POLE AND ANCHOR LOADING – SCJPC TECHNICAL RESOURCE

Elements of Pole Loading

- Loading District (Light, or Heavy Load District)
  - (See GO 95, Rule 43.1 & 43.2 and Appendix A)
  - Special Loading Districts (High Winds/Fire Area)
- Construction Grade (A-B-C-F) (See GO 95, Rule 42)
- Stability of the soil (Firm Soil, Rock, swamp, etc.) If a pole is to be set in *soft* ground, use short spans and/or increased setting depths to avoid overturning due to wind loading. Under such conditions, unduly short spans or deep settings may often be avoided by rocking-in or keying of poles by use of mud sills or possibly by storm guys. Rocking-in, keying of a pole or installing of mud sills are considered for mutual benefit in all circumstances and shall be a shared expense.
- Pole Height
- Pole Brand above ground to determine actual setting depth and class
  - Poles 20' to 50' in length, the brand is 10' from pole butt
  - After 1964 poles 55' and longer, the brand is 14' from pole butt
  - Poles 80' and longer 1955-1964, the brand is 15' from pole butt
  - 10' wood stubs, the brand is 9.5' from pole butt
- Date pole set (see date nail on pole or refer to pole record info)
- Angle/pull on poles (horizontal loads).
- Pole Class or pole circumference (diameter X 3.14 = circumference)
- Pole condition (i.e., shell rot, woodpecker holes, split top, large cracks, etc.)
- Shell Thickness (by bore test or removal of existing plug and use of a shell gauge. Poles identified as having decay may have tags affixed describing deterioration).
- Setting Depth (must meet or exceed the capability of the proposed load. New pole installations should be at a depth sufficient to meet the ultimate load capability of the pole. The ultimate bending moment should not exceed the ultimate overturning moment).
- Equipment weights (column loads)
- Height of Attachment (HOA) of all existing and proposed attachments
- Wire and cable types and sizes (diameters for all attachments)
- Span Lengths
- Anchor lead length and direction
- Guy strain (wire size and type)
- Mid Span separation due to Sag Differential (See GO 95, Appendix C)
- Clearance at 130 Fahrenheit temperature for final sag
- Calculated safety factor with calculated load for all attachments

Pole Loading Definitions / Types of Pole Loading

- Bending Moment / Overturning Moments – Poles should to be classed for bending moment as a pole must resist the wind loading by itself without the aid of supporting conductors or guys. The allowable overturning moment on a pole relates to the holding strength at ground line and the poles may be set to a depth that meets but does not exceed the ultimate loading of the pole class. The acronym to describe bending moment is “BM”

- Vertical Loading – Vertical load is the sum of all the weight on a pole, including conductors, cables, ice, equipment, and the column loading component from guying. The acronym to describe vertical loading is “VL”

- Equally Restrained Pole – 4-way tangent pole with equal type and sized cables and conductors, and in similar span lengths. Example: intersection pole; equal loading (zero-sum) in each direction, which cancels each other.

    - Vertical pole loading and Bending/Overturning moment loading is not required when poles are equally restrained as described above.

- Effectively Restrained Pole – 2-way (or more) dead-end pole with either unequal type and sized cables and conductors, or in dissimilar span lengths. Example: double dead end in two directions 90 degrees to each other with down guys in each direction; could be with different size conductors or cables in different directions. Slack spans are not an effective restraint

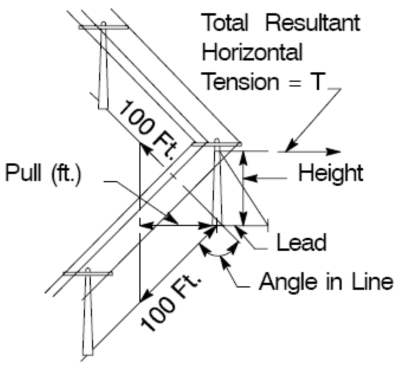
    - Vertical pole loading required

- Corner (double dead end) Pole

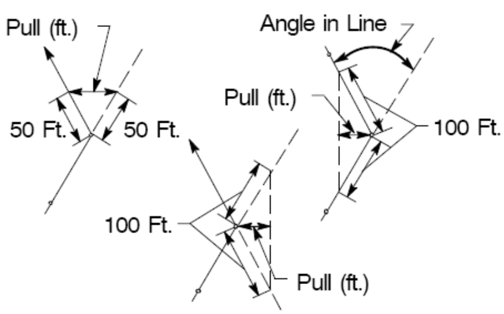
    - Vertical pole loading required

- Angle / Pull Pole – Pole set where conductors and/or cables have a change in direction creating an angle.

