Columns are generally built of riveted work of zedbars, channels, angles, plates, or lattice, of such form as will make the simplest and most easily constructed framing in the particular position in which the column is placed. The columns are sometimes run through two or more storeys and arranged to break joints at the different floors. In buildings to be used as offices, hotels, apartments, &c., it is usual in establishing the loads for the purpose of computation to assume that the columns carrying the roof and the upper storey will be called upon to sustain the full dead load due to material and the maximum computed variable load, but it is customary to reduce the variable loads at the rate of about 5% storey by storey towards the base, until a minimum of about 20% of the entire variable load is reached, for it is evidently impossible that the building can be loaded by a densely-packed moving crowd in all of its storeys simultaneously. In the case of factories and buildings used for storage purposes the maximum variable load which can be imposed for any serious length of time on each floor must be used without reduc­tion in computing the loads of the lower column, and proper allowances must be made for vibrating loads. In the case of very tall exposed buildings of small depth, the vertical load on the columns due to wind pressure in the opposite side of the building must be computed and allowed for, and in case the lower columns are without lateral support their bending moment must be sufficient to resist the lateral pressure due to wind and eccentricity of loading. In computing the column sections a proper allowance must be made for any eccentricity of loading. It is usual to limit the height of sections of columns without lateral support to 30 diameters, and to limit the maximum fibre stress to 12,000 lb per sq. in. The sectional areas are com­puted by the use of the ordinary formulae for columns and struts.

The standard sections in use are numerous and varied, and from time to time a steel user has occasion to design a new steel shape because no existing section is suitable. The experi­ments given by Professor Burr indicate that a closed column is stronger than an open one, but practice does not always sup­port theory, and many other questions besides mere form arise in connexion with the choice of a section; special considerations in the use of columns in buildings sometimes call for a form very different from the circular section, and such include the transfer of loads to the centre of the section, the maximum efficiency under loading, and the requirements for pipe space around or included in the column form. Lattice bars, fillers, brackets, &c., add just so much more weight without increasing the section, and must be allowed for; the method of riveting the sections together must also be taken into account.

For girders of small spans “ I ” beams or channels are generally used, but for greater spans girders are built of riveted work in the form of boxes with top and bottom plates, side plates, and angles with proper stiffening bars on the side plates, or “I's," or lattice, or other forms of truss work. In girders and beams the maximum fibre stress is usually limited to 16,000 lb. In very short girders the shear must be computed, and in long girders the deflexion, particularly the flexure from the variable load, since a flexure of more than 1/500 of the length is liable to crack the plastering of the ceilings carried by the girders. The same necessity for computing shear and flexure applies to the floor beams. The floors between the girders are constructed of “ I” beams, spaced generally about 5 ft. between centres; their ends are usually framed to fit the form of the girders, and rest either upon their lower flanges, or upon seats formed of angles riveted to their webs, being secured to them by a pair of angles at each end of the beam riveted to its web and to the web of the girder. Some­times the beams rest upon the girders, and are riveted through the flanges to it; in this case the abutting ends of beams are spliced by scarf plates placed on each side of the webs and secured by rivets. A similar construction is followed for flat roofs, the grades being generally formed in the girder and beam construction, and a flat ceiling secured by hanging from them, with steel straps, a light tier of ceiling beams. The floor beams are tied laterally by rods in continuous lines placed at or above their neutral axis. It is usual in both girders and beams to provide not only for the safe support of the greatest possible distributed load, but for the greatest weight, such as that of a safe or other heavy piece of furniture which may be moved over the floor at its weakest points, the centres of the girders and beams. It must always be borne in mind that the formulae for the ultimate strength of the “ I ” beams only hold good when the upper chord or flange is supported laterally.

Considerable improvement has been made in the design of rolled steel shapes; for example the rolling of a 16-in. joist was formerly deemed a remarkable achievement, though now there are several works producing 24-in. joists with flanges 7 and 7⅜ in. wide. The Broad Flange Differdange Beams are claimed by the manufacturers to be stronger and to minimize weight for use as girders; they are made in twenty-one different sizes with flanges from 85/8 to 12 in. wide.

The introduction of steel construction has simplified many details of architectural treatment, such as projections for cornices, bay windows and galleries. These may be supported by bracket-angles attached to the columns with a system of anchors to tie them back; the material must be carried in such a manner as to make it independent of the general structure, and must be constructed as light as possible. If the supporting member is a floor beam or girder the girder should be rigidly connected to the floor system to prevent any twisting due to the weight of the projection.

The arrangement of the building and floor framings is in a great measure governed by the architectural effect sought and by the arrangement and proper planning of the interior according to the intended uses; the positions of columns, girders and floor beams are usually the result of particular requirements, and unless complicated and expensive framing is to be expected the distance between columns must be kept within the limits of simple girder construction. The position of the columns having been determined, the girders must next be located; these serve to support the floor beams which transfer the loads direct to the columns, and also to brace the columns during erection. The spacing, or distance from centre to centre of the floor beams, will depend upon the type of fire-proof flooring employed; it also depends to a considerable extent upon the amount and character of the floor load and the length of span. If the loads to be carried are largely stationary, and if the span is small, the floor joists can be readily propor­tioned by means of tables given in the handbooks issued by many steel companies. The distance between joists should be limited to 5 Or 6 ft.; horizontal bracing by means of diagonal rods is sometimes used, but should be avoided. The following are the usual assumptions made in good practice for super­imposed loads:—

Floors of dwellings and offices ... 70 lb per sq. ft.

„ ,, churches, theatres and ball-rooms 125 ,, ,, ,, ,,

,, ,, warehouses 200 to 250 ,, ,, ,, ,,

,, ,, for heavy machinery . . . 250 to 400 ,, ,, ,, ,,

The relation between the velocity of wind and the pressure exerted upon surfaces must be considered in steel construction, and designers differ in regard to the forces to be resisted and the material to be used. Every building offers its own peculiar condition; the height, width, shape and situation of the structure, and character of the enclosing walls, will determine the amount of wind pressure to be provided against, and the internal appearance and the plan­ning of the various floors will largely influence the manner in which the bracing is to be treated. There are many and varied forms of bracing, each designer adopting methods peculiar to his own ideas. One form consists of adjustable diagonals, rods or bars, properly fastened to the columns in the building; these diagonals may run through one floor and be attached to the columns at the floor above. Another form is known as portal bracing; this is usually braced between adjacent columns in halls or passage-ways and extends from the foundations up from floor to floor to such a height that the stability of the