The collars are usually fixed to the spars immediately below the lower set of purlins, as shown in section AB. These collars are dovetail halved jointed to the spars as shown at Z, Fig. 36. As the span of the collars is approximately 14-ft., their size is 7-in. by 2-in. (see Table V. on p. 72). A plastered ceiling could be formed by nailing the laths to the underside of the collars and the lower portions of the spars (see broken lines).

Hip rafters usually support comparatively heavy loads from the purlins. They must be of sufficient strength to prevent sagging and must be fixed securely. The head of each rafter is nailed to the ridge, and in order that the load from the rafters shall be adequately distributed on to the walls, it is necessary to employ a special form of construction to receive the feet of the rafters and to make the angle of the roof secure. If the feet of the hip rafters were, like the spars, simply birdsmouthed and spiked to the wall plates, the concentrated inclined thrust may be sufficient to push out the quoins of the building. This construction is shown at E and F, Fig. 37, and in the details at G, H and J.[1]

An *angle tie* or *brace*, placed diagonally across the corner, is notched to the wall plates, and to counteract the thrust, these notches should be dovetailed as shown by the broken lines in the plan H. The wall plates are half-lapped for the same reason, and as shown their ends project some 3-in. This angle tie carries one end of a beam, called a *dragon* (or *dragging*) *beam*, which is the chief support for the hip rafter. This beam is tusk tenoned to the angle tie and single cogged over the wall plates. The foot of the hip rafter is connected to the dragon beam by means of an *oblique tenon joint* and bolt as shown, or by a *bridle joint* as illustrated at E and J, Fig. 40; these joints are described on p. 78. After the hip rafter has been fixed, the whole of the framing is made rigid by tightly driving down the wedge of the tusk tenon. For lowly pitched roofs, and where the eaves is not sprocketed, the foot of the hip rafter is sometimes projected beyond the outer face of the wall to the line of the projecting feet of the spars. In this case the rafter is notched over and is tenoned nearer to the outer end of the dragon beam.

The lower ends of jack rafters are fitted and spiked to the vertical faces of valley rafters (see P and Q, Fig. 73).

The eaves details are described on p. 76.

This type of roof in which purlins and collars are employed is often adopted (especially for houses) on account of its sound and economical construction. It is particularly suited for spans which do not exceed 24-ft.

Fig. 38 shows another type of double roof. It is similar to the close couple type described on p. 72 with the addition of purlins. The 4-in. by 2-in. spars are pitched at 30° (depending upon the covering material and required design), birdsmouthed to the wall plates, notched over one pair of purlins (which are placed vertically as an alternative to those shown in Fig. 37) and spiked to the ridge. The ceiling joists or ties are secured to the wall plates and the feet of the spars as already described, and as they are supported by two sets of hangers and runners, the size of these joists need only be 4-in. by 2-in. or 5-in. by 2-in., depending upon the weight of the roof covering. The hangers and runners have been described on p. 72. Sometimes the runners are notched over the ceiling joists to afford additional rigidity to the latter.

[1] Consideration of this construction may be deferred to the second year of the Course.

It is important that the lower ends of the hangers are not secured to the runners until *after* the slates or other covering material have been fixed, otherwise the weight of this material may cause the spars to sag slightly, which in turn would depress the ceiling joists through the hangers. It is the practice therefore for the carpenter to nail the runners to the ceiling joists and the upper ends of the hangers to the spars or purlins, and to defer nailing the lower ends of the hangers until the slater or tiler has completed his work.

Trimming is required at chimney stacks, dormers, skylights, etc., and the construction is much about the same as that for floors (see p. 66). The names of the various spars concerned are similar to those applied to floor trimming, *i.e.*, *trimming spars* (or rafters), *trimmer spars* and *trimmed spars* (see A and C, Fig. 38). The joint between the trimmer and trimming spars may be either a tusk tenon (see L, Fig. 34) or a similar joint without the tusk, called a *pinned tenon joint* (see **A and C, Fig. 38**). That between the trimmed and trimmer spars **should be either a dovetailed housed joint** (see M, Fig. 34) or a bevelled haunched **joint described on p. 66.**[1] The trimming of a roof round a chimney stack which penetrates a roof midway between the eaves and ridge is detailed at E, Fig. 73.

EAVES DETAILS.[2]—It is important that the eaves of a roof should be carefully designed. It is a common mistake to use an excessively deep fascia, and the clumsy effect which this produces is shown at M, Fig. 37. An excessive projection of the eaves in proportion to the size of the building is another error. As a general rule overhanging eaves should be of minimum depth. Over-elaboration should be avoided, the simpler the detail the better.

Flush, open projecting and closed projecting eaves have been referred to on p. 69.

Flush Eaves.—Two examples of this type are shown at Q and W, Fig. 36. The fascia is only sufficiently deep to cover the ends of the joists or spars, to which it is either nailed or screwed. In the latter detail the fascia projects slightly above the boarding in order to tilt the slates (see Chapter Five). The thickness of the fascia need not exceed 1-in. (nominal), and, if preferred, one or more fillets may be formed as shown.

Open Projecting Eaves (see X, Fig. 36).—The feet of the spars project 6-in. and are shaped as shown or as indicated at J and L, Fig. 69. It is not necessary to provide a fascia to an open eaves. A simple open projecting eaves is shown at C, Fig. 70.

Closed Projecting Eaves.—There are two forms of closed eaves, *i.e.*, those with sprockets and those without.

An example of the latter is shown at Y, Fig. 36. The ends of the rafters are sawn to the shape as shown, the soffit board is nailed to the spars, and the fascia is finally fixed with the edge of the soffit board engaging in the groove prepared to receive it. It will be observed that the brickwork is set back $4\frac{1}{2}$-in., and that

[1] In cheap work the trimmed spars are simply butt-jointed and nailed to the trimmers.
[2] Students should defer consideration of the slating details until Chapter Five is reached.