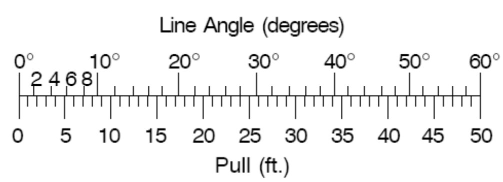
    - Vertical pole loading and Bending Moment/Overturning Moments are required; if either calculation fails, poles should be designed for the worst case scenario.



Example Illustration



Methods of Determining Pull



Scale for Changing Line Angles in Degrees to "Pull"

- Dead End Pole – Where conductors and/or cables terminate in any given direction on the pole
    - Vertical pole loading and Bending Moment/Overturning Moment Loading required
- Tangent Pole – When conductors and/or cables are running in a straight line configuration and the line has three degree's of angle or less and the pole is not guyed
    - Bending Moment/Overturning Moment Loading required

Note: Slack Spans – When un-guyed taps such as services or slack spans exist, consider the moment created by these attachments. Estimate the tension per attachment and multiply by the height of the attachment to obtain the moment.

Attachments in the opposite direction of the maximum moment reduce the moment (i.e., services in opposite directions cancel each other). Note: slack cables or conductors are usually installed at less than 75 pounds tension.

Characteristics of an Overloaded Pole

Characteristics that might indicate potential for overloading:

- Pole: deformed, bowed, bending, severe cracking, deteriorated
- Guys/anchors: Significant imbalance in guy/anchor loading, evidenced by loose guys in conjunction with extremely taut guys; anchors pulled out of ground
- Conductors: numerous large conductors/cables, significant differences in the length of spans between adjacent poles, improper sag or tension
- Extraordinarily complex loading systems that appear to have evolved as a "layering" of incremental changes – without analysis of integrated loading

Pole Safety Factors (SF) - Grade A Construction - Joint Poles with Power and C Class (Refer to GO 95 rule 42 for more information).

- Min. of 4.0 SF for new joint pole sets with electric and C Class facilities
- Min. of 4.0 SF for electric transmission poles with C Class facilities (new sets and for existing poles)
- Min. of 2.67 SF for existing jointly owned poles with distribution power and class communication facilities

Pole Inspection - Shell thickness / Deterioration impacts to pole loading

Some poles have tags affixed to them identifying deterioration of the pole below or above ground. When such tags exist, the Initiating Member may request a Receiving Member to provide pole test data to incorporate in their pole loading calculations. In cases where sufficient pole test data is not available, Members can agree to acceptable compensation to collect the data; Section 1.2 special agreement or use of billing items 19L 1-5, which ever is appropriate.

The chart (Figure 1) outlines what percentage of a poles maximum loading allowance would be reduced by based on remaining shell thickness.

Note: Many Members install tags on the poles which provide information regarding reduced shell thickness below ground or wood damage above ground. Some tags indicate a pole is being considered for pole reinforcement or for pole replacement. Contact the applicable joint owner(s) for the proper tag interpretation.
Note: Some Members have posted pole tagging information on www.scjpc.net.

The following chart provides guidance on how to take remaining shell thickness data and establish what percentage of the pole strength remains.

Pole Strength Example

Example:

Testing a pole with a 30-inch circumference at the groundline. Internal decay is found in the center of the pole. The shell-thickness gauge measures an existing average shell thickness of 2 inches.

1. Place one end of a ruler at the 30-inch increment of the pole circumference scale.
2. Place the opposite end of the ruler at the 2-inch increment of the shell-thickness scale.
3. The percent of the original pole strength can now be determined. The pole strength is 88% of the new or original pole strength.

