If mild steel beams were employed instead of wood binders, the size would be 9-in. by 4-in. by 21-lb. B.S.B. (British Standard Beam). This size is obtained as follows: $M = fZ$. $f$ (for mild steel) = 8 tons per sq. in. Adopting the same M as determined on p. 32, *i.e.*, 284,580-in.-lb. = 127-in.-tons.

Therefore, $127 = 8Z$; hence $Z = \frac{127}{8} = 15{\cdot}88$-in.units.

Structural Steelwork Handbooks are available which contain tables giving data of beams and other sections. Such data include the safe loads which steel beams can support for given spans, moduli of section, etc. Reference to such a book shows that a 9-in. by 4-in. by 21-lb. B.S.B. (which has a Z of 18·03-in. units) will safely support a distributed load of 5·3-tons for a span of 18-ft. This section has been adopted and is shown at M, Fig. 7.

The section at M shows the steel binder with the bridging joists notched at its upper flange and supported on 2-in. by 2-in. bearers which are secured to the web of the binder by ⅝-in. diameter bolts at 2-ft. 6-in. centres. In this detail, unlike that at E, the bridging joists are lathed and plastered, and the binder is suitably finished by *firring* (or *cradling*), lathing and plastering. Firring consists of two vertical 1 or 1¼-in. thick pieces of wood nailed to the sides of each pair of timber joists, and a similar firring fixed to the ends of the vertical members. The plasterers' laths are nailed to this cradling (see S, which shows somewhat similar cradling to a steel girder).

Framed or Triple Floors.—As implied, a triple floor consists of three sets of joists, *i.e.*, bridging joists, binders and girders. In the past the binders and girders were of wood and the former were framed or tenoned to the latter. Girders are now made of steel, and, as already mentioned, this material has to a large extent replaced wood for binders. A framed floor may be adopted when the narrowest span exceeds 24-ft. and the superimposed (live) load is relatively heavy.

Plan, sections and details of a framed floor are shown at J, K, L, N, O, P, Q, R and S, Fig. 7. The plan shows a portion of a large room, the width of which is 25-ft. Steel girders span the room at 10-ft. centres. These support two wood binders at one-third points (8-ft. 4-in. centres), and the latter carry the bridging joists and ceiling joists. The details at P and Q show the binders notched over the top flange of the girder and supported on 3½-in. by 3-in. by ⅜-in. mild steel angles secured to the web of the girder by ¾-in. diameter rivets at 15-in. centres. These angles also support the 3-in. by 2-in. bearers to which the cradling is nailed. Attached brick piers are formed on the 9-in. thick inner leaf of each of the long 16-in. cavity walls to provide adequate supports for the concentrated loads transmitted by the steel girders which are bedded upon hard stone pads. This construction and the steelwork are more clearly shown in the sketch at R. The sketch at S shows the cradling and other details, the former consisting of 2-in. by 1¼-in. firrings at 15-in. centres as fixings for the laths (and plaster).

The details of the binders, bridging joists and ceiling joists are similar to those of the double floor. Each 11-in. by 6-in. wood binder may consist of two 11-in. by 3-in. joists bolted together as shown at B and C, Fig. 8, the double row of bolts being staggered; the use of such stock sizes may be preferred if the larger single members are not readily available. If desired, the binders may be lowered and supported by wood bearers bolted to the steel girder; the detail at Q would then resemble that at M or, alternatively, as shown at F, Fig. 8.

The plastered ceiling may be attached direct to the bridging joists, and the binders may then be dealt with as suggested in some of the details in Fig. 8.

If steel is used instead of wood for the binders, it can be shown by calculation (see p. 35) that the size of the steel binders need only be 5-in. by 4½-in. by 20-lb. B.S.B. The use of steel would greatly simplify the details, as the 6-in. by 3-in. bridging joists would just be notched at both flanges of each steel binder, and a flush ceiling would result by simply nailing the laths direct to the joists. If the bridging joists are cut carefully and fitted tightly between the webs of the binders, no other fixing need be provided for the former.

*The advantages of steel over wood for girders will be appreciated when a comparison between the sizes of wood and steel members is made. Thus, a graded timber girder required to support the same load as that taken by the 15-in. by 5-in. by 42-lb. B.S.B. would have to be approximately 20-in. by 12 in. or equivalent, and its weight would be at least half a ton.*

The sizes of the various members of the framed floor illustrated in Fig. 7 were determined in the following manner (see also p. 32).

Bridging Joist C′.

1. *Weight.*—Assume the superimposed load is 100-lb. per sq. ft. Weight of 1⅛-in. boards = 3-lb. per sq. ft. (see p. 32). Bridging joists are at 15-in. centres, hence 1-lin. ft. of joist supports $\frac{15}{12}$ ft. × 1-ft. = $\frac{5}{4}$ sq. ft. of floor. To obtain its approximate weight, *assume* the size of joists to be 6-in. by 3-in. Hence its weight $= \frac{6}{12} \times \frac{3}{12} \times 1 \times 30$-lb. = 3·7-lb. (approx.) per lin. ft., and the proportionate weight of joist per sq. ft. of floor $= 3{\cdot}7 \div \frac{5}{4} = 3$-lb. Total dead weight = 3 + 3 = 6-lb. per sq. ft. Total load = superimposed load + dead weight = 100 + 6 = 106-lb. per sq. ft. Portion of floor supported by joist C′ is *jklm* (see broken lines), and its area $= \frac{5}{4}$ ft. × 8⅓-ft. $= \frac{125}{12}$ sq. ft. Therefore, W = area × load per sq. ft. $= \frac{125}{12} \times 106 = 1{,}100$-lb. (approx.).

2. *Bending Moment.*

$$M = \frac{WL}{8} = \frac{1{,}100 \times 8\frac{1}{3} \times 12}{8} = 13{,}750\text{-in.lb.}$$

3. *Sizes.*

$$M = MR = fZ = f\frac{bd^2}{6}.$$

Assume the timber is ungraded, with $f = 800$-lb. per sq. in. (see p. 32) and that $b = 3$-in.

Hence,

$$13{,}750 = 800 \times \frac{3d^2}{6}.$$

$$d = \sqrt{\frac{13{,}750}{400}} = 5{\cdot}9\text{-in., say 6-in.}$$

The size of the bridging joists shown at J, Fig. 7, is 6-in. × 3-in.