Chapter 20

Ceiling framing

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Learning Objectives

LO 20.1 **Know about ceiling framing components**

LO 20.2 **Construct ceiling frames**

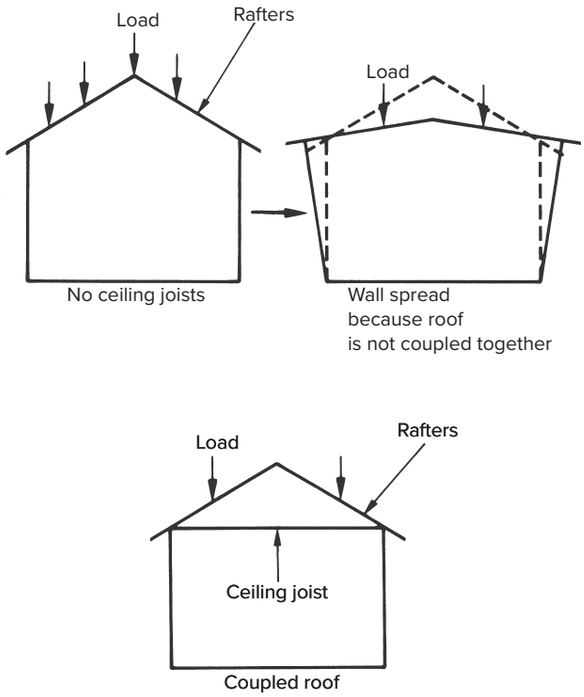
LO 20.3 **Understand ceiling framing safety**

LO 20.4 **Understand ceiling frame design**

Introduction

Ceiling framing is closely integrated with pitched roof construction: when a ceiling frame is constructed, it strengthens the structure by tying opposite walls together and stopping them from spreading apart once the roof is constructed and loaded as shown in Figure 20.1. The ceiling frame holds up the materials used to create the ceiling, e.g. plaster and timber. Some specific members of ceiling frames can be used to support the roof and its loads. In double-storey buildings, the ceiling frame can also be the floor framing for the floor above. Australian Standard (AS) 1684 *Residential timber-framed construction* details the fixing requirements, allowable spans for the ceiling framing components and basic design of a timber ceiling frame. If metal or other engineered products are used to construct the ceiling frame, you must consult with the appropriate standards, codes or manufacturer's specifications.

Fig. 20.1 **Ceiling framing—concept**



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In this chapter, you will learn how to set out and construct a ceiling frame for a single-storey building.

Reference to Chapter 21, Pitched roofing and Chapter 22, Construct advanced roofing may be helpful for a complete understanding.

20.1 Know about ceiling framing components

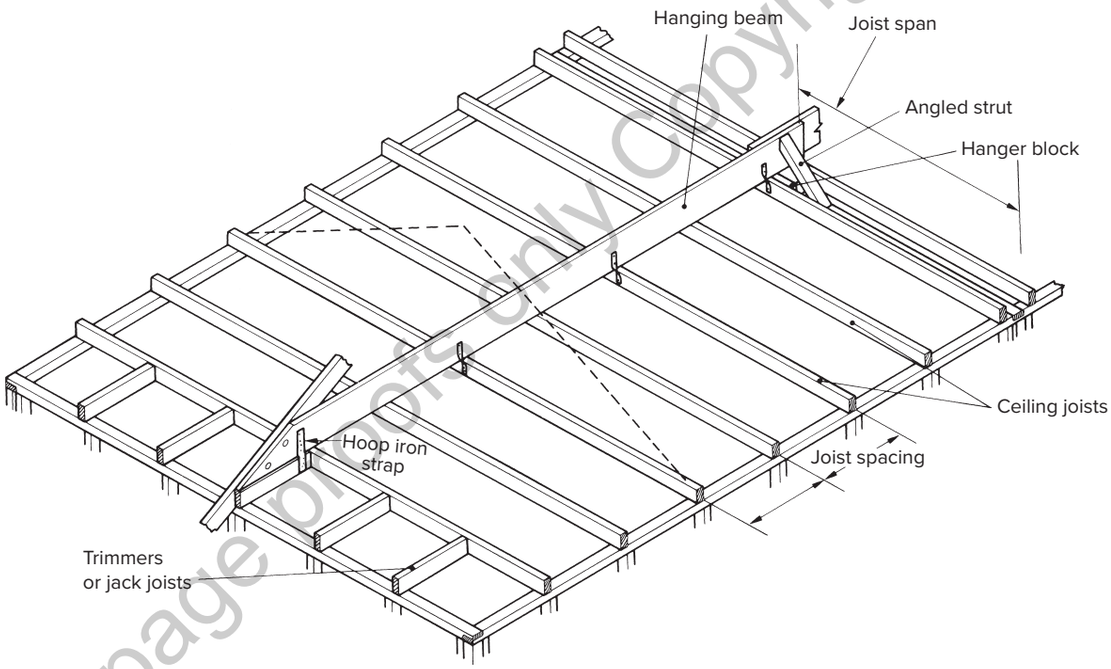
The ceiling frame consists of a number of different members/components. Each component has a specific purpose and name. These are listed below with a description of their purpose and location in the structure.

