Linings from 4 to 6 inches in width, and from three-fourths of an inch to an inch in thickness, are nailed on to the edges of the pulley pieces, and to the sill and head above and below, inside and outside, in the direction of the breadth of the sash frame, and are returned along the head in the direction of its length. The outside linings are made to extend within the pulley pieces about half an inch, to form a stop for the upper and outer sash; and the inside linings are made exactly flush with their inner faces. The casing is completed by fixing thin linings on the outer edges of the outside and inside linings, parallel to the pulley pieces, to prevent anything from impeding the weights. Thin slips called parting-beads are fitted tightly into the grooves previously noticed in the pulley pieces, but they are not fixed, as the upper sash can be put in or taken out only by the temporary removal of the parting-bead. An inner or stop bead is mitred round on the inside to complete the groove or channel for the lower sash; the stop-bead covers the edge of the inside linings on the sides and head, and is fixed by means of screws, which may be removed without violence when it is required to put in or take out the sashes. A hole covered with a movable piece large enough to allow the lead or iron weight to pass in and out, is made in each of the pulley pieces, so that the sashes may be hung after the frames are set, and to repair any accident that may occur to the hangings in after use (Plate XXVI. fig. 4). It may be remarked that sash frames require greater truth and precision from the workman than anything else in the joiners' work of a building; and unless the stuff employed be quite sound and perfectly seasoned all the workman's care will be thrown away.

Fitting of sashes.

Sashes, it may be remarked, are never fitted until these frames are immovably fixed, so that if there be any inaccuracy in the latter, the sashes are cut away or pieced out to make them fit; but, as they are intended to traverse, the fitting in that case can only apply to one particular position, and in every one but that there must be something wrong. Any incorrectness in the sash-frame, again, must throw the shutters and their back flaps out; indeed, the sash-frame, though apparently a secondary part of the arrangement, is that which affects all the rest beyond anything else. When sashes have been fitted, a plough groove, wide and deep enough to receive the sash-line, is made in the outer edges of the styles, for about two-thirds of their length, at their upper ends. They are then primed and glazed, and when the putty is sufficiently set the joiner hangs them. He is furnished with sash-line, which is made of the best flax well plaited together, tacks, and iron or lead weights, which are generally made cylindrical, with a ring at one end, to which the line may be attached. A sash is weighed, and two weights are selected which together amount to within a few ounces of a counterpoise. The line is then passed through the pulley, which was previously fixed in the pulley style; the end is knotted to a weight which is passed in at the hole left for the purpose; and at a sufficient distance, which a common degree of intelligence will readily determine, the line is cut off and the end tacked into the groove in the style of the sash. Other modes of attaching the sash-line to the sash are also used.

Of recent inventions connected with windows there are some for enabling the parting-beads to be taken out, or are dispensed with, so that sashes may be readily cleaned without the operator standing on the sill, a dangerous practice, and without the use of the glazier's horse, which tends to injure the inside painting. A contrivance for easily opening and closing sashes of large size by an arrangement of cords and pulleys, which likewise secure it when shut, is patented by Mr Meakin. Another, having counterbalancing rack slips for hanging sashes, dispenses with the use of sash lines, pulleys, and sash weights. An objection to this invention may be that both upper and lower sashes must be opened at the same time. There are other useful arrangements for opening windows, such as those used in the wards of hospitals, where the opening is divided into about four horizontal lights working on pivots, all opening to any required extent by a rack and pinion. A sash fastener with a second spring, which clips the projection on the lower sash when the fastening is closed, and another where the shape of the arm of the fastener is altered, both prevent the sash being opened from without by a knife, a common mode of forcing an entrance into buildings. Patent wrought windows, and patent wrought iron water-tight windows and frames suitable for churches, parsonage houses, &c., are readily obtainable.

