2017 PLS-CADD Advanced Training and User Group

Advanced FE Modeling

by

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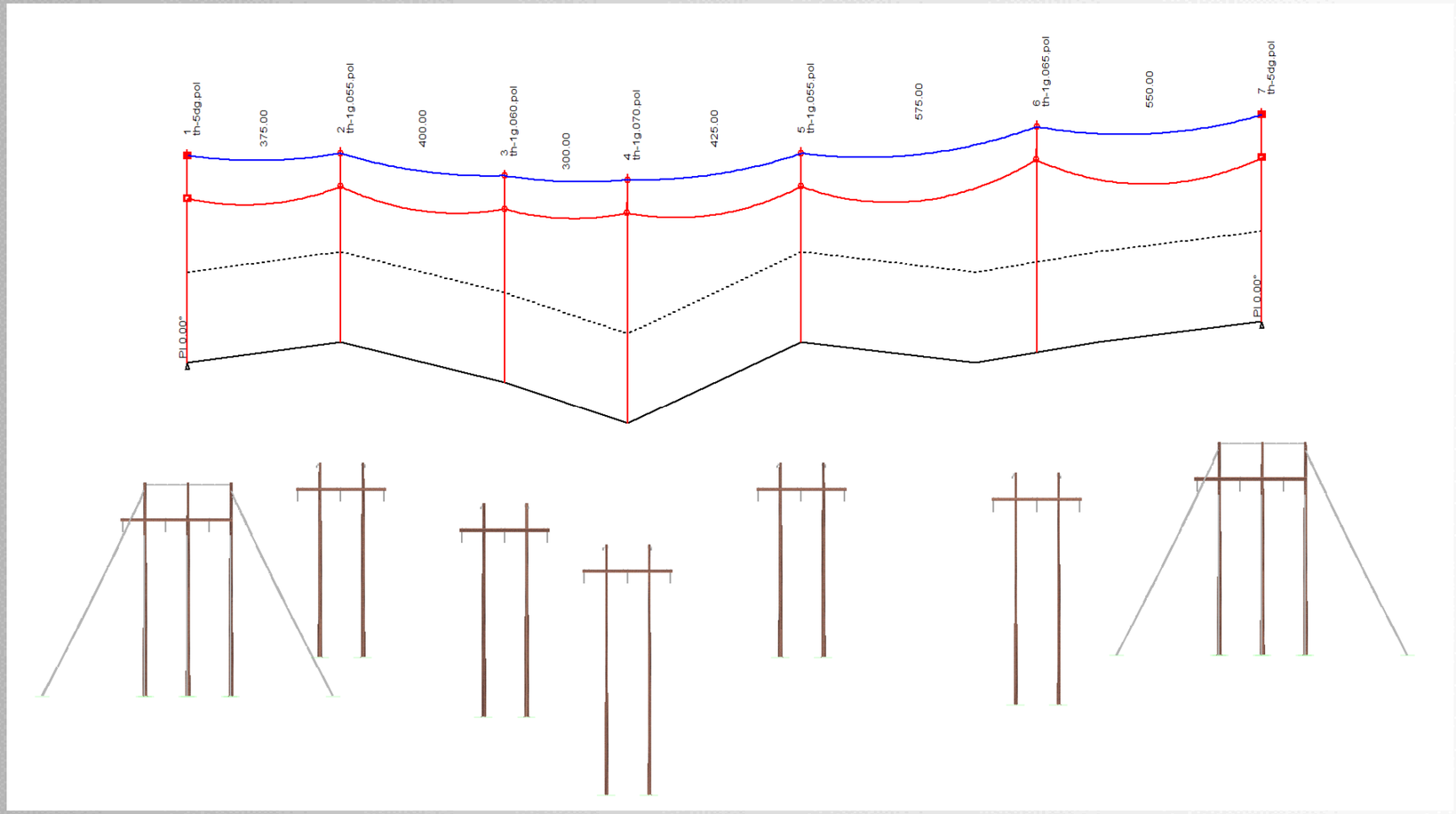
What We Will Cover

- Discuss Life cycle of a project
- Show how to create xyz points along a wire
- Discuss methods of graphical sagging
  - Show best techniques
  - Discuss common pitfalls and mistakes
  - Explain what sagging data conditions are
  - Explain how after graphical sagging in an ideal world we should match original design conditions
  - Show possible differences in results that can occur from making wrong assumptions
- Show changing a suspension structure to a floating DE
  - Explain what not to do
  - Show various tips and techniques to match existing tensions

