DATA SHEET

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Sheet #:	**D6i**
Title:	**POLE LINES**
Reformated:	**October 1999**
First Issued:	**April 1964 (D6u.01)**
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Source Material:	Specification for the Construction of Railroad Communications Pole Lines: A.A.R., Communications Section
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INTRODUCTION

Probably the most important non-revenue-producing department of a prototype railroad is its Communications Department. Nearly all railroad communications were, before the development and broad application of radios, cell phones and similar technologies, handled on pole lines. While pole lines are not needed in successful operation of a model railroad, they may be modeled with the effect of enhancing realism of the scenery, particularly if properly installed. These pages will furnish basic data for modeling pole, lines. Data has been adapted from AAR specifications for constructing communications pole lines; not all details are presented, and only communications lines are considered. Power and signal line circuits, transpositions, etc., are omitted from this paper.

HISTORICAL CONSIDERATIONS

As a general rule, the earlier the period of the railroad being modeled, the smaller will be its communications line. The use of telegraph in dispatching trains began about 1852, and that of telephone in 1879. Since then, the use of communications in railroading has grown immensely. A single wire is sufficient for each telegraph circuit, but telephone circuits require two wires -- a pair. Initially one pair per circuit was needed, but as the art advanced, means were found to impose greater numbers of circuits on each pair, resulting in reduction of the number of wires on a pole line. At one time, railroad pole lines also carried many commercial telegraph circuits, but some railroads have separated themselves from this activity. Railroad communications lines were greatest in number through the period of World War II; since then, with modern carrier circuitry, etc., they have been reduced in number, although not in volume of message traffic.

TRAFFIC CONSIDERATIONS

The first circuit on any pole line is the dispatching circuit. A message circuit for communications between headquarters and stations on other than dispatching business is usually added. A block circuit may extend from station to station, used for local business. Through circuits between terminals, headquarters-to-terminal circuits, etc., add still other lines. Obviously, the larger and busier the railroad, the more communication circuits it needs. Main lines demand larger communications lines than do branches. On some light branches, only the dispatcher's circuit is needed since local business may be transacted over the dispatcher's wire without undue interference.

DETERMINING SIZE OF COMMUNICATIONS LINES

The foregoing general statements introduce the principles on which physical size of communications lines are based; the number of circuits determines in part pole size, number of crossarms and pole spacing. These factors are also influenced by geographical location of the railroad being modeled, as shown on page 2 in the Loading Map. The more severe the winter weather to be expected, the stronger will the line have to be built.

DETERMINING SIZE OF COMMUNICATIONS LINES - continued

The main line of a major railroad could demand a communications line with six or seven crossarms. Modeling of such poles would not be difficult, but preparing enough of them to cover the railroad could be tedious. It is suggested, therefore, that the average, modern main-line model railroad be paralleled by a communications line constructed with three crossarms per pole. Earlier, lighter-duty main lines or fairly-heavy branches could be served by lines with two crossarms. For light branch lines, a single, ten-pin crossarm would be satisfactory, with six-pin crossarms employed on short lines. These are merely guiding principles for modeling practice; individual preference will determine the actual scope of the model, not excluding the full use of multiple-crossarm line poles.

GENERAL PRINCIPLE

In normal practice, all power lines cross above communications lines.

