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WIND BRACING IN FRAMED BUILDINGS.

The use of steel and the introduction of what is known as the "skeleton" system in the construction of large buildings has introduced many structural problems which never troubled the head of the architect in the days of brick, stone, and mortar. Most of these problems have been met and successfully solved by the application of those scientific methods of which we see the most successful applications in the great railroad and highway bridges that have been built in such numbers during the present generation in this country. The strains in the skeleton frame of a modern twenty-story building are calculated with all the care and detail that is bestowed upon the design of a complicated cantilever bridge or the three hundred foot trusses that carry the roof of a terminal train-shed. The weight of each girder, beam, and post, of each wall, partition, and roof, of fittings, furniture, and the possible floor loads of each story are closely predetermined, and the exact distribution of these loads among the various lines of supporting columns is estimated with a wonderfully close approximation to the truth. Knowing the maximum strains that will be brought to bear upon each member of the skeleton, it is a simple matter to provide steel columns of the proper diameter and sectional area of metal to carry the load with a proper margin of safety.

There is one element in the design of skeleton steel buildings, however, which frequently receives too little, if any, attention. We refer to the necessity of providing against the tendency to distortion, or overturning by the wind.

There is no denying the fact that in the earlier tall buildings the provision for wind strains was practically omitted; what lateral stiffness the building did possess being imparted by the riveting of the floor system to the columns and by the inertia of the inclosing shell of masonry. Many of the later buildings are stiffened by connecting the columns at each floor by deep girders—plate girders being used in the lower stories, where the accumulated bending strains of the superincumbent structure have to be resisted, and lighter lattice girders being used on the floors above.

While many of the later and larger buildings are thus strengthened against the bending effects of the wind, there are others in which no such provision exists. This is especially true of the smaller ten and twelve story structures which are being run up by small contractors. The buildings are put up for purely speculative purposes, and every item of cost, including the fees of a skilled architect and engineer, is cut down to the lowest possible limit. One may go out almost any day in our larger cities and see flimsy structures in course of erection, in which the skeleton is entirely of cast iron, and the only protection against the iron work shutting up under the pressure of a gale of wind is the holding power of a few bolts and cast iron lugs and flanges.

In the old system of brick and stone construction the solid walls gave all the necessary stability. They resisted the tendency to overturning or rupture by their dead weight and their inherent transverse strength; but as soon as the skeleton system of construction came in, builders appear to have lost sight of the fact that some form of diagonal bracing was necessary to replace the natural rigidity of solid walls and partitions. Nor does the brick or stone shell with which modern buildings are inclosed give the necessary stiffness, for it is in reality only a system of thin paneling, as it were, built into and carried by the steel frame.

Another point to which too little attention is given in the erection of skeleton steelwork is the provision of adequate temporary bracing during erection. The steelwork is run up and temporarily bolted too far ahead of the riveting, and while the towering columns are safe against ordinary wind pressures, they would be in serious danger of collapse if a storm of unusual severity were to strike them. Timber struts, one-inch screw bolts, and slight guy ropes that are amply sufficient to maintain the towering pile in the perpendicular in still air or ordinary breezes, will splinter and shear and snap asunder the moment a summer tornado bears down upon it.

That these remarks do not apply merely to tall buildings is shown by the collapse last week of one of the great pier sheds which are being erected for the use of the Atlantic liners on the North River, New York city. In saying this we are mindful of the fact that the storm which wrecked the building was cyclonic in its fury and that the structure was being erected by one of the most experienced firms in this class of work in the country. The plans of the shed, which was a huge affair, some 700 or 800 feet long, by 120 feet broad, had been approved by the Dock Board, and they correspond very closely to those of the many large sheds which have lately been erected by the same firm of contractors for other steamship companies. There was no motive for cheap or careless work, and as far as we could judge on a brief inspection of the ruins, the disaster was due to a storm of extraordinary force acting upon a partially erected steel structure whose temporary and permanent stiffening and wind bracing did not prove sufficient for the emergency.

We shall hope to take up the matter again in an early issue, and give an illustrated and more lengthy description of the construction of the shed and the present state of the wreck.

THE BICYCLE FRAME.

Our editorial of August 27 on the increasing weight of the bicycle has brought several letters to this office which deal not so much with the main point of the article as with a concluding suggestion which was made regarding the introduction of a strut within the diamond frame. The paragraph referred to ran as follows:

"It is strange that no maker has succeeded in introducing a feature into the bicycle which is not only thoroughly scientific, but would undoubtedly strengthen it, and at the same time allow a certain reduction in its weight. We refer to the introduction of a cross tie or strut within the frame, running either from the joint at the seat post to the joint at the bottom of the head, or from the top of the head to the crank hanger. The introduction of such a member would make the frame what it is not at present—a truss. It would cause all the strains, whether of tension or compression, to act along the axis of each tube, and it would have the important result of relieving the tubes at the joints of all bending strains acting in the plane of the frame."

Our attention is drawn to two machines in which the frame is an actual truss, that have had the test of hard riding on the road and given good results. The first was built by Mr. W. H. Hale, of New Haven, and in addition to having a strut running from the seat cluster down to the bottom of the head tube, it is an articulated frame, the connections being made by eye and bolt instead of by brazing—the construction thus approximating to that of a pin-connected truss bridge. The pin connections were adopted with a view to providing a "knock-down" machine that would be convenient for transportation, and it will interest our readers to know that this machine may be packed in a box thirty-two inches long by twenty-eight inches wide and seven inches in depth. We must confess, however, that while, under certain circumstances, the snug packing of a wheel would be a great convenience, we would not favor the substitution of bolted for brazed connections. At the same time, we are assured by the designer that while he has built these machines with brazed frames, he greatly prefers the bolted or "sectional" type, because of the ease of straightening frames, replacing broken tubes, or doing the hundred-and-one repair jobs that come to hand.