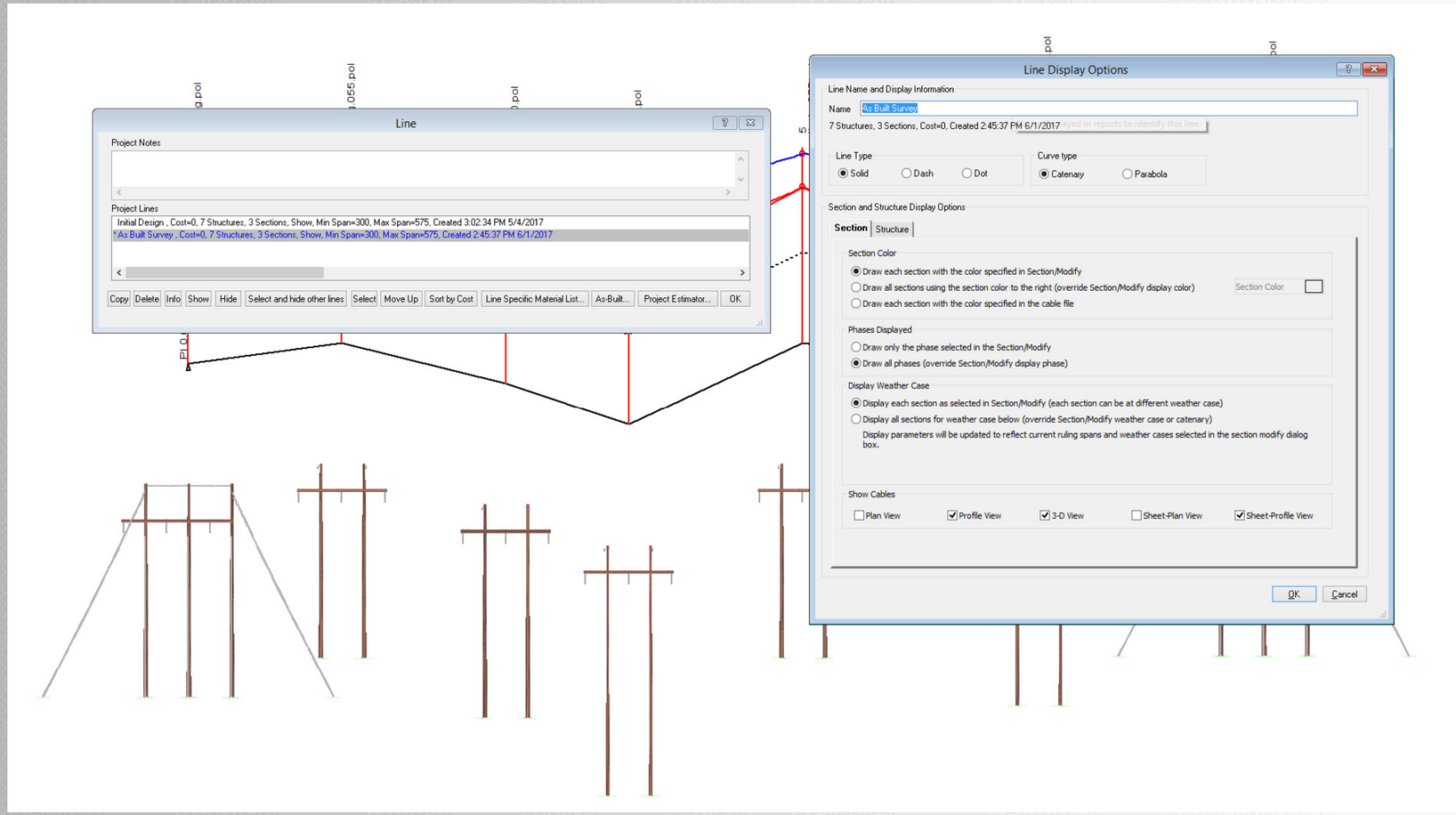
Step 1: Complete Desgin

- After automatic sagging the sections are clipped representing the final design.