20.1.1 Ceiling joists

Ceiling joists serve multiple functions:

- they provide fixing for various types of internal ceiling materials
- they tie opposite walls together (Fig. 20.2)
- they form an integral part of the roof framing, completing the couple with the sloping rafters.

Fig. 20.2 Ceiling frame—general view



Ceiling joists should run in the same direction as the **common rafters,** as shown in Figure 20.3 and later in Figure 20.10. They can be securely fastened to the heel/foot of the rafter depending on the spacings of the rafters. The ceiling joist spacings can vary, but 450 mm or 600 mm between centres are common. The spacing is usually determined by the type of material being used to line the ceiling and how far it can span.

20.1.2 Ceiling trimmers

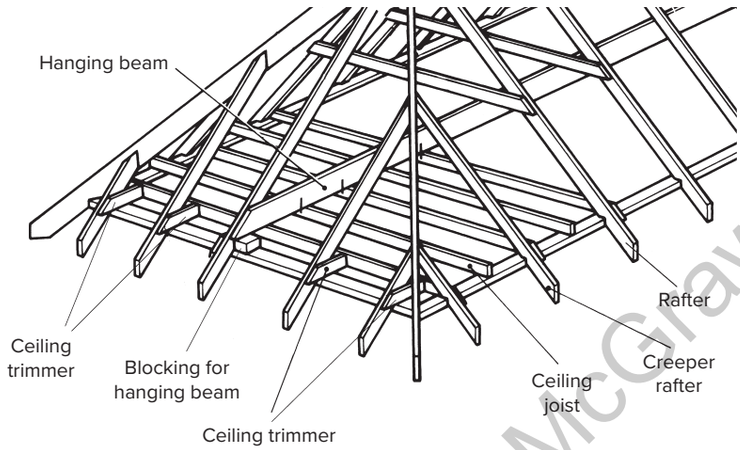
Where the ceiling joist at the end of a building would foul the rafters, it is omitted and replaced with *ceiling trimmers,* which run at right angles to the ceiling joists (Fig. 20.3).

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20.1.3 Hanging beams

Hanging beams are placed on edge over the ceiling joists to prevent them sagging over long spans (Fig. 20.3).

Fig. 20.3 Ceiling framing component locations



20.1.4 Blocking

Blocking is provided over load-bearing walls to support the ends of hanging beams (Fig. 20.4).

20.1.5 Ceiling ties

Ceiling ties, ceiling joist supports/hangers, ceiling dogs and timber cleats are devices used to strengthen the joint between the hanging beam and ceiling joist (Fig. 20.5).

Fig. 20.4 Hanging beam blocking

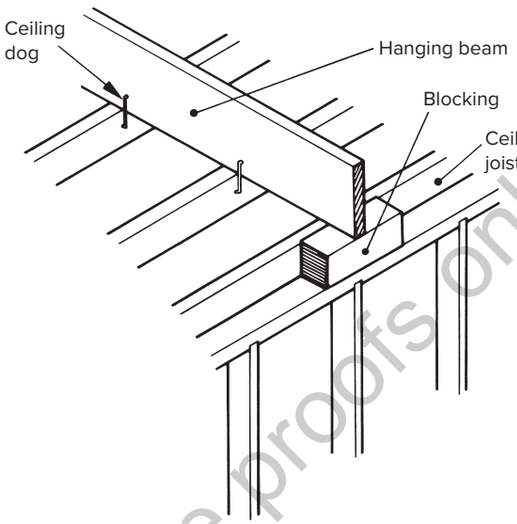
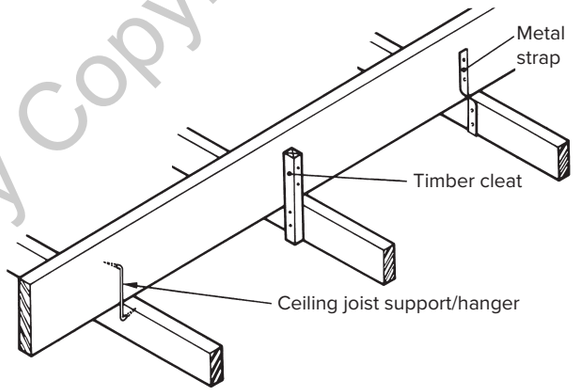


