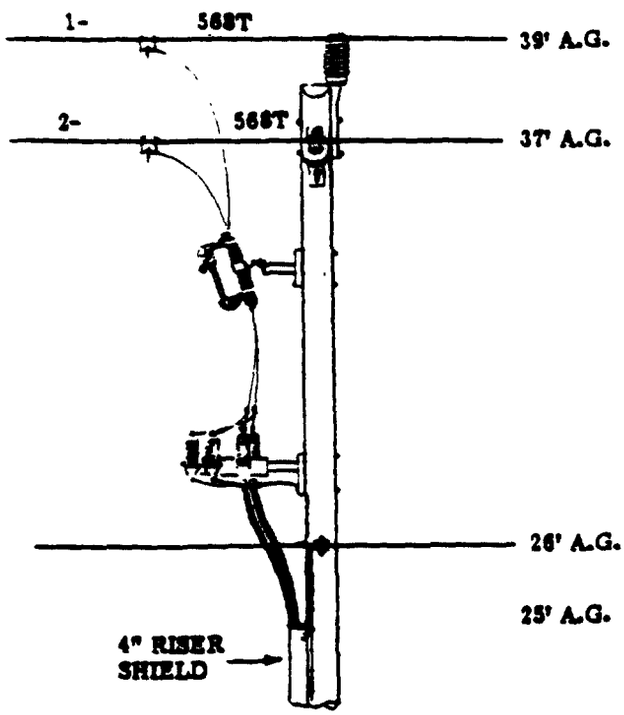

WIND LOADING CALCULATIONS: EXAMPLE C

Determine class of 45' pole required for 3-568 kcmil ACAR primary, 1 #3/0 AAAC neutral, and a 4" riser shield.

Proposed average span is 200'.

Calculate moment for each conductor and for riser shield. Total all moments.

No. of Conductors	x	Wind Load Per Foot (TABLE A-1)	x	Span Length	x	[Height Above Ground	+	Setting Depth / 3]		
1	x	.659	x	200'	x	(39'	+	2.33')	=	5,447.3
2	x	.659	x	200'	x	(37'	+	2.33')	=	10,367.4
1	x	.377	x	200'	x	(26'	+	2.33')	=	2,136.1

Riser Wind Load from TABLE A-2	x	Riser Height Above Ground	x	[Riser Height A.G. / 2	+	Setting Depth / 3]		
4 lb/ft	x	25'	x	(25/2	+	2.33')	=	1,483.0

Total of all moments = 19,433.8 ft.-lb.

From TABLE A-3, the initial allowable moment of a 45'/3 pole is 23,535 ft.-lbs.

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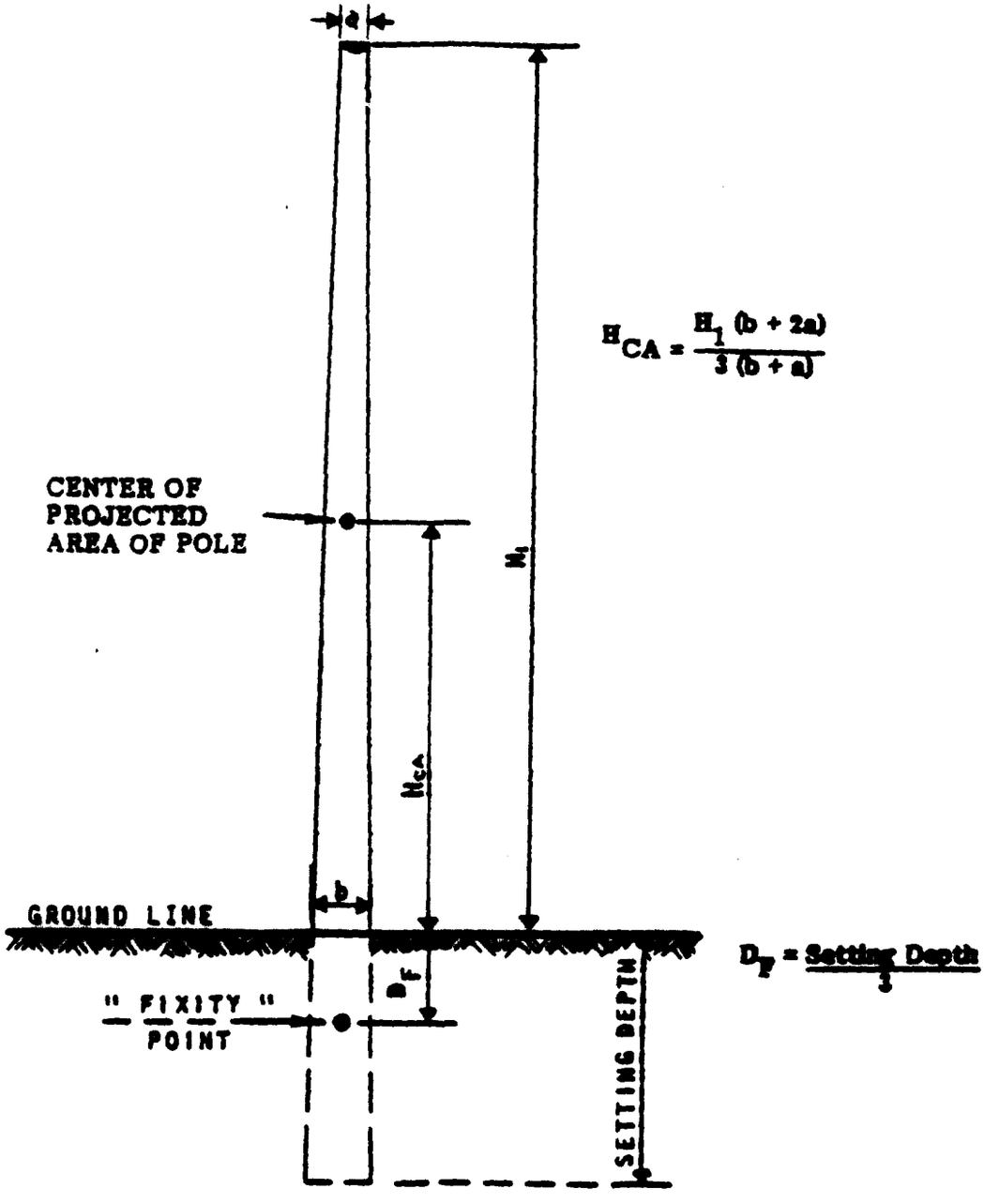

