STRUCTURAL-STEEL TOWERS AND POLES.*

By R. Fleming.†

Wood, Concrete and Tubular Poles.—According to the United States Census there were 3,870,000 wooden poles purchased during 1910. Of these 62% were cedar, 18% chestnut, 7% oak, the remaining 13% being pine, cypress and other woods. Classified according to length 17% were under 20 ft., 56% were 20 to 30 ft. (this being the length most commonly used by telegraph and telephone companies), 21% were from 30 to 40 ft., 5% were from 40 to 50 ft. and 1% over 50 ft. The bulletin from which the above statistics are quoted gives the number of poles purchased in 1909 as 3,738,000; in 1908, 3,249,000; in 1907, 3,283,000. Of the poles purchased in 1910 about 21% received some kind of preservative treatment before being set in place.

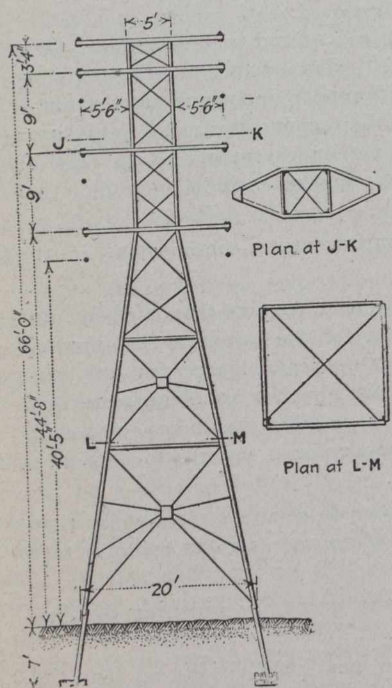

Fig. 1.—Standard Transmission-Line Tower, Connecticut River Power Co.

For 1909 the average first cost of wooden poles purchased was but $1.89. So, from the financial standpoint nothing has been found to take the place of wood for the ordinary telegraph or telephone line pole. The cost of renewals and maintenance is not great enough to warrant the additional first cost of either concrete, iron, or steel poles, and wood will continue to be largely used for some years to come.

Wood is increasing and fabricated steel is lessening in price. Fewer poles or towers are required if made of steel than of wood as they can be placed farther apart; this means fewer foundations, crossarms and insulators. In many cases, as for distribution systems in the yards of shops, wooden poles are not strong enough to carry the loads that will come upon them. Municipal authority has sometimes required the wooden pole on the city street be replaced by the steel pole. The fire risk is eliminated with the steel support, and this is important. A substitute for wood is therefore in many cases not only desirable, but necessary.

Reinforced concrete is being used to some extent for distribution lines of electric-light and power companies, and also for overhead construction of street railways. The general tendency seems to be in the direction of a more extended application.

Tubular poles, made of successive lengths of iron pipe, take up little room, present a round resisting surface to external loads, show excellent results when tested, and can easily be repainted when necessary. Their limitations as to size restrict their use to light loads.

Structural-Steel Towers.—This paper will be restricted to structural-steel supports—either poles or towers. The treatment of reinforced-concrete poles, tubular poles, or the different patented poles on the market will be left to others. The literature on steel towers is extensive—that on steel poles is limited.

We have yet no form of either pole or tower that can be called "standard." Present-day practice for poles is crystallizing about the latticed four-angle type. Towers are being built mostly of the square wind-mill type. An exception is the 140,000-volt line put in operation this year in Michigan, where the towers, of which there are 10 to the mile, are of the braced-tripod type, composed entirely of galvanized-steel angles. This line, at present 125 miles long, is being extended a hundred miles farther and carries the highest voltage yet undertaken, the previous maximum being 110,000 volts.

While the electrical features of a transmission line have received careful attention by the electrical engineer, the structural features have often been taken care of in a crude way, or left largely to chance. The electrical engineer fails sometimes to realize there are other problems to be solved besides those of a purely electrical nature. He should work with his brother, the structural engineer, as the chief item of cost in a transmission line is the structural-steel supports.

Loads.—In designing either a pole or tower the first question for determination is the loads to be carried. These loads are of three kinds: (1) Vertical or dead loads; (2) loads at right angles to the direction of line, due to lateral wind pressure; (3) unbalanced loading in the direction of the line, due to breaking wires. The forces of these three loadings are at right angles each to the other.

(1) The vertical or dead loads are: (a) the weight of the structure itself; (b) the weight of the wires supported by the structure; (c) the weight of the snow or ice coating, if any, on the wires. In sleet regions, ice is generally assumed to accumulate ½ in. thick around the wire. These vertical loads are easily determined, but are seldom a governing feature in the design of the structure, except for the crossarms. The crossarms should be designed for a minimum load of 1,000 lb. at each end. They carry not only the insulators and wires but at times a man or two to adjust them.

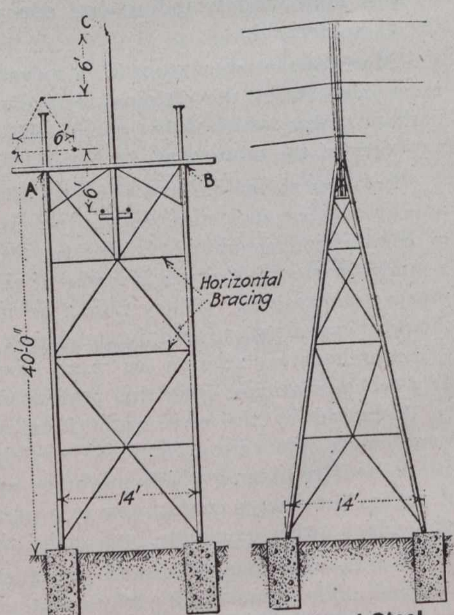

Fig. 2.—Standard Structural-Steel Tower, Georgia Power Co.

(2) The lateral wind pressure on transmission lines has been much discussed. Well known engineers have arrived at widely different conclusions. The author of the article on "Electrical Power Transmission in the Encyclopedia Britannica" writes:

> The actual possibility of wind pressure is very generally over-estimated, and has resulted in much needlessly costly construction.

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