Step 2: Copy Line Model

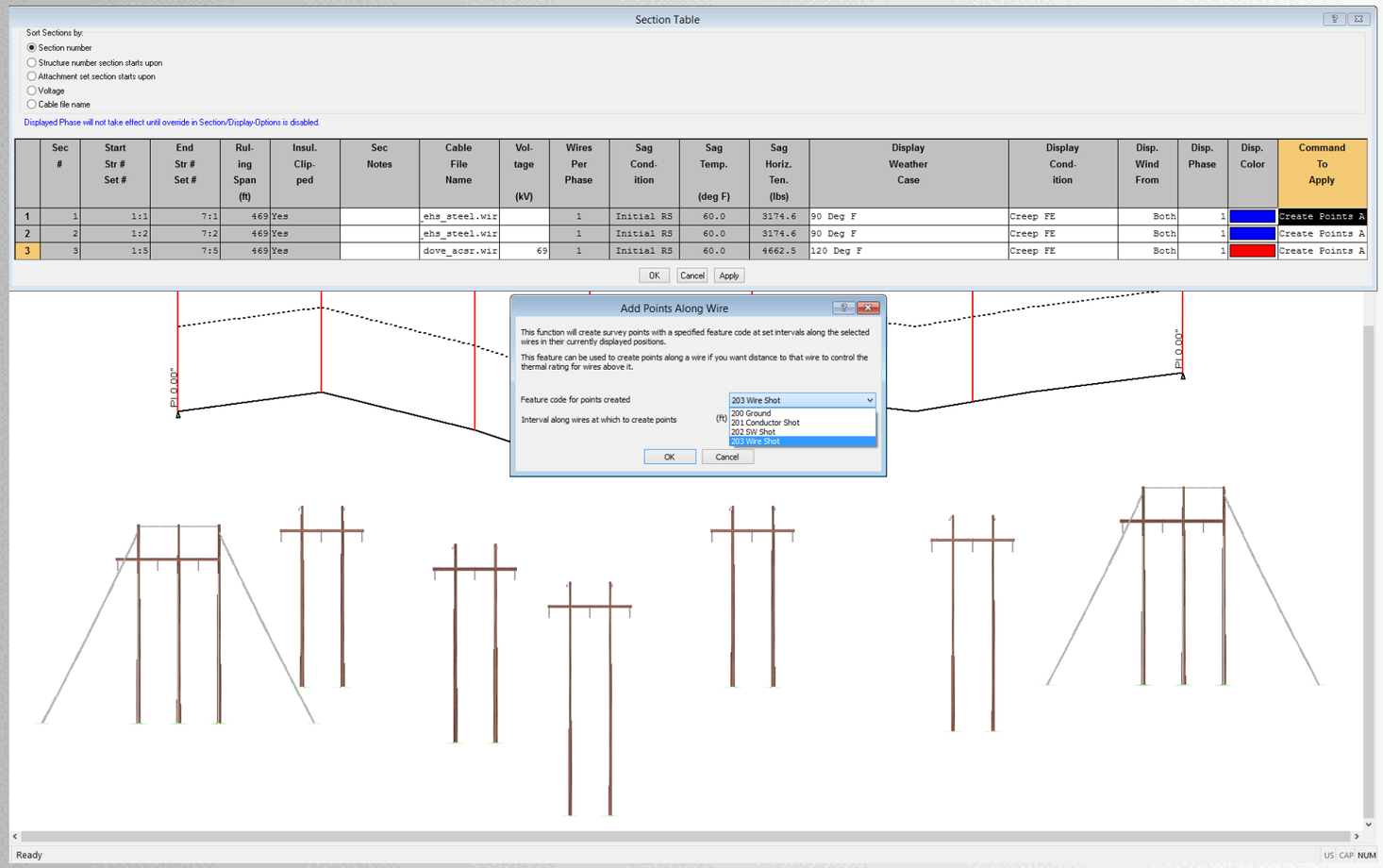
- Copy line model in **Lines/Edit…** and create an “as-surveyed” model



Step 3: Create LiDAR survey points

- To simulate LiDAR survey data I created points along the wires using the command to apply column in **Sections/Table…** with the wires displayed at an example surveyed condition of a hot summer day 10 years later after the wires are fully crept.

*Note: Wire shots are all placed on 1 feature code. This makes the process of finding graphical sag fit points easier because all wires can be done at once. If wires are on separate feature codes it's best to export them and re-import them into the project on 1 feature code for graphical sagging.



