5400 King James Way, Suite 300
Madison, WI 53719, U.S.A.
Phone: 608.238.2171
Email: support@powerlinesystems.com
URL: https://www.powerlinesystems.com/

How to Quickly Check Clearance to a Crossing Wire in PLS-CADD

This Technical Note will demonstrate how to check clearances between crossing wires in PLS-CADD. For this demonstration, we will be using the **demo.xyz** model, which is an example that ships with the software and is typically saved in: C:\Users\Public\Documents\PLS\pls_cadd\examples\projects.

*If you do not see the demo model in that folder, go to **Help/Download Examples** to have the model available.*

In the Demo model, navigate to the span between Structures 4 and 5 as shown in Figure 1 below. Here you can see that there is a crossing line modelled beneath the double circuit line. This double circuit line has a 345 kV circuit (blue wires - Kiwi ACSR) and a 138 kV circuit (magenta wires - Drake ACSR). The crossing line is a 12 kV circuit (red wire – Linnet ACSR).

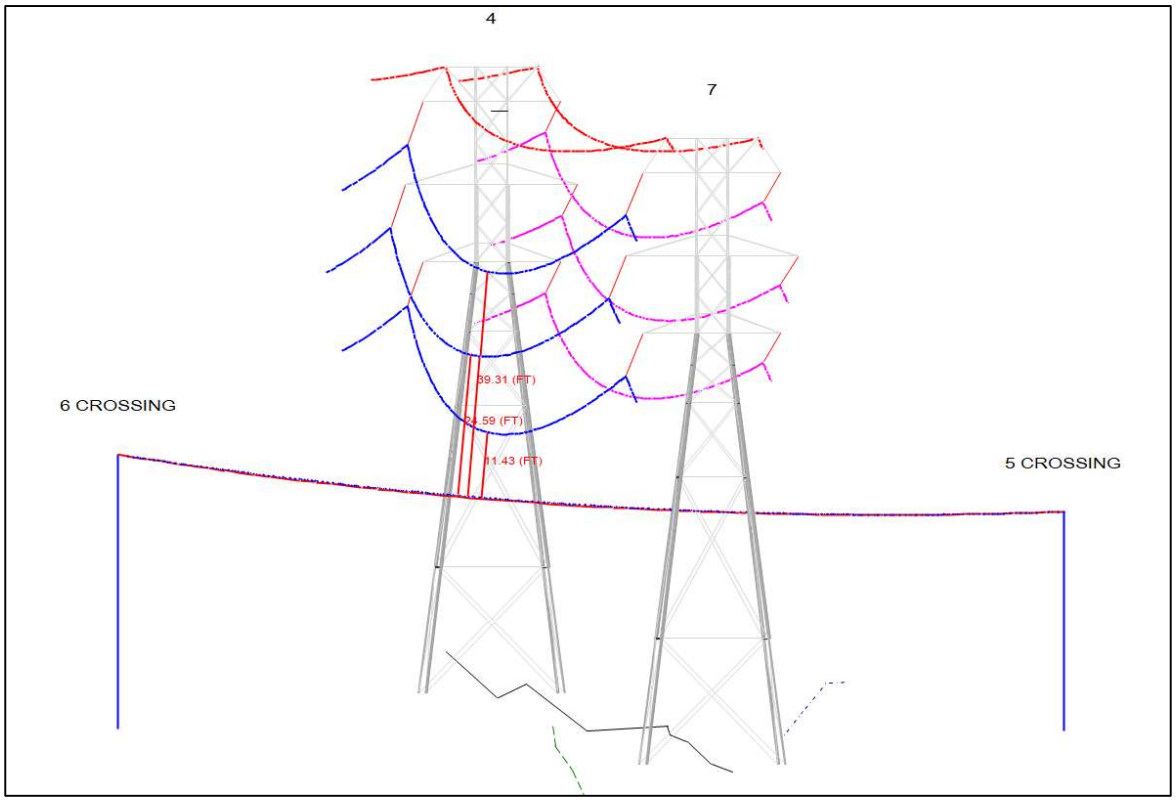


Figure 1: Span from Demo.xyz

The procedure described below includes steps for creating and spotting the crossing structures, as well as stringing and sagging the crossing wire.