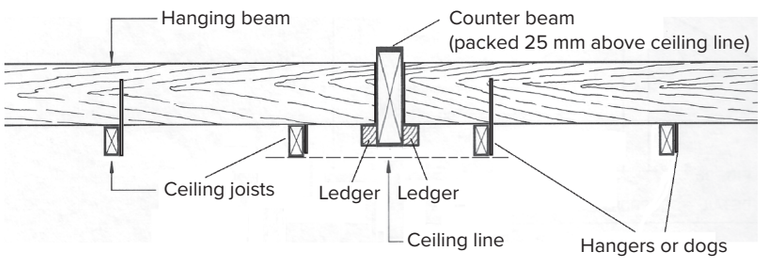
Fig. 20.5 Ceiling ties/support



20.1.6 Counter beams

Counter beams are used to provide support for the end of a hanging beam, where a wall is not available to support the end of the hanging beam (Fig. 20.6).

Fig. 20.6 Counter beam

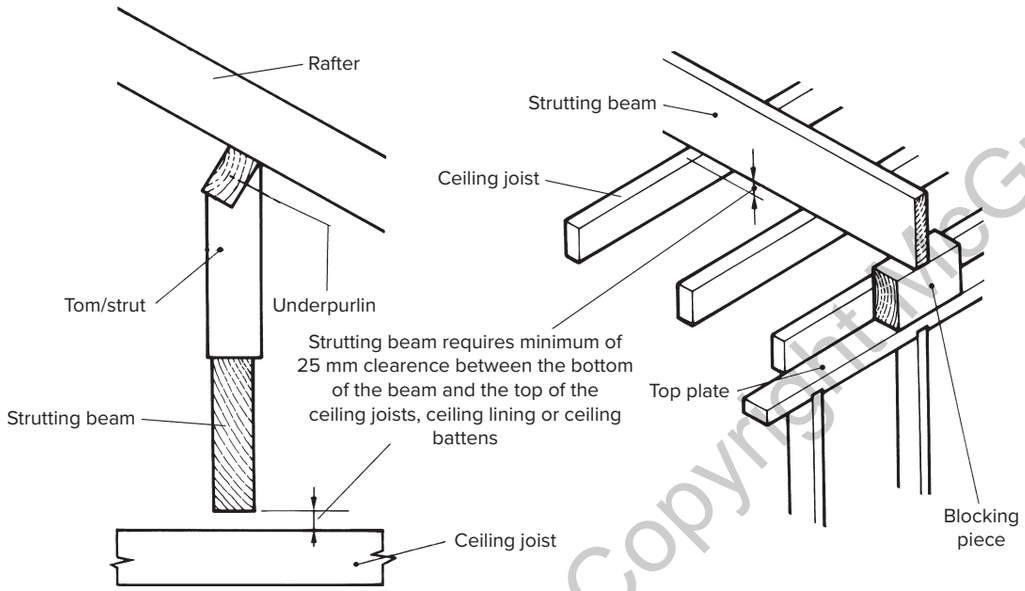


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20.1.7 Strutting beams

Strutting beams are used when an underpurlin is supported by a tom/strut and no wall is present to support the strut and take the roof load (Fig. 20.7).

