Width of tread Height of rise

in inches. in inches.

12 51/2

111/2 53/4

11 6

101/2 61/4

10 61/2

91/2 63/4

9 7

These dimensions give angles of ascent varying from 24° to 37°. The projection of the nosings is not reckoned in the width of the treads and must be added to determine the full width of the treads. It will be seen upon examination that these proportions may be expressed in the following simple formula: 23 = twice the rise in inches + the tread in inches. An American rule is to make the sum of the rise and tread equal to 17 or 171/2 in.

The forms of staircases are various, the simplest being a straight flight, which type should only be used to a low storey. In towns, where space cannot be allowed for convenient forms, they are often made angular, circular or elliptical, with winding steps, or are constructed of composite form partly straight and partly circular. In large buildings, where convenience and beauty are the chief objects of attention, winding steps are seldom introduced when it is possible to avoid them. Well-designed stairs should be planned as simply as possible to afford easy and convenient access to the higher level. The staircase must be placed in a position easy of approach, and convenient for both the lower and upper apartments. It must be well ventilated and lighted—the absence of sufficient light may prove the cause of serious accidents. At no part should the head room (that is, the height between the level of a tread and that portion of the structure immediately above it) be less than 7 ft. Straight flights should be composed of not less than four and not more than twelve steps. If it is desired to continue more than this number of steps in a straight line, a landing equal in length at least to the width of the stairs should be provided before starting up the next flight. Winders should be avoided if possible, but should they be found necessary it is advisable to put them at the bottom of a flight rather than at the top, the reason being that should they be the cause of an accident the unfortunate individual will not have far to fall.

Besides the straight flight of stairs, stairs may be designed in almost numberless different ways to suit the position which they arc to occupy or with a view to architectural effect, but whatever position or form they arc made to take their chief purpose of provid­ing convenient and easy access to a higher level must be steadily borne in mind. Some of the most ordinary forms from which staircases of a more ambitious character are elaborated are the or *newel* stair, *open newel* stair, *geometrical* stair, *circular newel* stairs (see fig. 1).

The *newel* or *dog-legged* stair is so termed from its supposed resemblance to a dog’s hind leg. In this form the staircase is divided in width into two equal parts and the outer string of the upper return of the stairs rises in a vertical plane immediately above that of the lower flight. There is therefore no well-hole in this form of construction (see fig. 4, plan and section).

*Open newel* stairs, as in the previous example, have newels placed at the angles, but arc so arranged as to enclose a well. This is more convenient for the distribution of light than the dog-legged stairs, especially when the lighting is effected by means of a lantern sky­light placed at the top of the staircase.

*Geometrical stairs* usually enclose a well, which may vary very much in size and shape from merely a narrow slit between the flights to a square opening admitting of ample ventilation and lighting. This form has continuous strings and handrail, and may be rectangu­lar, circular or elliptical in plan, although it is especially adapted for the curved forms and most satisfactory when so treated. Such stairs are more difficult to construct than the newel stairs already mentioned and lack their strength, as in the absence of the strong framed newel posts the handrail depends for support entirely upon the balusters, which must therefore be very securely fastened to the treads. When wood balusters for the most part are used bars of iron are often introduced at intervals to afford additional stiffness. *Circular geometrical* stairs are built on a circular plan around a well. Each step is necessarily a *winder* radiating from the *outer string* to the *wall string.* If in wood they must be very carefully framed, especially if the well-hole is small, owing to the difficulty of intro­ducing proper carriages for support, and the number of pieces of which the work must be built up on account of its curvature. This type of stairs is more suitable for building in stone, and in this case support is obtained by pinning the end of the stone step well into the wall and supporting each step upon the one below. The balusters and handrail also, in the case of stone, are much more firmly fixed by the former, which are usually of iron, being let into mortices in the tread or end of the step and run in with molten lead and caulked to secure a firm fixing.

*Solid newel* or *spiral* stairs are circular or polygonal on plan and built around a central pillar or newel, which may be square, poly­gonal or circular in section. This also is a form of stair-building especially suitable for erection in stone, the central newel being formed on the step itself, and the other end well pinned into the masonry of the wall. Each succeeding step should be dowelled at the newel to the one below and should lap for a matter of two or three inches at least for its entire length over the one below and in this way obtain extra support.

The newel stair was at its best in Elizabethan and later Renais­sance times. The older form of staircase with circular newel and narrow winding steps was found ill adapted to the altered conditions when convenience and elcgance were becoming more sought after. the designers of this period found in the open newel stair a construc­tion capable of being developed into a dignified and beautiful feature of domestic architecture, and they certainly brought out its possibilities in a remarkable manner. This is evidenced by the many fine examples, handed down to us by the architects of the Tudor period, to be found in the great mansions which date back to the time of the early Renaissance. Steps were arranged in broad short flights with wide treads and easy rise. Landings were freely used, and in many cases were large enough to be used as galleries for the display of pictures. The work was generally solidly executed in oak, and carved and moulded decoration was lavished upon every detail. The newels, much enriched, were frequently carried up to the ceiling and formed a portion of the arcading which was often a prominent feature around the well. In the period of the later Renaissance the newel principle of construction was still retained and the main features were the same, but they were planned with longer flights and the manner of decoration partook of a more severely classic nature. One of the first examples is that of the Château de Blois, and of modern treatment that of the Grand Opera House, Paris. In the period of the Georgian era the geometrical staircase was much favoured and very generally used in domestic buildings. Although more difficult to build it must be admitted that this type of stair is. not so satisfactory in a number of ways as the newel form. With its continuous curving strings and handrail it has a certain elegance of its own, but in principle of construction it is not so good, nor can it compete with the open newel stair in regard to the ease with which the latter lends itself to schemes of artistic decoration. As before remarked, however, it is well adapted for stairs circular and elliptical in plan.

Experience has proved concrete to have fire-resisting properties of the most effective character, and it does not possess the propensi­ties for splitting and flying under the action of heat that belong to stone. Steel or iron is often employed as an additional support for stone and concrete stairs. In the case of concrete work iron bars are fre­quently embedded in the steps for their full length, and are in this way hidden from sight while at the same time serving the pur­poses of support. When a more ornate appearance is desired than is obtained by the use of plain concrete the steps may be encased in other material to secure a richer effect. Marbles, tiles and mosaic are the principal materials used for this