FIG 1. DIMENSIONS USED IN CALCULATING WIND LOAD ON POLE

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4. Columnar (Axial) Loading On Wood Poles

a. General

At corners and deadends, poles are down-guyed to hold conductor tension. The vertical component of the tension in the guy wire places an axial compressive force on the pole. The pole is a column, and excessive axial compressive load will cause it to bow. The critical buckling load has been reached when bowing starts. At this point, if the loading is reduced, the pole will straighten out. If loading is increased, the bowing will increase, and failure by buckling will eventually result if the loading is increased enough.

Where a combination of vertical, transverse or longitudinal loads may occur simultaneously, the structure shall be designed to withstand the simultaneous application of these loads.

b. Longitudinal Strength at Deadends

NESC Rule 261A2 states that at deadends, the pole must be able to support the longitudinal loading multiplied by 2 when installed or 1.33 at replacement without exceeding the ultimate fiber stress. For guyed poles, this fiber stress is measured at point of attachment of the guy. FPL practice is to attach guys at or very near the point of application of conductor tension, so that this requirement is seldom a problem for standard guyed deadend poles. Where extreme wind loading conditions are used, (see NESC Rules 260C and 250C) a multiplier of not less than 1 may be used for poles.

c. Columnar (Axial) Loading

Guyed poles must be designed as columns resisting the vertical component of guy tension, plus any other vertical loads. A guyed deadend pole may be considered as a column fixed in place at the "fixity" point, defined as 0.33 of the setting depth below the ground line. At the top, it is fixed in position in one plane (the longitudinal) only and free to bow in either plane. Lateral movement of the pole top will be resisted by a slight increase in conductor tension.

d. Corner or Junction Poles

A corner pole or a junction pole can be considered to have the same restrictions at the bottom as a deadend pole. At the top, however, it is fixed in position in each plane.

At a junction pole, the guy would stress the pole in the same manner as at a deadend pole. At a 90° corner, there would be two guys, each exerting a downward force on the pole. However, the direction of the wind cannot be perpendicular to both conductors. A wind direction should be assumed which will give the maximum resultant load. Proper reduction should be made in loading to account for the reduced wind pressure on the wires resulting from the angularity of the application of the wind to the wires.

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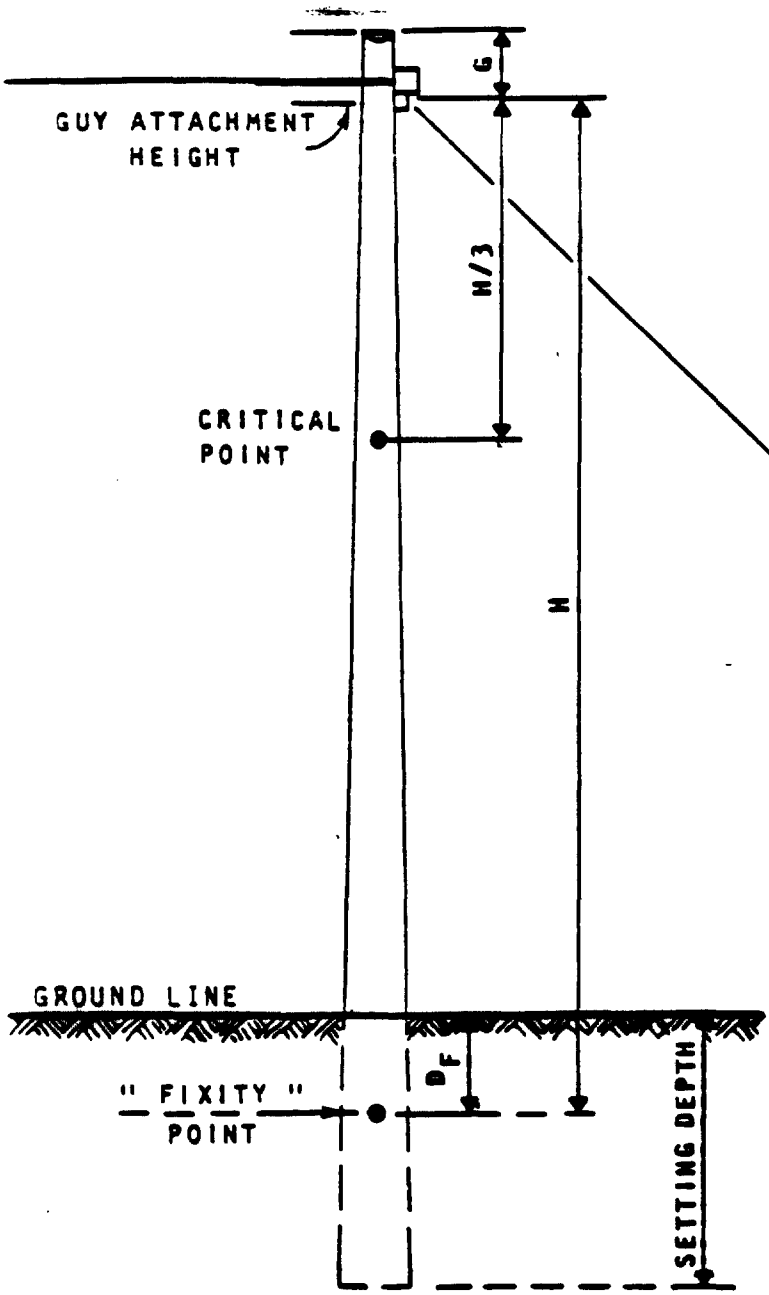

With pole framed per DCS E-11, Fig. 1, on concrete pole, dimension G = 11". With pole framed per DCS E-11, Fig. 4, on wood pole, dimension G = 21".