Fig. 20.7 Strutting beam



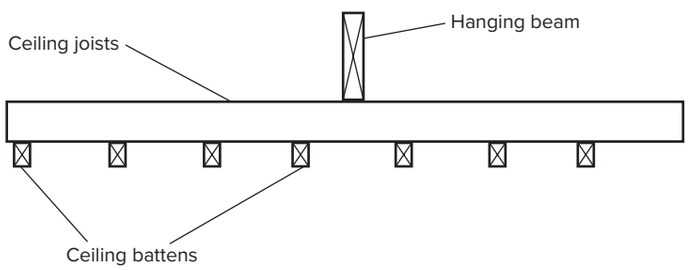
20.1.8 Combination strutting and counter beams

This type of beam combines the purposes of a strutting beam and counter beam in one. It is used when the internal wall frames provide little support to the roof and ceiling loads.

20.1.9 Ceiling battens

Ceiling battens may need to be installed on the underside of the ceiling joists when the ceiling lining will not be installed directly onto the ceiling joists. The battens run at 90 degrees to the ceiling joists (Fig. 20.8). The reasons for installing ceiling battens include:

Fig. 20.8 Ceiling battens



- the ceiling lining requires extra support as the ceiling joists are too far apart
- the direction in which the ceiling lining is installed does not correspond with the direction of the ceiling joists
- the ceiling joists cannot be straightened adequately, so battens are installed to provide a true flat surface for the lining materials to be attached to.

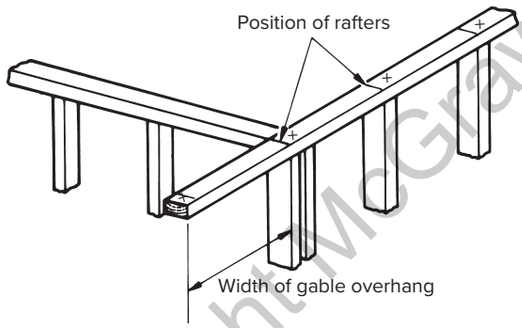
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20.2 Construct ceiling frames

The section dimensions for natural timber ceiling framing members and their spans can be found in AS 1684. If the material being used is a manufactured product, an engineer should perform the calculations or consult the manufacturer's specifications to establish the performance characteristics and limitations of the product being used.

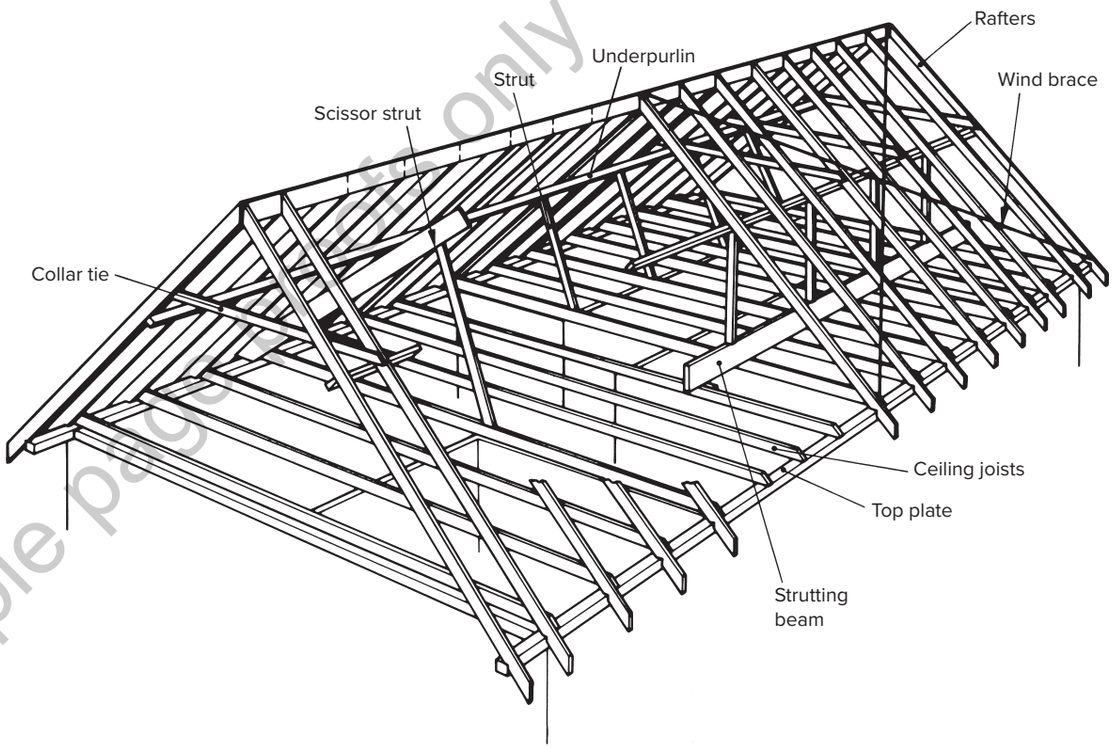
Before the ceiling joists are fixed, the location of the rafters must first be marked out on the upper face of the top plate. It is preferable that this be done at an earlier stage, when the plates are being set out on the ground. Marking out on the top of the walls after they have been erected can be a slow and precarious procedure. At this stage, note that the ceiling joists are placed beside the positions marked and are reserved for the rafters (Fig. 20.9).

