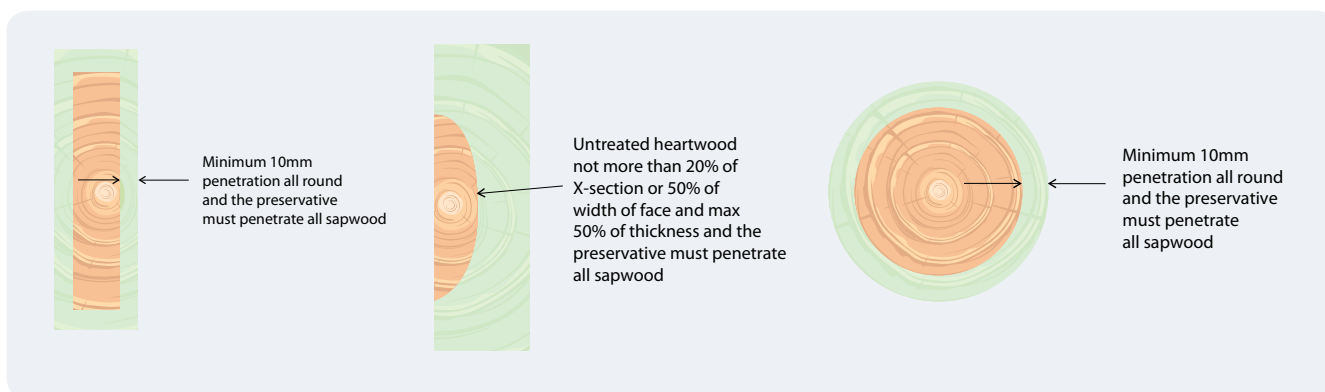


Figure 2.6: Preservative treatment Requirements for In-Ground Durability Class 3 and 4 Timber such as Softwood



Figure 2.7: Premature failure of incorrectly treated pine sleeper wall in school playground



Figure 2.6: Non-compliant CCA treated pine sleepers that failed after 5 years. Sleepers contained excessive amounts of untreated heartwood.

2.5 Corrosion

Timber that is treated with copper based preservatives such as described above, that is in contact with galvanized steel, can cause premature corrosion of the steel due to incompatibility of the copper in the preservative and the zinc coating on the steel. To minimise the potential for this to occur, the contact surfaces (timber and or steel) should be separated with a plastic or bituminous damp proof course or coated with an appropriate 'paint' such as bituminous paint.

3 Construction

3.1 General

Timber retaining walls up to one metre high can be constructed as shown in Figure 3.1.

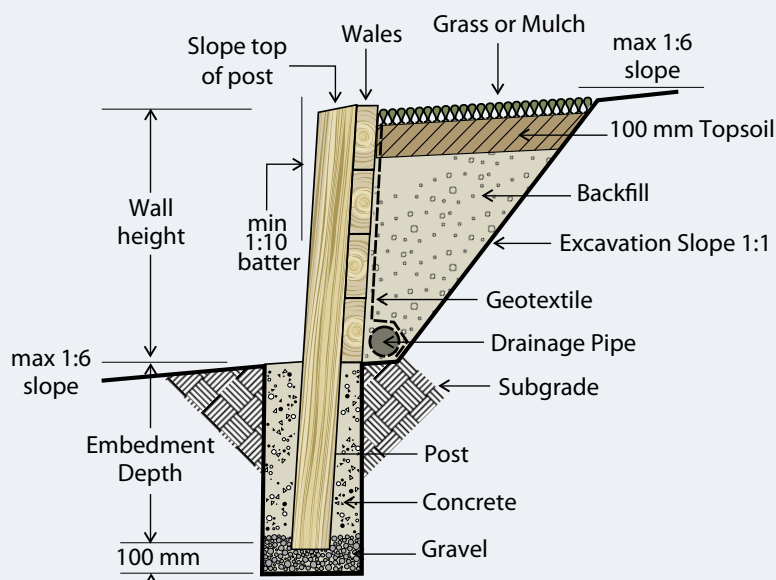


Figure 3.1: Retaining Wall Construction

3.2 Member Sizes and Embedment

Minimum member sizes and post embedment depths should be as outlined in Tables 3.1 and 3.2 for preservative treated softwood and hardwood, respectively.

Alternatives for round and sleeper post and wale arrangements are shown in Figures 3.2 (a) to 3.2 (i).

