SECTION 621-200-011
Issue 2, October 1968
Reprinted November 1984**

POLES

LOCATING, PREPARING, AND SOIL BRACING

CONTENTS PAGE

**Reprinted to comply with modified final judgment.

Printed in U.S.A.

1. GENERAL

1.01 This section covers instructions and recommendations for locating and preparing poles and stubs for erection in urban and rural areas. Grading, framing, hole digging, facing, and soft soil bracing are included.

1.02 This section is reissued to include up-dated information for this and the following sections which are cancelled: 621-200-012, 621-200-013, 621-200-021, 621-200-023, and 621-205-208. Since this is a consolidation and up-dating of sections, arrows normally used to indicate changes have been omitted.

1.03 Pole locations are staked or indicated by measurements from fixed objects. Pole spacings and locations are more critical when poles support toll open wire carrier or repeatered circuits. Three transposition poles per transposition section can be shifted not more than 10 feet ahead or back on line without advance approval of the plant engineer. Advise the plant engineer of any such changes made. If more than three need to be shifted, refer the matter to the plant engineer before the work is done.

1.04 The following general requirements covering the locating of poles and stubs apply to all classes of lines, with the exception mentioned above.

(a) Measure the span lenths specified for the line along the route designated by the engineer and for which the necessary rights of way have been secured until an obstacle or a fixed pole location, such as a corner, deadend, or crossing, is reached. Locate a pole at a satisfactory distance from the obstacle or at the fixed location. If it is then found that the span adjacent to this stake is more than 10 percent over, or more than 20 percent under the specified length of span, relocate a sufficient number of the adjoining stakes to make all spans come within these limits. Drive stakes at the proposed pole and stub locations. Where the line requires poles of different heights for grading, the pole height should be marked on the location stake. The number of poles specified per mile of line should, in general, not be increased or decreased by more than one pole, except where long span construction occurs. In selecting the route, it is important that consideration be given not only to providing a direct route, but also one that will be readily accessible for construction and maintenance activities.

(b) Locate poles in line so proper clearances will be provided from power lines, railways, airports, fire hydrants, signal pedestals, and curb lines. These clearances are contained in Section 620-210-012.

(c) Locate dead-end poles to obtain good guying facilities. If there is to be an underground connection, the conditions will be favorable for building the subsidiary conduit and pulling in the cable. Where conditions would make it difficult to provide the required guying, consider the use of slack span construction.

(d) Avoid having aerial plant overhang private property. If conditions make it desirable to overhang private property, obtain permission for such overhang.

(e) When locating a pole line, take into account the possibility of future highway widening to avoid the necessity for shifting the line at a later date. In cases of road intersections where it is anticipated that the intersecting road may be widened, locate poles at a sufficient distance from the intersecting road line to avoid the necessity for later shifting.

(f) Where local regulations provide a definite location for pole lines, ie, at a fixed distance from the center of the highway, comply with the regulations.

(g) Avoid long curves. The line should consist of straight sections and corners to reduce the amount of guying required.

(h) Avoid locating poles in inaccessible places, such as marshes, steep banks, banks that are exposed to washes, etc.

(i) Avoid the use of long or short poles for grading the line by shifting the stake locations (but not more than 10 percent over or 20 percent under the specified span length) to keep poles off the bottoms of depressions.

(j) Avoid pole locations which will involve the cable or wires in tree branches or foliage.

(k) Locate exchange poles to facilitate joint use.

2. LOCATING POLES OR STUBS

LOCATING POLES AT CORNERS

2.01 The principal factors to be considered in locating poles at corners are as follows:

(a) Locate corner poles to permit placing of anchors and guys without interference in the development or use of the highway.

(b) Unguyed corner poles should be set-in to give the proper rake, in accordance with Section 621-205-200. A stake should be placed to show where the pole hole is to be dug.

(c) In aerial cable lines, carrying all types and sizes of cables, construct corners on a single pole. The pole must be located so that adequate guying can be provided at the proper location, in accordance with instructions contained in the 621-410 Subdivision of the Practices concerning guying. If right-of-way or guying conditions do not permit the construction of a one-pole corner, construct a two- or more-pole corner.

(d) If conditions do not permit the construction of corner in accordance with (c), construct the turn on a strand crossover. (See Division 627 covering Aerial Cable Construction.)

(e) At street corners, where conditions such as radius curbs, sewer inlets, obstructions, etc, will not permit the construction of a single-pole or two-pole corner, construct the turn as shown in Fig. 1 and Fig. 2.

(f) In open wire lines carrying wires which have a guying wire equivalent of two or more per wire, use a single-pole corner where the pull will be less than 30 feet. Where the pull on a single pole would be 30 feet or more, in general make the corner on two or more poles.

Note: Wire equivalent information is outlined in 621-400-013, 621-400-015 and 621-410-212.

(g) In open wire lines carrying wires which have a guying wire equivalent of less than two per wire, use a single-pole corner where the pull will be less than 40 feet. Where the pull on a single pole would be 40 feet or more, in general make the corner on two poles.

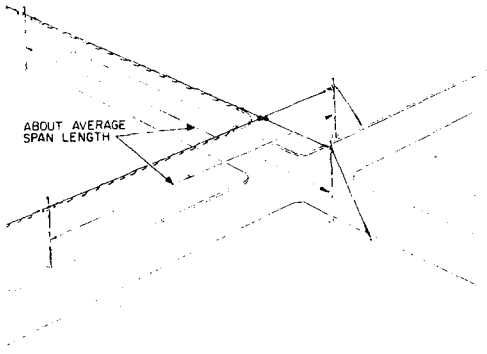

Fig. 1—Main Cable Turn

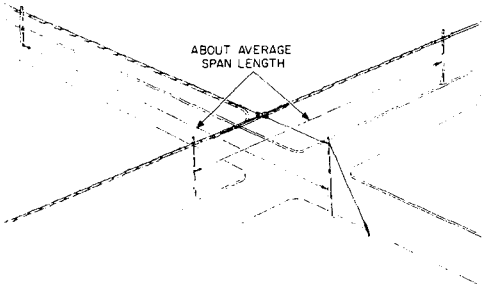

Fig. 2—Branch Cable Turn

LOCATING POLES OR STUBS IN URBAN AREAS

2.02 The following requirements apply more specifically to locating poles and stubs in towns and cities, and supplement the more general requirements.

(a) Avoid injury to trees, and inconvenience to property owners, tenants, or the public.

(b) Locate poles and stubs so they will be as inconspicuous as practical.

(c) In placing poles and stubs on private property, endeavor to locate them in the most desirable location from the telephone company's standpoint. If the owner of the property prefers other locations, endeavor to comply with his requests. If it appears, however, that such changes in locations are likely to introduce construction or maintenance difficulties, explain to the owner why it is undesirable to place the poles or stubs in the suggested locations.

(d) Avoid locations that would interfere with driveways, entrances to fields, street gutters, gates, coal chutes, and windows and doors of buildings.

(e) Locate poles carrying large terminals away from inflammable structures and material, and so that they will be as inconspicuous as practical.

(f) On Streets.

(1) Locate poles and stubs so that the street side of the pole or stub will be at least six inches from the street side of curb. Correct curb line should be obtained from city engineer or proper authority where curb line is indefinite or subject to change. Where local experience indicates that a greater clearance is desirable, provide it.

(2) Locate poles at property lines and entrances to alleys to facilitate distribution.

(g) In Alleys.

(1) Locate poles and stubs on transverse property lines and close to side lines of alleys, avoiding, where practical, the use of extension fixtures.

(2) Locate poles from which drop wire or cable is to be run to buildings so as to facilitate direct runs.

(3) Where practical, locate poles having terminals so that drop wire may be run directly to all parts of the area served from that terminal.