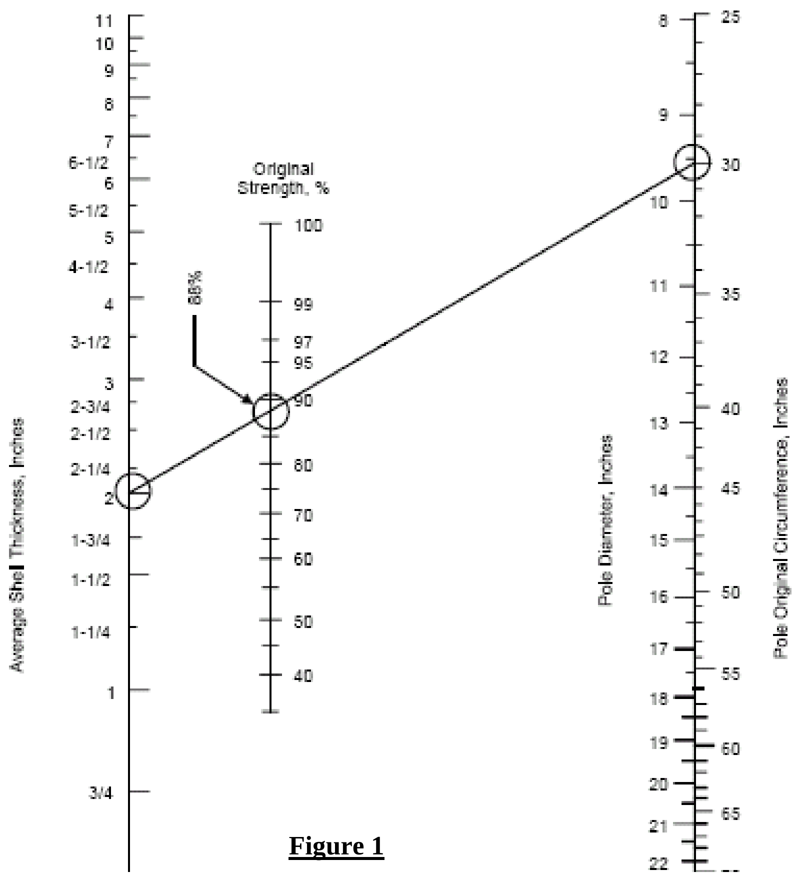


Figure 1

Note: For pole circumferences greater than 70" (i.e., generally cedar poles larger than 80 feet, Class H3) apply the formula below to determine the percentage of original strength.

% original strength = 1 – [1-(shell thickness / pole diameter) x 2]

Pole Setting Depth – Setting Poles Deeper

Setting a pole deeper than what is described in the “Grade and Space Chart by Pole Height” in Section 16 can establish a higher pole loading maximum allowance, which will accommodate future construction, and is considered mutually beneficial.

When poles are set deeper, the increased setting depth (in feet) shall be noted on the Form 2 within the “Location and Nature of Work”. The increased setting depth adds to the common area and reduces the usable space divided among owners for their exclusive use.

Note: The overall pole height above ground would be less than depicted in the “Grade and Space Chart by Pole Height” on page 16-2. Example: A 45’ pole set 2’ deeper requires the top of pole be depicted on the Form 2 as 37’, not 39’. The usable space would be 13’, not 15’ and the common area would be 32’ not 30’.

If a pole is to be set in soft ground, it is recommended to decrease span lengths and/or increase setting depths to decrease overturning moment due to wind loading.

Sections 3.14 & 7.14

Possible reasons for other than wood pole (Include but not limited to)

1. Steel Pole
    a. All poles with 4.8kv or higher voltage risers (LADWP)
    b. Pole loading doesn't pass on wood
        i. Increased safety factor required
    c. High fire/wind hazard area
    d. Areas subject to pole shrinkage and constant winds causing hardware to loosen (e.g.; Palm Springs, Tehachapi)
    e. Longevity
        i. Street, freeway, railway closures, etc. required for replacement
        ii. Excessively labor intensive
2. Composite Fiberglass Pole
    a. Access to pole location
        i. Property line-hand carry required
        ii. Helicopter set where weight is a factor
        iii. Reduce or avoid the need for a crane
        iv. Hill side
        v. Environmental issue
            1. Animals & Insects
            2. excessive moisture, fungus
    b. Areas subject to pole shrinkage and constant winds causing hardware to loosen (e.g.; Palm Springs, Tehachapi)
3. Concrete Pole
    a. All poles with 4.8kv or higher voltage risers (LADWP)
    b. Pole loading doesn't pass on wood
        i. Increased safety factor required
    c. High fire/wind hazard area
    d. Areas subject to pole shrinkage and constant winds causing hardware to loosen (e.g.; Palm Springs, Tehachapi)
    e. Longevity
        i. Street, freeway, railway closures, etc. required for replacement
        ii. Excessively labor intensive