POWER LINE ®

S Y S T E M S · I N C ·

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Checking Post Insulators with Multiple Interaction Curves

Introduction

Starting with PLS-POLE and TOWER version 7.64 you can input multiple post insulator strength interaction curves as shown in the dialog box at the right. Prior to this version, the curve was limited to being a single rectangle. You may now input as many curves of whatever shape you like with each curve having as many points as necessary to accurately describe the strength of the insulator. This improvement makes it easier to create a post insulator library that can be used for a variety of loading conditions.


	Longitudinal Capacity (lbs)	Transverse Capacity (lbs)	Vertical Capacity (lbs)
1	0.0	2500.0	0.0
2	0.0	2000.0	1500.0
3	0.0	0.0	2500.0
4	0.0	-2000.0	1500.0
5	0.0	-2500.0	0.0
6	1000.0	2250.0	0.0
7	1000.0	1750.0	1500.0
8	1000.0	0.0	2250.0
9	1000.0	-1750.0	1500.0
10	1000.0	-2250.0	0.0
11	1500.0	2000.0	0.0

Revisions

Version 7.64: Feature introduced

Creating the Library

When PLS-POLE or TOWER (hereafter only PLS-POLE will be referred to since post insulators are not normally used on lattice towers) opens a model saved in an earlier version it automatically translates the data in the *Vert. Down Capacity, Vert. Up Capacity, Trans. – Capacity, Trans. + Capacity* and *Long. Capacity* columns into a single interaction capacity rectangle. For models that did not check one or more of these values the program will arbitrarily select a 10,000,000 lb (or N) capacity as it needs a limit to create a usable interaction curve.

An interaction curve can be thought of as a 2d slice of a 3d interaction capacity sphere or volume. A slice is defined by a given value of longitudinal capacity and consists of at least three or more transverse and vertical capacity pairs. These pairs form a polygon which must be convex. The pairs must be input in counterclockwise order. If the input pairs are not entered in counterclockwise order or do not form a convex polygon then the program will display an error message.
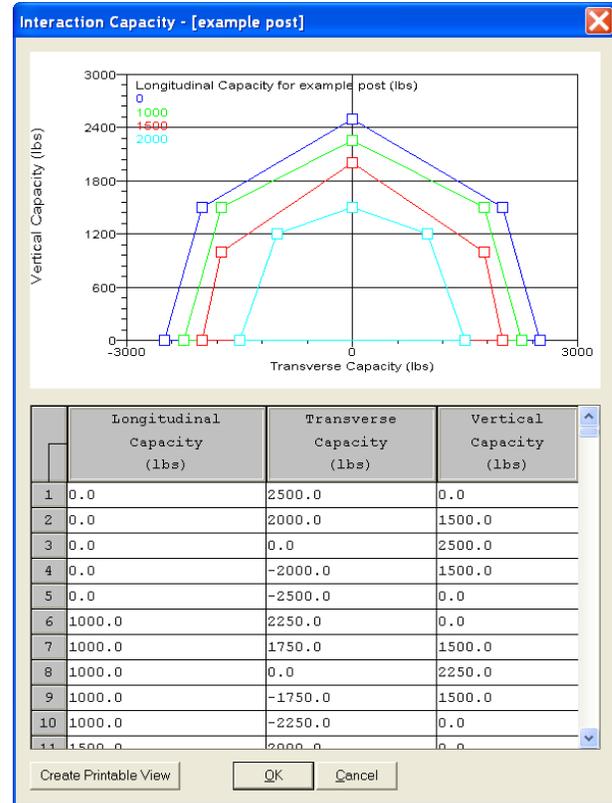
You may need to contact your post insulator representative and obtain their interaction curves. Note that manufacturers frequently supply curves that include strength factors. When inputting them in PLS-POLE you will need to reconcile any manufacturer applied strength factor with the *S.F. For Insulators* found in *Loads/Vector Loads* and in *Criteria/Structure Loads* in PLS-CADD. Some manufacturers even supply curves that use factors other than those specified in the NESC. In all cases, it is important that you sort out what strength factor will be used where before inputting the curve. You may want to review our NESC Insulator Requirements technical note at http://www.powline.com/products/nesc_insulators.html

As mentioned above the interaction curves are defined by three sets of numbers which are input by clicking on the button in the *Interaction Capacity* column found in the table reached via the *Components/Insulators/Post* command. These are:

> *Longitudinal Capacity*: longitudinal is defined as being perpendicular to the post and in the horizontal plane. The *Long. Capacity* column present in versions prior to 7.64 directly maps to this column. A curve is both identified and defined by its longitudinal capacity. A change in the longitudinal capacity input in the *Interaction Capacity* table indicates the start of a new curve. The *Longitudinal Capacity* is assumed symmetric and must be input as a positive number (program will assume the capacity in the negative direction is the same).