(h) At street corners, locate poles away from the corner so if catch basins are installed or the curb radius is changed, it will not be necessary to shift poles. It may be necessary to locate jointly used poles that are to carry street lights, at street corners.

(i) Locate interior block poles to obtain the best and most direct distribution from poles to buildings.

LOCATING POLES OR STUBS IN RURAL AREAS

2.03 The following requirements apply to locating poles in rural areas:

(a) Along the highway, locate line to conform to highway department regulations, generally close to the highway fence line. Where the distance between the fence line and drainage ditch will permit, place poles to avoid having crossarms overhang private property. It is also important that poles be placed as far back as practical from the shoulder of drainage ditches or other banks. This will lessen the possibility of reduced depth of setting due to erosion or earth moving operations which may result in poles "kicking out". When conditions permit, locate poles at transverse fence or property lines.

(b) The length and location of the subscribers' service connections must be considered.

(c) Locating poles at high points helps to provide ground clearance in the spans. Where practical, to eliminate the necessity for additional guying, poles should be located to stay within a 20 percent down-pull change in grade, as outlined in 3.26 to 3.30.

(d) Where the ground is level the maximum clearance is near the pole, consequently placing poles near driveways, etc, helps to provide clearance over them.

(e) Anchors and guys and push braces should be in fence lines, if possible.

(f) Highway crossing spans, where practical, should be about 50 percent of average length of the three spans adjacent to each side of the crossing, but not less than 150 feet unless shorter spans are desired for other reasons.

3. CHANGE IN GRADE

DEFINITION OF CHANGE IN GRADE

3.01 Change in grade is defined as a change in the slope of a line which results in an up pull or a down pull at a pole. The effect of a down pull in the conductor is to increase the downward load of the conductor on its support. The effect of an up pull is to decrease the downward load at the support. In some cases the change in grade resulting in up pull may be enough to exert a lift on the point of support. In open wire lines up pull may result in pins being pulled out of crossarms. Examples of change in grade resulting in up pull and down pull are illustrated in Fig. 3.

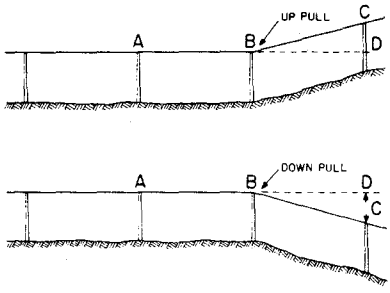

Fig. 3—Change in Grade

3.02 Change in grade is expressed as a percentage, such as 10 percent, or 20 percent, and is obtained by dividing CD by span length BC in Fig. 3.

3.03 Theoretically, measurement BD should be used instead of span length BC to obtain an exact measure of change in grade, but since the difference between BC and BD is minor due to the small angles involved, and since span length BC is easier to obtain than measurement BD, the span length is used.

3.04 Change in grade, thus determined and expressed as a percentage, is always a measure of the amount of up pull or down pull on the support regardless of the span lengths. In Fig. 4, a change in grade of 20 percent is shown with spans of various lengths. Table A shows how the measure of change in grade remains the same for all span lengths.

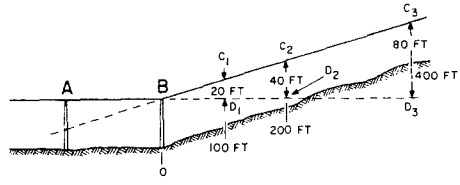

Fig. 4—Change Expressed as a Percentage

TABLE A

SPAN LENGTH IN FEET BC	VALUE IN FEET CD	CHANGE IN GRADE $\frac{CD}{BC}$
100	20	20/100 or 20 per cent
200	40	40/200 or 20 per cent
400	80	80/400 or 20 per cent

3.05 Where the span lengths are approximately equal, the measure of change in grade at a pole with a down pull can be determined as shown in Fig. 5.

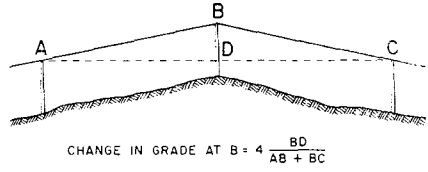

Fig. 5—Measure Down Pull of Equal Spans

(a) If one of the adjacent spans is 50 percent longer than the other, an error of about 5 percent will be introduced in the measurement of change in grade. This percentage of error

increases rapidly with greater differences in span length for variations within 50 percent, this method may be accepted as substantially accurate.

CHANGE IN GRADE—EXISTING POLE LINE

3.06 Measurements of change in grade in existing pole lines will frequently be necessary in connection with pole replacement or relocation work. Some suggested methods are outlined in the following paragraphs. Under many conditions these measurements can be readily obtained by one man.

Sighting from Tops of Poles or Same Relative Locations

3.07 Where unusually rough terrain is encountered, it may be necessary to climb poles and sight along their tops. This method should not be followed on jointly used poles where it would be necessary to climb into the power company's space on the pole. Fig. 6 shows method of measuring at up pulls.

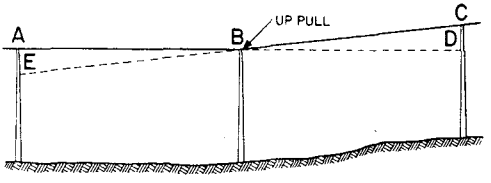

Fig. 6—Measure Up Pull

(a) Sight from Pole C along line AB and establish point D. Change in grade will be

$$\frac{CD}{\text{Span BC}}$$

or

(b) Sight from pole A along line BC and establish point E. Change in grade will be

$$\frac{AE}{\text{Span AB}}$$

(c) Fig. 7 shows method of measuring at down pulls. Man at pole C (or pole A) sights along line AC and directs man at B in establishing point D. Compute change in grade as outlined in 3.05.

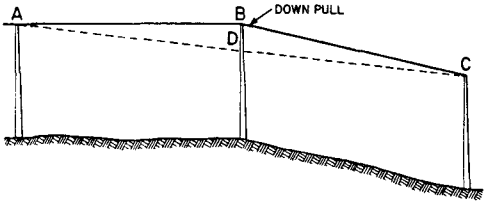

Fig. 7—Measure Down Pull

3.08 If there are no obstructions, change in grade can be sighted from the ground as shown in Fig. 8.

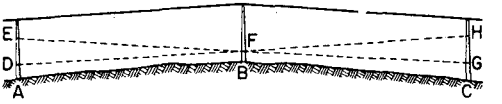

Fig. 8—Sighting from the Ground

(a) Locate points D, F, and G at same distance from tops of poles A, B, and C. These points may be at any convenient sighting height, or a point at which the distance from the top of the poles can be readily determined.

(b) Man at pole A sights along line DF and directs man at pole C in establishing point H. Change in grade will be

$$\frac{HG}{\text{Span BC}}$$

or

(c) Man at pole C sights along line GF and directs man at pole A in establishing point E. Change in grade will be

$$\frac{ED}{\text{Span AB}}$$

3.09 Where terrain permits, change in grade can be sighted from a remote location. Fig. 9.

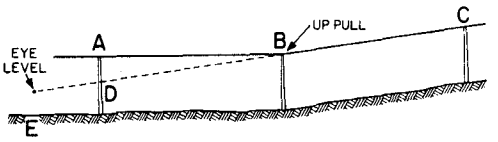

Fig. 9—Up Pull Sighting From Remote Location

(a) At Up Pulls

(1) Find a location along line of sight BC, as at E, and sighting along line BC, establish point D.

(2) Determine distance AD with a range finder or by sighting with a rule and comparing with crossarm spacing, gains or bolt holes, 10-foot brand markings, or other markings of known spacing.

