SOUTHERN CALIFORNIA EDISON
TRANSMISSION AND DISTRIBUTION

Pole Loading Manual (PLM)

July 31, 2026

►SCE Internal◄

SOUTHERN CALIFORNIA EDISON
TRANSMISSION AND DISTRIBUTION
STANDARDS PUBLICATIONS
1 INNOVATION WAY, POMONA, CALIFORNIA 91768-2560
EMAIL: STANDARDS.ENGINEERING@SCE.COM

Pole Loading Manual (PLM)

Revision Summary

2026 Third Quarter Issue

Effective Date: July 31, 2026

Overview

The main purpose of this revision summary is to describe new revisions to this manual. (Some or all of the information may have been previously communicated to field personnel by other means.)

Table 1 lists the revisions. Clickable page/sheet numbers link directly to individual revisions or the first of a series of revisions.

Table 2 defines six types of revisions and watermarks used: (1) Admin (Administrative), (2) Technical, (3) New, (4) Pilot, (5) For Planning Use Only, and (6) For Reference Only.

Note: **Admin** *and* **Technical** *revisions to existing standards or existing* **Pilot** *projects are identified with change bars* **|** *in the left margin.* **New** *standards (as well as new pilot projects) do not receive change bars. Editorial revisions, such as corrections to spelling, do not receive change bars.*

A The statutory minimum compliance requirements established by the CPUC (e.g., GO 95, GO 128, GO 165, GO 166, GO 167, and GO 174) form the basis of this engineering standard. For this reason, these standards should be followed at all times. When existing standards are not suitable the Standards Deviations Process must be applied, see Standards Process Manual - DP-3: Deviation Process. section provides contact information.

Table 1: Revisions

Chapter	Page	Description	Type
PLM-3	Sheet 31	Add new note indicating that the larger field measured GLC for non FR wrap wood poles can be used if the SPIDACalc default fails the SPIDACalc analysis. This process reflects current practice and aligns with Pole Loading DSN released 11-25-2024.	Admin

Table 2: Revision Types

Type	Definition
Admin	Administrative revisions do not significantly affect design, construction, maintenance or operation of the electrical distribution, substation, and transmission systems. They do not require Standards Review Team (SRT) or management approval; however, they have been approved by other organizations, as appropriate. They may include updates to material codes, updates to references, updates to standards for clarity, or deletions of outdated information.
Technical	Technical revisions are engineering changes to existing standards. They affect the design, construction, maintenance or operation of the electrical distribution, substation, and transmission systems. They require SRT and management approval.
New	Refers to a new standard. New technical standards require SRT and management approval.
Pilot	A *Pilot* is an in-field evaluation of a piece of equipment or work method, with the intention of approving for standardized use. Pilot standards will have a PILOT watermark so that they are easily identified throughout this manual.
For Planning Use Only	*For Planning Use Only* standards are intended exclusively for use by Design and Field Asset Services (DFAS) for planning purposes and by Distribution Engineering for scoping purposes. It is not authorized for use in construction processes at this time. Included with this watermark will be guidance in the body of the standard for anticipated construction start dates. For Planning Use Only standards will have a FOR PLANNING USE ONLY watermark so that they are easily identified throughout this manual.
For Reference Only	*For Reference Only* standards are provided solely for informational purposes. It may be used to guide understanding, planning, or decision-making, but it is not authorized for direct application in official processes, construction, or implementation. Users should not rely on this standard as a basis for action or compliance, as it may be subject to change or may not reflect current requirements. For Reference Only standards will have a FOR REFERENCE ONLY watermark so that they are easily identified throughout this manual.

Regulatory Compliance Requirements

The statutory minimum compliance requirements established by the CPUC (e.g., GO 95, GO 128, GO 165, GO 166, GO 167, and GO 174) form the basis of this engineering standard. For this reason, these standards should be followed at all times. When existing standards are not suitable the Standards Deviations Process must be applied, see Standards Process Manual - DP-3: Deviation Process.

Getting Help

Revisions

If you have any comments, corrections, questions, or suggestions concerning manual revisions, please call or click an email address to contact one of the following individuals:

Chapter 1 & 3

- Design Support — Email: Help Desk Form

Chapter 2, 4 & 5

- Standards Engineering — Email: Standards.Engineering@sce.com

Fernando A. Garcia
Director | Asset Management & Engineering

Aaron Smith
Director | Field Asset Services

This page intentionally left blank.

Pole Loading Manual (PLM) Table of Contents

Chapter

This page intentionally left blank.

PLM–1: Pole Loading Policies and Procedures

Table of Contents

Table of Contents (Continued)

1.0 Design Policies and Procedures

1.1 Description

This chapter describes the pole loading policies and procedures. These procedures discuss the use of the SPIDA Pole Load Tool (PLT). All pole loading scenarios (except where otherwise noted) require Planners or Qualified Planning Employee to use the SPIDA PLT for determination of the pole load calculation. Transverse (often referred to as “bending or wind loading”), vertical load, and guy adequacy safety factor calculations will be performed in advance of constructing new and replacement poles. These load calculations will also be performed when adding, rearranging, or replacing conductors or equipment to in-service structures. For in-service structures a Planner or a Qualified Planning Employee must perform a field verification of as-is pole conditions prior to preparation of a work order. All work shall adhere to the DCM 12-Week Scheduling Procedure.

1.2 Content Ownership

This chapter is owned and maintained by Design & Field Asset Services (DFAS) Department.

1.3 Procedure

A. New, Replacement, Primary and Subtransmission Pole Minimum Wire Size

New and replacement primary poles shall be pole loaded using at least a minimum wire size of 1/0 ACSR. Accordingly, any primary pole that replaces an existing primary pole must be pole loaded to carry a minimum of 1/0 ACSR conductor. Subtransmission poles that have distribution underbuild shall be pole loaded at least with a minimum of 1/0 ACSR conductor for the distribution conductor.

Exception: All pole loads started on and after November 1, 2014 must comply to the 1/0 min ACSR for pole loading policy. Pole loads committed and approved in SPIDAMin prior to November 1, 2014 are exempt from the 1/0 min ACSR for pole loading policy. If revisions to individual poles within the project are required after approval in SPIDAMin, create a separate SPIDA file for those poles. The poles that are loaded with the new SPIDA file, will comply with the 1/0 min ACSR for pole loading policy.

B. Planner and Qualified Planning Employee Responsibility

Planners can perform the same job function as a Qualified Planning Employee however, a Qualified Planning Employee cannot perform the same job function as a Planner.

Planners or Qualified Planning Employees are responsible for performing in-service pole load calculations in accordance with current wind maps during the design pole loading process. In addition, Planners are also responsible for the following:

1. New and replacement poles supporting only SCE facilities. (SCE-only pole)
2. New and replacement poles supporting SCE facilities and facilities owned/operated by a Southern California Joint Pole Committee (SCJPC) member. (Jointly-owned pole)
3. New and replacement poles supporting SCE facilities and facilities owned/operated by a Licensee/Tenant of SCE. (Joint-use pole)

4. Adding, rearranging, removing, or replacing SCE facilities to SCE-only poles.
5. Adding, rearranging, removing or replacing SCE facilities to jointly-owned or joint-use poles.
6. Adding, rearranging, or replacing Temporary Power installations.
7. Prior to recommending trenching, straightening, lowering or raising to grade (when it does not meet DOH, TOH standards) for any pole.
8. in HFRA, a pole-load must be performed for any new equipment addition, regardless of equipment weight.

Exceptions:

- Calculations are **not** required for meter only products or when adding, rearranging, or replacing minor material or equipment that is not listed on the equipment tab in the pole loading tool.
- Calculations are **not** required on pole(s) adjacent to a pole being replaced if the replacement pole installation is within 5 feet of the existing pole and in-line with the adjacent poles. If the replacement pole installation exceeds the 5 foot in-line threshold, or creates or increases an existing line angle to the adjacent poles, then the adjacent pole supporting the increased span length or the poles affected by the line angle change will require a pole load calculation.
- Calculations are **not** required for the following SmartConnect devices when they are being installed as stand-alone without any other electrical equipment or material: 1) RRE with or without the street light mast arm; 2) Cell Relay.
- Calculations are **not** required when replacing a streetlight head on a wood pole.
- In Non-HFRA, calculations are **not** required when the scope of work is only the addition, removal, or replacement of crossarms, insulators or equipment weighing less than 200 pounds. When any of these components are being worked in addition to conductors, equipment in excess of 200 pounds or a pole replacement, it must be included in the pole load calculation.
- Calculations are **not** required when installing a mid-span service that is greater than 5 feet away from the pole.
- Calculations are **not** required when installing a riser on a pole.
- Calculations are **not** required when removing SCE facilities, for relinquishment purposes, from SCE only, jointly-owned, and joint-use poles.
- Calculations are **not** required when removing SCE facilities from Temporary Power Installations.
- Calculations are **not** required when replacing capacitor units in an existing bank.
- Calculations are not required when replacing or repairing like-for-like conductor, crossarms, or equipment on an existing pole if a pole load calculation has been performed within the last five years. If using an existing pole load calculation, the Planner must field verify that the information is accurate (for example, pole species, class and length, wire sizes, wire counts, equipment type, attachment heights, span lengths, line angles, down guy count, down guy size, and down guy orientation). In addition, the Planner must determine if a wood pole intrusive test record is available. If a test record exists and the record indicates the RSM is less than previous pole load, a new pole load calculation that includes the RSM must be performed. If a pole load record does not exist, or, the existing pole load record is no longer relevant or does not represent the field conditions, a new pole load calculation is required.

C. Engineered Tubular Steel Poles (TSP)

When SCE is performing the work and an engineered Tubular Steel Pole (TSP) is needed, the transmission estimators are responsible for submitting data sheets to Engineering. Engineering will provide pole load calculations using the Steel Pole Moment (SPMOM) calculator. A copy of the SPMOM will be placed in the clerical jacket. Subtransmission poles that have distribution underbuild shall be pole loaded at least with the minimum wire size of 1/0 ACSR for the distribution conductor.

D. Heavy Loading Areas

Per General Order 95 Rule 43.1, heavy loading requirements shall apply in all parts of SCE's service territory where the terrain elevation exceeds 3,000 feet above sea level. Planners, Qualified Planning Employees, and Estimators can use the elevation tool that exists in E-World to ascertain elevation at the existing or proposed pole location. Poles being loaded per heavy loading criteria will be evaluated with Load Case "6 psf wind 1/2" Ice".

Per G.O. 95, Rule 31.1, known local conditions may require a company to follow the higher standard or more restrictive criteria.

Poles determined to be above 3,000 feet and also in a high wind zone should be evaluated using the 6 pound heavy wind rating with the 1/2" radial ice and at the corresponding wind load rating without the 1/2" radial ice, to determine the worst case loading condition.

For example, a pole is located above 3,000 feet, but is shown in E-World to also be in an 18 pound high wind zone. Perform wind load calculations for the 6 pound heavy wind load with the 1/2" radial ice as well as the 18 pound high wind zone without the 1/2" radial ice to determine the worst case pole loading condition.

Per G.O. 95 Rule 49.1-B, when a wood pole is being replaced or installed in Heavy Loading area and Grade A Construction is required, a Class 3 or larger pole shall be utilized.

E. Information/Data Requests

SCJPC members and Licensees may request SCE facility information (for example, wire or equipment dimensions or sag charts) directly from planners; or, submit written requests to the Joint Pole Organization (JPO) who will forward the request to the appropriate planning office. With supervisor approval, planners will respond directly to the requestor with facility information promptly, which, barring unusual or difficult circumstances is no more than 15 business days from the date of request.

Similarly, planners and Qualified Planning Employees may contact SCJPC members and Licensees directly to request facility information (for example, communication cable sizes or sag charts), which is the preferred method, or, submit written requests to the JPO for further administration. Responses to written requests administered by the JPO may take 20 or more business days to allow for JPO processing and delivery.

Upon written request and completion of the Intrusive Data Request (IDR) by SCJPC members and Licensees, the JPO will provide wood pole intrusive inspection data promptly, which; barring unusual or difficult circumstances, is no more than 15 business days.

F. SPIDA Pole Load Tool (PLT) Process

STEP 1. The Planner or Qualified Planning Employee can either gather information in the field using the SCE Pole Load Worksheet or enter the pole load information directly into the PLT if using a laptop in the field.

STEP 2. Check for Intrusive Inspection results in SAP using direct access through SAP or using DM as the access to SAP. Data discrepancies such as pole number, height, or class need to be documented and corrected. Complete the Asset Correction Form and forward the form to Field Accounting Organization (FAO) for record correction.

STEP 3. Refer to Printing Required Pole Information in SAP Job Aid.

STEP 4. Input the pole loading information into the PLT.

- Once a pole load is committed and approved, that version cannot be changed. The next pole load created on the same pole will have its own version, and it will not overwrite an existing pole load.

STEP 5. Determine safety factors.

STEP 6. Print a copy of the In Office Report from the PLT and place it in the Office and Field Work Order jackets. Access the report by going to *Reporting* > *Client Reports* and selecting In Office Report. Refer to PoLAR Job Aid #11 - Creating Reports for additional information.

STEP 7. If you have used the SCE Pole Load Worksheet to gather the field information, file the worksheet in the Office and Field Work Order jackets.

STEP 8. Once the work order is completed, the Construction Maintenance Accountant (CMA) will enter the load information into SAP.

G. PLC Results & Remediation Form

The PLC Remediation Form is required to be completed in permanent ink and uploaded for all work orders including those in process. Local Planning will make every attempt to complete a PLC Remediation Form on work orders created prior to 8-17-12 that contain Pole Load calculations. For this population, the PLC Remediation Form is required to be completed for “As-Designed” poles only. The following inputs on the PLC form are unique to this process:

1. In the approver name field, Indicate “PLC approved by (indicate organization that approved work order).”
2. In the Planner name field indicate actual Planner, Qualified Planning Employee or contractor name that performed pole loading calculation. In addition to the PLC form, the upload should also contain copies of the Pole Loading Worksheet, Pole Loading results & the In Office Summary; photos are not required. If necessary information is missing that will prevent the completion of the PLC remediation form, the PLC form and upload will need to be completed by the organization that created the work order.

H. SPIDA Pole Load Tool Support

- Access to the SPIDA PLT is restricted to those employees that have received formal classroom training and belong to the following classifications:
  Designers, Planners, Planning Supervisors, Qualified Planning Employees, Hub Design Managers, and all SCE Contract Planners and Supervisors. This is applicable to Distribution, Transmission, and Carrier Solutions. Exceptions to this rule will need to be reviewed and approved by Design Support Management.
- Currently, H frames are pole loaded with the SPIDA PLT. If an H frame with cross bracing fails the SPIDA assessment and requires a pole replacement larger than a class H1 pole, complete the H Frame Form and submit to the Pole and Towers Structural Analysis Engineering group.

I. Safety factors

The California Public Utilities Commission's G.O. 95 specifies safety factors for each "Grade" of overhead line construction. SCE's distribution facilities will be designed to meet or exceed either Grade A or Grade B requirements. The wind zone located on the E-World Portal Page must be referenced to help ensure the relevant wind pressure is considered during the design stage.

Refer to PLM–2, Section 2.0 for Safety Factors of Wood, Composite, and Light Weight Steel Poles.

Safety Factors for Joint-Owned and Joint-Use Poles can also be found in PLM–2, Section 2.0.

J. Corrective Action Priority Assignment and Replacement Schedule

Use table Table 1–1, Table 1–2, and Table 1–3 to determine the corrective action priority assignment and replacement schedule for In-service poles that fail pole loading safety factor calculations:

Note: Poles that pass all safety factors but are considered a visual reject due to bowing caused by transformers or equipment shall follow the visual reject replacement timeframe under the deteriorated poles guidelines.

Table 1–1: Corrective Action Priority Assignment and Replacement Schedule for In-Service Wood, Composite & Light Weight Steel Poles Located Outside High Fire Risk Area

	Wood & Composite Poles			Light Weight Steel Poles								
	Pole Load Failure			Pole Load Failure			Sidewalk Horizontal Brace	Vertical Buckling	Vertical Buckling	Guying		
	High Wind	Heavy/Light Loading		High Wind	Heavy /Light Loading							
Priority	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A & B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A & B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A & B	Description	Time-frame
1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is visible physical damage or record of deterioration recorded through an intrusive inspection.	Immediate Corrective Action Required
2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is no visible physical damage or record of deterioration.	Up to 6 months[a/]
2	≥1.00 and <1.50	≥1.00 and <2.00	≥1.00 and <1.50	≥1.00 and <1.50 [b/]	≥1.00 and <1.50 [b/]	≥1.00 and <1.50 [b/]	<1.33	≥1.00 and <2.00	≥1.00 and <1.50	<1.33	—	Up to 12 months[a/]
2	≥1.50 and <2.00	≥2.00 and <2.67	≥1.50 and <2.00	≥1.00 and <1.50	≥1.00 and <1.50	≥1.00 and <1.50	N/A	≥2.00 and <2.67	≥1.50 and <2.00	N/A	—	Up to 24 months[a/]

[a/] Notification due date is based on the last date the pole load calculation is committed to SPIDAMin.

[b/] Notification due date based on both guy and pole failing.

Note(s):

1. Poles identified with less than the minimum safety factor for poles required by G.O. 95.
2. When the pole load and SCE guying and/or sidewalk horizontal brace both fail, create one notification to remediate both failures.
3. When the pole load and CIP guying both fail, create one notification to remediate the pole failure and a second notification for the CIP failure.
4. When SCE guying and CIP guying both fail, create one notification to remediate SCE guying failure and a second notification for the CIP failure.
5. When the pole load, SCE guying, and CIP guying all fail, create one notification to remediate the SCE pole failure and guying failures and a second notification for the CIP failure

= For Reference Only

Table 1–2: Corrective Action Priority Assignment and Replacement Schedule for In-Service Wood, Composite & Light Weight Steel Poles Located Within Elevated High Fire Risk Areas

	Wood & Composite Poles			Light Weight Steel Poles								
	Pole Load Failure			Pole Load Failure			Sidewalk Horizontal Brace	Vertical Buckling	Vertical Buckling	Guying		
	High Wind	Heavy/Light Loading		High Wind	Heavy/Light Loading							
Priority	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A&B	Description	Time-frame
1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is visible physical damage or record of deterioration recorded through an intrusive inspection	Immediate Corrective Action Required
2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is no visible physical damage or record of deterioration.	Up to 6 Months[a/]
2	≥1.00 and <2.00	≥1.00 and <2.67	≥1.00 and <2.00	≥1.00 and <1.50	≥1.00 and <1.50	≥1.00 and <1.50	<1.33	≥1.00 and <2.67	≥1.00 and <2.00	<1.33	—	Up to 12 Months [a/]

[a/] Notification due date is based on the last date the pole load calculation is committed to SPIDAMin.

Note(s):

1. Poles identified with less than the minimum safety factor for wood poles required by G.O. 95.
2. Elevated High Fire Risk Areas consist of Tier 2 set forth by the CPUC and SCE SOB 322 areas.
3. When the pole load and SCE guying and/or sidewalk horizontal brace both fail, create one notification to remediate both failures.
4. When the pole load and CIP guying both fail, create one notification to remediate the pole failure and a second notification for the CIP failure.
5. When SCE guying and CIP guying both fail, create one notification to remediate SCE guying failure and a second notification for the CIP failure.
6. When the pole load, SCE guying, and CIP guying all fail, create one notification to remediate the SCE pole failure and guying failures and a second notification for the CIP failure.

= For Reference Only

Table 1–3: Corrective Action Priority Assignment and Replacement Schedule for In-Service Wood, Composite & Light Weight Steel Poles Located Within Extreme High Fire Risk Areas

	Wood & Composite Poles			Light Weight Steel Poles								
	Pole Load Failure			Pole Load Failure			Sidewalk Horizontal Brace	Vertical Buckling	Vertical Buckling	Guying		
	High Wind	Heavy/Light Loading		High Wind	Heavy/Light Loading							
Priority	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A&B	Safety Factor Grade A	Safety Factor Grade B	Safety Factor Grade A& B	Description	Time-frame
1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is visible physical damage or record of deterioration recorded through an intrusive inspection	Immediate Corrective Action Required
2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	N/A	<1.00	<1.00	N/A	Pole Load Failure where there is no visible physical damage or record of deterioration.	Up to 6 Months[a/]
2	≥1.00 and <2.00	≥1.00 and <2.67	≥1.00 and <2.00	≥1.00 and <1.50	≥1.00 and <1.50	≥1.00 and <1.50	<1.33	≥1.00 and <2.67	≥1.00 and <2.00	<1.33	–	Up to 6 Months[a/]

[a/] Notification due date is based on the last date the pole load calculation is committed to SPIDAMin.

Note(s):

1. Poles identified with less than the minimum safety factor for poles required by G.O. 95.
2. Extreme High Fire Risk Areas consist of Tier 3 areas set forth by the CPUC.
3. When the pole load and SCE guying and/or sidewalk horizontal brace both fail, create one notification to remediate both failures.
4. When the pole load and CIP guying both fail, create one notification to remediate the pole failure and a second notification for the CIP failure.
5. When SCE guying and CIP guying both fail, create one notification to remediate SCE guying failure and a second notification for the CIP failure.
6. When the pole load, SCE guying, and CIP guying all fail, create one notification to remediate the SCE pole failure and guying failures and a second notification for the CIP failure.

= For Reference Only

K. Third Party Attachments

- When an SCJPC member submits pole load calculations as part of the Joint Pole Authorization (JPA) process, the Planner shall perform a review of the facility information provided. The Planner will need to validate the pole load information that was provided with the JPA. The Planner will deny the JPA if the listed SCE facilities are clearly inaccurate or incomplete. If the JPA is denied, the Planner shall return the JPA indicating the reason for denial. The initiating SCJPC member must include a corrected pole load calculation when re-submitting the JPA.
- Pole load calculations performed (by SCE) for PLM-1 subsection 1.3 B3 will be shared with SCJPC members upon request.
- Planners are responsible for verifying SCE's Licensee's/Tenant's pole load calculations.
- If an SCJPC member requests pole load information from SCE for SCE structure(s), calculations/specifications will be provided within 15 business days.
  - — Pole Load Tool Results: loading information and detail assessment sheets shall be provided to requesting joint pole owners and renters.
- If a jointly owned pole is found in the field to be overloaded (existing condition and it is an authorized attachment), replacement of the structure will be accomplished according to Section 7.11 of the SCJPC Routine Handbook.
- JP Authorizations from SCE to SCJPC members will include load calculations for all poles and structures.
- Request For Attachment (RFA) submittals shall include a copy of the licensees (SCE, Comm, and CATV) pole loading calculation. The SCE Planner is required to validate all Licensees' calculations.
- When a Licensee submits a Request For Access application to the Joint Pole Organization, typically, the following information is supplied and verified by Planning:
  - — Cable diameter (w/messenger)
  - — Pole attachment height
  - — Number of attachments
  - — span lengths (ahead and back)
  - — Angle of deflection (ahead and back)
  - — Guy wire size and dead end tension (if applicable).
- The Planner should always verify through the Southern California Joint Pole Committee records and SAP Tenant records the purchased Grade and Space of the Members attached to the pole being pole loaded.

L. Work Order Process – DM Product & MAT selection

Should a pole load calculation indicate that an in-service pole must be replaced, it is important to know how the applicable costs for the new pole are charged.

- An as-found in-service pole that fails the pole load calculation (utilizing the load criteria applicable at the time of original construction) is considered a deteriorated pole; this also includes poles that have significant bowing caused by equipment attached to the pole which constitutes a visual reject. These pole replacements should follow the E1 notification process for remediation. Refer to the How to Create an E1P1 PLC Remediation Notification Job Aid or How to Create an E1P2 PLC

Remediation Notification Job Aid and the Procedures for Record Retention and Failure Remediation for As-Is Pole Loading Calculations (PLC) for additional information.

Note: Guying failures are not part of the deteriorated pole program and are considered a maintenance activity. An E1 notification will need to be submitted for resolution.

- Priority 1 Wood Pole Replacement — All priority 1 conditions that require immediate pole change out must follow the E1 - P1 notification process. The pole change out will be planned and performed by the district personnel and is not subject to any scheduling constraints associated with the deteriorated pole program. This work is considered breakdown maintenance and is not a part of the deteriorated pole program.
- As-found pole load calculation (PLC) failures — Infrastructure Replacement - Deteriorated Pole Replacement (2F6). This product type and MAT code are used for Non-Priority 1 conditions that do not require immediate pole change out. An E1 notification will need to be created for remediation of these pole load calculation failures.

  Refer to the Corrective Action Priority Assignment and Replacement Schedule Table 1–1, Table 1–2, and Table 1–3 to determine appropriate priority. An Infrastructure Replacement - Deteriorated Pole Replacement work order will need to be issued to capture all costs associated with the change out. This product type/MAT code captures budget expenditures associated with the Deteriorated Pole Program (DPP). The Planner can request DPP to either expedite the pole change out, or submit the pole for change out under the standard deteriorated pole program priority based replacement guidelines as they relate to pole loading failures:

  — Expedited pole change out (2F6) — The pole change out will be planned and performed by the district personnel. The Planner will need to submit an E1 notification to notify the deteriorated pole program of the required change out. The Planner will need to check the “Please Return to (USERID) for Remediation Design” box on the Pole Load Calculation Results and Remediation Form. Putting a check mark in this box informs the Deteriorated Pole Group to return the notification to the originating Planner (most likely Local Planning), rather than Technical Planning.

    The Planner will also need to submit the Deteriorated Pole Budget Request Form. The deteriorated pole group will review and validate the request to ensure the request meets the deteriorated pole expedited pole change out program criteria. Planner should not proceed with processing the change out as a deteriorated pole until after the deteriorated pole group has completed their validation.

  — DPP pole change out (2F6) — The pole change out will be planned and performed by the DPP and is subject to the replacement timelines as per the Corrective Action Priority Assignment and Replacement Schedule. Planner will need to submit an E1 notification to notify the DPP of the required change out. The deteriorated pole group will review and validate the request to ensure the request meets the DPP criteria.

  — Routine Preventive Maintenance — Deteriorated Pole Replacement (270/271) — This product type and MAT codes should no longer be used for remediation of deteriorated poles. All as found pole load calculation failures need to follow the E1 notification process for remediation.

M. New Business

- When installing a new transformer and
  a) the installation serves only the new customer: and
  b) the installation of this transformer causes the pole to be overloaded,
  then, the pole replacement will be charged to the applicable New Business work order.
- When installing or replacing a transformer:

  At the request of a customer and the transformer serves more than one customer; and the incoming transformer causes the pole to be overloaded, the pole replacement will be charged to the applicable New Business work order using the "EW" exception code.
- Temporary Power — Existing poles failing pole loading solely as a result of a temporary power request will billed to the requesting customer on the appropriate relocation product type. The balance of the temporary facilities requested will be installed and billed per the appropriate flat rate or established Rule 13 billing process.

  Note: Applicant can install a temporary underground service to alleviate the cost of this pole change out.

N. Required Information for the Planning Supervisor Pole Load Review Package

(For Routine and Emergent)

Note: The purpose of this package is to provide the Planning Supervisor all the necessary inputs to allow for a proper review and approval of the pole load calculation. This package will have more information than what is required for the pole load calculation results and remediation scan package requirements.

SPIDA Pole Loads:

STEP 1. Pole Load Calculation Results and Remediation Form
STEP 2. Pictures of the Pole
STEP 3. FIM maps
STEP 4. Pictures of the Brand showing its height and brand itself (if possible)
STEP 5. Copies of the SPMOM for Engineered Tubular Steel Poles (TSP).
— Used by Engineering
STEP 6. Copies of the In-Office Report (Project Analysis Summary from SPIDA PLT)
— Used by FAO and Planning Supervisor
STEP 7. Copies of SAP reports
— Intrusive Inspection results (if inspection is required)
— Pole Information

WLEA Pole Loads:

STEP 1. PLC Results and Remediation Form
STEP 2. Pictures of the Pole
STEP 3. FIM maps
STEP 4. Completed field work sheet (for existing and new)
STEP 5. Pictures of the Brand showing its height and brand itself. (if possible)
STEP 6. Copies of the SPMOM for Engineered Tubular Steel Poles.
— Used by Engineering
STEP 7. Copies of the Pole Load results (from WLEA Pole Load Tool)
— Used by FAO
STEP 8. Copies of the Office Report (from WLEA Pole Load Tool)
— Used by FAO and Planning Supervisor
STEP 9. Copies of SAP reports
— Intrusive Inspection results (if inspection is required)
— Pole Information

FAO will return the package if the pole load results and office report are not in the package or if the as built is different from the design.

O. PLC Results & Remediation — Upload Scan Package Requirements

(at a minimum, to create a single pdf file)

SPIDA Pole Loads:

☐ In-Office Report (Project Analysis Summary)
☐ PLC Results and Remediation Form
☐ Photographs (required for As-Is upload only; not required for As-Designed up loads)

WLEA Pole Loads:

☐ Pole Loading Worksheet (hand written field assessment)
☐ Pole Loading Results
☐ In-Office Summary
☐ PLC Results and Remediation Form
☐ Photographs (required for As-Is upload only; not required for As-Designed up loads)

P. Pole Loading Verification

All poles that require pole loading to clear a single incident or notification should be included as part of the initial SR/Product. Planner or Qualified Planning Employee will provide a PLC package for each pole to the Planning Supervisor, who will indicate the number of poles included to complete the incident on the Pole Loading tab at approval. Planner or Qualified Planning Employee should not create additional Products for additional poles (such as leading and lagging poles in a line). The Planning Supervisor must review and verify the pole loading package provided by the Planner or Qualified Planning Employee. Once the Planning Supervisor evaluates the results, he/she will update findings directly on the Pole Loading Verification tab data fields in DM. Refer to DM Job Aid #52 - Pole Loading Verification (PLV) for more information.

All poles used for “point loads” for span guys that fail As Is Analysis require Planning to complete and send a Deteriorated Pole Budget Request Form or create a E1 P1 Notification per Tables 1-1 and 1-2.

Q. Product Cancellation

Planners should only be canceling a product in DM and letting DM communicate with SAP. If Product requires cancellation, it is the Planner’s responsibility to cancel prior to the due date expiring. If Planner cancels the Product prior to the due date, the item will not reflect in the metric scoring. Any cancellations after the due date will be reflected for metric purposes. Refer to DM Job Aid #42 - Product Cancellation for more information.

R. E3 Notifications

Planners or Qualified Planning Employees called out to Pole Load prior to receiving a notification should complete the PLC as requested and confirm with the Requestor that an E3 notification is being created. Planner is not to create an additional SR/Product; they are to wait until the Requestor’s notification driven SR/Product is received by the SPOC. Planner will notify SPOC to route the applicable SR/Product to them for completion in DM. Refer to DM Job Aid #51 - E3 Pole Loading Verification Process for more information.

S. E1 Cancellation Due to Function Remediation

When a Planning Department determines that an E1 notification is not needed because a remediation sketch driven field change will correct the problem, that Planning Department can cancel the E1 provided the reason for cancellation is clearly stated in the notification comments.

T. Attaching Equipment to Wood and Composite Structures

For new construction or addition of new equipment on existing poles, follow the prescribed guides in Table 5: Minimum Pole Class for New Transformers and Equipment Mounted on Existing or New Wood and Composite Poles (PLM–2, Page 22). After selecting a pole class, a load calculation must still be performed. Utilize the minimum pole class required to satisfy requirements in both Table 5 and the load calculation.

Existing poles with existing transformers or equipment attached to it require a visual inspection to determine if there is bowing due to the attachment as well as a passing pole load.

The PLT can pole load existing and new platform racks.

2.0 Transmission Pole Loading Validation for Planned Work

2.1 Description

This document details the transmission pole loading process for planned work.

2.2 Link

Transmission Pole Loading Validation for Planned Work

3.0 Transmission Pole Load Calculation for Emergent/Storm Work

3.1 Description

This document details the transmission pole loading process for emergent/storm work.

3.2 Link

Transmission Pole Load Calculation for Emergent/Storm Work

4.0 Transmission Pole Load Calculation Requirements for Combo Poles

4.1 Description

This document details the transmission pole loading process for combination poles.

4.2 Link

Transmission Pole Load Calculation Requirements for Combo Poles

5.0 Transmission Pole Load Calculation of T&D Identified Guying Failures

5.1 Description

This document details the transmission pole loading process for T&D identified guying failures.

5.2 Link

Transmission Pole Load Calculation of T&D Identified Guying Failures

6.0 Distribution Pole Loading Process for Planned Work

6.1 Description

This document details the distribution pole loading process for planned work.

6.2 Link

Distribution Pole Loading Process for Planned Work

7.0 Distribution Pole Loading Process for Emergent Work

7.1 Description

This document details the distribution pole loading process for emergent work.

7.2 Link

Distribution Pole Loading Process for Emergent Work

8.0 Distribution Pole Loading Process - FIPLC Due to Non-Work Order Related Field Request

8.1 Description

This document details the distribution pole loading process for FIPLC due to non-work order related field request.

8.2 Link

Distribution Pole Loading Process - FIPLC Due to Non-Work Order Related Field Request

9.0 Distribution Pole Loading Process for Storm Work

9.1 Description

This document details the distribution pole loading process for storm work.

9.2 Link

Distribution Pole Loading Process for Storm Work

10.0 Edison Carrier Solutions Pole Loading for Capital Work

10.1 Description

This document details the Edison Carrier Solutions pole loading process for capital work.

10.2 Link

Edison Carrier Solutions Pole Loading for Capital Work

11.0 Edison Carrier Solutions Pole Loading for O&M Work

11.1 Description

This document details the Edison Carrier Solutions pole loading process for O&M work.

11.2 Link

Edison Carrier Solutions Pole Loading for O&M Work

12.0 Pole Loading Process for Third Party Attachment Group

12.1 Description

This document details the pole loading process for the Third Party Attachment Group.

12.2 Link

Pole Loading Process for Third Party Attachment Group

13.0 Joint Pole Organization E1 Notification for Failed CIP PLC

13.1 Description

This document details the Joint Pole Organization E1 Notification for Failed CIP PLC.

13.2 Link

Joint Pole Organization E1 Notification for Failed CIP PLC

This page intentionally left blank.

PLM–2: Pole Loading Standards

Table of Contents

Section
Page

1.0 General Information

Description

This chapter provides the distribution design criteria for wood and composite poles as it relates to pole loading. Wind zone criteria, equipment weight limits, safety factor for wood, composite and light weight steel poles, and guying criteria are included in this chapter.

Refer to the Transmission Overhead Construction Standards Manual (TOH), Section TO, for design criteria and pole loading calculation methodology for sub-transmission wood and Light Weight Steel (LWS) poles.

Content Ownership

This chapter is owned and maintained by the SPE Standards Engineering Organization

1.1 Pole Design

Poles used to support overhead conductors and equipment must be designed to meet the economic and operational needs of the Company.

A. Wood Poles

1. Wood poles are the preferred material for overhead structures due to lower cost compared with other available materials.

   Note: SCE's Primary Distribution System shall be designed to Grade A and B construction only. All joint pole attachments shall be designed to Grade A construction.

2. Refer to the Distribution Overhead (DOH) Construction Standards Manual, Section PO 100 for wood pole installation details.

B. Composite Poles

Refer to the Distribution Design Standards (DDS), Chapter 10 for design concept of composite poles.

1. Pole loading shall be done by selecting the appropriate pole class and size under the Composite Fiberglass species in the PLT.

CAUTION

Where, under the loading conditions described in this manual, the resultant bearing surface is not expected to prevent overturning or excessive movement of the pole at the ground line, and/or the soil is not firm, deeper settings or other special methods shall be used.

Refer to DOH, Section PO or TOH, Section TO.

1.2 Attachments to SCE Poles or Structures by a Foreign Utility

A. New or additional attachments to SCE poles or structures by a Foreign Utility (such as an Owner/Member of Southern California Joint Pole Committee (SCJPC), an SCE Tenant, or any other Third Party) shall not be made except when permission is granted by an authorized SCE representative, as outlined in the SCJPC Routine Handbook or SCE's Joint Pole Organization's "Request for Access — Guidelines to CATV and Third Party Attachments".

B. In all cases involving a tenant, a pole load calculation must be submitted by either the Foreign Utility or Third Party Representative for the requested attachment(s). The following information must also be submitted: type, diameter, span, quantity of cable, and/or nature of attachment.

C. An intrusive inspection must also be performed, for all poles greater than 15 years of age, to determine pole integrity or remaining strength of the wood structure. SCE or an approved contractor will perform the intrusive inspection.

In an emergency situation, where an intrusive inspection is required and cannot be performed prior to the pole load calculation, the calculation shall be made assuming zero deterioration, or 100 percent pole strength. The intrusive inspection shall be completed as soon as practical. If the results show less that 100 percent pole strength, another pole load calculation shall be performed, using the new value, and if overloaded, the pole shall be scheduled for replacement. A "field meet" is strongly recommended. Contact the Deteriorated Program Manager or Joint Pole Organization for more information.

D. SCE attachments to poles or structures owned by a Foreign Utility (Owner/Member of SCJPC), shall not be made except when permission is granted as outlined in the SCJPC Routine Handbook. If the company owning the pole is not a party to the SCJPC, proper authorization must be obtained via a Third Party Agreement or other satisfactory basis and approved by SCE's Joint Pole Organization Manager.

E. In all instances, the SCE representative proposing the attachment(s) must be prepared to submit a pole load calculation, including intrusive inspection record and calculation allowance for any deterioration, and pole contact information to the Foreign Utility or Third Party.

F. Refer to Corporate Standards for information on contact or blanket rental agreements.

1.3 Conductor

A. The number, size, height requirements, pole loading, and dead ending tension of conductors, supported by an overhead pole, are the primary factors used in determining the pole strength requirements. As-design poles associated with new and replacement Distribution poles or Subtransmission poles with Distribution underbuild, shall be pole loaded using at least a minimum conductor size of 1/0 ACSR Covered Conductor or #2 CU Covered Conductor in coastal areas (within one mile of the coast) for primary and 1/0 Al triplex for the secondary. Accordingly, any as-design pole that replaces an existing pole that has existing attached distribution primary conductors smaller than 1/0 ACSR or #2 CU shall be pole loaded to carry a minimum of 1/0 ACSR Covered Conductor or #2 CU Covered Conductor in coastal areas (within one mile of the coast) for the distribution primary conductor.

B. Overhead construction will utilize crossarm construction for primary voltages and rack or multiplex construction for secondary voltages. The maximum span lengths for various conductors and the type of construction necessary to provide adequate support are found in the DOH Manual, Section CO.

C. General conductor information, for example, use of copper wire in beach areas, weight, amperage, and diameter, is found in the DOH Manual, Section CO.

1.4 Crossarms/Insulators

Refer to the DDS Manual Chapter 10 for design requirements for crossarms and insulators.

1.5 Pole Selection

Selection of the proper pole must consider height and strength requirements based on the following:

- Terrain
- Number, voltage, and configuration of distribution circuits
- Pole loading
- Equipment to be placed on the pole
- Possible joint use by other utilities
- Minimum conductor ground clearance required by such other governmental agencies as Caltrans or Flood Control Districts
- Fire hazard

1.6 Pole Height

The conductor sag tables in the DOH Manual, Section CO provide the maximum sag for a given span and conductor size. The terrain, maximum sag, and pole space requirements (Distribution Apparatus [DAP] Construction Standards, Section AP and the DOH Manual, Section DC) must be known to determine the pole height that will meet the minimum clearances specified in General Order 95 (Table 1 and Table 2).

1.7 Pole Strength/Pole Loading

Poles must be capable of supporting horizontal loads caused by pole loading on the pole itself, plus the wind on the conductors supported by the pole, plus dead loads caused by the equipment. For usable pole strengths, see Table 1, Table 2, and Table 3.

A. Heavy-and Light-Loading Areas Above and Below 3,000 feet

General Order 95 defines areas of California above and below the 3,000-foot level as heavy-and light-loading areas, respectively. The Conductor Pole Loading Table, Table 4, provides the horizontal wind pressure in pounds/square foot for various conductor types and sizes. Pole loading for heavy-loading areas is calculated using a 6 pound wind (48 mph) and assuming 1/2-inch of ice on the conductor. Pole loading in light-loading areas is normally based on an 8 pound wind (56 mph); however, a 12 pound wind is used in areas subject to winds up to 68 mph. An 18 pound wind is used in areas subject to winds up to 84 mph, and a 24 pound wind is used in areas subject to winds up to 97 mph. The wind zone map (located on the E-World Portal) can be used to determine the area's proper pole load design criteria for their given area. If a pole is in an extreme wind area that is also considered a heavy loading area, then both the extreme wind and heavy loading cases shall be analyzed. The pole shall have a passing safety factor for both load cases. Examples dealing with pole strength and pole loading are included in this chapter.

Table 1: Unguyed Douglas-Fir Poles — Usable Strength Tables — Pole Strengths

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
25	5	5.0	20.0	25.5	0.342	25.842	8.226	19	8,430	11,465	8,204	11,240	10,788	10,111	9,433
30	5	5.5	24.5	27.5	0.354	27.677	8.810	19	10,142	13,872	9,794	13,523	12,826	11,780	10,735
35	H2	6.0	29.0	43.5	0.431	43.500	13.846	31	41,084	55,563	40,300	54,779	53,210	50,856	48,503
35	H1	6.0	29.0	41.5	0.431	41.500	13.210	29	35,498	48,070	34,758	47,330	45,851	43,631	41,411
35	1	6.0	29.0	39.0	0.414	39.000	12.414	27	29,229	39,663	28,537	38,972	37,589	35,514	33,439
35	2	6.0	29.0	36.5	0.397	36.500	11.618	25	23,732	32,285	23,088	31,642	30,356	28,426	26,496
35	3	6.0	29.0	34.0	0.379	34.000	10.823	23	18,957	25,870	18,362	25,276	24,086	22,301	20,516
35	4	6.0	29.0	31.5	0.362	31.500	10.027	21	14,855	20,353	14,308	19,806	18,713	17,073	15,434
35	5	6.0	29.0	29.0	0.345	29.000	9.231	19	11,376	15,666	10,878	15,168	14,171	12,677	11,182
40	H3	6.0	34.0	48.5	0.456	48.500	15.438	33	56,693	76,761	55,522	75,590	73,250	69,739	66,228
40	H2	6.0	34.0	46.0	0.441	46.000	14.642	31	48,054	65,176	46,950	64,072	61,864	58,552	55,241
40	H1	6.0	34.0	43.5	0.426	43.500	13.846	29	40,325	54,805	39,288	53,767	51,692	48,580	45,467
40	1	6.0	34.0	41.0	0.412	41.000	13.051	27	33,458	45,581	32,487	44,610	42,668	39,755	36,842
40	2	6.0	34.0	38.5	0.397	38.500	12.255	25	27,401	37,439	26,497	36,535	34,726	32,012	29,298
40	3	6.0	34.0	36.0	0.382	36.000	11.459	23	22,107	30,314	21,268	29,475	27,799	25,285	22,770
40	4	6.0	34.0	33.5	0.368	33.500	10.663	21	17,525	24,138	16,753	23,366	21,823	19,507	17,192
40	5	6.0	34.0	31.0	0.353	31.000	9.868	19	13,605	18,846	12,900	18,140	16,730	14,614	12,498
45	H5	6.5	38.5	56.0	0.487	55.756	17.748	37	86,369	116,860	84,669	115,159	111,758	106,656	101,554
45	H4	6.5	38.5	53.5	0.474	53.263	16.954	35	74,893	101,472	73,277	99,857	96,626	91,780	86,933
45	H3	6.5	38.5	51.0	0.462	50.769	16.160	33	64,465	87,483	62,934	85,953	82,892	78,301	73,710
45	H2	6.5	38.5	48.5	0.449	48.276	15.367	31	55,036	74,827	53,591	73,382	70,491	66,156	61,820
45	H1	6.5	38.5	45.5	0.423	45.288	14.416	29	44,958	61,297	43,604	59,943	57,236	53,175	49,114
45	1	6.5	38.5	43.0	0.410	42.795	13.622	27	37,554	51,340	36,285	50,072	47,534	43,729	39,923
45	2	6.5	38.5	40.5	0.397	40.301	12.828	25	30,992	42,506	29,809	41,323	38,956	35,405	31,855
45	3	6.5	38.5	37.5	0.372	37.314	11.877	23	24,141	33,280	23,049	32,188	30,004	26,729	23,453
45	4	6.5	38.5	35.0	0.359	34.821	11.084	21	19,259	26,686	18,252	25,679	23,665	20,645	17,624
45	5	6.5	38.5	32.5	0.346	32.327	10.290	19	15,062	21,005	14,141	20,083	18,240	15,475	12,710
50	H5	7.0	43.0	58.5	0.489	58.011	18.466	37	96,549	130,891	94,391	128,732	124,416	117,941	111,467
50	H4	7.0	43.0	55.5	0.466	55.034	17.518	35	81,829	111,150	79,785	109,106	105,018	98,885	92,753
50	H3	7.0	43.0	53.0	0.455	52.545	16.726	33	70,746	96,266	68,808	94,328	90,452	84,638	78,824
50	H2	7.0	43.0	50.5	0.443	50.057	15.934	31	60,693	82,757	58,861	80,925	77,261	71,765	66,269
50	H1	7.0	43.0	47.5	0.420	47.080	14.986	29	49,914	68,270	48,196	66,552	63,116	57,962	52,808
50	1	7.0	43.0	45.0	0.409	44.591	14.194	27	41,953	57,549	40,341	55,937	52,713	47,878	43,042
50	2	7.0	43.0	42.0	0.386	41.614	13.246	25	33,535	46,211	32,037	44,713	41,718	37,224	32,731
50	3	7.0	43.0	39.0	0.364	38.636	12.298	23	26,285	36,430	24,901	35,047	32,279	28,128	23,977

Table 1: Unguyed Douglas-Fir Poles — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
50	4	7.0	43.0	36.5	0.352	36.148	11.506	21	21,093	29,401	19,815	28,123	25,568	21,735	17,902
55	H5	7.5	47.5	60.5	0.480	59.781	19.029	37	104,734	142,314	102,065	139,645	134,307	126,301	118,294
55	H4	7.5	47.5	58.0	0.469	57.296	18.238	35	91,641	124,727	89,101	122,187	117,108	109,490	101,871
55	H3	7.5	47.5	55.0	0.449	54.327	17.293	33	77,411	105,615	75,011	103,215	98,414	91,213	84,011
55	H2	7.5	47.5	52.0	0.429	51.357	16.347	31	64,699	88,526	62,437	86,265	81,742	74,958	68,173
55	H1	7.5	47.5	49.5	0.418	48.872	15.557	29	55,205	75,739	53,073	73,607	69,343	62,947	56,551
55	1	7.5	47.5	46.5	0.398	45.903	14.611	27	45,062	62,076	43,069	60,083	56,097	50,118	44,139
55	2	7.5	47.5	43.5	0.378	42.934	13.666	25	36,201	50,122	34,347	48,268	44,560	38,998	33,436
55	3	7.5	47.5	40.5	0.357	39.964	12.721	23	28,538	39,766	26,824	38,051	34,621	29,477	24,332
60	H6	8.0	52.0	65.5	0.491	64.519	20.537	39	131,505	178,747	128,097	175,339	168,525	158,302	148,080
60	H5	8.0	52.0	62.5	0.472	61.556	19.594	37	113,361	154,389	110,120	151,148	144,666	134,943	125,220
60	H4	8.0	52.0	59.5	0.454	58.593	18.651	35	96,928	132,312	93,854	129,238	123,089	113,865	104,642
60	H3	8.0	52.0	57.0	0.444	56.111	17.861	33	84,469	115,545	81,550	112,626	106,787	98,028	89,270
60	H2	8.0	52.0	54.0	0.426	53.148	16.918	31	70,966	97,375	68,213	94,621	89,115	80,856	72,597
60	H1	8.0	52.0	51.0	0.407	50.185	15.974	29	58,940	81,174	56,354	78,587	73,414	65,654	57,895
60	1	8.0	52.0	48.0	0.389	47.222	15.031	27	48,309	66,833	45,889	64,413	59,572	52,312	45,052
60	2	8.0	52.0	45.0	0.370	44.259	14.088	25	38,991	54,242	36,738	51,988	47,481	40,720	33,960
65	H6	8.5	56.5	67.5	0.483	66.292	21.102	39	141,523	192,770	137,450	188,697	180,552	168,333	156,115
65	H5	8.5	56.5	64.5	0.466	63.335	20.160	37	122,439	167,128	118,563	163,252	155,499	143,870	132,241
65	H4	8.5	56.5	61.5	0.449	60.377	19.219	35	105,109	143,826	101,429	140,146	132,786	121,746	110,706
65	H3	8.5	56.5	58.5	0.432	57.419	18.277	33	89,452	122,753	85,968	119,269	112,302	101,851	91,400
65	H2	8.5	56.5	55.5	0.415	54.462	17.336	31	75,385	103,800	72,098	100,513	93,939	84,077	74,215
65	H1	8.5	56.5	52.5	0.398	51.504	16.394	29	62,826	86,859	59,735	83,768	77,587	68,314	59,042
65	1	8.5	56.5	49.5	0.381	48.547	15.453	27	51,694	71,820	48,800	68,926	63,137	54,453	45,770
65	2	8.5	56.5	46.5	0.364	45.589	14.511	25	41,907	58,574	39,209	55,876	50,480	42,385	34,291
70	H6	9.0	61.0	69.0	0.469	67.594	21.516	39	148,604	202,928	143,813	198,138	188,558	174,187	159,817
70	H5	9.0	61.0	66.5	0.461	65.117	20.727	37	131,978	180,547	127,401	175,970	166,816	153,085	139,354
70	H4	9.0	61.0	63.5	0.445	62.164	19.787	35	113,725	155,982	109,377	151,634	142,937	129,892	116,847
70	H3	9.0	61.0	60.5	0.430	59.211	18.847	33	97,189	133,705	93,070	129,586	121,347	108,988	96,630
70	H2	9.0	61.0	57.0	0.406	55.781	17.756	31	79,968	110,499	76,093	106,624	98,874	87,248	75,623
70	H1	9.0	61.0	54.0	0.391	52.828	16.816	29	66,864	92,798	63,217	89,152	81,859	70,920	59,981
70	1	9.0	61.0	51.0	0.375	49.875	15.876	27	55,218	77,042	51,801	73,624	66,789	56,536	46,283
70	2	9.0	61.0	48.0	0.359	46.922	14.936	25	44,950	63,122	41,761	59,933	53,555	43,989	34,422
75	H6	9.5	65.5	71.0	0.464	69.377	22.083	39	159,443	218,181	153,852	212,590	201,409	184,637	167,866
75	H5	9.5	65.5	68.0	0.449	66.428	21.145	37	138,702	190,263	133,375	184,936	174,282	158,301	142,320

Table 1: Unguyed Douglas-Fir Poles — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
75	H4	9.5	65.5	65.0	0.435	63.478	20.206	35	119,791	164,785	114,728	159,722	149,595	134,405	119,215
75	H3	9.5	65.5	62.0	0.420	60.529	19.267	33	102,629	141,638	97,829	136,838	127,239	112,839	98,440
75	H2	9.5	65.5	59.0	0.406	57.580	18.328	31	87,133	120,713	82,597	116,177	107,105	93,496	79,888
75	H1	9.5	65.5	55.5	0.384	54.156	17.238	29	71,054	98,993	66,799	94,738	86,229	73,466	60,702
75	1	9.5	65.5	52.5	0.370	51.207	16.300	27	58,883	82,502	54,892	78,511	70,529	58,556	46,583
75	2	9.5	65.5	49.0	0.348	47.783	15.210	25	46,444	65,634	42,734	61,925	54,506	43,378	32,251
80	H6	10.0	70.0	72.5	0.453	70.689	22.501	39	167,079	229,214	160,637	222,772	209,888	190,562	171,236
80	H5	10.0	70.0	69.5	0.439	67.743	21.563	37	145,635	200,320	139,493	194,179	181,897	163,474	145,051
80	H4	10.0	70.0	66.5	0.426	64.797	20.626	35	126,051	173,909	120,211	168,069	156,388	138,868	121,347
80	H3	10.0	70.0	63.5	0.412	61.851	19.688	33	108,249	149,871	102,710	144,332	133,254	116,636	100,018
80	H2	10.0	70.0	60.0	0.392	58.432	18.600	31	89,630	124,725	84,412	119,507	109,071	93,418	77,765
80	H1	10.0	70.0	57.0	0.378	55.486	17.662	29	75,398	105,448	70,482	100,531	90,697	75,947	61,196
80	1	10.0	70.0	54.0	0.365	52.541	16.724	27	62,691	88,204	58,075	83,588	74,356	60,509	46,661
80	2	10.0	70.0	50.5	0.345	49.122	15.636	25	49,665	70,515	45,371	66,220	57,631	44,748	31,864
85	H6	10.5	74.5	74.5	0.449	72.478	23.070	39	178,762	245,734	171,377	238,349	223,580	201,426	179,272
85	H5	10.5	74.5	71.5	0.437	69.535	22.134	37	156,289	215,430	149,245	208,386	194,298	173,166	152,034
85	H4	10.5	74.5	68.0	0.418	66.120	21.047	35	132,506	183,355	125,826	176,675	163,315	143,275	123,234
85	H3	10.5	74.5	65.0	0.405	63.177	20.110	33	114,052	158,409	107,713	152,069	139,391	120,372	101,354
85	H2	10.5	74.5	61.5	0.386	59.763	19.023	31	94,712	132,259	88,737	126,283	114,332	96,406	78,479
85	H1	10.5	74.5	58.5	0.373	56.820	18.086	29	79,900	112,168	74,265	106,533	95,264	78,359	61,455
85	1	10.5	74.5	55.0	0.354	53.405	16.999	27	64,567	91,360	59,296	86,089	75,548	59,735	43,922
85	2	10.5	74.5	51.5	0.335	49.991	15.912	25	51,206	73,181	46,299	68,274	58,460	43,739	29,018
90	H6	11.0	79.0	76.0	0.440	73.798	23.491	39	186,963	257,661	178,587	249,284	232,531	207,401	182,272
90	H5	11.0	79.0	73.0	0.429	70.857	22.555	37	163,756	226,335	155,763	218,342	202,355	178,374	154,393
90	H4	11.0	79.0	69.5	0.411	67.446	21.469	35	139,157	193,127	131,572	185,543	170,373	147,619	124,865
90	H3	11.0	79.0	66.5	0.399	64.506	20.533	33	120,039	167,254	112,837	160,052	145,649	124,044	102,439
90	H2	11.0	79.0	63.0	0.381	61.095	19.447	31	99,965	140,079	93,172	133,287	119,701	99,323	78,945
90	H1	11.0	79.0	59.5	0.363	57.685	18.362	29	82,141	115,905	75,757	109,521	96,754	77,603	58,451
90	1	11.0	79.0	56.0	0.345	54.274	17.276	27	66,442	94,564	60,467	88,589	76,640	58,715	40,791
90	2	11.0	79.0	53.0	0.333	51.333	16.340	25	54,608	78,402	49,016	72,811	61,627	44,851	28,076
95	H6	11.0	84.0	77.5	0.433	75.337	23.981	39	196,945	272,160	187,379	262,594	243,461	214,761	186,062
95	H5	11.0	84.0	74.5	0.421	72.393	23.043	37	172,814	239,551	163,680	230,418	212,152	184,752	157,352
95	H4	11.0	84.0	71.0	0.404	68.978	21.956	35	147,178	204,908	138,507	196,237	178,896	152,884	126,872
95	H3	11.0	84.0	67.5	0.388	65.562	20.869	33	124,090	173,661	115,882	165,453	149,037	124,413	99,790
95	H2	11.0	84.0	64.5	0.376	62.618	19.932	31	106,243	149,432	98,468	141,658	126,108	102,784	79,460

Table 1: Unguyed Douglas-Fir Poles — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
95	H1	11.0	84.0	61.0	0.360	59.202	18.845	29	87,564	124,064	80,251	116,751	102,127	80,191	58,255
95	1	11.0	84.0	57.0	0.337	55.315	17.607	27	68,854	98,625	62,034	91,805	78,165	57,705	37,245
95	2	11.0	84.0	54.0	0.326	52.371	16.670	25	56,639	81,906	50,252	75,519	62,745	43,585	24,425
100	H6	11.0	89.0	79.0	0.426	76.872	24.469	39	207,182	287,090	196,336	276,243	254,550	222,009	189,469
100	H5	11.0	89.0	76.0	0.415	73.926	23.531	37	182,117	253,183	171,757	242,822	222,102	191,021	159,940
100	H4	11.0	89.0	72.5	0.399	70.505	22.443	35	155,433	217,084	145,592	207,244	187,562	158,041	128,519
100	H3	11.0	89.0	69.0	0.383	67.085	21.354	33	131,360	184,467	122,039	175,147	156,505	128,542	100,580
100	H2	11.0	89.0	65.5	0.367	63.665	20.265	31	109,772	155,164	100,971	146,363	128,760	102,357	75,953
100	H1	11.0	89.0	62.0	0.351	60.245	19.176	29	90,542	129,004	82,261	120,723	104,160	79,315	54,471
100	1	11.0	89.0	58.5	0.335	56.824	18.088	27	73,543	105,820	65,782	98,058	82,534	59,249	35,963
100	2	11.0	89.0	55.0	0.319	53.404	16.999	25	58,650	85,442	51,408	78,200	63,715	41,989	20,263

Table 2: Unguyed Douglas-fir Through Bored Fiber Stress Poles (7600 psi) — Usable Strength Tables — Pole Strengths

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
40	H3	6.0	34.0	48.5	0.456	48.500	15.438	33	53,683	72,747	52,512	71,577	69,236	65,725	62,214
40	H2	6.0	34.0	46.0	0.441	46.000	14.642	31	45,486	61,751	44,382	60,648	58,440	55,128	51,816
40	H1	6.0	34.0	43.5	0.426	43.500	13.846	29	38,153	51,909	37,116	50,871	48,796	45,684	42,572
40	1	6.0	34.0	41.0	0.412	41.000	13.051	27	31,639	43,156	30,668	42,185	40,243	37,330	34,417
40	2	6.0	34.0	38.5	0.397	38.500	12.255	25	25,895	35,432	24,991	34,527	32,718	30,004	27,291
40	3	6.0	34.0	36.0	0.382	36.000	11.459	23	20,876	28,672	20,037	27,834	26,158	23,643	21,129
40	4	6.0	34.0	33.5	0.368	33.500	10.663	21	16,533	22,815	15,761	22,043	20,500	18,185	15,870
40	5	6.0	34.0	31.0	0.353	31.000	9.868	19	12,819	17,798	12,114	17,092	15,682	13,566	11,450
45	H5	6.5	38.5	56.0	0.487	55.756	17.748	37	81,796	110,762	80,095	109,061	105,660	100,558	95,456
45	H4	6.5	38.5	53.5	0.474	53.263	16.954	35	70,906	96,156	69,290	94,541	91,310	86,464	81,617
45	H3	6.5	38.5	51.0	0.462	50.769	16.160	33	61,012	82,880	59,482	81,349	78,289	73,697	69,106
45	H2	6.5	38.5	48.5	0.449	48.276	15.367	31	52,068	70,869	50,623	69,424	66,533	62,197	57,862
45	H1	6.5	38.5	45.5	0.423	45.288	14.416	29	42,507	58,029	41,153	56,676	53,968	49,907	45,846
45	1	6.5	38.5	43.0	0.410	42.795	13.622	27	35,486	48,583	34,217	47,314	44,777	40,971	37,165
45	2	6.5	38.5	40.5	0.397	40.301	12.828	25	29,265	40,204	28,082	39,020	36,653	33,103	29,552
45	3	6.5	38.5	37.5	0.372	37.314	11.877	23	22,770	31,452	21,678	30,360	28,177	24,901	21,625
45	4	6.5	38.5	35.0	0.359	34.821	11.084	21	18,145	25,200	17,138	24,193	22,180	19,159	16,139
45	5	6.5	38.5	32.5	0.346	32.327	10.290	19	14,171	19,816	13,249	18,895	17,051	14,286	11,521
50	H5	7.0	43.0	58.5	0.489	58.011	18.466	37	91,398	124,022	89,240	121,864	117,548	111,073	104,598
50	H4	7.0	43.0	55.5	0.466	55.034	17.518	35	77,431	105,286	75,387	103,242	99,153	93,021	86,889
50	H3	7.0	43.0	53.0	0.455	52.545	16.726	33	66,918	91,162	64,980	89,224	85,348	79,534	73,720
50	H2	7.0	43.0	50.5	0.443	50.057	15.934	31	57,384	78,344	55,552	76,512	72,848	67,352	61,856
50	H1	7.0	43.0	47.5	0.420	47.080	14.986	29	47,160	64,598	45,443	62,881	59,445	54,291	49,137
50	1	7.0	43.0	45.0	0.409	44.591	14.194	27	39,613	54,430	38,002	52,818	49,594	44,759	39,923
50	2	7.0	43.0	42.0	0.386	41.614	13.246	25	31,634	43,676	30,136	42,178	39,182	34,689	30,196
50	3	7.0	43.0	39.0	0.364	38.636	12.298	23	24,763	34,401	23,379	33,017	30,250	26,099	21,948
50	4	7.0	43.0	36.5	0.352	36.148	11.506	21	19,846	27,739	18,569	26,462	23,906	20,074	16,241
55	H5	7.5	47.5	60.5	0.480	59.781	19.029	37	99,097	134,798	96,428	132,129	126,791	118,785	110,778
55	H4	7.5	47.5	58.0	0.469	57.296	18.238	35	86,678	118,110	84,138	115,570	110,491	102,873	95,254
55	H3	7.5	47.5	55.0	0.449	54.327	17.293	33	73,181	99,975	70,780	97,574	92,773	85,572	78,370
55	H2	7.5	47.5	52.0	0.429	51.357	16.347	31	61,124	83,761	58,863	81,499	76,976	70,192	63,408
55	H1	7.5	47.5	49.5	0.418	48.872	15.557	29	52,125	71,632	49,993	69,500	65,236	58,840	52,444
55	1	7.5	47.5	46.5	0.398	45.903	14.611	27	42,510	58,674	40,517	56,681	52,694	46,715	40,736
55	2	7.5	47.5	43.5	0.378	42.934	13.666	25	34,113	47,338	32,259	45,484	41,776	36,214	30,652

Table 2: Unguyed Douglas-fir Through Bored Fiber Stress Poles (7600 psi) — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
55	3	7.5	47.5	40.5	0.357	39.964	12.721	23	26,854	37,521	25,139	35,806	32,376	27,231	22,086
60	H6	8.0	52.0	65.5	0.491	64.519	20.537	39	124,418	169,298	121,011	165,891	159,076	148,854	138,632
60	H5	8.0	52.0	62.5	0.472	61.556	19.594	37	107,207	146,183	103,966	142,942	136,460	126,738	117,015
60	H4	8.0	52.0	59.5	0.454	58.593	18.651	35	91,621	125,235	88,546	122,161	116,012	106,789	97,565
60	H3	8.0	52.0	57.0	0.444	56.111	17.861	33	79,808	109,330	76,888	106,411	100,572	91,813	83,055
60	H2	8.0	52.0	54.0	0.426	53.148	16.918	31	67,005	92,093	64,252	89,340	83,834	75,575	67,316
60	H1	8.0	52.0	51.0	0.407	50.185	15.974	29	55,605	76,727	53,019	74,140	68,967	61,208	53,448
60	1	8.0	52.0	48.0	0.389	47.222	15.031	27	45,531	63,128	43,111	60,708	55,868	48,608	41,347
60	2	8.0	52.0	45.0	0.370	44.259	14.088	25	36,704	51,192	34,450	48,938	44,431	37,670	30,909
65	H6	8.5	56.5	67.5	0.483	66.292	21.102	39	133,836	182,520	129,763	178,448	170,302	158,084	145,866
65	H5	8.5	56.5	64.5	0.466	63.335	20.160	37	115,735	158,190	111,859	154,314	146,561	134,932	123,303
65	H4	8.5	56.5	61.5	0.449	60.377	19.219	35	99,302	136,082	95,622	132,402	125,042	114,002	102,962
65	H3	8.5	56.5	58.5	0.432	57.419	18.277	33	84,457	116,093	80,973	112,609	105,642	95,191	84,740
65	H2	8.5	56.5	55.5	0.415	54.462	17.336	31	71,123	98,117	67,835	94,830	88,256	78,394	68,532
65	H1	8.5	56.5	52.5	0.398	51.504	16.394	29	59,221	82,053	56,131	78,962	72,780	63,508	54,235
65	1	8.5	56.5	49.5	0.381	48.547	15.453	27	48,675	67,795	45,781	64,900	59,112	50,428	41,745
65	2	8.5	56.5	46.5	0.364	45.589	14.511	25	39,407	55,240	36,709	52,542	47,146	39,052	30,958
70	H6	9.0	61.0	69.0	0.469	67.594	21.516	39	140,455	192,063	135,665	187,273	177,693	163,322	148,952
70	H5	9.0	61.0	66.5	0.461	65.117	20.727	37	124,692	170,833	120,115	166,256	157,102	143,371	129,640
70	H4	9.0	61.0	63.5	0.445	62.164	19.787	35	107,387	147,531	103,038	143,182	134,486	121,441	108,396
70	H3	9.0	61.0	60.5	0.430	59.211	18.847	33	91,712	126,402	87,593	122,283	114,044	101,685	89,326
70	H2	9.0	61.0	57.0	0.406	55.781	17.756	31	75,388	104,393	71,513	100,518	92,768	81,142	69,517
70	H1	9.0	61.0	54.0	0.391	52.828	16.816	29	62,974	87,611	59,327	83,965	76,672	65,733	54,794
70	1	9.0	61.0	51.0	0.375	49.875	15.876	27	51,945	72,677	48,527	69,259	62,424	52,172	41,919
70	2	9.0	61.0	48.0	0.359	46.922	14.936	25	42,224	59,487	39,035	56,299	49,921	40,354	30,788
75	H6	9.5	65.5	71.0	0.464	69.377	22.083	39	150,632	206,433	145,041	200,843	189,662	172,890	156,118
75	H5	9.5	65.5	68.0	0.449	66.428	21.145	37	130,968	179,951	125,641	174,624	163,970	147,989	132,008
75	H4	9.5	65.5	65.0	0.435	63.478	20.206	35	113,042	155,786	107,979	150,723	140,596	125,406	110,216
75	H3	9.5	65.5	62.0	0.420	60.529	19.267	33	96,777	133,836	91,977	129,036	119,437	105,037	90,638
75	H2	9.5	65.5	59.0	0.406	57.580	18.328	31	82,096	113,997	77,560	109,461	100,389	86,780	73,172
75	H1	9.5	65.5	55.5	0.384	54.156	17.238	29	66,863	93,405	62,608	89,150	80,641	67,878	55,114
75	1	9.5	65.5	52.5	0.370	51.207	16.300	27	55,340	77,778	51,349	73,787	65,805	53,832	41,860
75	2	9.5	65.5	49.0	0.348	47.783	15.210	25	43,565	61,796	39,856	58,087	50,668	39,540	28,412
80	H6	10.0	70.0	72.5	0.453	70.689	22.501	39	157,759	216,787	151,317	210,345	197,461	178,135	158,809