Fig. 20.9 Rafter/ceiling joist set-out



TIP If the ceiling joists being used are quite deep, the top external corner of the ceiling joist may need to be trimmed off in line with the top of the rafter, as shown in Figure 20.10. The ceiling joist must not sit above the rafter at any point as it will foul the roof battens or roofing material.

Fig. 20.10 Gable roof showing ceiling structure



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20.2.1 Procedure for constructing ceiling frames

1. Stand ceiling joists on end against the wall of the building, approximately where they will be required. Load the roof, laying each ceiling joist on the flat, adjacent to its final location.
2. With a carpenter at each end, stand each joist upright, with the round edge up, and skew nail to the top plates. Where joists are joined in their length, they can be lapped over a wall with the joists of an adjacent room and securely nailed together.
3. Mark the position for the hanging beam and fix the blocking to support the beam at each end (refer back to Fig. 20.4).
4. Lay the hanging beam across the ceiling joist–stand it upright and skew nail to blocking.
5. Lay a plank across the ceiling joists beside the hanging beam and, using a short sash cramp or other suitable clamping device, work across each room, cramping each joist up to the hanging beam. Ensure that the joists are in line; a string line 90° to the ceiling joists, strung on the underside of ceiling joists and stretched from one wall to the other. It can be useful to ensure the centre of the joists are in line. Usually, sighting by eye will keep the joists sufficiently straight, but for greater accuracy, the position for ceiling joists can be marked onto the hanging beam. Fix a ceiling tie or cleat at each junction on alternate sides of the hanging beam (refer back to Fig. 20.5).
6. Cut ceiling trimmers to length where required and fix in position, again beside the positions marked out for the rafters.

SAFETY TIP Never walk across the ceiling joists until they have finally been fixed and supported by the hanging beam as a joist could roll or collapse due to a knot or other defect, leading to a serious injury.

20.3 Understand ceiling framing safety

Constructing a ceiling frame will be performed as part of the overall construction of a roof. This construction will take place above ground at a height which, if you were to fall, would cause serious injury.

Working at height exposes the carpenter to numerous risks, and all precautions should be taken to reduce these risks, including:

- using scaffolds or some other platform to work from
- ensuring handrails/guardrails are used
- keeping the floor area clear and free of debris so that if you were to fall, you would not fall onto anything
- avoiding using ladders
- avoiding walking on top wall plates
- not rushing
- ensuring you have adequate training.

SAFETY TIP Consult your local WorkSafe authority to find out your jurisdiction requirements for working at height on a building site.

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20.4 Understand ceiling frame design

The design of a ceiling frame is dependent on many factors, including:

- room size
- available materials
- choice of ceiling lining material
- roof construction and whether the roof requires support
- rafter spacing
- roof pitch
- whether the roof space is to be used for storage
- whether anything heavy will be stored in the roof space, such as a heating or cooling system
- roof cladding.

If using natural milled timber to construct the ceiling frame, AS 1684 must be consulted as it details:

- member sizes and their spans according to their stress grade
- ceiling frame design
- fixing requirements.

If manufactured materials are to be used to construct the ceiling frame, the manufacturer's specifications should be consulted in conjunction with an engineer, taking into consideration the ceiling frame design factors listed above.

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Student research

Research what alternative products to natural timber can be used to construct a ceiling frame.

End-of-chapter activity

As part of your apprenticeship training, you will be required to construct a ceiling frame. This will be done as you are constructing a roof.

AUSTRALIAN BUILDING CODES AND STANDARDS

National Construction Code (NCC)

AS 1684—2010: Residential timber-framed construction

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Tradie talk—Always stagger the joist hangers