(3) Change in grade will be

$$\frac{AD}{\text{Span } AB}$$

(b) At Down Pulls (See Fig. 10)

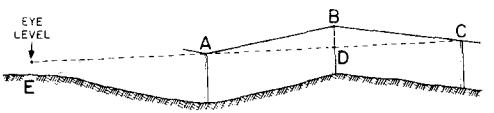

Fig. 10—Down Pull Sighting From Remote Location

(1) Find a location along line of sight AC, as at E, and sighting along line AC establish point D.

(2) Determine distance BD in the same manner as described in 3.09 (a) (2).

(3) Compute change in grade as outlined in 3.05.

Use of Pull Finder to Measure Change in Grade

3.10 The pull finder can be used to determine the change in grade at a pole by measuring the pull of the vertical corner resulting from the change in grade. The pull finder is used at the pole where the change in grade occurs and the pull in feet is read directly. (Instructions on the use of the pull finder for guying purposes will be found in Section 621-400-011.

3.11 The pull in feet, as determined by the pull finder, is converted to "Change in Grade" by multiplying pull by 2/100. Examples of this conversion are shown in Table B.

TABLE B

PULL (FEET)	CHANGE IN GRADE
5	10/100 or 10 per cent
10	20/100 or 20 per cent
15	30/100 or 30 per cent

3.12 The pull finder should be attached at a convenient point on the pole where the change in grade occurs. To simplify the procedure, the point of attachment of the pull finder and the sighting points on the adjacent poles should be at the same relative positions; ie, at the tops of the poles or at the same distance from the tops of the poles. At down pulls the tops of the corresponding crossarms may be convenient points; at up pulls, the bottoms of corresponding crossarms may be found convenient.

3.13 For measuring change in grade from the ground, the pull finder can be mounted on the pole by means of an adapter. A simple type of adapter which can be used for this purpose is shown in Fig. 11. No arrangements have been made for supplying this adapter as a standard, since quantity required is small. The adapter, a cylindrically shaped piece of soft wood of approximately the dimensions shown, is equipped with a No. 8 winged dowel screw, for attaching to the pole.

(a) The pull finder is first affixed to the adapter, and the adapter is then screwed into the pole.

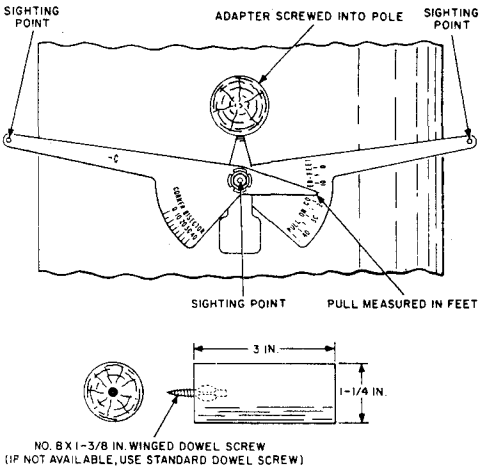

Fig. 11—Measure Change in Grade With Pull Finder

3.14 Fig. 12 illustrates the method of measuring change in grade from the ground by use of the pull finder.

(a) With point E at a convenient height for sighting, select and mark points D, E, and F at the same distance from the tops of poles A, B, and C.

(b) Attach the pull finder to pole B at point E.

(c) By aligning the legs of the pull finder along lines DE and EF, read the pull of the vertical corner.

(d) Convert the pull in feet to change in grade in accordance with 3.11.

Sighting Through Points Which Are Not at Same Distance from Tops of Poles

3.15 Change in grade can be measured by sighting through points which are not at the same distance from the tops of the poles, and by making

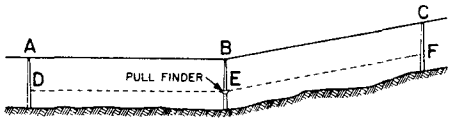

Fig. 12—Sighting From Ground with Pull Finder

adjustments to compensate for the differences. This procedure is illustrated in Fig. 13.

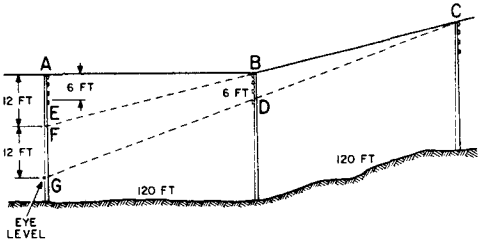

Fig. 13—Sighting Through Points at Various Distances

3.16 The change in grade is

$$\frac{AF}{\text{Span } AB}$$

Since sighting from point F would require climbing the pole, the change in grade can be determined in the following manner:

(a) Sight from pole A across the top of the top arm on pole C and one of the lower arms on pole B. (In this case, the arm in the fourth gain.) From this line of sight, CD, establish point G on pole A.

(b) Determine measurement BD by means described in 3.25. (In this example, BD = 6 feet.)

(c) FG will be greater than BD by the ratio of the sum of the spans to span BC.

$$\frac{FG}{BD} = \frac{\text{Span } AB + \text{Span } BC}{\text{Span } BC}$$

(In this example, FG is twice BD or 12 feet.)

(d) Determine measurement AG by methods described in 3.25.

(e) Subtract FG from AG. The remainder will be AF. (In this example, 24 feet - 12 feet = 12 feet.)

(f) The change of grade is

$$\frac{AF}{\text{Span } AB}$$

In this example,

$$\frac{12 \text{ feet}}{120 \text{ feet}} = \frac{1}{10}$$

or 10 percent.

3.17 The pull finder can be used for sighting through points which are not the same distance from the tops of the poles. Use of this method requires reference to previous paragraphs in this section:

(a) Under 3.10 to 3.14, it is pointed out that the pull finder provides a reading which can be converted directly into change in grade without regard to length of span or the relation between span lengths.

(b) As discussed in 3.05, the computation of change in grade from a vertical measurement at the pole where the change occurs requires that the two adjacent spans be approximately equal.

(c) The adjustment in vertical measurement, to compensate for differences in distance of sighting points from the tops of the poles, also requires that the adjacent spans be approximately equal.

(d) Proceed with measurement of change in grade as shown in Fig. 14.

(1) Attach pull finder to pole B at convenient point E. Sight through tops of poles A and C and read pull as described in 3.10. (In this example, assumed to be 15 feet.)

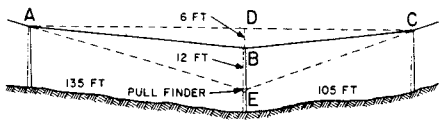

Fig. 14—Sighting Through Points at Various Distances Using Pull Finder

(2) Change in grade at point E will be 3/10 or 30 percent.

(3) Compute average of spans AB and BC

$$\frac{(135 \text{ feet} + 105 \text{ feet})}{2} = 120 \text{ feet}$$

(4) Multiply change in grade by average span length and divide by 2. This is distance DE.

$$\frac{(.30 \times 120)}{2} = 18 \text{ feet}$$

(5) Determine distance E to top of pole by methods described in 3.25.

(6) Subtract BE from DE. The remainder is DB. (18 - 12 = 6.)

(7) Multiply DB by 2 and divide by average span length from (3). This is the change in grade of the pole line at pole B.

$$\frac{(6 \times 2)}{120} = 1/10 \text{ or } 10 \text{ percent.}$$

CHANGE IN GRADE—LAYING OUT NEW POLE LINES

3.18 In laying out new lines, changes in grade may be determined from profile diagrams, by use of a transit or hand level, or with ranging rods. It is the use of ranging rods which this part outlines.

3.19 Methods of sighting and measuring changes in grade will be limited as compared with those available on existing lines. The added height of poles over ranging rods will not be available for sighting.

