

National Certificate in Building, Construction and Allied Trades Skills (BCATS)

**Construct a timber pergola as a
BCATS project**

Unit Standard – 12937

Level 2, Credit 5

Name: _____





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What you need to do

By the end of this unit, you should be able to:

- calculate quantities and prepare an order for materials for a timber pergola;
- set out and construct a timber pergola; and
- complete work operations.

How you will be assessed

During this unit, you need to show your teacher/tutor that you can:

- calculate materials correctly and prepare an order for materials including posts, beams, joists, and fixings;
- set out post positions and excavate post holes correctly;
- place posts correctly;
- set out, cut and fix beams and joists correctly;
- finish the pergola correctly;
- complete all operations safely;
- clean the work area and dispose of waste; and
- clean and store tools, plant and equipment correctly.



Glossary of Terms

Term	Meaning
Compaction	A hand or mechanical process used to consolidate and pack down the materials that will support the concrete slab
Concrete	A combination of cement, water, sand and coarse aggregate which hardens due to a series of chemical reactions between the cement and water
Galvanised	A zinc coating used to protect metal
Masonry	Stone or brick work
Plant	Fixed equipment
Plumb	True vertical
Work operations	How you do a job

Pergolas

Pergolas provide a focus and architectural form in a garden or attached to a building, and can provide support for climbing plants. They can be erected without planning consent if they are not covered to provide shelter.

Pergolas can be free-standing or fixed to a building, and must be designed to comply with the relevant Building Code requirements. A check with your local territorial authority during planning will identify any restrictions.

To achieve this unit standard, you need to construct a timber pergola.

This module covers the construction of a particular design of pergola; however, you could construct a different design to achieve this unit standard. Your teacher/tutor will tell you which project to complete.

For any construction job you carry out, it's important to:

- select and use appropriate personal protective equipment;
- use tools correctly and safely;
- clean the work area and dispose of waste; and
- clean, store and maintain tools correctly.

For any product or tool you use, make sure you read and understand any manufacturer's instructions and safety requirements that come with it before you start using it.

Materials

Materials required for a pergola include timber for posts, bearers and joists, and concrete and fixings.

Any timber used should be specifically treated with wood preserving chemicals for outdoor use:

- Posts in contact with the ground should have a treatment level of H5.
- Bearers and joists not in contact with the ground should have a treatment level of H3.2.

Fixings

Fixings (nails, bolts, screws) must be galvanised or, if in the coastal corrosion zone, stainless steel.

Tools required

- Spade or post hole borer
- Circular saw
- Electric drill, with a 12mm auger bit and either a 9mm twist bit or masonry bit
- Adjustable spanner (250mm)
- 2 G or F clamps
- Spirit level or line level
- Tape measure, square and pencil
- Jigsaw if cutting curves on ends of rafters (optional)

Safety when using tools

Most work in workshops involves the use of hand and power tools. The following sections cover some basic points that should be considered when any hand tool or portable power tool is to be used.

All BCATS National Certificates require students to competently and safely use tools.

Hand tools

About 15% of all accidents occur while hand tools are being used. Most of these accidents arise from one or more of the following:

- the tool not being properly used;
- using the wrong tool for the job; or
- using blunt or defective tools.

To avoid having an accident when using hand tools, always:

- use the right tool for the job;
- adopt the correct work method; and
- repair or replace defective or faulty tools.

Hand tools that are used for cutting must be kept sharp. It is much easier to be injured with a blunt tool than a sharp one.

Portable power tools

Portable power tools can be dangerous in the hands of untrained or careless operators. Anyone using portable power tools should be fully trained in their correct use.

Each time before using portable power tools, check for the following:

- faulty leads and plugs;
- trailing leads; and
- adequate earthing or insulation.

If a faulty power tool is identified, inform your teacher/tutor and follow the workplace procedures for repair or replacement. **Never** carry on using the tool or leave it where some other person could accidentally use it without realising it is faulty.

Calculating Quantities

Use the pergola plan and site specifications to calculate the materials required.