STRENGTH OF LINES

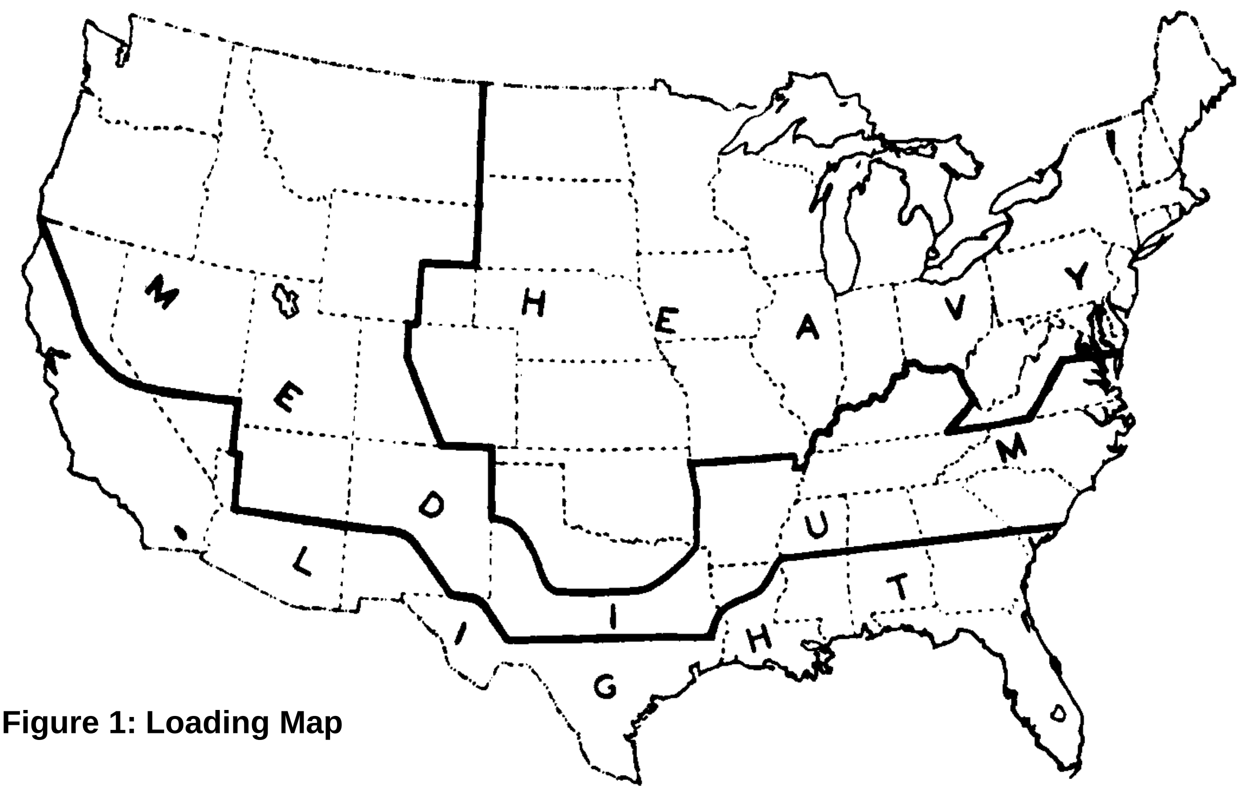

Figure 1: Loading Map

This Data Sheet provides for three grades of line strength. Grade I lines are intended for use in the Heavy Loading District, Grade II for the Medium Loading District and Grade III for the Light Loading District.

DATA SHEET

SPAN LENGTH (FEET)	POLES/MILE (APPROX.)
88	60
100	53
130	40
150	35
175	30
200	26

Table 1: Span Lengths and Poles per Mile

WIRES, TOTAL NUMBER	GRADE I		GRADE II		GRADE III	
	POLE CLASS	POLES /MILE	POLE CLASS	POLES /MILE	POLE CLASS	POLES /MILE
1 to 6	7	40	7	30	7	26
7 to 12	5	40	6	35	7	30
13 to 20	5	40	5	35	6	30
21 to 30	3	40	4	35	5	30
31 to 40	3	40	4	35	5	30
41 to 50	2	53	3	55	4	35

Table 2: Standard Class (see Table 3) and Spacing for Poles for Open Wires

CLEARANCES FOR POLES AND ATTACHMENTS

Clearances are measured between points of closest approach of objects concerned. Where practicable, poles are located so as to provide clearance of at least 13 feet from the inside of the nearest track rail, but in no case less than eight feet. Where possible, horizontal separation of at least eight feet from the nearest track rail is maintained for all crossarms, wires, etc. Where this clearance cannot be obtained, vertical clearances between the lowest crossarms and track level is provided as follows:

Horizontal Separation, Feet	Vertical Clearance, Feet
8 to 5	20
5 to 3	22
Less than 3	25

On level right-of-way the lowest crossarm ordinarily has vertical clearance of ten feet or more above ground. In irregular terrain, safe clearance is provided. Wires crossing over railroad tracks must have a minimum clearance of 27 feet above railheads. All wires on lines along or crossing city streets must have minimum clearance of 18 feet above ground. Wires clear buildings, bridges and other structures by at least two feet unless attached to them. Clearance of at least four feet from trees and underbrush is recommended.