3.20 In laying out new lines, measurements in change of grade will be related to changes in the contour of the ground. The grading of the pole line, and the heights of poles required in various locations, can be determined by computation, with the aid of single sketches such as those shown in Fig. 15, 16, and 17.

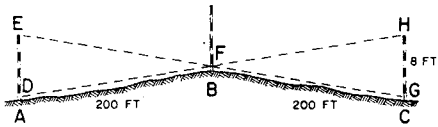

Fig. 15—Change in Grade—New Pole Line—Use of Ranging Rods

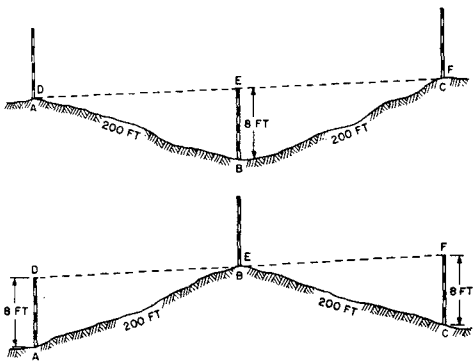

Fig. 16—Measure Up and Down Pulls—Three Ranging Rods

3.21 Change in grade can be measured with ranging rods in the manner illustrated in 3.08. The amount of change in grade which can be measured in this manner is limited by the length of the ranging rods as shown in Fig. 15.

(a) If conditions of terrain were such that it would be possible to obtain a full 8-foot reading at GH or DE, the change in grade in a 200-foot span would be only four percent.

(b) The amount of change in grade which can be measured will be increased by using the method shown for down pulls in 3.07. This method can be used for either up pulls or down pulls as shown in Fig. 16.

(c) As pointed out in 3.05, the measurement taken on rod B will be multiplied by two and divided by the average of spans AB and BC. Thus the change in grade will be

$$\frac{(8 \times 2)}{200} \text{ or } 8 \text{ percent.}$$

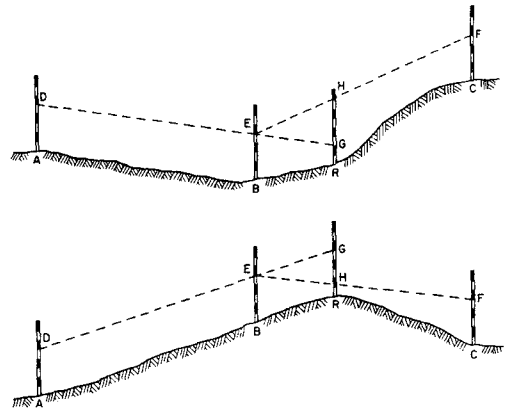

Fig. 17—Measure Up and Down Pulls Four Ranging Rods

3.22 When it is necessary to measure a change in grade that is in excess of the amounts possible by the methods described in 3.21, the method shown in Fig. 17 can be used.

(a) Use four ranging rods. Place one rod at each of the three proposed pole locations, A, B, and C. In span BC, and in line with rods B and C, place the fourth rod R at a distance of about 30 feet from B.

(b) Man at A sights through points at the same height, say the 5-foot mark, on rods A and B and directs man at R in locating point G on

rod R. If rod R is outside line of sight DE, move closer to B until it can be sighted and point G located.

(c) Man at C sights through points on rods C and B at the same height above ground as those sighted on rods A and B (in this case, 5 feet) and directs man at rod R in establishing point H.

(d) Change in grade will be

$$\frac{GH}{BR}$$

(e) Computations will be simplified if rod R is located at a distance from B which is a multiple of 10, such as 40 feet, 30 feet, or even 10 feet.

(f) It is not necessary that the ground level at rod R be in line with that at B and C, since the measurement GH is taken between two points on the rod R and the height above ground is not considered.

3.23 In difficult terrain, the pull finder can be used in conjunction with ranging rods for measuring change in grade. The procedure will be similar to that described in 3.10.

3.24 Sectional ranging rods may be lengthened by the use of one or more extension sections to increase the amount of change in grade which can be measured by the methods described in 3.21.

MEASURING VERTICAL DISTANCES

3.25 Several methods are available for determining vertical distances. Although some of these are not exact, they are sufficiently accurate for use in measuring changes in grade. Some suggested methods are listed below:

(a) When change in grade is obtained by climbing the poles, as in 3.07 and Fig. 6 and 7, a rule or measuring tape is the most convenient means of measurement.

(b) In determining change in grade from the ground, as in 3.08, a rule or a measuring rod may be used.

(c) When sighting from a remote location, as in 3.09 and Fig. 9 and 10, a rule held vertically in the line of sight may be used for measuring the vertical distance by comparing it with known distances, such as spacing of crossarms, pole gains, or crossarm bolt holes. If the point to be measured is a considerable distance below the crossarms or other known spacings, particularly on a high pole, compute the distance between the lowest identifiably spaced marking, and the 10-foot brand mark on the pole. By sighting with the rule, determine the location of the point with respect to these markings. To the measurement thus taken, add the known spacings to determine the total distance.

(d) The B height finder may also be used for this type of measurement as outlined in Section 620-255-602.

(e) When measuring from the base of a pole, particularly a tall pole, as in 3.15, the range finder provides a quick means of making a reasonably accurate measurement. See Section 620-255-601.

ALLOWABLE CHANGE IN GRADE

3.26 Instructions concerning the maximum permissible amounts of change in grade, and the types of construction to be employed for various lesser amounts, are contained in the sections of the practices covering the placing of the types of plant involved.

3.27 Specific instructions for open wire construction will be found in the 621-315 Subdivision, and the 621-310 Subdivision, and the 623-235 Subdivision.

3.28 Instructions for aerial cable construction are included in Division 627.

3.29 Requirements for additional guying are specified in the 621-400 Subdivision for both open wire and aerial cable construction.

3.30 If the downward change in grade on a pole exceeds the allowable maximum for the type of plant involved, the condition can be corrected, and additional strength provided at the critical point in the pole line by placing an additional pole as shown in Fig. 18.

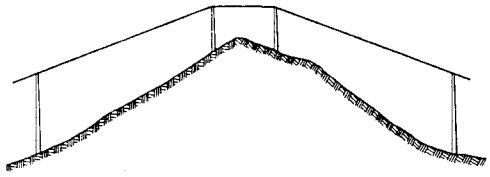

Fig. 18—Excessive Change in Grade—Add a Pole

TABLE C

POLE LENGTH (FEET)	CLASS	LENGTH OF SLAB GAIN (FT)	(IN)	NO. OF BOLT HOLES
All	9 and 10	1	1	1
20	1 to 7	1	1	1
25	1 to 7	3	1	2
30 and over	1 to 7	5	1	3

4. FRAMING POLES AND STUBS

FRAMING OR ROOFING POLES OR STUBS

4.01 The following procedure is recommended when it becomes necessary to cut off a full length treated pole or to otherwise expose untreated wood in such a pole.

4.02 The framing of full length treated poles after treatment should be avoided in so far as practical. New poles are not generally framed but if so specified may be framed for use in an open wire line or in a cable line prior to treatment. See Fig. 19 and Table C.

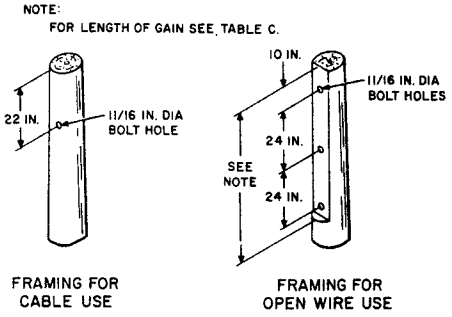

Fig. 19—Standard Pole Framing

4.03 The cutting of additional gains in a pole subsequent to treatment is not necessary as the metal pole gain can be used as shown in 621-315-200.