The machine in question carries a strut from the seat post to the bottom of the head tube in preference to one from the top of the head tube to the crank-hanger, experiment having shown that the former strut gives the best results. As regards the important features of stiffness and weight, we are assured that both are satisfactory. The first machine, which weighed twenty-two pounds complete, has been ridden some twenty thousand miles during the past two years by riders who have weighed up to 220 pounds, and has stood the test without any signs of failure.

This, of course, does not prove that a diamond frame of the same weight and of the common type (that is, without any interior strut) would not stand the same usage; but the presumption is that it would not. In case of collision or running over a large obstacle in the road, the diamond frame as now built is subjected to very severe bending strains at the point where the reinforcement ends, and that buckling is likely to take place at this point many a rider has found to his cost. The introduction of a strut instantly removes these bending strains, and the whole effect of a collision is resolved into simple strains of compression and tension acting along the axis of the tubes.

The thin, large diameter tubing now in use is particularly weak in resisting bending strains and wonderfully strong for its weight in resisting compressive or tensile strains acting along its axis. A parallel illustration of this fact may be shown by rolling up a sheet of drawing paper into a cylinder, standing it on end, and loading it with weights. It will stand an axial pressure out of all proportion to its weight. But if the cylinder be held at its ends and subjected to a bending or transverse strain, it will collapse under a very small load.

The internal strut, however, cannot be used to any advantage in the very low frames that are just now the fad; but when the heads have been again lengthened to reasonable proportions (a change that is likely to be made sooner or later), the obvious stiffening effect of the strut should lead to its early introduction.

Another communication has been received from Mr. Charles E. Duryea, who draws attention to his triangular frame, which consists of a single triangle made up of the rear braces, the forks, and the head, the head and the rear braces meeting under the saddle to form the apex of the triangle. There are unquestionably several points of merit, structurally considered, in this design; but we think that it would be greatly stiffened if the bottom member of the triangle ran straight (instead of in a curve) from the rear hubs to the bottom of the head, and if a center vertical strut were introduced between the apex and the crank-axle bearing. Such a strut would relieve the bottom member of the vertical bending strains and the torsional strains due to the pressure on the cranks. At the same time we think that the best results could be obtained by returning to a reasonable length of head (say twenty-four or twenty-five inches) and introducing a strut into the present type of diamond frame. The diameter of the tubing should be somewhat reduced and its gage increased, although, with the strength imparted by the strut, we question if the present gage would not be found sufficient even with a smaller diameter of tubing.

THE WATER SUPPLY AT CAMP THOMAS.

We have received from Mr. P. A. Maignan, of Philadelphia, a copy of his report recently made to Gen. Breckenridge on the supply of potable water at Camp Thomas. Mr. Maignan was sent to Chickamauga by Gens. Sternberg and Ludington for the purpose of investigating the workings of the water filters at Camp Thomas, and as the report deals at considerable length with the nature of the soil, the drainage of the camp, the quality of the water, and the methods, both mechanical and chemical, by which the water is or may be purified, we shall publish it in full in the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

It appears that nearly the whole camp is located above a magnesian limestone. The surface water passes directly through sink holes and fissures into the small water-pockets struck by the so-called artesian wells. Hence it has no chance of filtering and purifying itself, and after a freshet the wells give turbid water. There is obvious danger in drinking this water from a bacterian point of view, and the report dwells upon the fact that this water, like that of most springs in limestone formation, being very "hard," not only fails to cook the food properly, but has an injurious effect upon nutrition.

The Medical Congress of Brussels, in 1886, passed the following resolution: "Waters that are too hard, or contain mineral matters that are not in the human organism, form with the chyle an abnormal medium for hematosis (formation of blood), and they fatigue the kidneys, whose duty it is to eliminate them unceasingly, and they incrust the articulations." The effect of hard water on digestion is shown by placing the white of an egg in two test tubes with about an equal quantity of bile taken from a freshly killed animal, agitating the mixture and adding to one test tube some distilled rain water or spring water that has been softened, and to the other tube some untreated spring water or hard well water. If the tubes be again agitated, the emulsion in the first case will be perfect and readily assimilate; being perfectly soluble, it will pass into the blood, and give strength. On shaking the second tube, the contents will coagulate. The report states that this hardness of the water has had a great deal to do with the emaciated state of those men who, without any bacterian disease, have lost twenty or thirty pounds in weight. The prevalence of lumbago and rheumatism is attributed to the same hardness of the water.

The first attempt to provide good potable water by the use of asbestos and porcelain filters was a failure, as the muddy condition of the water from the creeks quickly clogged up the filtering material and rendered them useless. The report states that by treating the water with a small amount of lime and iron a heavy precipitate is formed which agglomerates and carries down the finely suspended clay, and that this treatment supplemented by filtration would have provided an excellent drinking water.

Fault is found with the spring water, which, after the creek water was abandoned, was hauled in barrels from different sources of supply. It appears that it was the custom to place an old canvas sack over the top of the barrel below the lid to prevent the spilling of the water. These sacks were often on the ground or on the floor of the wagon, and the impurities they picked up were washed out into the barrel by the splashing of the water against them.

It was the practice in the camp to have this water boiled, but boiling, while it afforded security against microbian diseases, did little in removing the mineral impurities. The recommendations of the report on

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