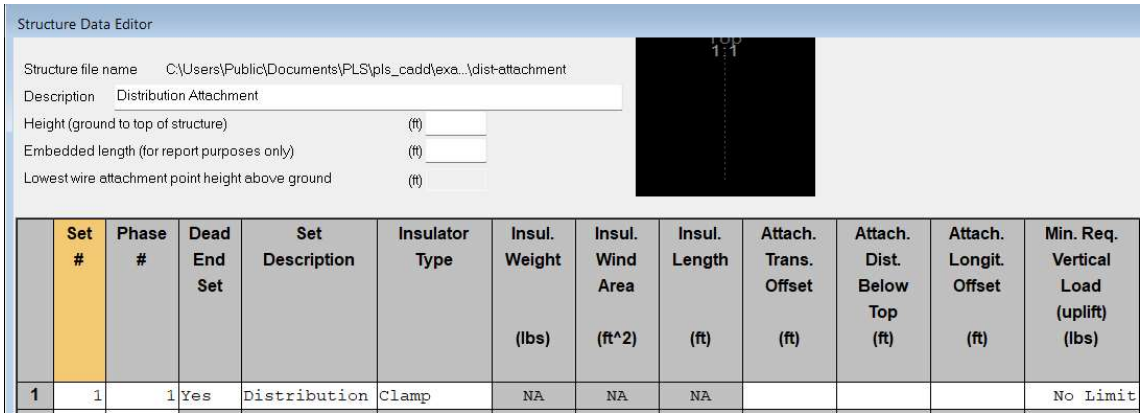
If your crossing structures and wire are already in place, you may go to the Clearance Check section of this tech note.

Modelling the Crossing

Create the structure files

Create a simplified dead-end structure for the undercrossing wires using the Structure Data editor accessed via the menu command ***Structures/Create New Structure***.

For this example, let us assume a height of 0 ft and use a dead end set (the Dead End Set column set is to "Yes"). Place a Clamp insulator at the top of the structure in Set 1: Phase 1, with No Limit for the Minimum Vertical Load check.



	Set #	Phase #	Dead End Set	Set Description	Insulator Type	Insul. Weight (lbs)	Insul. Wind Area (ft^2)	Insul. Length (ft)	Attach. Trans. Offset (ft)	Attach. Dist. Below Top (ft)	Attach. Longit. Offset (ft)	Min. Req. Vertical Load (uplift) (lbs)
1	1	1	Yes	Distribution	Clamp	NA	NA	NA				No Limit

Figure 2: Simple Stick Structure Properties

Spotting the structures

Next, we'll add the crossing structures to the model. Since we have a 0 ft tall structure we need to snap the base of this structure up at the attachment point.

We recommend adding the structures as XY Based since this is a rapid and accurate way to place structures inside a PLS-CADD model, but we'll also discuss two other approaches.

Option 1: XY-based structures

XY-based structures can be placed several ways within the model. IN this model there are survey points on feature code 230 (Distribution Attachment) at the desired structure location; we can place the XY Based structures at those points.

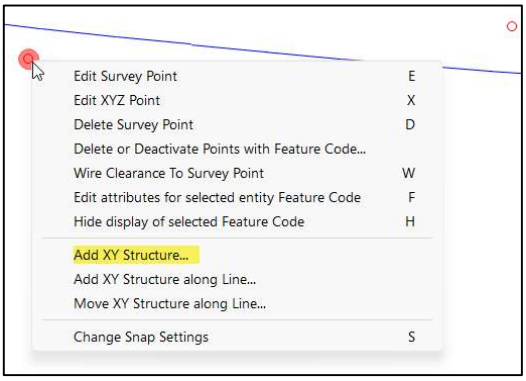


Figure 3: Context menu command to Add XY Structures

To do this:

- First, make sure only the Survey Points are selected in the Entity Info Snap Settings (**View/Entity Info Snap Settings...**)
- Then left-click on one of the survey points and select the **Add XY Structure...** option from the Entity Info commands.
- Finally, select the Method 1 structure you created in previously.
- Repeat this process at the other survey point.

There is no need to change the structure orientation in this case since we are using structures with a single-phase attachment.

However, adjustments to the structure orientation may be required if we had multi-circuit or multi-phase structures. Please see more information on how to place XYZ Based Structures in the PLS-CADD Manual, Section 10.2.8.1 *Adding XY Based Structures.*

Option 2: Station Based structures can be added on the same Alignment

To do this, you will use the ***Structures/Add/Along Alignment*** command to place the structure, click close to the desired station, and then manually type-in the required station, height adjustment and offset adjustment to match the support point. If you have survey points at the structure locations, you can use the ***Structures/Move/On Snap...***command to snap your structures to the surveyed points.

For a crossing span like this, add an offset on both structures (positive is to the right of the alignment and negative is to the left of the alignment). *This option is not recommended for perpendicular crossings since offset structures cannot be placed at the same station, regardless of the offset used.*

Option3: Station Based Structures on an Independent Alignment

The final method for adding structures is adding Station Based structures on an independent alignment. To do this, use the ***Terrain/Alignment/New Alignment...*** command to add in two new PI's at the structure locations. Note: This alignment must be an *Independent* Alignment (not a Branch). Then use the ***Structures/Add/Along Alignment*** command as in the previous approach (but without offset adjustments). Please see more information on the additional alignments in PLS-CADD Manual, Section 6.3.1.2 *Defining or Editing Additional Alignments*.