4.04 Holes can be bored in full length treated poles without requiring any supplementary preservative treatment of the holes; provided that the holes will be filled shortly after boring with pole steps, cable suspension bolts, drive screws, or other hardware. If the holes, for some reason, will be left unoccupied they should be swabbed with B Wood Preservative.

4.05 When necessary to roof poles and stubs, use a single cut, as shown in Fig. 20. Cut the roof of the pole with a saw, taking care not to splinter the wood at the finish of the cut. Apply a generous coating of B Wood Preservative to the full cross-section of the new roof, letting it flow into the checks and soak into the newly exposed wood. As a supplementary safeguard, the new roof surface can be given a coating of a commercial preservative such as Pole-Nu or Pole-Topper, immediately after the B Wood Preservative has been applied.

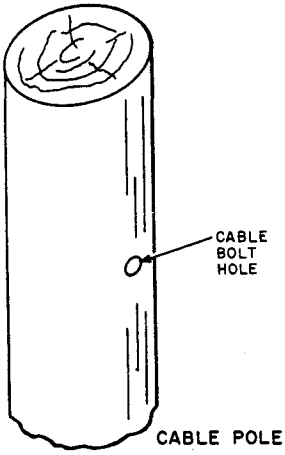

Fig. 20—Roofing Poles and Stubs

BORING HOLES IN POLES OR STUBS

4.06 Where practical it is desirable to bore holes for suspension bolts, for cable or crossarms, and pole steps before the pole is erected.

5. POLE HOLES

POLE HOLES—SAFETY PRECAUTIONS

5.01 Survey hole locations for signs of underground pipe or electric systems. Meters, cutoff valves, service boxes, etc, give indications of buried lines.

5.02 When foreign objects are encountered while digging, stop operations immediately. Expose and investigate objects cautiously. Do not cut, chop through, or break off underground obstructions, without first determining if they serve a useful purpose. Under no circumstances should underground electrical plant or pipe line (gas or otherwise) be disturbed.

5.03 ***If a gas line should be broken or damaged:***

(a) Leave the hole open to allow gas to dissipate into atmosphere.

(b) Warn residents and the public in the vicinity.

(c) Notify local fire department.

(d) Notify local gas company.

(e) Keep the public clear of the area until condition is cleared.

(f) Notify your supervisor.

5.04 ***If an electric line should be broken or damaged:***

(a) Barricade location until condition has been cleared.

(b) Notify the local electric company.

(c) Keep the public clear of the hazardous area.

(d) Notify your supervisor.

5.05 ***If a pipe line, other than gas, should be broken or damaged:***

(a) If a liquid is noticed which appears to be volatile, such as gasoline, follow instructions in 5.03.

(b) Notify the utility, municipality, etc, involved.

(c) Notify your supervisor.

5.06 Where excavations are to remain open at the end of the day's work, cover and mark them well to prevent accidents. Where conditions require it, the excavations should be covered with planking and suitably guarded, especially along a traveled right-of-way.

5.07 Where practical, the number of pole holes to be dug or bored each day should be just enough for a full day of erecting poles so all the holes can be filled the same day.

LOCATION

5.08 When stakes are used to show pole locations, dig or bore hole so the center of the pole hole will be at the location of the stake or at the specified distance from the stake.

5.09 Where no stakes are used, dig or bore holes where shown by detail plans or directed by supervisor, bearing in mind the requirements for clearances.

DIAMETER OF HOLES

5.10 Make holes large enough to permit the free setting of the pole without crowding its normal circumference at the butt, and of sufficient size to permit tamping of the backfill throughout the depth of the hole. Make the holes of uniform diameter from top to bottom. Where large poles are to be set with pike poles, trench the side of the hole facing toward the pole to facilitate the entrance of the pole into the hole.

DEPTH OF HOLES

5.11 In level ground, under average firm ground conditions and in solid rock, set poles to the depths given in the appropriate column in Table D. Under certain conditions, as described in 5.13, different depths of setting are recommended. Where

a pole hole is blasted in rock and the diameter of the hole at the surface of the rock is more than two feet, set the pole to the full depth recommended for poles set in firm ground. Where there is probability of the grade under the line being lowered within a short time, set poles so that they will be in the ground not less than the specified depths after the new grade is established.

TABLE D

LENGTH OF POLE (IN FEET)	DEPTH OF SETTING IN AVERAGE FIRM GROUND (IN FEET)	DEPTH OF SETTING IN SOLID ROCK (IN FEET)
16	3-1/2	3
18	3-1/2	3
20	4	3
22	4	3
25	5	3
30	5-1/2	3-1/2
35	6	4
40	6	4
45	6-1/2	4-1/2
50	7	4-1/2
55	7-1/2	5
60	8	5
65	8-1/2	6
70	9	6
75	9-1/2	6
80	10	7
85	10-1/2	7
90	11	7

These depths of setting are recommended where solid rock is encountered at the ground level and the diameter of the hole will permit pieces of rock to be wedged firmly between the pole surface and the walls of the hole to prevent the pole from leaning.

5.12 The depths of setting recommended in this section are applicable to nonjoint-use poles, but may also be used on joint-use pole lines, if agreeable to the other joint user. When deviations from the recommended depths are required on joint-use poles they will be indicated on detail plans.

5.13 The following conditions are exceptions to the normal pole hole depths recommended in 5.11.

CONDITIONS	RECOMMENDED DEPTH OF HOLE
Swampy ground.	See 7.01. Soft Soil and Swamp Construction
Loose earth.	1 to 2 feet deeper than normal.
Unguyed poles carrying heavy eccentric loads such as large power transformers, open wire extension fixtures or cable extension arms.	1 foot deeper than normal.
*Toll line poles which will support more than one full size cable.	1 foot deeper than normal.
*Poles which will support more than one full size cable or 2—101 pair or larger cables and the average span lengths exceed 150 feet.	1 foot deeper than normal.
*Open wire poles which will support more than 30 physical wires in heavy loading areas or 40 physical wires in medium loading areas.	1 foot deeper than normal.
Poles in sloping banks or within 4 feet of edge of a bank.	1 to 2 feet deeper than normal depending on nature of ground and load to be supported.
Pole replacements.	Set new pole to depth recommended in this section unless it is known that the old pole in the same location was set at a lesser depth and did not lean and conditions such as rock digging make it difficult to obtain the recommended depth.
**Unguyed corner poles, unguyed dead-end poles and unguyed stubs.	6 inches to 1 foot deeper than normal.

35 foot or longer poles in sheltered exchange lines.	6 inches less than normal.
Guyed exchange poles.	1 foot less than normal but not less than 3 feet deep.
30 foot or shorter poles in exchange lines which will carry only a distribution cable.	6 inches less than normal but not less than 3 feet deep.
Solid rock at various depths below ground level.	See 5.14.

*These conditions apply particularly where the line is exposed to strong cross winds.

**In some cases, the stabilization of unguyed corner and dead-end poles may require heavier class poles and further increase in the depth of setting. Such cases will be detailed by the plant engineer.

When two or more of the above conditions apply to any particular pole hole, all factors should be considered and a depth of setting selected which is at least as great as that required by the most severe condition. Generally, it will not be necessary to increase the depth of setting by the sum of the additional depths required by two or more of these conditions. Likewise if two or more conditions apply which, according to the above tabulation, permit lesser depths of setting, the pole hole depth should not be reduced more than that allowed for any one of the applicable conditions.

5.14 Where solid rock is encountered within 6 inches of the required depth of setting in firm ground, the pole may be set at this reduced depth, in order to avoid blasting, provided adjacent poles are set to the full standard depth. Where solid rock is encountered at other depths the pole hole depths as shown in Table E are recommended.

