An enlarged sketch detail of the connections at F is shown at G. The straining beam, which is in compression, as it resists the thrusts from the principal rafters, is bevel housed and tenoned to the queen post. An increased bearing is provided by the cleat which is bevel housed to the queen post. The principal rafter is tenoned to the post, which, like the king post, is shaped to provide a bevelled shoulder and a sound abutment. The strength of the joint is increased by a ¼-in. thick 3-way steel strap at each side, secured by bolts. The head of the post is bevelled to suit the purlin, and a cleat provides a satisfactory bearing for the latter.

The straining sill, which assists in counteracting the thrust from the struts, should be fitted tightly between the feet of the posts and nailed to the tie beam.

It is usual to form the tie beam of two pieces because of the difficulty and expense of obtaining single pieces of such large size. A suitable lapped joint between two pieces is shown by broken lines at C. It is a splayed scarf joint with folding wedges and a mild steel fish plate. The length of the joint must be at least three times the depth of the beam. This is a better form of scarfed joint for this purpose than that shown at R, Fig. 37, Vol. I, as the folding wedges when driven in draw the two pieces tightly together.

A section through the roof is shown at D. Small fillets are nailed to the tie beam to support the ceiling joists. The total weight of the plastered ceiling, including joists, is approximately 2-tons, and if a ceiling is not required, the thickness of the members of the truss can be reduced to 4-in. The space between the queen posts is sometimes used to provide storage, etc., accommodation, the joists forming the floor being supported on the tie beams; allowance for the additional weight of the floor, together with the superimposed load (that supported by the floor) must, of course, be made when deciding upon the scantlings of the truss members.

The tiling details are drawn to a larger scale in Fig. 44.

If subjected to high wind pressure and non-uniform loading of the floor (if provided), this type of truss is liable to become distorted because of the non-triangulated portion bounded by the posts, tie beam and straining beam. Deformation is not likely to occur if the joints are soundly constructed. Additional rigidity can be obtained by triangulating this rectangular portion with two diagonal braces, each extending from the foot of the queen post to the opposite corner formed by the straining beam and queen post.

Mild steel roof trusses, suitable for relatively small spans, are illustrated in Figs. 47, 48, 49 and 50, Vol. II.

TEMPORARY TIMBERING

The use of timbers for the temporary support of trenches and newly constructed arches is dealt with in Vol. I. The following is an extended description of these two forms of construction.

TIMBERING OF EXCAVATIONS

Whilst this work is not carried out by carpenters, but by those actually engaged on the digging operations, it is convenient to include it here.

Reference should be made to the typical methods of supporting the sides of shallow trenches described on pp. 82 and 83, Vol. I. The various members there mentioned are also used for deep trenches. These include poling boards, walings, struts and sheeting.

The object of the timbering is, of course, to retain the sides of the excavations and thereby (*a*) provide safe conditions for the men engaged upon the digging operations and the subsequent construction of the drains, foundations, walls, etc., and (*b*) prevent damage occurring to adjacent buildings, road surfaces, and drain, gas, water, etc., pipes.

Several methods of timbering employed for comparatively deep trenches are illustrated in Fig. 19. *These are typical only*. The sizes and disposition of the members are subject to considerable variation, according to the nature of the soil, the earth pressure to be resisted, the time occupied between the commencement of the work and the filling in of the excavations, and the stock of timber which is readily available.

As mentioned in Vol. I, there are many kinds of soils, varying from a sound rock in a cutting through which no timbering is required, to silt or mud in which excavations can only be made with difficulty and after close boarding or the equivalent has been provided. Extreme conditions may exist on one site, and therefore a common system of timbering cannot always be adopted throughout.

Earth pressures are also variable. Thus, a dense clay when subjected to heavy rain may expand and exert a considerable pressure on the struts in a newly timbered excavation, but the same soil may shrink in dry weather to such an extent as to cause the timbering to collapse if precautions—such as the tightening of the struts—are not taken. In most soils the pressure does not increase with the depth of the excavation, and therefore in a deep cutting in soil which is the same throughout, the size and spacing of the timbers at the bottom need only be the same as those provided near the surface.

Trenches which are to remain open for a long time usually require more poling boards and larger walings and struts than those cuttings which are to be refilled quickly. The less the distance apart of the struts, the smaller the sizes of the walings and struts required.

The timbers are roughly sawn, and the following are commonly used: Spruce for poling boards and runners (see p. 58); pitch pine or Douglas fir for large squared members such as walings, struts and props; larch for circular struts and props; and beech or pitch pine for wedges.

Trenches in Moderately Firm Ground (see A, B and C, Fig. 19).—The section at B is that of a trench in which a drain is to be constructed and shows approximately 4-ft. depth of loamy soil or dry chalk, which does not require close or heavy timbering, overlying a bed of loose gravel which needs to be timbered more closely.