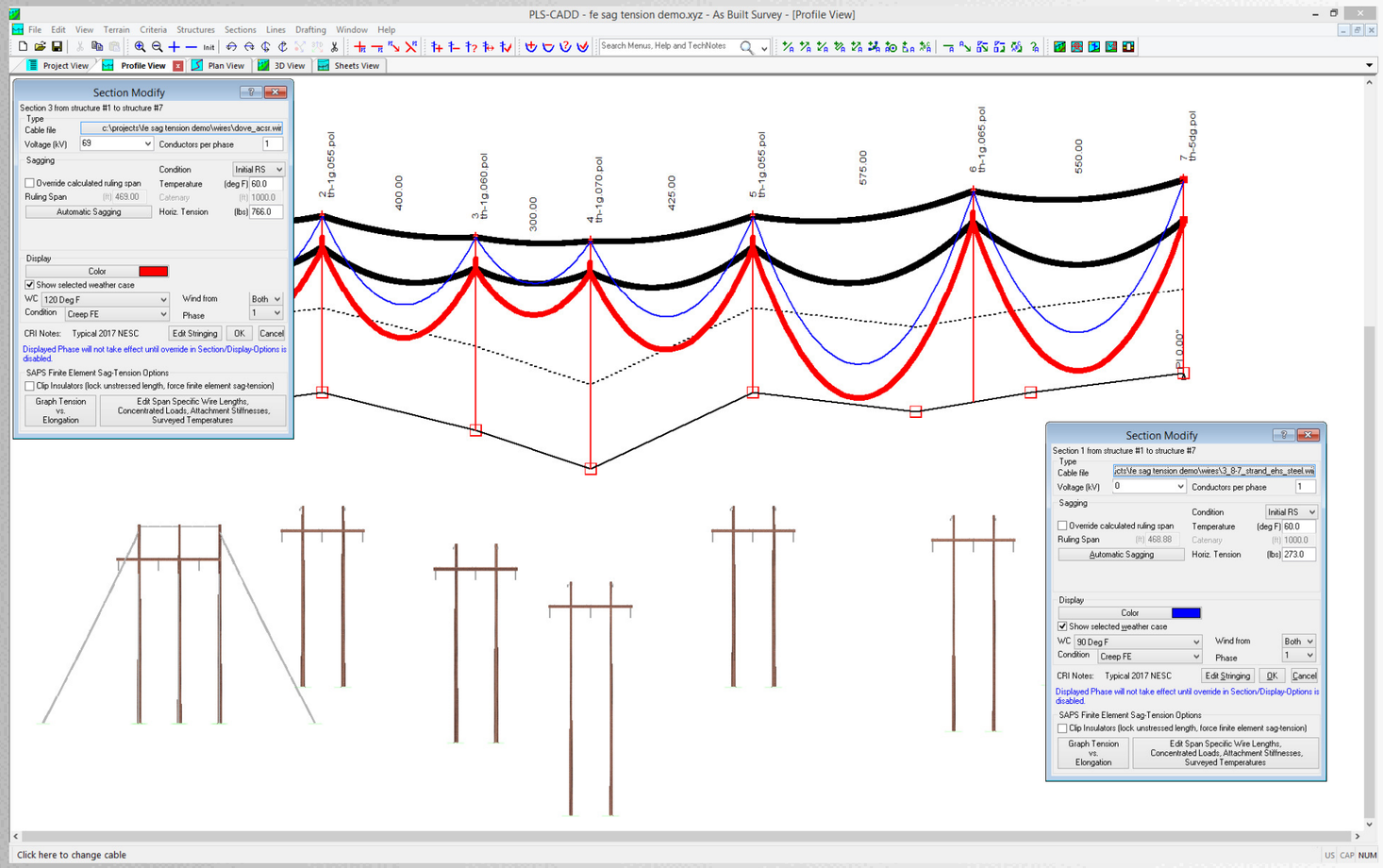
	Sec #	Start Str # Set #	End Str # Set #	Ruling Span (ft)	Insul. Clipped	Sec Notes	Cable File Name	Voltage (kV)	Wires Per Phase	Sag Condition	Sag Temp. (deg F)	Sag Horiz. Ten. (lbs)	Display Weather Case	Display Condition	Disp. Wind From	Disp. Phase	Disp. Color	Command To Apply
1	1	1:1	7:1	469	Yes		_ehs_steel.wir		1	Initial RS	60.0	3174.6	90 Deg F	Creep FE	Both	1		Create Points A
2	2	1:2	7:2	469	Yes		_ehs_steel.wir		1	Initial RS	60.0	3174.6	90 Deg F	Creep FE	Both	1		Create Points A
3	3	1:5	7:5	469	Yes		dove_acsr.wir	69	1	Initial RS	60.0	4662.5	120 Deg F	Creep FE	Both	1		Create Points A

Step 4: Change tensions and unclip

- To simulate creating a new line to match the survey data I unclipped the sections and lowered the tension to the 1000 foot catenary PLS-CADD defaults to after stringing wire.