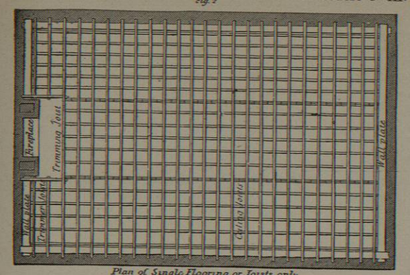
The fittings of a window which has boxed shutters consist of back linings, grounds, back elbows and soffit, together with shutters and back flaps, and architraves (or pilasters) round on the inside to form a moulded frame (figs. 1 and 4, Plate XXVI.) Back linings are generally framed with flush panels; they fit in between the inside lining of the sash frame and the framed ground, to both of which they are attached, and form the back of the boxing into which the shutters fall back. They are tongued into the inside lining by their inner edge, and on the outer edge the ground is nailed, and they are set at right angles to the sash-frame, or obtusely outwards, as the shutters may be splayed or not. The back is the continuation of the window fittings from the sash-sill to the floor on the inside; the elbows are its returns on both sides under the shutters, and the soffit is the piece of framing which extends from one side of the window to the other across the head, or from back lining to back lining. These are all framed to correspond with the shutters on the face; but, as they are fixed, their backs are left unwrought. Window shutters are framed in correspondence with the door and other framed work of the room to which they belong, in front, and generally with a flush panel behind; the back-flaps are in one or two separate breadths to each shutter, according to the width of the window and the depth of the recess; they are made lighter than the shutters themselves, and they should, when shut to, present faces exactly corresponding with those of the shutters, both internally and externally. The shutters are hung to the sash-frame with butt hinges, and the back flaps are hung to their outer styles with a hinge called a back-flap, from its use. The shutters and their back flaps are hung in one, two, or more heights, as may be found convenient. The moulded margin round the boxings of a window on the inner face are made to harmonize generally with the similar parts of the doors of the room or place to which it belongs. See other examples of shutters and their boxing in fig. 98. The fixing and hanging of window fittings or dressings are hardly less important, for the accuracy required, than the making and fixing of the sash-frame itself; the slightest infirmity or inaccuracy in any part will be likely to derange some essential operation.

Shutters

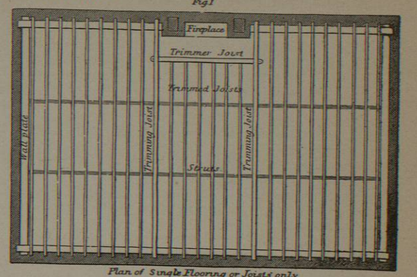
To this old manner of forming shutters must be added the rolling shutters of Clark, Bunnett, Francis, Snoxell, and others. These can be fixed either at the top, bottom, or side of the window as convenient, and are made of wood, steel, iron, or of wood and iron, many of them requiring machinery to raise and to lower them. The advantages consist in the small space occupied, the great security obtained, and the rapidity and ease in opening and shutting them. They are, however, apt to stick, and some are noisy, but one is called the "noiseless self-coiling revolving steel shutter." One variety consists in a sheet of well-tempered corrugated steel, which coils up on itself like a roll of paper; another is a self-acting wood revolving shutter, with hardened steel bands.

VOL. IV. BUILDING. PLATE XXV.

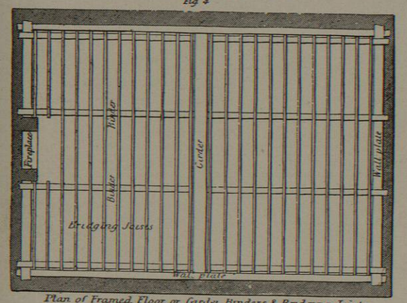
FLOORING AND PARTITIONS



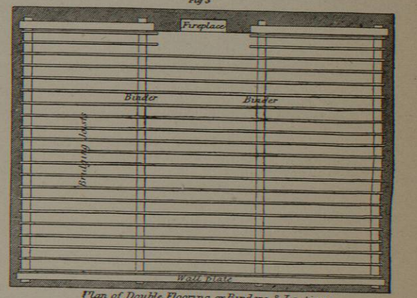
Plan of Single Flooring or Joists only



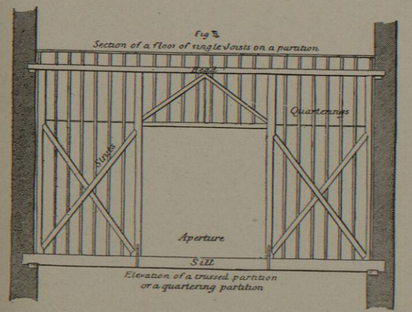
Plan of Single Flooring or Joists only



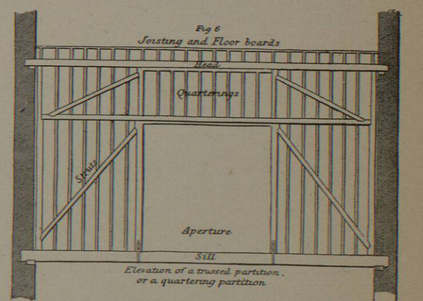
Plan of Framed Floor or Girder Binders & Bridging Joists