String and sag the crossing wire between the two Crossing structures.

This will create another tension section. To accurately model the crossing span wire, you will need some information about the section in question. At a minimum, you need to know the type of conductor and its temperature or current at the time of the survey, so that you can accurately represent the sags and tensions of this crossing span.

For this example, we'll use ***Sections/Add Graphical...*** to string in the wires. Click on the Start Dead end set and then the End Dead end set and press <Enter>.

On the *Section Add* dialog, select the cable file for Linnet ACSR wire, designate the voltage as 12 kV, and leave the Sag Horizontal Tension input at 0 lbs. *Leaving this input as zero forces the software to use the Automatic Sagging criteria to determine the wire tensions.* Then set the wire display weather case and cable condition to match the conditions at the time of the survey.

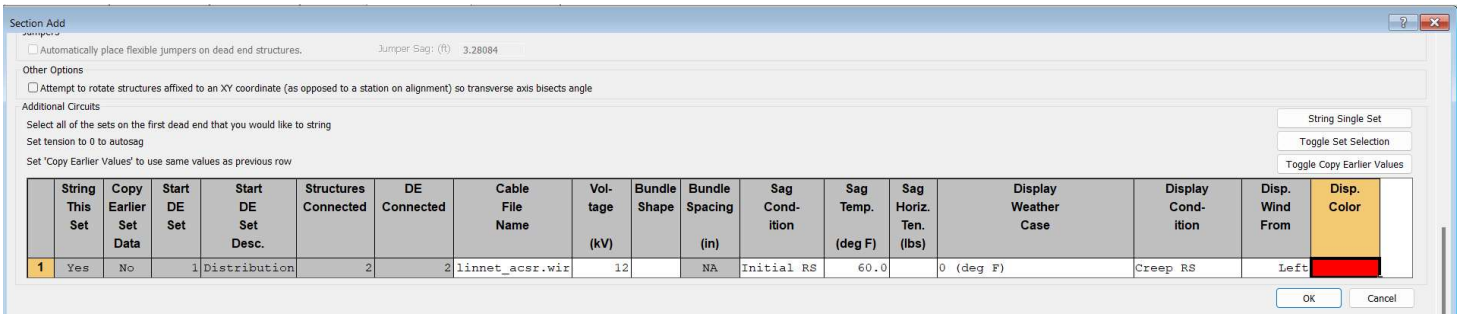


Figure 4: Section Add Graphical Dialog

To sag the wires in this model, we will make use of the survey point with feature code 234 (Surveyed cable) between the two structures we just added. Use ***Sections/Graphical Sag...*** use the correct Weather Case and Cable Condition, then make sure the Snap mode is set to "Fit to survey point closest to mouse" and click on that survey point. This ensures that the model matches the field surveyed conditions.

Clearance Check

Now that the structures and wires are installed, you can use the function ***Sections/Clearances/Between Sections*** to ensure adequate separation is maintained between your lines and guarantee its safe operation. In this example, we will check clearances between the reference (From) conductors in the 345 kV circuit (Kiwi ACSR Blue, Section12) and the target (To) conductor in the 12 kV circuit (Linnet ACSR, Red, Section 3). It may be helpful to make a note of the section numbers before proceeding to this menu. While manual selection of the From and To sections is supported in the Sections Clearances dialog, the most efficient way to use the tool is to click on the desired reference (From) conductor in the graphical view and drag or rubber band the cursor to the target (To) conductor, and release. This action will automatically populate the selected section numbers in the Section Clearances dialog, as shown below in Figure 5.