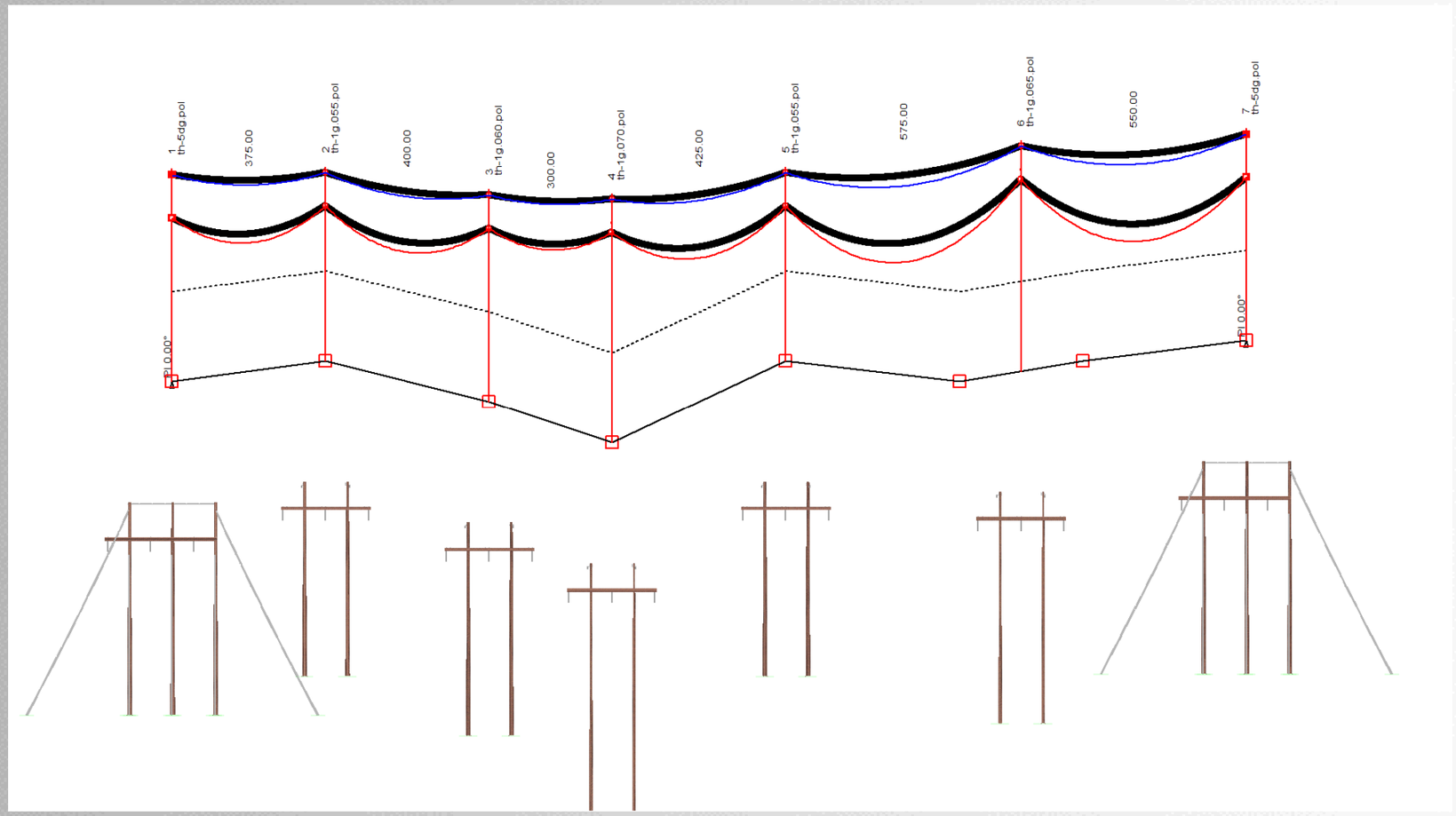
*Note: Sections have their sagging data set to Initial RS and 60 degrees F. These conditions represent the initial install conditions of the wire when the insulators were plumb and they represent the conditions the line exists at for the majority of its life which is what PLS-CADD bases the creep elongation on.