Table 2: Unguyed Douglas-fir Through Bored Fiber Stress Poles (7600 psi) — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
80	H5	10.0	70.0	69.5	0.439	67.743	21.563	37	137,432	189,383	131,291	183,242	170,960	152,537	134,113
80	H4	10.0	70.0	66.5	0.426	64.797	20.626	35	118,873	164,337	113,033	158,497	146,817	129,296	111,776
80	H3	10.0	70.0	63.5	0.412	61.851	19.688	33	102,006	141,547	96,466	136,008	124,929	108,311	91,694
80	H2	10.0	70.0	60.0	0.392	58.432	18.600	31	84,366	117,706	79,148	112,488	102,053	86,399	70,746
80	H1	10.0	70.0	57.0	0.378	55.486	17.662	29	70,891	99,438	65,974	94,521	84,688	69,937	55,186
80	1	10.0	70.0	54.0	0.365	52.541	16.724	27	58,864	83,102	54,248	78,486	69,254	55,406	41,558
80	2	10.0	70.0	50.5	0.345	49.122	15.636	25	46,538	66,345	42,243	62,050	53,461	40,578	27,694
85	H6	10.5	74.5	74.5	0.449	72.478	23.070	39	168,716	232,340	161,332	224,955	210,186	188,032	165,877
85	H5	10.5	74.5	71.5	0.437	69.535	22.134	37	147,418	203,602	140,374	196,558	182,470	161,338	140,206
85	H4	10.5	74.5	68.0	0.418	66.120	21.047	35	124,879	173,185	118,199	166,505	153,145	133,105	113,065
85	H3	10.5	74.5	65.0	0.405	63.177	20.110	33	107,398	149,537	101,059	143,198	130,519	111,501	92,483
85	H2	10.5	74.5	61.5	0.386	59.763	19.023	31	89,081	124,750	83,105	118,774	106,823	88,897	70,970
85	H1	10.5	74.5	58.5	0.373	56.820	18.086	29	75,060	105,714	69,425	100,080	88,810	71,906	55,001
85	1	10.5	74.5	55.0	0.354	53.405	16.999	27	60,548	86,002	55,277	80,731	70,189	54,376	38,563
85	2	10.5	74.5	51.5	0.335	49.991	15.912	25	47,909	68,786	43,002	63,879	54,065	39,344	24,623
90	H6	11.0	79.0	76.0	0.440	73.798	23.491	39	176,358	243,521	167,982	235,145	218,391	193,262	168,132
90	H5	11.0	79.0	73.0	0.429	70.857	22.555	37	154,369	213,819	146,376	205,826	189,839	165,858	141,877
90	H4	11.0	79.0	69.5	0.411	67.446	21.469	35	131,061	182,333	123,477	174,748	159,579	136,825	114,071
90	H3	11.0	79.0	66.5	0.399	64.506	20.533	33	112,957	157,811	105,755	150,609	136,206	114,601	92,996
90	H2	11.0	79.0	63.0	0.381	61.095	19.447	31	93,948	132,056	87,155	125,264	111,678	91,300	70,922
90	H1	11.0	79.0	59.5	0.363	57.685	18.362	29	77,076	109,152	70,693	102,769	90,001	70,850	51,699
90	1	11.0	79.0	56.0	0.345	54.274	17.276	27	62,224	88,940	56,249	82,965	71,015	53,091	35,166
90	2	11.0	79.0	53.0	0.333	51.333	16.340	25	51,039	73,644	45,447	68,052	56,868	40,093	23,317
95	H6	11.0	84.0	77.5	0.433	75.337	23.981	39	185,663	257,117	176,097	247,551	228,418	199,718	171,019
95	H5	11.0	84.0	74.5	0.421	72.393	23.043	37	162,803	226,204	153,670	217,071	198,804	171,404	144,004
95	H4	11.0	84.0	71.0	0.404	68.978	21.956	35	138,518	193,362	129,848	184,691	167,350	141,338	115,326
95	H3	11.0	84.0	67.5	0.388	65.562	20.869	33	116,654	163,747	108,446	155,539	139,123	114,499	89,875
95	H2	11.0	84.0	64.5	0.376	62.618	19.932	31	99,765	140,795	91,990	133,020	117,470	94,146	70,822
95	H1	11.0	84.0	61.0	0.360	59.202	18.845	29	82,089	116,764	74,776	109,451	94,827	72,891	50,955
95	1	11.0	84.0	57.0	0.337	55.315	17.607	27	64,388	92,671	57,568	85,851	72,211	51,751	31,291
95	2	11.0	84.0	54.0	0.326	52.371	16.670	25	52,849	76,852	46,462	70,466	57,692	38,532	19,371
100	H6	11.0	89.0	79.0	0.426	76.872	24.469	39	195,196	271,108	184,349	260,262	238,568	206,028	173,487
100	H5	11.0	89.0	76.0	0.415	73.926	23.531	37	171,457	238,970	161,097	228,609	207,889	176,808	145,727
100	H4	11.0	89.0	72.5	0.399	70.505	22.443	35	146,185	204,754	136,344	194,913	175,232	145,710	116,189

Table 2: Unguyed Douglas-fir Through Bored Fiber Stress Poles (7600 psi) — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
100	H3	11.0	89.0	69.0	0.383	67.085	21.354	33	123,394	173,846	114,073	164,525	145,883	117,921	89,958
100	H2	11.0	89.0	65.5	0.367	63.665	20.265	31	102,963	146,085	94,162	137,284	119,682	93,278	66,875
100	H1	11.0	89.0	62.0	0.351	60.245	19.176	29	84,773	121,312	76,491	113,030	96,467	71,623	46,778
100	1	11.0	89.0	58.5	0.335	56.824	18.088	27	68,702	99,365	60,940	91,603	76,079	52,794	29,508
100	2	11.0	89.0	55.0	0.319	53.404	16.999	25	54,631	80,083	47,389	72,841	58,357	36,631	14,904

Table 3: Unguyed Western Red Cedar Fiber Strength (6000 psi) — Usable Strength Tables — Pole Strengths

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
25	5	5.0	20.0	28.0	0.474	28.474	9.063	19	8,431	11,477	8,196	11,242	10,772	10,066	9,361
30	5	5.5	24.5	30.0	0.458	30.229	9.622	19	9,847	13,491	9,485	13,129	12,405	11,318	10,232
35	5	6.0	29.0	32.0	0.448	32.000	10.186	19	11,408	15,731	10,887	15,210	14,169	12,607	11,046
40	1	6.0	34.0	45.0	0.529	45.000	14.324	27	33,030	45,052	32,018	44,040	42,017	38,981	35,945
40	2	6.0	34.0	42.5	0.515	42.500	13.528	25	27,546	37,674	26,601	36,728	34,838	32,001	29,165
40	3	6.0	34.0	39.5	0.485	39.500	12.573	23	21,770	29,901	20,897	29,027	27,279	24,658	22,036
40	4	6.0	34.0	36.5	0.456	36.500	11.618	21	16,839	23,254	16,036	22,452	20,847	18,440	16,033
40	5	6.0	34.0	34.0	0.441	34.000	10.823	19	13,348	18,533	12,612	17,798	16,326	14,118	11,910
45	1	6.5	38.5	47.5	0.526	47.237	15.036	27	37,736	51,642	36,410	50,315	47,662	43,681	39,701
45	2	6.5	38.5	44.5	0.500	44.250	14.085	25	30,587	42,018	29,352	40,782	38,312	34,606	30,901
45	3	6.5	38.5	41.5	0.474	41.263	13.134	23	24,375	33,644	23,231	32,500	30,213	26,782	23,351
45	4	6.5	38.5	38.5	0.449	38.276	12.184	21	19,037	26,435	17,985	25,383	23,279	20,123	16,966
45	5	6.5	38.5	36.0	0.436	35.782	11.390	19	15,231	21,276	14,264	20,309	18,375	15,474	12,573
50	1	7.0	43.0	49.5	0.511	48.989	15.594	27	41,480	56,991	39,796	55,307	51,939	46,888	41,837
50	2	7.0	43.0	46.5	0.489	46.011	14.646	25	33,844	46,695	32,274	45,125	41,986	37,277	32,568
50	3	7.0	43.0	43.5	0.466	43.034	13.698	23	27,176	37,690	25,720	36,234	33,323	28,957	24,590
50	4	7.0	43.0	40.0	0.432	39.568	12.595	21	20,518	28,691	19,185	27,358	24,690	20,690	16,689
55	1	7.5	47.5	51.5	0.500	50.750	16.154	27	45,464	62,708	43,374	60,619	56,439	50,170	43,901
55	2	7.5	47.5	48.5	0.480	47.781	15.209	25	37,321	51,712	35,371	49,762	45,860	40,008	34,156
55	3	7.5	47.5	45.0	0.449	44.327	14.110	23	29,065	40,555	27,263	38,753	35,149	29,743	24,337
60	1	8.0	52.0	53.5	0.491	52.519	16.717	27	49,692	68,803	47,145	66,256	61,163	53,522	45,882
60	2	8.0	52.0	50.0	0.463	49.074	15.621	25	39,669	55,261	37,300	52,892	48,155	41,049	33,942
65	1	8.5	56.5	55.0	0.475	53.814	17.129	27	52,549	73,109	49,506	70,066	63,980	54,850	45,721
65	2	8.5	56.5	51.5	0.449	50.377	16.036	25	42,101	58,969	39,268	56,135	50,469	41,969	33,470
70	1	9.0	61.0	56.5	0.461	55.117	17.544	27	55,501	77,591	51,910	74,001	66,821	56,050	45,280
70	2	9.0	61.0	53.0	0.438	51.688	16.453	25	44,617	62,834	41,271	59,489	52,798	42,761	32,724
75	1	9.5	65.5	58.0	0.449	56.428	17.961	27	58,544	82,247	54,355	78,058	69,680	57,113	44,546
75	2	9.5	65.5	54.5	0.428	53.004	16.872	25	47,213	66,859	43,306	62,951	55,137	43,414	31,692
80	1	10.0	70.0	59.5	0.439	57.743	18.380	27	61,678	87,078	56,836	82,237	72,554	58,030	43,506
80	2	10.0	70.0	56.0	0.419	54.324	17.292	25	49,892	71,043	45,372	66,523	57,483	43,923	30,363
85	1	10.5	74.5	61.0	0.430	59.063	18.800	27	64,902	92,085	59,354	86,536	75,439	58,793	42,148
85	2	10.5	74.5	57.0	0.405	55.177	17.563	25	51,003	73,165	45,841	68,004	57,681	42,196	26,711
90	1	11.0	79.0	62.5	0.423	60.387	19.222	27	68,218	97,269	61,906	90,957	78,333	59,396	40,460
90	2	11.0	79.0	58.5	0.399	56.506	17.986	25	53,776	77,578	47,898	71,701	59,946	42,314	24,683

Table 3: Unguyed Western Red Cedar Fiber Strength (6000 psi) — Usable Strength Tables — Pole Strengths (Continued)

Pole Length (ft)	ANSI Size Class	Setting Depth (ft)	Height Above Ground (ft)	ANSI Circum. 6 ft from Butt	Taper Circ. (in/ft)	MIN Ground-Line Circum. (in)	MIN Ground-Line DIA (in)	Top Circum. (in)	6 lb Pole Loading		8 lb Pole Loading		12 lb Pole Loading	18 lb Pole Loading	24 lb Pole Loading
									Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A	Usable ft-lb Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B	Usable ft-lb Grade A & Grade B
									SF	SF	SF	SF	SF	SF	SF
									4.00	3.00	4.00	3.00	3.00	3.00	3.00
95	1	11.0	84.0	63.5	0.410	61.449	19.560	27	70,228	100,840	63,025	93,637	79,232	57,624	36,015
95	2	11.0	84.0	59.5	0.388	57.562	18.322	25	55,354	80,515	48,643	73,805	60,383	40,251	20,120
100	1	11.0	89.0	65.0	0.404	62.979	20.047	27	74,286	107,241	66,093	99,048	82,663	58,084	33,506
100	2	11.0	89.0	61.0	0.383	59.085	18.807	25	58,718	85,931	51,078	78,291	63,011	40,091	17,171

Table 4: Conductor Pole Loading

		Pole Loading per Foot (lb/ft)				
Conductor Size	DIA (in)	6 lb/ft^2 Heavy Load (above 3,000 ft)	8 lb/ft^2 (below 3,000 ft)	12 lb/ft^2	18 lb/ft^2	24 lb/ft^2
954 kcmil All Al	1.124	1.062	0.749	1.124	1.686	2.248
795 kcmil All Al	1.026	1.013	0.684	1.026	1.539	2.052
795 kcmil ACSR	1.108	1.054	0.739	1.108	1.662	2.216
636 kcmil All Al	0.918	0.959	0.612	0.918	1.377	1.836
653.9 kcmil ACSR	0.953	0.977	0.635	0.953	1.430	1.906
477 kcmil All Al	0.793	0.897	0.529	0.793	1.190	1.586
336.4 kcmil All Al	0.666	0.833	0.444	0.666	0.999	1.332
336.4 kcmil ACSR	0.684	0.842	0.456	0.684	1.026	1.368
4/0 ALL Al	0.527	0.764	0.351	0.527	0.791	1.054
4/0 ACSR	0.563	0.782	0.375	0.563	0.845	1.126
4/0 Bare Copper	0.528	0.764	0.352	0.528	0.792	1.056
4/0 WP Copper	0.678	0.839	0.452	0.678	1.017	1.356
2/0 All Al or BC	0.419	0.710	0.279	0.419	0.629	0.838
2/0 ACSR	0.447	0.724	0.298	0.447	0.671	0.894
2/0 WP Copper	0.570	0.785	0.380	0.570	0.855	1.140
1/0 ACSR	0.398	0.699	0.265	0.398	0.597	0.796
1/0 Bare Copper	0.373	0.687	0.249	0.373	0.560	0.746
1/0 WP Al or Cu	0.493	0.747	0.329	0.493	0.740	0.986
No. 1 Bare Copper	0.332	0.666	0.221	0.332	0.498	0.664
No. 2 All Al or BC	0.292	0.646	0.195	0.292	0.438	0.584
No. 2 ACSR	0.316	0.658	0.211	0.316	0.474	0.632
No. 2 WP Al or Cu	0.386	0.693	0.257	0.386	0.579	0.772
No. 4 All Al	0.232	0.616	0.155	0.232	0.348	0.464
No. 4 ACSR[a/]	0.250	0.625	0.167	0.250	0.325	0.500
No. 4 Str BC	0.232	0.616	0.155	0.232	0.348	0.464
No. 4 Bare Copper	0.204	0.602	0.136	0.204	0.306	0.408
No. 4 WP Copper	0.329	0.665	0.219	0.329	0.494	0.658

[a/] Not approved for use on new construction

Note(s):

1. The DIMP organization is responsible for maintaining the wind zone map in the E-world and Standards and Publications Portal Pages.
2. Horizontal pole loading per foot of conductor for conductors not listed above is determined by the following formulas:
   6 lb Heavy Loading = (Diameter + 1.0) × 0.5
   8 lb Light Loading = (Diameter ÷ 12) × 8
   12 lb Light Loading = (Diameter ÷ 12) × 12
   18 lb Light Loading = (Diameter ÷ 12) × 18
   24 lb Light Loading = (Diameter ÷ 12) × 24
3. Heavy-loading areas computed with 6-pound (48.41 mph) wind with 1/2-inch radial ice. Light-loading areas computed with 8-pound (55.90 mph) wind, 12-pound (68.47 mph) wind, 18-pound (83.85 mph) wind, or 24-pound (96.82 mph) wind.

Table 4: Conductor Pole Loading (Continued)

		Pole Loading per Foot (lbs/ft)				
Conductor Size	**DIA (in)**	**6 lb/ft² Heavy Load (above 3,000 ft)**	**8 lb/ft² (below 3,000 ft)**	**12 lb/ft²**	**18 lb/ft²**	**24 lb/ft²**
No. 6 Bare Copper	0.162	0.581	0.108	0.162	0.243	0.324
No. 6 WP Copper	0.287	0.644	0.191	0.287	0.431	0.574
No. 8 Bare Copper	0.129	0.564	0.086	0.129	0.193	0.257
No. 8 WP Copper	0.254	0.627	0.169	0.254	0.381	0.508
No. 6 Al Dup	0.450	0.725	0.300	0.450	0.675	0.900
No. 4 Al Dup	0.565	0.783	0.377	0.565	0.848	1.130
No. 4 Al Triplex	0.640	0.820	0.427	0.640	0.960	1.280
No. 2 Al Triplex	0.760	0.880	0.507	0.760	1.140	1.520
1/0 Al Triplex	0.990	0.995	0.660	0.990	1.485	1.980
4/0 Al Triplex	1.341	1.171	0.898	1.341	2.012	2.682
No. 4 Al Quad	0.848	0.924	0.565	0.848	1.272	1.696
1/0 Al Quad	1.120	1.060	0.747	1.120	1.680	2.240
4/0 Al Quad	1.490	1.245	0.993	1.490	2.235	2.980
No. 6 Cu Triplex	0.548	0.774	0.365	0.548	0.822	1.096
No. 4 Cu Triplex	0.646	0.823	0.431	0.646	0.969	1.292
No. 2 Cu Triplex	0.772	0.886	0.515	0.772	1.158	1.544
1/0 Aerial Cable	3.088	2.044	2.059	3.088	4.632	6.176
350 Aerial Cable	3.884	2.442	2.589	3.884	5.826	7.768
4/0 Aerial Cable	4.440	2.720	2.960	4.440	6.660	8.880
700 Aerial Cable	5.200	3.100	3.467	5.200	7.800	10.400
No. 2 Str. Aerial	3.040	2.020	2.027	3.040	4.560	6.080
No. 8 B.C. Aerial	3.040	2.020	2.027	3.040	4.560	6.080
#2 Copper XLPE 17 kV	0.622	0.807	0.409	0.613	0.920	1.226
1/0 ACSR HDPE 15 kV [a/] [b/]	0.698	0.831	0.441	0.661	0.992	1.322
1/0 ACSR HDPE 17 kV [a] [c/]	0.728	0.864	0.485	0.728	1.092	1.456
1/0 ACSR XLPE 17 kV	0.728	0.864	0.485	0.728	1.092	1.456
2/0 Copper XLPE 17 kV	0.744	0.866	0.488	0.732	1.098	1.464
4/0 Copper XLPE 17 kV	0.850	0.918	0.557	0.836	1.254	1.672
336.4 (18/1) kcmil ACSR XLPE 17 kV	1.013	1.007	0.675	1.013	1.520	2.026
336.4 (30/7) kcmil ACSR XLPE 17 kV	1.091	1.046	0.727	1.091	1.637	2.182
653.9 kcmil ACSR XLPE 17 kV	1.283	1.142	0.856	1.283	1.925	2.567
1/0 ACSR XLPE 35 kV	1.048	1.024	0.699	1.048	1.572	2.096
336.4 (18/1) kcmil ACSR XLPE 35 kV	1.333	1.165	0.887	1.330	1.995	2.660
336 (30/7) kcmil ACSR XLPE 35 kV	1.391	1.196	0.927	1.391	2.087	2.782
653.9 kcmil ACSR XLPE 35 kV	1.603	1.302	1.069	1.603	2.405	3.206
Guys						
7/32 inch	0.219	0.610	0.146	0.219	0.329	0.438
1/4 inch	0.250	0.625	0.167	0.250	0.375	0.500
9/32 inch	0.281	0.641	0.187	0.281	0.422	0.562
5/16 inch	0.313	0.6 57	0.209	0.313	0.470	0.626
3/8 inch	0.375	0.688	0.250	0.375	0.563	0.750
7/16 inch	0.438	0.719	0.292	0.438	0.657	0.876

[a/] Not approved for new construction.
[b/] 75° rated ACSR. See DOH Table CC 110-1.
[c/] 90° rated ACSR. See DOH Table CC 110-2.

Note(s):
1. The DIMP organization is responsible for maintaining the wind zone map in the E-world and Standards and Publications Portal Pages.
2. Horizontal pole loading per foot of conductor for conductors not listed above is determined by the following formulas:
   6 lb Heavy Loading = (Diameter + 1.0) × 0.5
   8 lb Light Loading = (Diameter ÷ 12) × 8
   12 lb Light Loading = (Diameter ÷ 12) × 12
   18 lb Light Loading = (Diameter ÷ 12) × 18
   24 lb Light Loading = (Diameter ÷ 12) × 24
3. Heavy-loading areas computed with 6-pound (48.41 mph) wind with 1/2-inch radial ice. Light-loading areas computed with 8-pound (55.90 mph) wind, 12-pound (68.47 mph) wind, 18-pound (83.85 mph) wind, or 24-pound (96.82 mph) wind.

Table 4: Conductor Pole Loading (Continued)

		Pole Loading per Foot (lb/ft)				
Conductor Size	**DIA (in)**	**6 lb/ft² Heavy Load (above 3,000 ft)**	**8 lb/ft² (below 3,000 ft)**	**12 lb/ft²**	**18 lb/ft²**	**24 lb/ft²**
Telephone Cable (Cont'd)	(Includes Messenger)					
25 Pair-5/16 Msgr	0.943	0.972	0.629	0.943	1.415	1.886
50 Pair-5/16 Msgr	1.153	1.077	0.769	1.153	1.730	2.306
100 Pair-5/16 Msgr	1.513	1.257	1.009	1.513	2.270	3.026
200 Pair-7/16 Msgr	1.938	1.469	1.292	1.938	2.907	3.876
400 Pair-7/16 Msgr	2.538	1.769	1.692	2.538	3.807	5.076
600 Pair-7/16 Msgr	2.938	1.969	1.959	2.938	4.407	5.876
900 Pair-7/16 Msgr	3.438	2.219	2.292	3.438	5.157	6.876
No. 9 Iron Wire	0.148	0.574	0.099	0.148	0.222	0.296
No. 12 Iron Wire	0.109	0.555	0.073	0.109	0.164	0.218
1/2" DIA - 1/4" Msgr	0.750	0.875	0.500	0.750	1.125	1.500
1/2" DIA - 5/16" Msgr	0.810	0.905	0.540	0.810	1.215	1.620
1/2" DIA - 7/16" Msgr	0.940	0.970	0.627	0.940	1.410	1.880
1/2" DIA - 1/2" Msgr	1.000	1.000	0.667	1.000	1.500	2.000
3/4" DIA - 1/4" Msgr	1.000	1.000	0.667	1.000	1.500	2.000
3/4" DIA - 5/16" Msgr	1.060	1.030	0.707	1.060	1.590	2.120
3/4" DIA - 7/16" Msgr	1.190	1.690	0.793	1.190	1.785	2.380
3/4" DIA - 1/2" Msgr	1.250	1.125	0.833	1.250	1.875	2.500
1" DIA - 1/4" Msgr	1.250	1.125	0.833	1.250	1.875	2.500
1" DIA - 5/16" Msgr	1.310	1.155	0.873	1.310	1.965	2.620
1" DIA - 7/16" Msgr	1.440	1.220	0.960	1.440	2.160	2.880
1" DIA - 1/2" Msgr	1.500	1.250	1.000	1.500	2.250	3.000
1.25" DIA - 1/4" Msgr	1.500	1.250	1.000	1.500	2.250	3.000
1.25" DIA - 5/16" Msgr	1.560	1.280	1.040	1.560	2.340	3.120

Note(s):

1. The DIMP organization is responsible for maintaining the wind zone map in the E-world and Standards and Publications Portal Pages.
2. Horizontal pole loading per foot of conductor for conductors not listed above is determined by the following formulas:
   6 lb Heavy Loading = (Diameter + 1.0) × 0.5
   8 lb Light Loading = (Diameter ÷ 12) × 8
   12 lb Light Loading = (Diameter ÷ 12) × 12
   18 lb Light Loading = (Diameter ÷ 12) × 18
   24 lb Light Loading = (Diameter ÷ 12) × 24
3. Heavy-loading areas computed with 6-pound (48.41 mph) wind with 1/2-inch radial ice. Light-loading areas computed with 8-pound (55.90 mph) wind, 12-pound (68.47 mph) wind, 18-pound (83.85 mph) wind, or 24-pound (96.82 mph) wind.

Table 4: Conductor Pole Loading (Continued)

		Pole Loading per Foot (lb/ft)				
Conductor Size	**DIA (in)**	**6 lb/ft^2 Heavy Load (above 3,000 ft)**	**8 lb/ft^2 (below 3,000 ft)**	**12 lb/ft^2**	**18 lb/ft^2**	**24 lb/ft^2**
Telephone Cable (Cont'd)	(Includes Messenger)					
1.25" DIA - 7/16" Msgr	1.690	1.345	1.127	1.690	2.535	3.380
1.25" DIA - 1/2" Msgr	1.750	1.375	1.167	1.750	2.625	3.500
1.5" DIA - 1/4" Msgr	1.750	1.375	1.167	1.750	2.625	3.500
1.5" DIA - 5/16" Msgr	1.810	1.405	1.207	1.810	2.715	3.620
1.5" DIA - 7/16" Msgr	1.940	1.407	1.293	1.940	2.910	3.880
1.5" DIA - 1/2" Msgr	2.000	1.500	1.333	2.000	3.000	4.000
2" DIA - 1/4" Msgr	2.250	1.625	1.500	2.250	3.375	4.500
2" DIA - 5/16" Msgr	2.310	1.655	1.540	2.310	3.465	4.620
2" DIA - 7/16" Msgr	2.440	1.720	1.627	2.440	3.660	4.880
2" DIA - 1/2" Msgr	3.000	2.000	2.000	3.000	4.500	6.000
2.5" DIA - 1/4" Msgr	2.750	1.875	1.833	2.750	4.125	5.500
2.5" DIA - 5/16" Msgr	2.810	1.905	1.873	2.810	4.215	5.620
2.5" DIA - 7/16" Msgr	2.940	1.970	1.960	2.940	4.410	5.880
2.5" DIA - 1/2" Msgr	3.000	2.000	2.000	3.000	4.500	6.000
3" DIA - 1/4" Msgr	3.250	2.125	2.167	3.250	4.875	6.500
3" DIA - 5/16" Msgr	3.310	2.155	2.207	3.310	4.965	6.620
3" DIA - 7/16" Msgr	3.440	2.220	2.293	3.440	5.160	6.880
3" DIA - 1/2" Msgr	3.500	2.250	2.333	3.500	5.250	7.000
3.5" DIA - 1/4" Msgr	3.750	2.375	2.500	3.750	5.625	7.500
3.5" DIA - 5/16" Msgr	3.810	2.405	2.540	3.810	5.715	7.620
3.5" DIA - 7/16" Msgr	3.940	2.470	2.627	3.940	5.910	7.880
3.5" DIA - 1/4" Msgr	4.000	2.500	2.667	4.000	6.000	8.000
4" DIA - 1/4" Msgr	4.250	2.625	2.833	4.250	6.375	8.500
4" DIA - 5/16" Msgr	4.310	2.655	2.873	4.310	6.465	8.620
4" DIA - 7/16" Msgr	4.440	2.720	2.960	4.440	6.660	8.880
4" DIA - 1/2" Msgr	4.500	2.750	3.000	4.500	6.750	9.000

Note(s):

1. The DIMP organization is responsible for maintaining the wind zone map in the E-world and Standards and Publications Portal Pages.
2. Horizontal pole loading per foot of conductor for conductors not listed above is determined by the following formulas:
   6 lb Heavy Loading = (Diameter + 1.0) × 0.5
   8 lb Light Loading = (Diameter ÷ 12) × 8
   12 lb Light Loading = (Diameter ÷ 12) × 12
   18 lb Light Loading = (Diameter ÷ 12) × 18
   24 lb Light Loading = (Diameter ÷ 12) × 24
3. Heavy-loading areas computed with 6-pound (48.41 mph) wind with 1/2-inch radial ice.
   Light-loading areas computed with 8-pound (55.90 mph) wind, 12-pound (68.47 mph) wind, 18-pound (83.85 mph) wind, or 24-pound (96.82 mph) wind.

Table 4: Conductor Pole Loading (Continued)

		Pole Loading per Foot (lb/ft)				
Conductor Size (CC 2.0)	DIA (in)	6 lb/ft^2 Heavy Load (above 3,000 ft)	8 lb/ft^2 (below 3,000 ft)	12 lb/ft^2	18 lb/ft^2	24 lb/ft^2
1/0 AWG ACSR/AW XLPE 17 kV	0.635	0.818	0.423	0.635	0.953	1.27
101.8 kcmil ACSR/AW XLPE 17 kV	0.732	0.866	0.488	0.732	1.098	1.464
336.4 (18/1) kcmil ACSR/AW XLPE 17 kV	0.898	0.949	0.599	0.898	1.347	1.796
336.4 (30/7) kcmil ACSR/AW XLPE 17 kV	0.96	0.980	0.640	0.960	1.440	1.92
653.9 kcmil ACSR/AW XLPE 17 kV	1.17	1.085	0.780	1.170	1.755	2.34
#2 Copper HDCU XLPE 17 kV	0.562	0.781	0.375	0.562	0.843	1.124
2/0 Copper HDCU XLPE 17 kV	0.684	0.842	0.456	0.684	1.026	1.368
4/0 Copper HDCU XLPE 17 kV	0.792	0.896	0.528	0.792	1.188	1.584
350 kcmil Copper HDCU XLPE 17 kV	0.989	0.995	0.659	0.989	1.484	1.978
500 kcmil Copper HDCU XLPE 17 kV	1.123	1.062	0.749	1.123	1.685	2.246
1/0 AWG ACSR/AW XLPE 35 kV	0.855	0.928	0.570	0.855	1.283	1.71
101.8 kcmil ACSR/AW XLPE 35 kV	0.952	0.976	0.635	0.952	1.428	1.904
336.4 (18/1) kcmil ACSR/AW XLPE 35 kV	1.12	1.060	0.747	1.120	1.680	2.24
336.4 (30/7) kcmil ACSR/AW XLPE 35 kV	1.18	1.090	0.787	1.180	1.770	2.36
653.9 kcmil ACSR/AW XLPE 35 kV	1.38	1.190	0.920	1.380	2.070	2.76
#2 Copper HDCU XLPE 35 kV	0.782	0.891	0.521	0.782	1.173	1.564
2/0 Copper HDCU XLPE 35 kV	0.904	0.952	0.603	0.904	1.356	1.808
4/0 Copper HDCU XLPE 35 kV	1.012	1.006	0.675	1.012	1.518	2.024
350 kcmil Copper HDCU XLPE 35 kV	1.209	1.105	0.806	1.209	1.814	2.418
500 kcmil Copper HDCU XLPE 35 kV	1.209	1.105	0.806	1.209	1.814	2.418

[a/] Not approved for new construction.
[b/] 75° rated ACSR. See DOH Table CC 110-1.
[c/] 90° rated ACSR. See DOH Table CC 110-2.

Note(s):

1. The DIMP organization is responsible for maintaining the wind zone map in the E-world and Standards and Publications Portal Pages.
2. Horizontal pole loading per foot of conductor for conductors not listed above is determined by the following formulas:
   6 lb Heavy Loading = (Diameter + 1.0) × 0.5
   8 lb Light Loading = (Diameter ÷ 12) × 8
   12 lb Light Loading = (Diameter ÷ 12) × 12
   18 lb Light Loading = (Diameter ÷ 12) × 18
   24 lb Light Loading = (Diameter ÷ 12) × 24
3. Heavy-loading areas computed with 6-pound (48.41 mph) wind with 1/2-inch radial ice. Light-loading areas computed with 8-pound (55.90 mph) wind, 12-pound (68.47 mph) wind, 18-pound (83.85 mph) wind, or 24-pound (96.82 mph) wind.

B. Extra Heavy Loading Areas above 5,000 feet

Special construction requirements have been established for extra heavy-loading areas above 5,000 feet (normal heavy-loading areas are between 3,000 feet and 5,000 feet elevation). Higher strength requirements in these areas are needed to eliminate damage to pole lines caused by extremely heavy ice formation on conductors, or extreme shock loads due to ice or snow “unloading.” These special requirements and maps are shown in the DOH Manual, Section DC.

C. Steel Stub

Existing poles with steel stubs installed and steel stub candidate poles shall be considered as being 100 percent sound and as having the pole class minimum ground line circumference (GLC) for pole loading purposes. Only use measured GLC when it is smaller than the pole class minimum GLC.

D. Star Pole Anchor (Pilot)

Poles installed on solid rock can be anchored to the rock with Star Pole Anchors. Star Pole anchors can be used only for installations with an As-Designed GLC of not more than 60 inches. Pole loading is done using the pole specie – “Douglas Fir-Star Pole”.

Only the pole class minimum GLC (using the Auto setting for GLC in SPIDA-Calc) can be used for pole loading poles using Star Pole Anchors whether new or in-service.

For poles set on exposed rock the butt of the pole is set at the GL in SPIDA, that is, the full length of pole is set for AGL in SPIDA-Calc. For poles set on buried rock the butt will need to be cut to allow for the through-bored section of the Douglas Fir Pole to be in the buried section of pole. In this case the pole loading should set the pole to the standard default setting depth (using Auto setting for AGL). The amount of pole cut off from the butt will result in the same above ground line height of pole as a normally set pole in soil.

The GLC from the SPIDA Calc report plus one inch is used to get the Star Pole Anchors size and estimated quantity from, DOH Table PO 141P-1. For GLC over 53.5" always select SPA-3 anchors.

The measured GLC of the pole in the field will be used to determine the final quantity of anchors required at each site.

Pilot is only approved for the following districts: 50 – Shaver Lake, 51 – Tulare, 52 – Tehachapi, 53 – Kernville

Note: For pilot no Star Pole species is available in the client file. Instead use non-through bored Douglas Fir and make sure Joint Use Pole safety factors are not below 5.3 for new and SCE Solely Use Poles safety factors are not less than 4 for new.

Refer to DOH PO 141P for more information.

1.8 Pole Strength/Equipment Weight Limits

A. Table 7 will be used as a precursor to performing a pole load calculation and will be used to determine the pole class based on the maximum weight of the equipment. Table 5 and Table 6 will be used to determine the pole class based on the maximum weight of the single-phase transformers mounted on crossarms or brackets on a wood pole. Once equipment has been determined, refer to Table 5, Table 6, and Table 7 to determine the class of pole. When transformer weights exceed the maximum allowable pole-mounted values as specified in the DAP Manual, AP 106 tables, then the proper 17'-4" platform rack (2-pole or 3-pole) may be installed.
Refer to the 17'-4" Platform Rack Design Criteria (Chapter 10, Section 5.2E) of the DDS Manual for details.

B. It is recommended to use the actual weight of equipment if it is available from the manufacturer's nameplate. If nameplate information is not available, Table 7 will be used to determine dimensions and weights of various types of equipment.

Table 5: Minimum Pole Class for New Transformers and Equipment Mounted on Existing or New Wood and Composite Poles

Equipment Mounting Height Above Ground Line (ft)	MIN Pole Class	Transformer and/or Equipment Weight (lb)
27.5 or Below	4	Up to 1,500
	3	1,501–1,850
	2	1,851–2,500
	1	2,501–3,350
	H1	3,351–4,250
	H2	4,251–4,850
	H3	over 4,851
	H4	over 4,851
27.6–32.0	4	Up to 1,300
	3	1,301–1,700
	2	1,701–2,200
	1	2,201–3,000
	H1	3,001–3,900
	H2	3,901–4,850
	H3	over 4,851
32.1–36.5	4	Up to 1,300
	3	1,301–1,700
	2	1,701–2,200
	1	2,201–3,000
	H1	3,001–4,000
	H2	4,001–4,850
	H3	over 4,851
36.6–41.0	4	Up to 1,200
	3	1,201–1,500
	2	1,501–2,200
	1	2,201–2,500
	H1	2,501–3,350
	H2	3,351–4,250
	H3	4,250–4,850
	H4	over 4,851
41.1–45.5	4	Up to 1,200
	3	1,201–1,500
	2	1,501–1,850
	1	1,851–2,500
	H1	2,501–3,350
	H2	3,351–4,250
	H3	4,251–4,850
	H4	over 4,851

Table 5: Minimum Pole Class for New Transformers and Equipment Mounted on Existing or New Wood and Composite Poles (Continued)

Equipment Mounting Height Above Ground Line (ft)	MIN Pole Class	Transformer and/or Equipment Weight (lb)
45.6–50.0	2	Up to 1,850
	1	1,851–2,500
	H1	2,501–3,350
	H2	3,351–4,250
	H3	4,251–4,850
	H4	over 4,850

Note(s):

1. For new poles, this table should be used to select pole class prior to pole loading. For existing poles with no existing transformers or equipment that are scheduled to have equipment attached, this table should be used prior to pole loading.
2. Existing poles with existing transformers or equipment installed to the pole do not need to meet this table criteria, however, a visual inspection is required to ensure that there is no excessive bowing due to the installed apparatus as well as a passing pole load calculation.
3. Changing like-for-like transformers or equipment requires a visual inspection and passing pole load calculation. See Paragraph 1.3 B. (Page 3) for exceptions.
4. This table shall be used if the existing transformers or equipment are being replaced with heavier ones. A passing pole load calculation is required.
5. Refer to PLM–2, Table 7: Equipment Weights and Surface Area for equipment weights.
6. A pole load calculation is required when any equipment weighing 200 pounds or more is installed on a wood pole.
7. Choose correct bracket to support the weight of the transformer being mounted. If weight exceeds the mounting bracket capacity, then an overhead platform rack shall be used. Refer to DOH DC 640 for platform rack details. Refer to DAP AP 131 for mounting brackets details.
8. In HFRA, a pole-load must be performed for any new equipment addition, regardless of equipment weight.

Table 6: Weight Limitation of Three-Phase Transformers — Transformer Bracket Mounted on Wood Pole

Transformer Size (kVA) (See Note 3)	Transformer Individual MAX Weight (lb) (See Note 1)	Transformer Weight (Times 3) (lb) (See Note 1)	Transformers & Mounting Bracket Total Weight (See Note 1)
(a)	(b)	(c)	(d)
10	286	858	1,208
15	313	939	1,289
25	450	1,350	1,700
37.5	500	1,500	1,850
50	650	1,950	2,300
75	1,000	3,000	3,350
100	1,300	3,900	4,250
167	1,500	4,500	4,850

= For Reference Only

Note(s):

1. A pole-load calculation must be performed whenever any equipment 200 pounds or greater is installed on a wood pole.
2. If a combination of three transformers are used (for example: 2 - 50 kVA and 1 - 100 kVA) which are not shown on this table, add the total weight of the transformers using columns (a) and (b) to determine total weight. Round up to the nearest transformer weight shown in column (d).
3. Transformers (10 kVA and 15 kVA) are not available and not approved for use on new installations or replacements.
4. Choose correct bracket to support the weight of three single-phase transformers. If weight exceeds the mounting bracket capacity, then an overhead platform rack shall be used. Refer to DOH DC 640 for platform rack details.
5. Refer to DAP AP 131 for mounting bracket details.
6. Transformer weights are for 4 kV, 12 kV, and 16 kV, 120/240 V and 277/460 V transformers only. For 33 kV primary or above 600 V secondary voltages, contact engineering.
7. In HFRA, a pole-load must be performed for any new equipment addition, regardless of equipment weight.

1.9 Equipment Weights and Dimensions Table

Weights and dimensions for various apparatus overhead equipment are identified in Table 7 and applied to the SPIDA PLT.

A pole load calculation is not required when the scope of work is only the addition, removal, or replacement of crossarms, insulators or equipment weighing less than 200 pounds. When any of these components are being worked in addition to conductors, equipment in excess of 200 pounds or a pole replacement, it must be included in the pole load calculation.

In HFRA, a pole-load must be performed for any new equipment addition, regardless of equipment weight.

Table 7: Equipment Weights and Surface Area

Equipment Type & Size	Weight (lbs)	Lateral Side Area (ft^2)	Pole Side Area (ft^2)
Arrestor			
5' Fuse Arm with 1 Cutout	25	1	0.82
BGAN Assembly	130	5.5	4
Fuse Arm with 2 Cutouts	50	2	1.64
Fuse Arm with 3 Cutouts	75	3	2.46
Net COS Control Box	250	5.22	5.22
Net COS Satellite Unite	72	6.5	12
Automatic Recloser			
Disconnect Auto, 4 kV	400	1.33	24
Disconnect Auto, 12 kV	400	1.33	24
Disconnect Auto, 16 kV	400	2.43	46
Disconnect Auto, 25 kV	400	2.43	46
Disconnect Auto, 35 kV	350	0.66	12
Oil, 17 kV	800	16	6
Oil, 34.5 kV	1,000	18	6
Oil, 38 kV	1,100	18	6
Solid, 17 kV	650	16	6
Solid Dielectric Nova, 25 kV	300	10.5	4.5
Solid Dielectric Viper, 27 kV	600	15.6	6
Solid Dielectric Viper, 38 kV	600	15.6	6
Capacitor (One unit per phase)			
150 kVAR	630	15	7.5
300 kVAR	630	15	7.5
450 kVAR	630	15	7.5
600 kVAR	630	15	7.5
900 kVAR	630	15	7.5
1200 kVAR	630	15	7.5
1800 kVAR	630	15	7.5

Table 7: Equipment Weights and Surface Area (Continued)

Equipment Type & Size	Weight (lbs)	Lateral Side Area (ft^2)	Pole Side Area (ft^2)
Capacitor (Two Units Per Phase)			
150 kVAR	1,100	10	7.5
300 kVAR	1,100	10	7.5
450 kVAR	1,100	10	7.5
600 kVAR	1,100	10	7.5
900 kVAR	1,100	10	7.5
1200 kVAR	1,100	10	7.5
1800 kVAR	1,100	10	7.5
Miscellaneous			
BGAN Assembly	130	5.5	4
Floodlight	65	3.36	2.13
6.6 Remote Controlled Outdoor Circuit	70	1.6	2.22
NEMA Enclosure 100A Panel	80	3	6
NEMA Enclosure 200A Panel	150	4	8
Raptor Protection Cover	5	0.5	1.75
Smart Connect Range Extender	2	0.24	0.24
Streetlight 2.5'	42	1.69	0.87
Streetlight 6'	60	2.18	0.87
Streetlight 16'	85	3.31	0.87
Solar Weather Station	140	11.34	13.27
Joint-Use Box – Communication			
Antenna 24" x 11" x 6	22	1	1.83
Antenna 24" x 12.5" x 4	25	0.67	2.08
Antenna 47" x 17" x 6	55	1.98	5.53
Antenna 51" x 10.5" x 5	33	1.77	3.72
Antenna 60" x 10" x 6	49	2.5	4.17
Antenna 72" x 13" x 4	37	2	6.6
Antenna 77" x 6" x 3	23	1.6	3.21
Antenna 81" x 10" x 6	62	3.38	5.86
Box 32" x 6" x 6	44	1.32	1.39
Box 36" x 25" x 26	280	6.5	6.25
Box 47" x 14" x 10	115	3.36	4.6
Cabinet Box 84" x 12	40	6.67	6.67
Large (18" X 18")	150	2.25	2.25
Mast Antenna 24" x 1	5	0.17	0.17
Medium (12" X 12")	75	1	1

Table 7: Equipment Weights and Surface Area (Continued)

Equipment Type & Size	Weight (lbs)	Lateral Side Area (ft^2)	Pole Side Area (ft^2)
Primary Metering Cabinet (48" x 18" x 38")	150	6	12.8
Small (6" X 6")	50	0.25	0.25
VZ-Antenna 24" x 17" x 10	30	1.67	2.84
VZ-Antenna 28" x 14" x 6	45	1.165	2.7
VZ-Antenna 48" x 12" x 7	46	2.32	4
VZ-Antenna 50" x 24" x 7	70	2.41	8.32
VZ-Antenna 51" x 12" x 7	53	2.46	4.25
VZ-Antenna 55" x 12" x 7	48	2.67	4.58
VZ-Antenna 73" x 12" x 7	62	3.52	6.08
VZ-Antenna Omni 30"	1 0	22	0.22
VZ-RRUL	42	1.047	1.37
VZ-RRUS11	50	2.13	0.88
VZ-RRUS12	58	2.618	1.033
VZ-RBS 2109	93	2.84	1.47
VZ-TE (TRI BAND) PRISM	151	3.5	3.5
VZ-Antenna Omni 30"	1 0	22	0.22
Overhead Switch			
Alduti-Rupter® Horizontal, 38 kV	461	7	11.50
CP 115 kV Vertical 10'/11'	919	19.92	7.6
CP 69 kV Vertical 8'	695	14.56	2.96
KPF (A2) 17 kV Horizontal	450	10	8
KPF (A6) 69 kV Horizontal	320	6.8	0.6
KPF (A8) 115 kV Horizontal	457	8.25	0.6
Omni-Rupter® Horizontal, 17 kV	307	5.60	9.00
Omni-Rupter ®Vertical, 17 kV[a/]	74	1.88	1.33
RCS Control Box	150	3.62	3.62
Transformer — Bank			
10 kVA	1,208	7.88	18.66
15 kVA	1,289	7.88	18.66
25 kVA	1,700	7.88	18.66
37.5 kVA	1,850	7.88	18.66
50 kVA	2,300	9.19	22.75
75 kVA	3,350	12	30.04
100 kVA	4,250	12.5	32.08
Overhead Transformer[b/ c/]			
10 kVA	286	5.25	5.25
15 kVA	313	5.25	5.25
25 kVA	450	5.25	5.25
37.5 kVA	500	5.25	5.25
50 kVA	650	6.125	6.125
75 kVA	1,000	8	8
100 kVA	1,300	8.32	8.32
167 kVA	1,500	9.36	9.36

Table 7: Equipment Weights and Surface Area (Continued)

Equipment Type & Size	Weight (lbs)	Lateral Side Area (ft^2)	Pole Side Area (ft^2)
Transformer — Open Delta Combo			
10 - 10 kVA	610	7.88	12
10 - 15 kVA	670	7.88	12
10 - 25 kVA	780	7.88	12
10 - 37.5 kVA	830	7.88	12
10 - 50 kVA	980	8.53	13
10 - 75 kVA	1,500	9.84	14
15 - 15 kVA	670	7.88	12
15 - 25 kVA	800	7.88	12
15 - 37.5 kVA	850	7.88	12
15 - 50 kVA	1,000	8.53	13
15 - 75 kVA	1350	9.84	14
25 - 25 kVA	935	7.88	12
25 - 37.5 kVA	985	7.88	12
25 - 50 kVA	1,135	8.53	13
25 - 75 kVA	1,485	9.84	14
37.5 - 37.5 kVA	1,035	7.88	12
37.5 - 50 kVA	1,185	8.53	13
37.5 - 75 kVA	1,535	9.84	14
50 - 50 kVA	1,335	9.19	13
50 - 75 kVA	1,685	10.55	16
75 - 75 kVA	2,035	12	18
75 - 100 kVA	2,335	12.25	19
13' x 6' Platform Rack with DOE Transformer	6,000	45	27
17' x 4' Platform Rack with DOE Transformer	6,500	48	27
Power Control Transformers[d/]			
Dry, 0.5 kVA	230	4.2	3.6
Dry, 1 kVA	230	4.2	3.6
Oil, 0.5 kVA	230	4.2	3.6
Oil, 1 kVA	230	4.2	3.6
Oil, 10 kVA	230	4.2	3.6
Voltage Regulator			
14.4 kV	2,050	21.32	16.1
19.9 kV	2,520	13.6	13.6
5 kV	3,050	16.79	16.79

[a/] Refer to the PLM for design criteria of poles and pole loading requirements.

[b/] 10 kVA and 15 kVA transformers are not available and not approved for use on new installations or replacements.

[c/] The transformer weights are applicable to 4 kV, 12 kV, 16 kV, and 25 kV systems. Refer to DAP AP 108 for 33 kV installations.

[d/] 10 kVA oil-type control power transformers are not approved for use on new installations.

1.10 Pole Loading Requirements for Platform Racks

Refer to the DDS Manual (Chapter 10, Section 5.2E) for design criteria of the platform racks. Pole loading procedures for the platform racks are outlined in PLM–1: Pole Loading Policies and Procedures.

1.11 Pole Loading Requirements for Pole-top Extensions

Refer to the DDS Manual (Chapter 10, Section 5.2H) for design criteria for pole top extensions.

2.0 Safety Factors for Wood, Composite, and Light Weight Steel Poles

Table 8: Safety Factors for Wood, Light Weight Steel (LWS), and Composite Fiber Glass Poles

Pole Type	Design Criteria (lb)	New Construction			In-Service Construction		
		Grade A Construction (Joint-Use Poles) Pole Load Safety Factor	Grade B Construction Pole Load Safety Factor	Buckling	Grade A Construction (Joint-Use Poles) Pole Load Safety Factor	Grade B Construction Pole Load Safety Factor	Buckling
Wood	6	4.00	3.00	4.00	2.67	2.00	2.67
	8	4.00	3.00	4.00	2.67	2.00	2.67
	12	3.00	3.00	4.00	2.00	2.00	2.67
	18	3.00	3.00	4.00	2.00	2.00	2.67
	24	3.00	3.00	4.00	2.00	2.00	2.67
LWS	6	2.50	1.88	2.50	1.50	1.50	1.50
	8	2.50	1.88	2.50	1.50	1.50	1.50
	12	1.88	1.88	1.88	1.50	1.50	1.50
	18	1.88	1.88	1.88	1.50	1.50	1.50
	24	1.88	1.88	1.88	1.50	1.50	1.50
Composite Fiberglass	6	4.00	3.00	4.00	2.67	2.00	2.67
	8	4.00	3.00	4.00	2.67	2.00	2.67
	12	3.00	3.00	4.00	2.00	2.00	2.67
	18	3.00	3.00	4.00	2.00	2.00	2.67
	24	3.00	3.00	4.00	2.00	2.00	2.67
Guying Requirements	-	2.00	2.00	-	1.33	1.33	-

= For Reference Only

3.0 Guying

3.1 Guys

Where mechanical loads from conductor attachments are to be imposed on poles (bending moment) creating an unbalanced load, additional strength shall be provided by the use of guys. The guy(s) shall be able to support the entire load induced onto the pole from the conductor(s) at each conductor level. The force of the conductor shall be balanced by the force of the guy.

Some situations that create unbalanced loads are, but are not limited to:

- Primary line deviations 1 degree and above
- Dead end poles/Poles with Buck arms
- Different quantities or sizes of conductor attached to the same cross arm (that is, 4-wire -336 ACSR going North and 3 wire 1/0 ACSR going south)
- Secondary conductors that do not continue from pole to pole

3.2 Fiberglass Guy Strain Insulator

All new installations, guying remediation, or pole replacements shall utilize the fiberglass guy strain insulator as the preferred guying pole attachment and will extend beyond the G.O. 95 Zone of Proximity to meet insulation/isolation requirements. Porcelain guy strain insulators will continue to be utilized in limited applications such as Non-HFRAs, wizzars, sidewalk horizontal brace, rear-property lines, and other applications where the use of the fiberglass guy strain insulator exceeds length requirements or does not allow for safe work practice. Refer to the Distribution Overhead (DOH) Manual, Section PO 300 for construction requirements.

3.3 Anchor Rods and Down Guys

The use of anchor rods and down guys are the main method of balancing dead-end strain on poles. If not enough room is available for traditional guying, a breast block and key must be used. Refer to PLM–5 for details.

3.4 Sidewalk Guys

Straight down guys and span guys are the preferred guying methods. Sidewalk guys are installed primarily over walkways for pedestrian clearance but may also be used where reduced anchor leads are necessary due to obstacles such as fences, houses, flood controls, property lines and the reduced anchor lead is insufficient to balance the dead-end strain using straight down guys.

3.5 Span Guys/Arm Guys

Span guys/arm guys (from pole-to-pole or from crossarm-to-pole) can be installed to carry dead-end or unbalanced tension to an adjacent pole where proper guy anchoring can be made with a down guy and anchor rod, or to a pole with enough usable pole strength to support the strain.

3.6 Additional Guy Examples

For additional information and examples for overhead guys, anchor guys, and span wires, refer to the DOH Manual, Section PO.

3.7 Composite Poles

When using composite poles, pole bands are required for use on down guys. For pole band installation instructions, refer to the DOH Manual, Section PO 300.

3.8 Guy Determination

A. The following information must be obtained in order to determine the method of guying:

- Conductor size
- Height of conductors from ground
- Anchor locations (lead)/Span guy locations
- Easement availability (if applicable)

B. Determining the available anchor locations requires plan and field checks to verify that there are no hazards, obstacles, or G.O. 95 infractions, for example, fences, houses, driveways, and flood control channels. For new pole and pole replacements, if space permits or can be provided at no additional cost or low cost minor work, maintain a minimum clearance of 36 inches for pedestrian right-of-way access. Avoid pole and/or guy placement in wheelchair ramp locations.

3.9 Approved Guying Methods

There are three (3) approved methods of guying:

A. Down Guys — The most common method used for guying.

The maximum distance between the conductor and down guys is 12 inches (1 foot) for Grade A construction and 2 feet for Grade B construction per DOH PO 340.3. The minimum separation between 2 or more down guys is 12 inches per DOH PO 300.

B. Sidewalk Guys — Installed where the guy lead of ten feet or less is required because of obstacles or obstructions, for example, fences, streets, and sidewalks.

C. Span Guys or Arm Guys — Installed from pole-to-pole or from a crossarm-to-pole when it is not feasible to install a down guy or sidewalk guy.

Guying tables and examples are shown in PLM–5: Section 1.1 Guying Tables and Examples.

4.0 Anchors and Rods for Guying

4.1 SCE Anchor Types and Application

Three (3) types of anchors are used by Edison:

A. Power-Installed Screw Anchor (PISA) — This anchor type is to be installed with the auger shaft of the digger-derrick/line truck. Use PISA even when access is limited. When access for digger-derrick/line truck to anchor location is NOT available use plate anchors. Refer to DOH for type of anchor materials. Holding strength of this anchor is based on the number of sheared pins. See PLM-5 Table 3 for the maximum allowable holding capacity.

B. Anchor Rod and Plate — The holding strength capacity of the anchor rod and plate is based on soil type. See PLM-5 Table 3 for the maximum allowable holding capacity.

C. Expanding Rock Anchor — This type of anchor shall be used for sound and unweathered hard rock. See PLM-5 Table 3 for the maximum allowable holding capacity.

4.2 Joint Use

Anchors and rod installations for joint use with other utilities shall be made as specified under “Stubs, Anchors, and Guys,” and as may be agreed upon under the Joint Pole Routine Agreement. When sizing anchors and rods for joint use, allow enough holding strength to accommodate the incoming utilities’ tension requirements.

4.3 Soil Type

The type of soil play a critical role in the holding capacity of anchors. Dense to very dense soils will have higher holding capacity compared to other types of soils. This soil table shall be used for determining anchor holding capacity.

Table 9: Soil and Types

Soil Type[1]	Description	Probe Values (ft-lb)3	Typical Blow Count "N" per ASTM-D1586[3]
A	Very dense sandy soil, gravel and cobbles, and soft rock. Soft rock can be identified based on site topography, such as mountain regions and hillsides. Hardpan.	Over 50	46-100+
B	Dense sandy soil, sand greater than 50%, or still silts and clay. Well compacted sandy soil with visible grains, typically coarse grained, often gravel and large rocks are present.	34-50	25-45
C	Medium dense, sandy soil or firm silts and clay. Soil contains a mixture of sand and clay. Sand grains are small that are barely visible. Soil moisture is medium to high.	17-33	8-24
D	Soft or loose soil consisting of clay. Clay is relatively plastic and can easily roll in hands. Soil moisture is high. Organic soil (black thin layers of soil with distinct odor) can be present.	0-16	0-7
E	Sound and unweathered hard rock.	-	-

Note(s):

1. Soils based on USGS Shear Wave Velocity (V30), which measures the average shear in the top 98 feet of soil and rock. Obtained through geophysical methods such as seismic refraction, downhole, and surface wave techniques.
2. Use SCEGeoView and turn on layers Landbase 3rd Party and Soil Type Layer.
3. These values shall be used when geotechnical investigation report conducted by California licensed engineer is required by project team.

4.4 Anchor Material

The table below shall be used to select appropriate anchor material based on the type of soil and site conditions at the project location. It is recommended to perform a pre-fielding prior to selecting the type of anchor.

Heavy-Duty Power-Installed Screw Anchors (PISA) provide minimal ground disturbance, speed of installation, and effectiveness in many types of soil. Digger-derrick/line truck access and the use of power-driven equipment/tools to install PISA. PISA's shall NOT be dropped in a pre-dug hole. The project will determine anchor best suited for soil and/or physical restrictions at the site.

Plate anchors are best to be used when physical site limitations such as: utilities (telecom, water, storm drain, gas, fibers) are within 24 inches horizontally away from anchor, permanent structures obstructions such as foundations, poles, buildings and inaccessible bucket truck access. As well as, in extremely loose soils and inaccessible areas.

Table 10: Anchor Selection

Soil Per Table 1	Suitable Anchors to achieve Higher Holding Capacity			Power Installed Screw Anchor (PISA) a/				Plate Anchor		Expanding Rock Anchor	
					Min. Anchor Spacing (ft) c/						
Type	PISA[a]	Plate[b]	Rock	Max. Allowable Guy Load (lbs)	4'Ø Double Helix	8'Ø Helix	10'Ø Helix	Max. Allowable Guy Load (lbs)	Min. Anchor Spacing (ft) c/	Max. Allowable Guy Load (lbs)	Min. Anchor Spacing (ft)c/
A	8" Single Helix (SAP 10217543) 4" Double Helix (SAP 10067289)	17" x 17" (SAP 10067304) 23" x 23" (SAP 10210268)	-	See Table 11	1.5	3	3.5	See Table 14	6	-	-
B	8" Single Helix (SAP 10217543) 4" Double Helix (SAP 10067289)	17" x 17" (SAP 10067304) 23" x 23" (SAP 10210268)	-	See Table 11	1.5	3	3.5	See Table 14	6	-	-
C	8" Single Helix (SAP 10217543) 8" Double helix (SAP 10200272) 10" Double helix (SAP 10200180)	17" x 17" (SAP 10067304) 23" x 23" (SAP 10210268)	-	See Table 11	1.5	3	3.5	See Table 14	6	-	-
D	8" Double helix (SAP 10200272) 10" Double helix (SAP 10200180)	17" x 17" (SAP 10067304) 23" x 23" (SAP 10210268)	-	See Table 11	-	-	-	See Table 14	6	-	-
E	-	-	3/4" x 30" (SAP 10215681) 1" x 30" (SAP 10215682)	-				-		See Table 16	3

a/ When truck access is possible, use digger-derrick/line truck or other power-driven equipment/tools to install PISA. PISA's shall NOT be dropped in a pre-dug hole.

b/ All types of plate and PISA anchors are available to be used depending on site conditions and allowable maximum capacity based on soil type. See Table 13 and Table 14.

c/ When minimum spacing cannot be achieved, see Table 12 for PISA and Table 15 for Plate Anchors, for reduced holding strength capacity.

4.5 Allowable Holding Strength

The allowable holding strength for guy anchors, rods and plates, and rock anchors are shown in Table 11, Table 12 and Table 13. An example for selecting the proper screw anchor or anchor and plate is also described in PLM–5: Section 1.2 Anchors and Rods for Guying Table and Example.

A. Power Installed Screw Anchor (PISA)

Table 11: Maximum Allowable Holding Capacity for PISA Guy Anchors

Anchor Rod	SAP Number	Photo	Anchor	1-1/2" Anchor Hub	SAP Number	Photo	Soil Type	Torque (in minimum pins sheared)	Maximum Allowable Guy Anchor Load (lbs)		Guying Options[a/]
									New Install (S.F. = 1.5)	In-Service (S.F.=1.33)	
1" x 7' Triple Eye Galvanized Steel	10185605 (Medium Strength		Power Installed Screw Anchors (PISA)	4" Double Helix	10067289		A	12	24,000	27,000	New Install: 2-7/16", or 2-3/8", 2-3/8" &1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-3/8", or 3-9/32"
				8" Single Helix (Tough One and Turbo Drive)	10217543		A	12	24,000	27,000	New Install: 2-7/16",or2-3/8", 2-3/8" &1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-3/8", or 3-9/32"
							B	9	18,000	20,000	New Install: 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32"
							C	7	14,000	15,000	New Install: 2-9/32", or 1-3/8", or 1-7/16" In-Service: 2-9/32", or 1-3/8", or 1-7/16"

Table 11: Maximum Allowable Holding Capacity for PISA Guy Anchors (Continued)

Anchor Rod	SAP Number	Photo	Anchor	1-1/2" Anchor Hub	SAP Number	Photo	Soil Type	Torque (in minimum pins sheared)	Maximum Allowable Guy Anchor Load (lbs)		Guying Options[a/]
									New Install (S.F. = 1.5)	In-Service (S.F.=1.33)	
1" x 7' Triple Eye Galvanized Steel	10185605 (Medium Strength		Power Installed Screw Anchors (PISA)	8" Double Helix	10200272		A	10	24,000	27,000	New Install: 2-7/16", or 2-3/8", 2-3/8" &1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-3/8", or 3-9/32"
							B	8	20,000	22,000	New Install: 2-7/16", or 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32"
							C	5	13,000	15,000	New Install: 2-9/32", or 1-3/8", or 1-7/16" In-Service: 2-9/32", or 1-3/8", or 1-7/16"
							D	2	6,000	7,000	New Install: 1-9/32" In-Service: 1-9/32"
				10" Double Helix	10200180		A	9	24,000	27,000	New Install: 2-7/16", or 2-3/8", 2-3/8" &1-9/32",or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-3/8", or 3-9/32"
							B	7	20,000	22,000	New Install: 2-7/16", or 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service: 2-7/16", or 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32"
							C	4	13,000	15,000	New Install: 2-9/32", or 1-3/8", or 1-7/16" In-Service: 2-9/32", or 1-3/8", or 1-7/16"
							D	2	7,000	8,000	New Install: 1-9/32" In-Service: 1-9/32"

[a/]Guy recommendations are guidelines to ensure that the anchor can support the full strength capability of the guys. For in-service installations or where limitations exist for anchor placement, the anchor may be loaded to its maximum table capability based on the evaluated maximum guy loads from the pole loading report.

1. When the minimum number of pins sheared is achieved and the PISA rod exceeds the maximum projection above ground, continue driving the PISA until the maximum projection is achieved. If that is not possible, try installing a smaller diameter PISA.
   - For 4 Inch double helix, 36 inches maximum projection above ground
   - For 8 inch single and double helix, 36 inches maximum projection above ground
   - For 10 inch double helix, 30 inches maximum projection above ground

2. New install safety factors for maximum allowable guy anchor load shall be used when replacing poles. Inservice safety factors for maximum allowable guy anchor load shall be used when equipment or components are added or removed on in service poles. Safety factors shown are for anchors only, NOT for guying.

3. Determine the maximum loading of each guy wire from SPIDA results and use the sum to compare the total maximum allowable anchor holding strength from Table 11. The sum of multiple guying in one anchor shall not exceed the maximum values shown in Table 11.

Table 12: Reduced Maximum Allowable Holding Capacity for PISA Guy Anchors

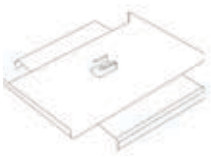
PISA	Spacing between PISA anchors	Reduced Maximum Load Allowed when minimum spacing cannot be achieved
4″ dia. helix	<1.5 feet	The anchors are limited to the holding capacity of one anchor. See Note 1.
8″ dia. helix	<3.0 feet	The anchors are limited to the holding capacity of one anchor. See Note 1.
10″ dia. helix	<3.5 feet	The anchors are limited to the holding capacity of one anchor. See Note 1.