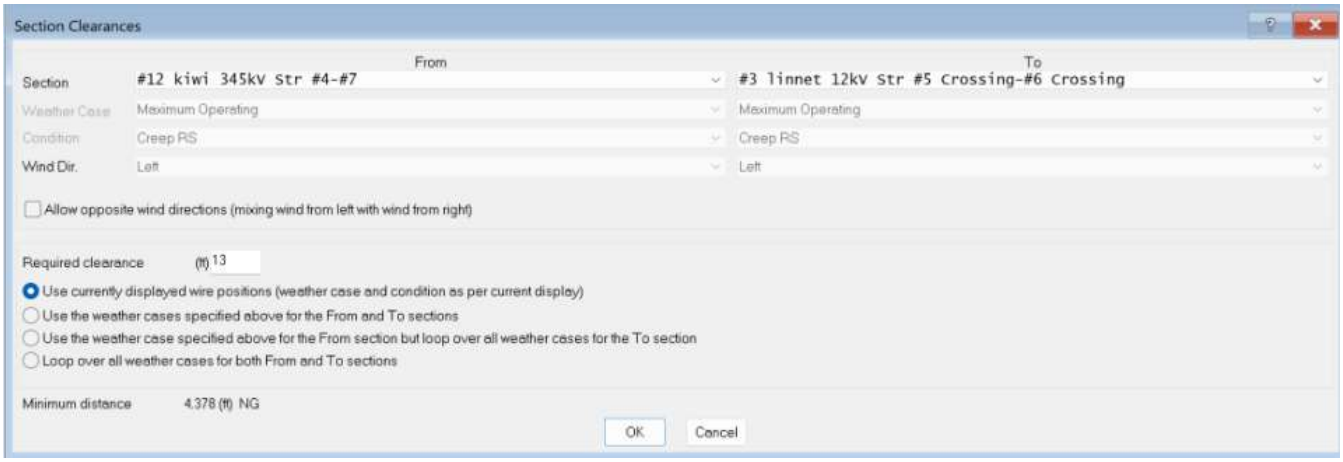


Figure 5: Section Clearances Dialog

The clearance between sections is calculated based on the input **Weather Case**, **Cable Condition** and **Wind Direction** parameters for your *Reference* (From) and *Target* (To) wires. While in this dialog, changes to these parameters will be reflected dynamically in the model views via blue dotted line markers denoting the wire positions and the red markers indicating the minimum clearance between the phase(s), as shown in Figure 1. To remove the markers, press the F5 key or use **View/Markers/Clear Markers** command. The function is extremely powerful as it computes the distances in 3-D at any point along the spans. The **Minimum distance** is shown in the bottom left of this dialog.

If you enter a **Required Clearance**, the PLS-CADD checks this against the calculated Minimum distance and shows an "OK" if the distance is greater than the required clearance, or a "NG" if it is less than at the end of the "Minimum distance" result.

There are four options that control how the program applies the **Weather Case**, **Cable Condition** and **Wind Direction** selections that you can make:

- **Use currently displayed wire positions (weather case and condition as per current display)** Using the option locks out the selection of Weather Case, Cable Condition and Wind Direction as it will calculate the distance based on the currently displayed weather case and condition for the Reference and Target sections. These are set in **Sections/Modify** and **Section/Display Options**.

- **Use the weather cases specified above for the From and To sections**
  This option will calculate the distance between the Reference and Target sections allowing you to select the parameters irrespective of what the model display is using in **Sections/Modify** and **Section/Display Options**. Instead of specifying a Weather Case it is possible to select the option to use a ***Straight Line Wire*** instead. This will model the cable as a straight-line interpolation of the cable between the attachment points. This is sometimes a code requirement and is a conservative upper limit of the wire position.

- **Use the weather case specified above for the From section but loop over all weather cases for the To section**
  This keeps the Reference section fixed at the selected parameters but calculates the distance for all weather cases in the Target section. This is particularly effective for verifying clearance against a crossing conductor that may undergo varying sag and sway conditions while the Reference conductor remains constant. Please note that only the Weather Case will change for the Target section, but the Condition and Wind Direction will remain the same.

- **Loop over all weather cases for both From and To sections**
  This is similar to the third option, but distance is checked for the same Weather Case for the Target and Reference sections for each Weather Case. While this may not yield critical data for crossing conductors, it is essential for verifying phase-to-phase clearance within a single section (where the Reference and Target sections are identical).

Once you are satisfied with your selections, pressing the OK button will generate a report listing out the calculated clearances and provide useful information on where the minimum distance occurs on both spans.

Section Clearance Report

Required clearance (ft) 0.00

Wire 1						Wire 2						Wire 1	Wire 2	Minimum Clearance	OK	Notes
Back Attachment Str. #	Set #	Phase #	Minimum Station (ft)	Clearance Offset (ft)	Point-Horiz. Distance To Back Str. (ft)	Back Attachment Str. #	Set #	Phase #	Minimum Station (ft)	Clearance Offset (ft)	Point-Horiz. Dist. To Back Str. (ft)	Wind From	Wind From	(ft)		
4	6	1	3730.59	20.74	391.26	5 Crossing	1	1	3730.10	24.24	121.61	Left	Left	39.31	OK	
4	6	2	3731.40	23.71	392.24	5 Crossing	1	1	3731.10	25.94	124.57	Left	Left	24.59	OK	
4	6	3	3728.78	20.74	389.45	5 Crossing	1	1	3728.63	21.74	120.67	Left	Left	11.43	OK	

Figure 6: Section Clearances Report

The procedure above can easily be modified to include multiple wires by substituting structures with multiple attachment sets for the structures used above.