CHAPTER 1

Types of Roofs

Roofs are constructed in a wide variety of different sizes, shapes, and designs, and there are a number of different ways of classifying them. The three most common methods of classification are based on roof design, roof construction, and the type of roofing material used to cover them. Roofing materials are described in the next chapter.

Roof Design

The easiest way to classify a roof is by its architectural design. The principal types of roof designs are illustrated in Figs. 1–1 through 1–3. A *gable roof* is composed of two sloping surfaces that meet and join together along a common ridge line (Fig. 1–1A). The triangular end wall formed at each end of the roof is called a gable. The degree of slope or pitch will vary on different roofs.

A roof that slopes away in *four* directions from a common ridge line is called a *hip roof* (Fig. 1–1B). The so-called hip is found where a gable would be located on a gable roof. Sometimes a hip roof is used to cover a wing that joins the main portion of the structure covered by a gable roof. This type of roof is frequently called a *gable-and-hip roof.*

Some roofs are designed with a change of slope or double pitch.

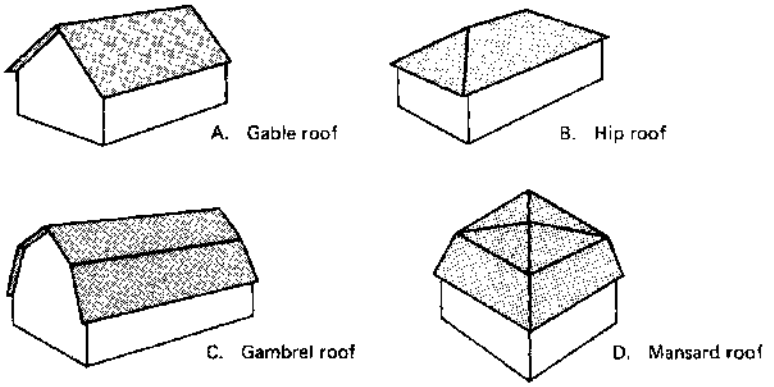

Fig. 1–1. Gable, hip, gambrel, and mansard roofs.

The *gambrel roof* roughly resembles the gable roof except that the gable formed at each end has a pentagonal shape (Fig. 1–1C).

The *mansard roof* design was first introduced in France by the architect François Mansart (1598–1666). It enjoyed initial popularity in the United States in areas of French settlement, particularly in and around New Orleans. During the nineteenth century it spread across the country with the French empire and Victorian styles of architecture. During the early- and mid-twentieth century it was ignored by American architects and builders. It is now experiencing a revival in popularity, especially in apartment construction.

On a mansard roof, a change of slope or double pitch occurs on all four sides of the roof (Fig. 1–1D). The lower slope is steeper than the upper one and has a pitch that is sometimes almost vertical. A mansard roof differs from a gambrel roof by having a nearly flat top or deck, which is usually covered by built-up roofing materials.

In a *pyramidal roof* the four sloping surfaces meet at a central point (Fig. 1–2A). Examples of this type of roof design are found in Victorian architecture where they are used to cover towers. Church steeple roofs provide other examples. The *conical roof* is used to cover round towers and silos.

The *flat roof* is as common on commercial and industrial structures as the gable and hip roofs are in residential construction (Fig. 1–3A). Usually flat roofs on residential buildings are built to slope slightly in

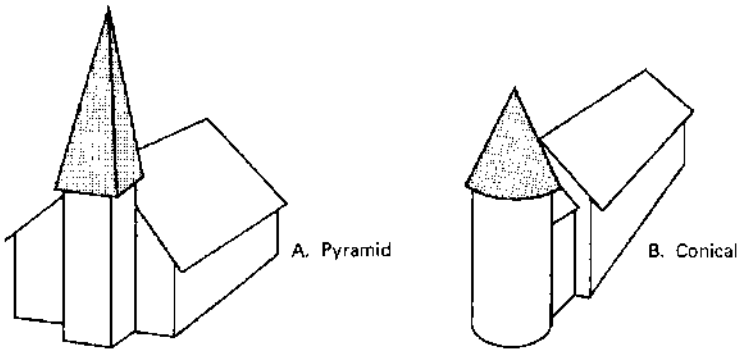

Fig. 1–2. Pyramid and conical roofs.

