SPECIFICATIONS FOR WOODEN PILES.

THE typical specification for a wooden pile, as used by most railroads, municipalities, etc., and as advocated by most producers, reads about as follows: The pile shall be so straight that a line stretched from centre of butt to centre of point will not leave the pile more than 1/100th (for example) of the length of the pile.

Mr. E. P. Goodrich, consulting engineer, on the staff of the Commissioner of Public Works, Borough of Manhattan, writing in Professional Memoirs, Corps of Engineers, U.S. Army, raises the following points in criticism of this specification:

(1) It is obviously impossible to stretch a line from centre of butt to centre of point; and, therefore, a substitute method has to be employed, which latter should logically also be substituted in the specification. Obviously, the pile will naturally lie on a flat surface so that its greatest curvature is horizontal. A line is then stretched from the butt to the point over the centre of each; and, by sighting down vertically along the string, the distance between the projection of the string and the side of pile is noted.

(2) What relation should exist, if any, between the crookedness of a pile and its length? Obviously, again, the pile must be straight enough to be placed in the pile-driver. It also must not be so crooked that a blow of the hammer will bend it so as to damage it; and it must not be so crooked that its final load will produce a bending moment in the pile so large in amount as to produce stresses exceeding a safe maximum. This load condition and the phenomena during driving are practically identical in nature, except that one is static and the other dynamic. Now, the theory of bent columns, or what is the same thing—of eccentrically loaded columns, or of arches, must of necessity apply to piles.

Again, it is obvious that with relation to members of the general size and shape of piles, the length has no effect upon the stresses due to eccentricity of loading at any section—the latter being due only to the amount of the eccentricity and the area of the corresponding section.

(3) What should be the maximum permissible crookedness? It would seem that it should depend upon the permissible maximum bending stress for the material composing the pile and of the area of the latter. Most engineers would doubtless concede a relatively high unit stress as permissible for the condition of combined direct stress and bending of a pile. From this, it is seen that when all piles are designed to be uniformly loaded when finally in place, a greater bend is permissible in a pile of large diameter than in a smaller one, because a less unit direct stress will exist in the large pile and a greater one due to the eccentricity of load may be allowed. Such a specification may not make inspection easy and may possibly be considered impracticable for other reasons, but its logical possibility is evident.

Of course, different kinds of wood must have different permissible bends. Also, the designer's load per mile will influence the allowable bend, if the limit placed on the total maximum unit stress is constant.

Assume, for example, a 12-inch round pile, area where bearing on soil commences 100 square inches, designed loading per pile 15 tons or 30,000 pounds. Then the direct stress per square inch is 300 pounds. If a safe total unit stress of combined compression and bending of 2,400 pounds is assumed [the recommendations of the Committee on Wooden Bridges and Trestles of the Am. Ry. Eng. & M. W. Assn., Vol. X., Part 1, page 564, are for long-leaf pine 3,800 ultimate, 1,300 safe stress, $1{,}300\left(1-\frac{l}{60D}\right)$ for long columns, 6,500 ultimate extreme bending, 1,300 safe], then 2,100 pounds may roughly be assumed as the maximum permissible bending stress due to eccentricity of load at the section. Since the moment of inertia is about 1,016.164 and the section modulus is 169.364, the maximum permissible eccentricity of stress at the ground level mould be 11.9 inches. Again, at a point approximately 8 inches in diameter, where the total direct stress may have been reduced by half, with an area of about 50 square inches, the permissible bending stress may be assumed at 2,250 pounds. The moment of inertia is 196.704, the section modulus 49.176 and the permissible eccentricity 7.4.

Examples might be multiplied; but it would seem evident from the two given that a modification in the type of specification now in use might be advantageous. It seems obvious that the permissible bend should not be measured in terms of the length of the pile, but rather in terms of its diameter at each point along its length. With this idea in view, the following wording with reference to yellow-pine piles is submitted for criticism:

The pile shall be so straight that a line held in contact with any two points selected so as to give the maximum deviation shall not be distant from the surface of the pile at any point more than the diameter of the pile opposite that point.

WATER-POWERS IN NORTHEASTERN CANADA.

The interior of Ungava or New Quebec is a huge plateau which rises somewhat abruptly within a few miles of the coast line to heights of 500 to 2,500 feet. The various streams, therefore, afford numerous water-powers, more especially where they leave the interior plateau to flow through the strip of low lands, a few miles wide immediately adjoining the coast. For instance, on Great Whale River, within 20 miles of the mouth, there are three falls 150 feet, 230 feet and 65 feet respectively. On the south branch of this same river, a few miles from its mouth, a fall of the river gives 136 feet. Nastapoka Falls near the coast has falls 170 feet. Near Richmond Gulf, the Wyachuan River falls give a head of 315 feet. A remarkable case of very high water-falls in the interior is that of the Hamilton River. The Grand Falls of this river are situated some 300 miles from Rigolet. They have a sheer drop of 302 feet, and Dr. A. P. Low, of the Geological Survey of Canada, has estimated their discharge at 50,000 cubic feet per second. For twelve miles above the falls, the river rises rapidly, so that in that distance the difference of level, including the falls proper, is 760 feet. Adopting the discharge estimated by Low, these figures would give approximately 1,500,000 h.p. for the falls proper and 3,660,000 h.p. for the twelve miles of falls of the river. However, Dr. Low only saw the river during a period of high water and the above figures are probably much too high. In the data compiled by the Commission of Conservation and published in the "Report on Water-Powers in Canada," the possibilities of Grand Falls are based on a low-water drainage of 0.4 cubic foot per second per square mile of drainage area, which is the quantity generally adopted under the climatic conditions of the country. Under these conditions, the estimated power of the falls would be 120,000 h.p. and of the total fall for a distance of twelve miles 300,000 h.p.