According to the Model Bye-laws, 1937, the minimum area of a window or windows shall be one-tenth of the floor area of the room, and at least half of this area shall be made to open for ventilation. Actually, the window area is frequently at least equal to one-quarter the floor area and most, if not all, of the sashes are made to open.

Those windows which are to receive extended treatment here are (*a*) solid frames with vertically hung sashes which open outwards, and (*b*) cased frames with vertical sliding sashes.

(*a*) WINDOWS WITH SOLID FRAMES AND VERTICALLY HUNG SASHES OPENING OUTWARDS (see Figs. 56, 57, 58 and 59).—Sashes which are made to open like a door are called *casements*, and the window is usually specified as a *casement window*. It is adopted extensively.[1]

FRAME.—If the window has only one sash (see A, Fig. 56), the frame consists of two vertical posts, stiles or *jambs*, a head and a wood sill. If it has two sashes (see B, Fig. 56), the additional vertical member is called a *mullion*. If the frame has a horizontal dividing member (called a *transome*) in addition to mullions, the appearance resembles that shown in Fig. 22, except that the members are of wood instead of stone.

Details A, B and C, Fig. 58, show typical joints of a window frame. Note that the jamb is haunched tenoned at each end and the head and sill are morticed to receive the tenons and wedges. The outer shoulder of the lower end of the jamb is scribed to the sill (see B and Section EE at C). These joints are sometimes pinned as described for door frames. The frames may be fixed as described on p. 87, the horns being removed if the frames are fixed after the walling has been completed. The bedding and pointing of the frames must receive special attention if they are not to be built in recesses. The head and jambs are rebated, $\frac{1}{2}$ to $\frac{5}{8}$-in. deep, to receive the sash. The inside edge of the frame may be square, pencil rounded, chamfered, ovolo-moulded, etc., as shown. The capillary grooves are referred to on p. 111.

The sill is sunk-weathered to cast off rain-water. Special attention must be paid to the bed joint between the wood sill and the stone or brick sill, as it is particularly vulnerable. Precautions taken to prevent the access of rain at this point include (*a*) the provision of a metal *water bar*, (*b*) lead tucked into a groove formed in the sill and continued as a covering to the brick sill, and (*c*) a mortar tongue formed in the groove of the sill. With reference to :

(*a*), A groove is formed in the brick sill (see Q, Fig. 60) or stone sill (see L and O, Fig. 25, and Detail T, Fig. 56) and the 1-in. by $\frac{1}{4}$-in. galvanized wrought iron water (or " weather ") bar, which is the full length of the sill, is partially inserted and bedded in cement mortar. The groove in the wood sill is filled with a mixture of white lead ground in linseed oil and the frame is firmly bedded on the mortar spread to receive it with the projecting bar engaging in the groove.

(*b*), The brick sill is covered with lead (weighing 4 or 5-lb. per sq. ft.) which has been *bossed* (shaped) by the plumber and the frame is carefully placed in position with the upturned portion of the lead fitting into the groove of the wood sill (see D and E, Figs. 58 and 59) ; the efficiency of this joint is increased if white lead mastic is spread along the edge of the lead before the frame is fitted. The lead projects $\frac{1}{2}$-in. beyond the face of the wall and the outer edge is turned under to give a double thickness which adds to its appearance, increases its stiffness and makes it more effective in throwing the water clear of the face of the wall.[1] A water bar, as described above, is sometimes used in addition to the lead, the upturned edge of the lead being dressed over the upper edge of the bar.

(*c*), This is adopted in cheap work and is not a reliable method (see O, Fig. 56) ; the groove may be rounded (see A and B, Fig. 16).

In a mullioned and transomed window the transome is the continuous member and is tenoned into the jambs ; the upper and lower mullions are tenoned into the head and transome and the sill and transome respectively.

Scantlings of Frame.—Heads, jambs, mullions and transomes are generally either 4-in. by $2\frac{1}{2}$-in., 4-in. by 3-in. or $4\frac{1}{2}$-in. by 3-in. ; sills vary from 4-in. by $2\frac{1}{2}$-in., 4-in. by 3-in., $4\frac{1}{2}$-in. by 3-in., $4\frac{1}{2}$-in. by $3\frac{1}{2}$-in., 5-in. by 3-in. and 7-in. by 3-in. These sizes may be exceeded for large frames.

For ordinary good-class work it is usual to specify redwood for the head, jambs, mullions and transomes, and either oak, teak or pitch pine for the sill ; for first-class work the whole of the frame may be specified to be in oak or teak.

SASHES.—The members of a sash or casement are similar to those of a door, *i.e.*, two vertical stiles, a top rail and a bottom rail. In addition, a sash may be divided by both horizontal and vertical bars or horizontal bars only. These are called *glazing bars* or *sash bars* or *astragals*.

The construction of the sashes is illustrated at H, J and K, Fig. 58, which show the top and bottom rails tenoned and wedged to the stiles. The projecting ends of the tenons and wedges are of course removed before the sash is fixed.

The joints between glazing bars are shown at M and N, Fig. 58. The *scribed joint* at M shows the horizontal bar to be continuous and morticed to receive the tenons formed on the ends of the vertical bars. The chamfered mould on the latter is scribed to the moulding on the horizontal bar. This is the commonest form of joint. The *franked joint* at N shows the continuous horizontal bar morticed to receive the halved and haunched tenons worked on the vertical bars. Another satisfactory method of jointing glazing bars is *halving* and this is shown at M, Fig. 61. All of these joints are glued immediately before assembly.

In both the scribed and franked joints the continuous bars may be either horizontal or vertical, depending upon circumstances. For casements, greater stiffness to the sash is obtained if the short horizontal bars are made continuous and the lengths of vertical members tenoned into them ; for vertical sliding sashes (see later) it is customary to make the vertical bars continuous ; in the halved joint both horizontal and vertical bars are continuous.

[1] Windows consisting of mild steel frames and casements (sometimes glazed with " leaded lights ") are very popular. These are detailed in **Chapter Two, Vol. III.**

[1] If the frame is set back to form a $4\frac{1}{2}$-in. outer reveal, the increased width of lead should be secured by a *lead dowel* formed in the middle of the brick or stone sill (see p. 150).