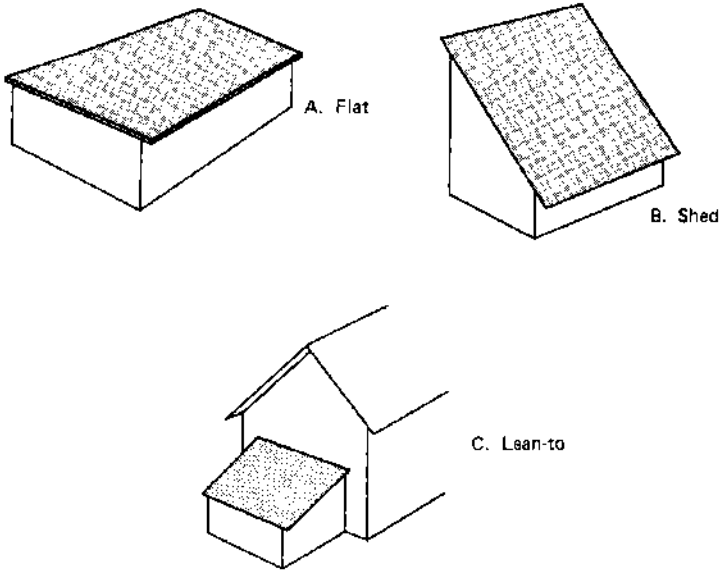

Fig. 1–3. Flat, shed, and lean-to roofs.

one direction to provide proper drainage for water. The degree of slope of pitch is almost imperceptible. All other roof types with a significant pitch are called *steep* or *pitched roofs*.

A *shed roof* slopes in one direction only (Fig. 1–3B). Although it bears some resemblance to a flat roof, its pitch is much greater. This type of roof is generally limited to small frame or industrial buildings, although it is occasionally found on houses and commercial buildings.

A *lean-to roof* is a shed roof with one end built against a higher wall of the main structure (Fig. 1–3C).

Each of these twelve types of roof designs is subject to some variation. Furthermore, several roofs or roof types will often be used to cover the same structure, particularly when offsets or wings join the main part of the structure.

The term *major roof* refers to the main roof covering the largest section of the structure. The term *minor roof*, on the other hand, designates any roof that covers a smaller section of the structure and intersects with the major roof to form a roof valley.

Roof Construction

The roof of a structure forms an integral part of an assembly that may also include the ceiling. In some instances, the underside of the roof functions as a ceiling, while the upper side provides a surface for the roofing materials. This type of roofing system is sometimes called an *open timber roof*, because the framing rafters or trusses are exposed to view.

In residential buildings it is common to join the sloping roof rafters with horizontal joists. The underside of these joists support the ceiling, and the upper side may be finished to serve as an attic floor.

Several different roof and ceiling assemblies are available. They may be divided into four basic types.

1. Truss roof assembly
2. Wood joist assembly
3. Wood joist and rafter assembly
4. Wood plank and beam assembly

Each of these four types of roof and ceiling assemblies enjoys widespread use in residential construction. Both the truss and wood joist and rafter type assemblies provide a flat ceiling surface for the rooms

or spaces below. Because this type of construction seals off an area immediately below the roof, adequate ventilation must be provided to prevent the build-up of condensation and excessive heat in these spaces.

One advantage of the wood-joist and rafter-type construction is that is creates an open area or attic that provides additional storage or living space. Truss-type construction limits use of the space because of the bracing between members.

The surface on which the roofing materials are laid is called the *roof deck*. The roof deck can be made of either wood or nonwood materials. Most pitched roof decks found on houses are constructed of wood boards or plywood panel sheathing.

The roof deck is either flat or slopes downward from both sides of a ridge line. A flat or low-pitched roof is level or almost level, and the frame members supporting the roof deck also serve as ceiling joists in most cases. Flat or low-pitched roofs are said to be of "single roof" construction. A *pitched roof*, which consists of rafters tied together by ceiling joists, has an intermediate or steep slope. The area enclosed by the rafters and joists forms an attic or attic crawl space.

Pitched Roof Framing

The deck of a pitched roof is supported primarily by common rafters and jack rafters (Fig. 1–4). The *common rafter* runs square with the wall plate and extends to the *ridge* or *ridge board*. The common rafters are the longest and certainly the most numerous rafters on gable, gambrel, and hip roofs.