Table 3.1 – Preservative Treated Softwood (SWD)

Table 3.1: Preservative Treated Softwood (SWD)

Member	Refer Figure	Post Spacing	1200				1500				2400			
		Wall Height	400	600	800	1000	400	600	800	1000	400	600	800	1000
Sleeper Posts	3.2 (a)	Size (bxd)	150x50	150x75	200x75	N/A	150x150	150x75	200x75	N/A	200x100	200x100	N/A	N/A
		Hole Dia. (Ø)	300	300	450	N/A	300	300	450	N/A	300	450	400	N/A
		Depth	400	600	600	N/A	400	600	650	N/A	400	600	N/A	N/A
Slab Posts	3.2 (b)	Thickness (t)	90	90	90	125	90	90	90	125	100	100	125	2/125
		Hole Diam.	300	300	300	300	300	300	300	300	300	300	300	450
		Depth	400	600	600	750	400	600	650	750	400	600	900	950
Single Round Posts	3.2 (c)	Post Dia. (Ø)	100	125	150	180	100	125	175	200	100	150	200	225
		Hole Dia. (Ø)	300	300	300	300	300	300	300	450	300	300	450	450
		Depth	400	600	800	1000	400	600	800	1000	600	800	1000	1400
Double Round Posts	3.2 (d)	Post Dia. (Ø)	100	100	125	150	100	100	150	175	100	125	175	200
		Hole Dia.	300	300	300	300	300	300	300	450	300	300	450	450
		Depth	400	600	800	1000	400	600	800	1200	600	800	1000	1400
Sleeper Wales	3.2 (e)	Size (bxd)	150x50	150x50	200x50	200x50	150x50	150x50	200x50	200x75	200x100	200x100	200x100	200x100
Slab Wales	3.2 (f)	Thickness (t)	90	90	90	90	90	90	90	90	90	100	100	125
Round Wales	3.2 (g)	Dia. (Ø)	75	75	75	75	75	75	75	75	100	100	100	100
Split Wales (1/2 round)	3.2 (h)	Dia. (Ø)	75	75	100	125	75	100	125	N/A	N/A	N/A	N/A	N/A
Winged Split Wales	3.2 (i)	Thickness (t)	100	100	100	100	100	100	100	100	N/A	N/A	N/A	N/A

Table 3.2: Hardwood (HWD) (refer Figures 3.2 (a) and 3.2 (e))

Member	Wall Height	400	600	800	1000
Posts	Post Spacing 1200				
	Size (bxd)	200 x 50	200 x 75	200 x 75	200 x 100
	Hole Dia.	300	300	300	300
	Depth	400	600	800	1000
Wales	Size (bxd)	200 x 50	200 x 50	200 x 50	200 x 50
Posts	Post Spacing 1500				
	Size (bxd)	200 x 50	200 x 75	200 x 75	200 x 100
	Hole Dia.	300	300	300	300
	Depth	400	600	800	1200
Wales	Size (bxd)	200 x 50	200 x 50	200 x 50	200 x 50
Posts	Post Spacing 2400				
	Size (bxd)	200 x 50	200 x 75	200 x 75	200 x 100
	Hole Dia.	300	300	300	300
	Depth	400	600	1000	1400
Wales	Size (bxd)	200 x 50	200 x 50	200 x 50	200 x 50

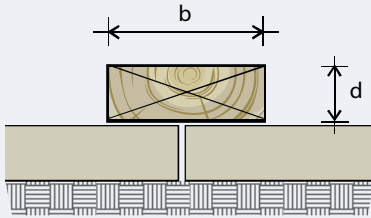


Figure 3.2 (a): Sleeper posts (HWD & SWD)

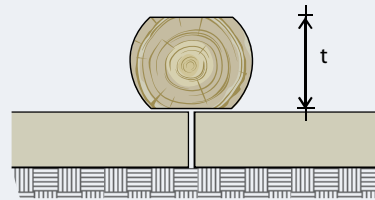


Figure 3.2 (a): Sleeper posts (HWD & SWD)

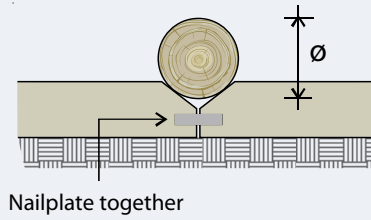


Figure 3.2 (c): Single round post (SWD)

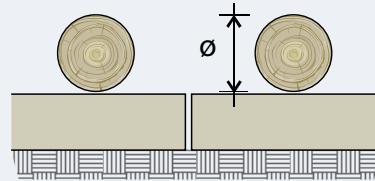


Figure 3.2 (d): Double round posts (SWD)

