reliable contractors and awarding the contracts, the laying out the lines of the work, the fixing of levels, the checking and approving detail drawings, the inspection of materials and work, the ordering and installing of and putting in operation the equipment, and the thousand and one details which have to be attended to in order that the work may be done in an orderly, expeditious and systematic way and be brought to a satisfactory and successful conclusion.

But these problems have to do with the actual design and construction and are beyond the scope of this paper.

CONCRETE, LATTICED AND TUBULAR POLES.*

Your committee in presenting the following paper on "Concrete, Latticed and Tubular Poles" recognizes that the concrete pole is now becoming better understood both as to construction and placing.

Like storage batteries, superheat and exhaust steam turbines, its introduction was handicappeed by a recommendation for general adoption. We believe that its merits will ultimately be recognized for use in special cases.

The latticed pole or tower for symmetry of construction and beauty of appearance and stability is in a field by itself and where extraordinary heights are called for to withstand very great strains, the properly designed latticed pole or tower undoubtedly will hold its own and possibly will never be replaced by any other form of construction.

The tubular pole has its own place and can be used on city lines where other poles would not be acceptable.

Concrete has been used in cases of emergency for reinforcing wooden poles, and tubular poles may also be protected by concrete or cement foundations that will give them great stability.

We are indebted to Gillette's Hand Book for the cost and construction data, permission to use which has been granted by the author of the book, and for which we desire to record our thanks.

We present the following data for your consideration:

Reinforced Concrete Poles.—The possibilities of reinforced concrete poles have recently been very carefully investigated by the Richmond (Ind.) Home Telephone Company, which has constructed a line across the Whitewater river, using poles ranging from 4 to 55 ft. in height, of the construction shown by Fig. 2.

For poles 30 ft. long and under, the moulding is done horizontally on the ground and the pole erected when hard like a wood pole; for poles over 30 ft. long the moulding is done in forms set vertically in the pole hole. The figures in Table A are given as the cost without royalty of concrete poles moulded as described. These costs are for poles erected excluding the material cost of steps but including labor cost of setting steps, and they are based on the following wages and prices:

Foreman, per day	$3.00
Laborers, per day	1.75
Cement, per barrel	2.00
Stone, gravel or sand, per cu. yd.	1.00

For sake of comparison, the cost of cedar poles has been added to the table; these costs include poles, unloading, dressing, gaining, roofing, boring, hauling and setting.

Regarding the methods of constructing concrete poles, all of the larger concrete poles (that is, poles over 30 ft. in height) are built upright in position ready for use, the former being set perpendicularly over the hole in which the pole is to be placed, the hole having been dug to conform with the size pole prior to the setting of form; thus when the concrete is poured in at the top of form, the hole is entirely filled and the concrete knit firmly to the solid earth that has never been disturbed. No replacing of earth or tamping is required.

All poles under 30 ft. in height, up to the present time, have been built on the ground and set after they have been seasoned. It is possible that with the proper equipment and a little practice it will be found that even the smaller poles can be built more economically upright. As the larger poles are built upright in the position which they are to occupy there is no heavy material to handle and consequently no necessity for any heavy rigging or equipment. After the form has been placed over the hole the reinforcing rods and binding wires are placed, and it is then ready to receive concrete. After the concrete has been poured in, it is left for about three or four days, depending on the weather, before the form is removed. The most economical way of handling concrete is with a small mixer, capable of mixing 2 or 3 cu. yds. per hour and the old fashioned grain elevator. With this equipment, the concrete is placed as rapidly as it is mixed and with the same power. The falling of the concrete from the top of the form tamps it sufficiently.

The estimate of the cost of the finished pole is based on the following prices: Crushed stone $1.25 per cu. yd.; sand $1.10 per cu. yd.; cement $1.75 per bbl., and labor 20 cents per hour.

On lines where the poles are close to the track, the most convenient method of erection is to rig a hinged stiff-leg derrick on a flat car, with a boom of sufficient length to pick up poles on cars at either end of the derrick car. This derrick should be hinged so as to be conveniently lowered to pass under grade crossings and obstructions of any nature. On

TABLE A—COMPARATIVE COST OF REINFORCED CONCRETE AND CEDAR POLES.

Richmond, Ind. Home Telephone Co.

Concrete Poles										Cedar Poles — Cost			
Length	Top	Bottom	Size steel	Cubic ft. conc.	Cost of steel	Cost of conc.	Cost of bind. W.	Labor	Total cost	Top	F. O. B. cars	Labor	Total
Ft.	*In.*	*In.*	*In.*							*In.*			
25	6	10	1/4	16	$1 57½	$2 24	$1 20	$1 70	$6 71½	7	$2 60	$1 50	$4 10
30	6	11	3/8	21	2 29	2 94	1 20	2 20	8 63	7	6 25	2 00	8 25
35	6	12	1/2	26	3 91½	3 64	1 20	2 70	11 45½	7	8 75	2 40	11 15
40	7	15	5/8	36	6 31	5 04	1 50	4 20	17 05	8	12 00	3 50	15 50
45	7	16	7/8	43	8 56	6 02	1 50	5 70	21 78	8	17 20	5 00	22 20
50	7	17	7/8	50	9 50	7 00	1 80	7 20	25 50	8	20 20	6 50	26 70
55	7	18	1	56	13 34	7 84	1 80	8 95	31 93	8	24 80	8 50	33 30
60	7	19	1	61	14 56	8 54	1 80	11 70	36 60	8	29 75	10 00	39 75

*From Report of Committee of American Street Railway Association at Annual Convention, Oct. 9, 1911.