Example

Calculate the materials required for the following freestanding pergola:

Width – 2.4m

Length – 2.3m

Height – 2.3m



Calculations

Concrete to posts

$$\begin{aligned}
 &= \text{length} \times \text{width} \times \text{depth of hole} \times \text{no. of holes} \\
 &= (0.300 \times 0.300 \times 0.700) \times 4 \\
 &= 0.063 \times 4 \\
 &= 0.252\text{m}^3
 \end{aligned}$$

Posts

$$\begin{aligned}
 &= \text{pergola height} + \text{post hole depth} - \text{footing base thickness} \\
 &= 2.300 + 0.700 - 0.100 \\
 &= 2.900\text{m}
 \end{aligned}$$

Bearers

$$\begin{aligned}
 &= (\text{pergola width} + \text{overhang}) \times \text{number required} \\
 &= (2.400 + 0.300) \times 4 \\
 &= 2.700 \times 4
 \end{aligned}$$

Number of joists

$$\begin{aligned}
 &= \frac{\text{distance between outside bearers}}{\text{desired joist spacing}} + 1 \\
 &= \frac{2.400}{0.300} + 1 \\
 &= 8 + 1 \\
 &= 9
 \end{aligned}$$

Length of joists

$$\begin{aligned}
 &= (\text{distance between outside bearers} + \text{overhang}) \times \text{number required} \\
 &= (2.400 + 0.300) \times 9 \\
 &= 2.700 \times 9
 \end{aligned}$$

Therefore the materials required are:

- Concrete to posts 0.25m³
- Posts 100 x 100mm H4 - 4/3m
- Bearers 150 x 50mm H3 – 4/2.7m
- Joists 150 x 50mm H3 – 9/2.7m
- Coach bolts 8/210 x 12mm galvanised, nuts and 50 x 50mm square washers
- Petroleum grease
- Nails 75mm galvanised jolt head nails

Preparing an Order for Materials

When placing an order with a supply merchant for building materials, you need to provide the following information. This will ensure that the right materials are supplied to the right place at the right time, and the correct information is supplied for budget and accounting purposes.

The order should be clearly written or typed, and include the following information:

- date of order;
- customer's name account number and billing address;
- job identification or number;
- order number;
- supply merchant's name;
- description of goods required and quantity;
- address where the order should be delivered;
- date and time required;
- any other delivery details; and
- authorised purchaser's signature.

Send the order to the supplier, allowing enough time for them to prepare and deliver it. (You should also keep a copy of the order for your records.) It's a good idea to follow up with a phone call if you don't receive confirmation that the order has been received.

Once your timber is delivered, stack it level and clear of the ground, and keep it covered or in the shade, to prevent it bowing or deteriorating.



Constructing a Freestanding Pergola

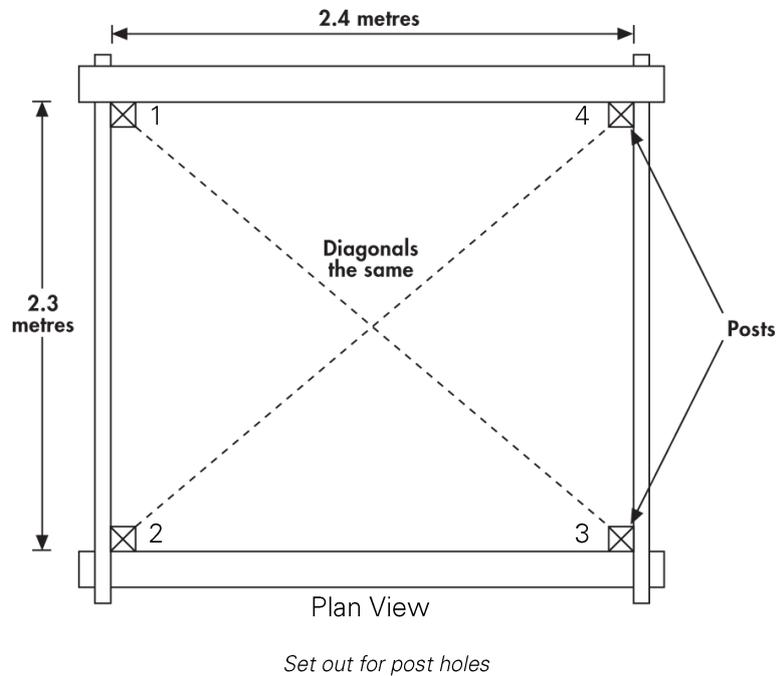
Setting out post holes

Take two lengths of 150 x 50mm timber, and mark two lines, 2.4 metres apart, across both.

Take two more lengths of 150 x 50mm timber and mark two lines, 2.3 metres apart, across both.

Lay the planks together in a rectangle where you want the pergola, so the inside of each plank rests on the lines of planks beneath or above it.

Square the corners by checking that the diagonals are the same length.



The inside of each corner of the rectangle marks the outside corner of each post. Mark the post positions on the ground, and dismantle and remove the rectangle.