METHODS OF DIGGING OR BORING HOLES

5.15 In normal earth.

(a) ***With Earth Boring Machine:*** Use the earth boring machine if one is available and conditions make its use advantageous. Refer to the 649-360 Subdivision for information relative to the operation of the earth boring machine. Tamp the earth at the bottom of the hole to compact any loose earth before setting the pole.

TABLE E

DEPTH BELOW GROUND AT WHICH SOLID ROCK IS ENCOUNTERED	MINIMUM TOTAL DEPTH OF SETTING							
	25-FT POLE	30-FT POLE	35-FT POLE	40-FT POLE	45-FT POLE	50-FT POLE	55-FT POLE	60-FT POLE
0′	3′- 0″	3′- 6″	4′- 0″	4′- 0″	4′- 6″	4′- 6″	5′- 0″	5′- 0″
0′-6″	3′- 6″	3′-11″	4′- 3″	4′- 3″	4′- 8″	4′-10″	5′- 2″	5′- 4″
1′	3′-10″	4′- 2″	4′- 6″	4′- 6″	4′-10″	5′- 1″	5′- 5″	5′- 8″
1′-6″	4′- 2″	4′- 5″	4′- 9″	4′- 9″	5′- 1″	5′- 4″	5′- 8″	5′-11″
2′	4′- 5″	4′- 8″	5′- 1″	5′- 1″	5′- 5″	5′- 9″	6′- 0″	6′- 4″
2′-6″	4′- 8″	5′- 0″	5′- 4″	5′- 4″	5′- 8″	6′- 0″	6′- 4″	6′- 8″
3′	4′-10″	5′- 2″	5′- 7″	5′- 7″	5′-11″	6′- 4″	6′- 8″	7′- 0″
3′-6″	4′-11″	5′- 4″	5′- 9″	5′- 9″	6′- 1″	6′- 7″	6′-11″	7′- 3″
4′	5′- 0″	5′- 5″	5′-11″	5′-11″	6′- 4″	6′- 9″	7′- 1″	7′- 6″
4′-6″	5′- 0″	5′- 6″	6′- 0″	6′- 0″	6′- 5″	6′-10″	7′- 3″	7′- 8″
5′	5′- 0″	5′- 6″	6′- 0″	6′- 0″	6′- 6″	7′- 0″	7′- 5″	7′-10″
5′-6″		5′- 6″	6′- 0″	6′- 0″	6′- 6″	7′- 0″	7′- 6″	7′-11″
6′			6′- 0″	6′- 0″	6′- 6″	7′- 0″	7′- 6″	8′- 0″
6′-6″					6′- 6″	7′- 0″	7′- 6″	8′- 0″
7′						7′- 0″	7′- 6″	8′- 0″
7′-6″							7′- 6″	8′- 0″
8′								8′- 0″

(b) ***By Hand:*** Use long handled shovel, digging spoon, and digging bars. Place the earth removed from the hole to one side where it will not interfere with the erection of the pole. Where the excavated material is partly rock, separate the rock from the earth to facilitate backfilling.

(c) ***With Hand Earth Auger or Post Hole Digger:*** The hand auger or post hole digger can be used to advantage where the required diameter of the holes is not greater than 10 inches and the earth is relatively free from large stones and rock. It will usually be desirable to have the shovel, spoon, and digging bars also available.

(d) ***With Dynamite:*** In general, any work with dynamite for pole holes should be done by contractor.

5.16 In soft soil and swampy ground.

(a) ***By Hand:*** Where the soil caves while digging, a barrel or oil drum with the heads removed or a split iron cylinder may be used to act as shoring. Place the barrel or cylinder in position when the earth starts to cave and force it down as the earth is removed from inside. After the pole is erected, the split cylinder may be removed for re-use.

(b) ***Water Jet Method:*** In sandy ground where water is close to the surface, and means are available for forcing a large volume of water through a nozzle to be placed alongside the pole to be set, the water jet method may be employed. See Section 621-205-200 for instructions regarding setting poles by the water jet method.

5.17 In hard clay, gumbo, or rock. The methods to be employed in hard soil will vary considerably with the conditions. The earth boring machine is capable of digging a hole under conditions that would be extremely difficult for hand digging. Under the most severe conditions, however, a contractor with dynamite should be employed. If compressed air tools are available, their use will facilitate the work of excavating holes. See 649-540 Subdivision.

5.18 In wet ground and loose ground that cannot be tamped to a firm foundation, the hole should be made large enough to permit placing an anchor plank under guyed corner or dead-end poles or unguyed poles that will carry a heavy load.

HOLES IN CONCRETE SIDEWALKS

5.19 In concrete sidewalks, remove only enough pavement to permit digging holes of the required size and proper tamping of the backfill.

REPAVING

5.20 When suitable arrangements can be made with the municipality or property owner involved, it is desirable to leave an unpaved collar (2 to 3 inches wide) around the pole. This will facilitate future pole inspection, replacement, or removal.

5.21 Where repaving up to the circumference of the pole is required, it is desirable that it should be deferred until the backfill has completely settled.

HOLES IN LAWNS

5.22 Exercise care to prevent unnecessary damage to lawns. Use a tarpaulin to store earth from the hole. Remove sod from hole location in such a manner that it may be replaced between pole and edge of hole.

6. FACING POLES

DEFINITION OF FACE

6.01 The face of a pole is defined as the concave side of the pole. If the pole is practically straight, the face may arbitrarily be designated as either side of the pole in line with the lead. The face of a pole is also defined as the side of the pole on which the crossarms are attached.

FACING OF POLES CARRYING CABLE ONLY

6.02 In straight sections of line, set poles so the cable bolt hole is at right angles to the direction of the lead.

6.03 At strand deadends, set poles so the cable bolt hole is in line with the direction of the lead.

6.04 At corners, set the poles so that the direction of the cable bolt hole bisects the corner angle.

FACING OF POLES CARRYING OPEN WIRE

6.05 In straight sections of line, set adjacent poles so they face in opposite directions. It is unnecessary to observe this general rule for pole replacement work. See Fig. 21.

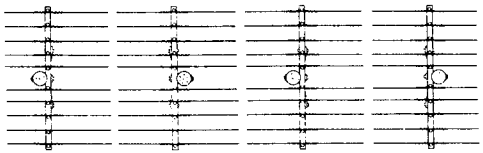

Fig. 21—Facing of Poles—Open Wire

6.06 Face a corner pole so the crossarms will bisect the corner angle as shown in Fig. 22. At two-pole corners, face the corner poles so that the crossarms will face away from the straight section of line. See Fig. 23. Crossarms on a straight line pole adjacent to a corner pole shall face toward the corner pole; however, in pole replacement work the replacing pole may be faced in the direction which will permit the easiest transfer of crossarms.

At corners where double crossarms are used and where head and side guys are required, the crossarms may be placed at right angles to the longer straight section of the line, to reduce interference between guys and crossarms. See Fig. 24.