*Note: Wires are displayed at survey conditions and the cable condition is set to Creep FE. When we perform the ruling span graphical sag “fit mode A” it will be the equivalent of option 2 in **Sections/Graphical Sag...** This means it’s more accurate because it looks for the 60 Degree plumb condition tension that yields the wire display at surveyed conditions in FE.



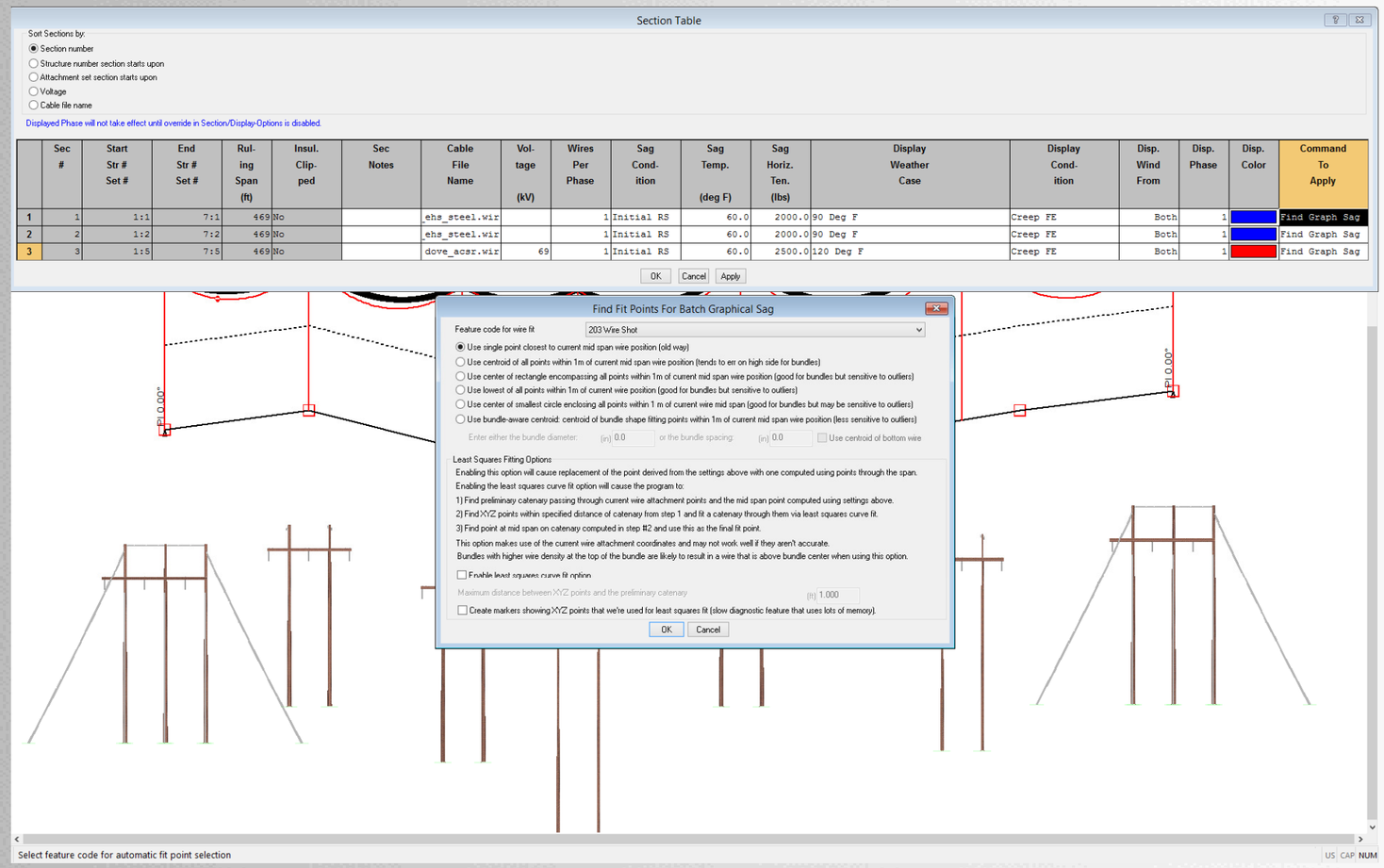
Step 5: Adjust sagging data tension

- I now adjust the sagging data tension so the wires are somewhat near the LiDAR shots and the find graphical sag fit points command can work properly.