LOCATION AND GRADING OF LINES

Lines are run as straight as right-of-way conditions will permit. Where practicable, crossings from one side of the right-of-way to the other are avoided. Lines are located as close to the outer edge of the right-of-way as possible, but need not be located more than the height of the average pole from the nearest rail.

Individual spans are kept as near as practical to the specified span length. Where a pole cannot be placed so as to give the correct span length, it is usually set as near as possible to correct location and the next span shortened or lengthened sufficiently to make the sum of the two spans equal to twice normal span length.

LOCATION AND GRADING OF LINES - continued

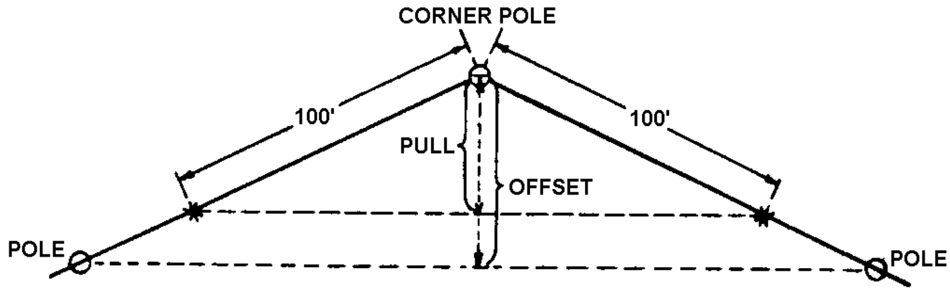

Figure 2: DETERMINING PULL AT A CORNER POLE

The angle that a line makes at a corner is commonly designated by the "pull" on the corner poles. Pull is defined as the distance a pole is out of line with two points located 100 feet away on opposite sides and in line with the corner pole and two adjacent poles. See Figure 2. Sharp corners should be avoided in laying out a line. The pull on a single pole corner should never exceed the values shown below:

Number of Wires	Pull not to exceed
1 to 10	40 feet
11 to 20	25 feet
21 to 30	20 feet
31 to 40	15 feet
More than 40	10 feet

Corners where the pull exceeds 40 feet are made on two poles, placed so that the pull on each of them is as nearly equal as possible.

Numerous corners with small pulls are considered undesirable. Figure 3 illustrates the tangent method of locating poles on curves. Several successive poles are set in a straight line so that the completed curve contains several short tangent sections and a few corner poles, each bearing a fairly heavy pull.

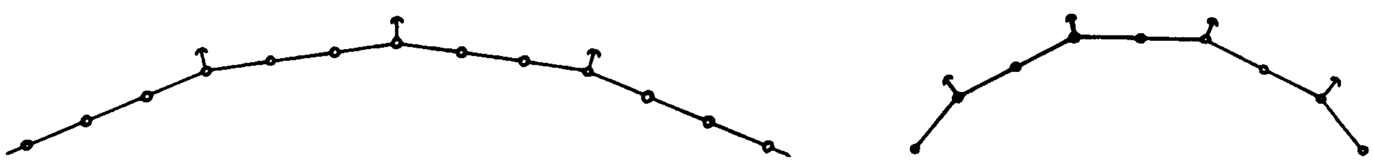

Figure 3: TANGENT METHOD OF LOCATING POLES ON CURVES

When practicable, span length at railroad crossings does not exceed 100 feet on Grade I, 125 feet on Grade II and 150 feet on Grade III lines.

In general, lines follow ground contours so poles may be of uniform height. Where ground contours change abruptly, or where it is necessary to change the level of a line to clear trees, buildings, crossings, etc., lines should be graded so as to avoid abrupt changes in slope. Pole heights are ordinarily proportioned so that upward or downward pull, (distance "d" in Figure 4,) does not exceed the following values:

Average span length 100 feet or less	4 feet
Average span length 130 feet	5 feet
Average span length 150 feet	6 feet
Average span length over 150 feet	7 feet

LOCATION AND GRADING OF LINES - continued

In mountainous country it is sometimes advisable to exceed these values to avoid undue costs. Where the upward or downward pull on a pole exceeds twice the amounts specified above, the pole should be equipped with double crossarms.