Plan of Double Flooring or Binders & Joistings



Elevation of a trussed partition or a quartering partition



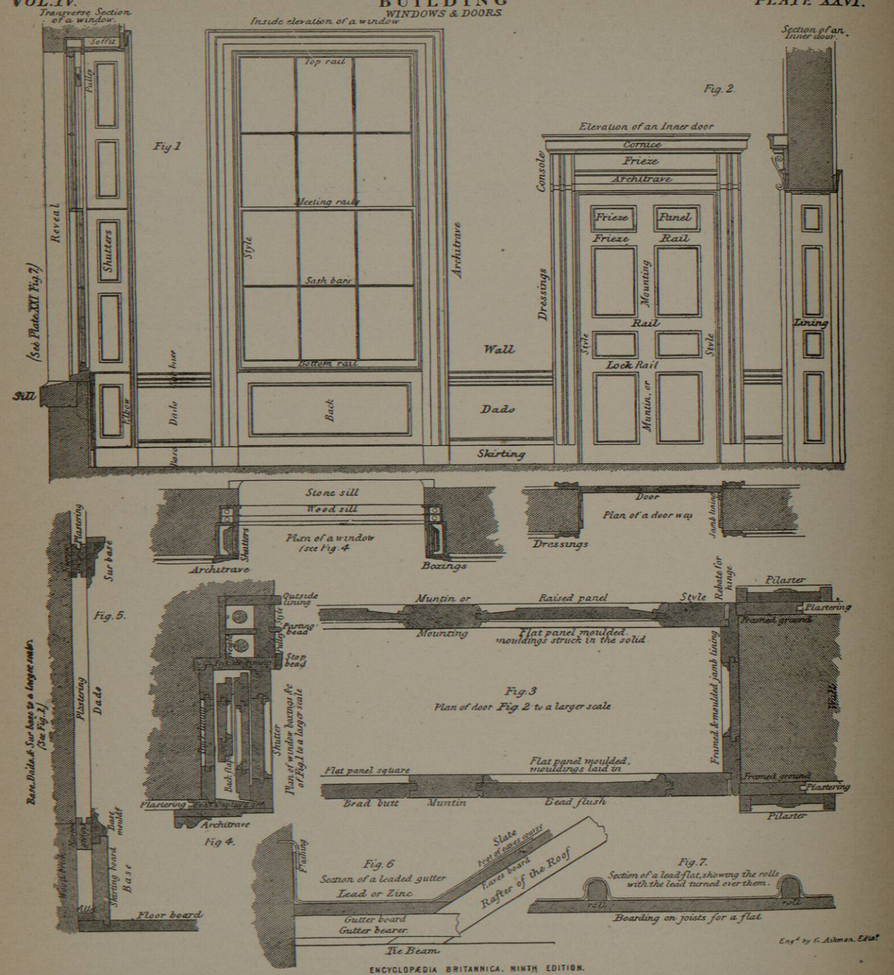
Elevation of a trussed partition or a quartering partition

Eng^d by C. Askew Edin.

ENCYCLOPÆDIA BRITANNICA NINTH EDITION

VOL. IV. BUILDING PLATE XXVI.

WINDOWS & DOORS



Engd by C. Aikman. Edint

ENCYCLOPÆDIA BRITANNICA. NINTH EDITION.

The construction of stairs is generally considered the highest department of the art of joinery. The principal object to be attended to is that the stairs should afford a safe and easy communication between floors at different levels. The strength of a stair ought to be apparent as well as real, in order that those who ascend it may feel conscious of safety. To make the communication safe, it should be guarded by a railing of proper height and strength; in order that it may be easy, the rise and width (or tread) of the steps should be regular and justly proportioned to each other, with convenient landings; there should be no winding steps, and the top of the rail should be of a convenient height for the hand. The first person that attempted to fix the relation between the height and width of a step, upon correct principles, was, we believe, Blondel, in his *Cours d'Architecture*. His formula is applicable to very large buildings, but not to ordinary dwellings. Mr Ashpitel, who investigated the subject at length, gives the following rules for buildings of seven different classes:—

Tread breadth in inches.	Rise height in inches.	Tread breadth in inches.	Rise height in inches.
12	5½	10	6½
11½	5¾	9½	6¾
11	6	9	7
10½	6¼		

These dimensions give angles of ascent varying from 24° to 37°. Of course the projection of the nosing is not reckoned.