H = Pole Length - (2/3 Setting Depth) - G

$D_F = \frac{\text{Setting Depth}}{3}$

FIG 2. DIMENSIONS USED IN CALCULATING AXIAL LOAD ON POLE

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e. Calculating Allowable Axial Loading

If we assume, as an approximation, that the bottom of the pole is fixed and that the top is held in place as though pinned on a ball joint, Euler's modified formula with an end condition factor of 0.8 may be used. However, to be more conservative, we used a factor of 1.0 to obtain the recommended allowable loadings shown in TABLE C. This table may be modified if new data, specifically applicable to guyed distribution poles, is obtained.

$$P = \frac{\pi^3 \times E \times d^4}{64 \times 1 \times SF \times (12H)^2} = \frac{\pi^3\ 1.76 \times 10^6}{64 \times 1 \times 1 \times 144} \times \frac{d^4}{H^2} = 5921\frac{d^4}{H^2}$$

(Euler's Formula, Southern Yellow Pine, with effective column length equal to actual column length)

where P = Allowable downward force on the pole, in pounds.

E = Modulus of elasticity, 1.76×10^6 psi for southern yellow pine.

H = Distance in feet from point of guy attachment to fixity point.

SF = Safety Factor. We justify using 1.0 on basis that maximum loading is based on wind loading, an infrequent, short-time load, and that Euler's formula is conservative for distribution length poles. In addition, minimum diameters for pole class were used.

d = Diameter, in inches at critical point, (1/3 H feet down from guy attachment).

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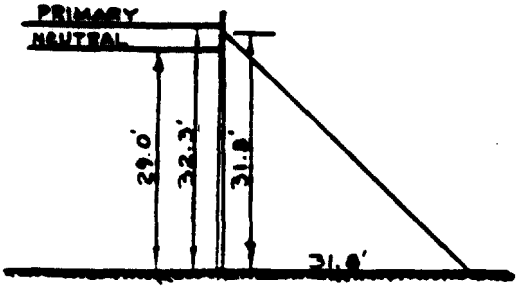
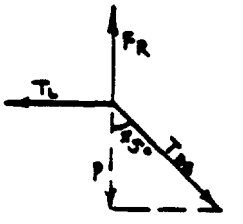
f. Examples

Example #1. Three phases of #3/0 AAAC and 1 #1/0 AAAC neutral are to be deadended on a 40 ft. pole as per DCS E-11, Fig. 4, with neutral 40" below the primary. Anchor lead is equal to attachment height. Is a class 5 pole adequate?





Primary: 3 #3/0 @ 2870# = 8610#; Moment = 8610 x 32.3 = 278,103 ft.-lb.
Neutral: 1 #1/0 = 1890# Moment = 1890 x 29.0 = 54,810 ft.-lb.
Total Moment = 332,913 ft.-lb.

Guy is attached at 31.8'; Horizontal component of guy tension

$$T_L = \frac{332,913}{31.8} = 10,469 \text{ lb.}$$

$P = T_L = 10,469$ lb. vertical force

T_L is the summation of the moments due to the conductors, all referred to the point where the down guy is attached.

In this case, since the guy is at an angle of 45° to the pole, the axial load on the pole (the vertical component of the guy tension) is equal to the horizontal component T_L.

Referring to TABLE C, the maximum allowable axial loading for a 40' class 5 pole is 15,500 lbs. Therefore, the class 5 pole is adequate.

For the vector diagram to be technically correct, the force F_R must be shown. F_R represents the resisting force with which the pole must push upward to counteract the downward pull of the guy. Thus, T_L, F_R, and T_{DG} are in equilibrium, all acting at the point of guy attachment on the pole.

At this point, we may as well proceed to calculate the guy tension and select the guy wire size.

With the 45° guy angle, $T_{DG} = \frac{10469}{\cos 45°} = \frac{10469}{.707} = 14,808$ lb.

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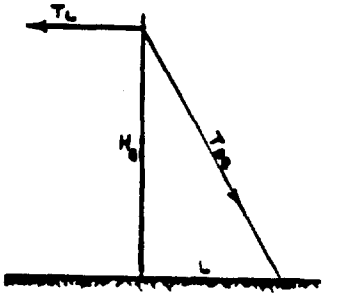
Or, it may be calculated this way: $T_{DG} = (10,469)^2 + (10469)^2 = 14,805$ lb. (more accurate).

Referring to DCS D-5, Table II, we find that a 9/16" EHS galvanized guy wire, with allowable deadend tension of 20,160 lbs. will be required.

If the guy is not attached at the optimum 45° angle, the calculation may be done as follows:



$$T_{DG} = \frac{T_L}{L} \times \sqrt{H_G^2 + L^2}$$

$$P = \frac{T_L}{H_G} \times \sqrt{H_G^2 + L^2}$$

Where H_G is the height above ground of the guy attachment, and L is the guy lead.

Having determined the pole class and the required guying, it is desirable to check to be sure that the simultaneous application of axial loading (caused by the deadend guying) and transverse wind loading does not overstress the pole fibers. The common practice in doing this is to consider that the greatest fiber stress is experienced at the "critical point" (see Fig. 1), which is defined as follows.

If poles were not tapered, axial loads would cause them to bow in the middle - that is, halfway between the fixity point and the point where the load is applied. Fiber stress due to bending moments from transverse loading would be uniform up and down the pole. However, since each pole is tapered, the point of maximum fiber stress is shifted upward. Looking again at Fig. 1, the critical point, or point of greatest fiber stress, is generally accepted to be at H/3, measured down from

(1) the pole top, when considering wind loading on the pole;
(2) the point of conductor attachment, when considering wind load upon conductors;
(3) the point of guy attachment, for axial loads.

Since points 1, 2, and 3 are usually only a few inches apart, it is sufficiently accurate for our purposes to assume one point, such as point 2, from which to measure to locate the critical point.