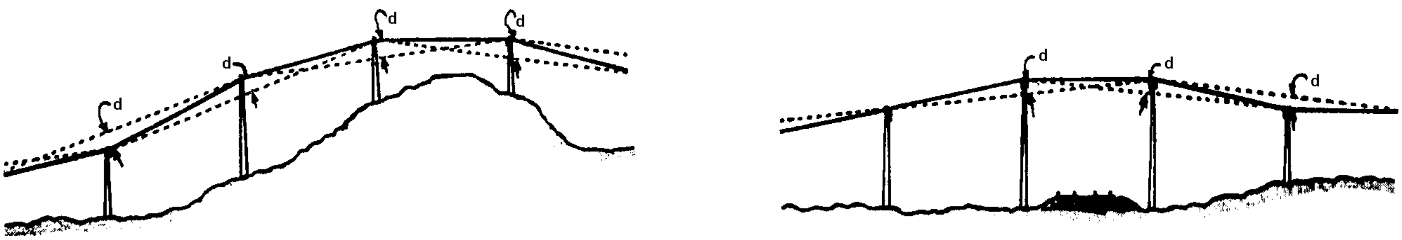

Figure 4: GRADING OF POLE LINES

FRAMING AND SETTING POLES

Poles are usually ***roofed*** and ***gained*** as shown in Figure 5. Gains are normally set on 20" centers.

Poles on straight sections are set so that the crossarms on adjacent poles face in opposite directions. On steep hills and grades, arms face toward the top of the grade. At corners, crossarms are so placed as to halve the angle formed by the line wires. Arms on poles adjacent to the corner should face the corner pole.

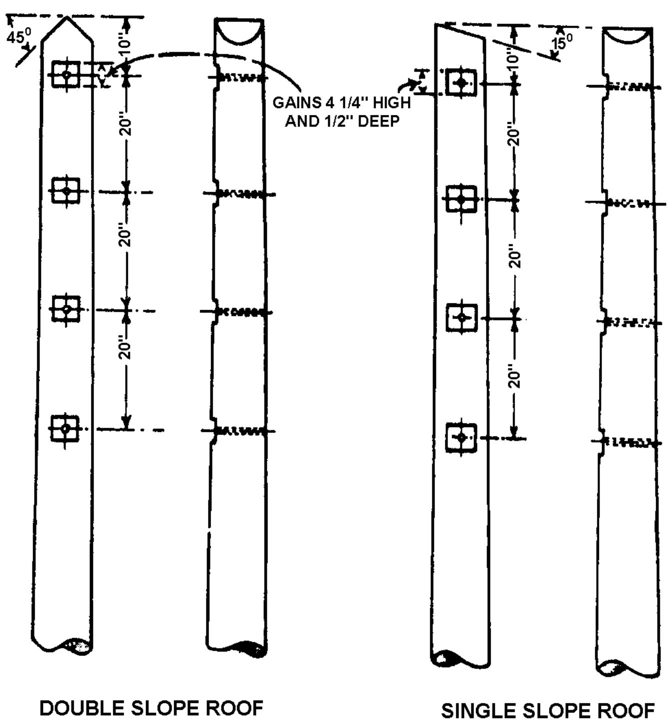

Figure 5: ROOFING AND GAINING OF POLE LINES

CROSSARMS

The standard types of crossarms are illustrated in Figure 6. Double crossarms are recommended in these situations:

a) On poles at railroad crossings, or crossings over trolley wires.
b) On corner poles having a pull of more than twenty feet.
c) On poles where the upward or downward pull exceeds twice the value specified in the section on Locating and Grading of Lines.
d) On poles supporting spans of more than 200 feet in Grade I, 300 feet in Grade II and 400 feet in Grade III lines.

CROSSARMS - continued

Crossarms are attached at right angles to poles and in vertical alignment. Each crossarm is secured by means of a standard crossarm bolt driven through from the back of the pole and fitted with two 2¼" square washers, and with crossarm braces, as shown in Figure 7. Double crossarms are arranged as shown in Figure 8. On these installations, gains are required for the arms on only one side of the pole. Double crossarms have only one pair of braces.

Where necessary to avoid obstructions, crossarms may be attached as shown in Figure 9.

Crossarms are 4" deep x 3¼" thick. Top edges are chamfered 3/8" x 45^0 or rounded on a 3/8" radius. Drawings indicate length of chamfer.