A *hip rafter* is used on a hip roof, and extends from the outside angle of the wall plate toward the apex of the roof (Fig. 1–5). A rafter that runs square with the wall plate and intersects the hip rafter is called a *jack rafter*. Jack rafters never extend the entire distance from the wall plate to the ridge or ridgeboard. Jack rafters can be divided into hip jacks, valley jacks, and cripple jacks.

A *hip jack* is a jack rafter that runs from the wall plate to a hip rafter. A jack rafter that extends from the ridgeboard to a valley rafter is called a *valley jack*. A *cripple jack* or *cripple rafter* cuts between a valley and a hip rafter.

A structure with a wing added to it will have a roof system that contains a valley where the minor roof (covering the wing) joins the major or main roof. A *valley* is the internal angle formed by the two

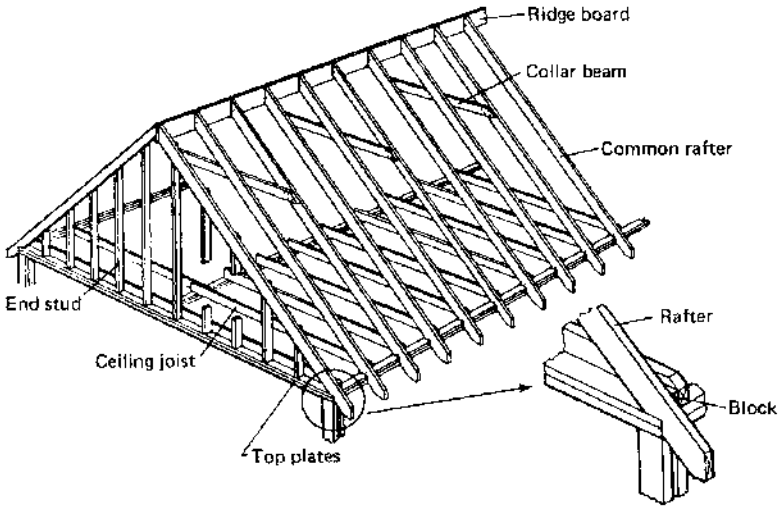

Fig. 1–4. Gable roof framing with rafter and joist assembly.

slopes of the intersecting roofs. A *valley rafter* extends from an inside angle of a wall plate toward the ridge or center line of the structure, and defines the angle of the roof valley (Fig. 1-6).

Rafters are nailed to a *wall plate* or *plate*, which generally consists of two 2 × 4s running horizontally across the top of the wall studs. The roof rafters extend a short distance beyond the wall plate on almost all pitched roofs forming an overhang or "eave" to permit water drainage from the roof surface at a suitable distance from the exterior walls and foundation. The portion of the rafter extending beyond the outer edge of the wall plate is called the *eave* or *tail* of the rafter.

A roof rafter is generally cut near its lower end to fit down on the wall plate. This is referred to as a *seat, bottom,* or *heel cut.* A *ridge, top,* or *plumb cut* is made at the other end of the rafter to allow it to fit against the ridgeboard or, when there is no ridgeboard, against an opposing rafter. Finally, a *side* or *cheek cut* is a bevel cut on the side of a rafter to fit it against another frame member. The various types of rafter cuts are illustrated in Fig. 1–7.