> *Transverse Capacity*: transverse is defined as being in the direction of the post and in the horizontal plane. Positive values of transverse capacity correspond to tension capacity and negative values correspond to compression capacity (for non-vertical posts). Therefore the *Trans – Capacity* present prior to version 7.64 is translated into a negative *Transverse Capacity* and the *Trans + Capacity* is translated into a positive *Transverse Capacity.*

> *Vertical Capacity*: vertical is the same as the global Z axis except a positive value indicates downward capacity and a negative value indicates uplift capacity. Therefore the *Vert. Down Capacity* present prior to version 7.64 is translated into a positive *Vertical Capacity* and the *Vert. Up Capacity* is translated into a negative *Vertical Capacity.* One special case to be aware of is the input of a negative *Vert. Up Capacity* which in previous versions signified a required minimum vertical load. This is translated into a positive *Vertical Capacity* and will result in an interaction curve that is entirely above the vertical axis.

Interaction Check and Results

Once you have defined the interaction curves then PLS-POLE can use them to check your post insulator. This check involves finding curves with a longitudinal capacity greater than the longitudinal load and seeing if the point defined by the transverse and vertical load falls within that curve while accounting for the insulator strength factor. The percent usage concept for this check is somewhat arbitrary and is designed to meet two goals: first, to produce the same results as previous versions did and second, to give you some intuition as to how close to the limit (how close to the edge of the curve or how far beyond the curve) your load is. To do this,

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separate longitudinal, transverse and vertical usages are calculated for every curve. Then the maximum of these three usages is compared with that of all other curves. Finally, the curve producing the lowest maximum usage is selected.

Example: Consider the following two load cases with the post insulator curves on page 1. Both load cases have an insulator strength factor of 1. Note that the curves on page 1 do not include any points with negative vertical capacity which indicates that there is no uplift capacity.

Longitudinal (lbs)	Transverse (lbs)	Vertical (lbs
0	2050	1200
1100	2050	1200

The output would be:

```
Summary of Post Capacities and Usages for Load Case "example":

Post Vertical Tran. Long. Cant. Axial Vert. Down Vert. Up Trans. - Trans. +  Long.   Cant.   Comp.  Tens. Insul. Usage
Label   Force Force Force Force Force Capacity Capacity Capacity Capacity Capacity Capacity Capacity Capacity  S.F.
       (kips)(kips)(kips)(kips)(kips)  (kips)  (kips)  (kips)  (kips)  (kips)  (kips)  (kips)  (kips)         %
-----------------------------------------------------------------------------------------------------------------
   C1    1.20  2.05  0.00  0.99  2.16    1.35    0.00    2.10    2.10    0.00    0.00    0.00    0.00  1.00  97.62
   C2    1.20  2.05 -1.10  1.48  2.16    2.00    0.00    1.40    1.40    1.50    0.00    0.00    0.00  1.00 146.43 NG Out of
bounds: arbitrary vertical capacity
```

This format should look familiar since it is exactly the same as that produced by previous versions of the software. For the 0 lb longitudinal load case the program picks the 0lb longitudinal curve (as indicated by the 0.00 Long Capacity) which has a 2100 lbs of Transverse Capacity resulting in 97% usage. For the longitudinal load of 1100lbs the program picks the 1500 lb curve which only has 1400 lbs of transverse capacity resulting in the 146% usage. Note that in this case the printed vertical capacity is arbitrary since the load cannot be projected on the interaction curve. A different algorithm may be used for calculating usage when the load lies so far outside of the interaction curve that neither the transverse nor the vertical load can be projected upon it. In all cases, you should not be overly concerned with the actual numeric value of the usage as all that matters is whether or not you are inside the curve (have a usage under 100%).