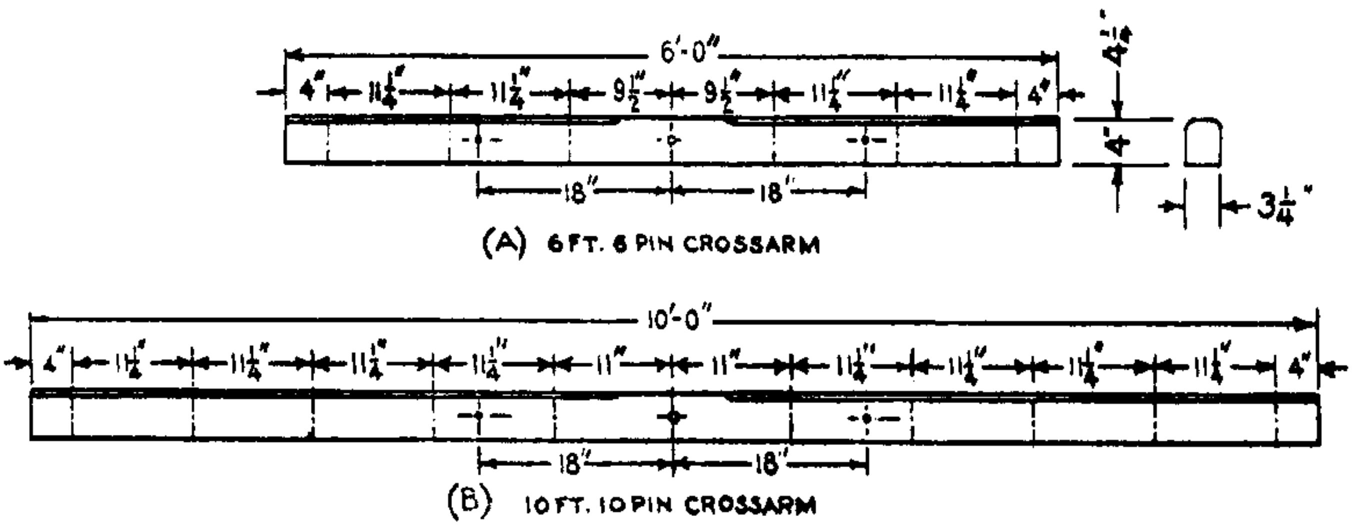

Figure 6: TWO STANDARD CROSSARMS

WOOD POLE BRACKETS

When not more than two wires are to be carried on a line, they are supported on wood pole brackets as shown in Figure 10. Brackets are also used to add one or two wires to an existing line; AAR specifications provide that no more than four wires shall be carried on brackets. Wood pole bracket construction is not permitted at major railroad crossings, where light crossarm construction is required. Brackets may be used, however, at crossing over minor tracks, and at crossings over trolley contact wires, provided that the wires involved are supported on each crossing pole by two brackets. A double-bracket attachment involves two brackets per wire. Brackets are affixed approximately thirty degrees apart and suitably aligned on one another to suit the needs of the wire.