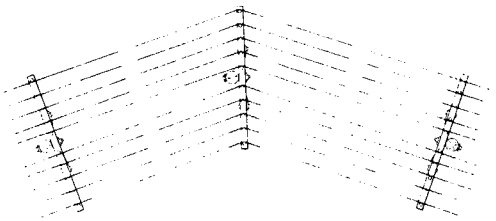

Fig. 22—Face Corner Pole

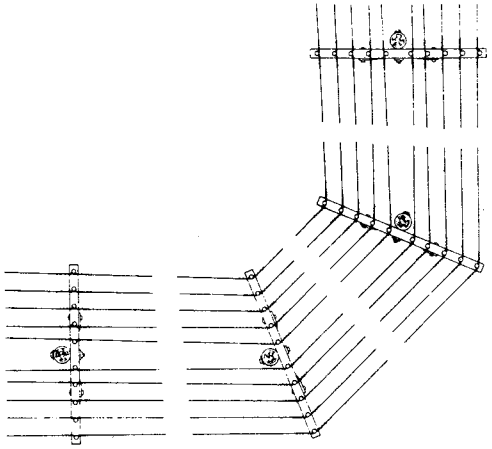

Fig. 23—Face Two Corner Poles

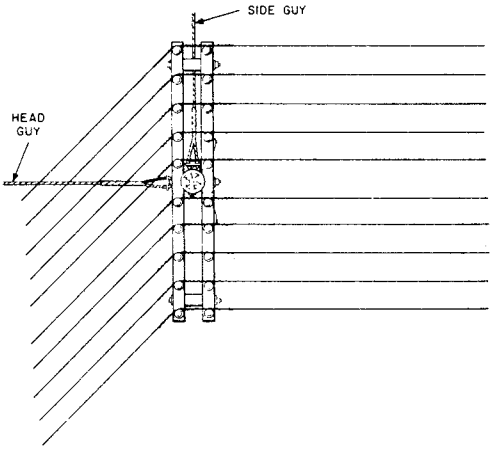

Fig. 24—Face Pole at Double Arm Corner

Note: A crossarms bisects a corner angle when it points to the midpoint of a tape line stretched between two points laid off a convenient distance, ie, 50 feet, along the lead from the corner pole as shown in Fig. 25. If a B or C Pull Finder is available, it will be more convenient to bisect the corner angle by its use, as outlined in Section 621-400-011.

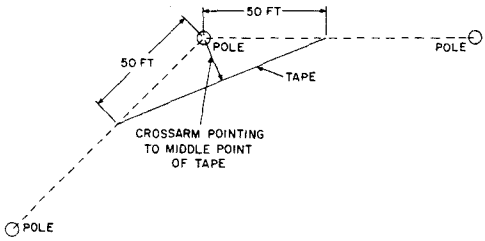

Fig. 25—Bisect a Corner Angle

6.07 At open wire deadends, set poles with the face away from the last span. Set the pole next to the dead-end pole with the face toward the last span (Fig. 26).

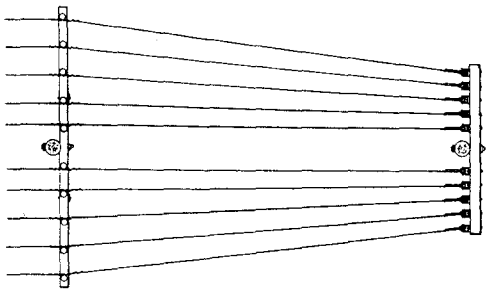

Fig. 26—Face Dead-End Pole—Open Wire

FACING GUY STUBS

6.08 Guy stubs should be set with the face toward the guy anchor.

7. SOFT SOIL BRACES

SOFT SOIL AND SWAMP CONSTRUCTION

7.01 The type of construction to be employed in swampy locations or in other unstable ground will vary with conditions. The following general description of types of fixtures will assist in the selection of the type to be employed. Under certain conditions, extra depth of set is needed in addition to soil bracing. The plant engineer will specify when extra depth of set is needed and the amount of extra depth.

(a) ***Anchor Plank Ground Bracing,*** as described in 7.02 is for use where the poles are set in earth which may be soft or unstable at certain seasons and the pole itself would not provide sufficient bearing area against the earth to remain vertical when exposed to crosswinds. This type of bracing is not suitable for use in cases where the loads to be supported are so heavy and the ground so soft that there would be a tendency for the poles to sink. Where such conditions exist, it is desirable to place an anchor plank under the pole to provide an additional footing, as described in 7.03 or to use a platform support as described in 7.04 and 7.06.

(b) ***Poles with Platform Support and Plank Bracing,*** as described in 7.04 are suitable for use where additional earth bearing is required to prevent the pole from sinking and the exposure to crosswinds is not severe.

(c) ***Poles Guyed with Swamp Anchors***—When the exposure to crosswinds is great, the required stability against overturning can be obtained by the use of swamp anchors as outlined in 7.05.

(d) ***Poles with Platform Support and Swamp Anchors*** are suitable for use where additional earth bearing is required to prevent the pole from sinking and the exposure to crosswinds is severe. See 7.06.

GROUND BRACED POLE USING ANCHOR PLANKS

7.02 The method of using anchor planks for ground bracing is shown in Fig. 27.

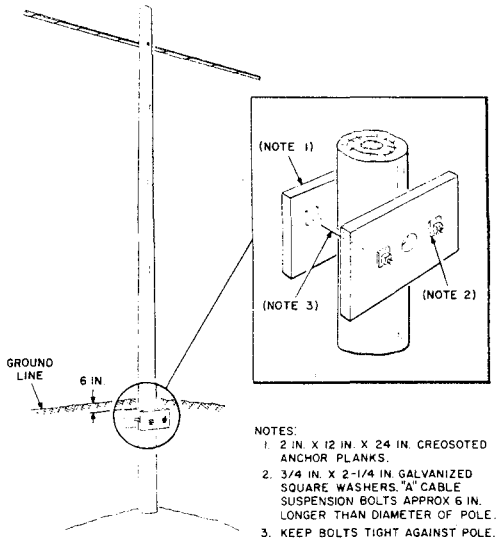

Fig. 27—Anchor Plank Ground Braced Pole

7.03 The use of an anchor plank under a pole provides additional footing to prevent a pole from sinking. See Fig. 28.

POLE WITH PLATFORM SUPPORT

7.04 The construction of a platform support to prevent a pole from sinking in swampy ground is shown in Fig. 29.

7.05 Preservative treated planks of pine or fir and of proper length should be ordered to avoid cutting in field and exposing untreated wood.

7.06 A cable suspension bolts must be approximately six inches longer than the diameter of the pole or of the length of blocks at ends of platform.

POLE GUYED WITH SWAMP ANCHORS

7.07 The 10-inch, 12-inch, and 15-inch screw type anchors are generally the most practical type of swamp anchor. They should be installed in accordance with Section 621-415-202. It is desirable that the Lead/Height of the guy be at least 1 to facilitate the installation and reduce the down pull of the guys on the pole. Fig. 30 shows a typical

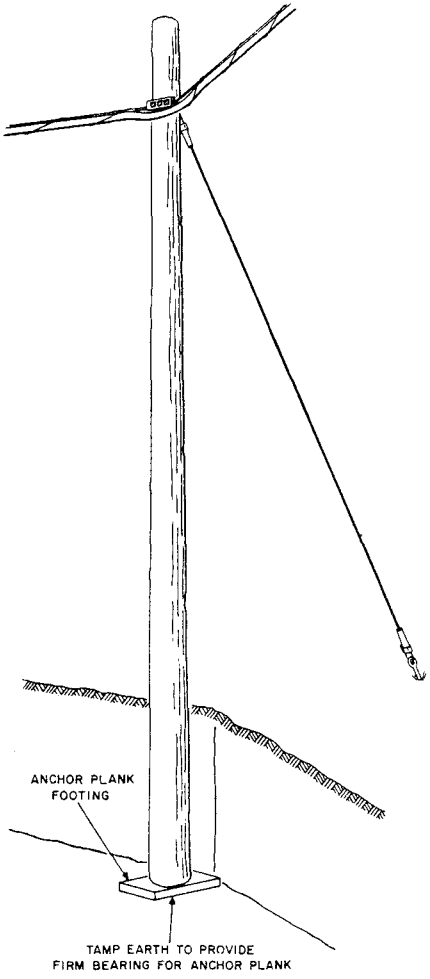

Fig. 28—Anchor Plank Footing

installation of swamp anchors. Generally, the pole should be provided with additional footing, such as is described in 7.03 or 7.08.