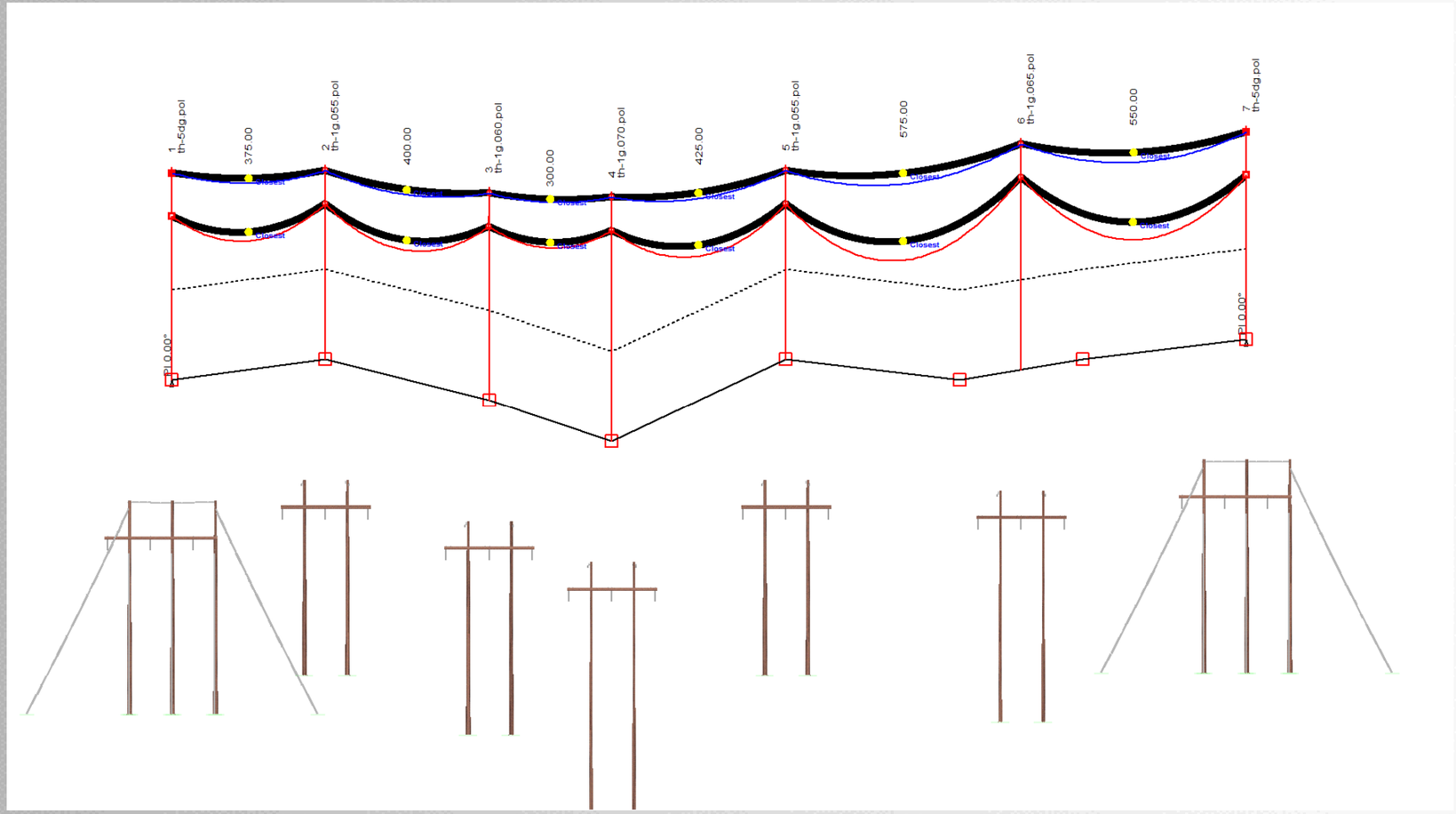
Step 6: Find graphical sag fit points

- Depending on your data and bundle geometry choose one of the options for finding graph sag fit points by going to **Sections/Table…** and using the command to apply column to apply the command Find Graph Sag Fit Points