Note(s):

1. New installations with two or more using PISA anchors with spacing less than the minimum spacing as listed on Table 10, the anchors are limited to the holding capacity of one anchor. The new allowable holding capacity is the Maximum Holding capacity (Table 11) divided by the number of anchors.
   a. Example #1, two 4" dia helix with allowable holding capacity of 6,000 lbs (based on Table 11) each anchor shall have a maximum holding capacity of 3,000 lbs. (6,000 lbs divided by the # of anchors)
   b. Example #2, three 10" dia helix with allowable holding of 18,000 lbs (based on Table 11) each anchor shall have a maximum holding capacity of 6,000 lbs (18.000 lbs divided by the # of anchors)

B. Plate Guy Anchor

Table 13: Plate Guy Anchors and Rods

Cross Plate Anchors	SAP	Photo	Anchor Rod	SAP	Photo
17" x 17"	10067304		1" x 10' Triple Eye GS	10185604	
23″ x 23″	10210268		1-1/4" x 10' Triple Eye GS	10210269	
20″ Round Concrete	10067305		1" x 10' Triple Eye SS	10067254	

1.In corrosive areas, use 1 inch stainless steel anchor rod - SAP 10067254

Table 14: Allowable Holding Strength for Plate Guy Anchors

Cross Plate Anchors	SAP	Soil Type	Anchor Angle of Inclination (Degrees), φ				
			90° (Sidewalk Anchor) (90° - 67.51°)	60° (67.50° - 52.51°)	45° (52.50° - 37.51°)	30° (37.50° - 22.51°)	15° (22.50° - 15°)
17" x 17"	10067304	A	Max. Allowable Load: New Install (SF=1.5): 18,000 lbs Guying Options [a/]: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service (SF=1.33): 20,000 lbs Guying Options [a/]: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 18,000 lbs Guying Options [a/]: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service (SF=1.33): 20,000 lbs Guying Options [a/]: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 2-3/8" & 1-7/16", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 14,000 lbs Guying Options [a/]: 1-7/16", 1-3/8", or 1-3/8" & 1-9/32", or 3-9/32" In-Service (SF=1.33): 15,500 lbs Guying Options [a/]: 1-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 13,000 lbs Guying Options [a/]: 1-7/16", 1-3/8", or 1-3/8" & 1-9/3 2", or 2-9/32" In-Service (SF=1.33): 14,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 12,000 lbs Guying Options [a/]: 1-7/16", 1-3/8", or 2-9/32" In-Service (SF=1.33): 13,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32", or 3-9/32"
		B	Max. Allowable Load: New Install (SF=1.5): 14,000 lbs Guying Options [a/]: 1-3/8", or 1-3/8" & 1-9/32", or 1-7/16", or 3-9/32" In-Service (SF=1.33): 15,500 lbs Guying Options [a/]: 1-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 13,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 2-9/32" In-Service (SF=1.33): 14,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install(SF=1.5): 12,000lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 13,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 11,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 12,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 1-9/32", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 9,000 lbs Guying Options [a/]: 1-3/8", 2-9/32" In-Service (SF=1.33): 10,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32"
		C	Max. Allowable Load: New Install (SF=1.5): 13,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 2-9/32" In-Service (SF=1.33): 14,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 10,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 11,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8" or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 9,500 lbs Guying Options [a/]: 1-3/8", or 2-9/32" In Service (SF=1.33): 10,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 9,000 lbs Guying Options [a/]: 1-3/8", or 2-9/32" In Service (SF=1.33): 10,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 8,000 lbs Guying Options [a/]: 1-3/8", or 1-9/32" In Service (SF=1.33): 9,000 lbs Guying Options [a/]: 1-3/8", or 2-9/32"
		D	Max. Allowable Load: New Install (SF=1.5): 7,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 8,000 lbs Guying Options [a/]: 1-3/8", or 1-9/32	Max. Allowable Load: New Install (SF=1.5): 6,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 6,500 lbs Guying Option [a/]: 1-9/32"	Max. Allowable Load: New Install (SF=1.5): 5,500 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 6,000 lbs Guying Option [a/]: 1-9/32"	Max. Allowable Load: New Install (SF=1.5): 5,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 5,500 lbs Guying Option [a/]: 1-9/32"	Max. Allowable Load: New Install (SF=1.5): 4,500 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 5,000 lbs Guying Option [a/]: 1-9/32"

Cross Plate Anchors	SAP	Soil Type	Anchor Inclination Angle (Degrees), φ				
			90° (Sidewalk Anchor) (90° - 67.51°)	60° (67.50° - 52.51°)	45° (52.50° - 37.51°)	30° (37.50° - 22.51°)	15° (22.50° - 15°)
23" x 23"	10210268	A	Max. Allowable Load: New Install (SF=1.5): 21,000 lbs Guying Options [a/]: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service (SF=1.33): 23,000 lbs Guying Options [a/]: 2-7/16", or 1-7/16" & 2-9/32", or 2-3/8" & 1-9/32", or 3-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 20,000 lbs Guying Options [a/]: 2-7/16", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32" In-Service (SF=1.33): 22,500 lbs Guying Options [a/]: 2-7/16", or 1-7/16" & 2-9/32", or 2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 16,000 lbs Guying Options [a/]: 2-3/8", or 1-3/8" & 1-9/32", or 1-9/32" & 1-7/16", or 3-9/32" In-Service (SF=1.33): 18,000 lbs Guying Options [a/]: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 15,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 3-9/32" In-Service (SF=1.33): 17,000 lbs Guying Options [a/]: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 14,000 lbs Guying Options [a/]: 1-7/16", 1-3/8", or 1-3/8" & 1-9/32", or 3-9/32" In-Service (SF=1.33): 16,000 lbs Guying Options a/: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 3-9/32"
		B	Max. Allowable Load: New Install (SF=1.5): 15,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 3-9/32" In-Service (SF=1.33): 17,000 lbs Guying Options [a/]: 1-7/16", 2-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 13,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 2-9/32" In-Service (SF=1.33): 14,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 12,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 2-9/32" In-Service (SF=1.33): 14,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 12,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8" or 2-9/32" In-Service (SF=1.33): 13,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 11,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32 In-Service (SF=1.33): 12,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 2-9/32"
		C	Max. Allowable Load: New Install (SF=1.5): 13,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 1-9/32", or 2-9/32" In-Service (SF=1.33): 14,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 3-9/32"	Max. Allowable Load: New Install (SF=1.5): 11,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 12,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 1-3/8" & 2-9/32", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 10,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 11,500 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 10,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32" In-Service (SF=1.33): 11,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32"	Max. Allowable Load: New Install (SF=1.5): 9,000 lbs Guying Options [a/]: 1-3/8", 2-9/32" In-Service (SF=1.33): 10,000 lbs Guying Options [a/]: 1-7/16", or 1-3/8", or 2-9/32"
		D	Max. Allowable Load: New Install (SF=1.5): 7,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 8,000 lbs Guying Option [a/]: 1-3/8", or 1-9/32	Max. Allowable Load: New Install (SF=1.5): 6,500 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 7,000 lbs Guying Option [a/]: 1-9/32	Max. Allowable Load: New Install (SF=1.5): 6,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 6,500 lbs Guying Option [a/]: 1-9/32	Max. Allowable Load: New Install (SF=1.5): 5,500 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 6,000 lbs Guying Option [a/]: 1-9/32	Max. Allowable Load: New Install (SF=1.5): 5,000 lbs Guying Option [a/]: 1-9/32" In-Service (SF=1.33): 5,500 lbs Guying Option [a/]: 1-9/32

[a/]Guy recommendations are guidelines to ensure that the anchor can support the full strength capability of the guys. For in-service installations or where limitations exist for anchor placement, the anchor may be loaded to its maximum table capability based on the evaluated maximum guy loads from the pole loading report.

1. Determine the maximum loading of each guy wire from SPIDA results and use the sum to compare the total maximum allowable anchor holding strength from Table 14. The sum of multiple guying in one anchor shall not exceed the maximum values shown in Table 14.

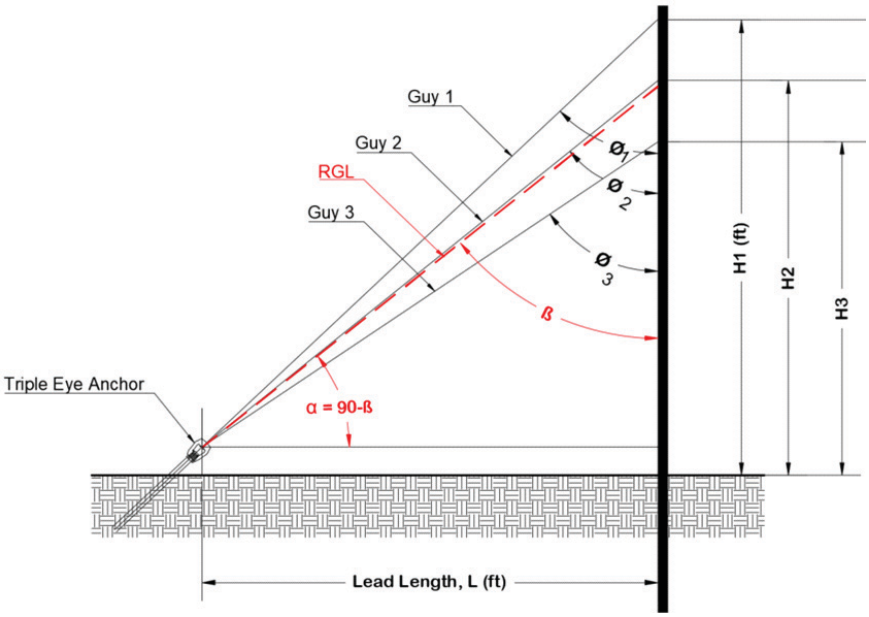
2. New install safety factors for maximum allowable guy anchor load shall be used when replacing poles. In-service safety factors for maximum allowable guy anchor load shall be used when equipment or components are added or removed on in-service poles. Safety factors shown in this table are for anchors only, NOT for guying.

3. Guy angle (β) is the angle or resultant angle that guy wire(s) make with the pole. Complementary angle (α), which is the difference between 90° & β, is the angle to be used to compare with the anchors angle of inclination (φ). Phi (φ), measured from the ground, shall not be less than 15°.

When a single guy is attached to the anchor, the load of a single guy shall not exceed the maximum allowable load.

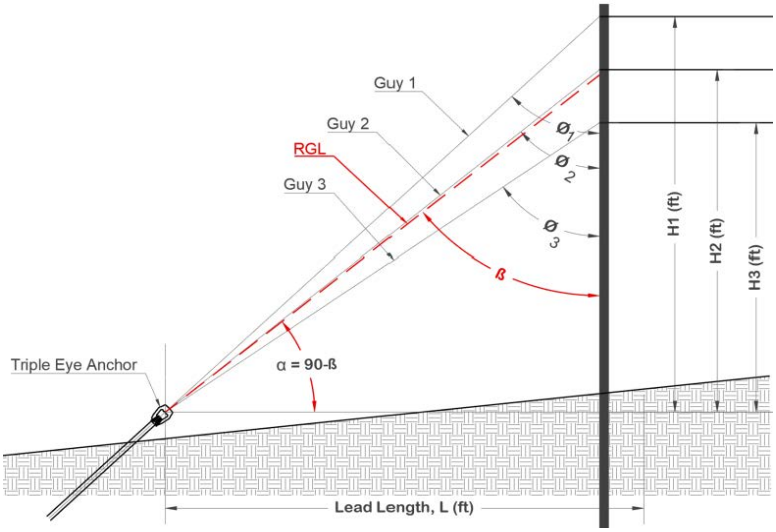
When two or three guys are attached to the anchor, the resultant guying load (RGL) shall not exceed the maximum allowable load. To calculate the resultant guying loads (RGL), use the Anchor Calculator or follow examples below. Resultant guying load (RGL) and resulting guy angle ONLY applies to plate anchors.

Figure 1: Resultant Guying Load (RGL) Calculation



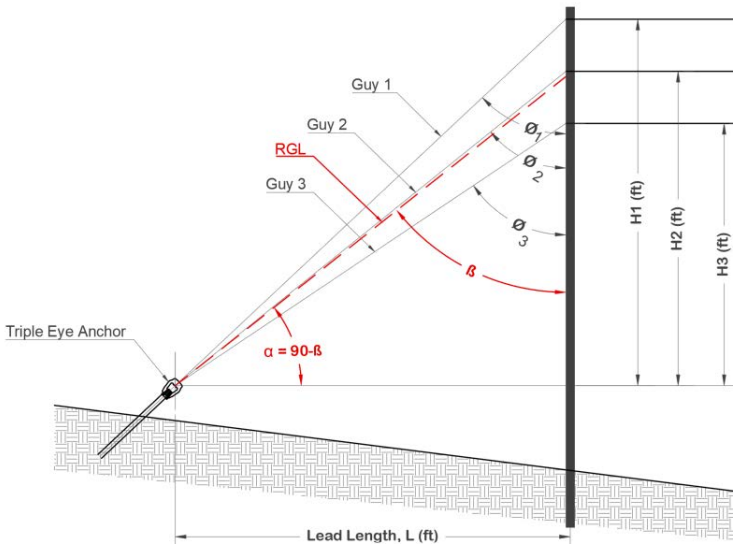
The guy height is the vertical distance from the point on the pole where the guy is attached and the anchor rod eye. This measurement should account for any slope in the finished grade to ensure accurate calculation.

Figure 2: Height Calculation with Pole Base Higher than Anchor Eye



Height = Height of Guy - (Height of Anchor Eye below Pole Base)
Example: If the anchor is installed 10 ft **below** the ground line of the pole and the guy is attached 40 ft above the pole groundline, the Guy Height input into the anchor tool should be 60 ft.
Height = (40' - (-10')) = 50'

Figure 3: Height Calculation with Pole Base lower than Anchor Eye



Height = Height of Guy - (Height of Anchor Eye above Pole Base)
Example: If the anchor is installed 20 ft **above** the ground line of the pole and the guy is attached 40 ft. above the pole groundline, the Guy Height input into the anchor tool should be 20 ft. Height = (40' - (20')) = 20'

C. How to calculate Resultant Guying Load (RGL) and Guy Angle (β):

1. Resultant guying load (RGL) when two guys are attached to an anchor

a. Calculate the horizontal (Fx) and vertical (Fy) components of each guy load

Fx_1 = Guy 1 Load x sin $Ø_1$ Fy_1 = Guy 1 Load x cos $Ø_1$
Fx_2 = Guy 2 Load x sin $Ø_2$ Fy_2 = Guy 2 Load x cos $Ø_2$

b. Sum of Horizontal and Vertical Forces
$\Sigma Fx = Fx_1 + Fx_2$
$\Sigma Fy = Fy_1 + Fy_2$

c. Resultant Guying Load (RGL)

$$RGL = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$$

d. RGL Guy Angle (β)

$$\beta = \arctan \frac{\Sigma Fx}{\Sigma Fy}$$

e. Calculate guy complementary angle (α). This angle is also the anchor angle of inclination (φ).
α = φ = (90- β)

f. Compare RGL guy complementary angle (α) to anchor angle of inclination (φ) from Table 14 to determine maximum allowable load to be used in the design. RGL guy complementary angle (α) shall be 7.50° < φ < 7.50°. Phi (φ) is the guy angle per Table 14: For inclined angles: Min φ = 15°, Max φ = 67.50°; For sidewalk anchors, φ = 90° or 90°-7.50

2. Resultant guying load (RGL) when three guys are attached to an anchor.

a. Calculate the horizontal (Fx) and vertical (Fy) components of each guy load [Note: Guy load is the applied load from SPIDAcalc Analysis Results]

$Fx1 = \text{Guy 1 Load} \times \sin Ø_1$ $Fy_1 = \text{Guy 1 Load} \times \cos Ø_1$
$Fx2 = \text{Guy 2 Load} \times \sin Ø_2$ $Fy_2 = \text{Guy 2 Load} \times \cos Ø_2$
$Fx3 = \text{Guy 3 Load} \times \sin Ø_3$ $Fy_3 = \text{Guy 3 Load} \times \cos Ø_3$

b. Sum of Horizontal and Vertical Forces
$\Sigma Fx = Fx_1 + Fx_2 + Fx_3$
$\Sigma Fy = Fy_1 + Fy_2 + Fy_3$

c. Resultant Guying Load (RGL)

$$RGL = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$$

d. RGL Guy Angle (β)

$$\beta = \arctan \frac{\Sigma Fx}{\Sigma Fy}$$

e. Calculate guy complementary angle (α). This angle is also the anchor angle of inclination (φ).
α = φ = (90- β)

f. Compare RGL guy complementary angle (α) to anchor angle of inclination (φ) from Table 14 to determine maximum allowable load to be used in the design. RGL guy complementary angle of inclination (α) shall be 7.50° < α < 7.50°. Phi (φ) is the guy angle per Table 14: For inclined angles: Min φ = 15°, Max φ = 67.50°; For sidewalk anchors, φ = 90° or 90°- 7.50

Example 1:

Soil Type: A SPIDACalc Analysis Result

Lead Length = 45 ft

Guy 1: Load Applied = 10,000 lbf, Ø1 = 45°
Guy 2: Load Applied = 8,000 lbf, Ø2 = 48°

a. Calculate the horizontal (Fx) and vertical (Fy) components of each guy load [Note: Guy load is the applied load from SPIDAcalc Analysis Results]

Fx1 = 10,000 lbf x sin 45° = 7,071 lbf
Fy1 = 10,000 lbf x cos 45° = 7,071 lbf
Fx2 = 8,000 lbf x sin 48° = 5,945 lbf
Fy2 = 8,000 lbf x cos 48° = 5,353 lbf

b. Sum of Horizontal and Vertical Forces

ΣFx = 7,071 lbf + 5,945 lbf =13,016 lbf
ΣFy = 7,071 lbf + 5,353 lbf =12,424 lbf

c. Resultant Guying Load (RGL)

$$\mathbf{RGL} = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$$

RGL = $(13,016)^2 + (12,424)^2$
RGL = 17,994 lbs

d. RGL Guy Angle (β)

β = arctan (ΣFx / ΣFy)
= arctan (13,016 lbf / 12,424 lbf)
= 46.33°

e. Calculate Guy Complementary Angle (α)
α = (90- β)
= (90-46.33)
= 43.67°

f. Compare RGL Guy complementary Angle (α) to anchor angle of inclination (φ)

From Table 14 and using 17" x 17" plate, the nearest angle is 45° with anchor max. holding capacity of 14,000 lbf, which is less than 17,994 lbf. Plan to install two 17" x 17" plate anchors 6 feet apart OR try changing lead length to achieve 60° anchor angle of inclination with anchor maximum holding capacity of 18,000 lbf.

Example 2:
Soil Type: B

SPIDACalc Analysis Result

Lead Length = 60 ft.

Guy 1: Load Applied = 9,000 lbf, Ø1 = 60°
Guy 2: Load Applied = 5,000 lbf, Ø2 = 50°
Guy 3: Load Applied = 2,000 lbf, Ø2 = 40°

a. Calculate the horizontal (Fx) and vertical (Fy) components of each guy load [Note: Guy load is the applied load from SPIDAcalc Analysis Results]

Fx_1 = 9,000 lbf x sin 60°= 7,794 lbf

Fy_1 = 9,000 lbf x cos 60°= 4,500 lbf

Fx_2 = 5,000 lbf x sin 50°= 3,830 lbf

Fy_2 = 5,000 lbf x cos 50°= 3,214 lbf

Fx_3 = 2,000 lbf x sin 40°= 1,286 lbf

Fy_3 = 2,000 lbf x cos 40°= 1,532 lbf

b. Sum of Horizontal and Vertical Forces

ΣFx = 7,794 lbf + 3,830 lbf + 1.286 lbf = 12,910 lbf

ΣFy = 4,500 lbf + 3,214 lbf + 1,532 lbf = 9,246 lbf

c. Resultant Guying Loads (RGL)

$$RGL = \sqrt{(\Sigma Fx)^2 + (\Sigma Fy)^2}$$

d. RGL = $(12,910)^2 + (9,246)^2$

RGL = 15,879 lbs

e. RGL Guy Angle (β)

β = arctan (ΣFx / ΣFy)
= arctan (12,910 lbf / 9,246 lbf)
= 54.40°

f. Calculate Guy Complementary Angle (α)
α = (90- β)
= (90-54.40)
= 43.67°

g. Compare RGL Guy complementary Angle (α) to anchor angle of inclination (φ)

From Table 14 and using 23" x 23" plate anchor, the nearest angle is 45° with anchor max. holding capacity of 12,500 lbf, which is less than 15,879 lbf. Therefore, single plate anchor with 3 guys attached to it is not sufficient.

h. Recalculate by reducing the number of guys attach to a plate anchor, i.e. 2 guys to 1 plate anchor and 1 guy to another plate anchor, repeat steps a through f above, compare RGL guy complementary angle to anchor angle of inclination, and determine the anticipated holding capacity. Repeat this process until the RGL is less than the allowable maximum holding capacity of the anchor per Table 14.

Table 15: Reduced Maximum Allowable Holding Capacity for Plate Guy Anchors

Plate Anchors	Spacing between anchors	Reduced Maximum Load Allowed when minimum spacing cannot be achieved (lbs)
17” x 17”	<4 ft	The anchors are limited to the holding capacity of one anchor. See Note 1.
	4 ft to <5 ft	10,000
	5 ft to <6 ft	15,000
	>6 ft	18,000
23” x 23”	<4 ft	The anchors are limited to the holding capacity of one anchor. See Note 1.
	4 ft to <5 ft	10,000
	5 ft to <6 ft	15,000
	>6 ft	21,000

Note(s):
1. New installations with two or more anchors spacing less than four feet, the anchors are limited to the holding capacity of one anchor. The new allowable holding capacity is the Maximum Holding capacity (Table 14) divided by the number of anchors.

a. Example #1, two 17" x 17" plate anchors with soil type A at a guy complementary angle of 45 degrees has a holding strength of 14,000 lbs (based on Table 14). Each anchor shall have a maximum holding capacity of 7,000 lbs. (14,000 lbs divided by the # of anchors)
b. Example #2, two 23" x 23" plate anchors with soil type B at a guy complementary angle of 15 degrees has a holding strength of 11,000 lbs (based on Table 14). Each anchor shall have a maximum holding capacity of 5,500 lbs. (11,000 lbs divided by the # of anchors)

D. Expanding Rock Anchor

Table 16: Allowable Holding Strength for Expanding Rock Guy Anchors

Expanding Rock	SAP	Photo	Maximum Allowable Guy Anchor Load (lbs)[1]		Guying Options
			New Installations[2] (S.F=1.5)	In-service[2] (S.F=1.33)	Guying Options a/
3/4" x 30" Triple Eye	10215681		15,000	17,000	3-9/32", or 1-3/8" & 1-9/32", or 1-7/16" & 1-9/32"
1" x 30" Triple Eye	10215682		24,000	27,000	2-3/8" & 1-9/32", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 2-7/16", or 3-9/32"

Note(s):
1. Determine the maximum loading of each guy wire from SPIDA results and use the sum to compare the total maximum allowable anchor holding strength from Table 16. The sum of multiple guying in one anchor shall not exceed the maximum values shown in Table 16.
2. New install safety factors for maximum allowable guy anchor load shall be used when replacing poles. Inservice safety factors for maximum allowable guy anchor load shall be used when equipment or components are added or removed on in service poles. Safety factors shown are for anchors only, NOT for guying.

= For Reference Only

5.0 Pole Push Brace and Unguyed Spans

5.1 Pole Push Brace

Refer to the Distribution Overhead Standards (DOH Section PO 142) for Pole Push Brace requirements.

5.2 Reduced Tension Spans

A. Unguyed (or “Slack”) Spans may be considered when the use of down guys or span guys is not feasible. The resultant (bending) moment created by the unguyed strain must be equalled or exceeded by the usable pole strength. A breast block and pole key (refer to DOH Section PO) must be installed on all unguyed dead-end poles.

Reduced tension unguyed spans where the resultant moment exceeds either the usable pole strength or the pole key resultant moment, the strain should be guyed or the resultant moment reduced. The moment may be reduced by reducing the height of the conductors while maintaining G.O. 95 clearances.

B. Reduced tension guyed spans may be considered when a full tension down guy lead is not feasible (that is, easement issue, obstruction).

C. Reduced tension span tensions have been determined by engineering in the following Tension Table and Figures. Table 12 and Table 10 are used to illustrate and document the values used in SPIDA. Only commonly used conductors and sizes are represented in the tables as examples, though all conductors and sizes are in SPIDA.

Figure 4: Reduced Tension Unguyed Span Example

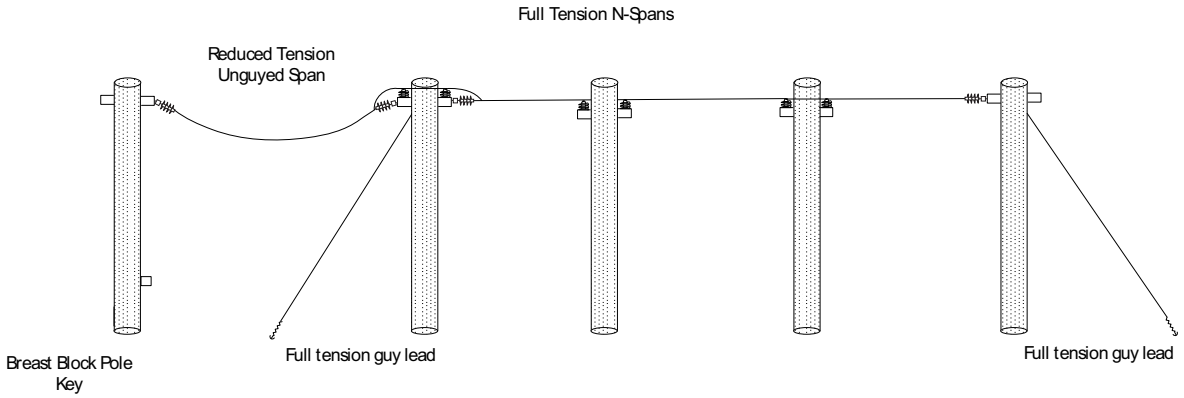


Figure 5: Reduced Tension Guyed Span Example

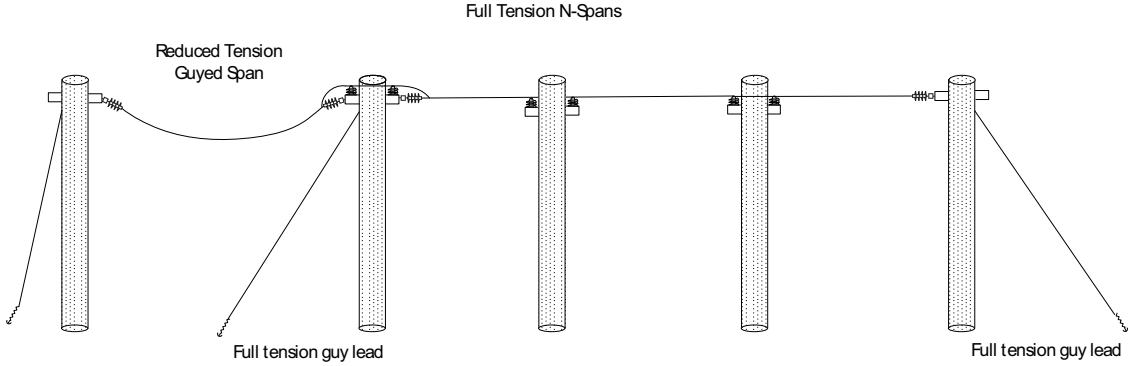


Table 17: Percent Full Tension of Conductor—Light Loading Areas

Bare ACSR Conductor			
	0–120 Feet	121–160 Feet	161–200 Feet
Guyed new and existing	20%	20%	20%
Unguyed existing[a/]	10%	10%	[b/]
Unguyed new	10%	N/A	N/A
Bare Copper Conductor			
	0–120 Feet	121–160 Feet	161–200 Feet
Guyed new and existing	15%	30%	30%
Unguyed existing [a/]	15%	30%	[b/]
Unguyed new	15%	N/A	N/A
ACSR MultiPlex Conductor			
	0–120 Feet	121–160 Feet	161–200 Feet
Guyed new and existing	50%	50%	[c/]
Unguyed existing [a/]	25%	50%	[c/]
Unguyed new	25%	N/A	N/A

[a/] This includes existing construction that requires rebuilding or pole replacement. When practicable, consider adding a guy (reduced tension) to the pole or additional poles to reduce span lengths.

[b/] Unguyed existing and rebuild spans for all conductor sizes exceeding 160 feet shall be guyed and considered reduced tension guyed spans.

[c/] All multiplex conductor sizes exceeding 160 feet shall be full tension and guyed.

Note(s):

1. This table applies to reduced tension guyed and reduced tension unguyed spans. See Figure 4 and Figure 5 for examples; other design configurations may apply.

Table 18: Percent Full Tension of Conductor Heavy — Loading Areas

Bare ACSR Conductor			
	Size	0–120 Feet	121–160 Feet
Guyed new and existing	#4 – 1/0	50%	50%
	336 – 653	25%	25%
Unguyed existing[a/]	#4 – 1/0	50%	50%
	336 – 653	25%	25%
Unguyed new	#4 – 1/0	50%	N/A
	336 – 653	25%	N/A
Bare Copper Conductor			
	Size	0–120 Feet	121–160 Feet
Guyed new and existing	#6 - #2	70%	70%
	2/0	40%	40%
	4/0	30%	30%
Unguyed existing [a/]	#6 - #2	70%	70%
	2/0	40%	40%
	4/0	30%	30%
Unguyed new	#6 - #2	70%	N/A
	2/0	40%	N/A
	4/0	30%	N/A
Aluminum Duplex (AD) and Aluminum Triplex (AT) Conductor			
	Size	0–120 Feet	121–160 Feet
Guyed new and existing	#6 AD - #2 AT	75%	75%
	1/0 AT	50%	50%
	4/0 AT	30%	30%
Unguyed existing [a/]	#6 AD - #2 AT	75%	75%
	1/0 AT	50%	50%
	4/0 AT	30%	30%
Unguyed new	#6 AD - #2 AT	75%	N/A
	1/0 AT	50%	N/A
	4/0 AT	30%	N/A
Aluminum Quadruplex (AQ) Conductor			
	Size	0–120 Feet	121–160 Feet
Guyed new and existing	#4	75%	75%
	1/0	50%	50%
	4/0	30%	30%
Unguyed existing [a/]	#4	75%	75%
	1/0	50%	50%
	4/0	30%	30%
Unguyed new	#4	75%	N/A
	1/0	50%	N/A
	4/0	30%	N/A

[a/] This includes existing construction that requires rebuilding or pole replacement. When practicable, consider adding a guy (reduced tension) to the pole or additional poles to reduce span lengths.

Note(s):

1. This table applies to reduced tension guyed and reduced tension unguyed spans. See Figure 4 and Figure 5 for examples; other design configurations may apply.

D. The reduced tension conductor sag tables and examples for new, existing, and rebuild construction are shown in PLM–5: Section 1.3 Unguyed Span hand calculation Example.

PLM–3: Pole Loading Tool (PLT) Training Manual

Table of Contents

Section **Page**

1.0 Description

A Pole Loading Calculation (PLC) shall be performed using a Pole Loading Tool (PLT) such as SPIDAcalc software.

This chapter describes process steps associated with the creation of a pole load design in the SPIDAcalc PLT. The addition of varying equipment elements on a pole are evaluated. In addition, the analysis within SPIDAcalc will produce engineered results including safety factors for single poles, sidewalk horizontal braces and guying.

2.0 Introduction

Both T&D Business Lines will comply with General Order (G.O.) 95, Section IV, “Strength Requirements for All Class of Lines”. Pole Loading will be performed as prescribed in PLM–1.

Therefore, Planners or Qualified Planning Employees are responsible for:

- Collecting accurate field data
- Researching SAP for pertinent structure information
- Navigating through each tab of the Pole Load Tool (SPIDAcalc)
- Understanding the information being entered
- Ensuring that the information entered are consistent with the PLM and the Distribution Overhead Construction Manual (DOH)
- Successfully completing all necessary Pole Loading calculations with the Pole Load Tool by achieving passing safety factors required for the type of construction being performed

3.0 Pole Load Definitions and Terms

To standardize communication of results from the Pole Load Tool, definitions and terms are listed to provide clarity to evolving terminology. The 'Pole Safety Factor,' previously referred to as the 'Bending' or 'Transverse' loading Safety Factor pertains to the effect of wind as it blows across and/or through conductors and other equipment.

'Guying Safety Factor' refers to the assessment done on all span guys and down guys in the analysis. This includes level span guys, high/low span guys, bisector down guys, and dead-end down guys. Down guys may be used in conjunction with sidewalk horizontal braces. The 'Brace Safety Factor' refers to the analysis of the sidewalk horizontal brace within the Pole Load Tool. All of these components, if utilized in the pole load design, must achieve passing safety factors.

4.0 Data Collection

4.1 Field Data

Prior to adding facilities to a pole and if a pole load calculation is needed (See Exceptions in PLM-1, 1.3B), the SCE Pole Load Worksheet must be used in when collecting field data. This worksheet outlines the various attributes that are required to be collected in the field in order to complete a pole load. It is consistent with the inputs required for the Pole Load Tool. For more information on how to collect field data, refer to PLM-4 Pole Load Assessment Reference Guide.

4.2 Office Data

Prior to entering field information into the Pole Loading tool, the Planner or Qualified Planning Employee must research existing pole information to find intrusive inspection results or requirements. This is currently accomplished by using SAP directly or by using SAP through DM or Portal. There are two methods of checking a pole for intrusive inspection results.

A. Pole tags

1. If the pole has an intrusive inspection tag, or the inspection information online indicates it passed, the pole is considered good for 20 years from the date of the inspection. The pole can be considered 100% sound.

2. If no inspection tag is found on the pole, users must research SAP for that information. However, if the pole is 15-years old and older, an intrusive inspection needs to be completed.

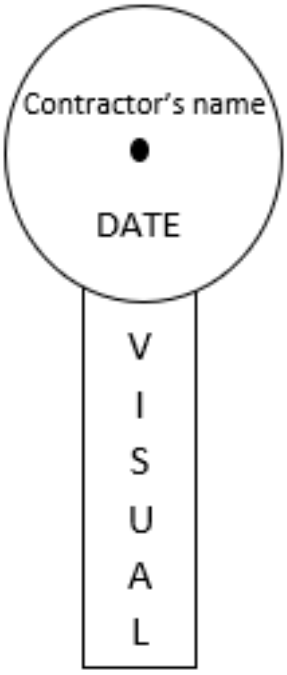
B. SAP using IH08

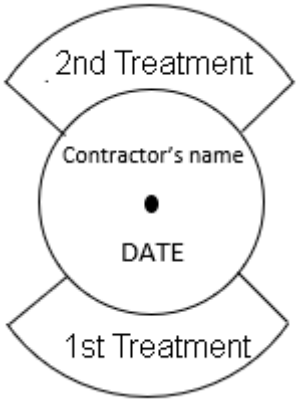
1. If the wood pole is less than 15-years old, no intrusive inspection is required and assumed it is 100% sound.

2. Pole loading calculations performed for wood structures more than 15 years old shall incorporate the results of intrusive inspections performed within the previous five years.

Pole Tags include the following information:

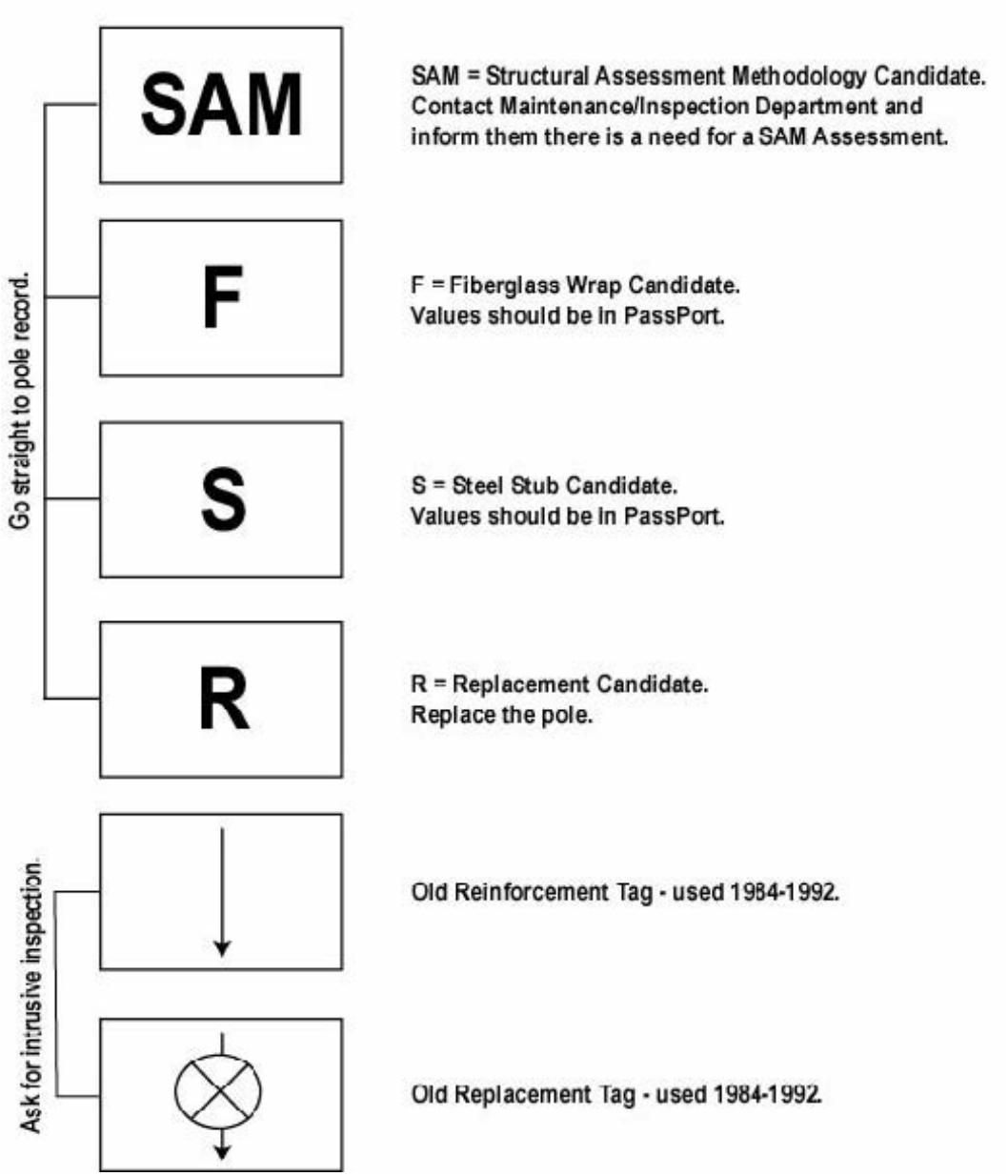
- Round tag is the standard tag
  - — Contractor's name
  - — Date
- Butterfly tag means the pole passed inspection
  - — Different types of remedial treatment





Treatment Type	Application Form	Years used on SCE poles
JECTA	Gel	2021 - Current
CUB	Liquid Gel	2018 - 2021
Boron ROD	Solid glass ROD	1980's - 2017
ULTRA FUME SUPER FUME G-fume	Granular, solid pour	8/2000 - 5/2018
Mitc FUME	Solid-Melt in tube	3/1990 – 7/1992
WOOD FUME VAPAM	Liquid pour	1956 - 1992

Pole tags that are also helpful in identifying additional types of descriptions:



The following tagging system outlines priority replacements based on the year. The alpha values are as follows:

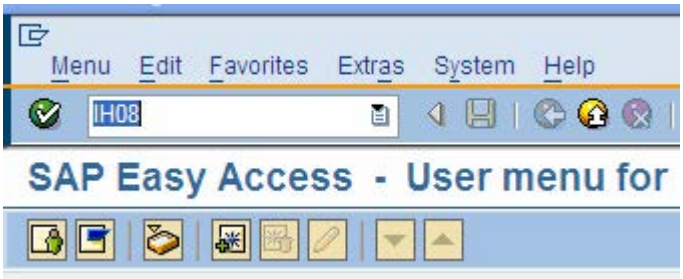
1. R (Replace)
2. F (Fiberglass wrap)
3. S (Steel stub)

	Tagging Prior to 2011	Tagging after 2011
	R1: Replacement. Replace within 3 days of intrusive inspection date.	R1: Replacement. Replace within 3 days of intrusive inspection date.
	R2: Replacement. Replace within 90 days of intrusive inspection date.	R2: R-2 will replace between 1 and 3 years.
	R3: Priority 3 Replacement. Replace within 365 days or 1 year of intrusive inspection date.	R3, R4 only used prior to 2011
	R4: Priority 4 Replacement. Replace within 1,095 days or 3 years of intrusive inspection date.	

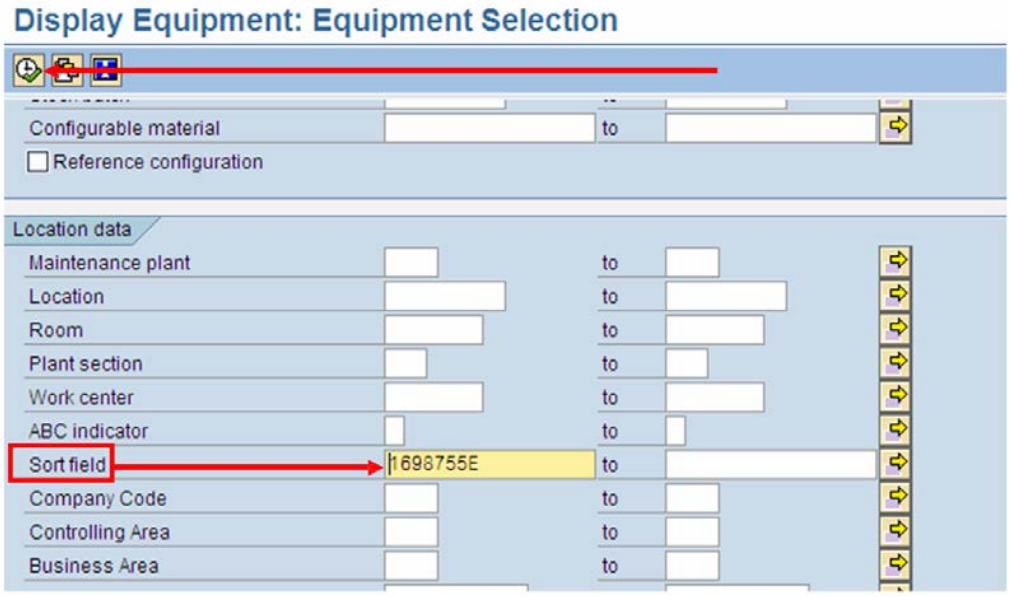
C. SAP Data

Prior to entering field information into the Pole Loading tool, the Planner or Qualified Planning Employee must research existing poles information to find intrusive inspection results.

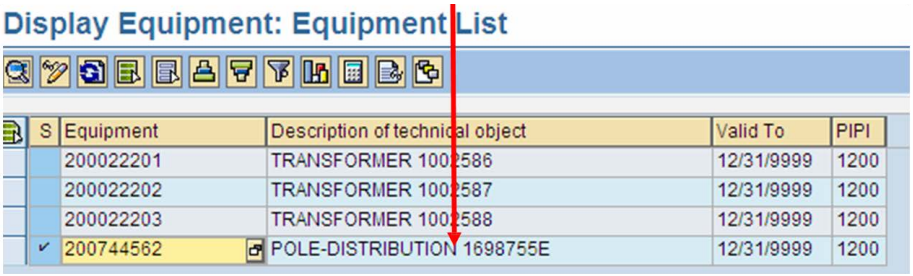
From Portal, click on “My Work” and select “Launch SAP”. Enter IH08 into SAP.



Scroll down to the Location data section and enter the pole structure number in the Sort field and begin the search by clicking the execute button.

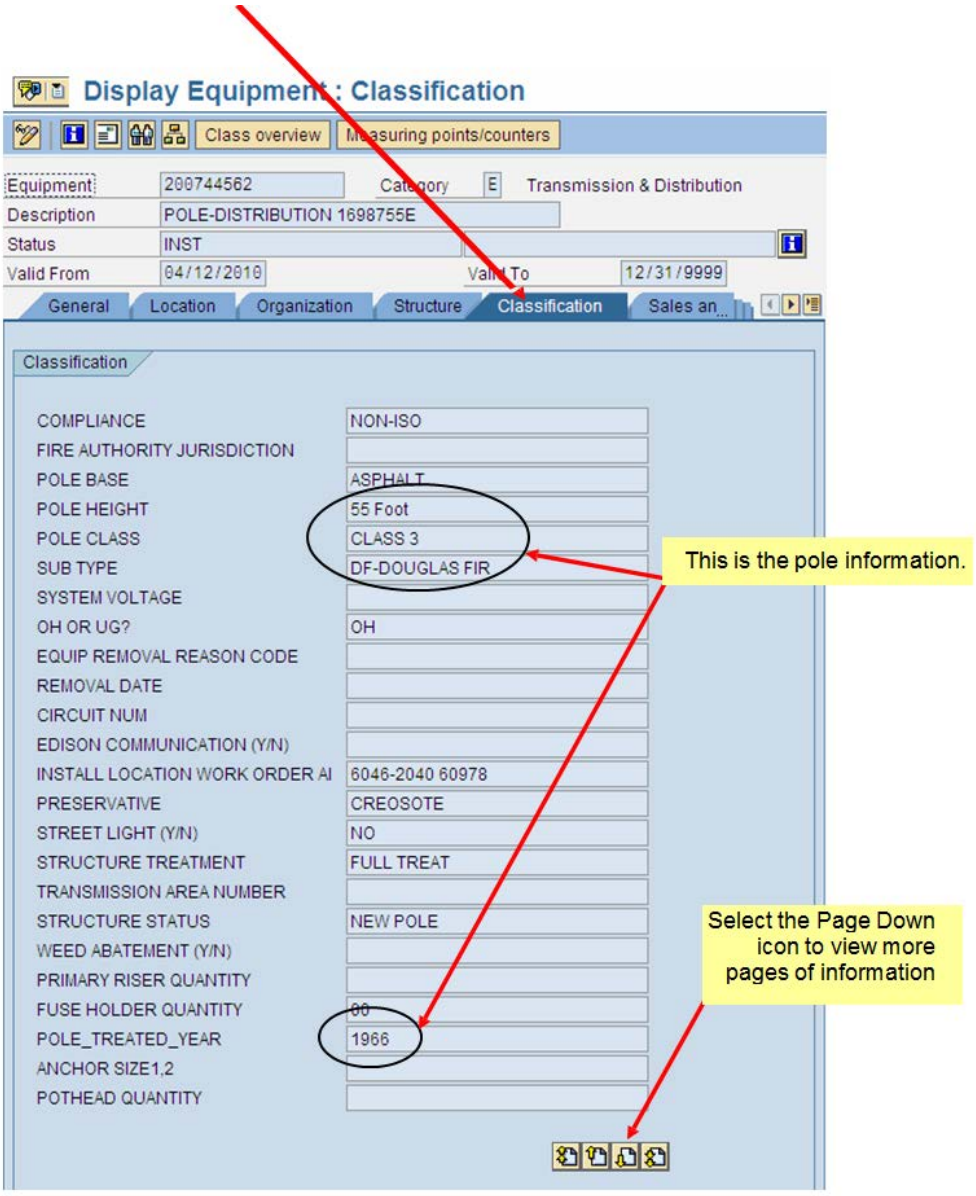


From the Results screen, select (double click) on the pole now.

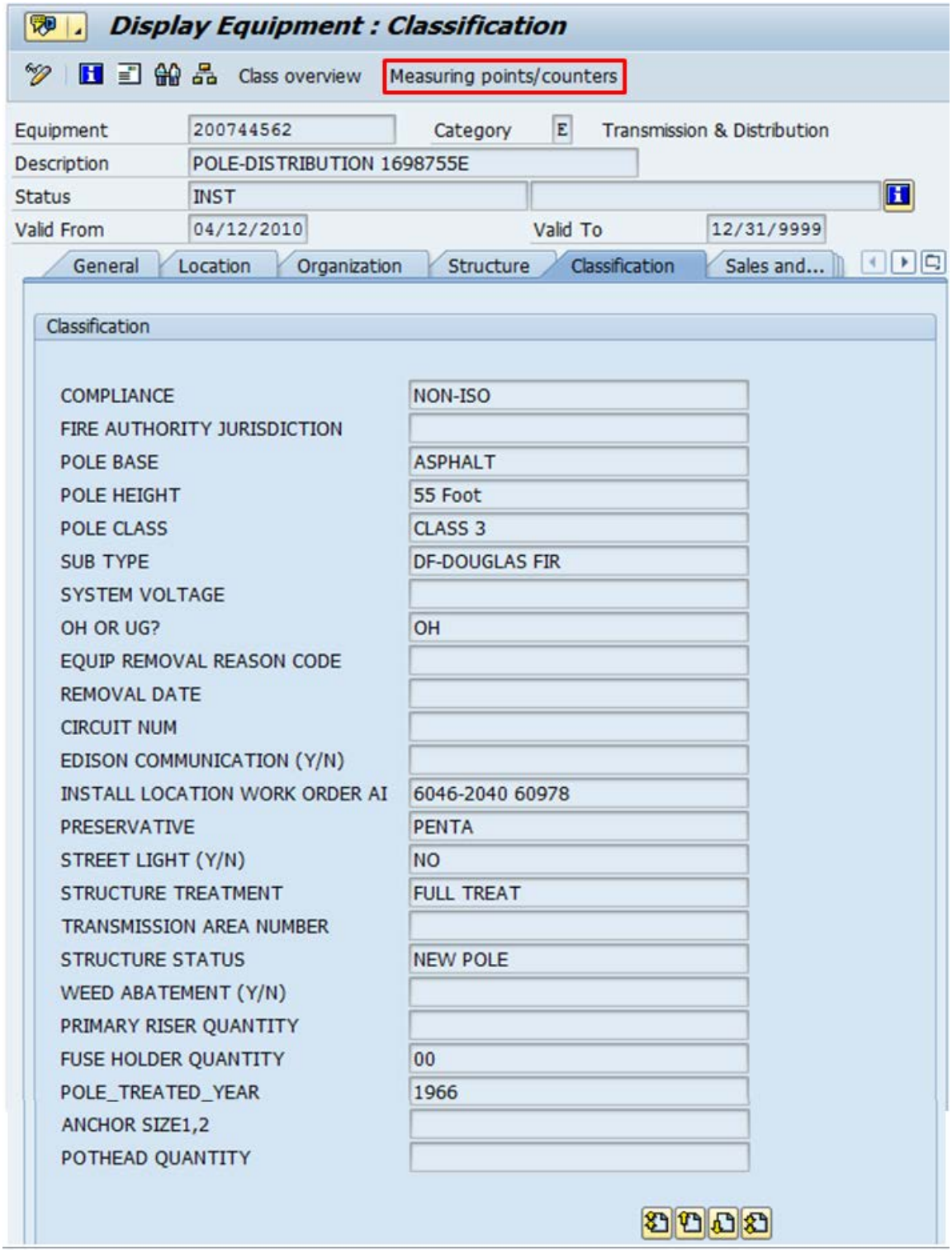


Viewing Pole Information in SAP

Click once on 'Classification' and the pole info will appear below:



To find inspection information, click once on ‘Measuring points/counters.’

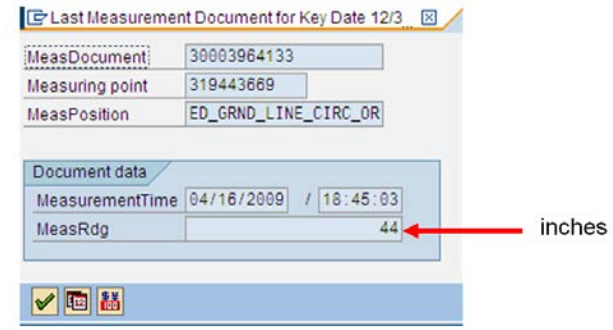


Viewing Pole Information in SAP (continued)

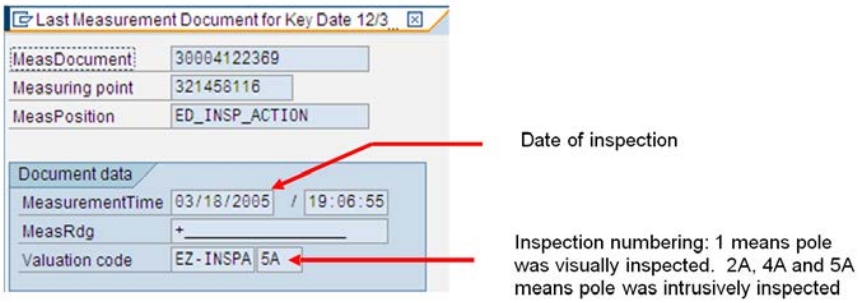
You would then review and record any inspection data, close the Detail screen, deselect the check box and repeat for the remaining line items.

1. Here is an example of Ground Line Circumference that can be found in SAP.

   Circumference found using ED_GRND_LINE_CIRC_OR and Last Measurement Document.

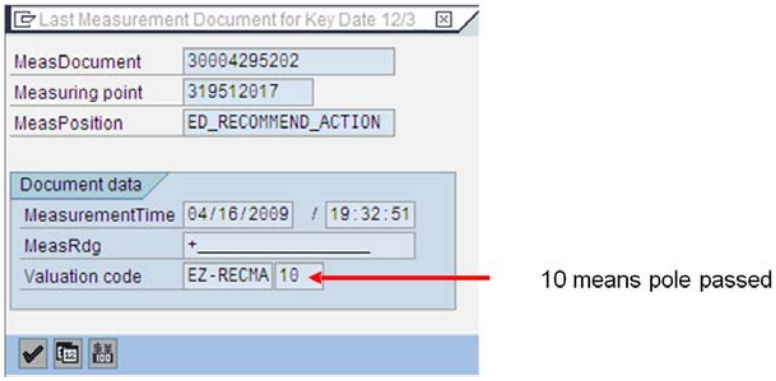


2. If you clicked in the ED_INSP_ACTION and clicked on the Last Measurement Document you would find this information:

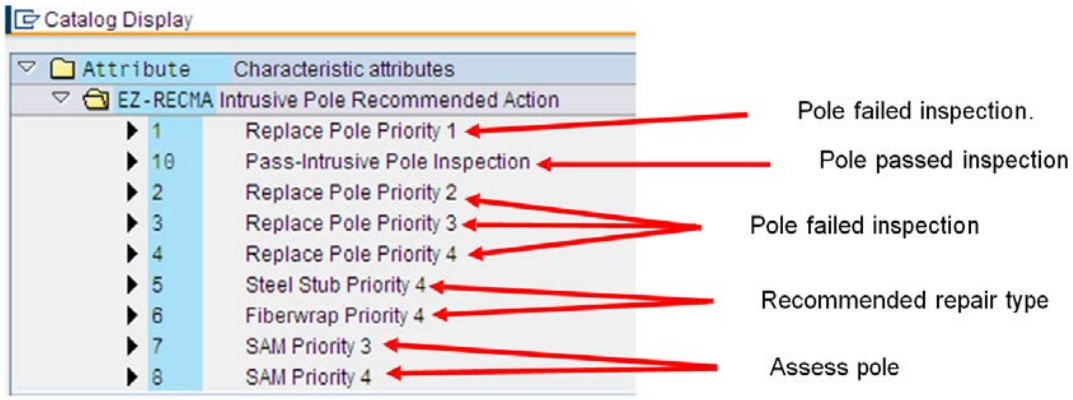


3. Here is an example of the Recommended Action Details.

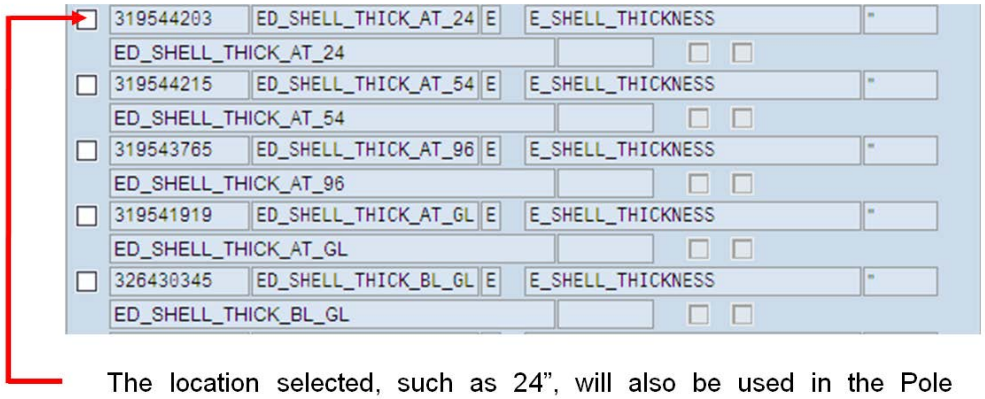
   Pole passes found using 'ED_RECOMMENDED_ ACTION and Last Measurement Document.



Here is a listing of information explaining the numbers shown in Last Measurement Document as it relates to inspection RESULTS or RECOMMENDED ACTION:

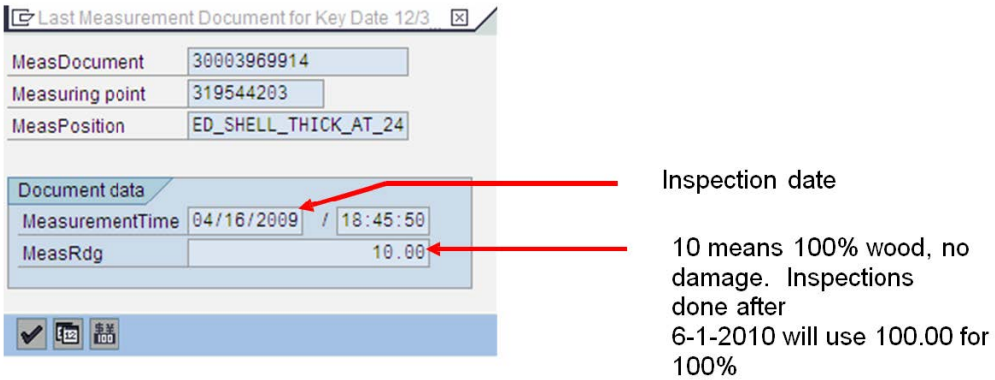


Shell damage can be found by selecting one of the following and Last Measurement Document:

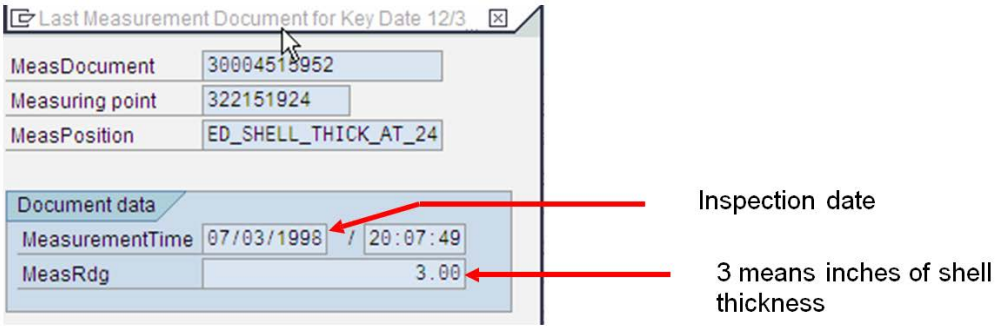


The location selected, such as 24", will also be used in the Pole Loading tool.

IMPORTANT: Please know that poles inspected prior to 1-1-09 had the shell thickness reported using inches. Poles inspected after 1-1-09 used percentages, however, the old system 'Passport' did not have room for three digits so 100% was shown as 10.00. 80% would be 8.00. SAP will be copying the two digit information from Passport. Inspections completed after 6-1-10 will have three digits of space meaning 100% will be shown as 100.00.



Below is an example that has the shell thickness shown in inches because the inspection was completed prior to 1-1-2009.



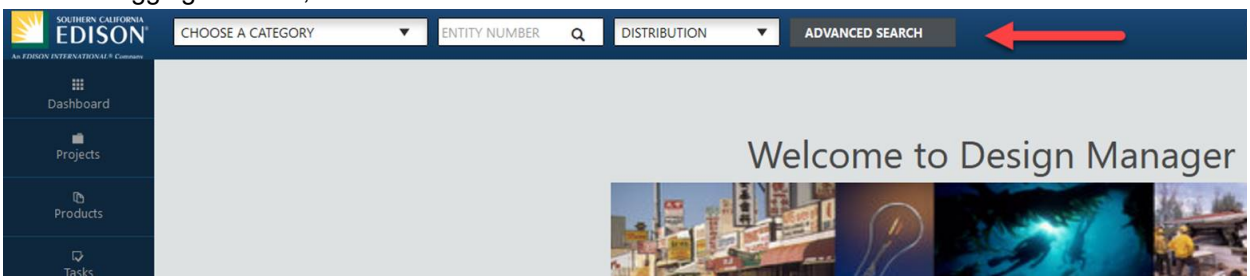
Shell Damage:

At the present time, SAP does not contain shell damage information.

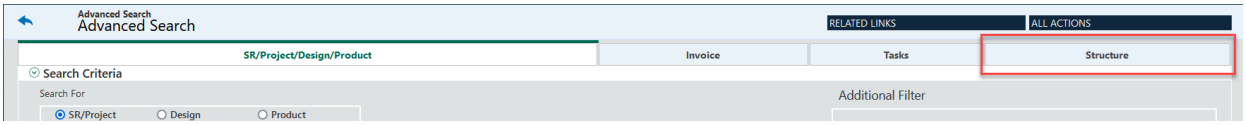
5.0 Using Design Manager (DM) to Navigate to Pole Information in SAP

(Distribution Design Manager)

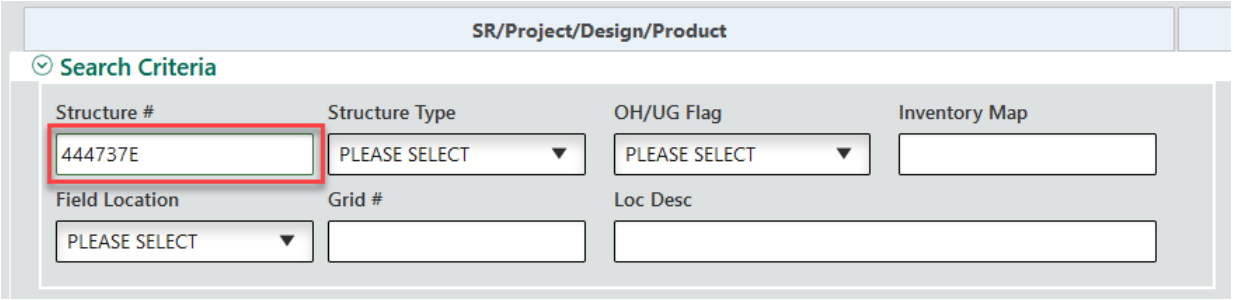
1. After logging in to DM, click on the Advanced Search



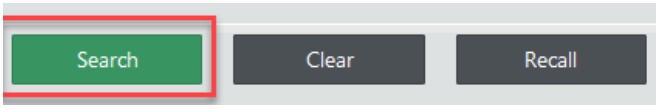
2. Click on the 'Structure' tab.



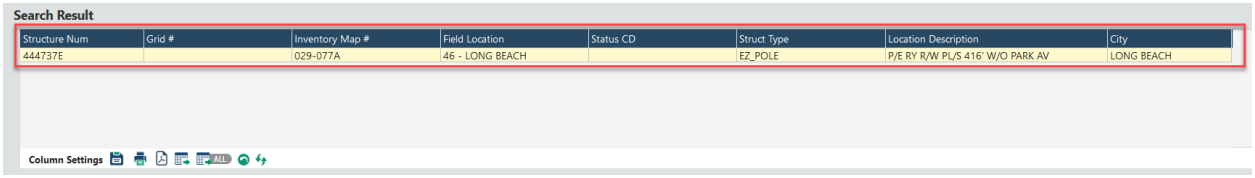
3. Then, enter the structure number:



4. Select search.

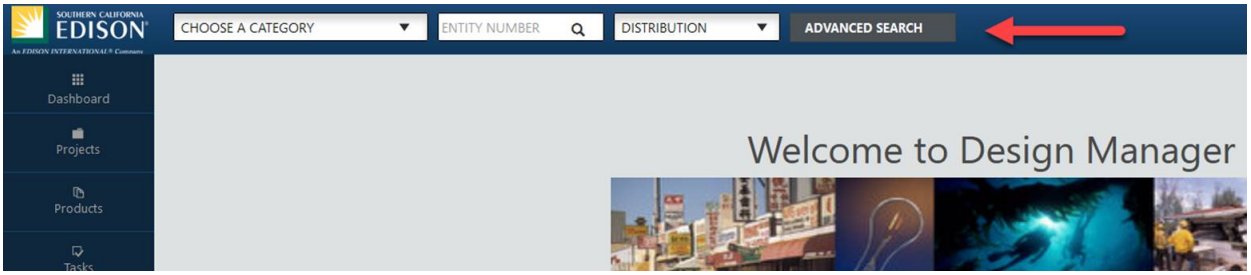


5. Double-click on the structure line at the bottom of the screen. This will open the Structure Details screen in SAP.

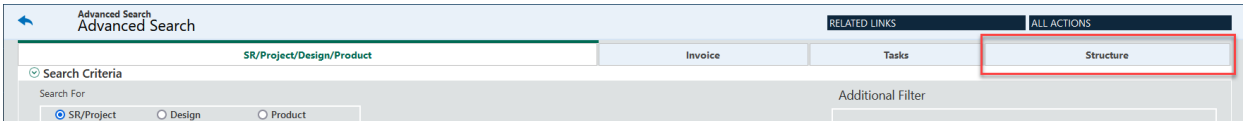


(Transmission Design Manager)

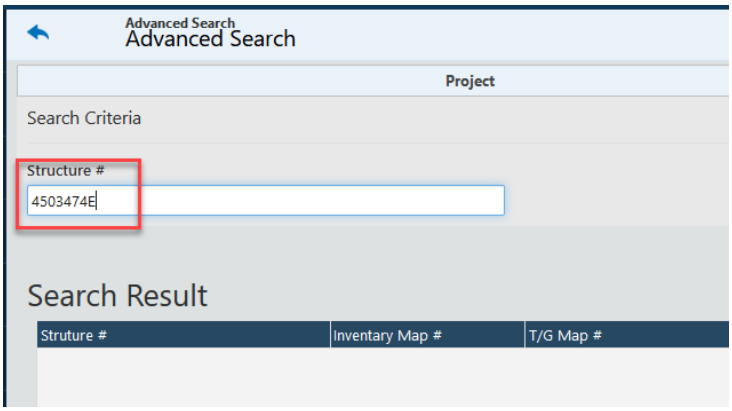
1. After logging in to DM, click on the Advanced Search



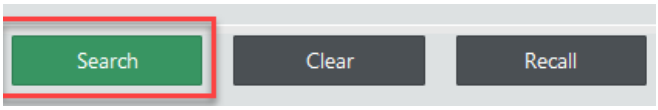
2. Click on the 'Structure' tab.