Installing the posts

Dig four 300mm diameter holes at least 700mm deep, but no deeper than 800mm.

Place 100mm of concrete in the bottom of each hole and set the posts in place on top. Make sure uncut ends go into the hole.

Check for plumb (vertical) in both directions and brace securely.

Pour in concrete to 150mm below ground level. Check for plumb again and rebrace if necessary.

Leave the concrete to set for at least 24 hours.

When the concrete has set, top up each hole with soil.

Measure 2.3 metres from ground level on one post.

Level that mark around onto each of the other posts, using a string level and string line, or a spirit level on a plank. Check the accuracy of all marks by levelling between post 4 and post 1.

Square and cut the posts to the correct height(s).

Fixing the bearers

Cut four bearers 2.7 metres long from 150 x 50mm. Check the dimensions at the post top before cutting.

Shape the ends of the bearers if required.

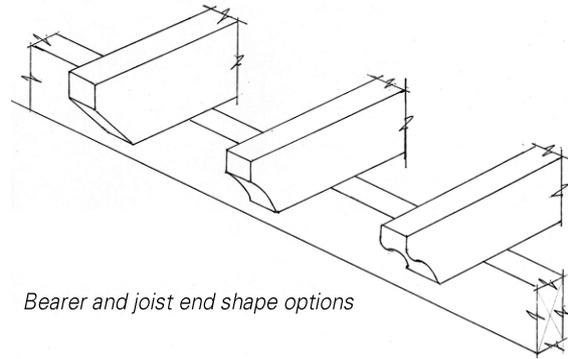
Temporarily nail the bearers between posts 1 and 4, and posts 2 and 3. (Make sure that temporary nails are in the middle of each bearer, as bolt holes have to be bored above and below that.) Position the bearers so that:

- the posts are sandwiched between the bearers;
- the top edge of the bearers is flush with the tops of the posts; and
- the bearers overhang the posts by 150mm at each end.

Mark points 40mm from the bottom and top edges of the bearers, in the centre of the posts.

Bore two 12mm holes on those points, through the bearers and posts. If your auger bit is less than 200mm long, measure and bore from both sides, ensuring that you maintain the holes level and square to the face of the bearer, so the holes from each side meet up.

Grease the bolts liberally, bolt through the holes and tighten.



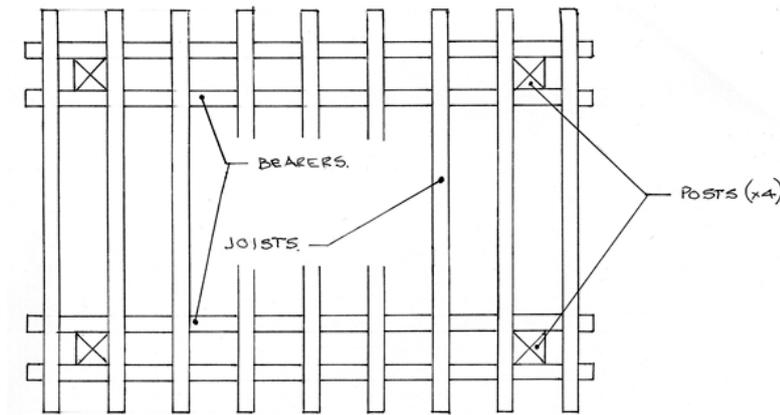
Bearer and joist end shape options

Fixing the joists

Cut 9 joists at 2.7 metres from the remaining 150 x 50mm. Shape the ends if required.

Start with the 2 end joists. Line up the outside edge of the posts with the inside of the joists, and have 150mm overhang at each end. Skew nail the joists to all four bearers with 75mm nails.

Space the remaining 7 joists evenly between the end joists, at about 300mm centres, and nail the joists in place.



Plan View scale)

Free standing pergola layout



Activity

1. Complete this order for materials required for the following freestanding pergola:

Width – 2.400m
Length – 3.200m
Height – 2.400m

- Concrete to posts m³
- Posts 100 x 100mm H4, 0.800m in ground
- Bearers 150 x 50mm H3, overhang 0.150m
- Joists 150 x 50mm H3
- Coach bolts 210 x 12mm galvanised, nuts and 50 x 50mm square washers
- Petroleum grease
- Nails 75mm galvanised jolt head nails

Material	Amount required

2. What method can be used to check if the corners of a rectangle are 90 degrees?

3. How long should you leave the concrete in the post holes to set before fixing the bearers and joists?

4. Describe how the bearers should be positioned.