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Having done this, it is common practice to add the "per-unit" of allowable axial loading and the per-unit of transverse loading at the critical point, and be sure that the sum of the two "per-units" is not greater than 1.0. In other words,

$$\frac{P}{P_{allowable}} + \frac{M}{M_{allowable}} \leq 1.0$$

From our previous calculations, the axial loading P in this example is 10,469 lbs. $P_{allowable}$ from TABLE C is 15,500 lbs.

To locate the critical point, we can measure from the primary attachment height.

Dimension H = 40' - 2/3 setting depth - distance from primary to pole top
H = 40' - 4.33' - 1.17' = 34.5'
H/3 = 34.5/3 or 11.5' (down from a point 1.17' below pole top)

Critical point is 12.67' below pole top. We can round this to 12.5'.

In calculating the transverse load due to the pole itself, we consider only the part of the pole above the critical point. The projected area of this portion equals the average diameter times its length. Diameters can be obtained from TABLE G.

$$\text{Projected Area } A_p = \frac{d_1 + d_2}{2 \times 12} \times 12.5' = \frac{6.05'' + 7.51''}{2 \times 12} \times 12.5' = 7.06 \text{ sq. ft.}$$

The transverse load due to the pole is 9 lbs.-per-sq.-ft. x 7.06 sq. ft. = 63.56 lb. Since this load can be considered to be concentrated at the center of the area, the moment can be computed as .46 x 12.5 ft. x 63.56 lbs. = 365.5 ft.-lbs.

The transverse load due to the conductors, from TABLE A-1, is 1.427 lb./ft. Assuming a 250' span (125' half-span), the transverse load is 178.4 lb. The moment, then, is 178.4 lb. x 11.5 ft. = 2052 ft.-lbs.

Total moment at critical point = 2052 + 365.5 = 2,417.5 ft.-lbs = 29,010 in.-lbs.

$$M \text{ (Fiber Stress)} = \frac{\text{Moment}}{\text{Section Modulus}} = \frac{29{,}010}{\pi \times D^3/32}$$

$$= \frac{29{,}010}{\pi \times (7.51)^3/32} = 698 \text{ p.s.i.}$$

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The final check is: $\dfrac{P}{P_{allowable}} + \dfrac{M}{M_{allowable}}$

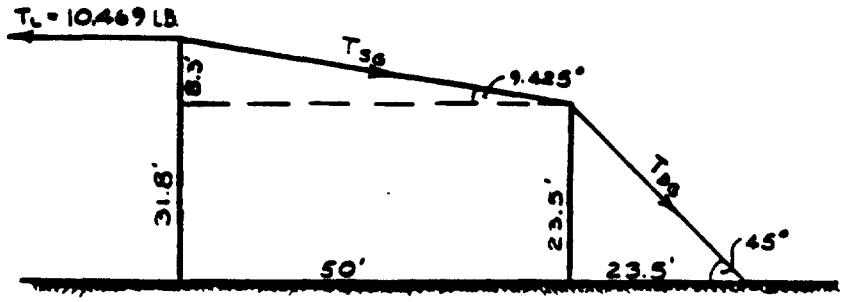
$$= \frac{10,469}{15,500} + \frac{698}{8000} \leq 1.0 \ ?$$

$$.6754 + .0873 = .7627 \leq 1.0$$

The combined loading is acceptable.

It is not suggested that this involved calculation need be done for every proposed deadend pole. However, it should be done for several commonly seen combinations of pole, conductor size and span lengths. This will give an understanding of the process, and a file of solutions which will cover many situations.

Example #2. In Example 1, suppose it was not possible to get an adequate lead for a down guy. Design a span guy and guyed stub to hold this deadend. The stub would be 50 ft. from the deadend.



$T_L/T_{SG} = \cos(\tan^{-1} 8.3/50) = \cos 9.425^\circ = 0.9865$

$T_{SG} = T_L/0.9865 = 10,469/0.9865 = 10,612$ lb.

Axial load on DE pole due to $T_{SG} = T_{SG} \times \sin 9.425^\circ = 1,738$ lb.

$T_L/T_{DG} = \cos 45^\circ = 0.707$; $T_{DG} = T_L/0.707 = 10,469/0.707 = 14,808$ lb.

Axial load on guy stub = Downward Component T_{DG} - Upward Component T_{SG}

Axial load on stub = $T_{DG}(\sin 45^\circ) - 1738 = 10,469 - 1738 = 8,731$ lb.

The axial load on stub is within allowable limits for a 30 ft. class 5 pole (TABLE C); 7/16 EHS guy wire will be required for the span guy and 9/16 EHS for the down guy.

<u>Solution</u>: Use 30 ft. class 5 stub, with 1:1 anchor lead, 7/16 EHS guy wire for the span guy and 9/16 EHS for down guy. Choose an anchor from DCS D-4 which will not exceed the allowable tension when holding 14,808 lb. Check to see that P/Pa + M/Ma = 1 for the stub. In this case, we are well on the safe side.

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D. SELECTING POLE HEIGHTS

Where joint use is anticipated, our standard height poles have been 40' on streets or alleys, 35' in rear easements, and 30' for most guy stubs and service poles. However, there are many factors and conditions which may require extra height, such as vertical-framed primary plus telephone and CATV attachments.

Other factors which should be considered before specifying pole height include the following:

1. Will the pole have a primary tap or crossover requiring extra height?

2. Will extra pole height be required to accommodate a transformer installation, or cable riser?

3. Will additional height be needed to cross a railroad, canal, telephone circuit, traffic signal facility, sign or other obstacle?

4. Is it likely that a street light will be installed on the pole and if so, what mounting height will be required? The larger mercury vapor and sodium vapor lights require mounting heights in excess of 30'.

5. To control the conductor elevation in a flying tap, will the pole need to be set at a non-standard depth?

6. Will the pole height need to be restricted because the line passes under a transmission line or is near an airport?

7. Will the pole chosen create a change in grade for the conductors of no more than 5' in 100'?

8. Will the pole height be adequate to accommodate planned future facilities? One phase now—three phase in the future!

9. Is the soil condition unstable so that the pole may have to be set deeper?

E. POLE PLACEMENT

1. Residential Areas

a. Rear distribution poles generally should be set 12" to 18" from the property line. This will ensure that our facilities do not interfere with present or future surveys. Particular attention should be paid to proper staking when lines cross from one block to another to ensure the line remains in the easement.