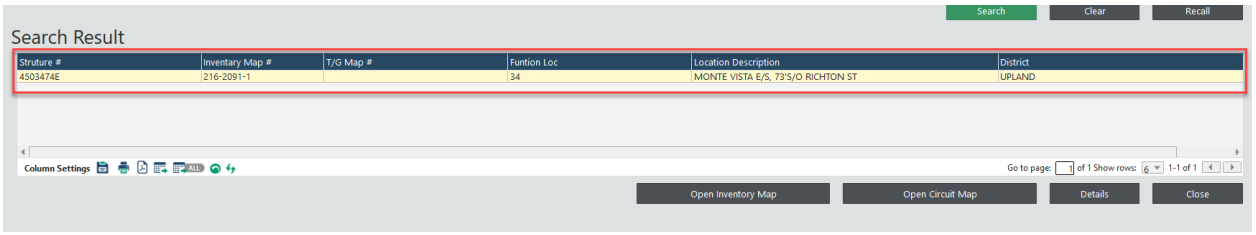
3. Then, enter the structure number:



4. Select search.

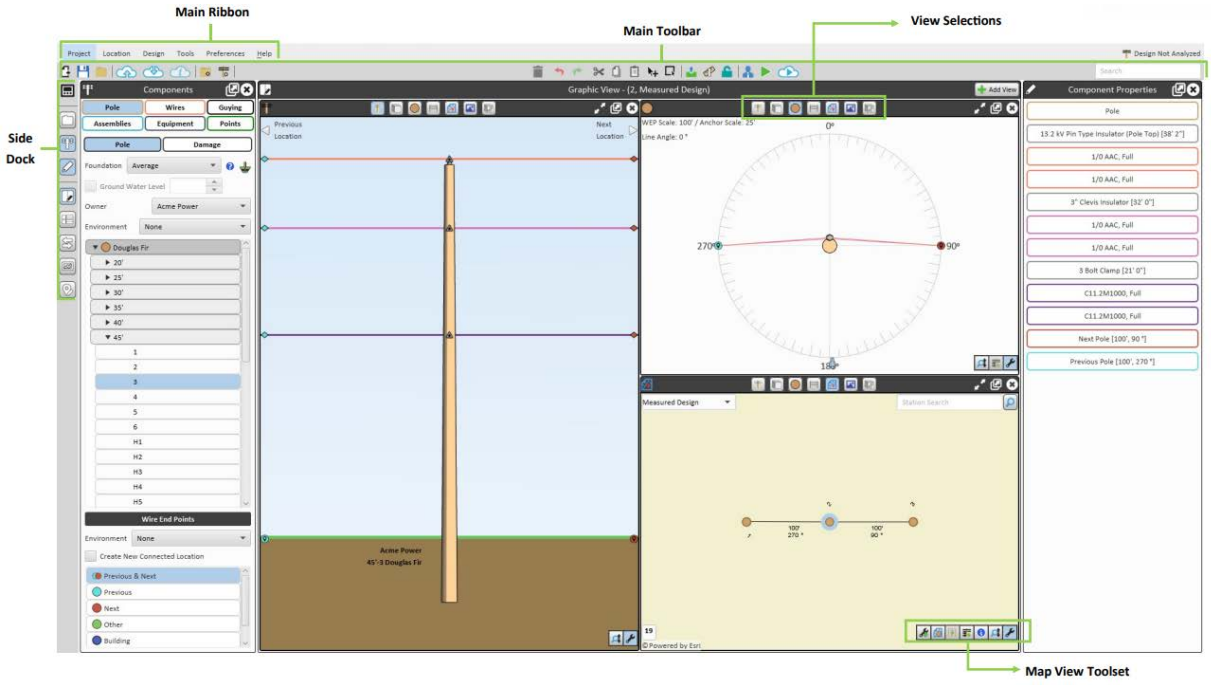


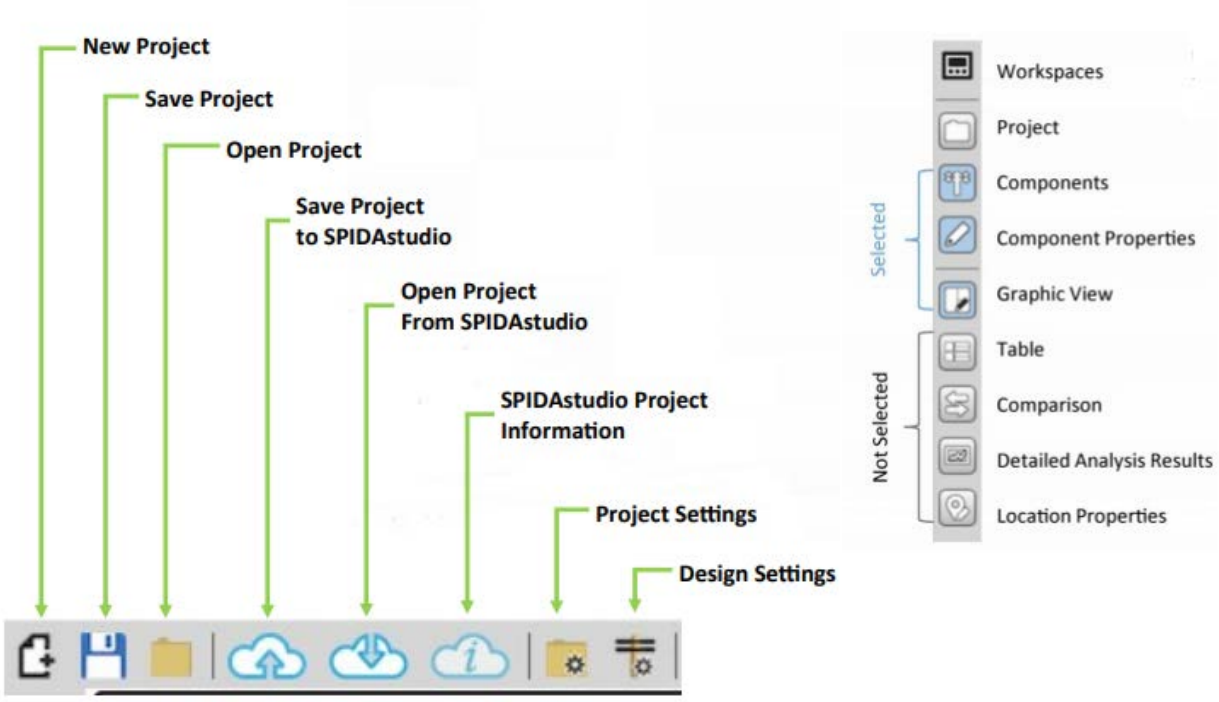
5. Double-click on the structure line at the bottom of the screen. This will open the Structure Details screen in SAP.



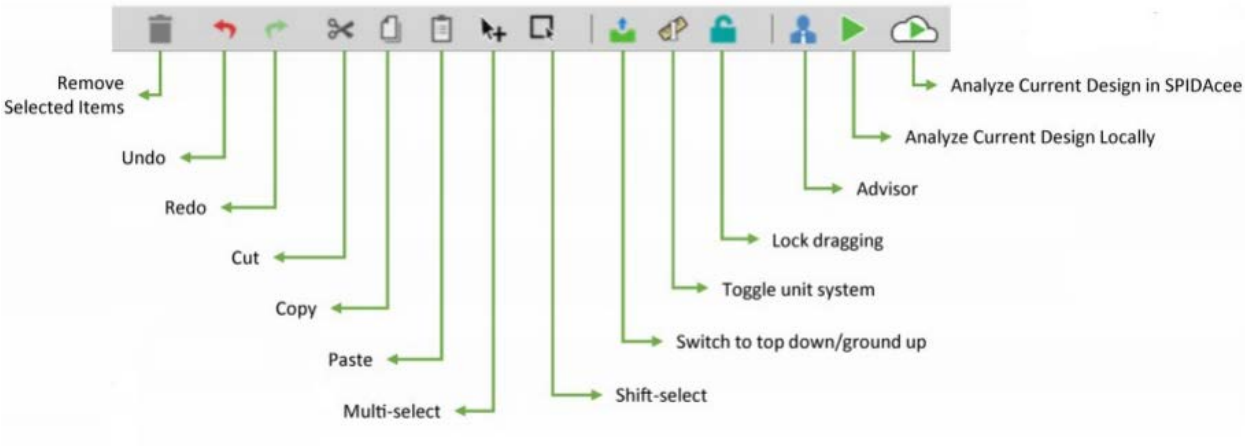
6.0 Entering Data into the Pole Load Tool

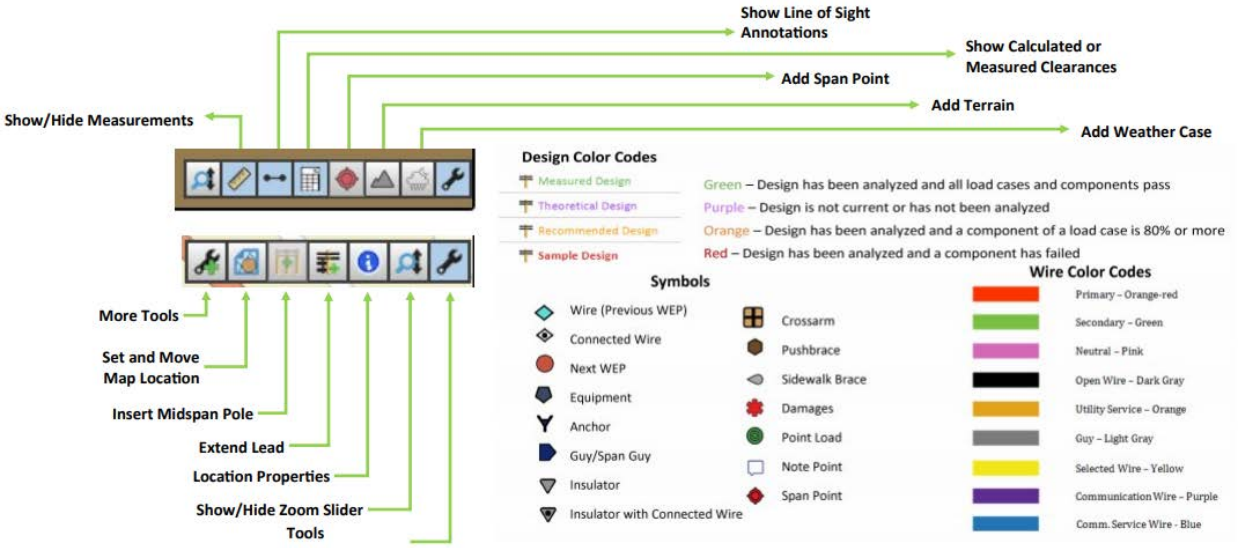
Pole Load Tool Interface Reference





Pole Load Tool Interface Reference





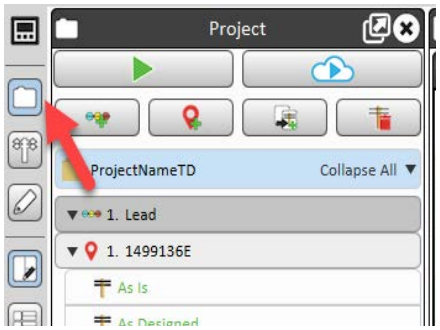
If the Project panel is not visible, you can click on the Project panel icon on the left. It will open the Project panel in which you can dock or keep floating as needed.

Click on this icon to dock the panel.

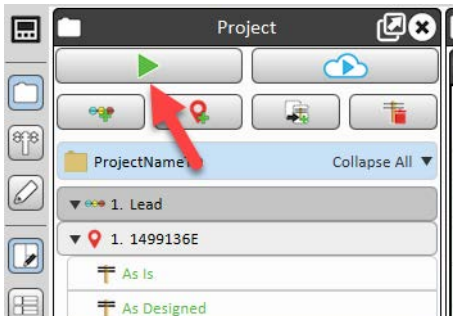
Click on this icon to float the panel.

Click on this icon to maximize the panel.

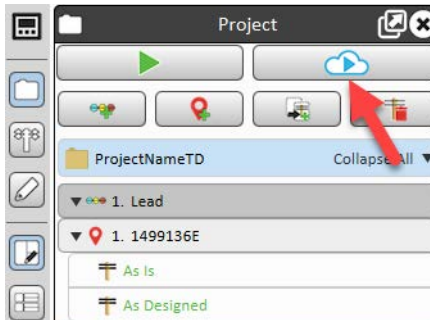
Project Panel Overview



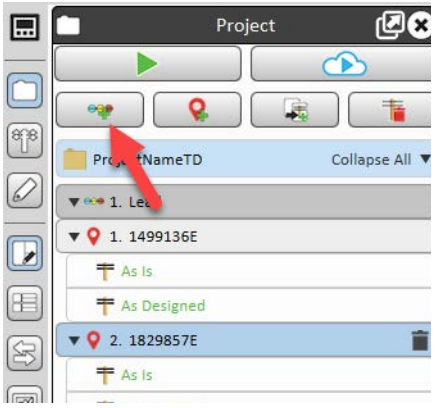
This icon will open the Project panel.



This is the analysis option that will allow you to analyze your project locally.



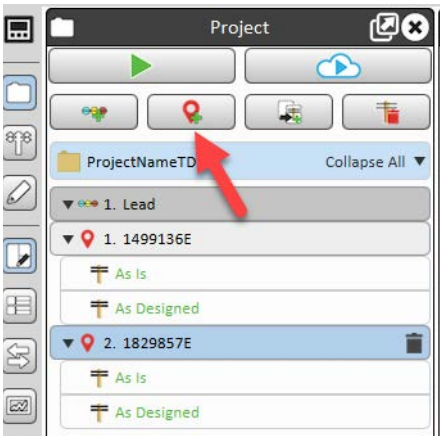
This option will let you analyze your project in SPIDACee.



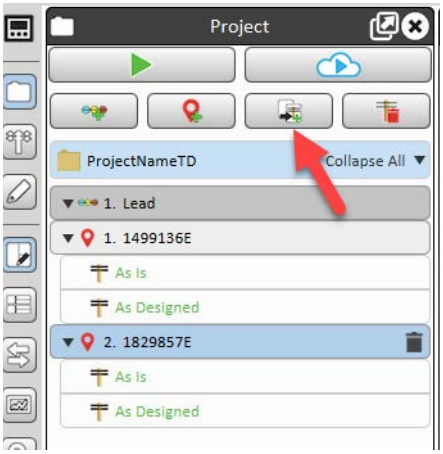
The next group of icons will allow you to perform different functions in your project.

The first button will let you add a Lead. Leads can be used as an organization tool that could help break up a large project

Project Panel Overview

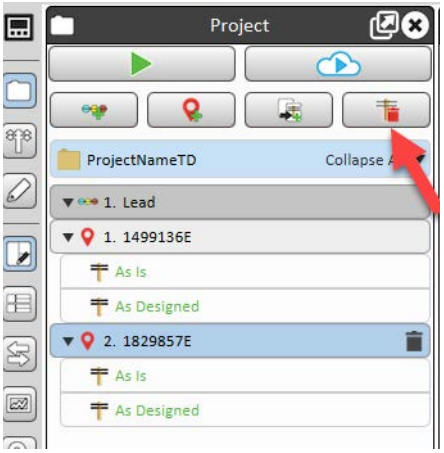


This is the add Location button that lets you add poles to a project. In this scenario, we have 2 poles under the same Lead.

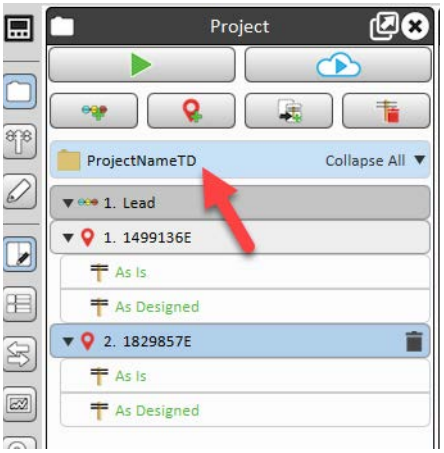


This button will let you clone design layers under the poles in the project. This clones the entire layer for every pole in the project at the same time.

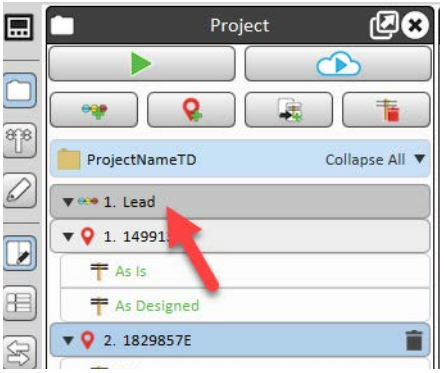
Project Panel Overview



This button will let you remove the design layers in a project. This removes the entire layer for every pole in the project at the same time.



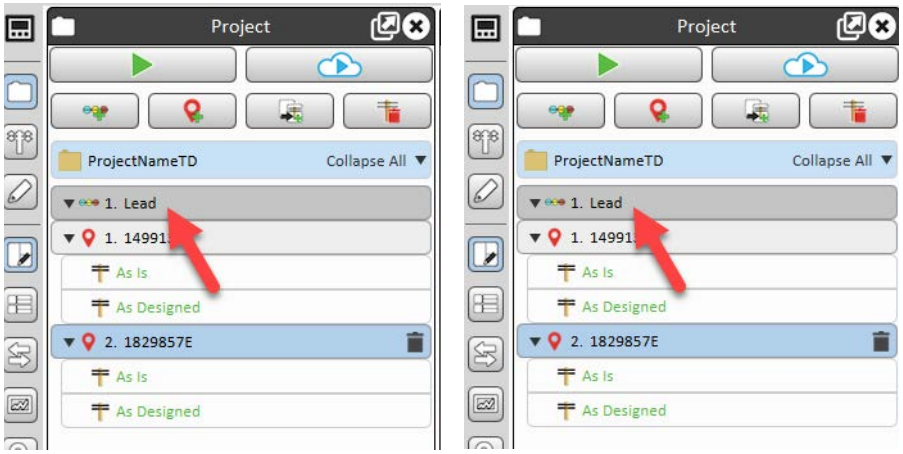
The hierarchy underneath will start with the Project Name, Lead, each of the poles in the project, and then the design layers for each pole.



This is the lead for the project.

Project Panel Overview

This project has 2 poles under the same lead. You can select between each pole by selecting them in the Project panel.

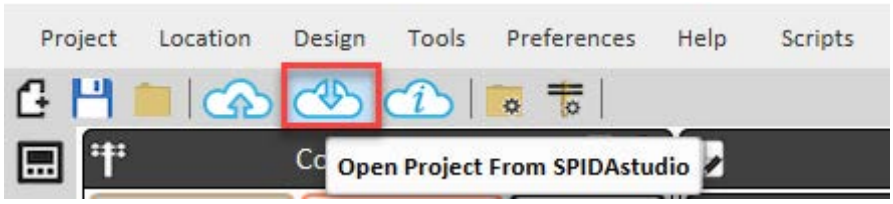


6.1 Starting a Project

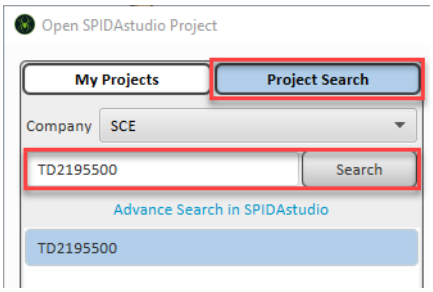
When you first launch SPIDAcalc, the Project tab, Components tab, Component Properties tab and Graphic view tab, with Side View, Top View and Map View are displayed.

STEP 1. Launch SPIDAcalc. It may take a few moments for the program to load.

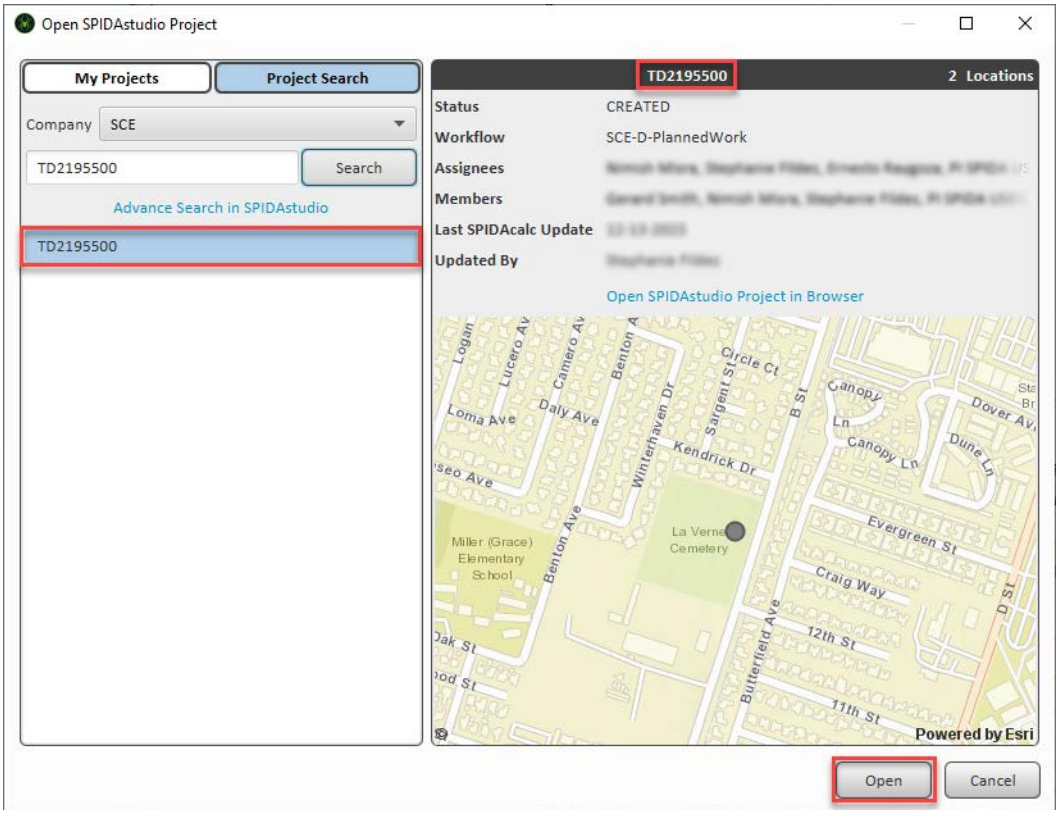
STEP 2. Step 2. Select **Open Project From SPIDAstudio** icon to open a project.



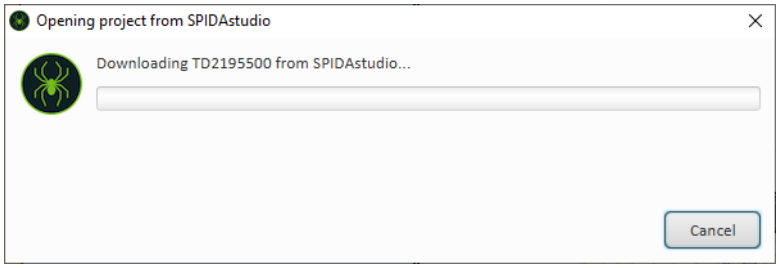
STEP 3. The **Open SPIDAstudio Project** dialog box will appear. Select **Project Search** tab, enter a project name in the search field and select Search. This search is not case sensitive and can search with partial information. In this example, TD2195500 is used for the search.



STEP 4. Once search is complete, select the desired project (highlighted in blue) and click on Open.

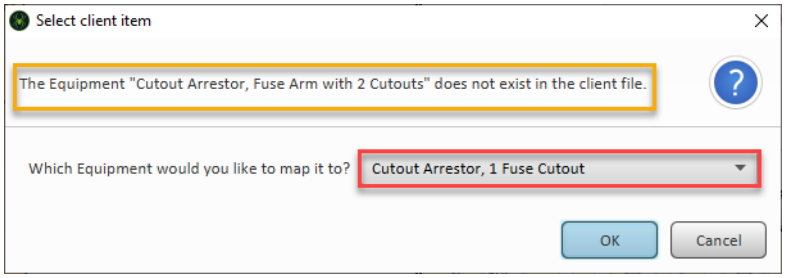


A dialog box will appear, Opening project from SPIDAstudio.

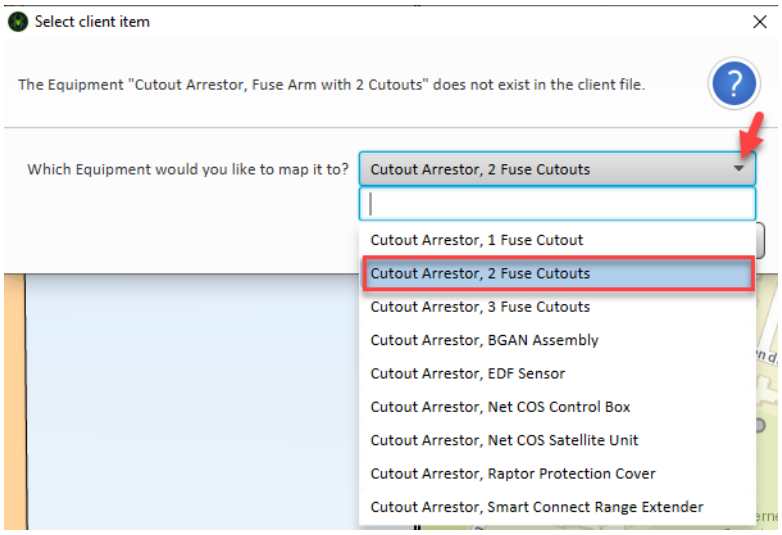


NOTE

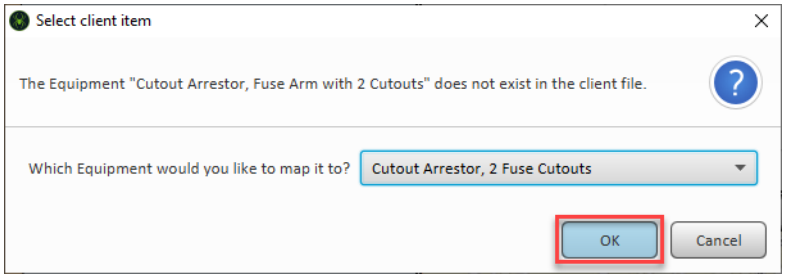
If you are using existing pole loads from SPIDAstudio that are Legacy Pole Loads (previous versions of SPIDA) you may receive a separate dialog box. In the Select client item dialog box, it will prompt a message to update an item. In this example, the message is displaying, "The Equipment "Cutout Arrestor, Fuse Arm with 2 Cutouts" does not exist in the client file."" This will need to be updated.



Select the pull down and select the correct equipment type. In this example, the Cutout Arrestor, 2 Fuse Cutouts is selected.

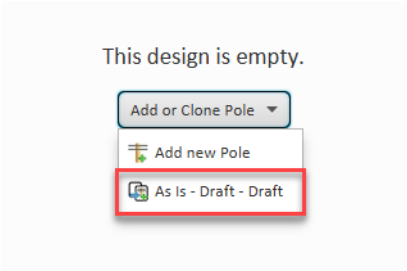


Once the correct equipment is selected, click OK.

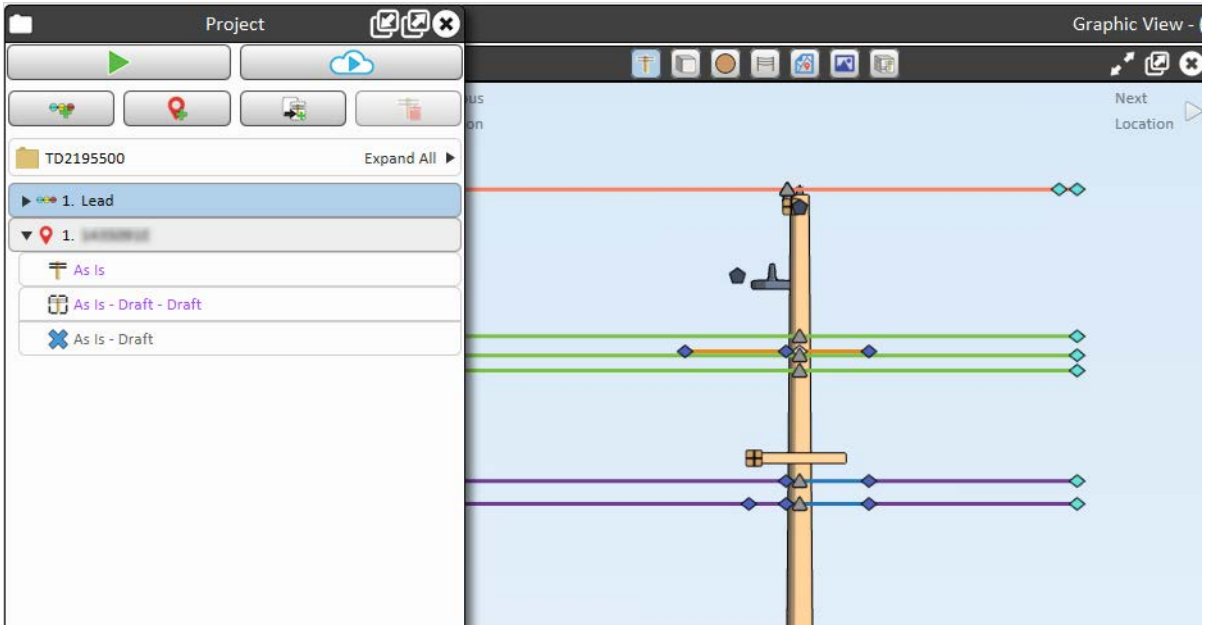


The Graphic View panel will display a message, "The design is empty." The pulldown displays "Add or Clone Pole". There two selections "Add new Pole" (this for a New Pole) or As Is - Draft - Draft (this is the As-Is Legacy Pole Load).

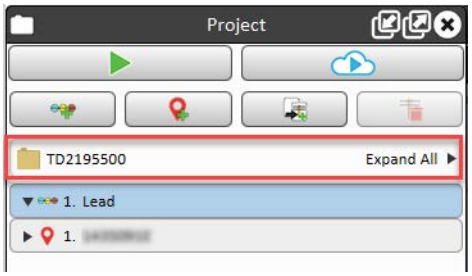
In this example, select the As Is - Draft - Draft.



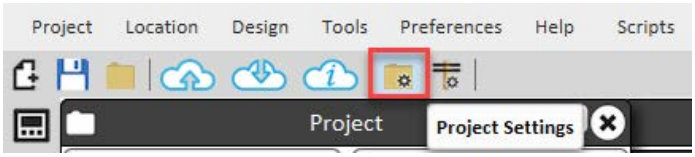
The "As Is - Draft - Draft" is loaded to the project.



STEP 5. Project is open. You can verify the project by checking the folder in the Project panel.

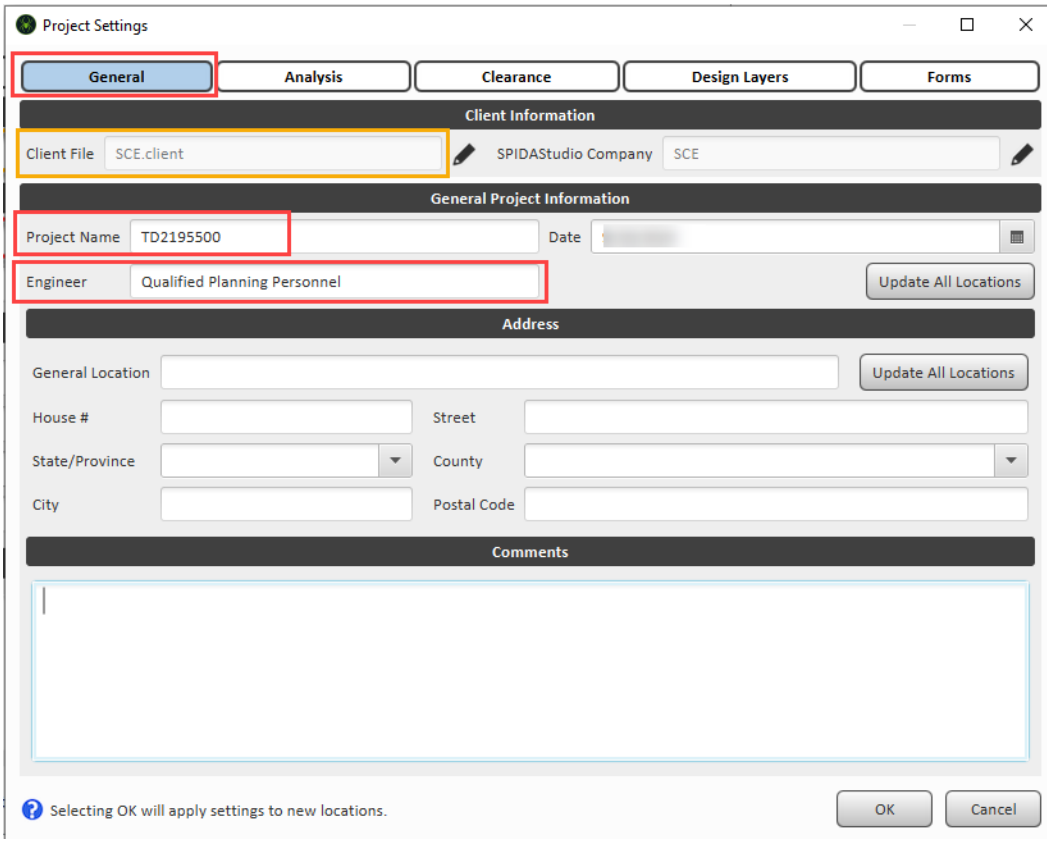


STEP 6. In the main tool bar, select Project Settings icon. Project Settings dialog box will open.



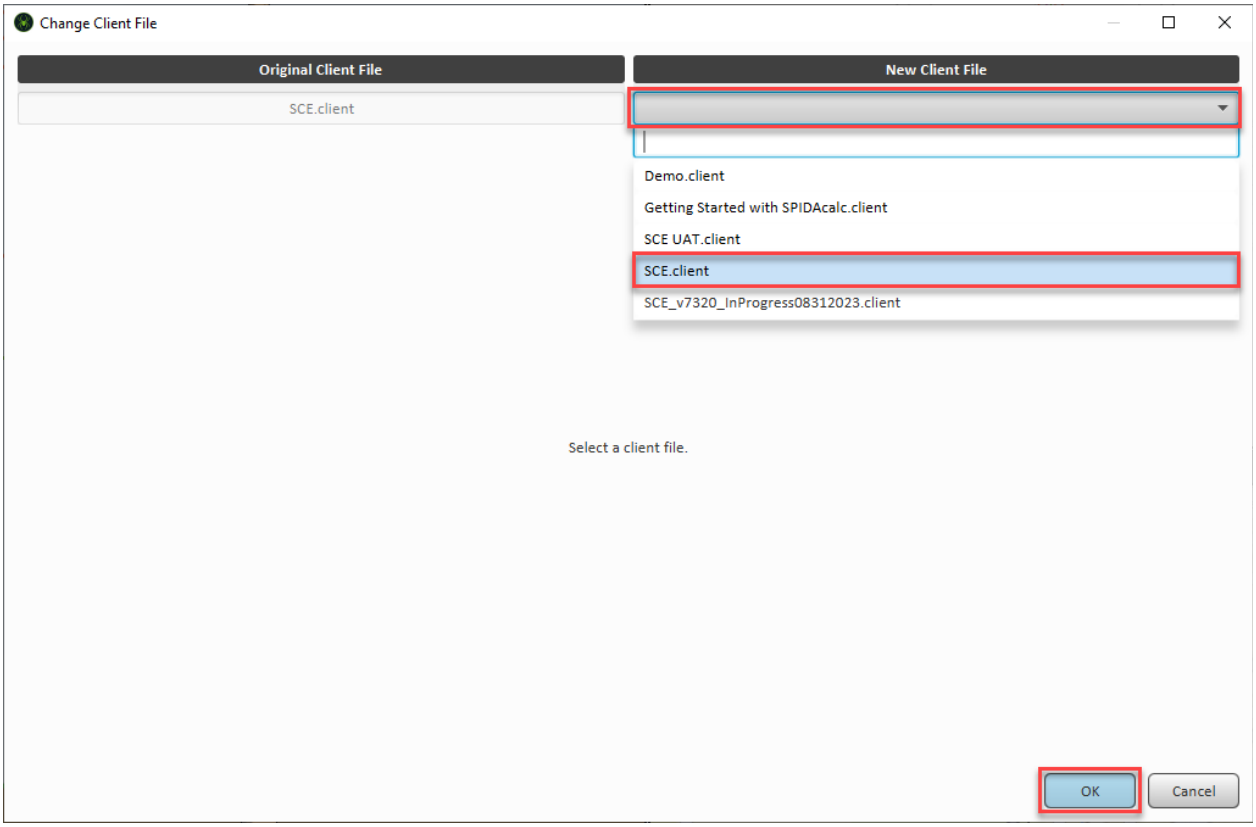
STEP 7. Under the **General** tab, in the **Project Name** field, the TD/900 number will appear (in this example, TD2195500 is displayed).
Make sure that **Client File** field is set to SCE.client.

In the **Engineer** field, enter the name of the person completing the pole load in the tool.

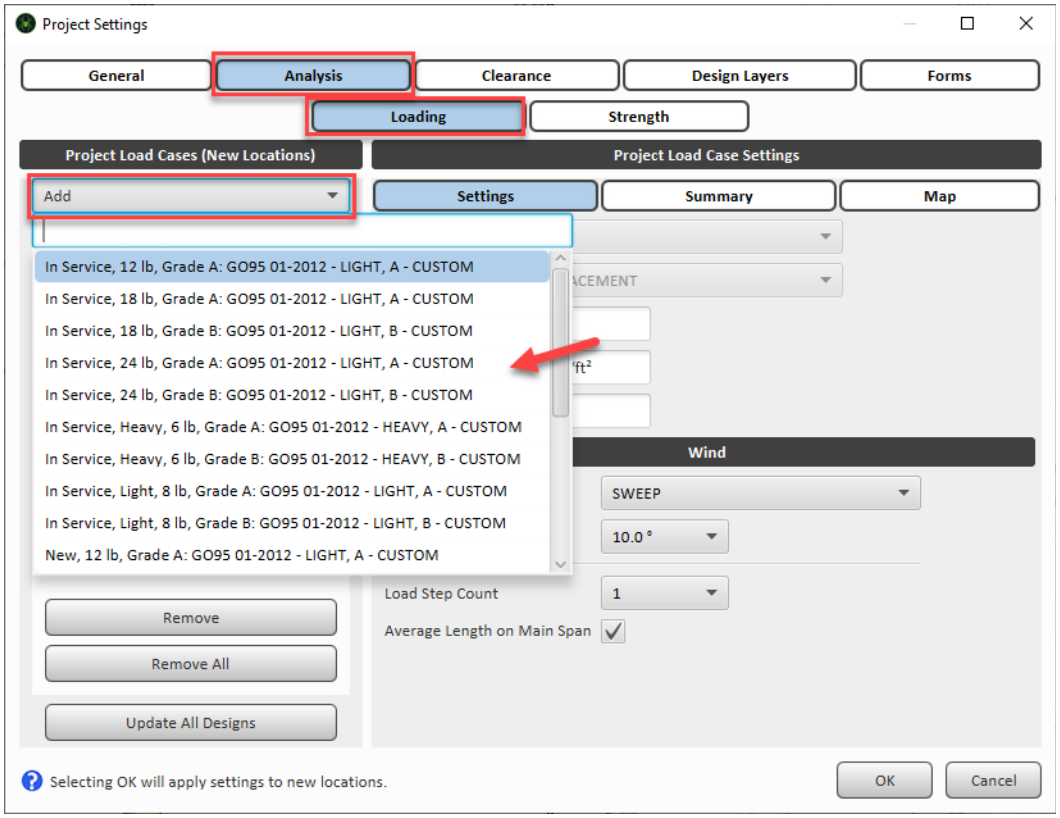


NOTE

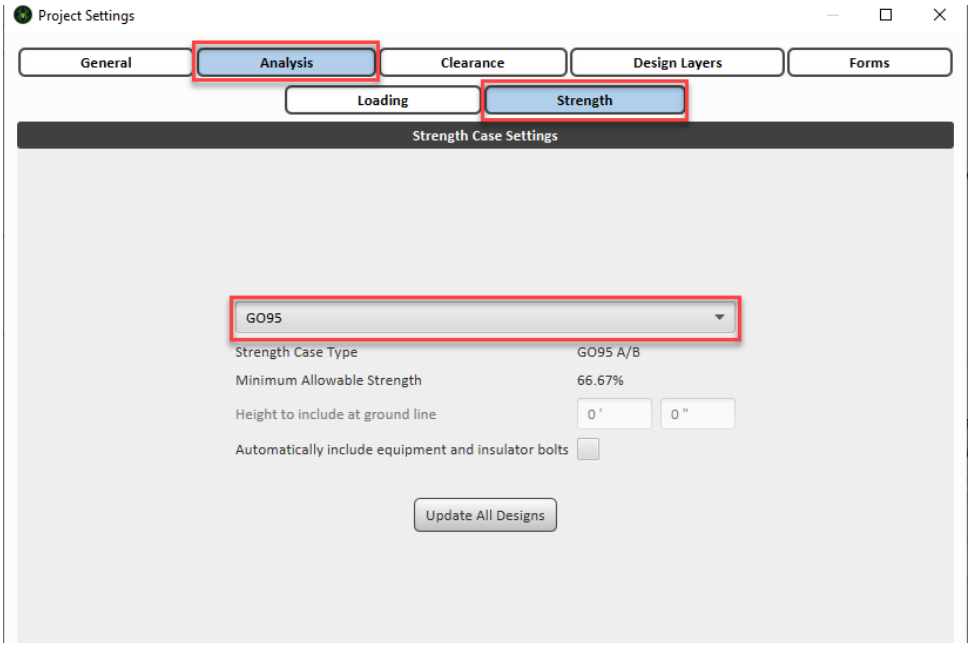
If SCE.client file is not displayed, you can update by selecting the pencil icon. This will bring the Change Client File dialog box. In the New Client File tab, select pulldown and select SCE.client, click OK to update.



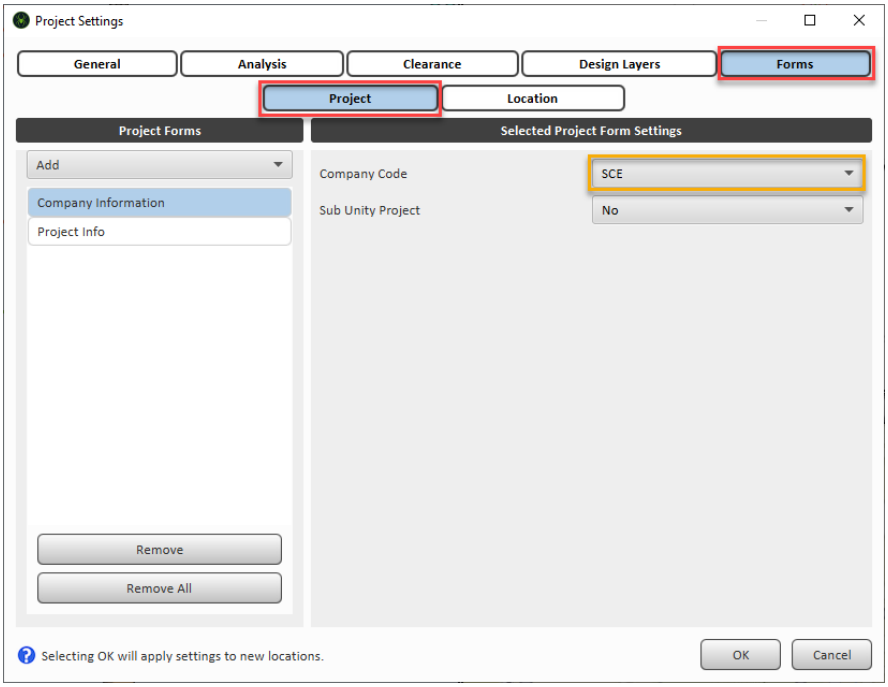
STEP 8. Under the **Analysis** tab, select **Loading** sub tab. In the **Project Load Cases** (New Locations) tab, select ADD drop down and select the proper load case for the project.



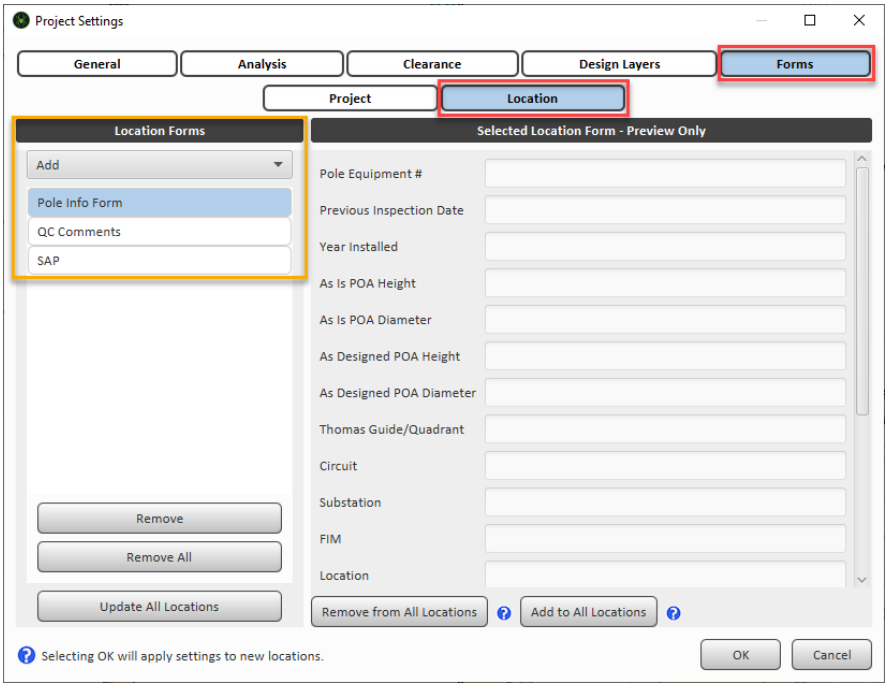
STEP 9. Under the **Analysis** tab, select **Strength** sub tab, select drop down and confirm it is set to **GO95**.



STEP 10. Under the Forms tab, select Project sub tab. In the Selected Project Form Settings sub tab, confirm the company information is displayed correctly.

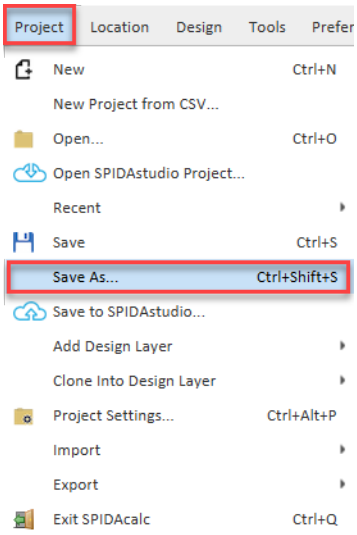


STEP 11. Under the Forms tab, select Location sub tab. In the Location Forms sub tab, confirm the Pole Info Form, QC Comments and SAP are displaying. When legacy designs are included in the project, click to Update All Locations to update the SAP form to the latest version.

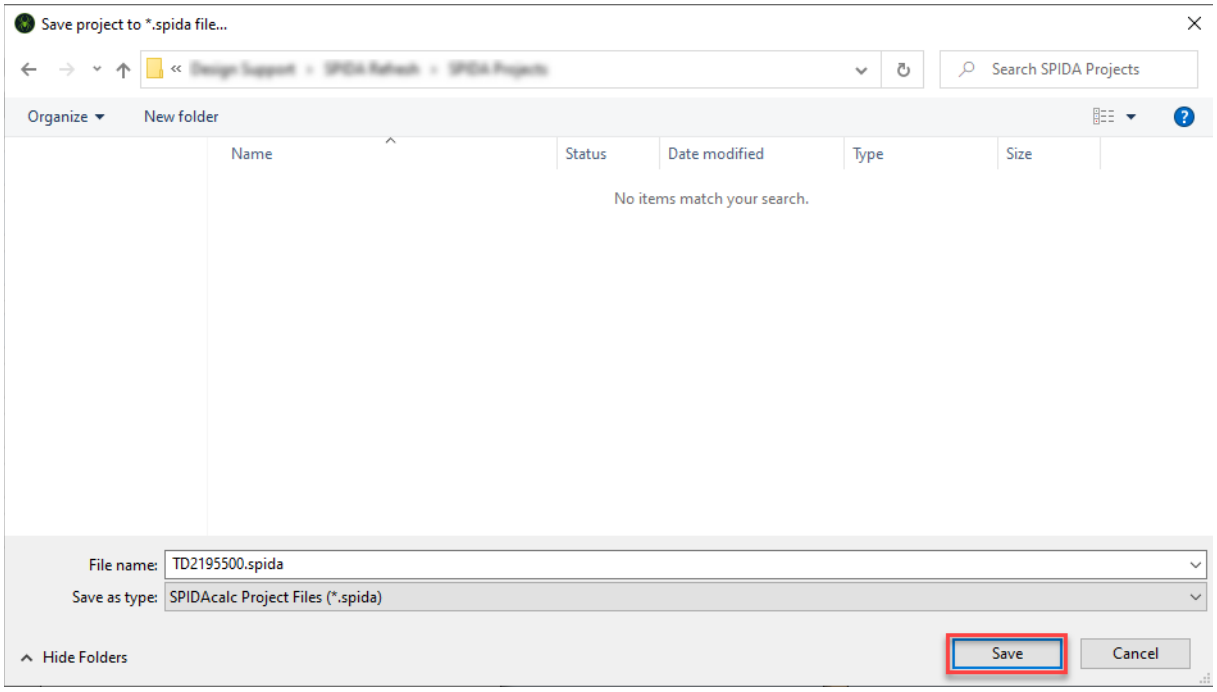


STEP 12. Select **OK** at the bottom right to close window.

STEP 13. Save Project.
In the main toolbar, select the **Project** tab, and select **Save As**…



STEP 14. The Save project to *spida file… dialog box will appear. Save project to a location on the C: drive or one drive. Once location is selected, click Save.

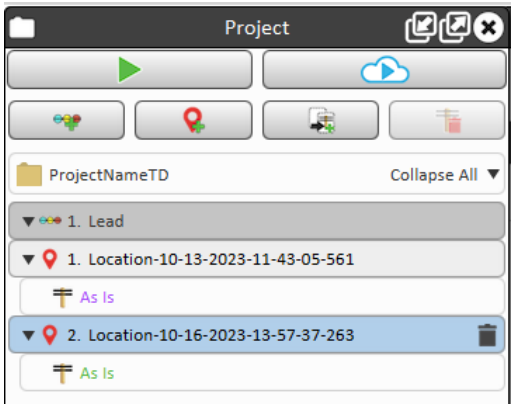


Project has been saved. Continue with design.

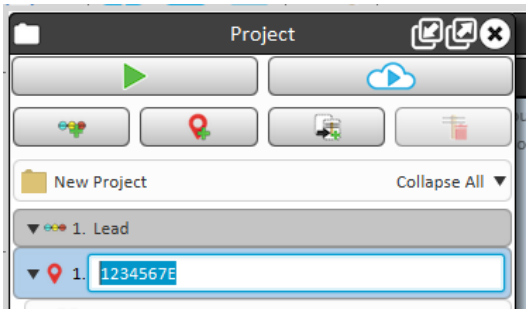
6.2 Renaming a Location

The project panel is a tool that enables you to manage and analyze your projects, locations, leads, and design layers. You can rename any of these elements by following the steps below.

STEP 1. Double-click on the location text.



STEP 2. Enter the Pole Number, example: 1234567E



STEP 3. Under the Location Properties (Located on Side Dock) select Pole Info Form. Fill out the applicable information.

NOTE

Renaming a location can **only** be done with a **NEW** location. For EXISTING locations, the correct location needs to be added and the incorrect location deleted from the project.

6.3 Selecting a Pole

If the project panel is not visible, you can click on the project panel icon on the Side Dock.

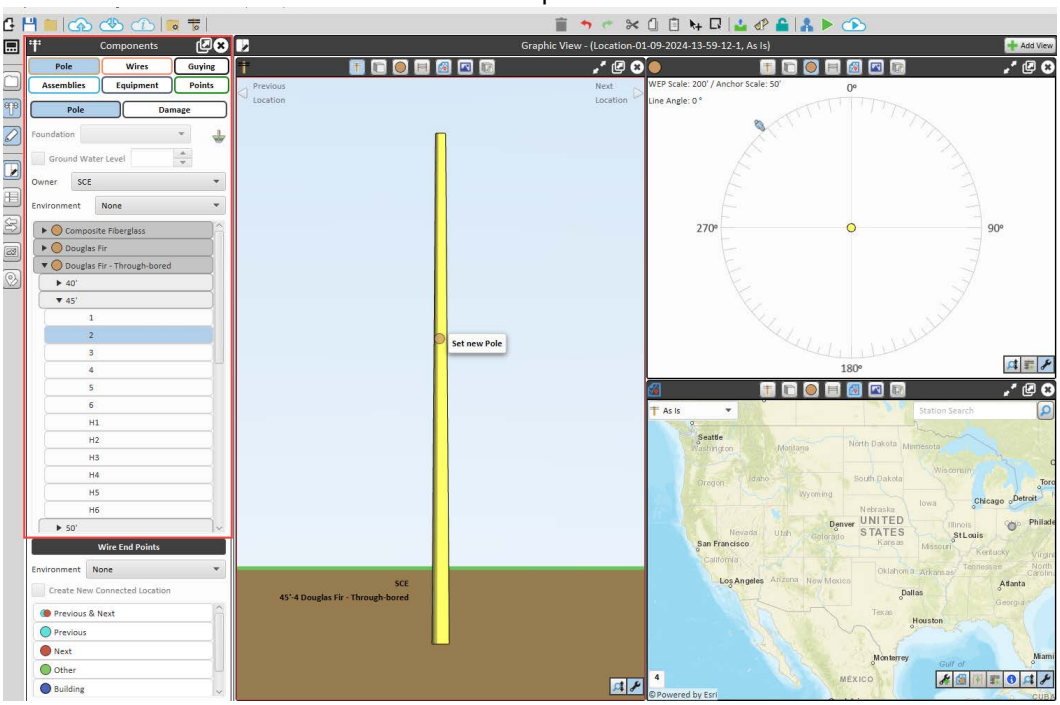
Within the SPIDAcalc Pole Load Tool, there are several options for pole selections.

For Wood Poles, the options are Douglas Fir, Douglas Fir - Through-Bored, Ponderosa Pine, Ponderosa Western Pine, Southern Pine, and Western Red Cedar. In the non-wood poles, Composite Fiberglass and Light Weight Steel poles (LWSP) are included.

STEP 1. From the Components Panel Select Pole Tab.

STEP 2. Click the desired pole species to expand the available pole choices.

STEP 3. Select the appropriate height and class and drag and drop your choice onto either Side View or 3D View panel.



For all new poles, default AGL and default GLC shall be used to perform pole loading calculation by selecting the Auto check boxes.

For in service poles, follow the categories below to perform any pole loading calculation:

Field measured AGL is required for:

- Wood Pole
- Composite Pole
- Light Weight Steel Pole (LWS)
- Steel Stub Pole
- Star Anchor Pole (Pilot)

Field measured GLC is required for:

- Wood Pole (non-FR Wrap) (See Note 4 below)
  - — If the field measured GLC is smaller than the Spida default GLC, use the field measured GLC for the SPIDACalc analysis..
  - — If the field measured GLC is larger than or equal to the Spida default GLC, use the SPIDA default GLC for the SPIDACalc analysis.
  - — If the SPIDACalc default GLC fails the SPIDACalc analysis and the larger field measured GLC passes SPIDACalc analysis, the larger field measure GLC can be used for the SPIDACalc analysis.

SPIDA default GLC is required for:

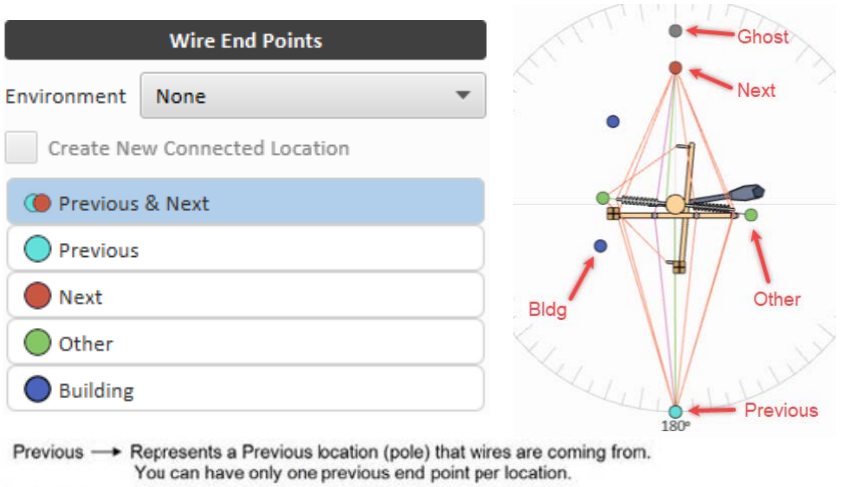
- Wood Pole (FR Wrap)
- Composite Pole
- Light Weight Steel Pole (LWS)
- Steel Stub Pole
- Star Anchor Pole (Pilot)

1. Use Spida default AGL or default GLC if there is no safe access or there are obstructions that prohibit accurate measurement with SCE approved tools (See PLM–4: Pole Loading Assessment Tools).
2. Contact Pole Engineering group for determining GLC for Topped Poles.
3. For new poles, the AGL can be adjusted if specifically designed for deeper set poles. For shallow set poles, contact Pole Engineering for review and approval. By adjusting the AGL in SPIDAcalc, it recalculates the GLC automatically to a calculated default value.
4. For non-SCE owned wood pole (non-FR Wrap), use field measured GLC.

6.4 Establishing Wire End Points

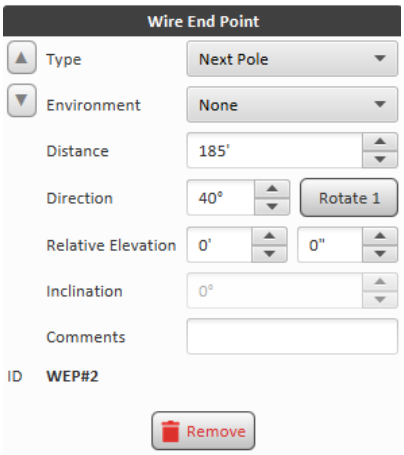
Wire End Points (WEPs) are a span type used in SPIDAcalc that was typically used as the Previous, Next, Other, and Building attachments in the project. They can be distinguished by the following:

- Previous WEPs are represented by cyan
- Next WEPs are represented by dark red
- Other WEPs are represented by green
- Buildings WEPs are represented by dark blue
- “Ghost" poles are represented by gray

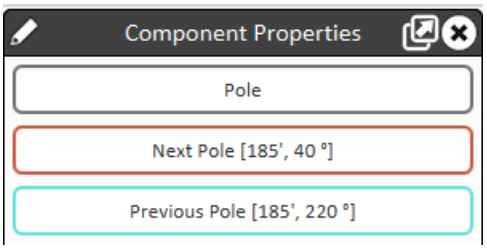


Selecting any WEP presents the following fields:

- Type
- Environment
- Distance
- Direction
- Relative Elevation: Use this field to account for any topographical variances from pole to pole.
- Inclination: This field is calculated automatically based upon the relative inclination.
- Comments



Users can also connect a selected WEP or switch over to a connected WEP's location from the Component Properties panel.



Before wire can be attached to a pole, wire end points must first be established. All wires that are attached to a pole must have a destination that they are going to; these destinations are represented by wire end points in SPIDAcalc. Wire End Points (WEPs) create the framework for attaching wires to a pole.

A. Establishing Wire End Points

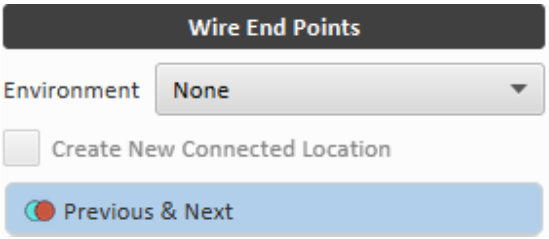
STEP 1. From the Components panel select the Wires sub tab.

STEP 2. Select the Next or previous button. This allows you to set the wire end point for those respective spans.

STEP 3. Either click or drag the WEP to the Top View. You can place in the desired location or drop the WEP in the Top view and use the Component Properties Panel to change the Distance and Direction.

STEP 4. Continue to select WEPs until all of the wire locations have been set in the Top View.

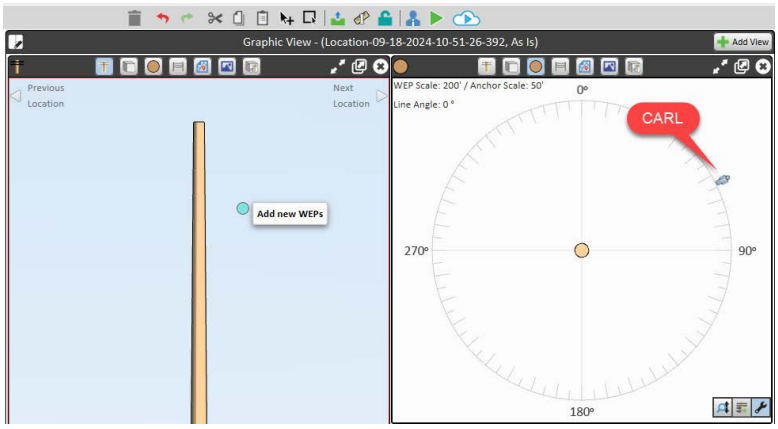
B. Placing Previous/Next WEPs at same time

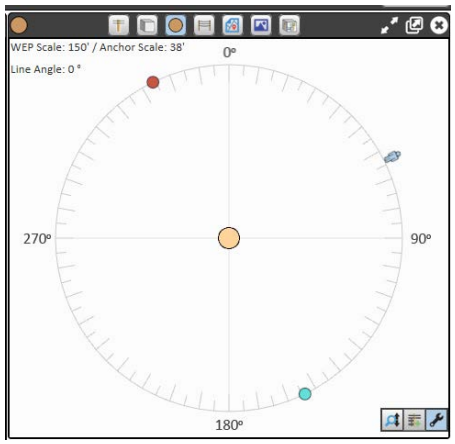


C. Dragging Previous & Next

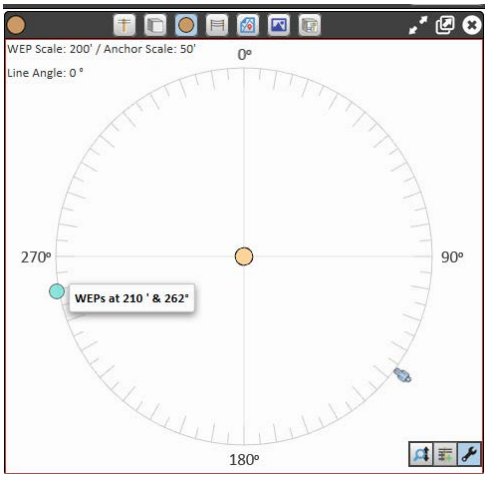
Option behaves differently depending on the View it is dragged to:

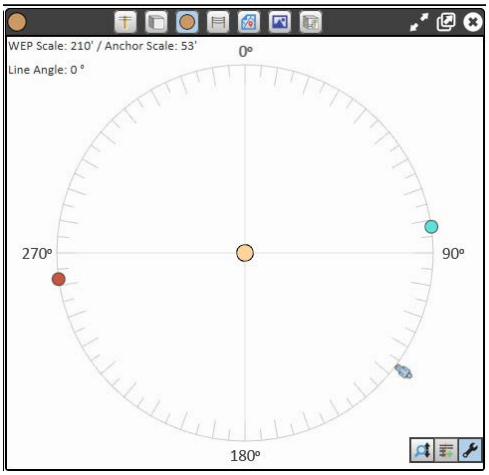
- Side View: Previous and Next will be 180° apart, bisecting where CARL (Camera Angle ReLocation) is on the Top View.



