building itself is sufficient to resist the assumed wind pressure. In general, if the building is square or nearly so wind-bracing should be placed close to the comers. In case neither of the above methods can be applied, brackets should be used at each floor level or a continuous deep beam or girder carried all around the building. Some architects depend solely upon partitions, and a building with a well-constructed iron frame should be safe if provided with brick partitions or if the exterior of the iron framework is covered with well-built masonry of sufficient thickness.

Truss rods, portals, or lattice or plate girders constitute the more definite types of wind-bracing ordinarily employed; the bracing must reach to some solid connexion at the ground. The greatest wind pressure to which a building is subjected is that from a horizontal wind. The maximum pressure is not uniform from the ground level to the roof but is greatest at the centre; it is diminished near the ground level by the frictional resistance of the ground, and at the eaves by the eddies formed by the air escaping over the roof. The change in direction of the air when striking a flat surface such as the side of a building will form a cushion to diminish the effects of impulses and shocks from local gusts.

The building laws of the city of New York require the following provisions as regards wind forces:—

“ All structures exposed to wind shall be designed to resist a horizontal wind pressure of thirty pounds for every square foot of surface thus exposed, from the ground to the top of the same, including roof, in any direction. In no case shall the overturning moment due to wind pressure exceed seventy-five per centum of the moment of stability of the structure. In all structures exposed to wind, if the resisting moments of the ordinary materials of construction, such as masonry, partitions, floors and connexions, are not sufficient to resist the moment of distortion due to wind pressure, taken in any direction on any part of the structure, ad­ditional bracing shall be introduced sufficient to make up the differ­ence in the moments. In calculations for wind pressures, the working stresses set forth in the code may be increased by fifty per centum. In buildings under one hundred feet in height, pro­vided the height does not exceed four times the average width of the base, the wind pressure may be disregarded.”

The steel used throughout the entire structure should be subjected to the most thorough chemical and mechanical tests and inspection, first at the mill and subsequently at the fabricating shops and the building, to ensure that it shall not contain more than 0∙08% of phosphorus or 0∙06% of sulphur, that it shall have an ultimate strength of between 60,000 and 70,000 lb per sq. in., with an elastic limit of not less than 35,000 lb per sq. in., and an elongation before fracture of not less than 25% in 8 in. of length, and that a piece of the material may be bent cold 180° over a mandril equal to the thickness of the piece tested without fracture of the fibres on the outside of the bend. At least two pieces are taken from each melt or blow at the mill, and are stamped or marked, and all the various sections rolled from the melt or blow are required to bear a similar stamp or mark for identifica­tion. All finished material is carefully examined to see that it possesses a smooth surface, and that it is free from cracks, seams and other defects, and that it is true to section throughout. Rivets are either of wrought iron or of extra soft steel, with an ultimate tensile strength of 55,000 lb per sq. in. The material must be sufficiently tough to bend cold 180° flat on itself without sign of fracture. The. greatest care is taken that no steel is left in a brittle condition by heating and cooling without proper annealing. All abutting joints in riveted work are faced to exact lengths and absolutely at right angles to the axis of the piece, and are spliced by scarf plates of proper dimensions adequately secured by rivets. The work should be so accurate that no packing pieces are necessary. If the conditions are such that a packing or filling piece must be used, the end of one piece is cut to a new and true surface, and the filling piece is planed to fill the space accurately. Where cast iron is used it must be of tough grey iron free from defects. In testing it pieces 14 in. long and 1 in. square are cast from each heat and supported on blunt knife edges spaced 12 in. apart; under a load in the centre of the piece of 2500 lb the deflexion must not exceed 3/16 in.

The filling between the girders and floor beams consists of segmental arches of brick, segmental or flat arches of porous (sawdust) terra-cotta, or hard-burned hollow terra­cotta voussoirs, or various patented forms of con­crete floors containing ties or supports of steel or iron. In all cases it is customary to fill on top of the arches with a strong Portland cement concrete to a uniform level, generally the top of the deepest beam; the floor filling is constructed and carried to this level immediately upon the completion of each tier of beams, for the purpose not only of stiffening the frame laterally, and of adding to its stability by the imposition of a static load, but also to afford constantly safe and strong working platforms at regular and convenient intervals for use throughout the entire period of the construction. In cases in which the lateral rigidity of the floors is depended upon to transfer the horizontal strains to the exterior walls which are framed to resist them, no form of floor construction should be used which is not laterally strong and rigid. With very rapid building, no method of construction of floors furrings, or partitions should be adopted which will not dry out with great speed. In flat forms of masonry floor construction the level of its bottom is placed somewhat below the bottom of the “ I ” beams and girders, so that when it is plastered a continuous surface of at least an inch of mortar will form a fire-proof protection for the lower flanges of the beams and girders. Where the width of the flange is considerable it is first covered with metal lath secured to the under side of the floor masonry. Girders projecting below the floor are usually encased in from 1 to 2 in. of fire­proof material, 2 or 4 in. of which is also put on all columns. Such fire-proof coverings, and also interior partitions, are com­posed of hollow, hard-burned terra-cotta blocks, of porous (sawdust) terra cotta, or various plastic compositions applied to metallic lath, many of which are patented both as to material and method of application. The most simple test for the value of a system of fire-proof coverings, and of partitions and furrings, is to erect a large sample of the work and to subject it alternately to the continued action of an intensely hot flame which is allowed to impinge upon it, and to a stream of cold water directed upon it from the ordinary service nozzle of a steam fire engine. It is important in all fire-proofing of columns and girders, and in all floor construction, furring and partitions, that there shall be no continuous voids, either vertical or horizontal, which may possibly serve as flues for the spread of heat or flame in case of fire. All furrings and partitions must be started on the solid masonry of the floors to prevent the possible passage of fire from the room in which it may occur. The failure to make this provision has been the cause of very serious losses in buildings which were supposed to be fire-proof.

Steel construction possesses great advantages in time required for erection. When once the site is cleared and the founda­tions prepared and set, work can be pushed on the walls at different storeys at one and the same time, and often main comices and filling-in work are fixed before special details and ornamentation. In the Commercial Cable Building, New York, seven complete tiers aggregating 7000 tons were erected in nine weeks. In the Unity Building, Chicago, of seventeen storeys, the metal frame-work from basement columns to finished roof was accomplished in nine weeks. In the Fisher Building, Chicago, the entire steel skeleton above the first floor, nineteen storeys and attic, was erected in twenty-six days.

Owing to the low price of steel it is possible to make a steel column of equivalent strength cheaper than one in cast iron. The question of cost is purely a commercial one, but the cost of the raw material will practically never determine the relative cost between various forms, as the expense of manufacture and the detail and duplication of members will all influence the ultimate cost to a much greater extent than the simple cost of the plain materials. The steelwork for a building of any considerable size is almost invariably rolled to order.