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b. For front distribution, easements should be obtained, and poles set one foot inside the property. If this is impractical, front distribution poles generally should be in the road right-of-way (R/W), set with the field face at the R/W line. Poles should be not less than one foot from the street side of the curb where there is a curb. See also DCS B-3, Note 12.

2. Primary and Secondary Roads

Sidewalk widths vary somewhat, but the five-foot sidewalk with six-inch curb is most prevalent. The practice of leaving a grass strip between the sidewalk and the curb has essentially been abandoned. As a consequence, any new pole line located on a six-foot offset from the R/W line is a candidate for future relocation.

It is therefore recommended that an attempt to be made to locate all new pole lines on private property with the road face of the pole at the R/W line. With vertical construction, this will eliminate conductor encroachment over private property. Setback regulations for building will ordinarily eliminate any interference but easements for the poles will, in all cases, be required.

In areas where apartment or other buildings preclude this location due to inadequate clearances, the proposed pole line should be staked with street face three inches back of a future curb. If the future curb location cannot be ascertained, assume a five-foot sidewalk with abutting curb or street face of pole to be 4.75 feet from the R/W line into the street.

3. DOT Requirement

On all Federal, State and County maintained roads, all new pole lines should be installed at the R/W line, regardless of the distance from the through travel lanes.

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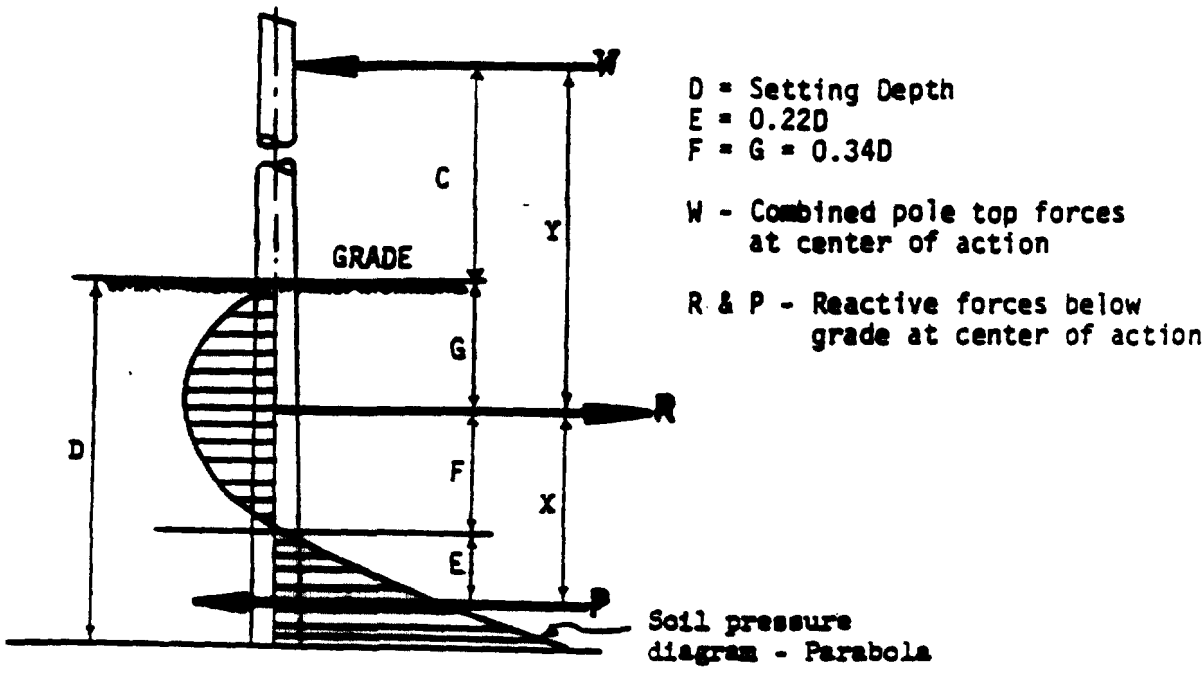
F. UNGUYED POLES

1. Limitations

Where guy installation is impractical it may be possible to install an unguyed pole. All safety factors and pole strength limits discussed in the Poles General Section must be applied as well as below grade upset limitations. (By "upset" we mean the pole leaning due to movement of the earth.) Upset limitations can be calculated in the following manner:



The figure shows the principal forces acting on a pole set in compressible soil and subjected to a horizontal load at a certain distance above the ground line. The pressures developed are considered as the ordinates to a parabola located such that the pressure area on one side of the pole bears the same relation to that on the other side as R does to P, these being the butt reactions. By the principle of moments,

$$P = W\frac{Y}{X} \text{ and } R = P + W.$$

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Maximum soil pressures developed are calculated by the formula

$$p \text{ (tons per square foot)} = \frac{0.003\ R}{D \times d} \text{ where}$$

D = setting depth in feet and d = butt diameter in feet.

from the Figure: E = 0.22D and F = G = 0.34D

2. <u>Lateral Bearing Strength of Soil</u>

The following discussion uses values of soil strengths that are somewhat conservative. Therefore, calculations for pole upset should be limited to cases where poor soil strength conditions exist or where in good soils, poles not listed on TABLE A (i.e. transmission guy stubs) are used unguyed.

The lateral bearing strength of various soils cannot be listed precisely and completely because soils do not behave in this manner. Soils that look similar may have different values of bearing strengths, and soils may completely change characteristics as depth increases. The only sure method of finding these values is an actual test of the individual soils, procured from the depth in question. This test can be performed by a testing laboratory.