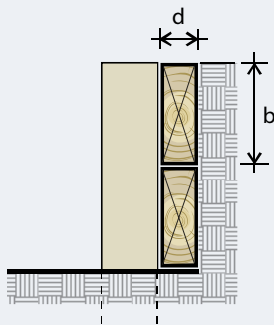


Figure 3.2 (e): Sleeper wales (HWD & SWD)

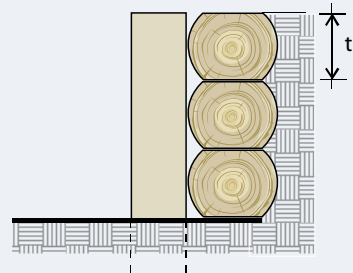


Figure 3.2 (f): Slab wales (SWD)

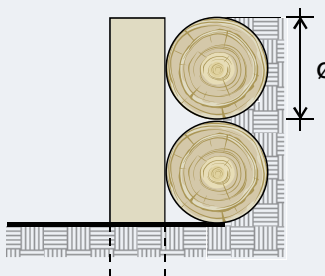


Figure 3.2 (g): Round wales (SWD)

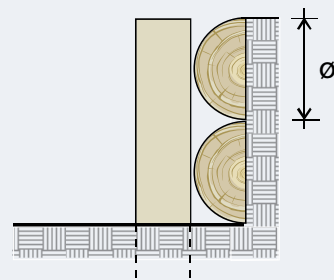


Figure 3.2 (h): Split wales (SWD)

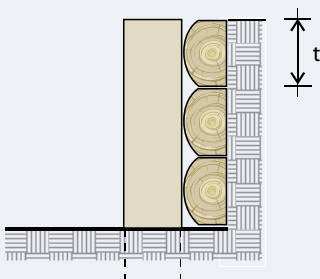


Figure 3.2 (i): Winged split wales (SWD)

Walls exceeding 400 mm high should have a 1:10 batter as shown in Fig 3.1.

The batter allows for the wall to have some lateral movement and still appear stable.

Post holes should have a 100 mm layer of coarse gravel installed prior to placing posts and backfilling with concrete.

'No-fines' concrete is recommended for hardwood posts.

Walls up to 400 mm high may have concealed posts, with wales fixed to the outside of posts with hot dipped galvanised batten screws, coach screws or bolts (refer Fig 3.3a). Walls above 400 mm shall have wales behind posts (refer Fig 3.3b). Typical methods of positioning posts at ends and corners are shown on Figure 2.

Wales may require temporary fixing to posts with wire ties, skew nails or batten screws.

The top of posts should be cut with a slight slope to shed water and should be sealed with a preservative emulsion.



Figure 3.3: Sloping cut to top of ironbark retaining wall post in this 23 year old wall

3.3 Drainage

Drainage should be provided behind walls exceeding 400 mm high to prevent additional loads due to the build-up of ground water. A slotted polyethylene drainage pipe should be provided at the base of the wall, discharging to a suitable outlet. To prevent backfill material from flowing through gaps in the wall and to assist in drainage, geotextile should be placed to the inside face of wales and between the drainage pipe and the backfill. See Figure 3.1.

Backfill should be a free flowing material such as ashes, sand or gravel– not clay. Backfill should be installed no sooner than three days after concreting posts.



Figure 3.4: Well designed and constructed treated pine retaining wall. Wall is battered and tops of posts have angle cut to shed water

3.4 Retaining Wall Posts and Garden Edges

Typical corner and end restraints are shown in Figure 3.5 (a) to 3.5 (c). Alternatively, posts can be positioned as shown on Figure 3.xx.