Hawksley's patent treads for staircases to public thoroughfares are composed of iron frames, in which small blocks of wood, placed the end way of the grain, are so secured as to present to the foot a roughened surface. They appear to be durable, and to admit of easy renewal of the wood when worn or injured.

The forms of staircases are various, commencing with a straight flight, which should only be used to a low story. In towns, where space cannot be allowed for convenient forms, they are often made triangular, circular, or elliptical, with winding steps, or are made of a mixed form, with straight sides and circular ends. In large mansions, and in other situations where convenience and beauty are the chief objects of attention, winding steps are never introduced when it is possible to avoid them. Good stairs, therefore, require less geometrical skill than those of an inferior character. The best architectural effect is produced by rectangular staircases, with ornamented railing and newels. In Gothic structures scarcely any other kind can be adopted with propriety for a principal staircase. Modern architecture admits of greater latitude in this respect,—the end of the staircase being sometimes circular, and the hand-rail continued, beginning from either a scroll or a newel.

When a rectangular staircase has a continued rail, it is necessary that it should be curved so as to change gradually from a level to an inclined direction. This curvature is called the *ramp* of the rail. The plan of a staircase of this kind is represented by ABCD in fig. 101; and fig. 103 shows a section of it, supposing it to be cut through at $a\,b$, on the plan. The hand-rail is supposed to begin with a newel at the bottom, and the form of the cap of the newel ought to be determined so that it will mitre with the hand-rail. Let H in fig. 102 be the section of the hand-rail, and $a\,b$ the radius of the newel: then the form of the cap may be traced at

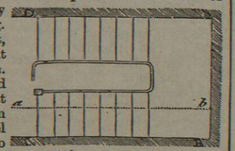


Fig. 101.—Plan of Rectangular Staircase.

C. The sections of hand-rails are of various shapes; some of the most common ones are too small; a hand-rail should never be less than would require a square of which the side is 2½ inches to circumscribe it. For the level landings of a staircase the height of the top of the hand-rail should never be more than about 40 inches, and in any part of the inclined rail the height of its upper side above the middle of the width of the step should be 40 inches, less the rise of one step when measured in a vertical direction. To describe the ramps, let $r\,s$ in fig. 103 be a vertical line drawn through the middle of the width of the step; set $r\,u$ equal to $r\,s$, and draw $u\,t$ at right angles with the back of the rail, cutting the horizontal line $s\,t$ in t; then from the point t, as a centre, describe the curve of the rail. When there is a contrary flexure, as in the case before us, the method of describing the lesser curve is the same.

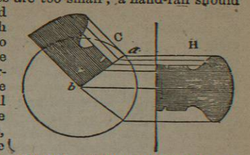


Fig. 102.—Section of Hand-Rail and Newel.

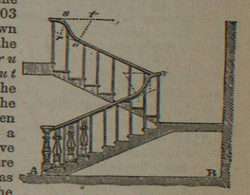


Fig. 103.—Section for Construction of Ramps.

The hand-rail of a stair generally begins with a scroll, and the first step of the stair is generally finished with what is called a curtail, a form corresponding closely to the scroll. There are a great variety of geometrical spirals; but as they all finish on a point, and as all architectural scrolls and volutes finish on a circle or eye, the usual mathematical scrolls are inapplicable. The earliest spiral adapted to architecture was that of De Lorme. Since his time several systems have been invented, particularly that of Goldmann; the best is that derived from the ionic volute (fig. 104).

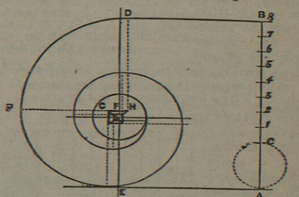


Fig. 104

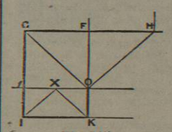


Fig. 105.

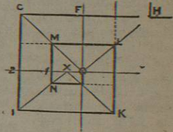


Fig. 106.

Figs. 104 to 106 illustrate the construction of the Ionic Volute.

The height, eye, and number of revolutions of the