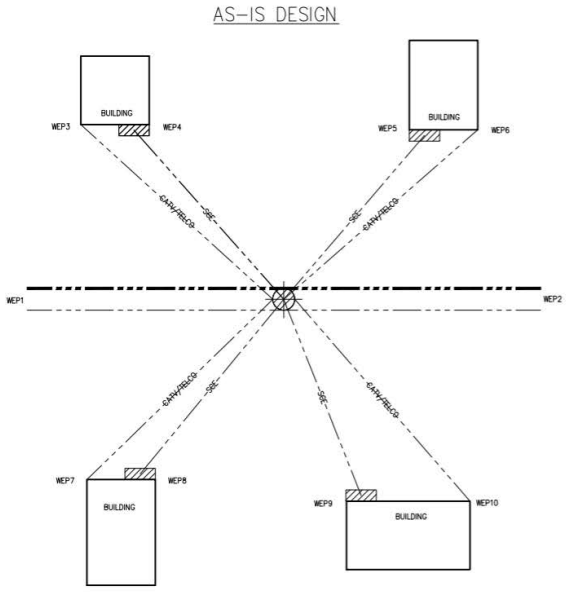


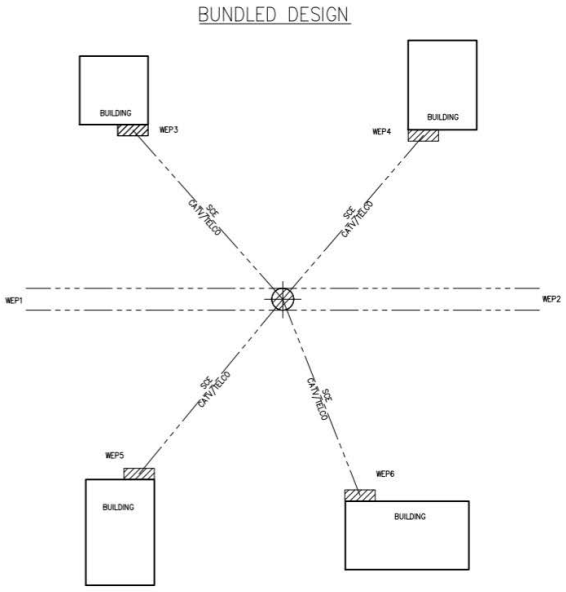
- 3D View: Next at 0°, Previous at 180°
- Top View: Next will be placed where you drop with Previous 180° apart and same distance





D. Building Examples



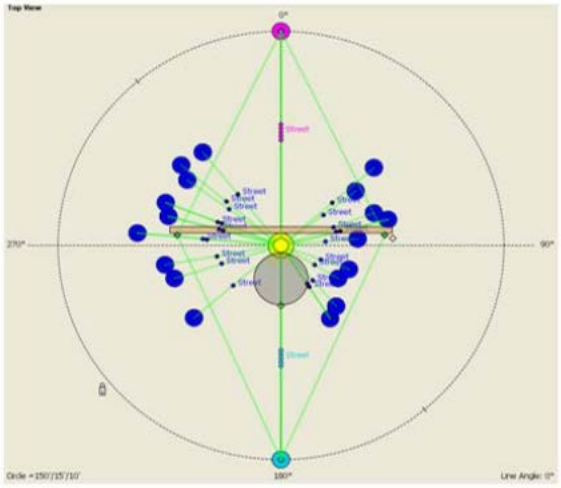


NOTE

When bundling phone, cable, and SCE it is acceptable to attach all the wires to the same endpoint. However, it DOES NOT mean to bundle the wires themselves to create a new, larger wire. Each wire must be accounted for individually when conducting pole loading.

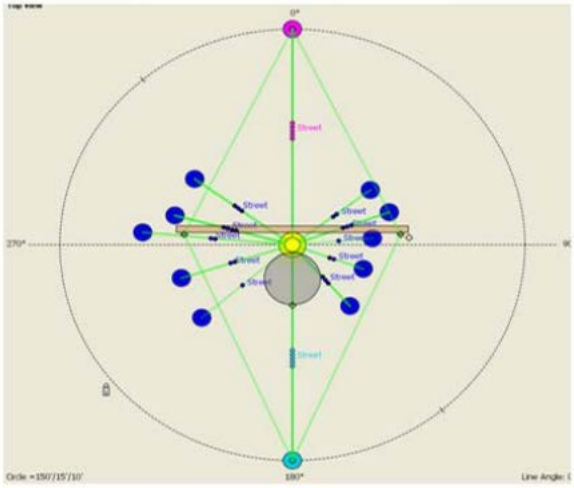
Actual Case Analyzed in SPIDA

Pole in SPIDA Before Bundling



Safety Factor: 6.69
Wire End Points: 18
Electrical Services: 10
Communication Services: 13

Pole in SPIDA After Bundling

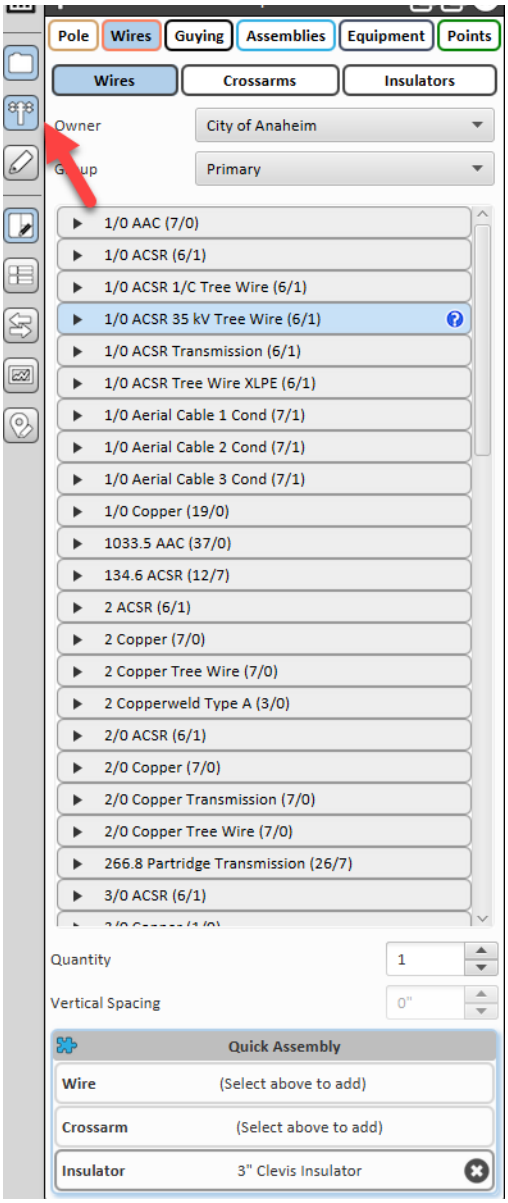


Safety Factor: 6.74
Wire End Points: 10
Electrical Services: 10
Communication Services: 13

Difference
Safety Factor Change: 0.05

6.5 Wires

Wires can be added using the Components panel. If the panel is not visible, click on the Components button on the Side Dock.



The component panel allows users to select pole properties and add attachments to a design using 6 component tabs. The 6 component tabs are broken down into categories which are further broken down into subcategories that can be used to filter the options that are shown.

Selecting the top component tab of Wires, the subcategories of Wires, Crossarms, and Insulators will become available. This is where all the items related to wires live; not just the wires but crossarms and insulators as well. Once the components are added to the design, adjustments can be made using the Component Properties Panel.

A. Wires Sub-Tab

Wire owner, group type, wire size, tension group, quantity, and vertical spacing are selected and will appear in the Quick Assembly list.

When a communication owner is selected, Client and Quick Bundles become available.

All communication wires should be input using the Self-Supporting or Communication Service Group.

NOTE Quick Bundles are not an approved method of adding wires

B. Crossarms Sub-Tab

Crossarm owner and size are selected and will appear in the Quick Assembly list.

C. Insulators Sub-Tab

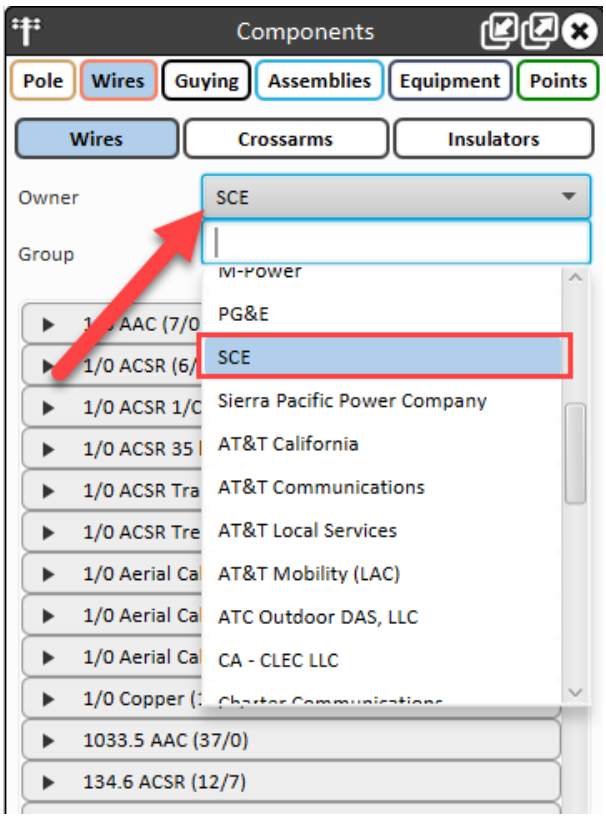
Insulator owner, type, and size are selected and will appear in the Quick Assembly list.

D. Wires Sub-Tab

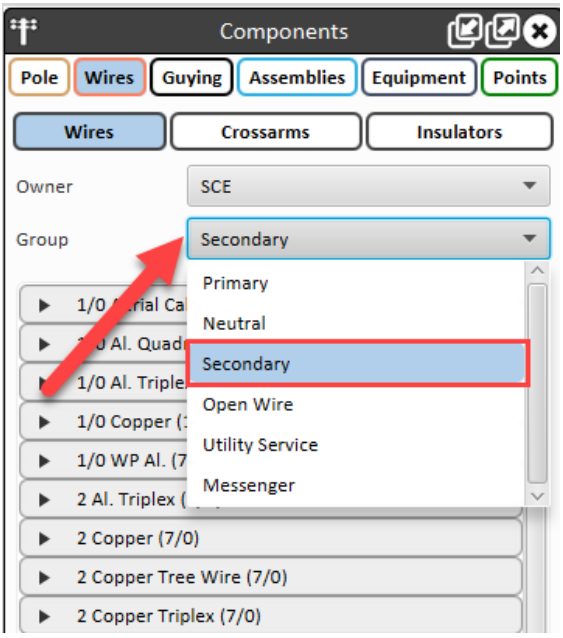
STEP 1. Select the Wires tab in the Components panel.

STEP 2. Select the sub tab of Wires.

STEP 3. Within the wire section, change the Owner to the appropriate selection.



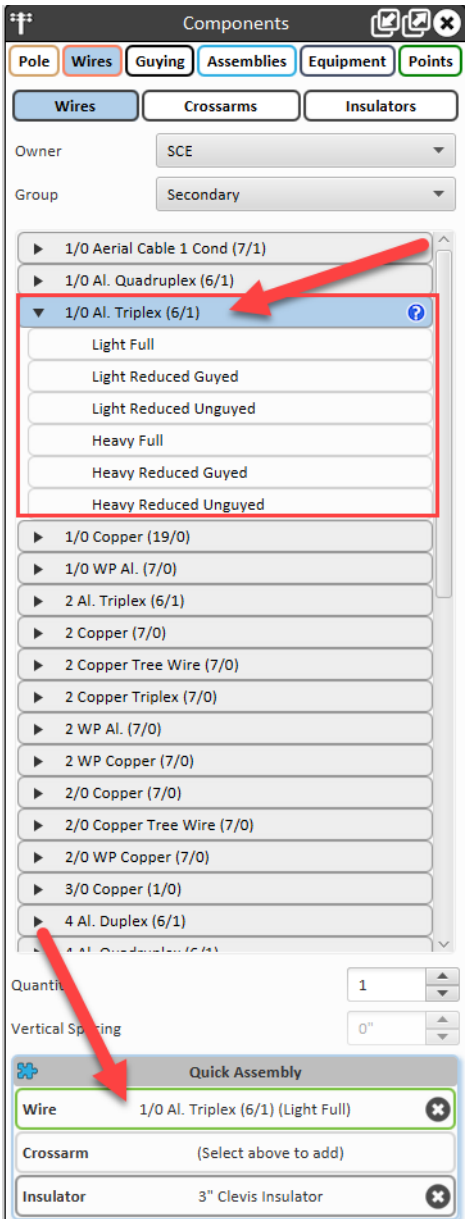
STEP 4. In the Group drop-down, select the appropriate group. This is how the wires are further organized. Selecting the Secondary group will change the list of wires available below.



STEP 5. Select a wire from the list, two things will happen:

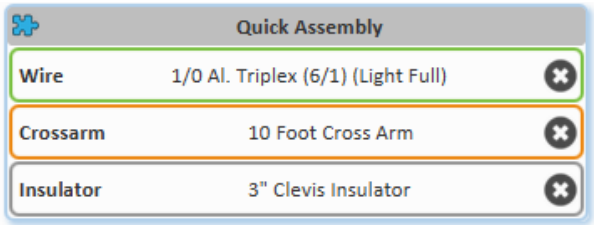
First, the dropdown list will appear with the dropdown tensions of that specific wire.

Second, the wire selected will also populate at the bottom of the Components panel under the Quick Assembly section.

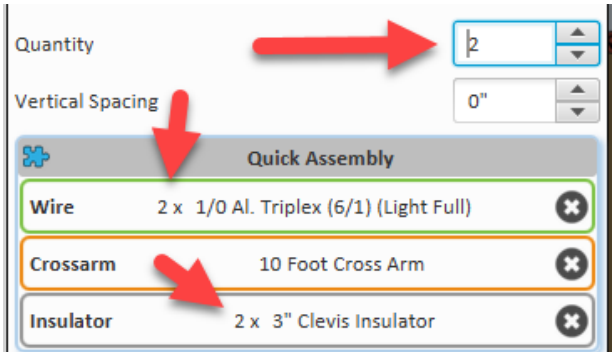


1. QUICK ASSEMBLY Section

This section is where items you selected will be staged to be added to your pole for on-the-fly pole design.



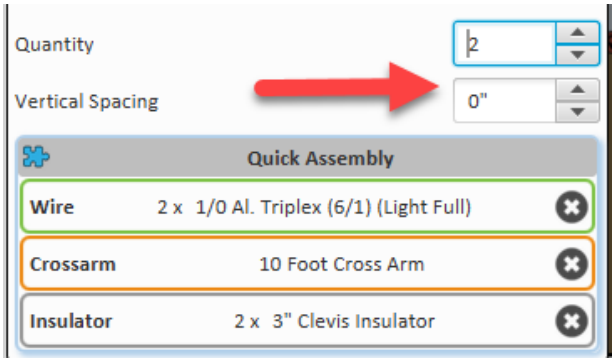
STEP 1. Select the appropriate quantity of wires for your design.



NOTE

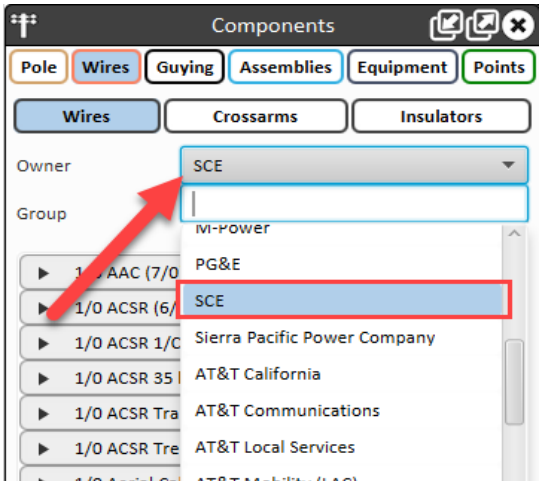
The Quick Assembly section will change the number of wires and insulators based on the quantity chosen.

STEP 2. The Vertical Spacing can be used when designing vertical assemblies. This will allow users to use pre-determined spacing between multiple spans of the same wire on the pole.



6.6 Equipment

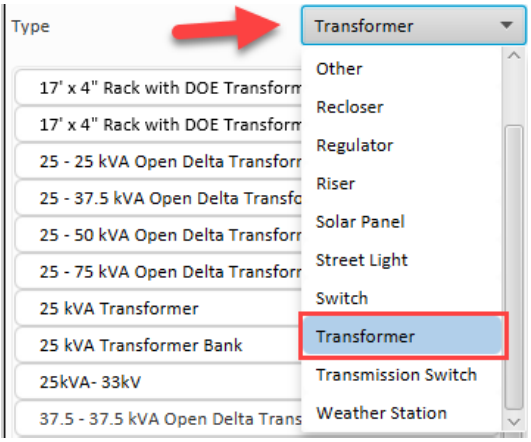
The Equipment tab in the Components Panel will provide a list of different types of equipment based on the Owner and Type selected from the drop-down.



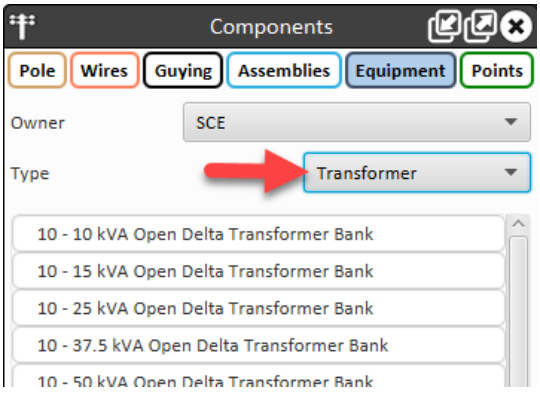
STEP 1. Select the Equipment tab in the Components Panel.

STEP 2. Select an Owner from the drop-down menu. The Owner, SCE will be selected in this example.

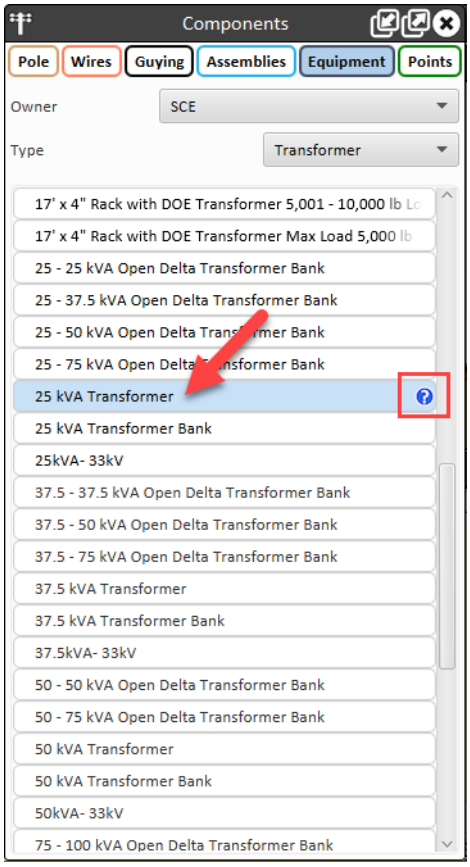
STEP 3. Select the Type of Equipment from the drop-down menu



In this example, the Transformer type of Equipment will be selected.

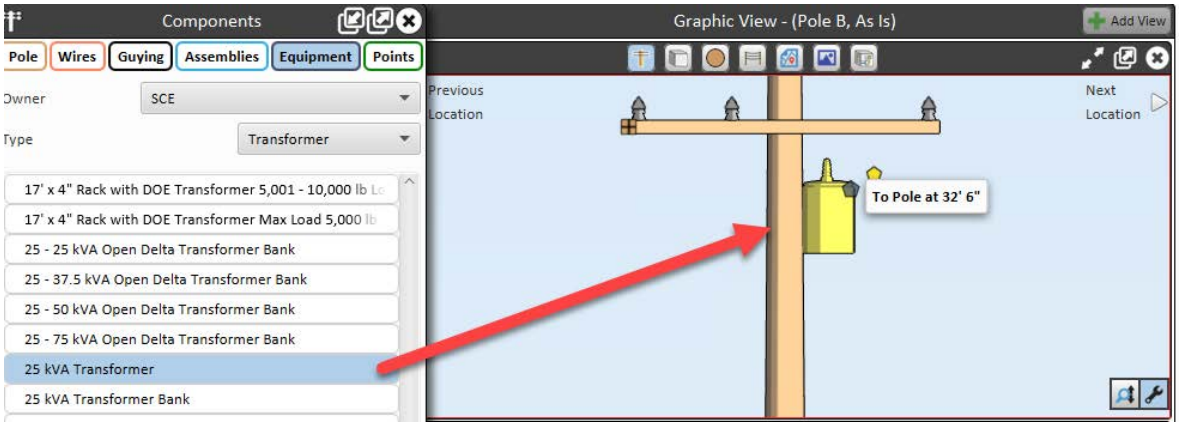


STEP 4. Highlighting any equipment in the list below will display a to the right of the item.



This blue question mark to the right of the description will always show you additional properties or information about the selected item. This question mark icon is not limited to this section and can be seen on other items in the list of each category under the Components panel.

STEP 5. Click and drag the line item into the pole design.

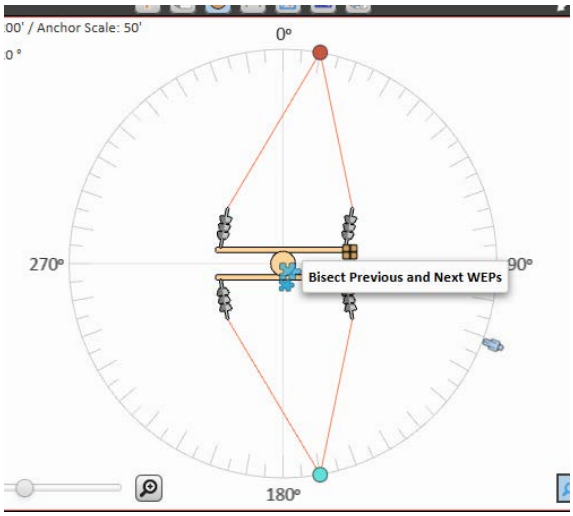


6.7 Anchor, Guying and Sidewalk Braces/Struts

You can add anchors, guying, and sidewalk braces through the Guying tab on the Component panel in the Design Workspace, using Quick Assemblies of these support elements.

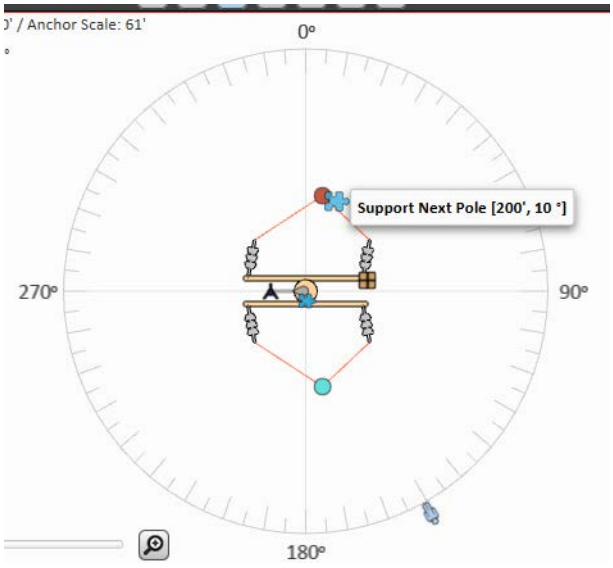
A. Anchor Behavior #1

If both the Previous and Next wire end points are defined but not selected, drag-and-dropping a new anchor object directly to the pole positions it as a bisecting support element at a distance of 15 feet from the current pole. Moving either of the wire end point objects readjusts the anchor, preserving its bisecting offset position.



B. Anchor Behavior #2

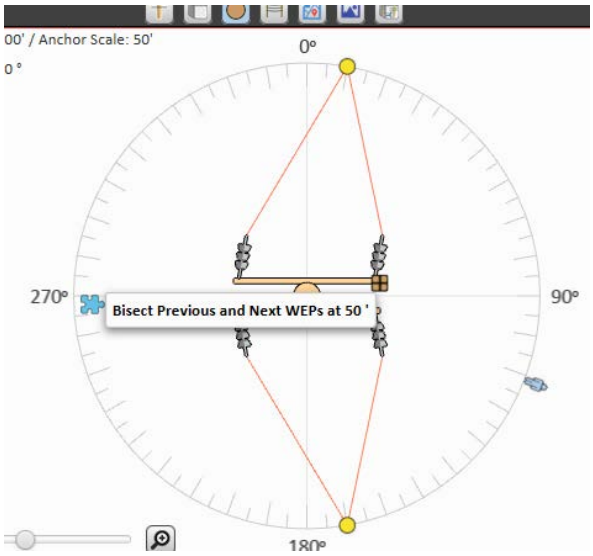
From the Top View, drag-and-dropping a new anchor object directly onto a defined wire end point positions the anchor as a single support offset to the selected wire end point at a distance of 10 feet from the pole. Moving the original selected wire end point readjusts the anchor to the appropriate offset position



C. Anchor Behavior #3

If two WEPs are selected, drag-and-dropping the anchor/guy Quick Assembly to the Top View will bisect the two WEPs at the chosen lead length.

NOTE Lead lengths are available in 5' increments, then can be adjusted to exact feet & inches once placed

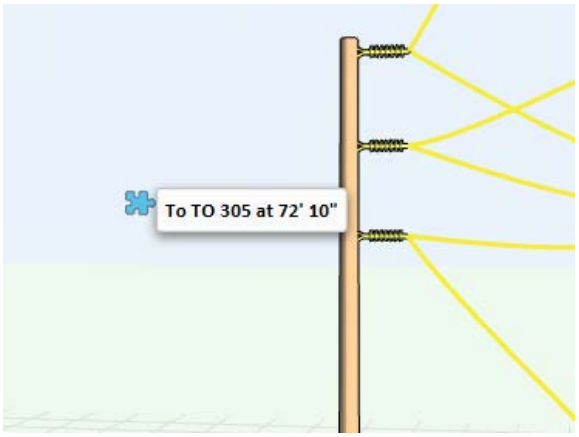


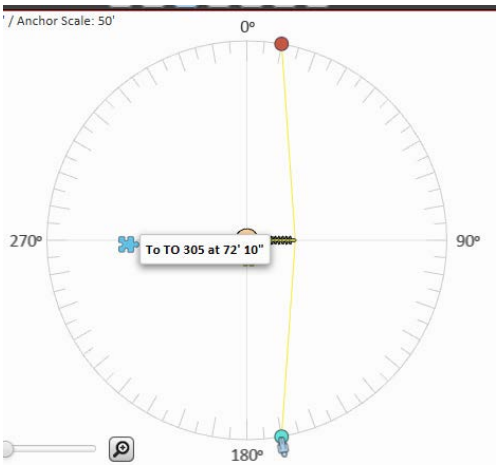
D. Anchor Behavior #4

Guying attachment points are pre-set for many Transmission assemblies. To add an anchor and guy, select the polehead assembly puzzle piece then drag-and-drop the anchor/guy Quick Assembly onto the 3D or Top View panel. The guy will attach to the top-most guying point of the assembly and the anchor will set at the relevant angle to the guy attachment point. Adjust the lead length and/or height of the anchor as needed.

- If additional guys and/or anchors are needed; select the polehead assembly puzzle piece again and drag- and-drop another guy and anchor Quick Assembly to the 3D View panel. The guy will attach to the highest available guy attachment point of the polehead assembly with the anchor at the default 15' Lead Length. Adjust the Lead Length as needed.

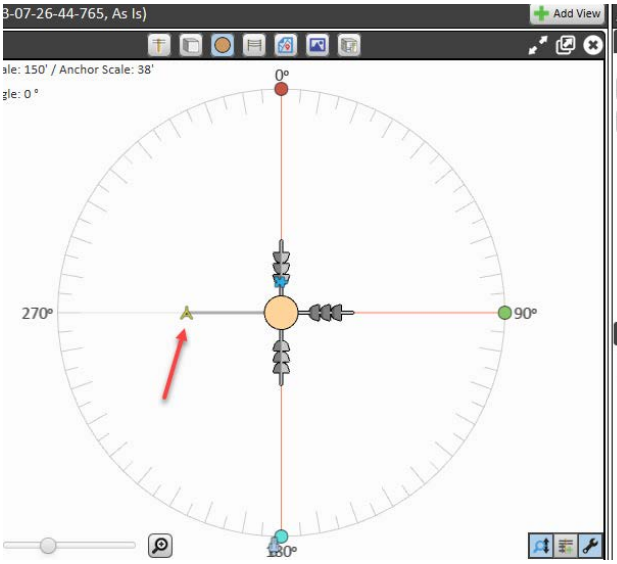
- If just a down guy without additional anchor is needed, select both the polehead assembly puzzle piece and the anchor in the 3D View panel, then drag-and-drop the desired guy into the panel. The guy will attach at the highest available guy attachment point and the selected anchor.

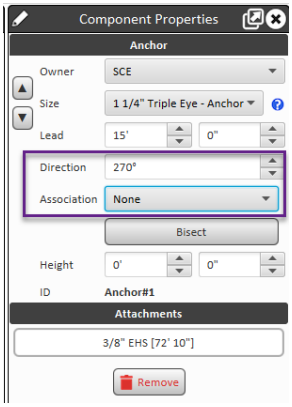




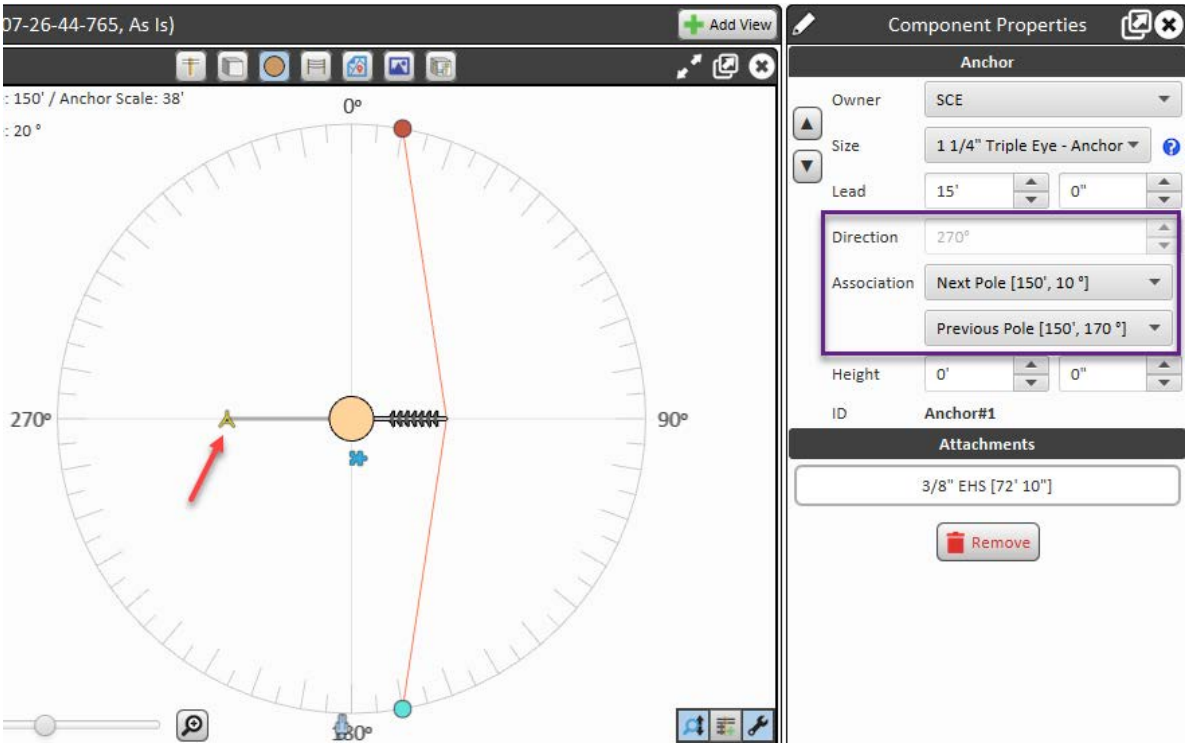
If an anchor's position offsets a single wire end point (Example 1) or bisects two end points (Example 2), the Direction in the Components Properties panel becomes grayed out. The only way to override the relationship is to deselect an Association to one or both of the Wire End Points (WEPs).

Example 1





Example 2

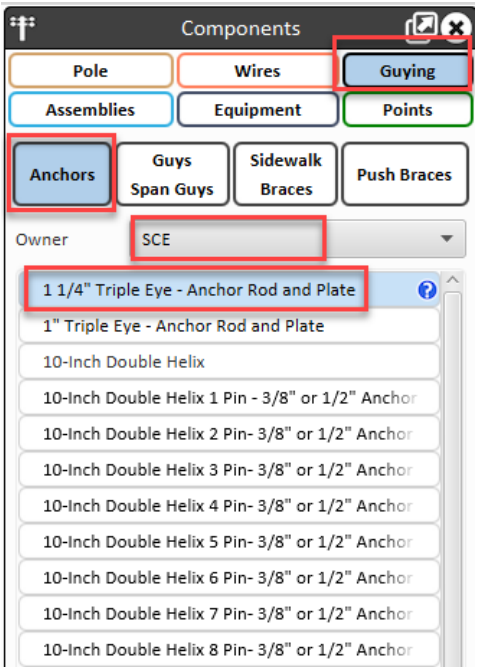


E. To place an anchor, guy, and sidewalk brace:

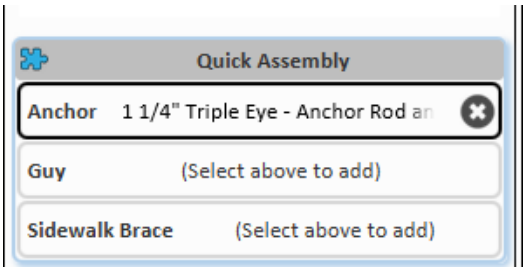
STEP 1. On the Components panel, select the Guying tab.

STEP 2. Select the Anchors sub-tab.

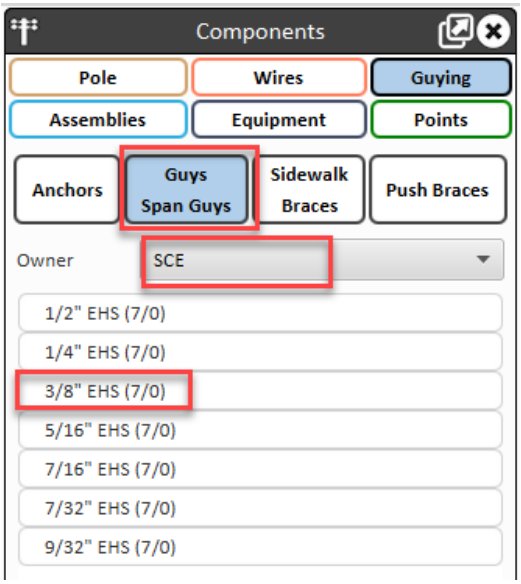
STEP 3. Select the desired Owner from the dropdown menu.



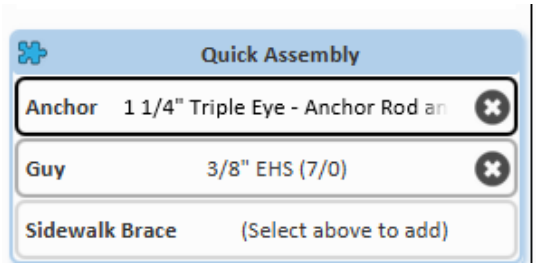
STEP 4. Select the required anchor. The anchor will display in the Quick Assembly at the bottom of the Component panel.



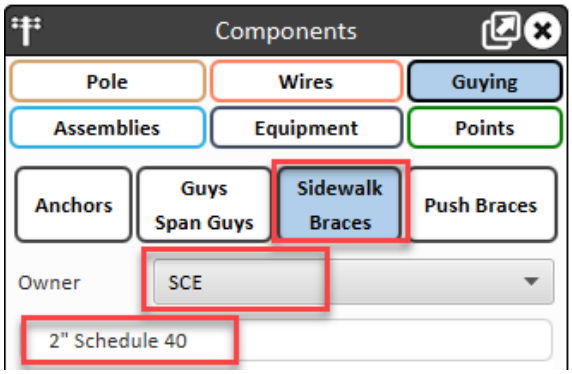
STEP 5. Select the Guys/Span Guys sub-tab.



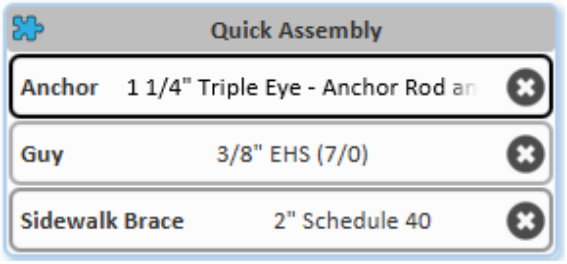
STEP 6. Select the required down guy size. The down guy will display in the Quick Assembly at the bottom of the Component panel.



STEP 7. Select the **Sidewalk Braces** sub-tab (if applicable).



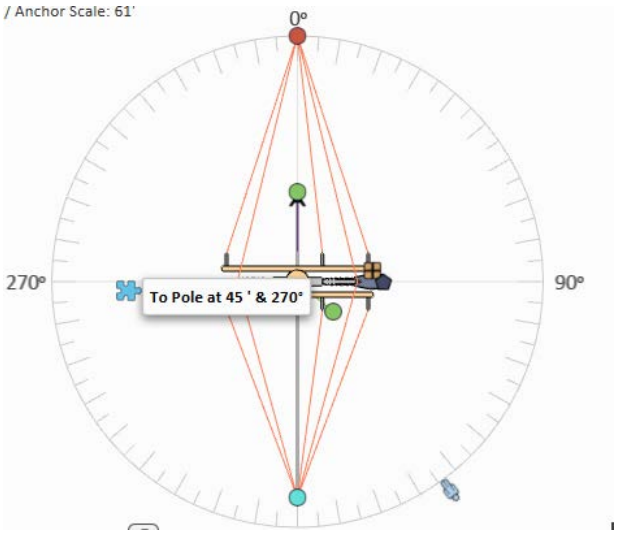
STEP 8. Select the required size. Brace will display in the Quick Assembly at the bottom of the Component panel.



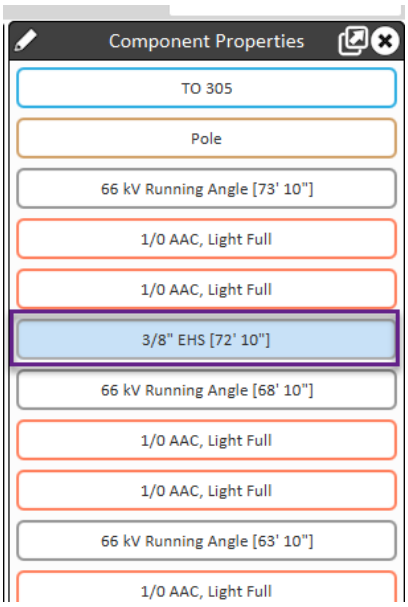
STEP 9. Drag-and-drop the Quick Assembly to the Top View at the closest lead length and angle.

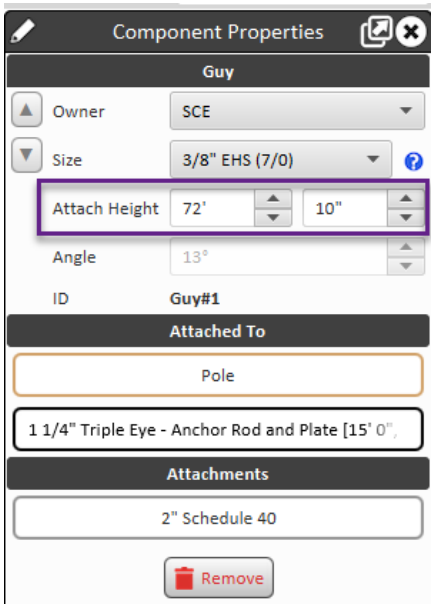
NOTE

Lead lengths are available in 5' increments, then can be adjusted to exact feet & inches once placed.



STEP 10. Click on the down guy in the Component Properties or a graphic view panel to adjust the *Attach Height* on the pole.

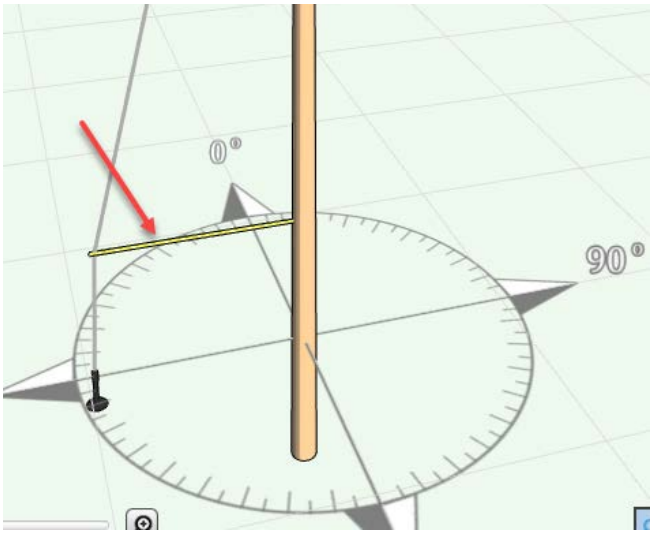


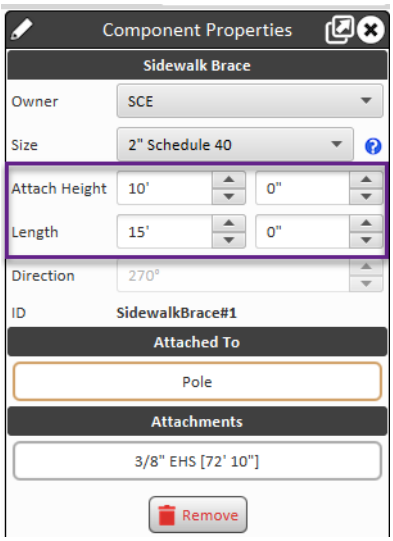


STEP 11. Click on the Sidewalk Brace in the Components Properties or a graphic view panel to adjust the Attach Heighton the pole and Length of the brace.

NOTE

The *Length* for the brace will default to the initial *Lead* of the associated anchor, up to 21'.

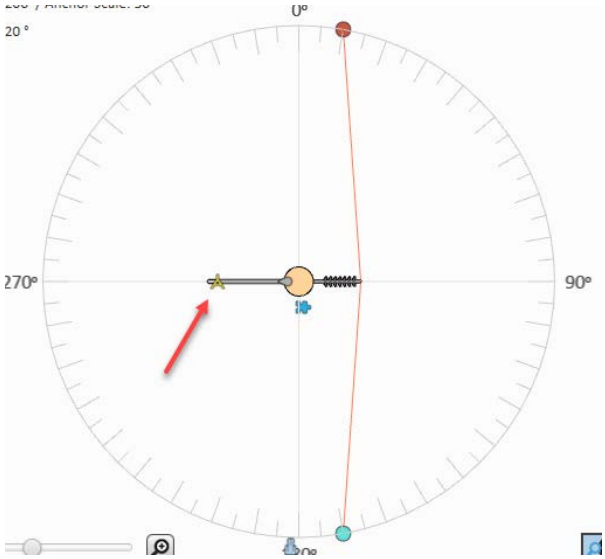


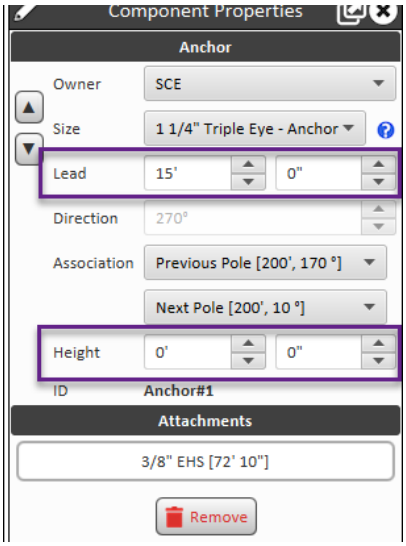


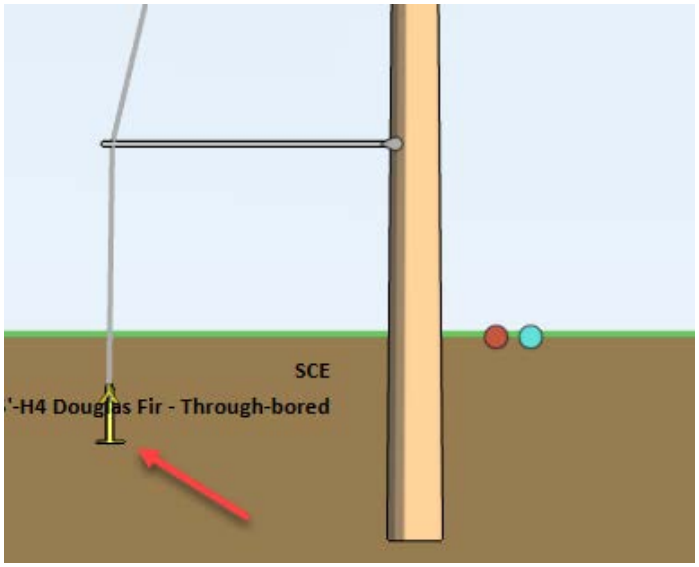
STEP 12. Click on the Anchor in the Component Properties or a graphic view panel to adjust the Lead and/or the Height if it is offset from the elevation at which the GLC was measured.

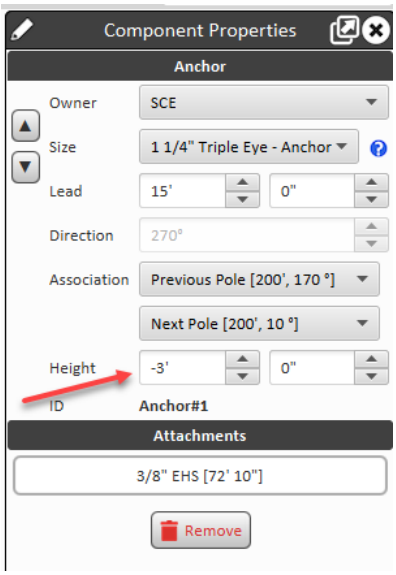
NOTE

The anchor height should only be adjusted if the elevation of the anchor is different than the ground line of the pole (i.e., on a slope).









F. To attach additional down guys to an anchor and/or sidewalk brace:

STEP 1. Select the desired anchor and sidewalk brace in the Side View panel.

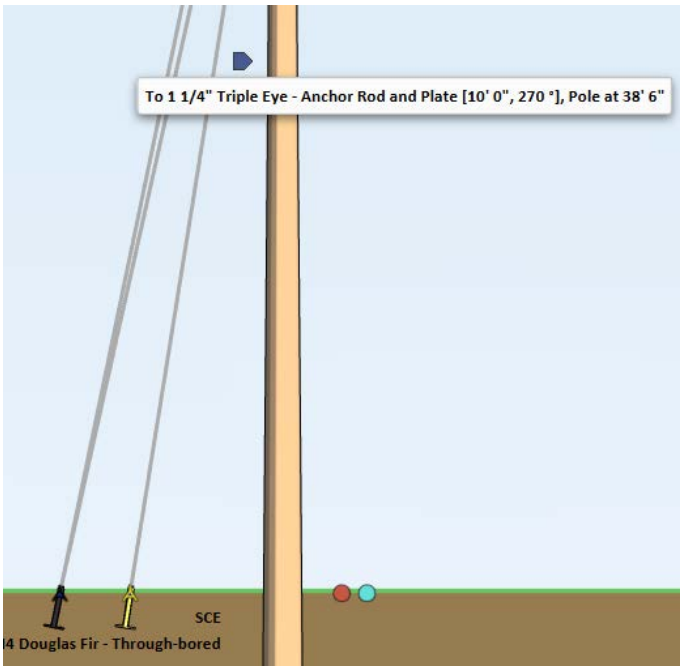
STEP 2. Select the Guys/Span Guys sub-tab.

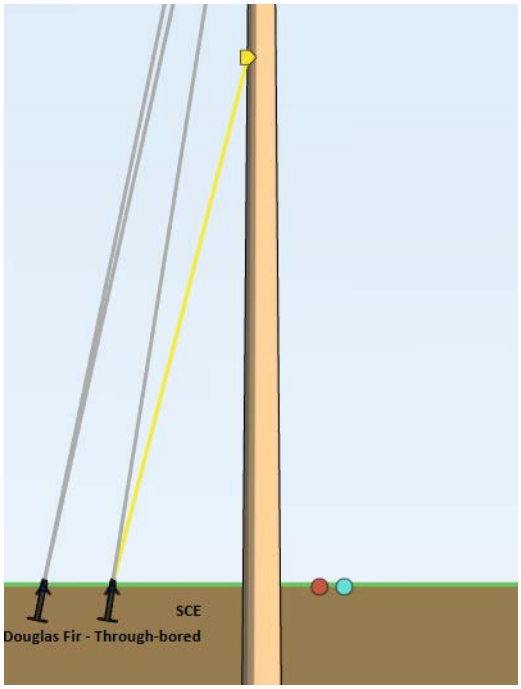
STEP 3. Drag-and-drop the required down guy to the appropriate height on the pole in the Side View panel. (Example 3)

NOTE

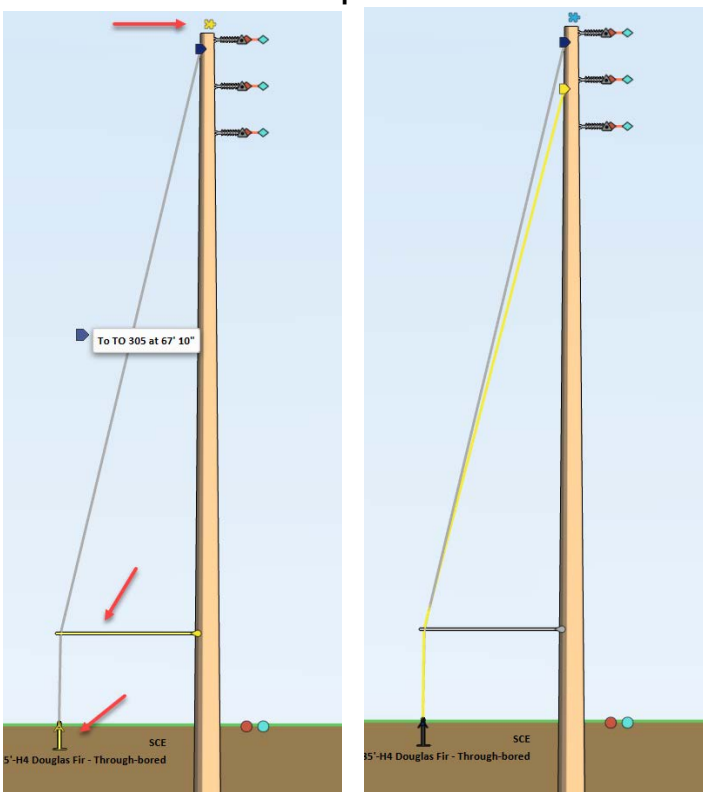
If also attaching to an additional guying attachment point of a polehead assembly, have the puzzle piece for the assembly selected along with the anchor and brace before setting the guy. (Example 4)

Example 3





Example 4

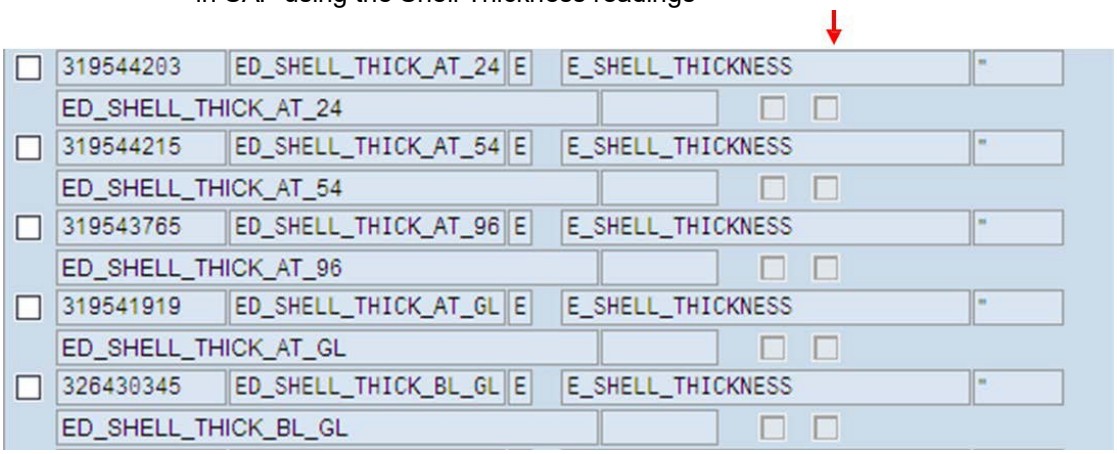


Additional information can be found in the Spida Job Aid #19 on the Spida SharePoint site to cover Sidewalk Braces in more detail.

6.8 Damages

Damages are placed with the Damages Element Tab. There are eight defined types to select from and set parameters for.

- Heart Damage (Shell Thickness caused by termites eating middle of pole).Can be found in SAP using the Shell Thickness readings

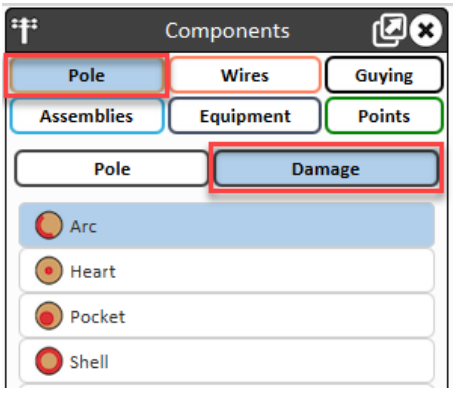


- Shell Damage (Currently Shell Damage cannot be found in SAP)
- Pocket Damage (Will be incorporated into the percentage of damage of thepole. Example pole rated at 70%)
- Wedge Damage (Discovered by Planner and entered by Planner into tool)
- Arc Damage Section (Discovered by Planner and entered by Planner into tool)
- Slice Damage (Discovered by Planner and entered by Planner into tool)
- Woodpecker (Usually these are found and filled, or pole is scheduled to bereplaced)
- Through Bolt Hole (Discovered by Planner and entered by Planner into tool)

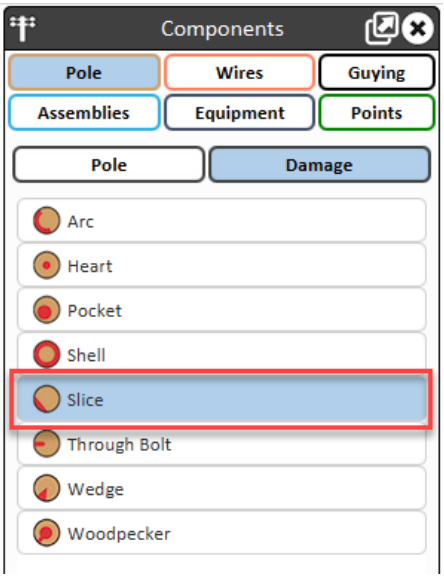
Poles that have been inspected after 1-1-09 will have the results of damage shownusing percentages in SAP. However, SAP will use 2 digits for the percentages forpoles inspected from 1-1-09 to 6-1-09, e.g., 10.00 = 100%; 9.00 = 90% and so on.Percentages after 6-1-10 should reflect full numbers such as 100%. Even though SAP uses percentages, the damage is input to the pole load tool in inches.

To enter Damages:

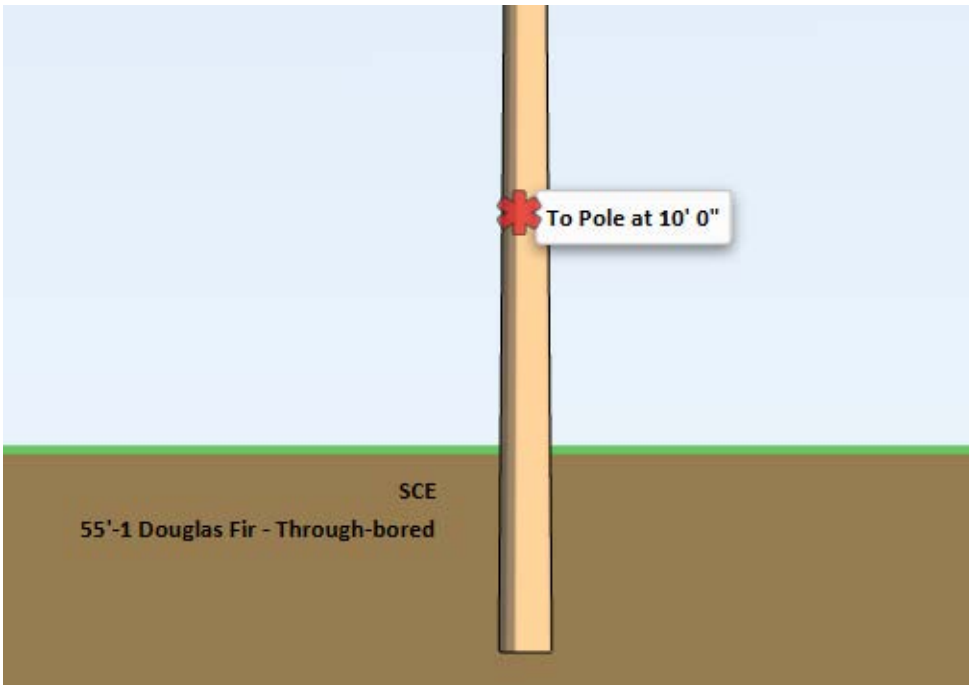
STEP 1. Under the Components view tab, select the **Pole** tab, and select the **Damage** sub tab.



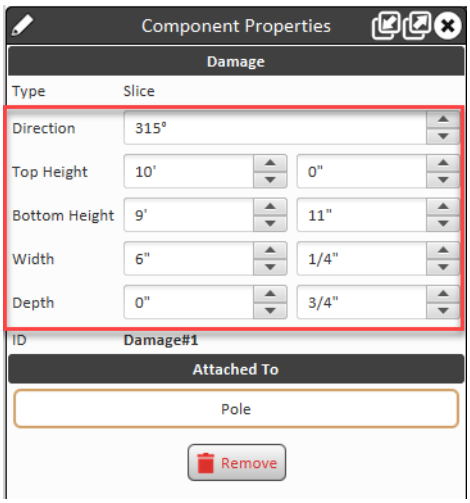
STEP 2. Select type of damage. In this example, the Slice damage is selected.

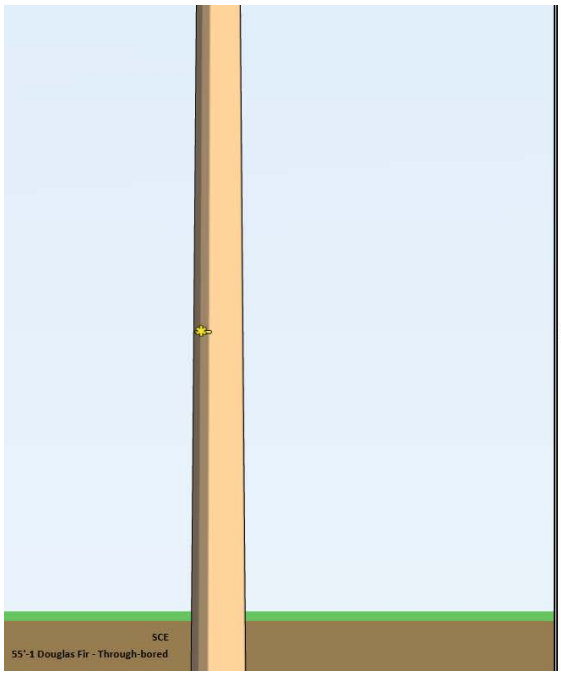


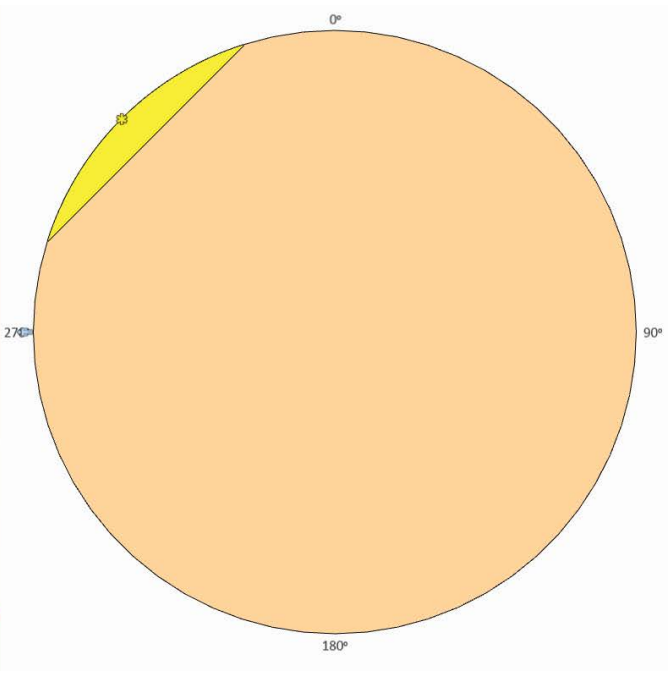
STEP 3. While selecting the type of damage, hold left button mouse and drag and drop to the pole at the height of the damage in the Side View panel, in the Graphic View.



STEP 4. Adjust the various dimensions of the damage by selecting the type of damage (highlighted in yellow). In the **Component Properties** tab, under the **Damage** sub tab, update fields to recorded findings.





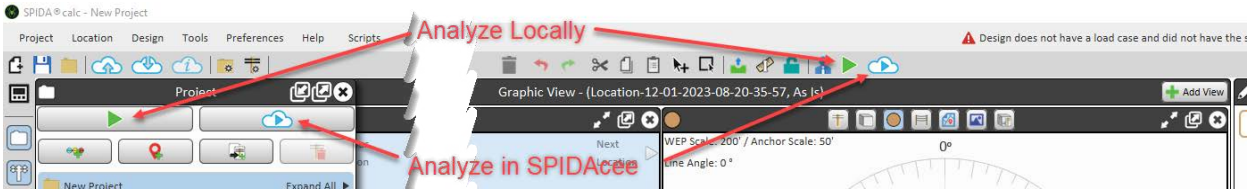


6.9 Reviewing and Analyzing Designs

Once pole data and attachment elements are entered into SPIDAcalc using either Table or Graphic View, a load analysis can be generated. During a load analysis, SPIDAcalc performs a comparison between the applied forces (loads) and the structure capacity (strength), which includes the pole itself and any supporting guy wires and anchors. For the analysis, the G.O. 95 load cases are used to establish the applied climate, ice, and wind forces as well as the applicable strength and load factors.

Analysis results are displayed in a tree format and 3-D graphical representation. The 3-D graph renders a model of the pole design that provides a visual indication of wind direction, displacement, pole stress, shear, and moment.

You can initiate a design analysis in a couple of ways. You can use the Analyze Locally or Analyze in SPIDAcee button on either the Project panel or at the middle of the main toolbar. The Analyze in SPIDAcee is a cloud-based analysis which allows you to continue working in SPIDAcalc.



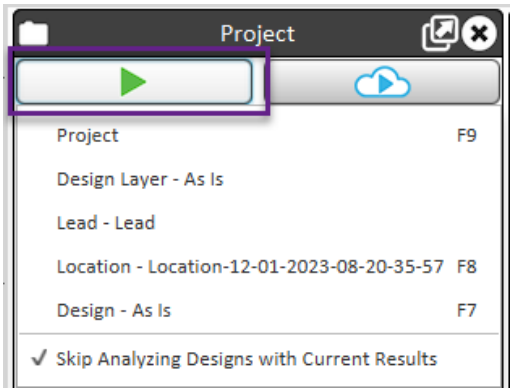
Preliminary designs or those requiring updates because of intervening changes are indicated on the Project panel with a purple font color and in the map view as a purple pole.

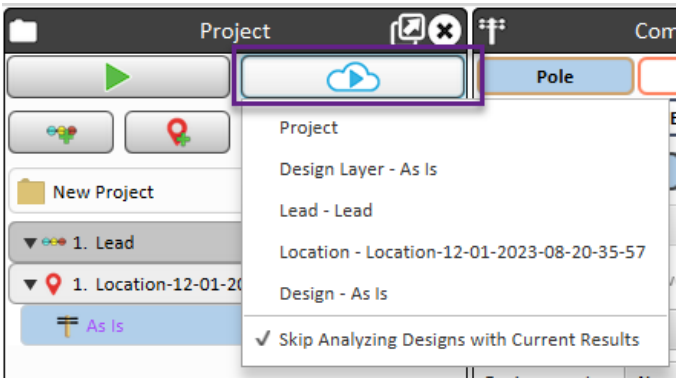
Clicking either of the analyze buttons from the Project panel gives a drop down of options to select parts of the project to analyze.

- Project: will analyze all locations and designs within the entire project
- Design Layer - (layer): option is based on design layer selected in Project panel, will analyze all locations in the design layer
- Lead - (lead): option is based on lead selected in Project panel, will analyze all locations and designs within the selected lead
- Location - (location): will analyze all design layers within the selected location
- Design - (location layer): Will analyze only the selected design layer

NOTE

There is also a setting to Skip Analyzing Design with Current Results. If enabled, SPIDAcalc will not perform an analysis of a design that has current results.