An approximate value can however be used if sufficient safety factors and good judgement are applied. A value of 1500 psf/ft. of depth can be applied to most cohesive Florida soils. Generally if the sides of an augered hole do not collapse, the stated value of 1500 psf/ft. can be used for upset calculations (this includes no Safety Factor). Some other values of lateral bearing strength to be used as a guide for estimating soil strengths are: rock 4000 psf/ft. and dry sand 500 psf/ft. Using these 3 figures and judgement, an approximate value for all soils can be arrived at. Remember to apply safety factors discussed on TABLE A to your calculations for pole strengths.

Applying the above to an example of an unguyed pole:

<u>Example for soil bearing calculations:</u>

40 ft. class 2 pole set at 6 ft. in soil judged to be approximately 800 lbs. per sq. ft./ft. of depth in lateral bearing strength. A force of 700 lbs. is acting at 33' above ground level.

Using tables for pole circumference d = 1.08'

W = 700 lbs; C = 33'; D = 6'

F = G = .34D = 2.04'; E = .22D = 1.32'

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$X = E + F = 3.36'$

$Y = G + C = 35'$

$P = W\frac{Y}{X} = 700 \ \frac{35}{3.36} = 7291.67 = 7292$

$R = P + W = 7992$

$p = \frac{.003R}{D \times d} = \frac{.003\ (7992)}{6 \times 1.08} = \frac{23.98}{6.48} = 3.7$ ton psf

at 6' of depth this soil's value of lateral bearing strength = 6 x 800/2000 = 2.4 tons psf

Since the strain on the pole produces a load on the soil that exceeds its ultimate this pole should: (1) be guyed, (2) have a slug of concrete poured around it, (3) be set at a greater than standard depth. The slug size will be determined by the above method using the dimensions of the slug instead of the pole butt. In the example above very little concrete would be required since the values of load versus capacity of the soil are close.

Using the following formulas from $p = \frac{.003R}{D \times d}$

$$d = \frac{.003R}{p \times D}$$

$$D = \frac{.003R}{p \times d}$$

The size of the slug or the increased depth can be calculated.

$$d = \frac{.003R}{p \times D}$$

$$d = \frac{.003R\ (7992)}{2.4 \times 6} = \frac{23.98}{14.4} = 1.67 \text{ ft. dia.}$$

$$D = \frac{.003R}{2.4 \times 1.08} = \frac{23.98}{2.59} = 9.26 \text{ ft. depth}$$

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G. GUYS

Guy Strength - See DCS D-5.

1. Design Criteria

FPL uses the requirements of Table 261-5 of the NESC as their design criteria for guys. For Grade B construction, this requires that we load deadend guys to only 60% of their ultimate strength and side or transverse guys to 33.8%. The conductor deadend tensions used to determine guy size and number are located in DCS D-5. These tensions are the sum of conductor stringing tension and a 9 pound per square foot wind load on the conductor, per NESC. For examples of guying calculations, see pages 10, 11, and 13, this section.

2. Guy Material

FPL uses galvanized guys in non-salt areas and copperweld in salt areas. The galvanized guy is preferred over copperweld, because it is more economical. However, galvanized rusts rapidly in salt areas and therefore, copperweld is the FPL standard there. Some copperweld guys do exist in non-salt areas, because at one time that was the only type FPL installed. It should be noted that if the copper coating of copperweld is nicked, exposing the underlying steel layer, the steel will sacrifice to the copper. The copper coating is left intact but the steel will corrode away. This will reduce the holding strength of the guy even though most of the guy wire appears to be in good shape.

3. Fiberglass Guy Strain Insulators

Guy insulators are used to increase BIL on wood poles in non-salt spray areas whenever a guy is installed above the neutral for 13 kV and above. Insulators need not be installed where arresters are on the pole. Guy strain insulators are not to be installed in salt areas or on concrete poles, since all wood pole hardware is bonded to ground, and concrete pole hardware is effectively grounded. Their use would not increase BIL. Occasionally, there is an exception to this rule. When a galvanized screw anchor or a galvanized anchor rod is buried in moist earth saturated with salt or other electrolyte near buried copper or copperweld electrodes, excessive corrosion of the galvanized member may occur. When this condition is discovered, installing a guy strain insulator will break the path of galvanic current and reduce further corrosion.

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H. GENERAL INFORMATION -ANCHORS

1. Anchor Types

FPL uses three types of anchors: the screw anchor, the concrete slug and the rock anchor. (See DCS D-4 for M&S numbers, strength and holding abilities of these anchors.) The screw anchor is preferred over the others, because it is the most economical and quickest to install. Concrete slug anchors are used in poor soil conditions or where space will not permit screw anchor installations. The rock anchor is used where rock conditions make it impossible to install a screw anchor, but are favorable for cementing in the rod of a rock anchor.

2. Anchor Rod Identification

The type of an existing anchor can be determined by checking the anchor rod. A concrete anchor will have an anchor rod that is 3/4" or 1" in diameter with a twin eye for attaching guys. A screw anchor rod will be 1-1/4" in diameter with a triple eye. Anchor rod sizes and manufacturer are also stamped just below the eye of the rod. The anchor rods might, as an example bear the marking C-3/4-8 which indicates, Chance (vendor) -3/4" rod -8' long. Screw anchors are marked the same, such as, C-10-96. This indicates, Chance -10" helix -96" long.

3. Copperweld Anchor Rods

The standard anchor rods to be used with our concrete anchors are galvanized steel (3/4" & 1"); however in situations where the anchor must be installed in brackish water, or filled areas known to be corrosive, a copperweld rod should be used. This is necessary because the galvanized rod would rapidly deteriorate in the salt water.

4. Multi-Helix Screw Anchors

Should be used on feeder size conductor deadends where possible and any other instances where their holding strength is needed.

5. Anchor Locations

Use caution in anchor placement. Anchors are usually more objectionable to the customer than a pole. Stay clear of driveways and walkways. Try to anchor along fence or hedge lines. This will hide the down guy and also eliminate yard maintenance problems. Follow fence lines in acreage also. Cattlemen and horsemen object to anchors and guys in pastures.

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6. Easements For Anchors

An easement should be secured for each anchor placed on private property. If the hole to place a concrete anchor will encroach on private property, then either an easement or permission should be secured before an attempt is made to place the anchor.