POLES WITH PLATFORM SUPPORT AND SWAMP ANCHORS

7.08 This type of construction is a combination of the platform support shown in 7.04 and swamp anchors shown in 7.07. A typical installation is shown in Fig. 31.

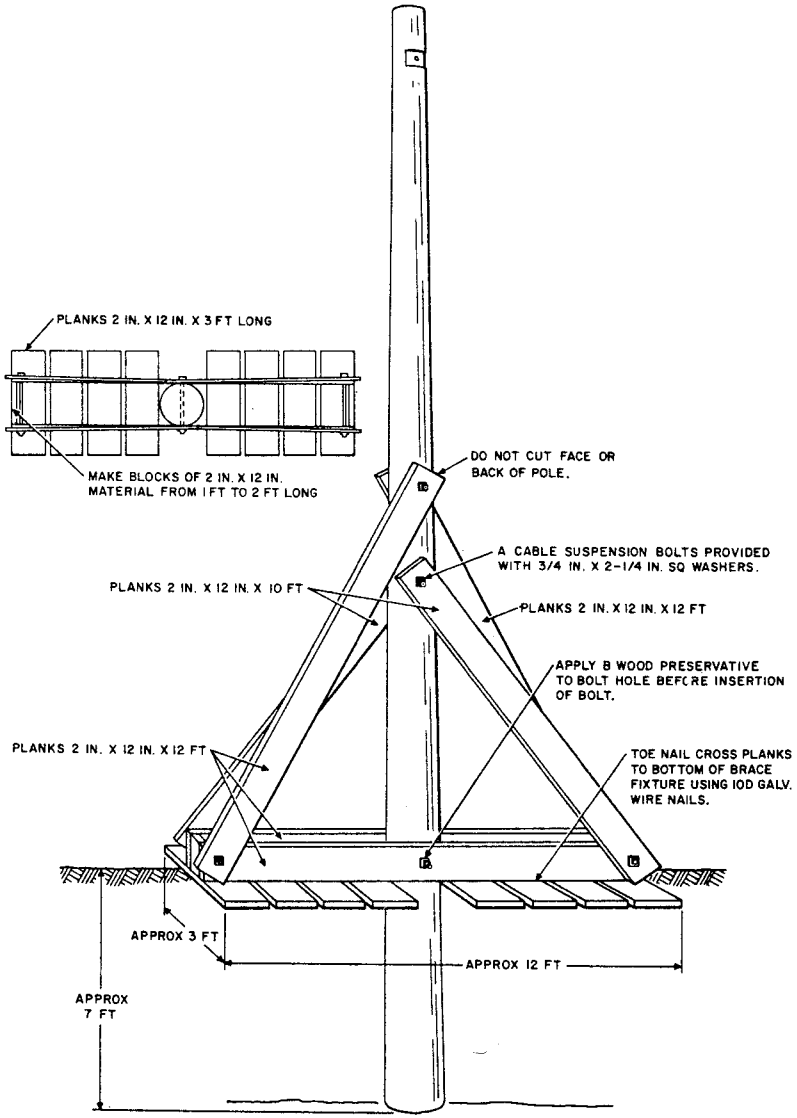

Fig. 29—Platform Support With Plank Bracing

Note: Swamp anchors eliminate the need for a plank bracing.

7.09 See 7.05 and 7.06 for information on planks and A cable suspension bolts.

H FIXTURE WITH PLATFORM SUPPORT

7.10 H fixtures set in unstable ground may require ground bracing to prevent the fixture from sinking. The type of support to be provided will usually be of the platform type described in 7.04. A typical installation of an H fixture provided with a plank platform is shown in Fig. 32.

Note: The two-pole fixture with crossarms eliminates the need for plank bracing.

7.11 See 7.05 and 7.06 for information on planks and A cable suspension bolts.

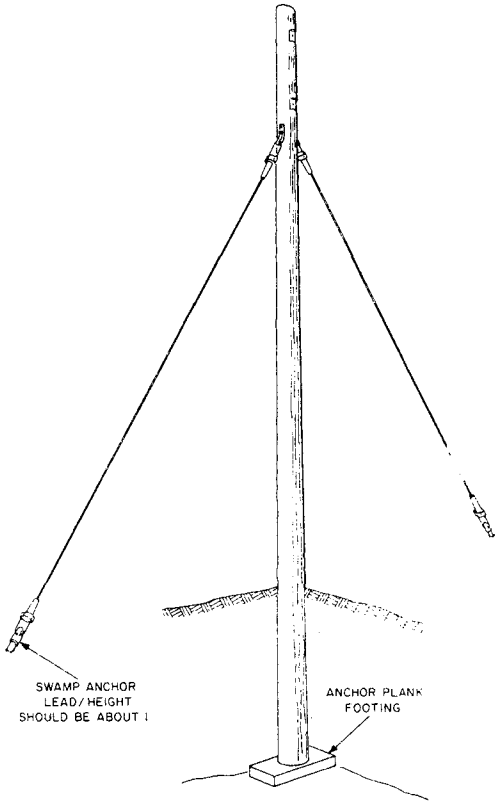

Fig. 30—Swamp Anchors

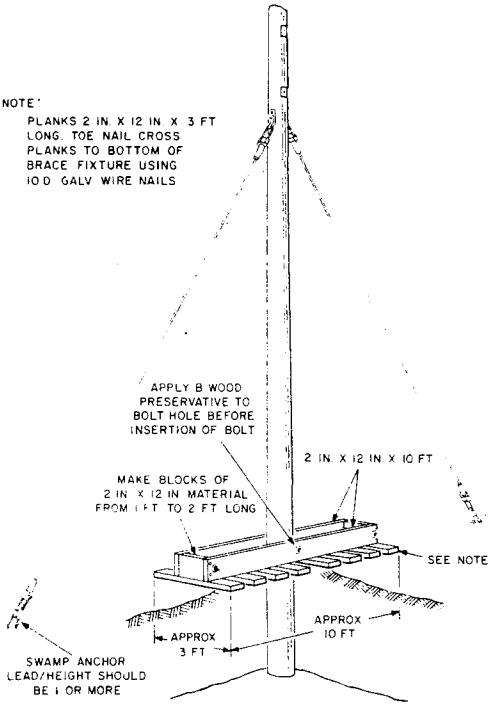

Fig. 31—Platform Support and Swamp Anchors

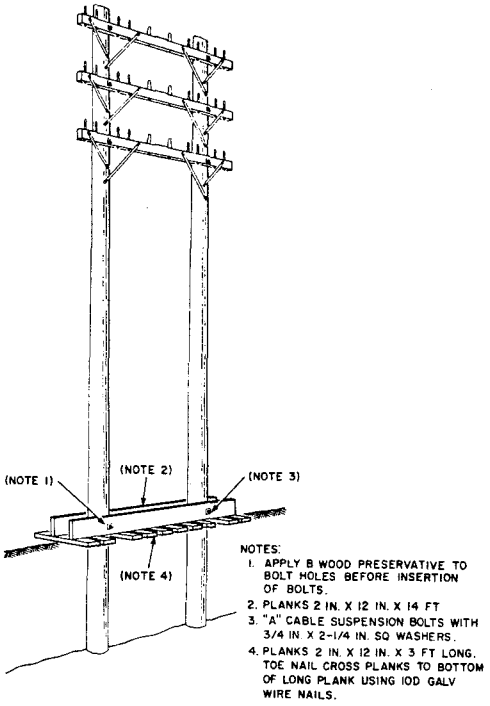

Fig. 32—H Fixture With Platform Support