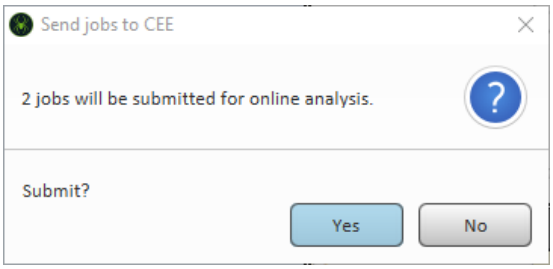




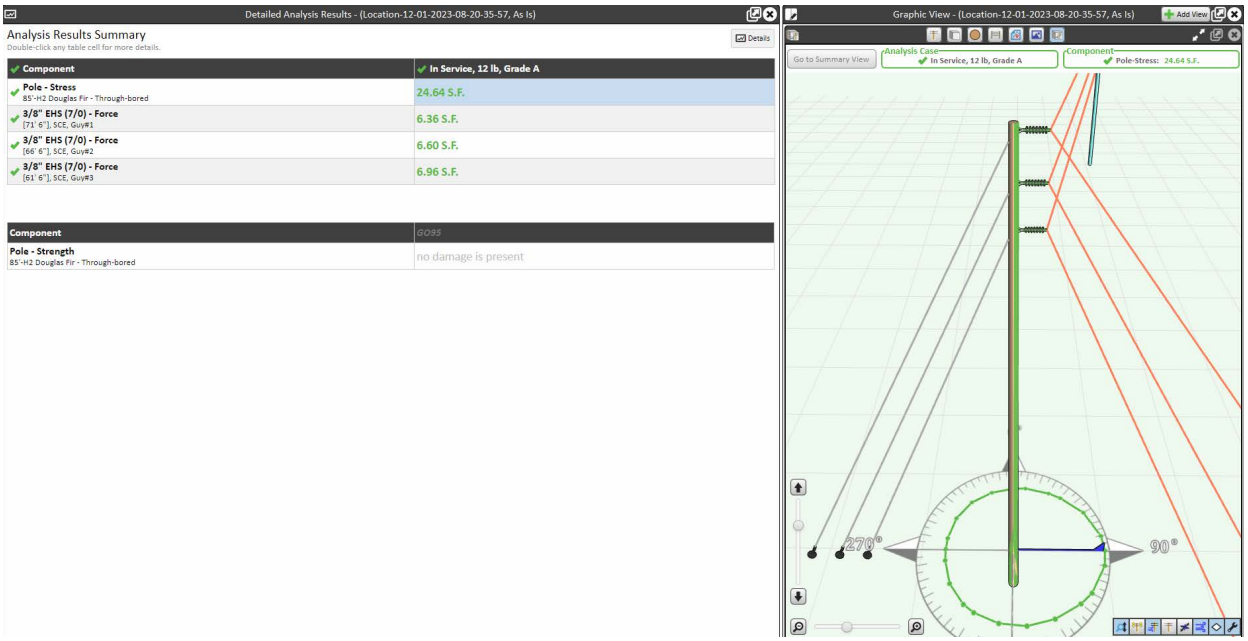
Clicking either of the analyze buttons from the tool bar will analyze the part of the project that was selected in the Project panel, Project, Lead, Location, or specific Design Layer for a Location.

When you select to Analyze in SPIDAcee, the **"Send jobs to CEE"** dialog box will display. The total number of jobs submitted will depend on the total number of Load cases plus the total number of designs present.

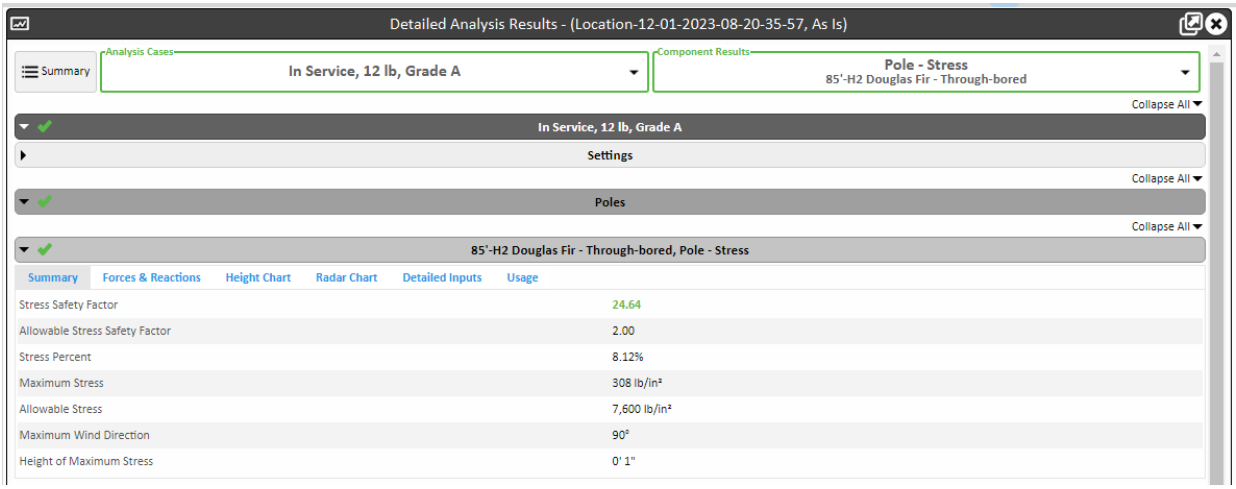
Select **Yes** to send for analysis.



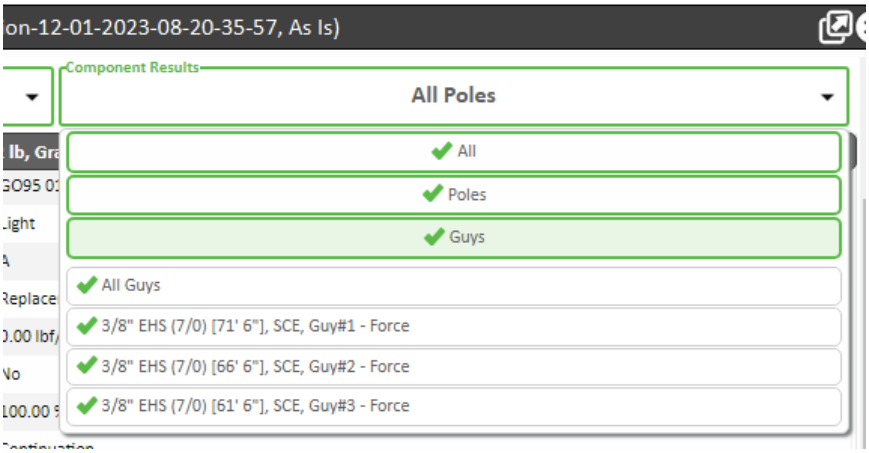
Once the analysis is complete, the workspace will switch to the Analysis view and display the Detailed Analysis Results and Graphic View.



You can double click on each safety factor to see the further details on the analysis or click the Details button on the upper right of the Detailed Analysis Results panel.



From the Component Results drop down, you can select the individual parts of the project to look at the details for the components in the design.

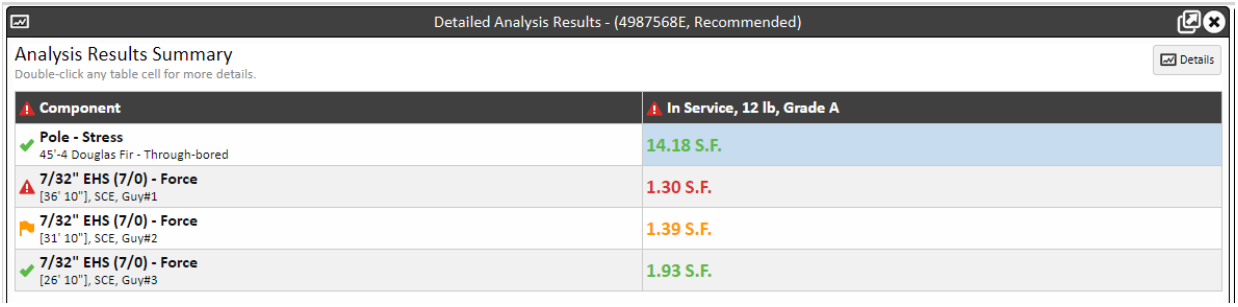


Depending on the analysis result, the Safety Factor will display in color:

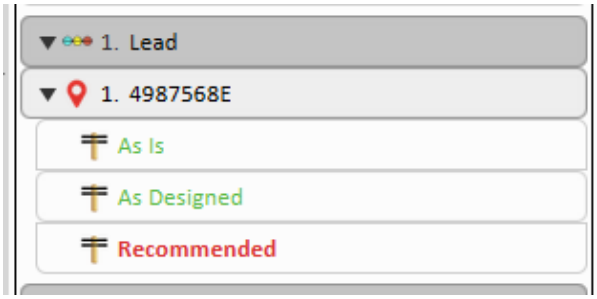
Green: Pass

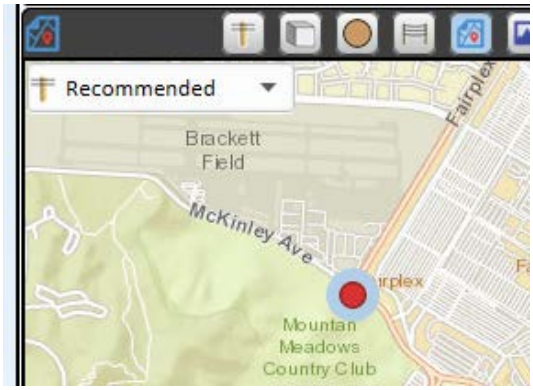
Orange: Pass, but close to failing safety factors

Red: Fail



These colors will also display in the Project panel and for the pole location in the Map View for that Design Layer. The color displayed will be for the lowest Safety Factor of any element for that Design Layer.





IMPORTANT: User must verify the Safety Factor value is passing, regardless of the color displayed. See PLM-2, Table 8.

6.10 Cloning Designs

You can quickly clone a design layer of a project into another design layer. There are seven design layer types plus the ability to create a custom named layer.

- As Is- current field conditions prior to work being performed
- As Designed- the proposed changes to be made for the project
- Recommended- additional changes to the pole that could be needed (i.e., loading pole with 1/0 conductor for future upgrades)
- SCE QC- reserved for Quality Control group
- Rework- used for PLP (Pole Load Program)
- SCE TSP- DO NOT USE
- As Built- used to pole load field changes made to a pole after approval of the work order and without a change order

IMPORTANT: The new layer will be added to ALL locations of the project at the same time. In addition, deleting a Design layer will remove that layer from every location.

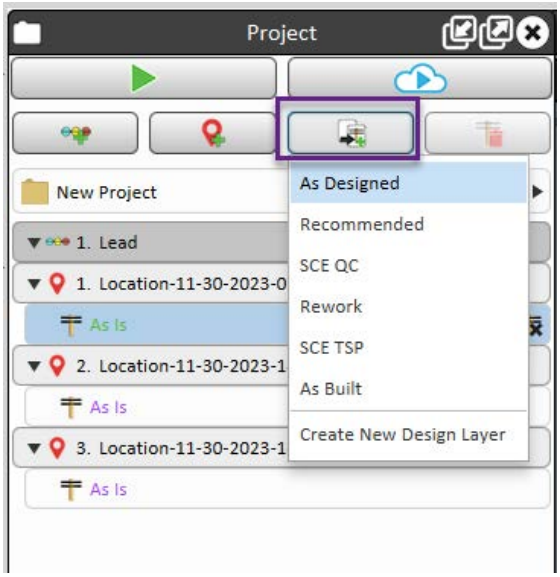
As an example, to clone the As Is design layer into an As Designed design layer:

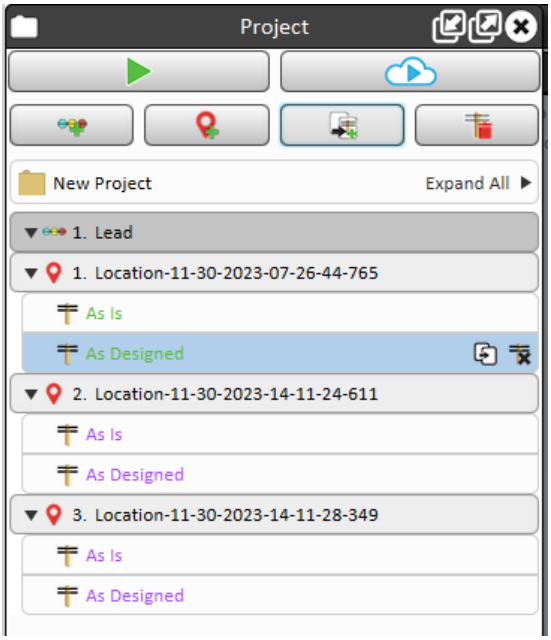
STEP 1. Complete the As Is design layer for each location of the project.

STEP 2. With an As Is design layer selected, click the **Clone Design Layer** button on the Project panel.

STEP 3. Select As Designed.

STEP 4. The As Designed layer populates to each location of the project.

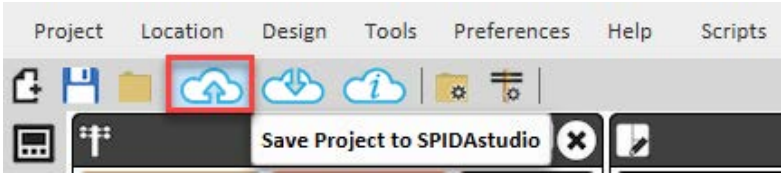




STEP 5. Update the As Designed design layer for each location for the proposed changes.

6.11 Save and Commit projects to SPIDAstudio

STEP 1. In the main toolbar select **Save Project to SPIDAstudio** icon to save project.



STEP 2. The **Select Designs to Commit** dialog box will appear. Make sure all required Pole Loads are checked before continuing with commit. Click on **Next**. In this example, teh As-Is, As-Designed, and Location Forms are checked.

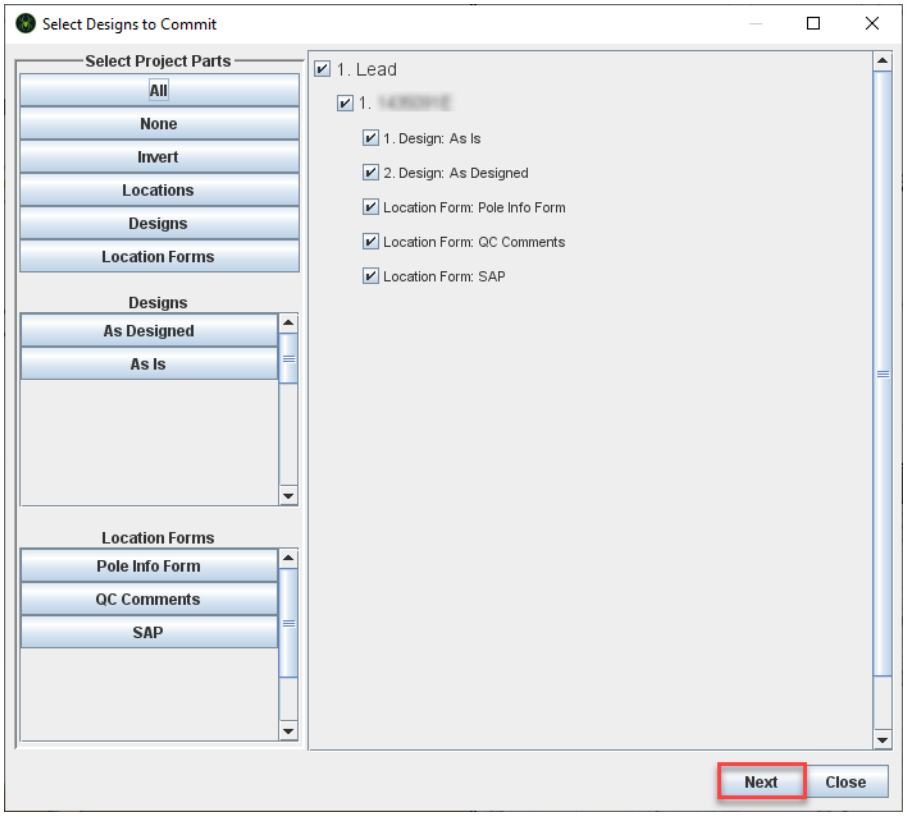
NOTE

The layers selected in this box determines the designs included in the spida.calc file that is saved in SPIDAstudio and the measurement points that will be available to be sent to SAP at the appropriate status.

As-Is will be sent when the project is Approved As Designed and As Built will be sent as follows:

- Existing poles: when project reaches Completed
- New/Replaced poles: when project is at Completed and new equipment number is available.

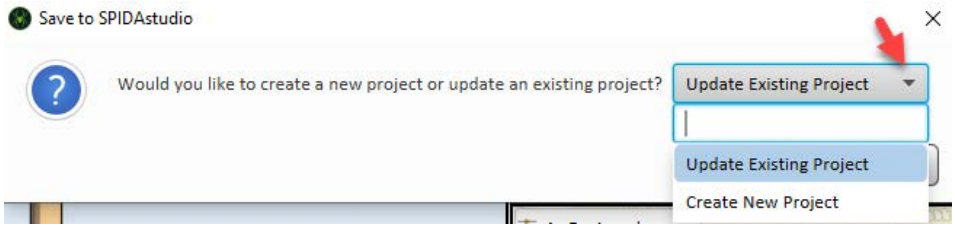
No other layer will send measurement points to SAP.



STEP 3. The **Save to SPIDAstudio dialog box** will display. Select the appropriate option for the project.

NOTE

In the pulldown you can select either Update Existing Project or Create New Project. All projects that have been initiated from Design Manager should use the Update Existing Project option.



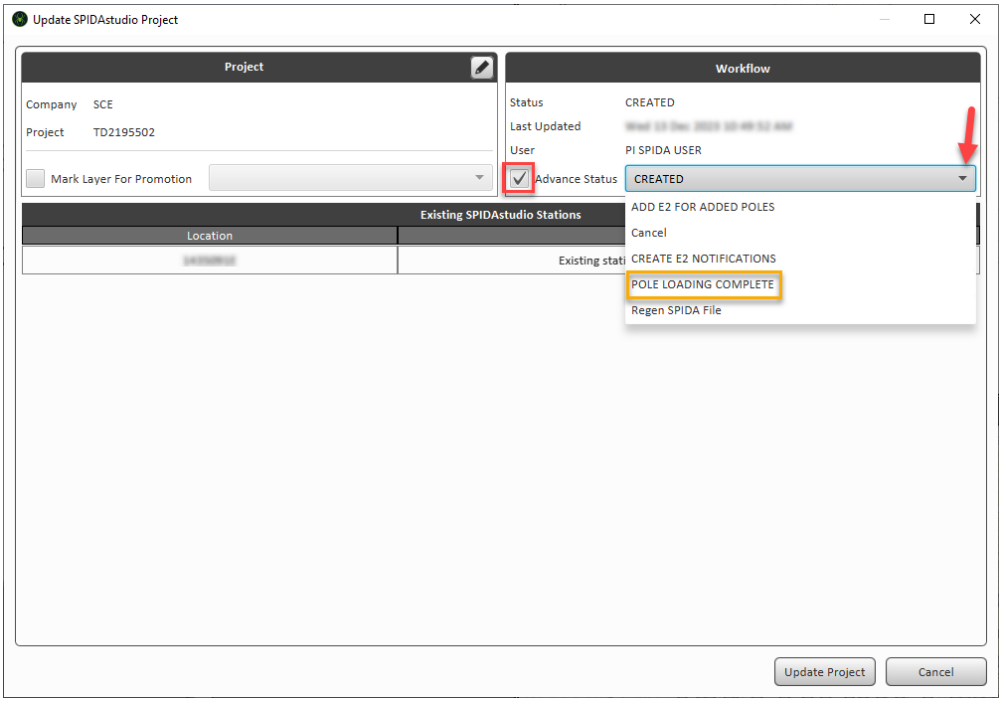
In this example, the Update Existing Project has been selected. Click **OK**.

STEP 4. The **Update SPIDAstudio Project** dialog box will display.

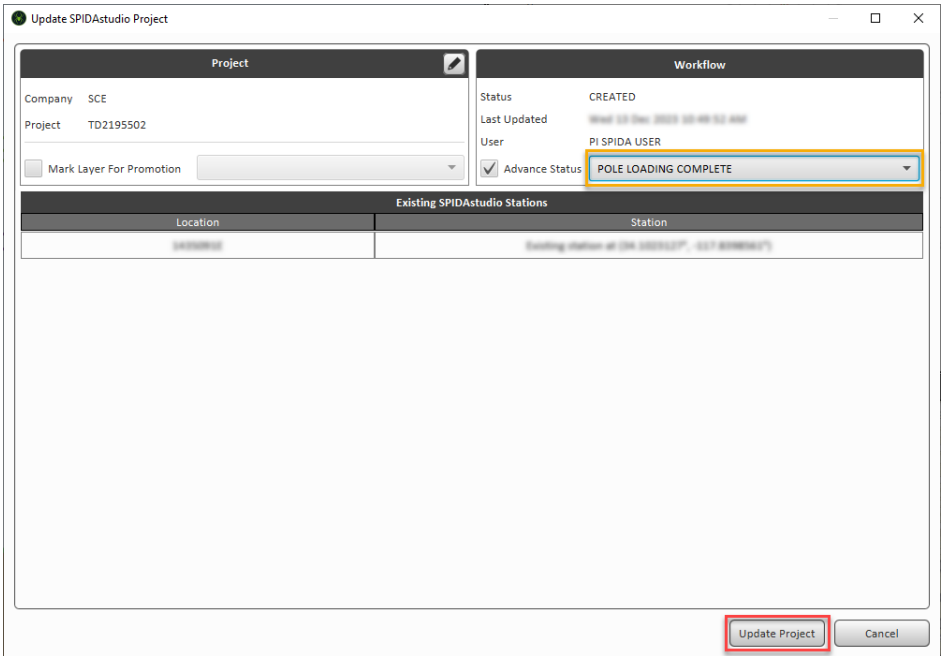
Project panel: Select the check box to "Mark Layer for Promotion" and select the appropriate layer.

Promoting layers designates the pole load calculation to be used the next time that pole is included in a future project. Promotion occurs when the project reaches Finish status.

Workflow panel: The **Advance Status** can be checked. Once checked, a pulldown will be active. Click on pulldown and select **POLE LOADING COMPLETE**.



Once selections are made, click on **Update Project**.

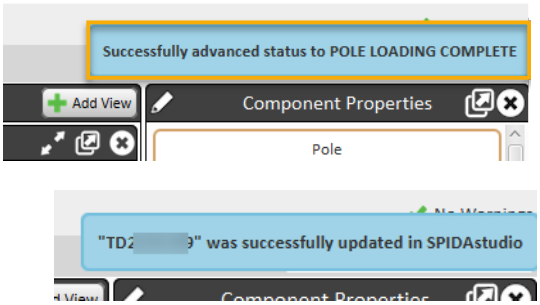


NOTE

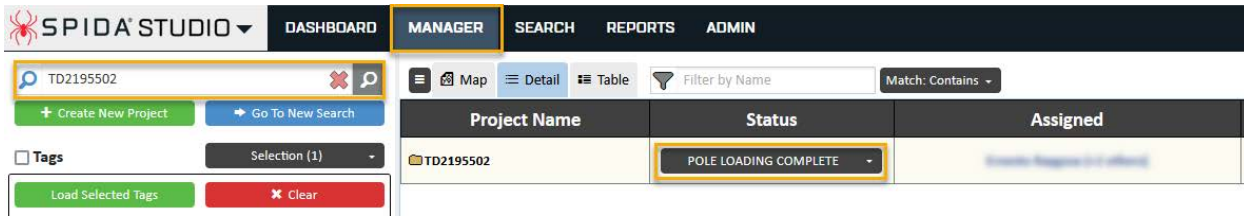
Safety Factors are sent to Design Manager when project is set to Pole Loading Complete.

A dialog box will appear, displaying Saving project to SPIDAstudio. Note: this can take some time.

Once saved to SPIDAstudio, a blue popup window will display on the top right corner. It will display "Successfully advanced status to **POLE LOADING COMPLETE**" and/or that the project "was successfully updated in SPIDAstudio."



STEP 5. To verify design has been committed to SPIDAstudio, go to SPIDAstudio, in the Manager tab. Search for TD #, in this example TD2195502 is searched. Select the Detail tab, in the Status sub



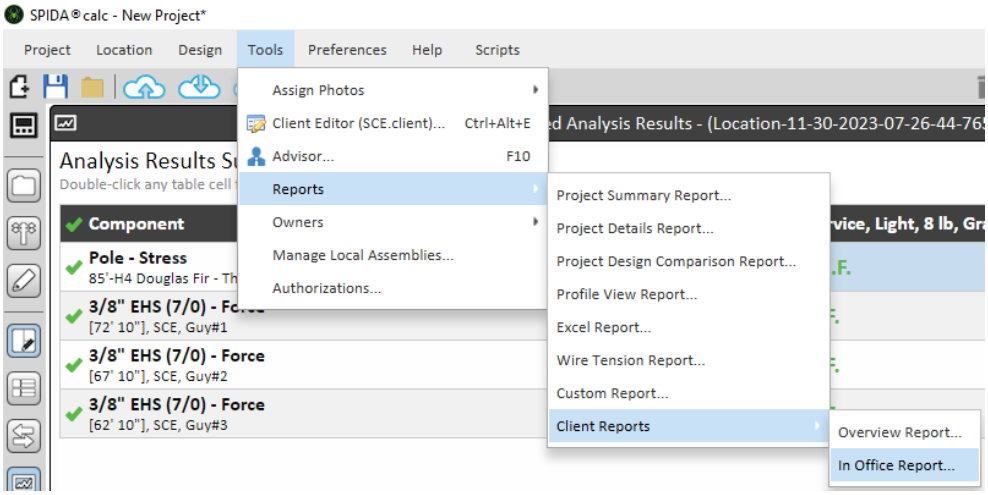
6.12 Reports

There are two SCE specific reports available in SPIDAcalc. The Overview report and In Office report.

- The Overview report is not required.
- The In Office report is required to be in Work Order packages for review by the manager and information for the construction crew.

NOTE All Location Forms should be completed, and the project must be analyzed prior to generating any reports.

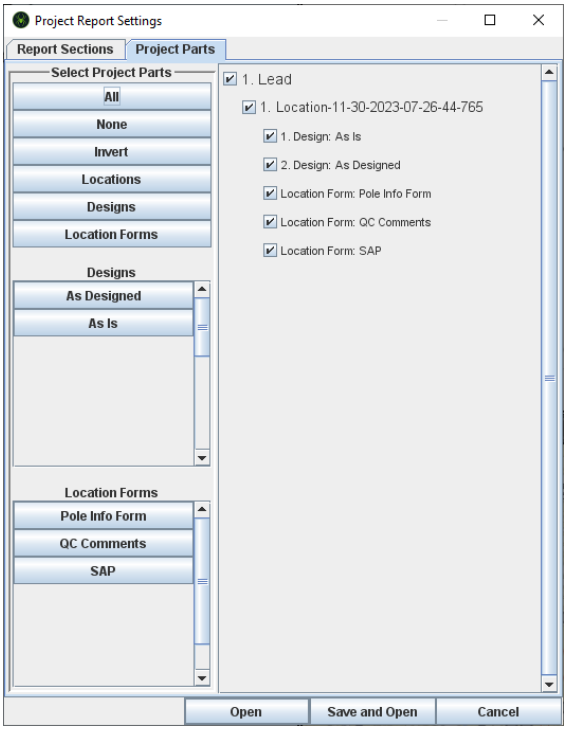
- Click Tools>Reports>Client Reports>In Office Report…



- The *Project Report* Setting dialog box will display.

- In the *Format* section at the bottom of the **Report Sections** Tab, select the radio button for PDF.

- Click on the **Project Parts** tab, the available Design layers are displayed along with the Location Forms.



- In the right panel, you can select the various project parts individually to be included in the report.
- In the left panel, buttons are available to select that part of the project for all locations at the same time. Only layers/forms that have been included in the project will have a button available (i.e., if any one station has a Recommended layer designed then a Recommended button will display)
  - — All: selects every item
  - — None: De-selects every item
  - — Invert: Swaps the selection showing (de-selects items that are checked and selects items that are unchecked).
  - — Locations: Selects all the Locations in the project
  - — Designs: Selects all the Designs in the project
  - — Location Forms: Selects all the Location Forms in the project.
  - — As Designed: Selects all the As Designed layers in the project
  - — As Is: Selects all the As Is layers in the project
  - — Recommended: Selects all the Recommended layers in the project (if applicable)

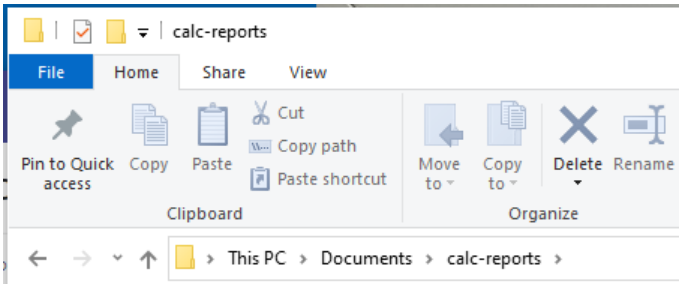
NOTE

If a 'Recommended' layer is needed to show a 3rd party guying failure, it will be the Planner's or Qualified Planning Employee's responsibility to print that out.

  - — Pole Info Form: Selects all Pole Info Forms in the project
  - — QC Comments: Selects all QC Comment forms in the project
  - — SAP: Selects all SAP forms in the project.
- Once all parts desired for the report are selected, click either:

1. The Save and Open button

   a. The PDF will be saved to the default folder- This PC>Documents>calc-reports



   b. The PDF will open in Adobe Acrobat.

2. The Open button

   a. The PDF will open in Adobe Acrobat

   b. The PDF will need to be manually saved to the desired folder

6.13 Additional Scenarios

In addition to the basic functionality shown in this section, several job aids that gointo greater detail with regards to specific scenarios can be found on the SPIDA job aid sharepoint:

https://edisonintl.sharepoint.com/sites/TD/org/SPIDAcalc%20Job%20Aids/Forms/AllItems.aspx

7.0 SPIDA Release Timeline

SPIDA Release Timeline

2/21/13	• The PoLAR Team announces that the project has been and end usertraining will commence.
4/29/13	• End User training begins. As each user attended the two day class, their computerswere updated with the new SPIDA Calc and SPIDA Min (Mozilla Firefox) software. • The expectation is set that all new pole loads will be done in the SPIDA Calc toolonce the user attends training. (existing work may be completed in WLEA until • 7/1/13).
6/6/13	• All internal SCE users have completed training. No WLEA reports dated after thisdate will be acceptable from internal SCE planners. • Contractor users begin end user training.
6/20/13	• The 'In Office Report' is developed and released for use. Effective this date, all • reports shall be formatted to use this report only. PoLAR Job Aid #11- Creating • Reports, outlines the process.
6/27/13	• Naming conventions released. Expectations for how projects should be named (requiring a tracking number or other department appropriate method). Structure • numbers are not acceptable as project names.
7/1/13	• WLEA is decommissioned for internal SCE users. Any work not completed inWLEA will now have to be completed in SPIDA
7/18/13	• Buckling Safety Factor was revised. • Version 4.4.2.0 was released • BGAN • Assembly added to the equipment selection list • The approval process in SPIDA Min changed. Job Aid #10 - Changing Status &Approving Projects, was released to outline the revised process.
8/15/13	• Revisions were made to the transformer weights and dimensions in the Client Fileof SPIDA Calc. This will result in changes to the results of pole loading utilizing • transformers in the design. Overall, some pole size decreases may be seen.
9/1/13	• WLEA is decommissioned for SCE contractors. • No WLEA forms dated after this date will be accepted for pole loading from • contractors. In flight projects are subjected to a case by case review if there is aconflict with dates.
9/19/13	• Revisions were made to the following items: switches, regulators, capacitor banksand Cleaveland Price Switches. Based on review of capacitor banks by the • apparatus engineering group, a new option has been added to the SPIDACalc equipment tab. In circumstances where six units are used the "KVAR size – old" entry shall be used. Where banks have three units, "KVAR size – new install" shallbe used. For all new installations, cap banks use three units. The change in weightsand dimensions will result in changes to the results of pole loading utilizing these items in the design. Some pole size decreases may be seen. • The "In Office" Report was updated to include the Species, GLC and diagraming. • No change in functionality for the user.
12/12/13	• Safety Factors are now analyzed on all span guys. New span guys are assessed ata minimum of 2.0 passing safety factor, and in service are required to pass with • 1.33 minimum safety factor. • Douglas Fir Through bored poles are added to the pole type options. For all new Douglas Fir Pole sets beginning 1/1/14, this is the required pole type to be used. Job Aid # 18 - Douglas Fir-Thru Bored Poles, is released outlining the details. Dueto the 5% reduction in overall strength, larger poles may be concluded. • Additional crossarm lengths, insulators, joint use boxes and antennae are added.

SPIDA Release Timeline (Continued)

2/20/14	• Version 5.0.0.0 is released. • All projects analyzed in version 4.4.2.0 that are not in SPIDA Min must bere-analyzed prior to committing to SPIDA Min or an error will be returned. • New (back end) guying methodology was employed, reducing some of the • increased pole sizes previously being required through the analysis. No change infunctionality for the user. • Conductor tension values have been revised for majority of the wires in the Client • File. Impacts to pole loading results will vary based on the combination of changeswith the guying component revision. • Equipment (other than transformers, switches, and capacitor banks) has been • revised by apparatus engineering and new values are included in the tool. Variations include both increases and decreases to weights and dimensions ofvarious pieces of equipment. • New pieces of equipment have been added to the selections. Once the item has • been placed into the Client File (with the exception of risers) it will be required to beincluded on a pole load analysis. It does not mean that it drives the requirement fora pole load to be completed. • 'Uplift Issue' occurs as a result of this release. Workaround direction provided to • 'zero out' the Z forces so that projects can be committed until the next version is • released.
5/18/14	• Version 5.1.1.0 is released • 'Uplift Issue' is resolved. No change in functionality for the user. • Struts are now assessed in the tool. New struts installations must pass at a 1.5 Safety Factor, and in service struts must pass at a 1.33 safety factor. Job Aid # 21 -Struts, is released outlining the details. • New Platform Rack Construction can be assessed in the SPIDA Calc tool. Job Aid • # 23 - Platform Racks, is released outlining the details. • SAP Tab under the 'Location' must be present in order to analyze. It is not necessary to fill this out at this time unless it is work being done related to the PLPprogram.
9/23/24	• End User training begins for Version 7.3.2 • Contractors will be doing their own training.
10/10/24	• End User training ends for Version 7.3.2
10/14/24	• SPIDA Version 7.3.2 was released and pushed to each end user's computer. • New client file was updated with this release, • SAP form requirements updated

PLM–4: Pole Loading Assessment Reference Guide

Table of Contents

Owners

This chapter is owned and managed by the SPE Standards Engineering Organization

Description

This Pole Loading Reference Guide (PLM-4) provides standards for pole loading. Because there are different types of field tools utilized, only some sections of this guide may be applicable for certain situations.

This guide does not provide information or instructions for entering data into the SPIDACalc Pole Loading Tool (PLT) or completing the Field Worksheet. Refer to the Polar Website for information and instructions on using SPIDACalc and completing the Field Worksheet.

Note: Personnel are required to wear the correct Personal Protective Equipment (PPE) described in the Accident Prevention Manual while performing field work.

Introduction

SCE conducts pole loading assessments to ensure the new, existing, and replacement poles meet or exceed G.O. 95 requirements and meet applicable T&D construction standards.

Safety factors are determined by performing pole load calculations. These calculations include an evaluation of a pole's size, strength, attachments, and environmental conditions (wind and ice).

A pole load calculation requires accurate information collected and entered into the SPIDACalc Pole Loading Tool (PLT). Personnel performing a pole load calculation must be able to properly identify the pole size, class, and species, and must also be able to identify equipment and relevant conductor specifications (for example, sizes, span lengths, angles, and attachment points).

This reference guide provides information and instructions for:

- Using Pole Loading Assessment Tools
- Identifying Pole Characteristics
- Taking Accurate Measurements
- Collecting Accurate Data

1.0 Pole Loading Assessment Tools

In order to collect accurate information, the personnel performing a pole load calculation must be able to utilize the tools listed in this section effectively.

1.1 Logger's Tape

The Logger's Tape is used to measure the pole's Groundline Circumference (GLC).

WARNING Be aware of exposed wires when using this tool.

Figure 1: Logger's Tape (SAP 10215219) (Preferred)

Figure 2: Logger's Tape (SAP 10215219) (Alternative)

Note(s):
1. This tool is available to internal and external users.

1.2 Calipers

Calipers are used to measure obstructions such as risers and U-Guard risers when determining GL circumference. See PLM–4 Section 3.2.A. "Determining GL Circumference by One of Three Categories" for details on when calipers are permitted for use. Calipers are not to be used to measure GL Circumference.

Figure 3: Calipers, Calipers used to Measure U-Guard (SAP 10182460)

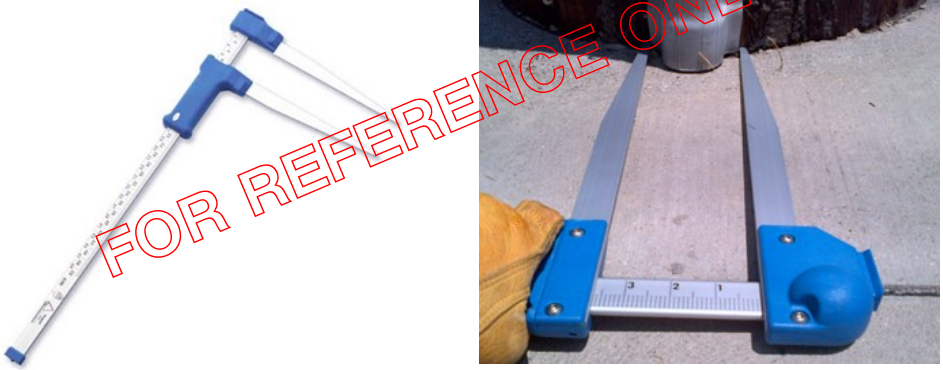


Figure 4: Calipers, Calipers used to Measure U-Guard (SAP 10182460)

Note(s):

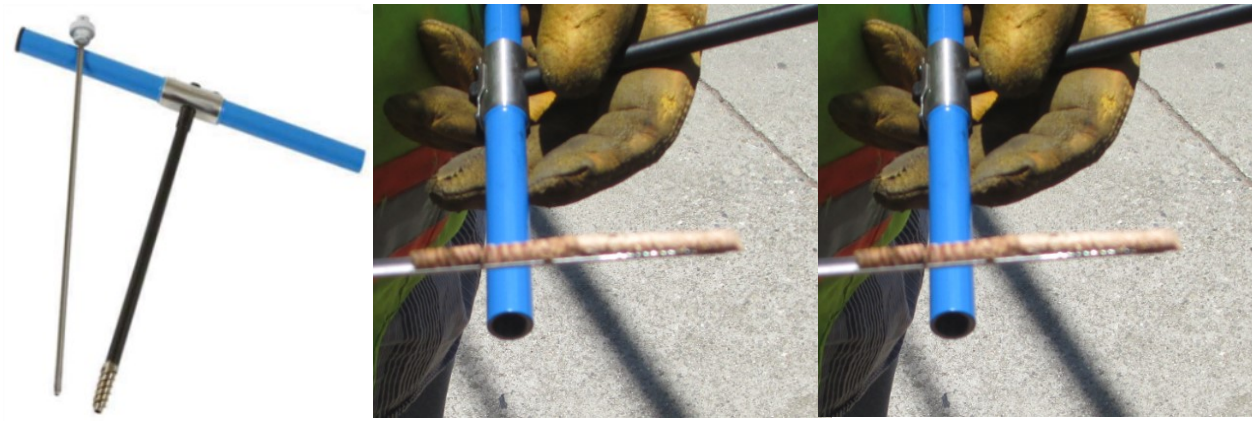
1. This tool is available to internal and external users.
2. Not for use to measure diameter of the pole.

1.3 Increment Borer

The Increment Borer is used to extract core samples needed to determine the pole species. When using this tool:

- Avoid boring into cracked portions of the pole as this may produce a partial sample, making it more difficult to determine the pole species.
- Coring should be separated by at least six inches vertically and on separate quadrants of the pole.
- After boring, plug holes with treated wood plugs.

Figure 5: Increment Borer



Note(s):

1. This tool is available for use by PLP, intrusive inspection, wood products, and QC.

1.4 TruPulse 360/360R Range Finder

The TruPulse 360/360R Range Finder is used to measure span lengths, angles and heights of attachment. It can be utilized as a standalone instrument to measure missing lines and elevation changes or it can be attached to the TruAngle. It is important to note that the azimuth function in the True Pulse can be inaccurate, due to magnetic interference. In situations where there is potential for magnetic interference (autos, street signs, fences, and so forth) the TruPulse should not be used to measure angles. The tool should be calibrated at least once daily and every time there is a major change in location. Refer to Section Four: Measuring & Collecting Data for calibration instructions.

Figure 6: TruPulse 360R & TruPulse 360 Range Finders

Figure 6.1: TruPulse 360R

Figure 6.2: TruPulse 360

Note(s):
1. This tool is available to internal and external users.

1.5 TruAngle

The Tru Angle is used to measure span angles, in conjunction with the True Pulse. The Tru Angle is used in situations where objects (autos, street signs, fences, and so forth) are present and have the potential to cause magnetic interference to the True Pulse. Refer to Section Four: Measuring & Collecting Data for calibration instructions.

Figure 7: TruAngle

Figure 7.1: TruAngle

Figure 7.2: Mounted with TruPulse

Figure 7.3: Mounted with TruPulse 360R

Note(s):
1. This tool is available for use by The Wood Products and QC Inspection groups.

1.6 Remote Trigger

Accessory used to obtain accurate measurements with the TruAngle and TruPulse. The remote trigger allows personnel performing a pole load calculation to take a more accurate shot by providing stability when pressing the trigger. The other advantage of the remote trigger is that it allows the TruPulse to communicate with the TruAngle, when the two instruments are wired together.

Figure 8: Remote Trigger

Figure 8.1: Remote Trigger

Figure 8.2: Remote Trigger with TruPulse 360

Note(s):
1. This tool is available for use by The Wood Products and QC Inspection groups.

1.7 Tri-Pod

The Tri-pod, with adjustable legs, is useful for obtaining a level platform for instruments on uneven surfaces commonly found in the field. The Tri-pod can be mounted with True Angle, TruPulse or the RD-1000 in a variety of configurations.

Figure 9: Tri-pod

Note(s):
1. This tool is available for use by all groups.

1.8 Brackets

The TruPulse can be mounted on the tri-pod with brackets, to be used as a stand-alone instrument. It can also be mounted and used in conjunction with the TruAngle or the RD-1000.

Figure 10: Bracket Attached to Tru Pulse 360R and RD 1000

Note(s):
1. Available for use by SCE Planners.

1.9 RD 1000

The RD 1000 is used to measure the cross section of wood (diameter) on a pole, at the point of attachment (see Figure 8).

1.10 Hastings Stick

The Hastings Stick is used to measure the height of non-electrical facilities (3rd party attachments).

WARNING

This tool is not to be used on electrical or energized facilities.

Be aware of environmental factors such as wind and rain when using this tool.

Figure 11: Hastings Stick

Note(s):
1. This tool is not approved for use by SCE Planners. Used by QC Inspectors.

1.11 Guy Gauges

Guy Gauges are used to measure the diameter of guy wires.

Figure 12: Guy Gauges

Note(s):
1. This tool is available to internal and external users.

1.12 Camera

A camera is used to capture a visual record of each pole as it exists in the field. Personnel performing a pole load calculation should capture pictures of the:

- Pole number
- Brand, if available
- Full length of the pole

Figure 13: Camera

Note(s):
1. This tool is available to internal and external users.

2.0 Identifying Pole Characteristics

There are three characteristics needed for the pole loading assessment:

- Species
- Class
- Length

This information can be located on the pole brand. If the pole does not have a brand, the species, class and length are determined by the personnel performing a pole load calculation. See PLM–4 Section 2.2: Poles without Visible Brands for information and instructions on determining characteristics for poles without a brand.

Note: If you can read only portions of the brand, use the characteristics that you can read from the brand and refer to the appropriate section in Poles without brands to determine the unreadable characteristics.

2.1 Pole with Visible Brands

If the brand is ***visible*** on the pole, the personnel performing a pole load calculation will always use the data provided by the brand. If one or more characteristics are not visible, proceed to PLM–4 Section 2.2: Poles without Visible Brands to determine the missing characteristics. Brands often come in two different types:

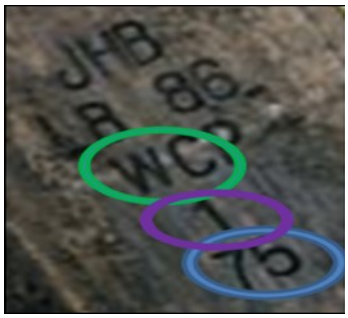
- Brands Burned into the Pole
- Medallions Nailed into the Pole

Note: The pole brand is typically located on the same side of the pole as the cross-arm gain at the top of the pole.

A. Brands Burned into the Pole

The images below display brands burned into the pole and how to find the three key characteristics.

Species: WC Western Cedar
Class: 1
Length: 75 Feet



Species:DF Douglas Fir
Class: 5
Length: 45 Feet

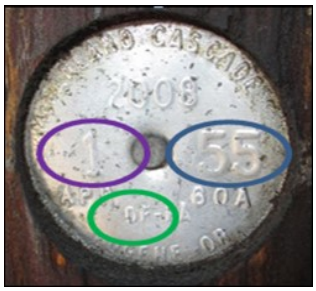
Species: Southern Pine
Class: 4
Length: 45 Feet

B. Medallions Nailed into the Pole

The images below display medallion brands nailed into the pole and how to find the three key characteristics.

Species: WC Western Cedar
Class: 2
Length: 70 Feet

Species: DF Douglas Fir
Class: 1
Length: 55 Feet



Species: Western Pine
Class: 5
Length: 35 Feet

2.2 Poles without Visible Brands

If the pole brand is not on the pole or one or more of the characteristics are not legible, it is the responsibility of personnel performing a pole load calculation to accurately identify these characteristics. It is important that the personnel performing a pole load calculation determine the characteristics in the order listed below:

A. Determining Pole Species without Brand

There is a two-step process to correctly identify the Poles species without visible brand:

STEP 1. Determine if the pole is a Through-Bored Pole, Section PLM–4 2.2.A.1. "Through-Bored Poles"

STEP 2. Increment Bore the pole to extract and analyze core to accurately determine Species without Brand, PLM–4 Section 2.2.A.2. "Increment Boring"

1. Through-Bored Poles

A Through-Bored pole has a pattern of 1/2 inch holes that extend 18"–24" above groundline. The holes are drilled in a diagonal pattern that extends through the pole.

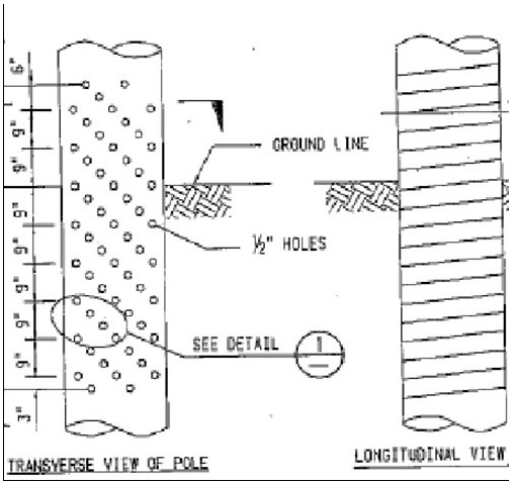
- If you find this condition, then the pole is a **Douglas Fir**.
- If through-boring does not exist, then proceed to increment boring, PLM–4 Section 2.2.A.2. "Increment Boring"

Notes:

- These holes are used to enhance the preservative penetration into the Pole and not to be considered damage to the pole.
- All Poles with or without visible Brand that have this pattern need to be captured by the personnel performing a pole load calculation as Douglas-fir Through-Bored Poles.

The figure below displays images of Through-Bored poles.

Figure 14: Through-Bored Poles



2. Increment Boring

If the pole is not Through-Bored, the increment borer is used to extract a core sample. This section provides instructions and information on using the increment borer to extract core samples and analyzing those samples to determine the accurate pole species.

When using the increment borer tool:

- Bore to a minimum of 3" to 4" into the pole.
- The best core sample is provided by a solid section of wood.
- Avoid boring into cracked portions. This may provide a partial sample, making the species more difficult to identify.

When analyzing the core samples, the following characteristics are used to determine the wood species:

- Depth of sapwood
- Penetration of preservative
- Clarity of growth rings
- Coloration

a. Core Identification

The tables below provide information and images for core samples for the Douglas-fir, Western Red Cedar, Southern Pine and Western Pine poles.

Table 1: Douglas Fir Core Sample

Douglas Fir **Note:** Douglas Fir cores have a smoother surface than Cedar	
Depth of Sapwood	• 3/4 to 2 inches
Penetration	• Heartwood is virtually impermeable to preservatives
Growth Rings	• Distinct contrast between early wood (pinkish in color) and late wood (brown in color)
Coloration	• Sapwood is yellowish/light brown in color when untreated • Heartwood is pinkish/brown in color

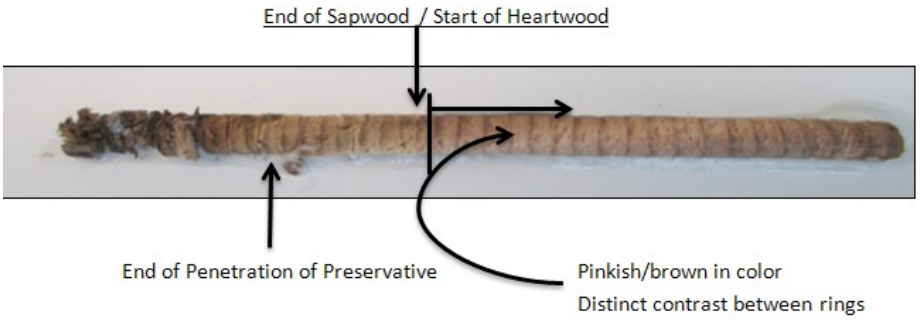


Table 2: Western Red Cedar Core Sample

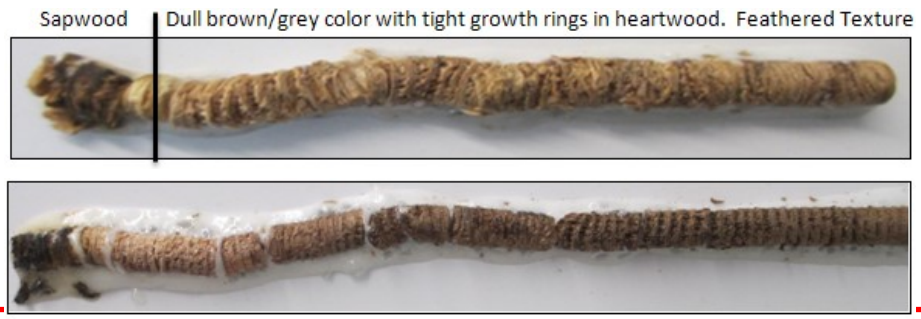
Western Red Cedar	
Depth of Sapwood	• 1/4 to 1/2 inch
Penetration	• Heartwood is virtually impermeable to preservatives
Growth Rings	• No distinct contrast between early wood and late wood • Tighter spacing and a more feathered texture than Douglas-fir and Pine poles
Coloration	• Sapwood is yellow to white in color when untreated • Heartwood is dull brown to gray in color • Heartwood does not contrast with the sapwood in color as much as Douglas-fir
	

Table 3: Southern Pine Core Sample

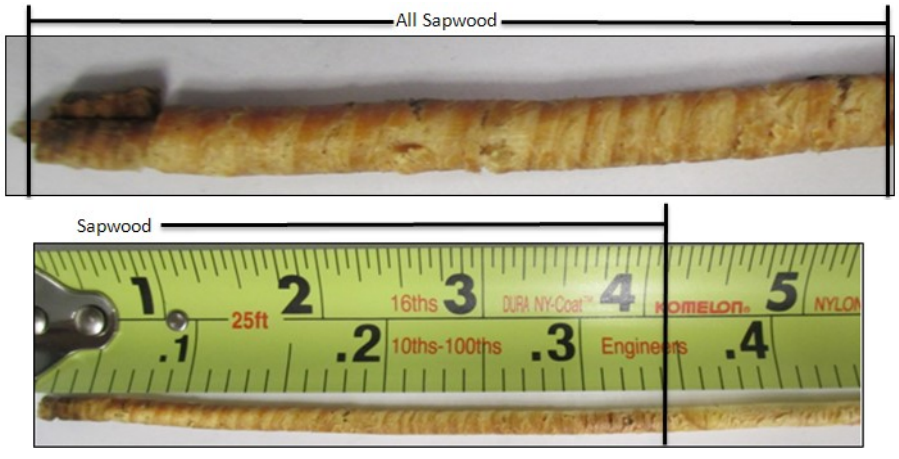
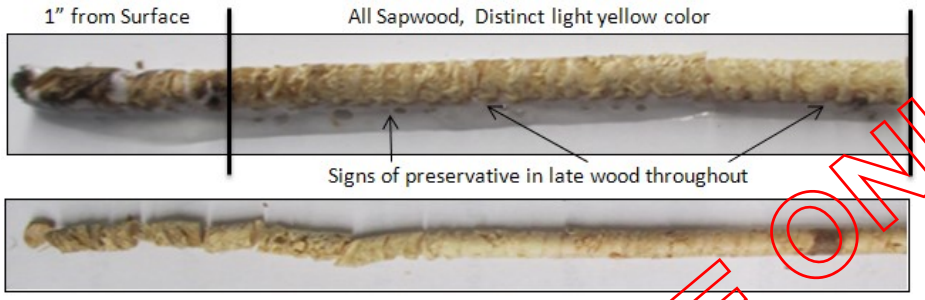
Southern Pine **Note:** The core only consists of sapwood and will have a shiny oily surface.	
Depth of Sapwood	• 3 to 5 inches
Penetration	• Sapwood only • Full penetration of preservative
Growth Rings	• Yellow to tan in color
Coloration	• Distinct contrast between early wood and late wood • Late wood is narrower in width and tanner in color
	

Table 4: Western Pine Core Sample

Western Pine **Note:** The core only consists of sapwood and will have a distinct light yellow color starting ¾ to 1 inch in depth beyond the outer surface.	
Depth of Sapwood	• 3 to 5 inches
Penetration	• Full penetration of preservative
Growth Rings	• Distinct contrast between early wood and late wood
Coloration	• Yellow to tan in color



B. Determining Pole Length without Brand

1. Pole's Length Nail

a. The personnel performing a pole load calculation needs to look for the length nail. If one exists, the nail is located below and to the left of the original pole tag. There are generally two nails. The one to the left identifies the pole length and the one on the right identifies the year the pole was set. See PLM–4 Section 2.2.C. "Determining the Year the Pole was Set" for additional information.

- Replacement pole tags have removable numbers and may alter the location of the length nail to the pole tag reference.
- If the pole does not have a pole tag, the nail is located on the street-facing side of the pole.

= FOR REFERENCE ONLY

The figures below display images of the pole length nails.

Figure 15: Pole Length Nails

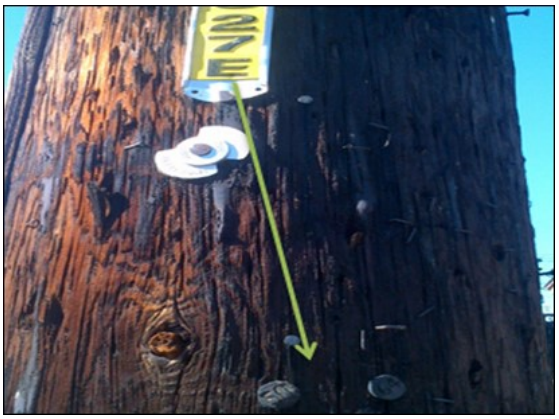


Figure 15.1: Nail Below Pole Tag – Length 50 ft

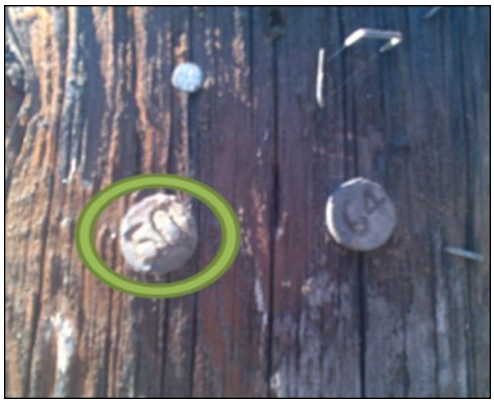


Figure 15.2: No Pole Tag – Length 50 ft

Figure 15.3: Nail Below Pole Tag – Length 45 ft

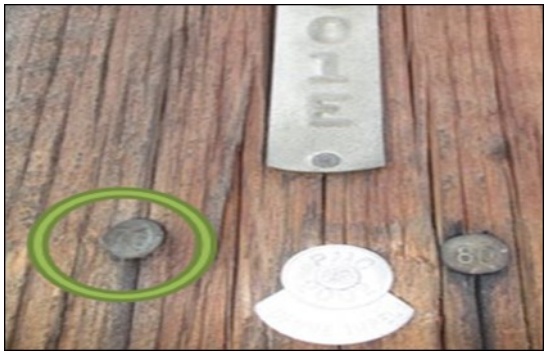


Figure 15.4: Nail Below Pole Tag – Length 70 ft

b. If the date/length nail is not present:

1) Utilize the true pulse 360 to measure the height above groundline:

STEP 1. Use the GL location determined in Section 3: Determining Groundline with a known vertical offset from this point for Angle 1.

STEP 2. For Angle 2, shoot the tip of the pole to determine the tip's height above GL.

STEP 3. After establishing the tip's height above GL, use the table below (determining pole length from Tips Height above GL) to determine the accurate pole length.

Table 5: Pole Length Table

Pole Height	Measured height above GL if set 10% + 2' in ground	Measured height above GL if set 10% + 1.5' in ground
25	20.5	21
30	25	25.5
35	29.5	30
40	34	34.5
45	38.5	39
50	43	43.5
55	47.5	48
60	52	52.5
65	56.5	57
70	61	61.5
75	65.5	66
80	70	70.5
85	74.5	75
90	79	79.5
95	83.5	84
100	88	88
105	93	93
110	98	98
115	103	103
120	108	108

Note(s):
1. All poles in excess of 100 feet are set at a 12 foot setting depth.
2. If the measured length is in-between two lengths, use the longer pole length.
3. The use of this table is for in-service poles and not for use with new construction.

C. Determining the Year the Pole was Set

If a pole does not have a brand, the pole class is determined based upon the year the pole was set. Information on the year the pole was set is engraved on a Date Nail. (Needed to accurately class poles without brands.)

1. Date Set Nail

The personnel performing a pole load calculation needs to look for the date set nail. If one exists, the nail is located below and to the Right of the original pole tag.

Note: Replacement tags have removable numbers and may alter the location of the date set nail to the pole tag reference.

Figure 16: Pole Year Set Nails

Figure 16.1: Pole Year Set 1965

Figure 16.2: Pole Year Set 1980

2. Determining Date Set without Visible Marker

If the pole does not have a date set nail, the personnel performing a pole load calculation will need to use the record recorded in SAP.

If the information is not recorded in SAP, the personnel performing a pole load calculation needs to determine if the pole was set prior to the year 2000 or after January 1, 2000. This determination is based upon the pole species as follows:

- All Western Red Cedar, Western Pine and Southern Pine poles were set prior to the year 2000.
- Through-Bored Douglas-fir poles were set after January 1, 2000.
- Non Through-Bored Douglas-fir poles were set prior to year 2000.

Note: Douglas-fir poles 35 feet in height or less are not Through-Bored, regardless of year set. If there is no Date nail or records recorded in SAP, the personnel performing a pole load calculation will consider this pole set prior to 2000.

= FOR REFERENCE ONLY

D. Determining Pole Class without Brand

In order for the personnel performing a pole load calculation to accurately determine the class of the pole without a visible brand, the personnel performing a pole load calculation needs to first know if the Pole was set prior to the year 2000 or after January 1, 2000. For both Categories (Set Prior to 2000 and Set after January 1, 2000) the personnel performing a pole load calculation needs to know the length and in some case the circumference at groundline.

1. Poles Set prior to 2000 without Brand

   a. Use Table 36: Determination of Pole Class (Without a Brand) for Poles set Prior to January 1, 2000 (PLM–5, Page 5-55)

   b. Determining Class for Poles 65 feet in length and larger.

      Considering there are two classes to choose from (Class 2 and 1) you will need to use the Minimum GL Circumference tables.

      - You will need the circumference of the pole, species of the pole, and the length.
        — If the circumference of the pole meets or exceeds the minimum circumference for a Class 1, a Class 1 will be recorded.
        — If the circumference of the pole does not meet the minimum circumference for a Class 1, a Class 2 will be recorded.
        — If the circumference of the pole does not meet the minimum circumference for a Class 2, a Class 2 will be recorded. It is important that the personnel performing a pole load calculation always uses and records their measured GL circumference.

Table 6: Minimum Groundline Circumference Tables

Douglas-fir Minimum Groundline Circumference			
		Class	
		1	2
Pole Length	Min Top Circum. (inches)	27	25
35		40.9	37.9
40		41.0	38.5
45		42.8	40.3
50		44.6	41.6
55		45.9	42.9
60		47.2	44.3
65		48.5	45.6
70		49.9	46.9
75		51.2	47.8
80		52.5	49.1
85		53.4	50.0
90		54.3	51.3
95		55.3	52.4
100		56.8	53.4

Table 6.1: Douglas-Fir Minimum GL

Western Red Cedar Minimum Groundline Circumference			
		Class	
		1	2
Pole Length	Min Top Circum. (inches)	27	25
35		40.9	37.9
40		45.0	42.5
45		47.2	44.3
50		49.0	46.0
55		50.8	47.8
60		52.5	49.1
65		53.8	50.4
70		55.1	51.7
75		56.4	53.0
80		57.7	54.3
85		59.1	55.2
90		60.4	56.5
95		61.4	57.6
100		63.0	59.1

Table 6.2: Western Red Cedar Minimum GL

Note(s):

1. These tables are to be used for poles 65 feet or greater only.

2. Poles Set After January 1, 2000 without Brand

   When the length and circumference are known for an existing pole set after January 1, 2000, use Table 38: Douglas Fir Minimum Groundline Circumference (PLM–5, Page 5-57) and Table 39: Western Red Cedar Minimum Groundline Circumference (PLM–5, Page 5-59).

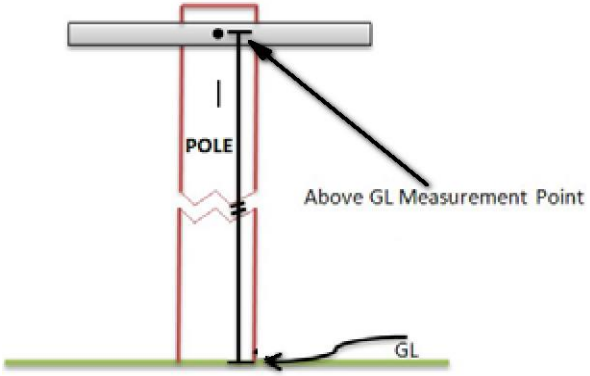
3.0 Determining Groundline (GL)

3.1 Groundline Location

It is important that a repeatable GL location is determined so consistent measurements can be obtained on all poles.

There are two measurement aspects that the GL location impact, accurate GL Circumference and all Attachment Heights above GL measurement point. Attachment height above GL measurement point refers to the point on the pole that is used to measure all attachment points above GL from (see Figure 15).

Figure 17: Attachment Height above GL Measurement Point



A. Variables to Determine GL Location

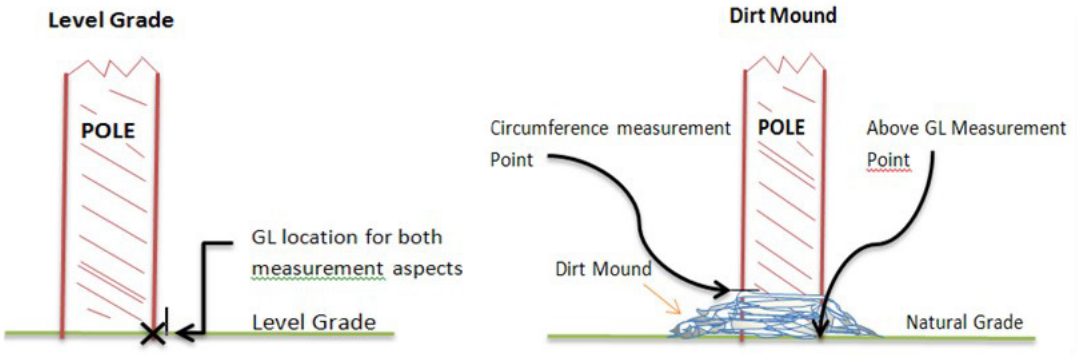
1. Level Grade

   If the pole is set on level grade the GL will be the point where the pole touches the earth. Both measurement aspects will use this point.

2. Dirt Mound

   - The GL circumference measurement will be taken at the top of the mound with no taper adjustment factor added.
   - The GL location for measuring attachment heights above GL will be the lowest point at which the natural grade hits the pole.