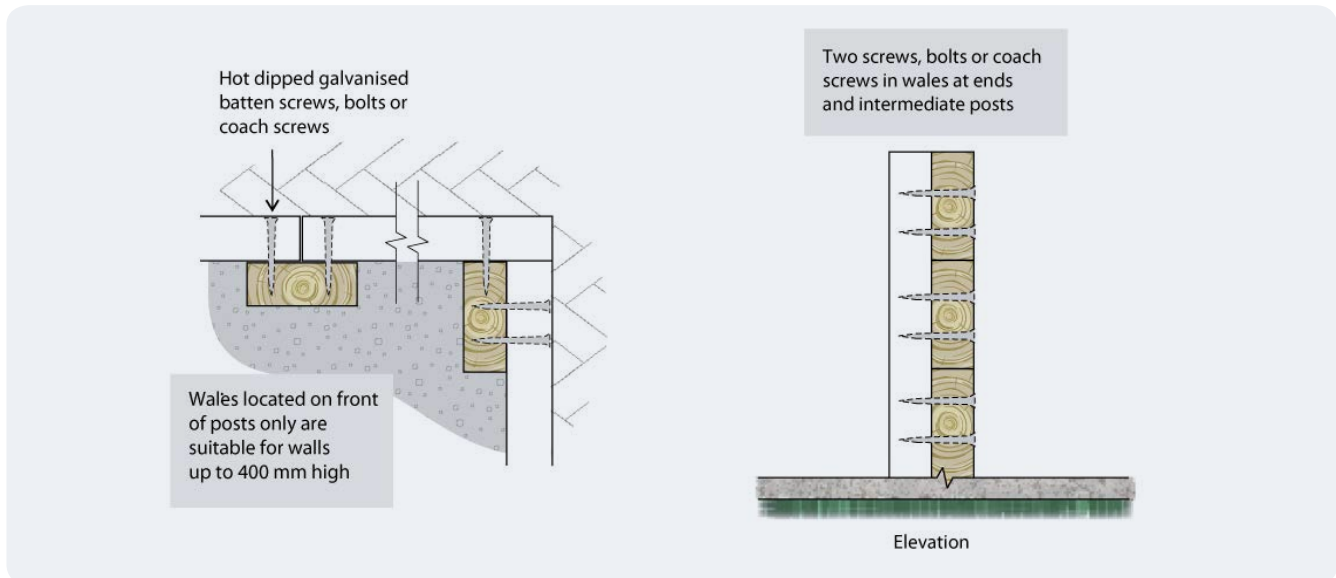


Figure 3.5 (a): Sleeper Post Arrangement (Inside Wall)

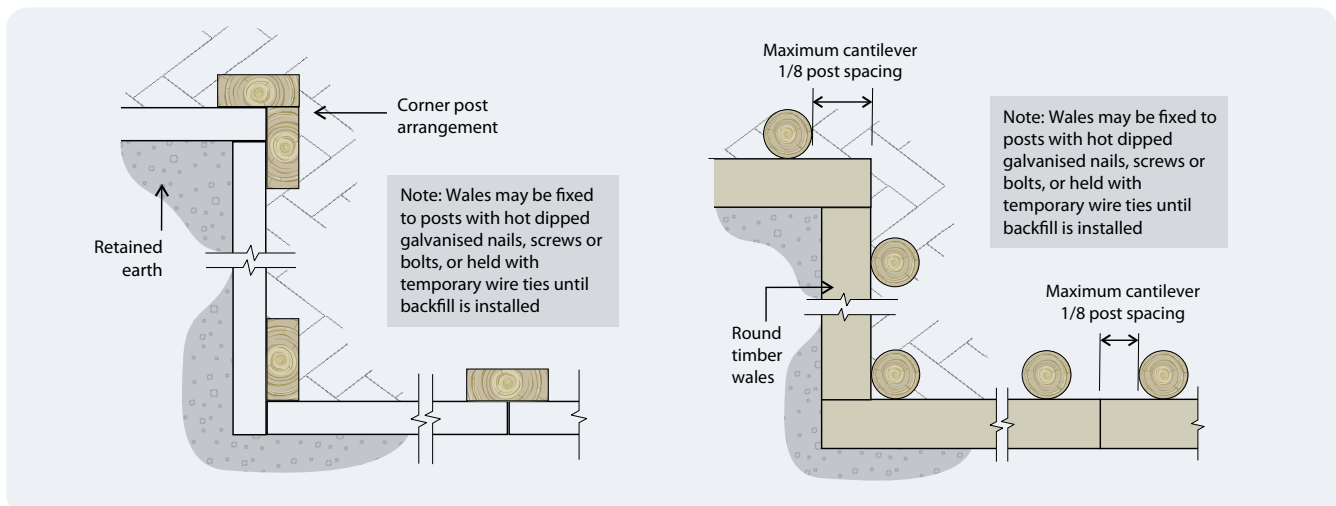


Figure 3.5 (b): Sleeper Post Arrangement (Outside Wall) Figure 3.5 (c): Round Post Arrangement (Inside Wall)

Single sleepers and rounds can be used to form garden edges.

Garden edges can be self-supporting or may require restraining at corners and ends such as shown in Figure 3.5.