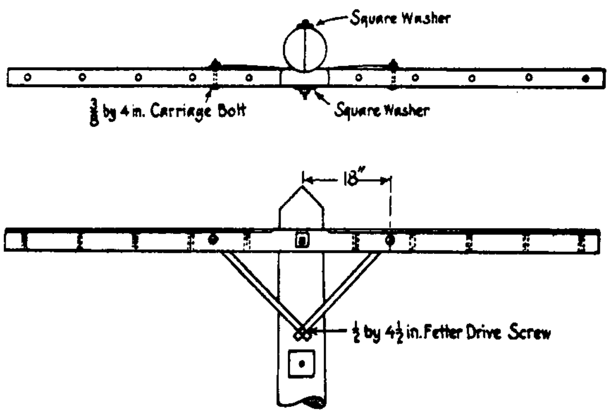

Figure 7: METHOD OF ATTACHING SINGLE CROSSARM

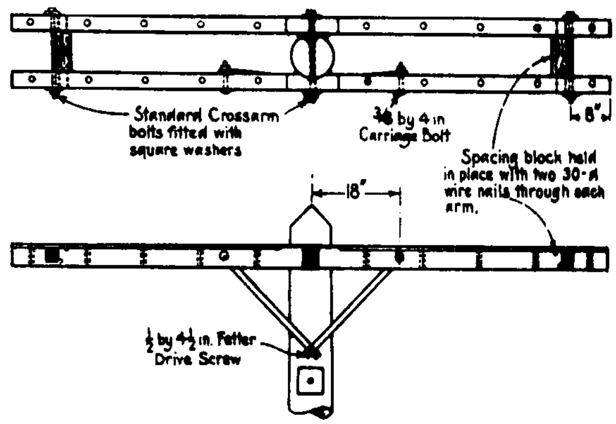

Figure 8: METHOD OF ATTACHING DOUBLE CROSSARM

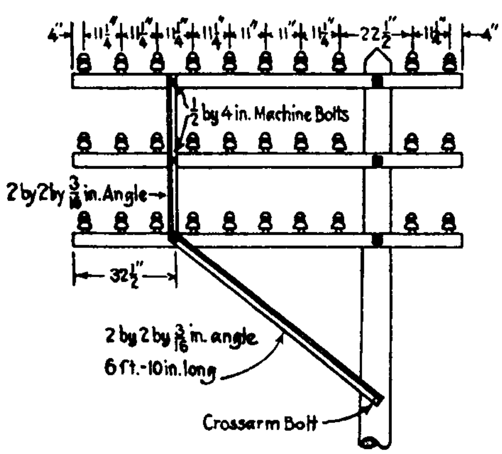

Figure 9: SIDE ARMS

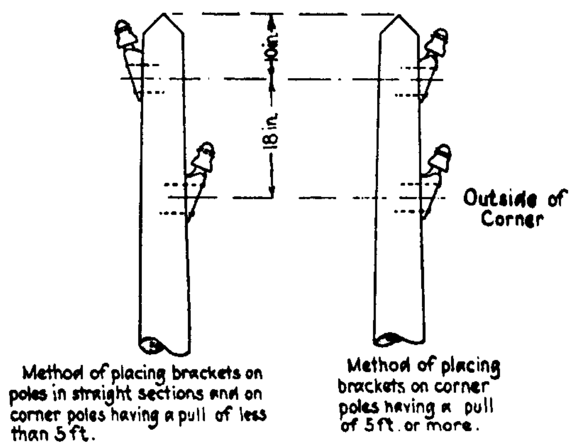

Figure 10: WOOD POLE BRACKETS

CLASS OF POLE	1	2	3	4	5	6	7
MINIMUM TOP DIAMETER (In.)	8½	8	7½	7	6	5½	5
LENGTH OF POLE ABOVE GROUND LINE (Ft.)							
10					6½	6	5½
12			8	7½	7	6½	6½
14	10	9½	8½	8	7½	7	6½
16	10½	10	9	8½	8	7½	7
20	11	10½	9½	9	8½	8	7½
25	12	11	10½	10	9	8½	8
30	12½	12	11	10½	9½	9	8½
35	13½	12½	11½	11	10	9½	9
40	14	13	12	11½	10½	10	9½
45	14½	13½	12½	12	11	10½	10
50	15	14	13	12½	11½	11	
55	15½	14½	13½	13	12	11½	
60	16	15	14	13½	12½		
65	16½	15½	14½	14	13		
70	17	16½	15½	14½			
75	17½	16½	15½	14½			
80	18	17	16				

Table 3: POLE DIMENSIONS

CONSTRUCTION SUGGESTIONS

Poles may be scratch built of commercial doweling of appropriate size, tapered by sanding. Crossarms may be fashioned of stripwood of proper dimensions. Especially in O scale, clear or pale green transparent beads of the kind sold in variety stores for jewelry making may be used to simulate insulators. These may be attached with a lills pin, pushed through bead and crossarm and clipped off close to the under side of the arm. Jigs will assist the builder in framing and gaining poles and in affixing insulators.

Plastic poles complete with crossarms, braces and insulators are commercially available. While better suited to power and signal applications, these poles may be used for communications lines. Individual crossarms may be removed through careful use of a razor saw, and cemented to other poles, permitting the modeling of varied crossarm arrangements. Actual stringing of wires is impractical in any of the common scales for the reason that material will not sag realistically. Furthermore, strung wires would interfere with maintenance and equipment handling, and be liable to excessive damage. A well-built, realistically constructed pole line will be accepted by the eye as readily as if the wires were in place.