7. Retirement And/Or Removal

When an existing anchor is no longer required, it should be either cut off, or driven to 12" below finished grade and covered. When practical, screw anchors may be removed and re-used if in good condition; galvanizing should be intact. If there is a possibility of future excavation, then where possible, all anchors should be removed.

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TRANSVERSE POLE LOADING DUE TO WIND; TABLES A-1, A-2, and A-3

All strength requirements of National Electrical Safety Code Grade B construction are to be used as minimum design criteria for all overhead distribution lines, even where Grade B construction would not be indicated by the Code. As a consequence, minimum pole strength shall be calculated using a 9 lb. per square foot wind load acting upon the projected area of cylindrical surfaces, with a 1.6 multiplier used for the wind load on the area of flat surfaces.

For wood poles: On new construction, wood poles shall have a safety factor of 4 based upon their ultimate strength under the above conditions. This is equivalent to a wind load of 36 lb. per square foot based upon ultimate pole strength. Existing wood poles may be loaded to higher values shown in TABLE A-3 prior to replacement. These values, however, are based upon full remaining strength of the pole; they must be reduced to compensate for any deterioration. Strength of wood poles is based upon minimum dimensions outlined in ANSI Specification No. 5.1.

For concrete poles: Concrete poles shall have a safety factor of 2.5, as specified in NESC, Table 261-2. Strength of concrete poles, except for Type IIIG, is based upon the maximum repetitive load without opening permanent cracks.

For both wood and concrete poles: Strength of a pole is the maximum resisting moment at a fixity point or fulcrum point, 1/3 of the setting depth below the ground line. It is based upon setting depths as shown on DCS sheet D-3; the same figures may be used whether the pole is set in earth or rock. If the pole is set in concrete, or in a solid concrete sidewalk, the fulcrum point will be at the ground line; under this condition, use of the table will result in a slightly increased safety factor. Net allowable pole loadings are given in TABLE A-3. The strength absorbed by wind loading on the pole itself has already been deducted, and safety factors are already included.

Conductor loading given in TABLE A-1 is based upon projected area and a 9 lb. per square foot wind.

The tables are offered as a convenience. It is not intended that they be a substitute for engineering judgment or independent calculations if required.

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TABLE A-1

FPL CONDUCTORS

WIND LOAD IS MEASURED IN LBS/FT OF SPAN

$$\text{FORCE IN LBS/FT} = \left[\frac{\text{WIRE DIA. IN INCHES}}{12}\right] 9\#/\text{SQ. FT.}$$

WIRE SIZE	* O.D. IN INCHES	FORCE IN LBS./FT.
#6 COPPER	0.1620	0.122
#4 COPPER	0.2043	0.153
#4 ALUMINUM	0.2500	0.188
#2 COPPER	0.2920	0.219
#2 ALUMINUM	0.3160	0.237
#2 AL TREE WIRE	0.6560	0.492
#2 CU TREE WIRE	0.6322	0.474
1/0 COPPER	0.3680	0.276
#1/0 ALUMINUM	0.3980	0.299
#2/0 COPPER	0.4140	0.311
#3/0 ALUMINUM	0.5020	0.377
#4/0 COPPER	0.5220	0.392
#4/0 CU TREE WIRE	0.8617	0.646
#343.6 MCM ACAR	0.6840	0.513
#350 COPPER	0.6790	0.509
#568.3 MCM ACAR	0.8790	0.659
#568 AL TREE WIRE	1.2190	0.914
#4/0 CABLE SEC.	1.3760	1.032
#6 DUPLEX W/#4N	0.7040	0.528
#6 DUPLEX W/#6N	0.4760	0.357
#4 TRIPLEX	0.7040	0.528
#2 TRIPLEX	0.8290	0.622
#1/0 TRIPLEX	1.0650	0.799
#3/0 TRIPLEX	1.2680	0.951
#2 QUADRUPLEX	0.9270	0.695
#1/0 QUADRUPLEX	1.1900	0.893

* O.D. OBTAINED FROM DIST. STD. F-7A

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TABLE A-1 (continued)

$$\text{FORCE IN LBS/FT} = \left[\frac{\text{CABLE DIA. IN INCHES} + \text{MESSENGER'S DIA. IN INCHES}}{12}\right] 9\#/\text{SQ. FT.}$$

TELEPHONE CABLES

# OF PAIRS	COMMON MESSENGER SIZE	FORCE IN LBS/FT PIC 22-GA BHAA	24-GA BKMA	26-GA BKTA
25	5/16	0.71	0.64	0.59
50	5/16	0.84	0.74	0.66
100	5/16	1.03	0.88	0.66
200	5/16	1.32	1.11	0.95
300	5/16	1.55	1.28	1.08
400	3/8	1.78	1.49	1.23
600	3/8	2.08	1.72	1.41
900	3/8		2.00	1.66

SELF - SUPPORTING TELEPHONE CABLES

# OF PAIRS	FORCE IN LBS/FT 22-GA BHAS	22-GA BHAP	24-GA BKMS	24-GA BKMP	26-GA BKTS	26-GA BKTP
25	0.52	2.78	0.46	0.74	0.46	0.68
50	0.64	3.40	0.64	0.90	0.49	0.74
100	0.84	1.10	0.84	1.10	0.61	0.80
200			0.93		0.78	0.99
300					0.90	1.10

CATV CABLES

CABLE NAME	MESSENGER SIZE	DIA. IN INCHES	FORCE IN LBS./FT.
FEEDER	1/4	0.50	0.56
TRUNK	1/4	0.75	0.75

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TABLE A-2 FPL EQUIPMENT

WIND LOAD ON EQUIPMENT IS MEASURED IN LBS.