Some roof framing terms are used specifically for making layout

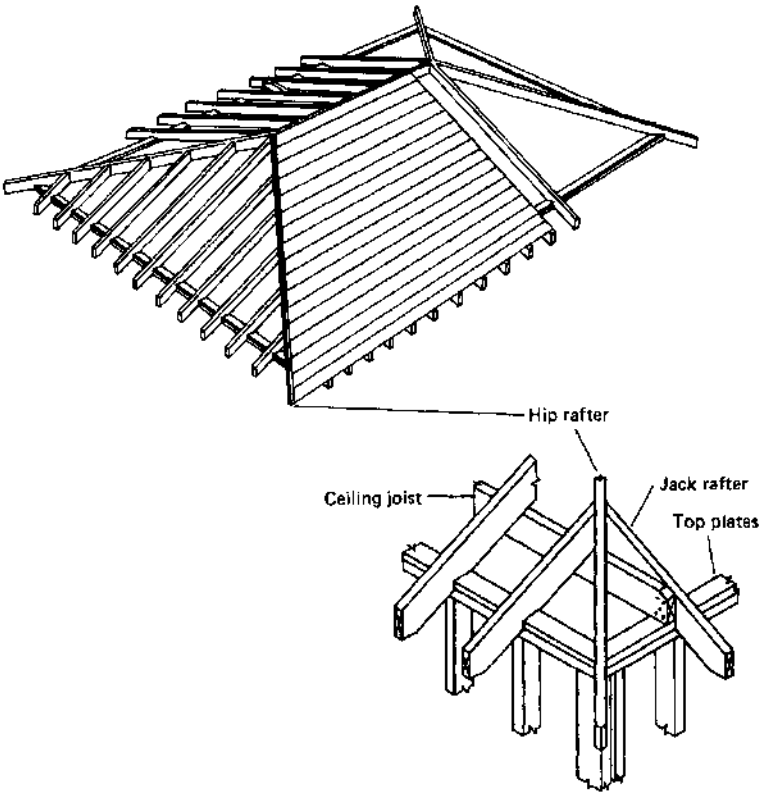

Fig. 1–5. Hip roof framing.

measurements, for example, in determining rafter length or the angle of rafter cut. *Pitch* and *slope* are two of the most commonly used terms belonging to this category of roof-framing terminology. The two terms are often, but incorrectly, used synonymously. Both terms may be used in a general sense to refer to the angle or incline which the roof surface makes with a horizontal plane, but each term more specifically describes a distinctly different mathematical relationship between the total rise and the span of a roof.

The horizontal (level) distance over which the roof rafter passes is

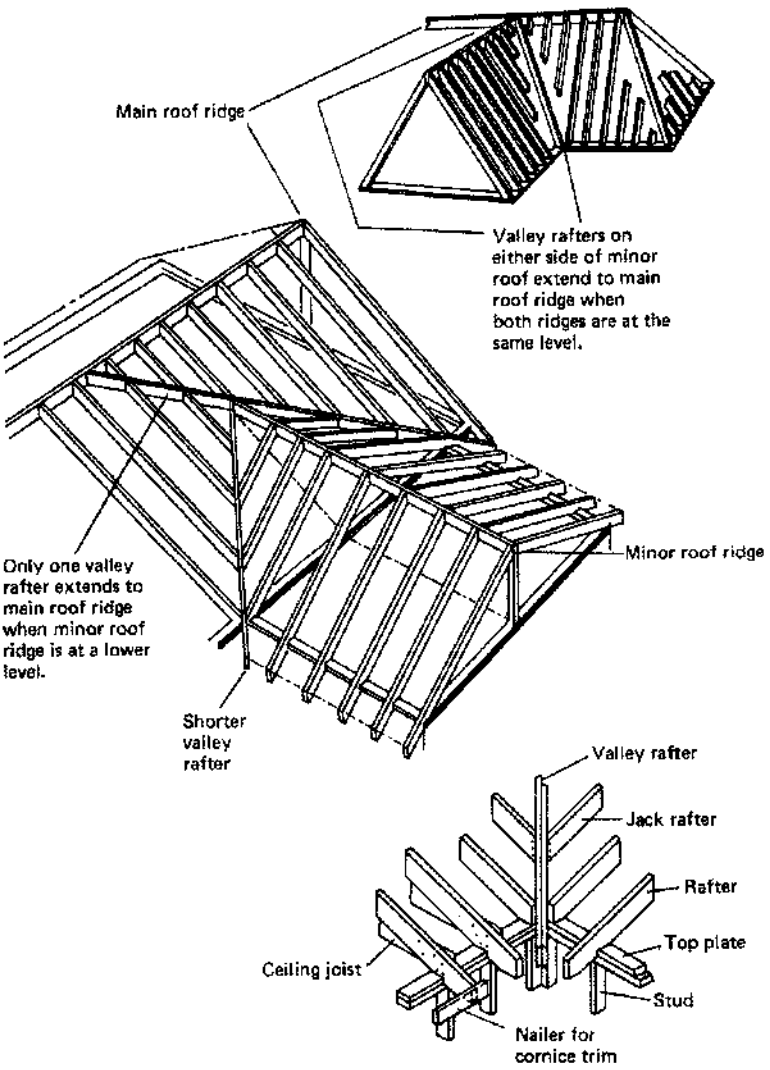

Fig. 1–6. Valley framing.