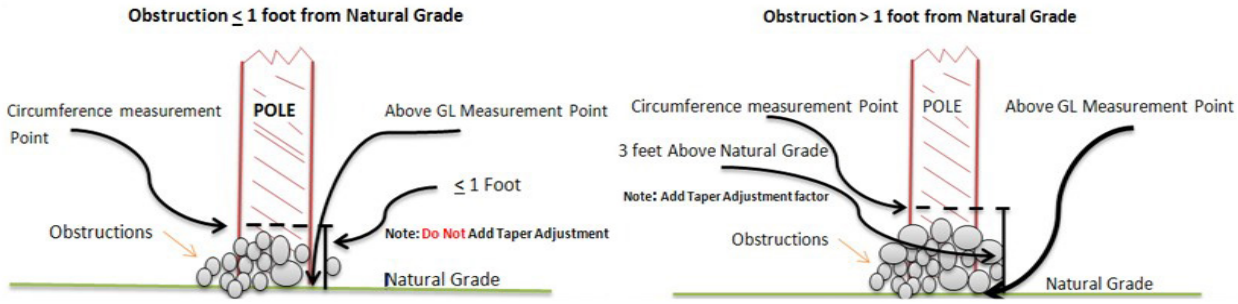
Figure 18: Level Grade and Dirt Mound GL Location



3. Level Grade with Obstruction

   - If the obstruction is less than or equal to 1 foot above the Natural Grade, the GL Circumference measurement will be taken at the top of obstruction. No taper adjustment factor will be applied.
   - If the obstruction is greater than one foot from the natural grade, measure up the pole three feet from the natural grade and take the pole circumference and add the taper adjustment factor, see PLM–4 Section 3.1 B. "Taper Adjustment Factor"
   - The GL location for measuring attachment heights above GL will be the lowest point at which the natural grade hits the pole (see Figure 17).

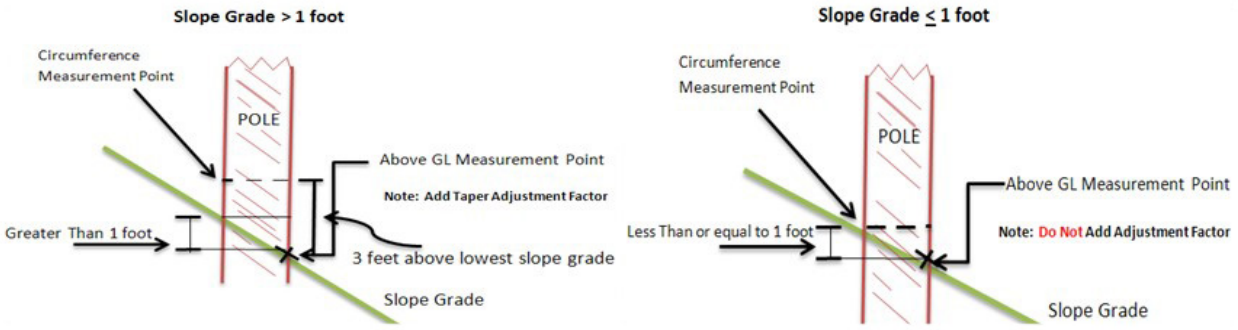
Figure 19: Level Grade with Obstruction



4. Slope Grade

   - The GL circumference will be measured at the highest point at which the slope grade hits the pole ***if*** less than or equal to one foot above the lowest slope grade point. No taper adjustment factor will be applied.
   - If the highest point is greater than one foot from the lowest point, measure up the pole three feet from the lowest point at which the slope grade hits the pole and take the circumference and add the taper adjustment factor, see PLM–4 Section 3.1 B. "Taper Adjustment Factor".
   - The GL location for measuring attachment heights above GL will be the lowest point at which the slope grade hits the pole.

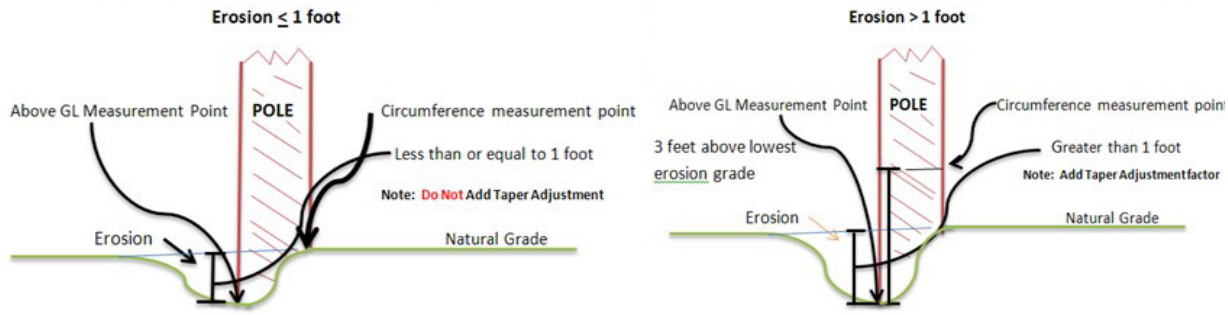
Figure 20: Slope Grade



5. Erosion

   - The GL circumference will be measured at the highest point at which the natural grade hits the pole if this point is less than or equal to one foot above the lowest erosion points contact with the pole. No taper adjustment factor will be applied.
   - If the highest point is greater than one foot from the lowest erosion point, measure up the pole three feet from the lowest erosion point and take the pole circumference and add the taper adjustment factor, see Section 3.1. B. Taper Adjustment Factor.
   - The GL location for measuring attachment heights above GL will be the lowest erosion point at which earth contacts the pole.

Figure 21: Erosion



B. Taper Adjustment Factor

When encountering one of the variables listed above that requires the circumference to be measured three feet above GL, you will need to add the Taper Adjustment factor listed below to determine your GL Circumference.

Circumference at 3 ft AGL + Taper Adjustment Factor = Adjusted GL Circumference

Table 7: Taper Adjustment Factors

Douglas Fir	Western Red Cedar	Pine (All)
1/2 inch	1 inch	1/2 inch

Note(s):

1. After determining the proper location to measure the circumference, proceed to Section 3.2 Measuring GL Circumference. If unable to measure the GL circumference three feet above the determined above GL measurement point, default to class minimum.

3.2 Measuring GL Circumference

To measure GL circumference, wrap the Loggers tape around the pole. The tape should be perpendicular, or 90 degrees to the pole. This measurement needs to be taken as close to the ground-line as possible. Refer to PLM–4 Section 3.1: Groundline Location to determine the proper GL location.

A. Determining GL Circumference by One of Three Categories

WARNING

Prior to measuring GLC, ensure there is no exposed conductor at base of pole. If exposed conductor is found at base of pole, perform measurement at 3 feet AGL, if no exposure issue exists at the 3 foot AGL level, and it is safe to do so. Notify SCE rep to have repair notification created for exposed conductor.

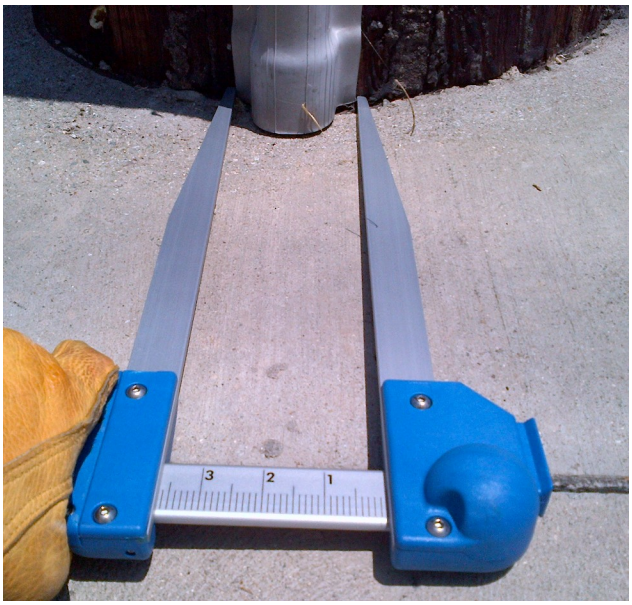
1. Full Measurement

- No obstructions on pole. Tool: Logger's Tape
- If risers are present, measure behind the risers to get a clean GL circumference.
  - — If unable to get a clean measurement due to obstructions (risers), proceed to PLM–4 Section 3.2.A.2. "Partial Measurement"
- If a U-Guard riser is on the pole, for safety reasons do not measure behind the U-Guard riser. Proceed to PLM–4 Section 3.2.A.2. "Partial Measurement"
- If there is a wood ground molding, for safety reasons do not measure behind the molding. To remedy this situation, measure over the top of the wood ground molding and subtract 3/4 of an inch from the measured circumference of the pole.
- If there are more than one wood ground molding, Step 4 above applies as long as there is enough separation between the moldings so that the tape touches the pole on both sides of every molding. If you are unable to regain contact with pole between the wood ground moldings proceed to PLM–4 Section 3.2.A.2. "Partial Measurement".

2. Partial Measurement

   - Obstruction on pole. Tools: Logger's tape and caliper
   - If more than one riser and/or U-Guard on the pole that cannot be measured behind:

   STEP 1. Measure the available surface of the pole between obstructions.



   STEP 2. Caliper the width of the riser and/or U-Guard (Obstructions).

   STEP 3. Add the measurements together.

   Available Surface + Calipered Obstructions = GL Circumference

   64" + 3.7" = 67.7" GL Circumference

   - If there are wood ground moldings on the pole that you cannot measure with the tape touching the pole on both sides of every molding, measure the available surface of the pole and add 1 inch for every wood molding. Wood ground moldings do not need to be calipered to obtain their width.

3. Unable to Measure (Spida Calc will provide the ANSI minimum)

   If you are unable to measure the GL circumference, default to class minimums. For poles with Fiberglass Wrap, Mod Poles, poles set in caisson over 6 foot AGL or hard to measure Steel Stubs, default to class minimum.

4.0 Measuring and Collecting Data

The TruPulse 360/360R Range Finder is the tool used to measure span lengths, angles, and attachment heights above groundline.

4.1 Calibrating the TruPulse 360/360R

The tool should be calibrated at least once daily and every time there is a major change in location. There are two calibration routines:

- Inclinometer Calibration: See Appendix A for instructions.
- Horizontal Angle Calibration: See Appendix B for instructions.

Before calibrating the tool, the personnel performing a pole load calculation should ensure he is clear of items that may interfere with the magnetic compass, such as cellphones, iron, steel, cobalt, nickel and other ferromagnetic materials.

A. Testing for Magnetic Interference

The following is a list of objects and or materials that could cause interference with the TruPulse 360 compass, this list is NOT all inclusive and there are other items that need to be considered.

- 6 in (15 cm) minimum: Metal rim glasses, pen/pencil, metal watch band, pocket knife, metal zipper/buttons, belt buckle, batteries, binoculars, cell phone, keys, camera, camcorder, survey nails, metal tape measure.
- 18 in (50 cm) minimum: Clipboard, data collector, computer, GPS antenna, 2-way radio, hand gun, hatchet, cell phone case with magnetic closure.
- 6 ft (2 m) minimum: Bicycle, fire hydrant, road signs, sewer cap or drain, steel pole, ATV, guy wire, magnets, chain-link fence, bar-wire fence, data collectors that use a magnet to hold the stylus.
- 15 ft (5 m) minimum: Electrical box, small car/truck, powerline, building with concrete & steel.
- 30 ft (10 m) minimum: Large truck, metal building, heavy machinery.

The following procedure provides instructions for testing local magnetic interference:

STEP 1. Choose a target that is at least 300 feet away.

STEP 2. In the AZ Function, shoot to the target.

STEP 3. Note the azimuth.

STEP 4. Step backward or forward one yard along the site-line.

STEP 5. Shoot to the target again.

Result: The second azimuth should be within 1/10 to 5/10 of a degree of the first azimuth.

STEP 5.1 IF the second azimuth is 1/10 to 5/10 of a degree of the first azimuth: the area is very likely free of magnetic interference. Proceed to Step 6.

STEP 5.2 IF the second azimuth is not 1/10 to 5/10 of a degree of the first azimuth: Choose another location. Repeat Steps 1–5 until a satisfactory result is achieved.

STEP 6. Repeat the test to confirm by shooting a target 90 degrees to the azimuth of the first target.

STEP 7. Begin the calibration routines. See Appendix A and Appendix B for calibration instructions.

4.2 Measuring and Collecting Data with the TruPulse 360

A. Measuring Span Lengths with the TruPulse 360

Span length measurements are to be taken from the centerline of the pole and to all endpoints that are to be captured in the measurement.

Before shooing an endpoint, care is to be taken to avoid shooting any objects in between that would give an inaccurate measurement. When determining an accurate location to take the span length measurement, the following conditions are taken into consideration:

- Clear Line of Sight — The area from the subject pole to the pole ahead and the pole behind if free of obstructions.
- Obstructed Sight — Obstructions exist between the subject pole, the pole ahead and/or the pole behind, but the measurement can be taken using an offset.
- Missing line — Obstructions exist between the subject pole, the pole ahead and/or the pole behind and the measurement cannot be taken using an offset.

It is important to calibrate the TruPulse 360/360R prior to taking measurements. Refer to Appendix A and Appendix B for calibration instructions.

1. Clear Line of Sight

   All adjacent poles and endpoints that have a clear line of sight when the personnel performing a pole load calculation can setup the tripod with no more than a 6 inch horizontal offset from the perimeter of the subject pole. In order to maintain the centerline of the subject pole, the setup location may be re-positioned multiple times in-order to capture accurate measurements.

   The procedure below provides information and instructions for taking span length measurements when there is a clear line of sight.

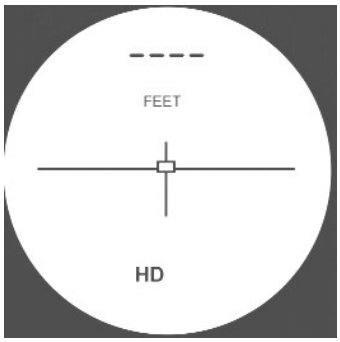
Measuring Span Lengths – Clear Line of Sight

STEP 1. Establish a set-up location that provides a clear line of sight from the subject pole to the pole ahead and the pole behind.

- Avoid shooting objects between poles that could give a false footage reading.
- For minor obstructions that do not allow a horizontal shot to be taken, shoot at any point along the vertical plane of the adjacent endpoint

STEP 2. Set the TruPulse 360/360R to the HD function.

Note: The HD function allows the shot to be taken at an incline or decline position while still reporting an accurate triangulated horizontal measurement in feet.



STEP 3. Determine the structure to be shot.

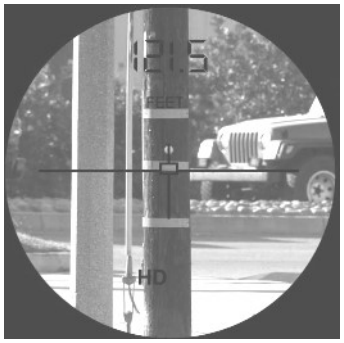
- If the endpoint is a pole, the target will be the inline center of the adjacent pole.
- If the endpoint is not a pole, the shot should be taken at the point where wire and/or cable meet the endpoint.

STEP 4. Aim at the center line of the first pole.

If possible, aim at the reflective visibility (vis) strips because they will give the most accurate reading.

STEP 5. Press the **Fire** button. 

Result: The measurement displays in the main display.



Measuring Span Lengths – Clear Line of Sight (Continued)

STEP 6. Record the measurement.

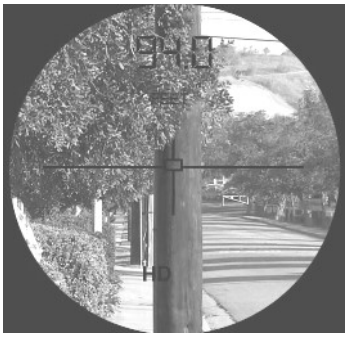
STEP 7. Leave the tripod in the same location and rotate the TruPulse towards the next pole.

STEP 8. Aim at the center of the second pole.

STEP 9. Press the Fire button (FIRE) to obtain the next span length.

Result: The measurement displays in the Main Display.

Note: After capturing the main span lengths the tripod may need to be relocated to collect the rest of the wire end-point measurements.



STEP 10. Record the measurement.

(End of Procedure)

2. Obstructed Sight

If a clear line of sight cannot be established, the personnel performing a pole load calculation will need to measure a horizontal offset distance (example 5 feet) from the subject pole that will provide a line of sight to the other poles.

A horizontal offset is a determined distance in feet and/or inches by which something is out of line. In order to achieve accurate measurements you cannot create an offset on the subject pole greater than 6 inches without creating the same offset on all endpoints being measured. Creating offsets allow accurate measurements to be taken parallel to the subject pole and adjacent endpoints without altering the measured values.

A safety cone or other objects can be used as markers to establish the distance from the center line of the subject pole. The marker is used to establish the same offset distance for the other wire end-points that will be shot.

Once the offset has been established for the subject pole and the other wire end-points, shoot from the instrument location to the markers next to the other wire end-points.

If it is impractical to establish offsets because the obstruction or distance is too great, the measurements can be taken using the missing line process.

3. Missing Line

When it is extremely difficult or impossible to collect data from a position close to the subject pole, the True Pulse 360 has the ability to shoot two targets from a remote location and then it will internally calculate the span length and azimuth. This function is dependent on clear lines of sight from the remote location to both of the targets. It is also dependent on proper calibration of the horizontal and inclination functions of the instrument.

When setting up for the missing line measurement care must be taken to avoid objects that could cause magnetic interference to the compass see PLM–4 Section 4.1. A. "Testing for Magnetic Interference" for instructions. The internal compass is a vital part of the internal calculation.

It is important to calibrate the TruPulse 360/360R prior to taking measurements. See Appendix A and Appendix B for calibration instructions.

The Missing Line Measurements procedure below provides information and instructions for taking span length measurements when there is not a clear line of sight and obstructions prohibit the personnel performing a pole load calculation from taking the measurements using off-sets.

Missing Line Measurements

STEP 1. Set up and level the tripod using the bubble level on the TruPulse L bracket.

STEP 2. Press the Up ▲ or Down ▼ arrow to select the "HD-ML" function.

*Result: **Shot 1** displays in the Main Display.*

STEP 3. Align the crosshairs on a visible section of the first pole.

STEP 4. Press the **Fire** button.

*Result: The measurement in the Main Display briefly displays then **Shot 2** displays.*

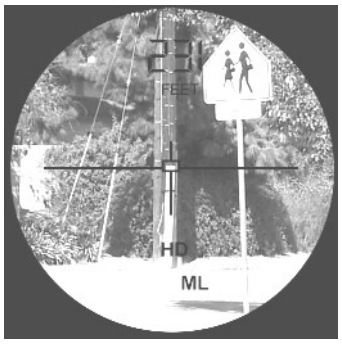
STEP 5. Align the crosshairs on the 2nd pole.

STEP 6. Press the **Fire** button.

Result: The instrument will calculate a span length between the two targets and a footage reading displays in the Main Display.

Note: By scrolling through the menu to the azimuth (AZ) function, the personnel performing a pole load calculation can view the compass azimuth of the span.

(End of Procedure)



B. Measuring Angles with the TruPulse 360

The most critical angles are the primary conductors, secondary conductors and/or main communication or cable TV lines. These are critical because they impart most of the load on the pole, due to tension and wind load, and will have a profound effect on the resulting safety factor if the angles are incorrect.

The TruPulse is a magnetic instrument that will be affected by outside influences, for example: cars, fences, fire hydrants, manhole covers or any magnetic type of metal. It is important to test for magnetic interference prior to taking measurements. See PLM–4 Section 4.1.A. "Testing for Magnetic Interference" for additional information.

Also, it is important to calibrate the TruPulse 360/360R prior to taking measurements. Refer to the TruPulse 360/360R Calibration section of this guide for instructions.

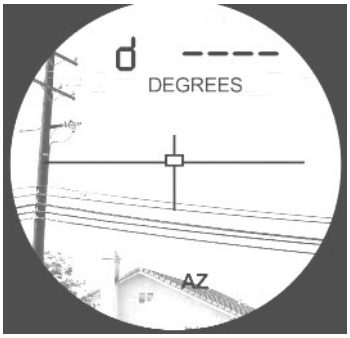
The procedure below provides information and instructions for taking angle measurements.

Measuring Angles

STEP 1. Press the Up ▲ or Down ▼ arrow to select the AZ setting.

Result: d ---- DEGREES displays in the Main Display.

Note: When using the azimuth function, care must be taken to identify the location of the tripod relative to the subject pole. This "offset" must be accounted for on the next pole.



STEP 2. Install the Thumb Trigger to the TruPulse 306/360R to give the tool stability and remove magnetic interference as far away from the tool as possible.

STEP 3. Set up the TruPulse/tripod so there is a line of sight to the largest number of targets/poles from a single location.

STEP 4. If needed, establish an off-set away from the first pole.

STEP 5. Aim at the target.

STEP 6. Press the **Fire** button. FIRE

Result: The measurement displays in the Main Display

STEP 7. Record the measurement.

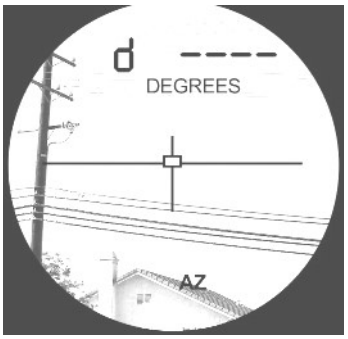
Measuring Angles (Continued)

STEP 8. Move the TruPulse/tripod as needed to measure the next pole.

Note: When obstacles exist, move the tripod to different locations in order to collect all of the angles to the associated wire end points.

STEP 9. Aim at the next target.

Result: d ---- DEGREES displays in the Main Display.



STEP 10. Press the **Fire** button. FIRE

Result: The measurement displays in the Main Display

STEP 11. Record the measurement.

STEP 12. Repeat Steps 5–8 until all measurements are taken and recorded.

Note: It is best practice to double-check the angle measurements. For example, if the True Pulse shows a delta of 150 degrees and it is obviously a straight line (0–180), you will need to take corrective action to eliminate the discrepancy.

(End of Procedure)

C. Measuring Heights with the TruPulse 360

Measuring the Heights above Groundline (HAGL) is a three shot routine using the TruPulse 360/360R.

- The first shot is to determine the distance from the pole to the TruPulse.
- The second shot is the groundline shot or a shot to a known point above the groundline.
- The third shot is the second angle.

It is important to calibrate the TruPulse 360/360R prior to taking measurements. See Appendix A and Appendix B for calibration instructions.

The procedure below provides information and instructions for measuring HAGL.

Measuring Heights Above Groundline

STEP 1. Level the TruPulse 360/360R.

STEP 2. Select a distance away from the target that is approximately 90 feet or 1.5 times the height of the pole.

STEP 3. Establish a clear line of sight to the entire length of the pole.

Note: When the butt of the pole cannot be seen due to field conditions, mark a known reference point on the pole at a level that clears the obstruction. This establishes an offset to GL. Be sure to record this offset height and add it to the other measurements.

STEP 4. Select the HD-HT function.

STEP 5. Press the **Fire** button (FIRE) to capture the distance from the tool to the pole.

Result: The measurement displays in the Main Display.

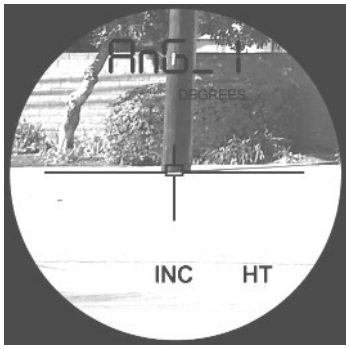
Note: It is important to try to capture this measurement from a reflective surface, as this footage measurement is used to calculate all of the subsequent readings for attachments. The VIS strip or the pole tag is a good example.

Measuring Heights Above Groundline (Continued)

STEP 6. Press the **Up** arrow.

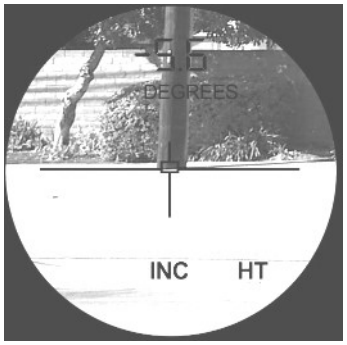
Result: AnGL1 displays in the Main Display

STEP 7. Scan down to the bottom of the pole, where the pole touches the ground.



STEP 8. Press the **Fire** button to capture the first andle shot.

Result: The measurement flashes in the Main Display and then Ang_2 displays.



STEP 9. Scan to the top of the pole.

STEP 10. Start at the very tip of the pole and press the **Fire** button to measure the HAGL for the pole.

Result: The measurement displays in the Main Display.

Measuring Heights Above Groundline (Continued)

STEP 11. Record the measurement.

STEP 12. Press the **Up** arrow once.

Result: AnG_2 DEGREES displays in the Main Display

STEP 13. Locate the next point of attachment and press the **Fire** button.

Result: The measurement displays in the Main Display.

STEP 14. Record the measurement.

STEP 15. Repeat Steps 12–14 until all of the points of attachment have been measured and recorded.

(End of Procedure)

Appendix A: TruPulse 360/360R Inclinometer Calibration

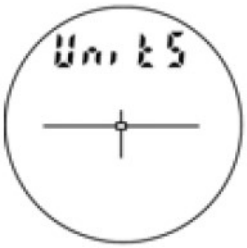
The procedure below provides information and instructions on conducting the inclinometer calibration on the TruPulse 360 Range Finder.

TruPulse 360/360R Inclinometer Calibration

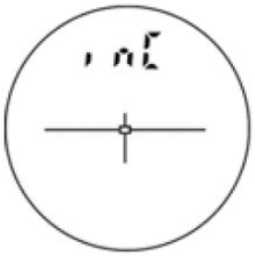
STEP 1. Look through the eye piece of the tool.

STEP 2. Press and hold the **Down** arrow ▼ for four seconds to access the System Setup Mode.

*Result: **UnitS** displays in the Main Display.*

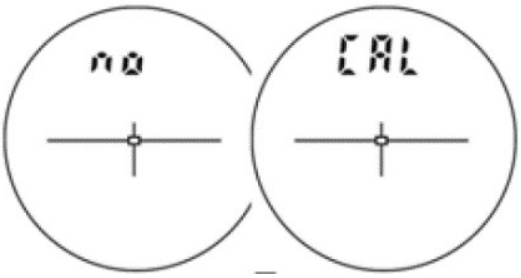


STEP 3. Press the **Down** arrow ▼ to display the **inC** option.



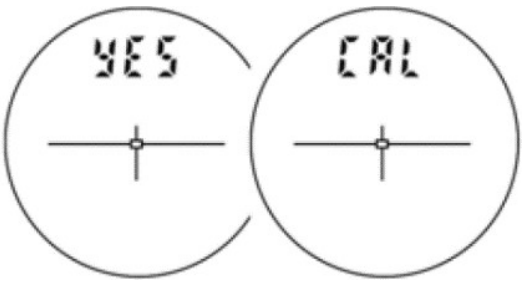
STEP 4. Press the **Fire** button. (FIRE)

*Result: **no CAL** displays.*



STEP 5. Press the **Down** arrow. ▼

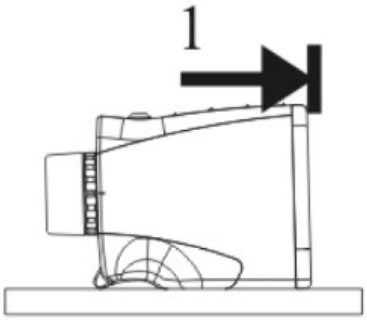
*Result: **YES CAL** displays.*



TruPulse 360/360R Inclinometer Calibration (Continued)

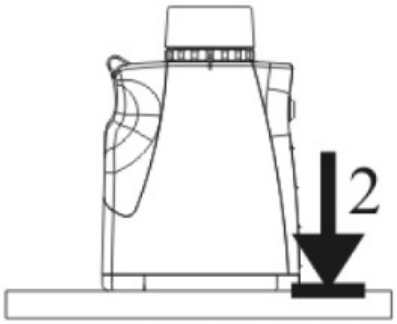
STEP 6. Press the **Fire** button.
Result: The calibration routine is entered.

STEP 7. Position the tool on a flat, relatively level surface with the lenses facing forward.



STEP 8. Press the **Fire** button.
Result: The first calibration point is stored.

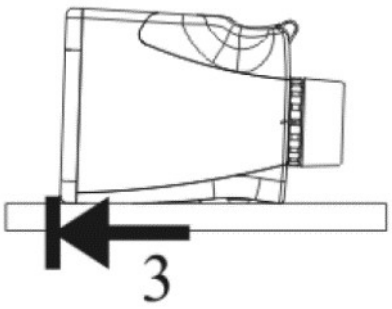
STEP 9. Rotate the tool 90 degrees.



STEP 10. Wait one second.

STEP 11. Press the **Fire** button.
Result: The second calibration point is stored.

STEP 12. Rotate the tool 90 degrees.

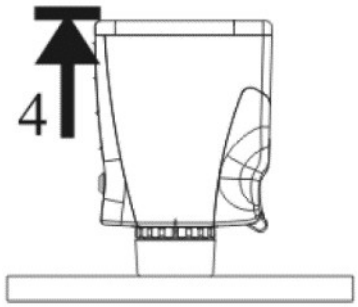


STEP 13. Wait one second.

STEP 14. Press the **Up** ▲ or **Down** ▼ arrow.
Note: A long press will abort the calibration routine
Result: The third calibration point is stored.

TruPulse 360/360R Inclinometer Calibration (Continued)

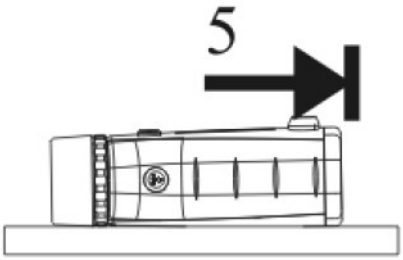
STEP 15. Rotate the tool 90 degrees.



STEP 16. Wait one second.

STEP 17. Press the **Fire** button. FIRE
Result: The fourth calibration point is stored.

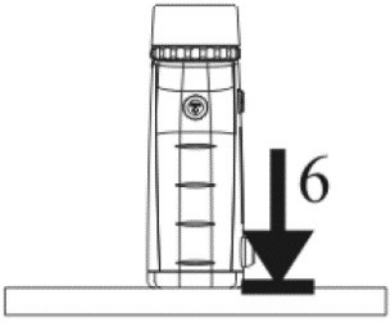
STEP 18. Rotate the tool 90 degrees



STEP 19. Wait one second.

STEP 20. Press the **Fire** button. FIRE
Result: The fifth calibration point is stored.

STEP 21. Rotate the tool 90 degrees

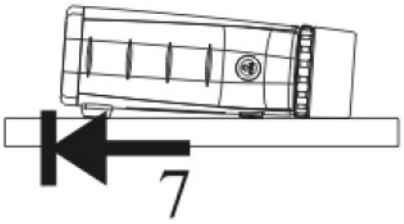


STEP 22. Wait one second.

STEP 23. Press the **Fire** button. FIRE
Result: The sixth calibration point is stored.

TruPulse 360/360R Inclinometer Calibration (Continued)

STEP 24. Rotate the tool 90 degrees.

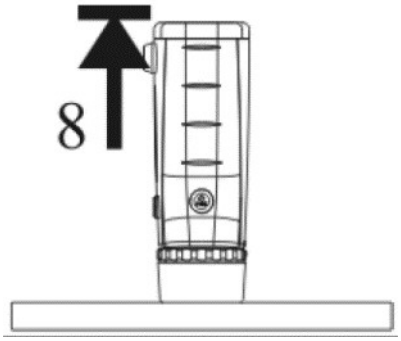


STEP 25. Wait one second.

STEP 26. Press the **Fire** button. FIRE

Result: The seventh calibration point is stored.

STEP 27. Rotate the tool 90 degrees.



STEP 28. Wait one second.

TruPulse 360/360R Inclinometer Calibration (Continued)

STEP 29. Press the **Fire** button.

Result: The eigth calibration point is stored.

STEP 30. Look through the eye piece to view the pass or fail message.

*Result: The **Pass** or **FAiL** message displays.*

STEP 30.1 IF **PASS** displays:

- Press the **Fire** button to return to the Measurement Mode.

STEP 30.2 IF **FAiL** displays:

- Note the reason failure reason using the codes below.
  - — FAiL 1: Excessive motion during calibration. Unit was not held steady.
  - — FAiL 2: Magnetic saturation error. Local magnetic field too strong.
  - — FAiL 3: Mathematical error.
  - — FAiL 4: Calibration convergence error.
  - — FAiL 6: Orientations were wrong during calibration.
- Press the Fire button.

  *Result: **no CAL** displays.*
- Repeat steps 4 through 30 to calibrate the tool.

(End of Procedure)

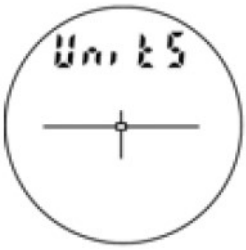
Appendix B: TruPulse 360/360R Horizontal Angle Compass Calibration

The procedure below provides information and instructions for conducting the horizontal angle compass calibration routine on the TruPulse 360 Range Finder.

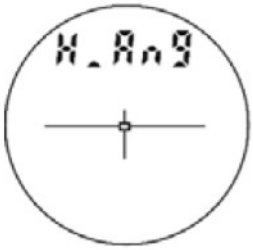
TruPule 360/360R Horizontal Angle Compass Calibration

STEP 1. Look through the eye piece of the tool to the North within 15 degrees.

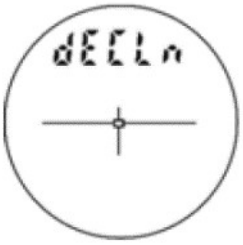
STEP 2. Press and hold the **Down** arrow ▼ for four seconds to access the System Setup Mode.
*Result: **UnitS** displays in the Main Display.*



STEP 3. Press the **Down** arrow ▼ until **H_Ang** appears in the Main Display.



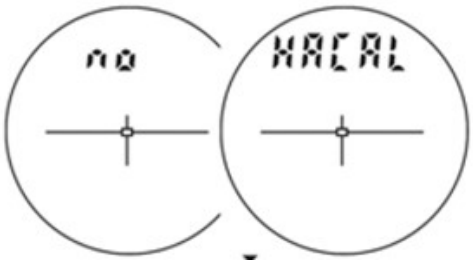
STEP 4. Press the **Fire** button. (FIRE)
*Result: **dECLn** displays in the Main Display.*



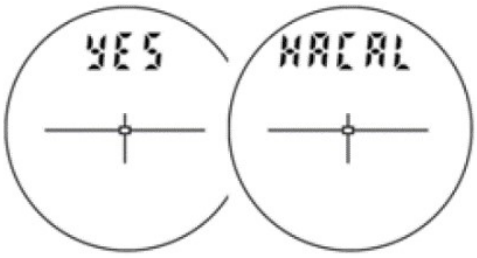
STEP 5. Press the **Up** ▲ arrow to display the **HACAL** option

TruPule 360/360R Horizontal Angle Compass Calibration (Continued)

STEP 6. Press the **Fire** button.
*Result: **no HACAL** displays in the Main Display*



STEP 7. Press the **Up** ▲ or **Down** ▼ arrow.
*Result: **yes HACAL** displays in the Main Display*

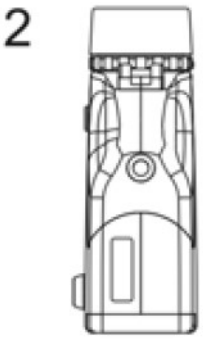


STEP 8. Press the **Fire** button to begin the calibration routine.
*Result: **C1-Fd** displays in the Main Display.*

STEP 9. Hold the tool facing close to magnetic North.

STEP 10. Press the **Fire** button.
Result: The first calibration point is stored.

STEP 11. Rotate the tool 90 degrees.



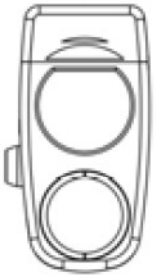
STEP 12. Wait one second

TruPule 360/360R Horizontal Angle Compass Calibration (Continued)

STEP 13. Press the **Fire** button.
Result: The second calibration point is stored.

STEP 14. Rotate the tool 90 degrees.

3



STEP 15. Wait one second.

STEP 16. Press the **Fire** button.
Result: The third calibration point is stored.

STEP 17. Rotate the tool 90 degrees.

4

STEP 18. Wait one second.

STEP 19. Press the **Fire** button.
Result: The fourth calibration point is stored.

STEP 20. Rotate the tool 90 degrees.

5

TruPulse FacingNorth
Serial Port Pointing Up

STEP 21. Wait one second.

STEP 22. Press the **Fire** button.
Result: The fifth calibration point is stored.

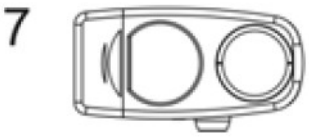
TruPule 360/360R Horizontal Angle Compass Calibration (Continued)

STEP 23. Rotate the tool 90 degrees.

STEP 24. Wait one second.

STEP 25. Press the **Fire** button. FIRE
Result: The sixth calibration point is stored.

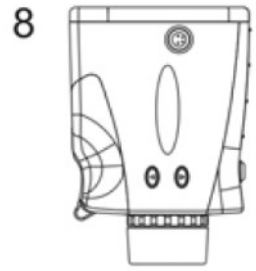
STEP 26. Rotate the tool 90 degrees.



STEP 27. Wait one second.

STEP 28. Press the **Fire** button. FIRE
Result: The seventh calibration point is stored.

STEP 29. Rotate the tool 90 degrees.



STEP 30. Wait one second.

TruPule 360/360R Horizontal Angle Compass Calibration (Continued)

STEP 31. Press the **Fire** button FIRE.
Result: The eigth calibration point is stored.

STEP 32. Look through the eye piece.
*Result: The **PASS** or **FAiL** message displays.*

STEP 32.1 If **PASS** displays:

- Press the **Fire** button FIRE to return to Measurement Mode

STEP 32.2 If **FAiL** displays:

- Note the reason failure reason using the codes below.
  - — FAiL 1: Excessive motion during calibration. Unit was not held steady.
  - — FAiL 2: Magnetic saturation error. Local magnetic field too strong.
  - — FAiL 3: Mathematical error.
  - — FAiL 4: Calibration convergence error.
  - — FAiL 6: Orientations were wrong during calibration.
- Press the **Fire** button. FIRE
  *Result: **no CAL** displays.*
- Repeat calibration procedure.

(End of Procedure)

PLM–5: Miscellaneous

Table of Contents

1.0 Reference Tables and Formulas

1.1 Guying Tables and Examples

The tables in this section provide data when hand calculations for guying evaluation(s) are needed. Included is information addressing down guys, side guys, span guys, and sidewalk guys. Guying examples are shown in Section H.

A. Determination of Conductor Dead-end Tension

Table 1 lists the dead-end tension of conductors for California light- or heavy-loading conditions. The dead-end tension must be multiplied by the number of conductors to determine the total dead-end tension for guying. Conduction tension may vary depending on span length and wind-loading conditions. The tensions presented were determined with the use of G.O. 95 requirements for light and heavy loading.

Table 1: Conductor Dead-End Tension

Conductor Size/Type (Solid or Stranded)	Wire Size (kcmil or AWG)	Wire Tension at Dead-End (lb)
		Distribution
ACSR	#4[a/]	604
	1/0	1,415
	336.4 kcmil	2,846
	653.9 kcmil	3,267
Copper Triplex	#4	484
	#2	761
Aluminum Triplex or Quadruplex	1/0	1,415
	4/0	2,780
Weather-Resistant Copper	#6	375
	#4	540
	#2	830
	2/0	1,590
	4/0	2,455
Bare Copper	#6	320
	#4	484
	#2	761
	2/0	1,482
	4/0	2,288

[a/] Not approved for use on new construction.

Table 1: Conductor Dead-End Tension

Type of Conductor	Wire Size AWG		Wire Tension at Dead-End (lb)	
	Size	Strands	Light	Heavy
ACSR	#4[a/]	6/1	520	604
	#2	6/1	675	761
	1/0	6/1	1,242	1,415
	2/0	6/1	1,543	1,768
	3/0	6/1	1,914	2,204
	4/0	6/1	2,402	2,780
	336.4	18/1	2,284	2,768
	336.4	30/7	3,260	3,260
	653.9	18/3	2,847	3,200
Covered Conductor (ACSR)	1/0	6/1	1,415	1,415
	336.4	18/1	2,846	2,846
	336.4	30/7	N/A	5,000
	653.9	18/3	2,846	3,267
Aluminum Duplex	#4	6/1	592	604
	#6	6/1	385	386
Aluminum Triplex	#6	6/1	386	382
	#4	6/1	576	604
	#2	6/1	580	761
	1/0	6/1	1,309	1,415
	4/0	6/1	2,469	2,781
Aluminum Quadruplex	#4	6/1	575	604
	1/0	6/1	1,313	1,415
	4/0	6/1	2,474	2,771
AAC	1/0	7	567	662
	4/0	7	1,075	1,312
	336.4	19	1,533	1,994
	477	19	1,939	2,498
	636	37	2,591	3,130
	1033.5	37	4,545	5,477

Table 1: Conductor Dead-End Tension *(Continued)*

Type of Conductor	Wire Size AWG		Wire Tension at Dead-End (lb)	
	Size	Strands	Light	Heavy
Copper	#6	1	320	
	#4	1	484	
	#4	7	484	
	#2	7	761	
	1/0	19	1,415	
	2/0	7	1,482	
	3/0	1	1,680	
	4/0	19	2,288	
Covered Conductor (Copper)	#2	7	925	
	2/0	7	1,800	
	4/0	7	2,780	
Weather Resistant Copper	#6	7	375	
	#4	1	484	
	#2	7	830	
	2/0	7	1,590	
	4/0	7	2,455	
Copper Triplex	#6	7	320	640
	#4	7	484	970
	#2	7	761	1,015

[a/] Not approved for use on new construction.

B. Determination of Deviation Angle

To determine the deviation angle, use Table 2 as follows. Measure any convenient distance from 20 to 60 feet as a continuation of the line in one direction. This distance will correspond to “A” in Table 2. Next, measure the distance at right angles to this extension until the line in the new direction is encountered. This will correspond to “B” in Table 2 below. The deviation angle is used with Table 3 to determine the resultant conductor tension on an angle pole.

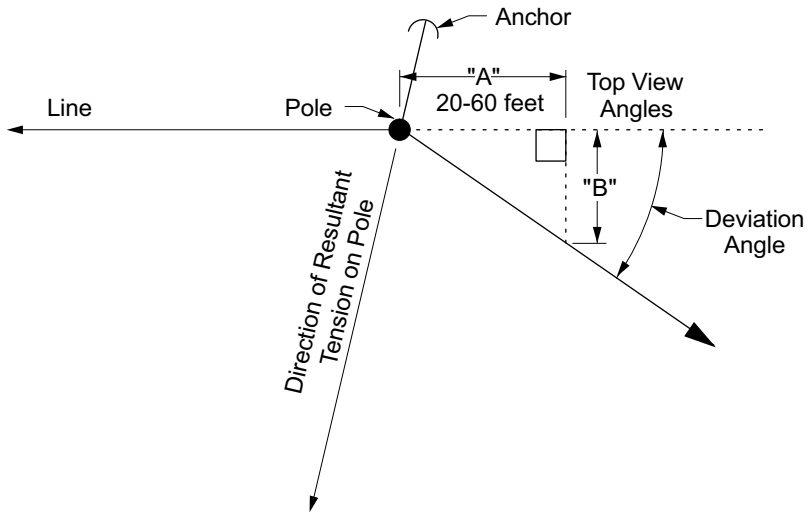


Table 2: Deviation Angles

Distance "A" (ft)	Distance "B" (ft)											
60	5	11	16	22	28	35	42	50	60	71	86	104
55	5	10	15	20	26	32	38	46	55	65	78	95
50	4	9	13	18	23	29	35	42	50	60	71	86
45	4	8	12	16	21	26	31	38	45	54	64	78
40	3	7	11	15	19	23	28	34	40	48	57	69
35	3	6	9	13	16	20	25	29	35	42	50	61
30	3	5	8	11	14	17	21	25	30	36	43	52
25	2	4	7	9	12	14	17	21	25	30	36	42
20	2	4	5	7	9	12	14	17	20	24	29	35
Deviation Angle	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°

EXAMPLE:

If Distance “A” = 50 feet and Distance “B” = 29 feet, the Deviation Angle is 30 degrees.

C. Determination of Conductor Side Tensions

Table 3 is used to calculate the resultant-side tension per conductor when the deviation angle of the conductors is known. When this table is used with Table 5 and Table 6, the proper guy wire size may be determined. To determine the deviation angle, use Table 2. Example 3 illustrates the use of side guys.

Table 3a: Side Guying Tensions (Light Loading)

Conductor Type		Strands	Deviation Angles (Degrees)											
			5	10	15	20	25	30	35	40	45	50	55	60
			Tension (lb)											
ACSR	# 4[a/]	6/1	45	91	136	181	225	269	313	356	398	440	480	520
	#2	6/1	59	118	176	234	292	349	406	462	517	571	623	675
	1/0	6/1	108	216	324	431	538	643	747	850	951	1,050	1,147	1,242
	2/0	6/1	135	269	403	536	668	799	928	1,055	1,181	1,304	1,425	1,543
	3/0	6/1	167	334	500	665	829	991	1,151	1,309	1,465	1,618	1,768	1,914
	4/0	6/1	210	419	627	834	1,040	1,243	1,445	1,643	1,838	2,030	2,218	2,402
	336.4	18/1	199	398	596	793	989	1,182	1,374	1,562	1,748	1,931	2,109	2,284
	336.4	30/7	284	568	851	1,132	1,411	1,688	1,961	2,230	2,495	2,755	3,011	3,260
	653.9	18/3	248	496	743	989	1,232	1,474	1,712	1,947	2,179	2,406	2,629	2,847
Aluminum Duplex	#4	6/1	51	101	152	202	252	301	349	397	445	491	537	581
	#6	6/1	34	67	101	134	167	199	232	263	295	325	356	385
Aluminum Triplex	#6	6/1	34	67	101	134	167	200	232	264	295	326	356	386
	#4	6/1	50	100	150	200	249	298	346	394	441	487	532	576
	#2	6/1	63	126	188	250	312	373	434	493	552	609	666	721
	1/0	6/1	114	228	342	455	567	678	787	895	1,002	1,106	1,209	1,309
	4/0	6/1	215	431	645	858	1,069	1,279	1,485	1,690	1,890	2,088	2,281	2,470
Aluminum Quadruplex	#4	6/1	50	100	150	200	249	298	346	393	440	486	531	575
	1/0	6/1	115	229	343	456	568	680	790	898	1,005	1,110	1,213	1,313
	4/0	6/1	216	431	646	860	1,071	1,281	1,488	1,693	1,894	2,092	2,286	2,475
AAC	1/0	7	49	99	148	197	245	294	341	388	434	479	524	567
	4/0	7	94	187	281	373	465	556	647	735	823	909	993	1075
	336.4	19	134	267	400	532	664	794	922	1,049	1,173	1,296	1,416	1533
	477	19	169	338	506	673	839	1,004	1,166	1,326	1,484	1,639	1,791	1939
	636	37	226	452	676	900	1,122	1,341	1,558	1,772	1,983	2,190	2,393	2591
	1033.5	37	397	792	1,186	1,578	1,967	2,353	2,733	3,109	3,479	3,842	4,197	4545
Copper	#6	1	28	56	84	111	139	166	192	219	245	270	296	320
	#4	1	42	84	126	168	210	251	291	331	370	409	447	484
	#4	7	42	84	126	168	210	251	291	331	370	409	447	484
	#2	7	66	133	199	264	329	394	458	521	582	643	703	761
	1/0	19	123	247	369	491	613	732	851	968	1,083	1,196	1,307	1,415
	2/0	7	129	258	387	515	642	767	891	1,014	1,134	1,253	1,369	1,482
	3/0	1	147	293	439	583	727	870	1,010	1,149	1,286	1,420	1,551	1,680
	4/0	19	199	397	595	792	987	1,180	1,371	1,560	1,745	1,927	2,106	2,280

Table 3a: Side Guying Tensions (Light Loading) *(Continued)*

Conductor Type		Strands	Deviation Angles (Degrees)											
			5	10	15	20	25	30	35	40	45	50	55	60
			Tension (lb)											
Weather Resistant Copper	#6	7	33	65	98	130	162	194	226	257	287	317	346	375
	#4	1	42	84	126	168	210	251	291	331	370	409	447	484
	#2	7	72	145	217	288	359	430	499	568	635	702	767	830
	2/0	7	139	277	415	552	688	823	956	1,088	1,217	1,344	1,468	1,590
	4/0	7	214	428	641	853	1,063	1,271	1,476	1,679	1,879	2,075	2,267	2,455
Copper Triplex	#6	7	28	56	84	111	139	166	192	219	245	270	296	320
	#4	7	42	84	126	168	210	251	291	331	370	409	447	484
	#2	7	66	133	199	264	329	394	458	521	582	643	703	761

[a/] Not approved for use on new construction

Example:

See shaded areas—one 1/0 ACSR conductor at a deviation angle of 30 degrees has a side tension of 732 pounds (see shaded areas).

Table 3b: Side Guying Tensions (Heavy Loading)

Conductor Type		Strands	Deviation Angles (Degrees)											
			5	10	15	20	25	30	35	40	45	50	55	60
			Tension (lb)											
	# 4[a/]	6/1	53	105	158	210	261	313	363	413	462	511	558	604
	#2	6/1	66	133	199	264	329	394	458	521	582	643	703	761
	1/0	6/1	123	247	369	491	613	732	851	968	1,083	1,196	1,307	1,415
	2/0	6/1	154	308	462	614	765	915	1,063	1,209	1,353	1,494	1,633	1,768
	3/0	6/1	192	384	575	765	954	1,141	1,326	1,508	1,687	1,863	2,035	2,204
	4/0	6/1	243	485	726	965	1,203	1,439	1,672	1,902	2,128	2,350	2,567	2,780
	336.4	18/1	241	482	723	961	1,198	1,433	1,665	1,893	2,119	2,340	2,556	2,768
	336.4	30/7	284	568	851	1,132	1,411	1,688	1,961	2,230	2,495	2,755	3,011	3,260
ACSR	653.9	18/3	279	558	835	1,111	1,385	1,656	1,925	2,189	2,449	2,705	2,955	3,200
Aluminum Duplex	#4	6/1	53	105	158	210	261	313	363	413	462	511	558	604
	#6	6/1	34	67	101	134	167	200	232	264	295	326	356	386
	#6	6/1	33	67	100	133	165	198	230	261	292	323	353	382
	#4	6/1	53	105	158	210	261	313	363	413	462	511	558	604
	#2	6/1	66	133	199	264	329	394	458	521	582	643	703	761
Aluminum Triplex	1/0	6/1	123	247	369	491	613	732	851	968	1,083	1,196	1,307	1,415
	4/0	6/1	243	485	726	965	1,203	1,439	1,672	1,902	2,128	2,350	2,567	2,780
	#4	6/1	53	105	158	210	261	313	363	413	462	511	558	604
Aluminum Quadruplex	1/0	6/1	123	247	369	491	613	732	851	968	1,083	1,196	1,307	1,415
	4/0	6/1	243	485	726	965	1,203	1,439	1,672	1,902	2,128	2,350	2,567	2,780

Table 3b: Side Guying Tensions (Heavy Loading) *(Continued)*

Conductor Type		Strands	Deviation Angles (Degrees)											
			5	10	15	20	25	30	35	40	45	50	55	60
			Tension (lb)											
	1/0	7	58	115	173	230	287	343	398	453	507	560	611	662
	4/0	7	114	229	343	456	568	679	789	897	1,004	1,109	1,212	1,312
	336.4	19	174	348	521	693	863	1,032	1,199	1,364	1,526	1,685	1,841	1,994
	477	19	218	435	652	868	1,081	1,293	1,502	1,709	1,912	2,111	2,307	2,498
	636	37	273	546	817	1,087	1,355	1,620	1,882	2,141	2,396	2,646	2,891	3,130
AAC	1033.5	37	478	955	1,430	1,902	2,371	2,835	3,294	3,746	4,192	4,629	5,058	5,477
	#6	1	28	56	84	111	139	166	192	219	245	270	296	320
	#4	1	42	84	126	168	210	251	291	331	370	409	447	484
	#4	7	42	84	126	168	210	251	291	331	370	409	447	484
	#2	7	66	133	199	264	329	394	458	521	582	643	703	761
	1/0	19	123	247	369	491	613	732	851	968	1,083	1,196	1,307	1,415
	2/0	7	129	258	387	515	642	767	891	1,014	1,134	1,253	1,369	1,482
	3/0	1	147	293	439	583	727	870	1,010	1,149	1,286	1,420	1,551	1,680
Copper	4/0	19	199	397	595	792	987	1,180	1,371	1,560	1,745	1,927	2,106	2,280
	#6	7	33	65	98	130	162	194	226	257	287	317	346	375
	#4	1	42	84	126	168	210	251	291	331	370	409	447	484
	#2	7	72	145	217	288	359	430	499	568	635	702	767	830
Weather Resistant	2/0	7	139	277	415	552	688	823	956	1,088	1,217	1,344	1,468	1,590
Copper	4/0	7	214	428	641	853	1,063	1,271	1,476	1,679	1,879	2,075	2,267	2,455
	#6	7	56	112	167	222	277	331	385	438	490	541	591	640
Copper	#4	7	85	169	253	337	420	502	583	664	742	820	896	970
Triplex	#2	7	89	177	265	353	439	525	610	694	777	858	937	1,015

[a/] Not approved for use on new construction.

D. Determination of Angle from Guy to Pole

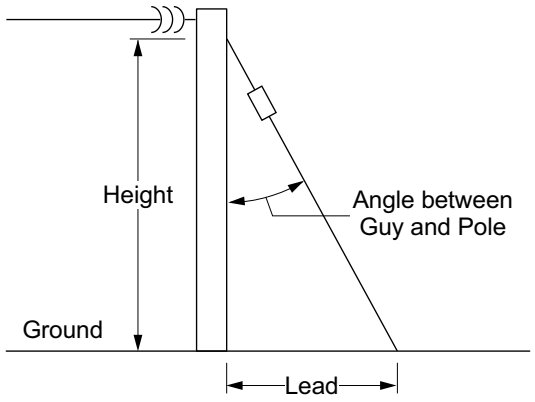
Table 4 is used to determine the angle created by the guy wire and the pole. When used with Table 5 and Table 6, the guying tensions for dead-ended conductors and side guying may be determined.

Table 4: Angle between Guy and Pole

Height (Guy-to-Ground [ft])	Lead (Pole-to-Anchor [ft])															
90	5	8	11	14	17	21	24	33	42	52	63	76	90	107	129	156
85	4	7	10	13	17	20	23	31	40	49	60	71	85	101	121	147
80	4	7	10	13	16	18	21	29	37	46	56	67	80	95	114	139
75	4	7	9	12	15	17	20	27	35	43	53	63	75	89	107	130
70	4	6	9	11	14	16	19	25	33	40	49	59	70	83	100	121
65	3	6	8	10	13	15	17	24	30	38	46	55	65	77	93	113
60	3	5	7	10	12	14	16	22	28	35	42	50	60	71	86	104
55	3	5	7	9	11	13	15	20	26	32	38	46	55	65	78	95
50'	3	4	6	8	10	12	13	18	23	29	35	42	50	60	71	86
45	2	4	6	7	9	10	12	16	21	26	31	38	45	54	64	78
40	2	3	5	6	8	9	11	15	19	23	28	34	40	48	57	69
35	2	3	4	6	7	8	9	13	16	20	25	29	35	42	50	61
30	2	3	4	5	6	7	8	11	14	17	21	25	30	36	43	52
25	1	2	3	4	5	6	7	9	12	14	17	21	25	30	36	43
20	1	2	2	3	4	5	5	7	9	12	14	17	20	24	29	35
Angle (Guy-to-Pole)	3°	5°	7°	9°	11°	13°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°

Example:

A guy wire is attached to a pole 45 feet above the ground and the lead is 38 feet. The angle between the guy and the pole is 40 degrees.



E. Determination of Guy Wire Size

Table 5 list the types, sizes, and safety factors of guy wires purchased by Edison. When the maximum conductor tensions are known, these tables can be used to determine the guy wire size and number of guy wires required. The maximum number of guys for a sidewalk anchor is two.

Table 5: MAX Conductor Tension for Guy Wires — Grade A or B Construction
(Safety Factor = 2)

MAX Safe Conductor Tension (lb) for One Guy Wire[b/]							
Angle (Guy-to-Pole) (Degrees)	**Guy Size**						
	1/4	**7/32[a/]**	**5/16**	**9/32[a/]**	**3/8[a/]**	**7/16**	**7/16 (EHS)**
3	—	—	209	234	403	379	544
5	—	—	349	390	671	632	906
7	—	—	487	545	938	884	1,267
9	—	—	626	700	1,205	1,134	1,627
11	—	—	763	854	1,469	1,383	1,984
13	—	—	900	1,007	1,732	1,631	2,339
15	—	—	1,035	1,158	1,993	1,876	2,692
20	—	—	1,368	1,531	2,634	2,480	3,557
25	—	—	1,690	1,891	3,254	3,064	4,395
30	—	—	2,000	2,238	3,850	3,625	5,200
35	—	—	2,294	2,567	4,417	4,158	5,965
40	—	—	2,571	2,876	4,949	4,660	6,685
45	—	—	2,828	3,164	5,445	5,127	7,354
50	—	—	3,064	3,428	5,899	5,554	7,967
55	—	—	3,277	3,666	6,307	5,939	8,519
60	—	—	3,464	3,875	6,668	6,279	9,007
Level (Overhead Guy)	2,375	2,400	4,000	4,475	7,700	7,250	10,400

[a/] Standard extra-high-strength steel guy strand sizes
[b/] Ultimate conductor tension divided by Safety Factor (from Table 24, General Order 95).
1/4 inch, 5/16 inch, and 7/16 inch entries are listed for reference only. The Maximum number of guys for a sidewalk anchor is two.

Table 5a: MAX Conductor Tension for New Guy Wires — Grade A or B Construction (Safety Factor = 2)

MAX Safe Conductor Tension (lb) for One Guy Wire[a/]			
Angle (Guy-to-Pole) (Degrees)	**Guy Size**		
	9/32 (EHS)	**3/8 (EHS)**	**7/16 (EHS)**
3	234	403	523
5	390	671	872
7	545	938	1,219
9	700	1,205	1,564
11	854	1,469	1,908
13	1,007	1,732	2,250
15	1,158	1,993	2,588
20	1,531	2,634	3,420
25	1,891	3,254	4,226
30	2,238	3,850	5,000
35	2,567	4,417	5,736
40	2,876	4,949	6,428
45	3,164	5,445	7,071
50	3,428	5,899	7,660
55	3,666	6,307	8,192
60	3,875	6,668	8,660
Level (Overhead Guy)	4,475	7,700	10,000

[a/] Ultimate conductor tension divided by Safety Factor (from Table 24, G.O. 95). The high-strength (1/4 inch, 5/16 inch, and 7/16 inch) entries are listed for reference only. The Maximum number of guys for a sidewalk anchor is two.

Example:

A single 3/8-inch guy wire installed at a 40 degrees angle, between the pole and guy, is capable of supporting a conductor tension of 4,949 pounds in Grade A construction.

Table 5b: MAX Conductor Tension for In-Service Guy Wires — Grade A or B Construction (Safety Factor = 1.33)

MAX Safe Conductor Tension (lb) for One Guy Wire[a/]			
Angle (Guy-to-Pole) (Degrees)	**Guy Size**		
	9/32 (EHS)	**3/8 (EHS)**	**7/16 (EHS)**
3	351	605	785
5	585	1,007	1,307
7	818	1,407	1,828
9	1,050	1,808	2,347
11	1,281	2,204	2,862
13	1,511	2,598	3,374
15	1,737	2,990	3,882
20	2,297	3,951	5,130
25	2,837	4,881	6,339
30	3,357	5,775	7,500
35	3,851	6,626	8,604
40	4,314	7,424	9,642
45	4,746	8,168	10,607
50	5,142	8,849	11,491
55	5,499	9,461	12,287
60	5,813	10,002	12,990
Level (Overhead Guy)	6,713	11,550	15,000

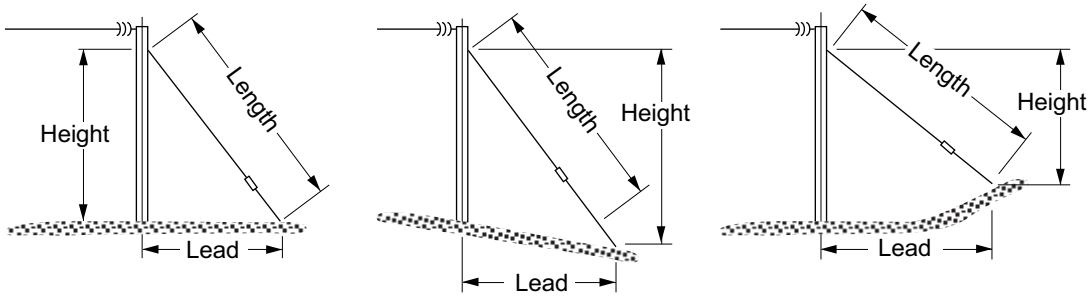
[a/] Ultimate conductor tension divided by Safety Factor (from Table 24, G.O. 95). The high-strength (1/4 inch, 5/16 inch, and 7/16 inch) entries are listed for reference only. The Maximum number of guys for a sidewalk anchor is two.

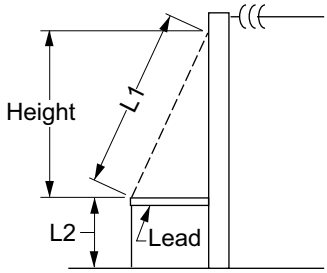
F. Determination of Down Guy Length

Table 6 may be used to determine the length of a down guy when the height of the guy is known and the lead (distance from the pole to the anchor) is known.

Table 6: Guy Wire Length

Height (ft) \ Lead (ft)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
10	14	18	23	27	32	37	42	46	51	56	61	66	71	76	81	86	92
15	18	21	25	30	34	39	43	48	53	58	62	67	72	77	82	87	92
20	23	25	28	33	36	41	45	50	54	59	64	68	73	78	83	88	93
25	27	30	33	36	40	43	48	52	57	60	66	71	75	79	84	89	94
30	32	34	36	40	43	47	50	55	59	63	68	72	77	81	86	90	96
35	37	39	41	44	47	50	55	58	62	66	71	75	79	83	88	92	98
40	42	43	45	48	50	54	57	61	65	69	73	77	81	85	90	94	100
45	46	48	51	53	55	58	62	64	69	72	76	80	84	88	92	96	102
50	51	53	54	56	59	61	65	68	71	75	79	82	87	90	95	98	104
55	56	58	59	61	64	66	70	72	76	78	83	86	90	93	97	102	106
60	61	62	64	65	68	70	73	75	79	81	85	89	93	96	100	105	109
65	66	67	68	71	73	75	78	80	83	86	90	93	97	98	103	107	112
70	71	72	73	74	77	78	81	83	87	89	93	97	99	103	107	110	115
75	76	77	78	79	81	83	85	88	90	93	96	98	103	106	110	114	118
80	81	82	83	84	86	88	90	92	95	97	100	103	107	110	114	117	121
85	86	87	88	89	90	92	94	96	98	102	105	107	110	114	117	120	124
90	92	92	93	94	96	98	100	102	104	106	109	112	115	118	121	124	128





NOTE: L1 = length from the table.
L1 and L2 = Total length of guy wire for a sidewalk anchor

G. Determination of Angle from Guy-to-Pole for Sidewalk Anchors

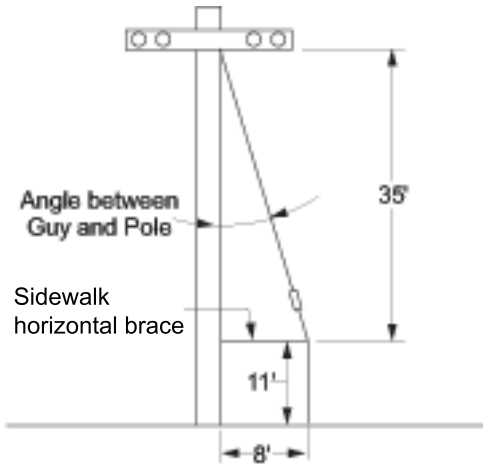
Table 7 is used to determine the angle from the guy to the pole created by a sidewalk anchor. When used with Table 5 and Table 6, the guying tensions for sidewalk anchoring may be determined.

Table 7: Angle between Guy and Pole for Sidewalk Anchor

Height (Guy Attachment-to-Sidewalk Horizontal Brace) (ft)	Length of Sidewalk Horizontal Brace (ft)							
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**
10	17	22	27	31	35	39	42	45
15	11	15	18	22	25	28	31	34
20	9	11	14	17	19	22	24	27
25	7	9	11	13	16	18	20	22
30	6	8	9	11	13	15	17	18
35	5	7	8	10	11	13	14	16
40	4	6	7	9	10	11	13	14
45	4	5	6	8	9	19	11	13
50	3	5	6	7	8	9	10	11
55	3	4	5	6	7	8	9	10
60	3	4	5	6	7	8	9	9
65	3	4	4	5	6	7	8	9

EXAMPLE:

A sidewalk anchor is installed with the guy wire attached 35 feet above an 8-foot sidewalk horizontal brace. The angle between the guy and pole is 13 degrees.

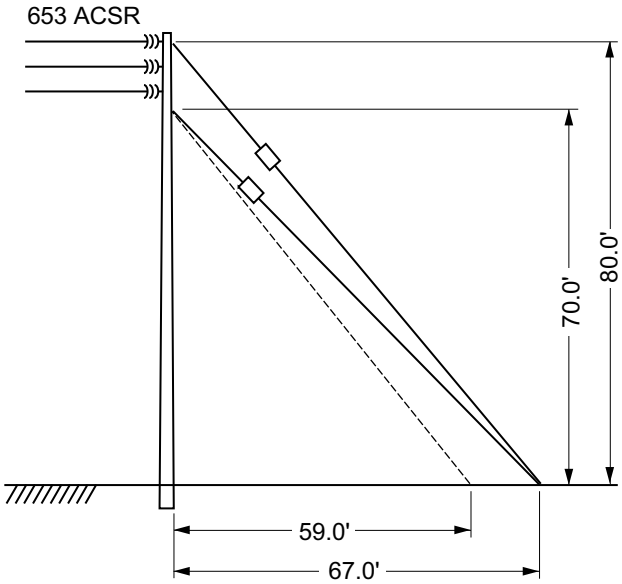


H. Guying Examples

The following examples illustrate the use of Table 1 through Table 6 to determine guying requirements.

