CHAPTER FOUR

MILD STEEL ROOF TRUSSES

Syllabus.—Mild steel roof trusses up to 40-ft.[1] span, with alternative details.

MILD steel [2] is much stronger than timber, it is more fire-resisting and its sections can be readily assembled to form comparatively simple connections. It is principally for these reasons that mild steel is now employed extensively for roof trusses of small and medium spans and for its supersedence of wood as a material for trusses of large span.[3] Whilst wood is still preferred to steel for trusses of open (unceiled) roofs of certain buildings, well-designed steel trusses for large spanned open roofs of buildings of the industrial, etc., type have a light and satisfactory appearance, chiefly because of the small size of the members and the simple joints. Mild steel roof trusses must be painted at intervals to prevent corrosion.

A steel roof truss, like a wood king post roof truss (see p. 76, Vol. I), is a triangulated structure. The principal rafters (abbreviated to " rafters ") are prevented from spreading by connecting their lower ends by a tie (*main tie*), and struts and subsidiary ties are provided at intermediate points to afford adequate bracing. Struts should be kept as short as possible. The centre line principle is adopted throughout (see p. 122), and thus the point of attachment of each purlin coincides with the intersection of the axes of the truss members. Secondary stresses, such as bending moments in the rafters, are thereby avoided.

All of the members of a modern metal roof truss are of mild steel, and most, if not all, of them are angles (see D and E, Fig. 77, Vol. I). Angles effectively resist both compression and tension stresses; they can be conveniently attached and they are produced economically. Thus, whereas formerly T-bars were used for rafters, either a single angle or two angles placed back to back are now employed. Struts consist of either single or double angles, and either one or two angles placed back to back are used for a main tie. Until comparatively recently, it was a common practice to use single or double flat bars for a main tie, as they were suitable for resisting tension stresses. However, owing to wind pressure and the abnormal strain imposed during the transporting and erection of trusses, members may be subjected to changes of stresses, and flats will not resist compression. *Flat main ties therefore tend to become buckled.* If a ceiling is to be provided, ceiling joists can be readily fixed to a main tie of double angles (see F, Fig. 49), and this is an additional reason why they should be used instead of flats, which latter are useless for this purpose unless metallic lathing instead of wood laths is employed. Flat bars are still used, but less frequently than formerly, for subsidiary tie members (see Fig. 50); angles are preferred.

The members of a truss are connected together by means of rivets or bolts [1] and thin plates, called *gussets*.

The *pitch* of rivets is the distance between their centres. According to the British Standard Specification for " The Use of Structural Steel in Building," No. 449—1937, (*a*) the minimum pitch shall be not less than three times the diameter of the rivets, (*b*) the maximum pitch is 6-in. for compression members and 8-in. for tension members, and (*c*) the minimum distance from the centre of any rivet or bolt to the end of a member or edge of a gusset shall be $1\frac{1}{8}$-in. and $1\frac{1}{4}$-in. for $\frac{5}{8}$-in. and $\frac{3}{4}$-in. diameter rivets respectively. The size of the rivets and bolts depends upon that of the members to be connected, thus $\frac{5}{8}$-in. diameter rivets are commonly employed for angles and flats up to $2\frac{1}{2}$-in. wide and $\frac{3}{4}$-in. diameter rivets and bolts for larger members. When riveting is employed, a member, even if subjected to a small stress, should be connected to a gusset by at least two rivets. Riveting can thereby be facilitated by the placing of a temporary bolt in the second hole, which is subsequently replaced by a rivet. Further, if one of the rivets is defective the second prevents failure of the joint.

The thickness of gussets theoretically depends upon the bearing value of the rivets employed. The minimum thickness is $\frac{1}{4}$-in. and these have been used for the small truss detailed in Fig. 47; $\frac{5}{16}$-in. gussets are used for roofs of larger span up to at least 40-ft. and the thickness rarely exceeds $\frac{3}{8}$-in. even for very large trusses. The size and shape vary according to the pitch of the rivets,

[1] In many syllabuses the span is limited to 30-ft.

[2] The manufacture and characteristics of mild steel and other metals are described in Vol. IV.

[3] An exception is the bow-string or similar laminated wood type of truss which is still occasionally adopted for large spans.

[1] Welding, as an alternative to riveting and bolting, is a comparatively recent development. Gussets are dispensed with and the members, all angles, are welded together. Thus, referring to the detail at T, Fig. 50, the ties and strut would be connected directly on to the rafter by means of *fillet welds*. An electric current or gas (an oxy-acetylene flame) is employed to melt a steel rod or wire (called an *electrode*) and the adjacent edges of the members in such a manner that the molten metal from the electrode is deposited along the points of contact and fused into them.