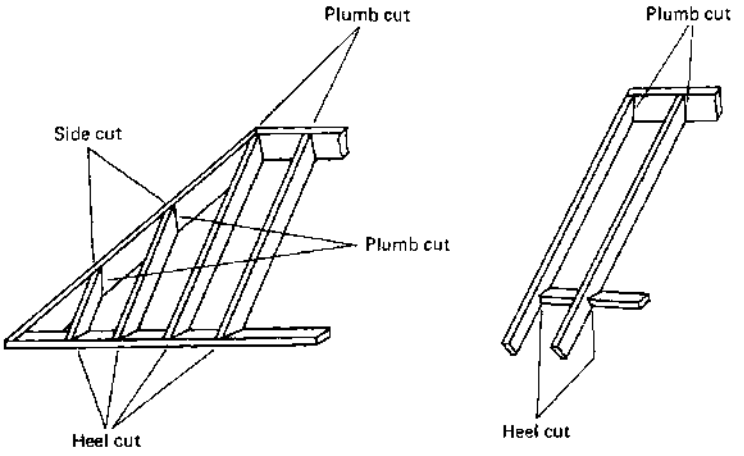

Fig. 1–7. Various types of rafter cuts.

called the *total run* or *horizontal run.* It represents the area covered by the rafter from the outer edge of the wall plate to a vertical line extending down from the exact middle of the ridgeboard, and really has nothing to do with the actual length of the rafter. The total run of a common rafter is one half the width of the structure.

The *span* of the roof is double the total run, and represents the exact width of the structure between the outer edges of opposing wall plates. The *total rise* or *vertical rise,* on the other hand, is the distance extending vertically from the plate line to the top of the ridgeboard. The relationships of the terms run, span, and total rise are illustrated in Fig. 1–8. These relationships determine the "pitch" or "slope" of the roof. Both pitch and slope are explained in Chapter 2 because they are determining factors in the type of roofing materials used on the roof.

Flat Roof Framing

The flat or low-pitched roof is usually constructed with a slight slope or pitch to improve drainage. The frame members that support the roof deck and also serve as ceiling joists are sometimes called *roof joists.*

Construction details of flat or low-pitched roof framing are illus-

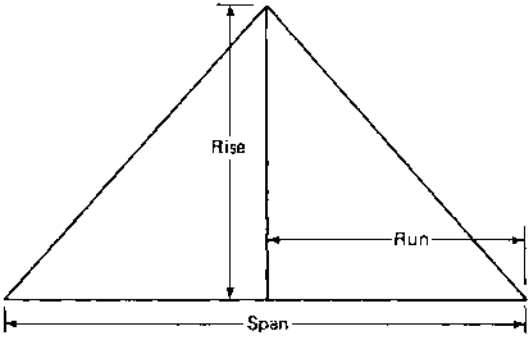

Fig. 1–8. Relationship of total run, span, and total rise.

trated in Fig. 1–9. The lookout rafter provides roof overhang. Each *lookout rafter* is toenailed to the wall plate and nailed at the other end to a double header. The distance from the double header to the wall line is generally twice the overhang measurement. A nailing header for securing the soffit and fascia boards is sometimes nailed to the ends of the lookout rafters.

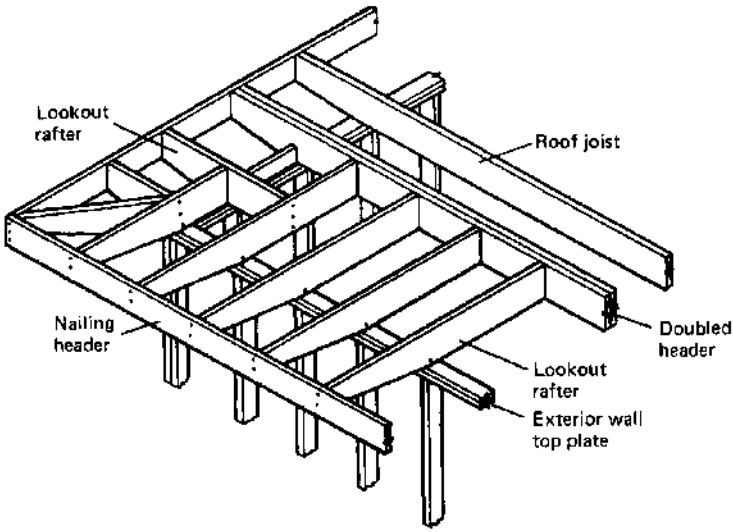

Fig. 1–9. Flat roof framing.