	SIZE	FORCE IN LBS.
TRANSFORMERS	10 KVA	29
	15 KVA	29.5
	25 KVA	33
	37 KVA	41
	50 KVA	49
	75 KVA	68
	100 KVA	70
	167 KVA	80
	FOR 2 PHASE BANK, ADD TX WIND LOADS	
	FOR 3 PHASE BANK, DOUBLE WIND LOAD OF LARGEST TX	

	SIZE BANK	FORCE IN LBS.
CAPACITORS	1200 KVAR SWITCHED	112
	1200 KVAR FIXED	95

	SIZE	FORCE IN LBS.
REGULATORS 1 PHASE, POLE MTD.	76.2 KVA, 100 A	104
	167 KVA, 219 A	153

	SIZE	FORCE IN LBS.
RECLOSERS	1 PHASE (DCS C-7)	36
	3 PHASE (DCS C-8)	95

	WIND LOAD IS MEASURED IN LBS PER FT OF CONDUIT	
RISER CONDUITS	NOMINAL SIZE	FORCE IN LBS/FT ABOVE GRADE
	2"	1.7
	4"	3.2
	5"	3.9
	6"	4.7

	WIND LOAD IS MEASURED IN LBS PER FT OF RISER SHIELD	
RISER SHIELDS	NOMINAL SIZE	FORCE IN LBS/FT ABOVE GRADE
	4"	4
	5:	7

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TABLE A-3

NET ALLOWABLE LOADING OF POLES

IN LBS.-FT AT FULCRUM ARM

FULCRUM ARM IS EQUAL TO
HEIGHT AG + (SET DEPTH/3)

	POLE SIZE	SET DEPTH IN EARTH	ALLOWABLE MOMENT FOR ATTACHMENT	
			INITIAL	BEFORE REPLACEMENT
WOOD POLE HEIGHT AND CLASS	30/6	5.5	7400	11087
	30/5	5.5	10176	15244
	30/3	5.5	16587	24849
	35/5	6.0	11237	16834
	35/4	6.0	14835	22225
	35/3	6.0	19089	28598
	40/5	6.5	13129	19668
	40/4	6.5	17115	25640
	40/3	6.5	21790	32644
	40/2	6.5	27163	40694
	45/3	7.0	23535	35258
	45/2	7.0	30585	45820
	50/2	7.0	33016	49463
	55/2	7.5	35273	52844
	60/1	8.0	47193	70702
	65/1	8.5	50032	74954
	70/1	9.0	52944	79317
	75/1	9.5	55931	83792
	85/1	10.5	59905	89594

	POLE SIZE	SET DEPTH IN EARTH	ALLOWABLE MOMENT FOR ATTACHMENTS
CONCRETE POLE HEIGHT AND TYPE	35III	6.0	9613
	35IIIG	6.0	21493
	35IIIH	6.0	39211
	40III	6.5	10581
	40IIIG	6.5	24661
	40IIIH	6.5	45419
	45III	7.0	11237
	45IIIG	7.0	27517
	45IIIH	7.0	51238
	50IIIH	7.0	56410
	55IIIH	7.5	61356
	60IIIH	8.0	65852

WIND FORCE ON POLE SURFACE
HAS BEEN DEDUCTED

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EXHIBIT B

CATV ATTACHMENT AGREEMENT

THIS AGREEMENT, made this 6th day of November, 19 90, between FLORIDA POWER & LIGHT COMPANY, a corporation organized and doing business under the laws of the State of Florida, hereinafter called "FPL" and Continental Cablevision of Jacksonville, Inc., a (corporation/~~general or limited partnership/individual/joint venture~~) organized and doing business under the laws of the State of Florida, hereinafter called "Licensee."

WITNESSETH

WHEREAS Licensee proposes to furnish television distribution service ("Cable Service") in the following areas where authorization has been granted by the political jurisdiction having authority for the areas: (List the political jurisdictions covered under this Agreement and with the signed original of this Agreement provide a copy of all existing franchises or other authorizations to furnish CATV service within FPL's service area. Where the franchisee has changed from the time of issuance of the franchise, provide a statement from an officer of Licensee showing how the franchise or other authorization gives authority for Licensee to operate in the jurisdiction. The copy for all new franchises and amendments must contain an original certification that it is a true and correct copy.)

Jacksonville	Welaka
St. Johns County(unincorporated areas)	Crescent City
McClenny	Hastings
Lake Butler	Glen St. Mary Baker County(unincorporated areas)
Waldo	Union County(unincorporated areas) Pomono Park
Hilliard	Putnam County(unincorporated areas Nassau County(unincorporated areas
Callahan	

and will need to erect and maintain aerial cables, wires and associated support hardware throughout the area to be served and desires to attach such cables, wires and associated support hardware to Poles of FPL; and

WHEREAS FPL is willing to permit, to the extent it may lawfully do so, the attachment of said cables, wires and associated support hardware to its existing Poles where, in its judgment, such use will not interfere with its own or other joint Pole users' service requirements, including considerations of economy and safety;

NOW, THEREFORE, in consideration of the mutual covenants, terms and conditions herein contained, the parties covenant and agree as follows:

1. <u>Definitions</u>

1.1 Attachment: The physical attachments of the Licensee's Cable Service system or Non-Cable Service system to an FPL Pole consisting of the cables, wires, and supporting hardware required to attach the system to the FPL Pole. All other equipment and hardware required to operate the Licensee's system are excluded from this definition and will not be allowed on FPL Poles, except that existing power supplies and associated equipment may remain on FPL Poles until such FPL Poles are replaced or relocated.

1.2 Cable Service: Television distribution service as defined as Cable Service in 47 U.S.C. §522(5) of the Cable Act and, for purposes of this Agreement only, non-profit public service which the Licensee lawfully is required to provide to the government entity issuing Licensee's franchise as a condition of such franchise.

1.3 FPL Pole or Pole: A Pole owned by FPL used for the distribution of electricity.

1.4 Make-Ready Work: Work that must be performed on an FPL Pole so that the Pole will accept a cable attachment in compliance with the National Electric Safety Code and any additional requirement by FPL.

1.5 Non-Cable Service: All transmissions of Licensee which are not included in the definition of Cable Service.

1.6 Service Area: That area wherein Licensee proposes to furnish Cable Service, specifically described in the first "Whereas" clause above.