follows therefore that the close couple roof is stronger than the collar roof, but the latter has one advantage over the former in that it permits of an increase in the height of the room below. Thus, as shown at V, the plastered ceiling may be formed on the underside of the collars and the lower portion of the spars. This effects an economy in walling, for, if the same height of room was required and a close couple roof employed, the two walls would have to be increased in height to the level of the collar.

The dovetail halved joint at U is detailed at Z. A ½-in.[1] sinking is formed on the side of the spar and the upper edge is dovetailed. The end of the collar is checked out ½-in., and the remainder of the thickness of the collar is dovetailed along the upper edge as shown so that when the collar is fitted to the spar it will be housed to the extent of ½-in. (see section B′B′). The collar is then well spiked to the spars, or a ⅜-in. diameter bolt may be used at each end for the same purpose.

This joint is effective in resisting both tension and compression stresses. Thus any tendency for the spars to spread (when the collar would be in tension) is counteracted by the top shoulder (edge) of the collar bearing on the upper edge of the dovetailed notch formed on the spar, and the spars are prevented from sagging (to produce a compression stress in the collar) by the inclined abutment of the collar which is fitted tightly against the underside of the spar near each end.

The sizes of collars should conform with the sizes of ties given on the previous page (the " maximum span " being the length of collar). It is not economical to adopt the collar type of single roof for spans exceeding 16-ft.

(*b*) DOUBLE OR PURLIN ROOFS (see Figs. 37 and 38).—Purlins are introduced in this class of roof to provide intermediate supports to the common rafters. Purlins are necessary for roofs with spans of 18-ft. and upwards, otherwise the spars would need to be increased to an uneconomical size. The maximum span (inclined) of spars is 8-ft. and this should be reduced to 6-ft. when the roofs have a small pitch and are covered with heavy material. The introduction of sufficient purlins permits the use of comparatively small (and therefore light) spars which are readily handled.

All the single roofs shown in Fig. 36 may be altered to double roofs by the addition of one or more sets of purlins.

Fig. 37 shows the plan F of a portion of a double roof of the collar type, together with a section at E. A hipped end has been introduced so as to illustrate the application of hip rafters and the construction involved. The spars are inclined at 55° (see p. 69) and two purlins are provided at each side to support the spars which have a clear span of 5-ft. 6-in. The spars are nailed to the wall-plate, purlins and ridge, and to reduce any tendency for the rafters to slide downwards they are cogged (see p. 61) 1-in. over the purlins,[2] in addition to birdsmouthing their lower ends to the wall plates (see K). At the hipped end the spars are cut short (when they are called jack rafters) and the heads are fitted and spiked to the hip rafters.

Purlins are supported by cross division walls of bedrooms, etc. (which are carried up to the underside of the purlins), and at the ends by the hip rafters to which they are shaped and well spiked or bolted. The ends may be fixed to valley rafters in a similar manner. The purlins may be placed normal (right angles) to the spars as shown at E, or they may be fixed vertically as shown at N and O, Fig. 37, and in Fig. 38. A secure bearing on the walls is provided when the purlins are vertical, and in good work stone pads are introduced at the supports to effectively distribute the weight on to the wall (see broken lines at N). Joints in long lengths of purlins are best arranged to coincide with and lap at the wall supports (see N and O).

Jointing known as *scarfing* or *splicing* is resorted to when a purlin is required to be increased in length. The best form for purlins is the *splayed* or *raking scarfed joint* shown at R where the length of joint is from two to two and a half times the depth of the purlin. Right angled cuts are made at the ends of the splayed portion as shown. Three or four ½-in. diameter bolts, tightened by nuts, make the joint rigid. A mild steel or wrought iron strap should be fixed at the underside of the joint (see sketch). This joint is also used for lengthening a ridge where the length need only be one and a half times the depth ; a metal strap is not required and long nails are used instead of bolts. It is also the usual form of joint for lengthening tie beams (see p. 81).

Fishing is an alternative form to scarfing. A fished joint is formed by butting the two squared ends of the timber together and connecting them by means of two metal (or wood) plates (one top and bottom) and bolting them as for a scarfed joint. The length of the plates equals four times the depth of the jointed member, and if wood plates are used their thickness should equal one-quarter the depth. This is a suitable joint for struts which are subjected to compressional stresses.

The following table gives the sizes of purlins which comply with most bye-laws :—

TABLE VI

Span.	Maximum inclined distance apart.		
	6-Ft.	7-Ft. 6-In.	9-Ft.
6 ft.	4½ in. by 3 in.	5 in. by 3 in.	6 in. by 3 in.
8 ,,	6 ,, by 3 ,,	7 ,, by 3 ,,	7 ,, by 4 ,,
10 ,,	7 ,, by 3 ,,	7 ,, by 4 ,,	8 ,, by 4 ,,
12 ,,	7 ,, by 6 ,,	8 ,, by 6 ,,	9 ,, by 5 ,,
14 ,,	9 ,, by 5 ,,	10 ,, by 4½ ,,	11 ,, by 4 ,,
16 ,,	11 ,, by 4 ,,	11 ,, by 5 ,,	11 ,, by 6 ,,

Purlins exceeding 16-ft. in length are not economical. In the absence of cross-walls or partitions, trusses are provided to limit the unsupported length of purlins to 16-ft.

[1] Alternatively, the depth of the notch in the side of the spar is increased to 1-in. and the end of the collar is checked out by a similar amount so that when assembled both sides of the collar are flush with those of the spar.

[2] Cogging is omitted in cheap work.