Example 1: Minimum Anchor Guy Lead

Given three 653.9 kcmil ACSR conductors in light loading area new construction sagged at 2,847 pounds in vertical configuration and supported by a 90-foot pole set 9 feet in the ground, find the minimum lead (distance from pole-to-anchor) required when two 3/8-inch anchor guys are to support the line in Grade A construction. Each guy wire will support one-half of the total conductor pull.



a. From Table 1, determine the conductor tension on each guy wire. Multiply 2,847 pounds by three and divide by two.

Answer: 4,270 pounds.

b. Find in Table 5a, under 3/8-inch guy, a conductor pull safe for one guy that exceeds 4,270 pounds.

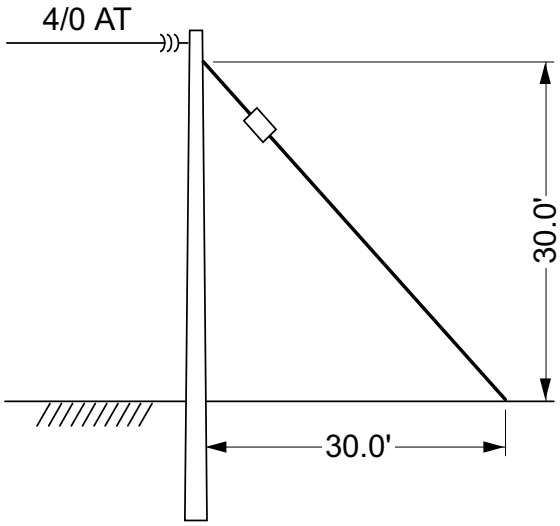
Answer: 4,425 pounds. Determine that the angle of guy-to-pole is 35 degrees.

c. Find in Table 4, the value under the Height (Guy-to-Ground) of 80 feet. Read across row to the 35 degrees column (Angle Guy-to-Pole) and see that the lead distance is 59 feet.

d. This 59 feet is the minimum lead required for the top guy. If the lower guy is attached at 70 feet on the pole, find in Table 4, that the minimum lead required for a second anchor is 49 feet.

Example 2: Size of Anchor Guy Wire

Given 4/0 aluminum triplex secondary at dead-end in light loading area and new construction, to be anchor guyed, with a lead of 30 feet the guy attached to the pole 30 feet above the ground (height), find the size of guy required. Spans are 150 feet in urban areas.



a. Find in Table 1, the tension for 4/0 aluminum triplex conductor.

   Answer: 2,469 pounds

b. Next find in Table 4, the guy angle most nearly corresponding to a height of 30 feet and a lead of 30 feet.

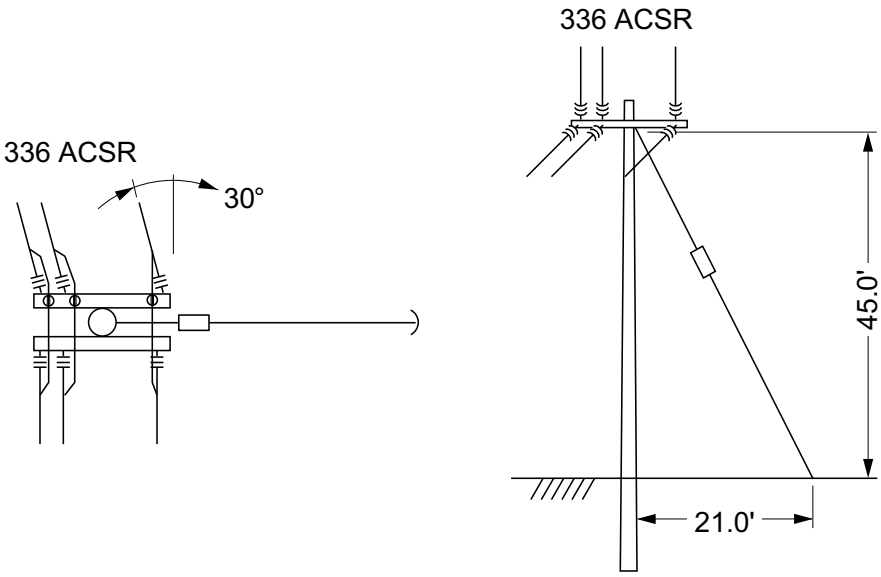
   Answer: 45 degrees

c. Then find in Table 5a, the required size for guy to hold a conductor tension of (a) 2,469 pounds at a guy angle of (b) 45 degrees using the next larger figure above 2,469 pounds. In this case the next larger figure in the column for a 45-degree angle is 3,164.

   Answer: One 9/32-inch guy with a maximum conductor tension of 3,164 pounds should be used.

Example 3: Size of Side Anchor Guy Wire

Given three existing 336.4 kcmil ACSR (18/1) distribution conductors in light loading area with a deviation angle of 30 degrees in the line, find the size of guy to hold the angle pole with a height of 45 feet and a lead of 21 feet, for both Grade A and B construction.



a. Find in Table 3a, the resultant side pull for three 336.4 kcmil ACSR conductors at a deviation angle of 30 degrees. 3 x 1,182 = 3,546 lb

Answer: 3,546

b. Next, find in Table 4, the guy angle most nearly corresponding to a height of 45 feet and a lead of 21 feet.

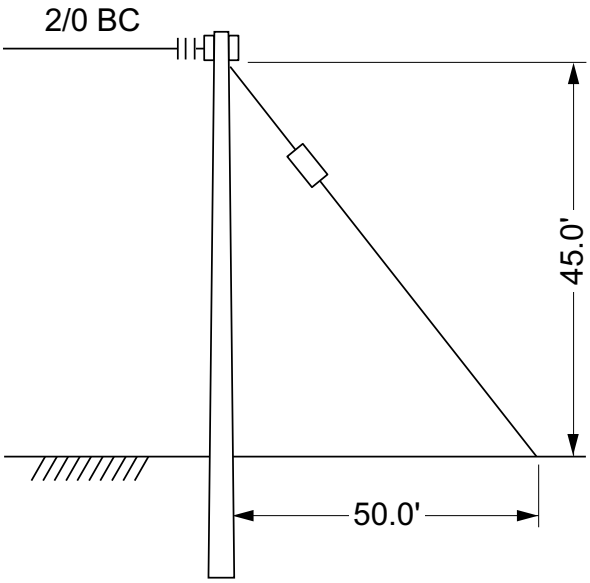
Answer: 25 degrees

c. For a Grade A construction, find in Table 5a, the required size of guy for a resultant pull of (a) 3,546 pounds and a guy angle of (b) 25 degrees, using the next larger tension above 3,546 pounds. In this case, the next tension or combination of tensions in the 25 degree column is 1,891 + 3,254 pounds.

Answer: Use one 9/32-inch guy and one 3/8-inch guy (standard guy sizes).

Example 4: Size of Anchor Guy Wire

Given three 2/0 bare copper distribution conductors at dead-end in Light-Loading and new construction, to be anchor guyed 45 feet above the ground (height), with a 50-foot lead, find the size of guy required.



a. Find in Table 1, the tension for one 2/0 bare copper conductor (1,482 pounds) Multiply 1,482 x 3 = 4,446 pounds.

Answer: 4,446 pounds

b. Next, find in Table 4, the guy angle most nearly corresponding to a height of 45 feet and a lead of 50 feet.

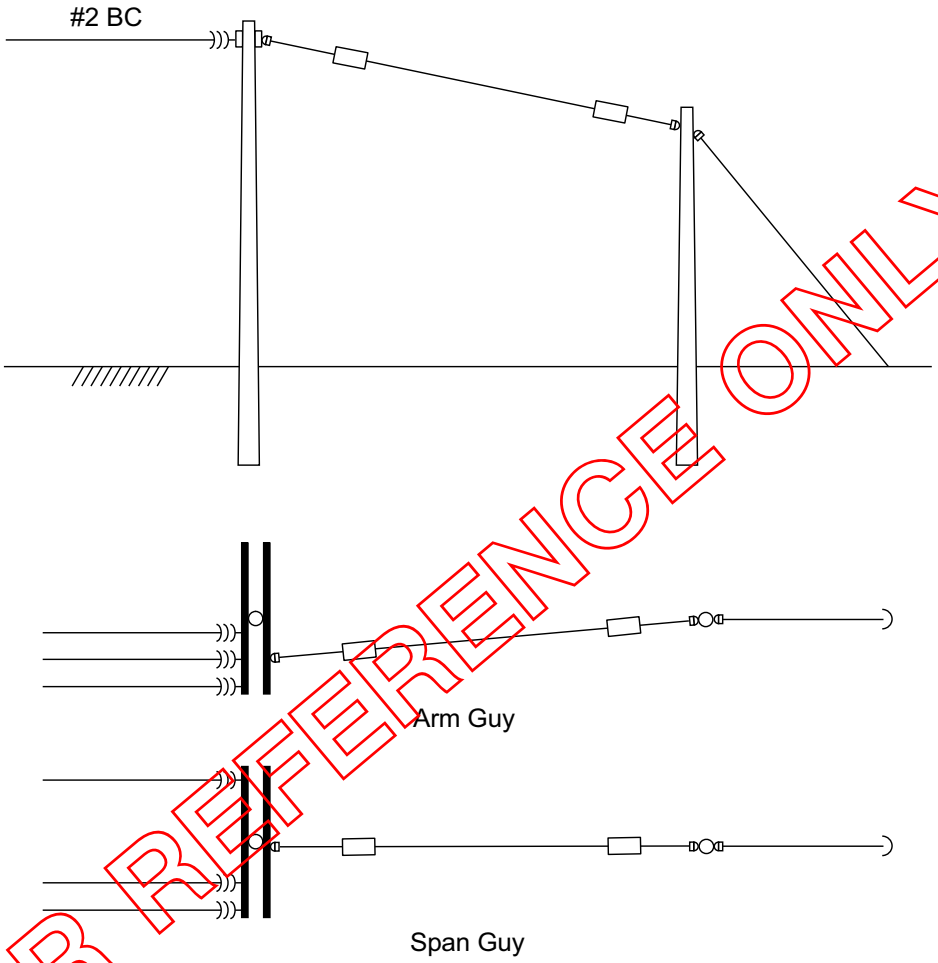
Answer: 50 degrees

c. Then, find in Table 5a, the required size of guy for conductor tension of (a) 4,446 pounds at a guy angle of (b) 50 degrees, using the next larger tension above 4,446 pounds. In this case, the next larger figure in the column for a 50-degree angle is 5,899 pounds.

Answer: Use one 3/8-inch EHS guy (standard guy size).

Example 5: Overhead Span/Arm Guy

Given three No. 2 bare copper conductors at dead-end on a crossarm, find the size of guy to hold the total load.



a. Find in Table 1, the tension for one No. 2 bare copper conductor. Multiply this tension by three. 761 x 3 = 2,283 pounds.

Answer: 2,283 lb

b. Next, find in Table 5, the row labeled “Level-Overhead Guys” the required size of guy for a conductor tension of (a) 2,283 pounds, using the next larger figure above 2,283 pounds. In this case, the next larger figure in the column for “level guys” is 2,400 pounds.

Answer: Use one 7/32-inch guy. The down guy may then be calculated using conductor tension of 2,283 pounds.

1.2 Anchors and Rods for Guying Table and Example

Table 8 lists the holding strength for standard anchors and rods used by Edison. This table will be used when hand calculations for guying evaluation(s) are needed. The anchor and rod shall have an allowable holding strength equal to or greater than the working strength of the guy or guys attached to it. The working strength of a guy wire shall be that of the guy wire in a level position shown on Table 5 and Table 6.

The actual holding strength of a power-installed crew anchor is determined by the number of shear pins used when the anchor is installed. Soft soil conditions may limit the holding strength of a single-helix anchor and require the installation of a double-helix anchor. Refer to the DOH Manual, Section PO.

Table 8: Allowable Holding Strength for Guy Anchors

Type of Anchors	Torque (in Minimum Pins Sheared)			Anchor Assembly Load Rating (lb)			
Power Installed Screw Anchors (PISA)	8-Inch Single	8-Inch Double	10-Inch Double	At Failure	Allowable New (S.F. = 2)	Allowable In-Service (S.F. = 1.33)	Guideline for Guys[a/]
1-3/8" or 1-1/2" Anchor hub	3	2	2	10,000	5,000	7,500	1 - 9/32"
	7	5	4	20,000	10,000	15,000	2 - 9/32", or 1 - 3/8", or 1 - 7/16"
1-1/2" Anchor Hub Only	9	8	7	30,000	15,000	22,600	3 - 9/32", or 1 - 9/32" & 1 - 3/8", or 1 - 9/32" & 1 - 7/16"
	12	10	9	36,000	18,000	27,100	2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3 - 9/32",
4" Granite Anchors		4-Inch Single	4-Inch Double				
		9		20,000	10,000	15,000	2 - 9/32", or 1 - 3/8", or 1 - 7/16"
		10		30,000	15,000	22,600	3 - 9/32", or 1 - 9/32" & 1 - 3/8", or 1 - 9/32" & 1 - 7/16"
		12	12	36,000	18,000	27,100	2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3 - 9/32"
Cross-Plate Anchors	Anchor Rod and Plate						
	3/4" x 8' Double Eye[b/]			23,000	11,500	17,300	2-9/32' or 1-3/8" or 1-7/16"
	1" x 10' Triple Eye[b/]			36,000	18,000	27,100	2-3/8", or 1-3/8" & 2-9/32", or 1-3/8" & 1-7/16", or 3 - 9/32"
	1-1/4" x 10' Triple Eye[b/]			58,000	29,000	43,600	2-7/16" or 3-3/8" or 2-3/8" and 1-9/32"
Expanding Rock	3/4" x 15" Triple Eye			23,000	11,500	17,300	2-9/32' or 1-3/8" or 1-7/16"

[a/] Guy recommendations are guidelines to insure that the anchor can support the full strength capability of the guys. For in-service installations or where limitations exist for anchor placement, the anchor may be loaded to its maximum table capability based on the evaluated maximum guy loads from the pole loading report.

Note(s):

1. The 3/8 inch Single Eye Anchor is not approved for new installations.
2. Table 8 is for reference only and is not to be used for new installations. See PLM-2 Table 11 and Table 14 for maximum allowable holding capacity of PISA and Plate Guy Anchors respectively approved for new installations.

Note(s):

1. Anchors shall have the same safety factor requirements as the guys they support (2.0 for new and 1.33 for in-service).
2. PISA anchors shall be installed with a minimum spacing of 4 times the largest helix. For example, for two-8 inch anchors, the minimum spacing between the two shall be 32 inches.
3. It is recommended that there be a minimum of 6 feet of spacing between the plate anchors. If the recommended spacing can't be obtained, then the following criteria shall be used:
   - 4 feet for installations up to 10,000 lbs. new (15,000 lb in-service)
   - 5 feet for installations up to 15,000 lbs. new (22,500 lb in-service)
   - 6 feet for installations greater than 15,000 lbs. new (22,500 lb in-service)
4. Refer to DOH PO 320, Table 8 for placement of anchor plate relative to anchor eye rod.
5. For multiple backhoe installations, trenches should be perpendicular to guy wire.

The following examples illustrate the selection of the proper screw anchor or anchor and plate.

Example 1: Selection of Guy Anchor

One 3/8-inch and one 9/32-inch Extra-High Strength (EHS) guys are to be attached to an anchor in an urban area, Grade A new construction. What size guy anchor should be selected?

Answer:

See Table 5a. The total conductor pull at a level angle is the rated guy strength with a safety factor of two (working tension); therefore, 1-3/8-inch EHS guy has a working tension of 7,700 pounds, and 1-9/32-inch guy has a working tension of 4,475 pounds. The total holding strength for the anchor should be the sum of the rated working tensions of both guys, or 7,700 pounds + 4,475 pounds = 12,175 pounds. Referring to Table 8, it can be determined that an 8-inch single helix screw anchor with nine loading pins sheared will meet the required holding strength. If an anchor rod and plate is required, a 1" × 10'/ triple eye should be selected.

Example 2: Selection of Guy Anchor

Two 3/8-inch and one 9/32-inch EHS guys are to be installed on an anchor in an urban area, Grade A new construction. (The maximum amount allowed on a triple-eye rod per Table 8). What size guy anchor should be selected?

Answer:

According to Table 5a, the full rated working tension for guys with a safety factor of two can be found under **level** angle. 2-3/8-inch EHS, with a working tension of 7,700 pounds, and one 9/32-inch EHS of 4,475 pounds. The total pull will be 15,400 pounds + 4,475 pounds = 19,875 pounds.

In accordance with Table 8, an anchor with a holding strength above 19,875 pounds should be used. Therefore, a single 8-inch PISA should be selected to shear seven loading pins. If an anchor rod and plate are to be installed, a 1" × 10'/triple eye having a holding strength of 24,000 pounds should be selected.

1.3 Unguyed Span hand calculation Example

Based on typical unguyed span measurements, DOH CO 168 Reduced tension sag charts provide the reduced dead-end tension of various conductors in both light and heavy loading areas. These tables will be used when hand calculations for unguyed span evaluations are needed. These dead-end tensions are multiplied by the number of conductors and the height of the conductors to determine the resultant moment on the pole supporting the unguyed span. The resultant moment must be checked against the usable pole strengths. A breast block and pole key must be installed on all unguyed spans. Refer to the DOH Manual, Section PO. The pole key resisting moment must be greater than the resultant moment on the pole supporting the unguyed span. If the resultant moment exceeds either the usable pole strength or the pole key resisting moment, the strain should be guyed or the resultant moment reduced. The moment may be reduced by (1) reducing the height of the conductors, or (2) increasing the conductor sag thereby reducing the dead-ending tension. According to Table 9, pole key resisting moments will vary depending on the type of soil.

With the conductor tensions from DOH CO 168 Reduced tension sag charts, the resultant moment can be calculated using Formulas A or B.

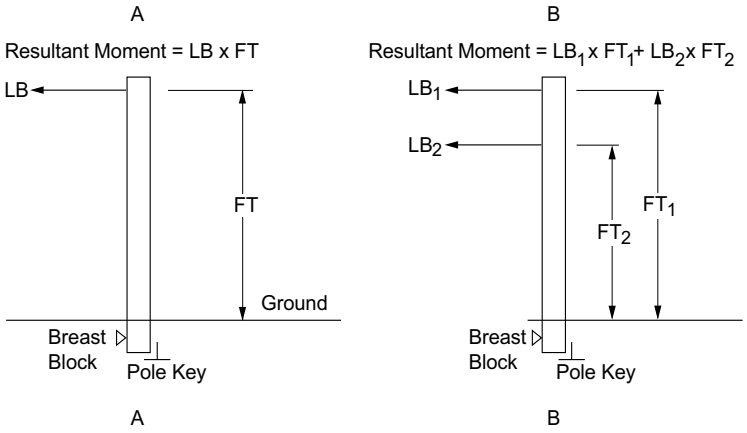


Table 9: Resisting Moment Applications[a/]

Type of Soil		Pole-Key Resisting Moment (ft-lb)[b/]
Class	**Description**	
3	Shale; broken red rock; hardpan; compact clay-gravel mixtures	55,125
4	Gravel; compact gravel and sand; claypan	47,500
5	Medium-firm clay; loose sand and gravel; compact coarse sand	36,750
6	Soft-plastic clay; loose coarse sand; clay silt, compact fine sand	28,875

a/ For an unguyed reduced tension span, the corresponding pole's new imposed ground line moments shall be demonstrated to be adequately resisted without the use of a breast block-pole key configuration.

b/ Resisting moment is due to combined effects of adding pole key and breast block support elements and a standard pole embedment of 10 percent of pole length + 2 feet.

Table 10: Unguyed Span Tensions — Secondary Conductors Light Loading

	Span Length (ft)	Final Sag at 130°F Close-Up				
		1-Foot Sag	2-Foot Sag	3-Foot Sag	4-Foot Sag	5-Foot Sag
		Unguyed Span Dead-End Tension per Conductor (lb)				
#6 Al Duplex	60	198	79	50	37	29
	80	292	149	91	66	52
	100	363	233	147	105	82
	120	436	314	213	154	120
#4 Al Duplex	60	286	102	63	47	38
	80	432	199	118	85	67
	100	545	328	193	136	106
	120	660	449	290	202	155
#4 Al Triplex	60	338	122	75	55	44
	80	500	242	140	100	79
	100	—	391	232	161	125
	120	—	525	344	241	185
#2 Al Triplex	60	480	152	93	68	55
	80	733	314	175	124	98
	100	965	535	295	202	155
	120	—	741	452	306	231
1/0 Al Triplex	60	660	206	127	93	75
	80	1,135	421	237	169	133
	100	—	748	399	274	211
	120	—	1,113	626	414	313
4/0 Al Triplex	60	1,163	318	194	143	114
	80	—	666	364	259	204
	100	—	1,260	621	421	324
	120	—	—	1,004	643	482
1/0 Al Quad	60	783	249	152	112	89
	80	—	512	285	203	159
	100	—	899	484	330	254
	120	—	1,272	753	502	377
4/0 Al Quad	60	—	391	237	174	139
	80	—	827	447	317	248
	100	—	—	768	517	396
	120	—	—	1,242	794	591

Example:A 1/0 Al Triplex unguyed span with a final sag of 3 feet will have a dead-end tension of 399 pounds.

Table 11: Unguyed Span Tensions — Primary Conductors Light Loading[a/b/]

	Span (ft)	Final Sag at 130°F				
		1-Foot Sag	2-Foot Sag	3-Foot Sag	4-Foot Sag	5-Foot Sag
		Unguyed Span Dead-End Tension per Conductor (lb)				
#4[c/] ACSR	60	159	46	28	21	17
	80	310	93	53	38	30
	100	385	169	88	61	47
	120	450	265	138	92	70
1/0 ACSR	60	318	79	49	36	29
	80	653	163	91	65	51
	100	—	310	153	105	81
	120	—	524	243	159	120
336.4 ACSR	60	—	158	95	70	56
	80	—	359	180	127	99
	100	—	—	319	208	159
	120	—	—	572	326	239
653.9 ACSR	60	—	276	157	113	90
	80	—	—	305	209	161
	100	—	—	554	347	261
	120	—	—	—	549	394
#6 Copper	60	159	37	22	16	13
	80	284	77	41	29	23
	100	371	146	71	48	37
	120	—	230	112	72	54
#4 Copper	60	248	55	33	24	19
	80	447	117	62	44	34
	100	585	224	106	72	55
	120	—	357	170	109	82
#2 Copper	60	381	78	46	34	27
	80	—	166	88	62	48
	100	—	329	150	101	77
	120	—	543	243	154	115
2/0 Copper	60	—	136	81	59	47
	80	—	295	154	108	85
	100	—	607	265	177	136
	120	—	—	434	271	202
4/0 Copper	60	—	204	122	89	71
	80	—	444	231	162	127
	100	—	—	397	265	203
	120	—	—	—	406	302

a. Use on all 4, 12, 16, and 33 systems.
- 4 kV is 20-inch minimum pin spacing.
- 12, 16, and 33 is 36-inch minimum pin spacing.

b. 4 kV requires 36-inch minimum pin spacing.

c. Not approved for use on new construction.

Table 12: Sag Chart for New and Existing Reduced Tension Guyed Primary #4-653 ACSR — Light Loading [a/]

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 ACSR[b/]	60	1'-0"	1'-2"
	80	1'-6"	1'-7"
	100	2'-0"	2'-6"
	120	3'-0"	3'-4"
	140	4'-0"	4'-1"
	160	5'-0"	5'-4"
	180	6'-0"	6'-6"
	200	7'-6"	8'-0"
1/0 ACSR	60	1'-0"	1'-2"
	80	1'-6"	1'-7"
	100	2'-0"	2'-6"
	120	2'-6"	2'-8"
	140	3'-0"	3'-6"
	160	3'-6"	4'-3"
	180	4'-6"	5'-4"
	200	5'-6"	6'-4"
336 ACSR	60	1'-0"	1'-2"
	80	1'-6"	1'-7"
	100	2'-0"	2'-6"
	120	2'-6"	2'-8"
	140	3'-0"	3'-6"
	160	3'-6"	4'-3"
	180	4'-6"	5'-4"
	200	5'-6"	6'-4"
653 ACSR	60	1'-0"	1'-2"
	80	1'-6"	2'-0"
	100	2'-0"	2'-6"
	120	3'-0"	3'-6"
	140	4'-0"	4'-6"
	160	5'-0"	5'-6"
	180	6'-0"	6'-8"
	200	7'-6"	8'-4"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction.

Table 13: Sag Chart for New and Existing Reduced Tension Guyed Primary #6-4/0 Copper — Light Loading [a/]

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#6 Copper	60	1'-6"	1'-8"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-0"	6'-0"
	140	4'-0"	4'-2"
	160	5'-0"	5'-6"
	180	6'-0"	6'-10"
	200	7'-6"	8'-3"
#4 Copper	60	1'-6"	1'-6"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-6"	5'-6"
	140	3'-6"	4'-0"
	160	4'-6"	4'-4"
	180	6'-0"	6'-6"
	200	7'-0"	7'-8"
#2 Copper	60	1'-6"	1'-7"
	80	2'-6"	2'-6"
	100	3'-6"	3'-7"
	120	4'-6"	5'-0"
	140	3'-6"	4'-0"
	160	4'-6"	5'-0"
	180	5'-6"	6'-0"
	200	6'-6"	7'-2"
2/0 Copper	60	1'-6"	1'-7"
	80	2'-0"	2'-1"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"
	140	3'-6"	3'-8"
	160	4'-0"	4'-6"
	180	5'-0"	5'-6"
	200	6'-0"	6'-6"

Table 13: Sag Chart for New and Existing Reduced Tension Guyed Primary #6-4/0 Copper — Light Loading [a/] *(Continued)*

4/0 Copper	60	1'-6"	1'-6"
	80	2'-0"	2'-0"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"
	140	3'-6"	3'-8"
	160	4'-0"	4'-6"
	180	4'-6"	5'-6"
	200	6'-0"	6'-6"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

Table 14: Sag Chart for New and Existing Reduced Tension Guyed #6 — 1/0 Aluminum Duplex and Triplex — Light Loading

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Aluminum Duplex	60	0'-8"	1'-0"
	80	1'-2"	1'-7"
	100	1'-10"	2'-4"
	120	2'-9"	3'-4"
	140	3'-9"	4'-4"
	160	5'-0"	5'-6"
#4 Aluminum Duplex	60	0'-6"	1'-0"
	80	1'-0"	1'-6"
	100	1'-6"	2'-2"
	120	2'-4"	2'-10"
	140	3'-2"	3'-10"
	160	4'-0"	4'-10"
#4 Aluminum Triplex	60	0'-8"	1'-1"
	80	1'-2"	1'-9"
	100	1'-10"	2'-6"
	120	2'-9"	3'-4"
	140	3'-9"	4'-4"
	160	4'-10"	5'-6"
#2 Aluminum Triplex	60	0'-10"	1'-1"
	80	1'-4"	1'-10"
	100	2'-0"	2'-6"
	120	2'-10"	3'-6"
	140	3'-10"	4'-6"
	160	5'-0"	5'-6"
1/0 Aluminum Triplex	60	0'-7"	1'-0"
	80	1'-0"	1'-6"
	100	1'-6"	2'-2"
	120	2'-0"	2'-10"
	140	2'-10"	3'-8"
	160	3'-6"	4'-7"

Table 15: Sag Chart for New and Existing Reduced Tension Guyed #4-4/0 Aluminum Quadruplex - Light Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 Aluminum Quadruplex	60	0'-10"	1'-3"
	80	1'-6"	2'-0"
	100	2'-3"	2'-10"
	120	3'-3"	3'-10"
	140	4'-4"	5'-0"
	160	5'-9"	6'-4"
#1/0 Aluminum Quadruplex	60	0'-8"	1'-4"
	80	1'-2"	1'-9"
	100	1'-9"	2'-6"
	120	2'-6"	3'-10"
	140	3'-6"	4'-2"
	160	4'-6"	5'-2"
#4/0 Aluminum Quadruplex	60	0'-7"	1'-0"
	80	1'-0"	1'-7"
	100	1'-6"	2'-3"
	120	2'-2"	3'-0"
	140	2'-10"	3'-9"
	160	3'-8"	4'-7"

Table 16: Sag Chart for Reduced Tension New Construction Unguyed Primary #4-653 ACSR — Light Loading[a/]

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 ACSR [b/]	60	1'-6"	1'-8"
	80	2'-6"	2'-9"
	100	4'-0"	4'-1"
	120	5'-6"	5'-8"
1/0 ACSR	60	1'-6"	1'-7"
	80	2'-0"	2'-3"
	100	3'-0"	3'-3"
	120	4'-0"	4'-5"
336 ACSR	60	1'-6"	1'-7"
	80	2'-0"	2'-3"
	100	3'-0"	3'-3"
	120	4'-0"	4'-5"
653 ACSR	60	1'-6"	1'-9"
	80	2'-6"	2'-9"
	100	4'-0"	4'-1"
	120	5'-6"	5'-8"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction

Table 17: Sag Chart for Reduced Tension New Construction of Unguyed Primary #6 — 4/0 Copper — Light Loading[a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Copper	60	1'-6"	1'-8"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-0"	6'-0"
#4 Copper	60	1'-6"	1'-6"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-6"	5'-6"
#2 Copper	60	1'-6"	1'-7"
	80	2'-6"	2'-6"
	100	3'-6"	3'-7"
	120	4'-6"	5'-0"
2/0 Copper	60	1'-6"	1'-7"
	80	2'-0"	2'-1"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"
4/0 Copper	60	1'-6"	1'-6"
	80	2'-0"	2'-0"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

Table 18: Sag Chart for Reduced Tension New Construction unguyed #6 — 1/0 Aluminum Duplex and Triplex — Light Loading

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Aluminum Duplex	60	1'-6"	1'-8"
	80	2'-6"	2'-10"
	100	4'-0"	4'-6"
	120	5'-6"	6'-0"
#4 Aluminum Duplex	60	1'-6"	1'-7"
	80	2'-6"	2'-6"
	100	3'-6"	3'-7"
	120	4'-6"	5'-0"
#4 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-6"	2'-7"
	100	4'-0"	4'-2"
	120	5'-6"	6'-0"
#2 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-6"	4'-0"
	100	4'-0"	4'-2"
	120	5'-6"	6'-0"
1/0 Aluminum Triplex	60	1'-6"	1'-7"
	80	2'-0"	2'-2"
	100	3'-0"	3'-3"
	120	4'-0"	4'-6"

Table 19: Sag Chart for Reduced Tension New Construction Unguyed #4 — 4/0 Aluminum Quadruplex — Light Loading

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#4 Aluminum Quadruplex	60	1'-6"	1'-10"
	80	3'-0"	3'-2"
	100	4'-6"	4'-8"
	120	6'-6"	6'-10"
#1/0 Aluminum Quadruplex	60	1'-0"	1'-7"
	80	2'-6"	2'-7"
	100	3'-5"	3'-9"
	120	5'-0"	5'-3"
#4/0 Aluminum Quadruplex	60	1'-6"	1'-7"
	80	2'-0"	2'-3"
	100	3'-0"	3'-3"
	120	4'-0"	4'-5"

Table 20: Sag Chart for Reduced Tension Rebuild Construction Unguyed Primary #4 — 653 ACSR — Light Loading[a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#4 ACSR[b/]	60	1'-6"	1'-8"
	80	2'-6"	2'-9"
	100	4'-0"	4'-1"
	120	5'-6"	5'-8"
	140	7'-6"	7'-7"
	160	9'-6"	9'-7"
1/0 ACSR	60	1'-6"	1'-7"
	80	2'-0"	2'-3"
	100	3'-0"	3'-3"
	120	4'-0"	4'-5"
	140	5'-6"	5'-8"
	160	7'-0"	7'-2"
336 ACSR	60	1'-6"	1'-7"
	80	2'-0"	2'-3"
	100	3'-0"	3'-3"
	120	4'-0"	4'-5"
	140	5'-6"	5'-7"
	160	7'-0"	7'-2"
653 ACSR	60	1'-6"	1'-9"
	80	2'-6"	2'-9"
	100	4'-0"	4'-1"
	120	5'-6"	5'-8"
	140	7'-0"	7'-2"
	160	9'-6"	9'-8"

a/ Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

b/ Not for new construction.

Table 21: Sag Chart for Reduced Tension Rebuild Construction Unguyed Primary #6 — 4/0 Copper — Light Loading[a/]

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#6 Copper	60	1'-6"	1'-8"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-0"	6'-0"
	140	4'-0"	4'-2"
	160	5'-0"	5'-6"
#4 Copper	60	1'-6"	1'-6"
	80	2'-6"	2'-8"
	100	3'-6"	4'-0"
	120	5'-6"	5'-6"
	140	3'-6"	4'-0"
	160	4'-6"	5'-4"
#2 Copper	60	1'-6"	1'-7"
	80	2'-6"	2'-6"
	100	3'-6"	3'-7"
	120	4'-6"	5'-0"
	140	3'-6"	4'-0"
	160	4'-6"	5'-0"
2/0 Copper	60	1'-6"	1'-7"
	80	2'-0"	2'-1"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"
	140	3'-6"	3'-8"
	160	4'-0"	4'-6"
4/0 Copper	60	1'-6"	1'-6"
	80	2'-0"	2'-0"
	100	3'-0"	3'-1"
	120	4'-6"	4'-7"
	140	3'-6"	3'-8"
	160	4'-0"	4'-6"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

Table 22: Sag Chart for Reduced Tension Rebuild Construction Unguyed #6 — 4/0 Aluminum Duplex and Triplex — Light Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#6 Aluminum Duplex	60	1'-6"	1'-8"
	80	2'-6"	2'-10"
	100	4'-0"	4'-6"
	120	5'-6"	6'-0"
	140	3'-10"	4'-4"
	160	5'-0"	5'-7"
#4 Aluminum Duplex	60	1'-6"	1'-7"
	80	2'-6"	2'-6"
	100	3'-6"	3'-7"
	120	4'-6"	5'-0"
	140	3'-0"	3'-10"
	160	4'-0"	4'-10"
#4 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-6"	2'-7"
	100	4'-0"	4'-2"
	120	5'-6"	6'-0"
	140	3'-8"	4'-4"
	160	4'-10"	5'-6"
#2 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-6"	4'-0"
	100	4'-0"	4'-2"
	120	5'-6"	6'-0"
	140	3'-10"	4'-2"
	160	5'-0"	5'-7"

Table 22: Sag Chart for Reduced Tension Rebuild Construction Unguyed #6 — 4/0 Aluminum Duplex and Triplex — Light Loading *(Continued)*

1/0 Aluminum Triplex	60	0'-7"	1'-0"
	80	1'-0"	1'-6"
	100	1'-6"	2'-2"
	120	2'-0"	2'-10"
	140	2'-10"	3'-8"
	160	3'-6"	4'-7"
1/0 Aluminum Duplex	60	1'-6"	1'-7"
	80	2'-0"	2'-2"
	100	3'-0"	3'-3
	120	4'-0"	4'-6"
	140	2'-10"	3'-8"
	160	3'-7"	4'-7"
4/0 Aluminum Duplex	60	1'-0"	1'-3"
	80	1'-6"	2'-0"
	100	2'-6"	2'-9"
	120	3'-6"	3'-8"
	140	2'-3"	3'-4"
	160	3'-0"	4'-0"

Table 23: Unguyed Span Tensions — Secondary Conductors Heavy Loading

	Span (ft)	Final Sag at 130°F				
		1-Foot Sag	2-Foot Sag	3-Foot Sag	4-Foot Sag	5-Foot Sag
		Unguyed Span Dead-End Tension per Conductor (lb)				
#4 Al Duplex	60	521	275	178	132	105
	80	701	463	316	235	187
	100	850	634	474	363	291
	120	990	782	628	505	413
#4 Al Triplex	60	575	303	195	144	115
	80	783	512	348	258	205
	100	—	708	523	400	319
	120	—	870	698	554	454
#2 Al Triplex	60	789	359	224	164	131
	80	1,097	646	409	297	234
	100	—	943	646	470	369
	120	—	1,196	895	679	535
1/0 Triplex	60	1,073	447	274	201	160
	80	—	838	508	364	286
	100	—	1,266	818	584	454
	120	—	—	1,169	855	665
4/- Al Triplex	60	—	620	373	273	217
	80	—	1,256	702	496	388
	100	—	—	1,179	807	619
	120	—	—	—	1,216	916
1/0 Al Quad	60	1,208	507	311	228	182
	80	—	953	578	413	325
	100	—	—	931	664	515
	120	—	—	—	973	756
4/0 Al Quad	60	—	721	432	315	252
	80	—	—	816	575	450
	100	—	—	—	938	719
	120	—	—	—	—	1,069

Table 24: Unguyed Span Tensions — Primary Conductors Heavy Loading [a/b/]

	Span (ft)	Final Sag at 130°F				
		1-Foot Sag	2-Foot Sag	3-Foot Sag	4-Foot Sag	5-Foot Sag
		Unguyed Span Dead-End Tension per Conductor (lb)				
#4[c/] ACSR	60	421	206	132	97	78
	80	569	363	238	174	138
	100	—	509	367	274	217
	120	—	627	494	387	311
1/0 ACSR	60	—	265	162	119	95
	80	—	512	301	215	170
	100	—	—	492	346	269
	120	—	—	—	511	394
336.4 ACSR	60	—	396	230	167	133
	80	—	—	442	307	239
	100	—	—	—	507	384
	120	—	—	—	—	578
653.9 ACSR	60	—	596	321	229	181
	80	—	—	642	428	328
	100	—	—	—	—	534
	120	—	—	—	—	—
#4 Copper	60	533	228	140	102	82
	80	—	417	258	185	146
	100	—	611	408	295	230
	120	—	—	570	426	335
#2 Copper	60	—	262	158	115	91
	80	—	510	295	209	164
	100	—	—	482	338	261
	120	—	—	—	499	383
2/0 Copper	60	—	343	201	146	116
	80	—	—	383	268	209
	100	—	—	650	438	334
	120	—	—	—	663	497
4/0 Copper	60	—	429	250	181	144
	80	—	—	479	333	259
	100	—	—	—	547	416
	120	—	—	—	—	621

a\ Use on all 4, 12, 16, and 33 systems.

- 4 kV is 20-inch minimum pin spacing.
- 12 kV, 16 kV, 33 kV, and kV is 36-inch minimum pin spacing.

b\ 4 kV requires 36-inch minimum pin spacing.

c\ Not approved for use on new construction.

Table 25: Sag Chart for New and Existing Reduced Tension Guyed Primary #4 — 653 ACSR — Heavy Loading[a/]

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 ACSR[b/]	60	1'-3"	1'-6"
	80	2'-2"	2'-6"
	100	3'-6"	3'-7"
	120	4'-10"	5'-2"
	140	6'-10"	7'-0"
	160	8'-9"	9'-0"
#2 ACSR[b/]	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	3'-0"	3'-4"
	120	4'-5"	4'-7"
	140	5'-10"	6'-2"
	160	7'-8"	8'-0"
1/0 ACSR	60	1'-0"	1'-1"
	80	1'-2"	1'-6"
	100	1'-10"	2'-4"
	120	2'-7"	3'-0"
	140	3'-6"	4'-0"
	160	4'-7"	5'-0"
336 ACSR	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	2'-10"	3'-3"
	120	4'-0"	4'-5"
	140	5'-4 "	5'-8"
	160	6'-8"	7'-2"
653 ACSR	60	1'-6"	1'-9"
	80	2'-3"	2'-6"
	100	3'-4"	3'-7"
	120	5'-6"	5'-8"
	140	6'-0"	6'-5"
	160	7'-10"	8'-2"

a/ Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

b/ Not approved for new construction.

Table 26: Sag Chart for New and Existing Reduced Tension Guyed Primary #6 — 4/0 Copper — Heavy Loading [a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Copper[b/]	60	1'-6"	1'-10"
	80	2'-10"	3'-0"
	100	4'-4"	4'-6"
	120	6'-0"	6'-6"
	140	N/A[c/]	N/A[c/]
	160	N/A [c/]	N/A [c/]
#4 Copper[b/]	60	1'-3"	1'-6"
	80	2'-0"	2'-5"
	100	3'-2"	3'-6"
	120	4'-6"	5'-0"
	140	6'-3"	6'-7"
	160	N/A [c/]	N/A [c/]
#2 Copper[b/]	60	1'-0"	1'-7"
	80	1'-6"	2'-0"
	100	2'-4"	2'-9"
	120	3'-4"	3'-9"
	140	4'-6"	5'-0"
	160	5'-10"	6'-4"
2/0 Copper	60	1'-2"	1'-6"
	80	2'-0"	2'-3"
	100	2'-10"	3'-3"
	120	4'-0"	4'-6"
	140	5'-4"	5'-9"
	160	6'-10"	7'-4"
4/0 Copper	60	1'-2"	1'-6"
	80	1'-8"	2'-0"
	100	2'-5"	2'-10"
	120	3'-4"	3'-10"
	140	4'-6"	4'-10"
	160	5'-8"	6'-3"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction.

[c/] Excessive sagging, use full tension.

Table 27: Sag Chart for New and Existing Reduced Tension Guyed #6 — 1/0 Aluminum Duplex and Triplex — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#6 Aluminum Duplex	60	1'-6"	1'-8"
	80	2'-6"	2'-10"
	100	4'-0"	4'-6"
	120	6'-0"	6'-3"
	140	8'-3"	8'-6"
	160	11'-0"	11'-1"
#4 Aluminum Duplex	60	1'-0"	1'-3"
	80	1'-8"	2'-2"
	100	2'-9"	3'-3"
	120	4'-4"	4'-6"
	140	5'-10"	6'-3"
	160	7'-6"	8'-0"
#4 Aluminum Triplex	60	1'-0"	1'-3"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-7"
	140	6'-5"	6'-8"
	160	8'-6"	8'-9"
#2 Aluminum Triplex	60	1'-0"	1'-5"
	80	2'-0"	2'-3"
	100	3'-0"	3'-6"
	120	4'-5"	4'-9"
	140	6'-0"	6'-4"
	160	7'-10"	8'-3"
1/0 Aluminum Triplex	60	1'-3"	1'-5"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-8"
	140	6'-10"	6'-4"
	160	7'-9"	8'-3"
4/0 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-5"	2'-8"
	100	3'-8"	3'-10"
	120	5'-3"	5'-6"
	140	7'-0"	7'-4"
	160	9'-0"	9'-6"

Table 28: Sag Chart for New and Existing Reduced Tension Guyed #4 — 4/0 Aluminum Quadruplex — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 Aluminum Quadruplex	60	1'-2"	1'-6"
	80	2'-3"	2'-6"
	100	3'-6"	3'-10"
	120	5'-3"	5'-6"
	140	7'-0"	7'-5"
	160	9'-4"	9'-8"
#1/0 Aluminum Quadruplex	60	1'-4"	1'-7"
	80	2'-2"	2'-7"
	100	3'-5"	3'-10"
	120	5'-0"	5'-5"
	140	6'-9"	7'-0"
	160	8'-9"	9'-2"
#4/0 Aluminum Quadruplex	60	1'7"	1'-10"
	80	2'-0"	3'-0"
	100	4'-3"	4'-6"
	120	6'-0"	6'-3"
	140	8'-0"	8'-4"
	160	10'-5"	10'-9"

Table 29: Sag Chart for Reduced Tension New Construction Unguyed Primary #4 — 653 ACSR — Heavy Loading[a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#4 ACSR [b/]	60	1'-3"	1'-6"
	80	2'-2"	2'-6"
	100	3'-6"	3'-7"
	120	4'-10"	5'-2"
2 ACSR [b/]	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	3'-0"	3'-4"
	120	4'-5"	4'-7"
1/0 ACSR	60	1'-0"	1'-1"
	80	1'-2"	1'-6"
	100	1'-10"	2'-4"
	120	2'-7"	3'-0"
336 ACSR	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	2'-10"	3'-3"
	120	4'-0"	4'-5"
653 ACSR	60	1'-6"	1'-9"
	80	2'-3"	2'-6"
	100	3'-4"	3'-7"
	120	5'-6"	5'-8"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction.

Table 30: Sag Chart for Reduced Tension New Construction of Unguyed Primary #6 — 4/0 Copper — Heavy Loading[a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Copper [b/]	60	1'-6"	1'-10"
	80	2'-10"	3'-0"
	100	4'-4"	4'-6"
	120	6'-0"	6'-6"
#4 Copper [b/]	60	1'-3"	1'-6"
	80	2'-0"	2'-5"
	100	3'-2"	3'-6"
	120	4'-6"	5'-0"
#2 Copper [b/]	60	1'-0"	1'-7"
	80	1'-6"	2'-0"
	100	2'-4"	2'-9"
	120	3'-4"	3'-9"
2/0 Copper	60	1'-2"	1'-6"
	80	2'-0"	2'-3"
	100	2'-10"	3'-3"
	120	4'-0"	4'-6"
4/0 Copper	60	1'-2"	1'-6"
	80	1'-8"	2'-0"
	100	2'-5"	2'-10"
	120	3'-4"	3'-10"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction.

Table 31: Sag Chart for Reduced Tension New Construction Unguyed #6 — 1/0 Aluminum Duplex and Triplex — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#6 Aluminum Duplex	60	1'-6"	1'-8"
	80	2'-6"	2'-10"
	100	4'-0"	4'-6"
	120	6'-0"	6'-3"
#4 Aluminum Duplex	60	1'-0"	1'-3"
	80	1'-8"	2'-2"
	100	2'-9"	3'-3"
	120	4'-4"	4'-6"
#4 Aluminum Triplex	60	1'-0"	1'-3"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-7"
#2 Aluminum Triplex	60	1'-0"	1'-5"
	80	2'-0"	2'-3"
	100	3'-0"	3'-6"
	120	4'-5"	4'-9"
1/0 Aluminum Triplex	60	1'-3"	1'-5"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-8"
1/0 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-5"	2'-8"
	100	3'-8"	3'-10"
	120	5'-3"	5'-6"
4/0 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-5"	2'-8"
	100	3'-8"	3'-10"
	120	5'-3"	5'-6"

Table 32: Sag Chart for Reduced Tension New Construction Unguyed #4 — 4/0 Aluminum Quadruplex — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag	Final Sag
		50°–110°F	130°F
#4 Aluminum Quadruplex	60	1'-2"	1'-6"
	80	2'-3"	2'-6"
	100	3'-6"	3'-10"
	120	5'-3"	5'-6"
#1/0 Aluminum Quadruplex	60	1'-4"	1'-7"
	80	2'-2"	2'-7"
	100	3'-5"	3'-10"
	120	5'-0"	5'-5"
#4/0 Aluminum Quadruplex	60	1'-7"	1'-10"
	80	2'-0"	3'-0"
	100	4'-3"	4'-6"
	120	6'-0"	6'-3"

Table 33: Sag Chart for Reduced Tension Rebuild Construction Unguyed Primary #4 — 653 ACSR — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#4 ACSR b/	60	1'-3"	1'-6"
	80	2'-2"	2'-6"
	100	3'-6"	3'-7"
	120	4'-10"	5'-2"
	140	6'-10"	7'-0"
	160	8'-9"	9'-0"
#2 ACSR b/	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	3'-0"	3'-4"
	120	4'-5"	4'-7"
	140	5'-10"	6'-2"
	160	7'-8"	8'-0"
1/0 ACSR	60	1'-0"	1'-1"
	80	1'-2"	1'-6"
	100	1'-10"	2'-4"
	120	2'-7"	3'-0"
	140	3'-6"	4'-0"
	160	4'-7"	5'-0"
336 ACSR	60	1'-3"	1'-6"
	80	2'-0"	2'-4"
	100	2'-10"	3'-3"
	120	4'-0"	4'-5"
	140	5'-4 "	5'-8"
	160	6'-8"	7'-2"
653 ACSR	60	1'-6"	1'-9"
	80	2'-3"	2'-6"
	100	3'-4"	3'-7"
	120	5'-6"	5'-8"
	140	6'-0"	6'-5"
	160	7'-10"	8'-2"

Table 34: Sag Chart for Reduced Tension Rebuild Construction Unguyed Primary #6 — 4/0 Copper — Heavy Loading[a/]

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Copper[b/]	60	1'-6"	1'-10"
	80	2'-10"	3'-0"
	100	4'-4"	4'-6"
	120	6'-0"	6'-6"
	140	N/A[c/]	N/A[c/]
	160	N/A[c//]	N/A[c/]
#4 Copper [b/]	60	1'-3"	1'-6"
	80	2'-0"	2'-5"
	100	3'-2"	3'-6"
	120	4'-6"	5'-0"
	140	6'-3"	6'-7"
	160	N/A[c/]	N/A[c/]
#2 Copper [b/]	60	1'-0"	1'-7"
	80	1'-6"	2'-0"
	100	2'-4"	2'-9"
	120	3'-4"	3'-9"
	140	4'-6"	5'-0"
	160	5'-10"	6'-4"
2/0 Copper	60	1'-2"	1'-6"
	80	2'-0"	2'-3"
	100	2'-10"	3'-3"
	120	4'-0"	4'-6"
	140	5'-4"	5'-9"
	160	6'-10"	7'-4"
4/0 Copper	60	1'-2"	1'-6"
	80	1'-8"	2'-0"
	100	2'-5"	2'-10"
	120	3'-4"	3'-10"
	140	4'-6"	4'-10"
	160	5'-8"	6'-3"

[a/] Use on all 2.4 through 33 kV systems. 36-inch minimum mid span conductor spacing depending on deviation angle may require more than 36-inch pin spacing to achieve 36-inch conductor spacing.

[b/] Not approved for new construction.

[c/] Excessive sagging, use full tension.

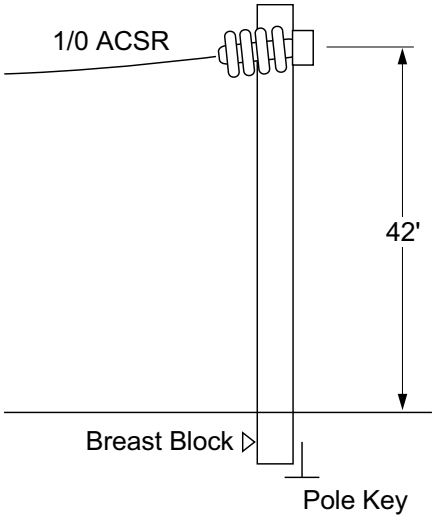
Table 35: Sag Chart for Reduced Tension Rebuild Construction Unguyed #6 — 4/0 Aluminum Duplex and Triplex — Heavy Loading

Conductor Type	Span (Feet)	Initial Sag 50°–110°F	Final Sag 130°F
#6 Aluminum Duplex	60	1'-6"	1'-8"
	80	2'-6"	2'-10"
	100	4'-0"	4'-6"
	120	6'-0"	6'-3"
	140	8'-3"	8'-6"
	160	11'-0"	11'-1"
#4 Aluminum Duplex	60	1'-0"	1'-3"
	80	1'-8"	2'-2"
	100	2'-9"	3'-3"
	120	4'-4"	4'-6"
	140	5'-10"	6'-3"
	160	7'-6"	8'-0"
#4 Aluminum Triplex	60	1'-0"	1'-3"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-7"
	140	6'-5"	6'-8"
	160	8'-6"	8'-9"
#2 Aluminum Triplex	60	1'-0"	1'-5"
	80	2'-0"	2'-3"
	100	3'-0"	3'-6"
	120	4'-5"	4'-9"
	140	6'-0"	6'-4"
	160	7'-10"	8'-3"
1/0 Aluminum Triplex	60	1'-3"	1'-5"
	80	2'-0"	2'-4"
	100	3'-0"	3'-6"
	120	4'-6"	4'-8"
	140	6'-10"	6'-4"
	160	7'-9"	8'-3"
4/0 Aluminum Triplex	60	1'-6"	1'-8"
	80	2'-5"	2'-8"
	100	3'-8"	3'-10"
	120	5'-3"	5'-6"
	140	7'-0"	7'-4"
	160	9'-0"	9'-6"

The following examples illustrate the method of determining usable pole strength in unguyed spans.

Example 1: Unguyed Span

Given four 1/0 ACSR conductors dead-ended to an unguyed 50-foot pole 42 feet above ground level, in a 12 pound wind zone. determine the proper class of pole and final sag for an unguyed span that meets vertical clearances. The conductor span is 90 feet, in Class 5 soil, and the construction is Grade B in light loading area.



a. Find in unguyed span table DOH CO 168-7 the tension for one 1/0 ACSR conductor.
Answer = 142 pounds, or 10 percent of full tension.
Multiply the tension by four. 142 pounds x 4 = 568 pounds.

Answer: 568 pounds

b. Then, multiply the conductor tension by the height from the ground to the point of attachment of the conductors to determine the resultant moment.
568 x 42 = 23,856 ft-lb

Answer: 23,856 ft-lb

c. Next, compare the moment from (b) to the usable pole strengths based on the type of pole to select the proper class of pole.

Answer: A 50-foot class 4 Douglas Fir pole with 12 pounds of windloading, does provide enough usable pole strength (25,568 ft-lb).

d. Compare the answer from (c) to the resisting moment, which should be used for all unguyed poles. Refer to the DOH Manual, Section PO 130.

Answer: The moment applied to the pole does not exceed the pole-key resisting moment of 36,750 ft-lb (see Table 9).

1.4 Safety Factor Formulas for Unguyed In-Service Pole

The following formulas are for use when hand calculations are needed to investigate unguyed, in-service pole conditions.

A. Wood Bending Moment

Wood bending moment = 0.000264 × average fiber stress × ground-line circumference^3

Safety Factor = 3 for Grade B construction, 4 for Grade A construction

B. Wood Pole Moment

$$\text{Wood Pole Moment} = 0.000264 \times (A_{fs})C^3$$

Where: A_{fs} = 8,000 - lb (average fiber stress for Douglas Fir)

C = Ground line circumference

C. Void Moment

$$\text{Void Moment} = 0.000264 \times (A_{fs})[C - 2\pi(S_t)]^3$$

Where: A_{fs} = 8,000 - lb (average fiber stress for Douglas fir)

C = Ground line circumference

(S_t) = Shell thickness

D. Moment from Wind on Equipment

$$\text{Moment from Wind on Equipment} = (W_e) \times (H_e) \times P \times (H_a) \times Q$$

Where: W_e = Width of equipment

H_e = Height of equipment

P = 8-pound pole load

H_a = Height of attachment

Q = Quantity of equipment

E. Safety Factor

$$\text{Safety Factor} = \frac{\text{Wood Pole Moment} - \text{Void Moment}}{\text{Moments from Wind on (Conductor + Pole + Equipment)}}$$

F. Moments from Wind on Pole

$$\text{Moments from Wind on Pole} = \frac{P(H_{op})^2[C + 2c]}{72\pi}$$

Where: P = 8-lb pole load
H_{op} = Height of pole above ground (feet)
C = Ground-line circumference (inches)
c = Top circumference (inches)

G. Moment from Conductor on Pole

$$\text{Moments from Conductor on Pole} = \frac{P(H_{op})^2[C + 2c]}{72\pi}$$

Where: P = (Diameter + 1.0) × 0.5 for 6 pound light loading or heavy loading areas
P = (Diameter ÷ 12) × 8 for 8 pound light loading
P = (Diameter ÷ 12) × 12 for 12 pound light loading
P = (Diameter ÷ 12) × 18 for 18 pound light loading
H_{op} = Height of pole above ground (feet)
C = Ground-line circumference (inches)
c = Top circumference (inches)

2.0 Special Conditions

2.1 Determination of Pole Class (Without a Brand) for Poles Set Prior to January 1, 2000

Table 36: Determination of Pole Class (Without a Brand) for Poles set Prior to January 1, 2000

Length of Pole	Correct Class	Incorrect Class as Recorded
25	5	Record Lists as 6, 7, or 8
30	5	Record Lists as 6, 7, or 8
35	5	Record Lists as 6, 7, or 8
40	5	Record Lists as 6, 7, or 8
45	4	Record Lists as 5, 6, 7
50	4	Record Lists as 5, 6, 7
55	3	Record Lists as 4, 5, 6
60	2	Record Lists as 3, 4, 5
65	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
70	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
75	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
80	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
85	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
90	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
95	2 & 1[a/]	Record Lists as 3, 4, 5[b/]
100	2 & 1[a/]	Record Lists as 3, 4, 5[b/]

[a/] 75 percent of the poles purchased prior to 2000 were Class 1, and 25 percent were Class 2

[b/] Use Tables (length and circumference) to determine Class

2.2 Determination of Pole Class (Without a Brand) for Poles Set After January 1, 2000

Table 37: Determination of Pole Class (Without a Brand) for Poles Set After January 1, 2000

Length of Pole	Correct class can be any of the listed classes. Brand should be available to read. SAP might also list class. Otherwise, use table to determine class.
25	5
30	5
35	H2, H1, 1, 2, 3, 4 or 5
40	H4, H3, H2, H1, 1, 2, 3, 4 or 5
45	H5, H4, H3, H2, H1, 1, 2, 3 or 4
50	H5, H4, H3, H2, H1, 1, 2, 3 or 4
55	H5, H4, H3, H2, H1, 1, 2 or 3
60	H6, H5, H4, H3, H2, H1, 1 or 2
65	H6, H5, H4, H3, H2, H1, 1 or 2
70	H6, H5, H4, H3, H2, H1, 1 or 2
75	H6, H5, H4, H3, H2, H1, 1 or 2
80	H6, H5, H4, H3, H2, H1, 1 or 2
85	H6, H5, H4, H3, H2, H1, 1 or 2
90	H6, H5, H4, H3, H2, H1, 1 or 2
95	H6, H5, H4, H3, H2, H1, 1 or 2
100	H6, H5, H4, H3, H2, H1, 1 or 2

2.3 Douglas Fir Minimum Ground Line Circumference and Determination of Pole Class for Topped Poles and Pole Top Extension (PTX)

Table 38 will be used to determine the class of poles for the following scenarios:

- Length and circumference are known for an In-Service pole set after year 2000 and the brand or class cannot be found in SAP
- Poles set prior to year 2000 and groundline and a top of pole circumference are known
- Topped Douglas Fir Poles
- Douglas Fir Poles with PTX. Please note: at no time can a pole with a PTX be classed Greater than a Class 2 pole due to the limitations of the PTX.

Table 38: Douglas Fir Minimum Groundline Circumference

	Class (CL)[a/]										
	H6	**H5**	**H4**	**H3**	**H2**	**H1**	**1**	**2**	**3**	**4**	**5**
Pole Length	39	37	35	33	31	29	27	25	23	21	19
25	—	—	—	—	—	—	—	—	—	—	25.8
30		—	—	—	—	—	—	—	—	—	27.7
35	—	—	—	—	—	—	40.9	37.9	35.0	32.5	29.0
40	—	—	51.0	48.5	46.0	43.5	41.0	38.5	36.0	33.5	31.0
45	—	55.8	53.3	50.8	48.3	45.3	42.8	40.3	37.3	34.8	32.2
50	—	58.0	55.0	52.5	50.1	47.1	44.6	41.6	38.6	36.1	—
55	—	59.8	57.3	54.3	51.4	48.9	45.9	42.9	40.0	—	—
60	64.5	61.6	58.6	56.1	53.1	50.2	47.2	44.3	—	—	—
65	66.3	63.3	60.4	57.4	54.5	51.5	48.5	45.6	—	—	—
70	67.6	65.1	62.2	59.2	55.8	52.8	49.9	46.9	—	—	—
75	69.4	66.4	63.5	60.5	57.6	54.2	51.2	47.8	—	—	—
80	70.7	67.7	64.8	61.9	58.4	55.5	52.5	49.1	—	—	—
85	72.5	69.5	66.1	63.2	59.8	56.8	53.4	50.0	—	—	—
90	73.8	70.9	67.4	64.5	61.1	57.7	54.3	51.3	—	—	—
95	75.3	72.4	69.0	65.6	62.6	59.2	55.3	52.4	—	—	—
100	76.9	73.9	70.5	67.1	63.7	60.2	56.8	53.4	—	—	—

[a/] If the Douglas Fir pole with a circumference that is much greater than the circumferences above, it means that the species is incorrect. The pole is probably a Western Red Cedar.

Example of Groundline Circumference:

A pole is set in 2005 as a 45 foot pole. It has a groundline circumference of 42 inches. In the chart above, begin by finding the pole height- in this case, 45 feet. At a 42 inches groundline, it is too small to be a CL 1, but it is greater than the CL 2 circumference of 40.3 inches. Therefore, the pole is a Class 2 pole. If the circumference would have been 40 inches, the pole would have been a Class 3. The groundline must be greater than or equal to the circumference shown under that class of pole for the new height.

Example of a Topped Pole:

A pole is originally set as a Douglas Fir 55 foot Class 3 pole. It has a groundline circumference of 42 inches. The pole was topped, removing 10 feet. The new height of the pole is 45 feet. In the chart, begin by determining the new pole height- in this case, 45 feet. At 42 inches, it is too small to be a Class 1, but it is greater than the Class 2 circumference of 40.3 inches. Therefore, the pole will be considered a Class 2. The groundline must be greater than or equal to the circumference shown under that class of pole for the new height.

Example of a PTX:

A pole is originally set as a Douglas Fir 45 foot Class 3 pole. It has a groundline circumference of 38 inches. The pole has an extension of 5 feet placed on it, making the new height 50 feet. In the chart, begin by determining the new pole height- in this case, 50 feet. At 38 inches, it is too small to be a Class 3, but it is greater than the Class 4 circumference of 36.1 inches. Therefore, the pole will be considered a Class 4. The groundline must be greater than or equal to the circumference shown under that class of pole for the new height. **At no time can a pole with a PTX be classed Greater than a Class 2 pole due to the limitations of the PTX.**

2.4 Western Red Cedar Minimum Ground Line Circumference and Determination of Pole Class for Topped Poles and Pole Top Extension (PTX)

Table 39 will be used to determine the class of poles for the following scenarios:

- Topped Western Red Cedar Poles
- Western Red Cedar Poles with PTX. Please note: at no time can a pole with a PTX be classed Greater than a Class 2 pole due to the limitations of the PTX.
- To determine the class for poles that do not have a visible brand, being with Table 36 prior to assessing either the pole topped condition or the PTX.

Table 39: Western Red Cedar Minimum Groundline Circumference

	Class										
	H6	**H5**	**H4**	**H3**	**H2**	**H1**	**1**	**2**	**3**	**4**	**5**
Pole Length	39	37	35	33	31	29	27	25	23	21	19
25	—	—	—	—	—	—	—	—	—	—	28.5
30	—	—	—	—	—	—	—	—	—	—	30.2
35	—	—	—	—	—	—	40.9	37.9	35.0	32.5	32.0
40	—	—	56.5	53.5	51.0	48.0	45.0	42.5	39.5	36.5	34.0
45	—	61.7	58.7	55.7	53.2	50.2	47.2	44.3	41.3	38.3	35.8
50	—	63.9	60.9	57.9	54.9	52.0	49.0	46.0	43.0	39.6	—
55	—	66.1	63.1	60.1	56.7	53.7	50.8	47.8	44.3	—	—
60	70.8	67.8	64.9	61.9	58.4	55.5	52.5	49.1	—	—	—
65	73.0	70.0	66.6	63.6	60.2	57.3	53.8	50.4	—	—	—
70	74.7	71.8	68.4	65.4	62.0	58.5	55.1	51.7	—	—	—
75	76.5	73.5	70.1	66.7	63.3	59.9	56.4	53.0	—	—	—
80	78.3	74.8	71.9	68.5	65.1	61.2	57.7	54.3	—	—	—
85	80.0	76.6	73.2	69.8	66.4	62.5	59.1	55.2	—	—	—
90	81.8	78.4	74.5	71.1	67.7	63.8	60.4	56.5	—	—	—
95	83.4	79.9	76.5	72.6	69.2	65.3	61.4	57.6	—	—	—
100	84.9	81.5	78.1	74.2	70.3	66.9	63.0	59.1	—	—	—

Example of Groundline Circumference:

A pole is set in 1980 as a 50 foot pole. It has a groundline circumference of 47 inches and a top circumference of 23 inches. In the chart above, begin by finding the pole height- in this case, 50 feet. At a 47 inches groundline, it is too small to be a Class 1, but it is greater than the Class 2 circumference of 46 inches. However, the top circumference must also be considered. At 23 inches, the pole would then be considered a Class 3. Whichever measurement- groundline or top circumference- arrives at the worst case scenario must be used.

Example of a Topped Pole:

A pole is originally set as a Western Red Cedar 55 foot Class 3 pole. It has a groundline circumference of 46 inches. The pole was topped, removing 10 feet. The new height of the pole is 45 feet. In the chart, begin by determining the new pole height- in this case, 45 feet. At 46 inches, it is too small to be a Class 1, but it is greater than the Class 2 circumference of 44.3 inches. Therefore, the pole will be considered a Class 2. The groundline must be greater than or equal to the circumference shown under that class of pole for the new height.

Example of a PTX:

If a 45-foot H-1 pole is found with a PTX installed and the GLC is 45.5 inches, it must be re-classed to a Class 2 pole even though the table indicates that it could be a class 1 (GLC for a CL-1 50 is 44.8 inches) and the load calculation performed with the Class 2 pole, even though the tables show that it could be a Class 1 pole. At no time can a pole with a PTX be classed Greater than a Class 2 pole due to the limitations of the PTX.