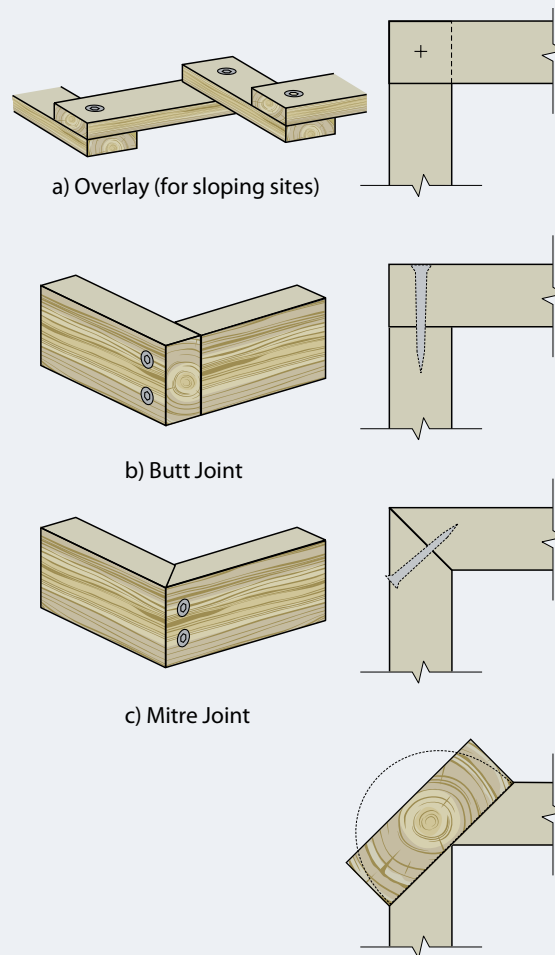


Figure 3.6: Garden Edge Arrangements

3.5 Steps

Single sleepers can be used to form steps or to terrace gently sloping ground.

Ends can be restrained by one of the methods shown in Figures 3.5 or 3.6. Alternatively, end restraint can be achieved by fixing to retaining walls as shown on Figure 3.8.

Tread options include bricks, pavers, gravel, compacted earth, or timber sleepers 'on flat'.

Note: Pine sleepers are not recommended to be used on the flat unless the piece can be securely fixed evenly across the face with at least two fixings at ends and intermediate supports.



Figure 3.7: Inadequately fixed (screws of insufficient length) resulting in distortion (twisting) of sleepers used on flat.

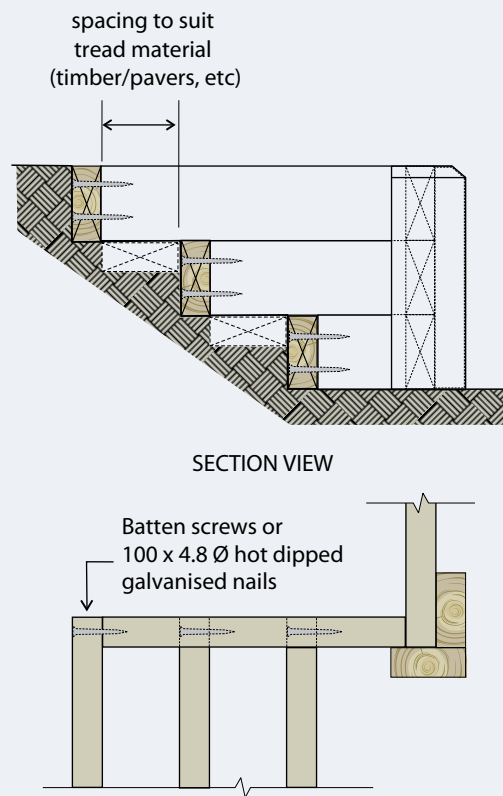


Figure 3.8: Steps

4 Maintenance

Treated timber is treated to resist termite and fungal attack only. Weathering and sun exposure without appropriate maintenance will impact on the appearance and life of treated sleepers and posts.

The appearance and longevity of timber retaining walls can be significantly enhanced by regular maintenance. The following maintenance procedures should be considered.

- All fresh cut end grain and other surfaces: Apply a liberal coating of copper naphthenate oil (CN Oil)
- Tops of posts: Apply CN oil or CN emulsion every 2 – 3 years
- Face of walls: Apply penetrating pigmented (preferably light colours) oil based stains or CN oil every 2 to 3 years. This will assist in minimising weathering of the timber and maintain visual appeal.
- Base of posts: Keep base of posts clear of any dirt, leaves and other debris. Apply a generous coating of CN emulsion around the base of the posts annually.



Figure 4.1: Treated pine retaining wall (and fence) being regularly maintained with application of timber preservative oil.



Figure 4.2: Hardwood retaining wall and fence posts being maintained with CN oil.

5 Safe Working and Disposal of Off-cuts

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

As with all treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.

6 References

Australian Standards

AS 1604.1 – 2012. Specification for preservative treatment, Part 1: Sawn and round timber

Additional Sources

Timber retaining walls for residential applications. Timber Queensland, March 2014



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