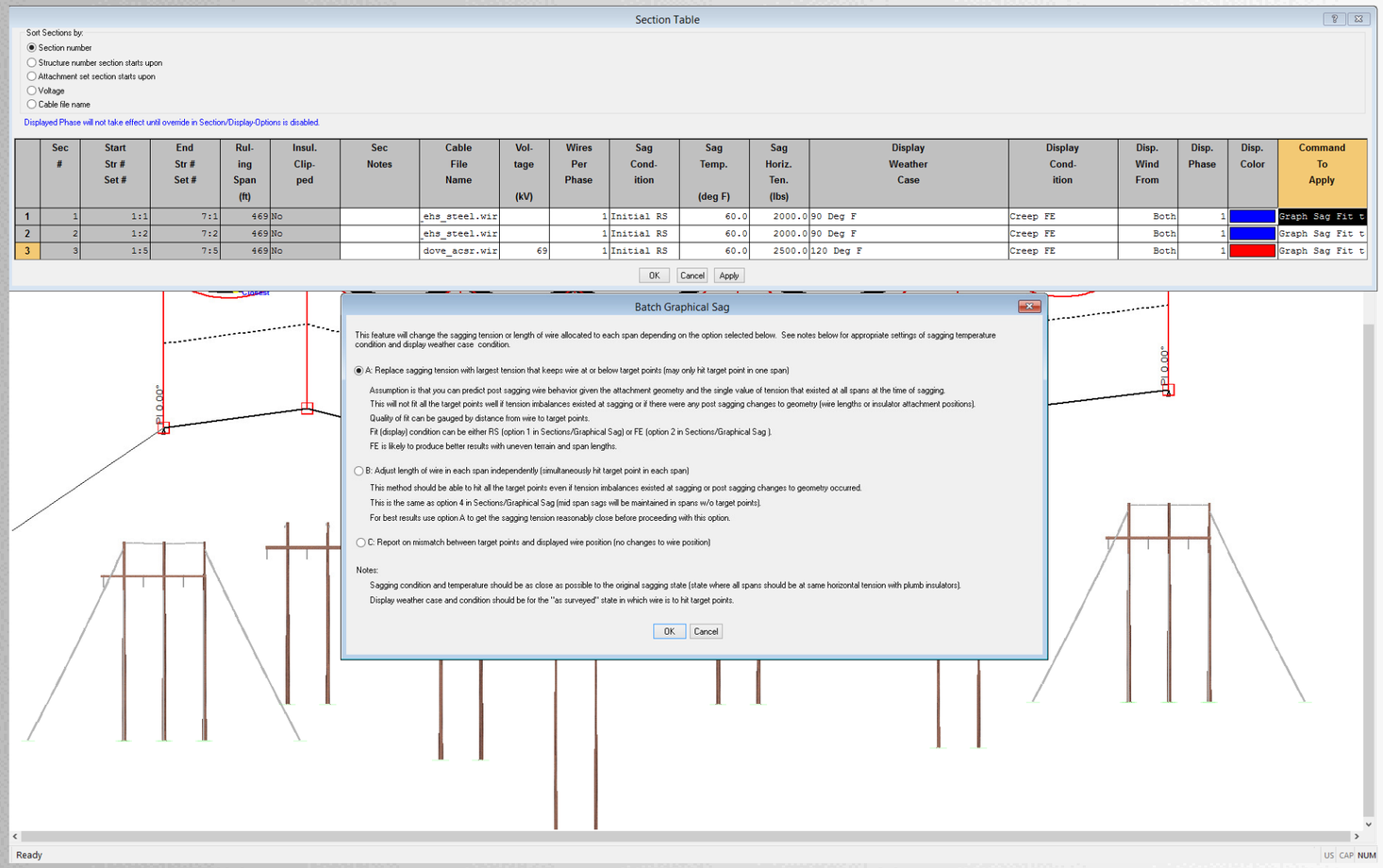
Step 7: Check graph sag fit points

- Look at the QA/QC report and look at the markers in the profile and 3D views to ensure a valid fit point was found for every wire in every span.



Step 8: Perform ruling span fit mode A

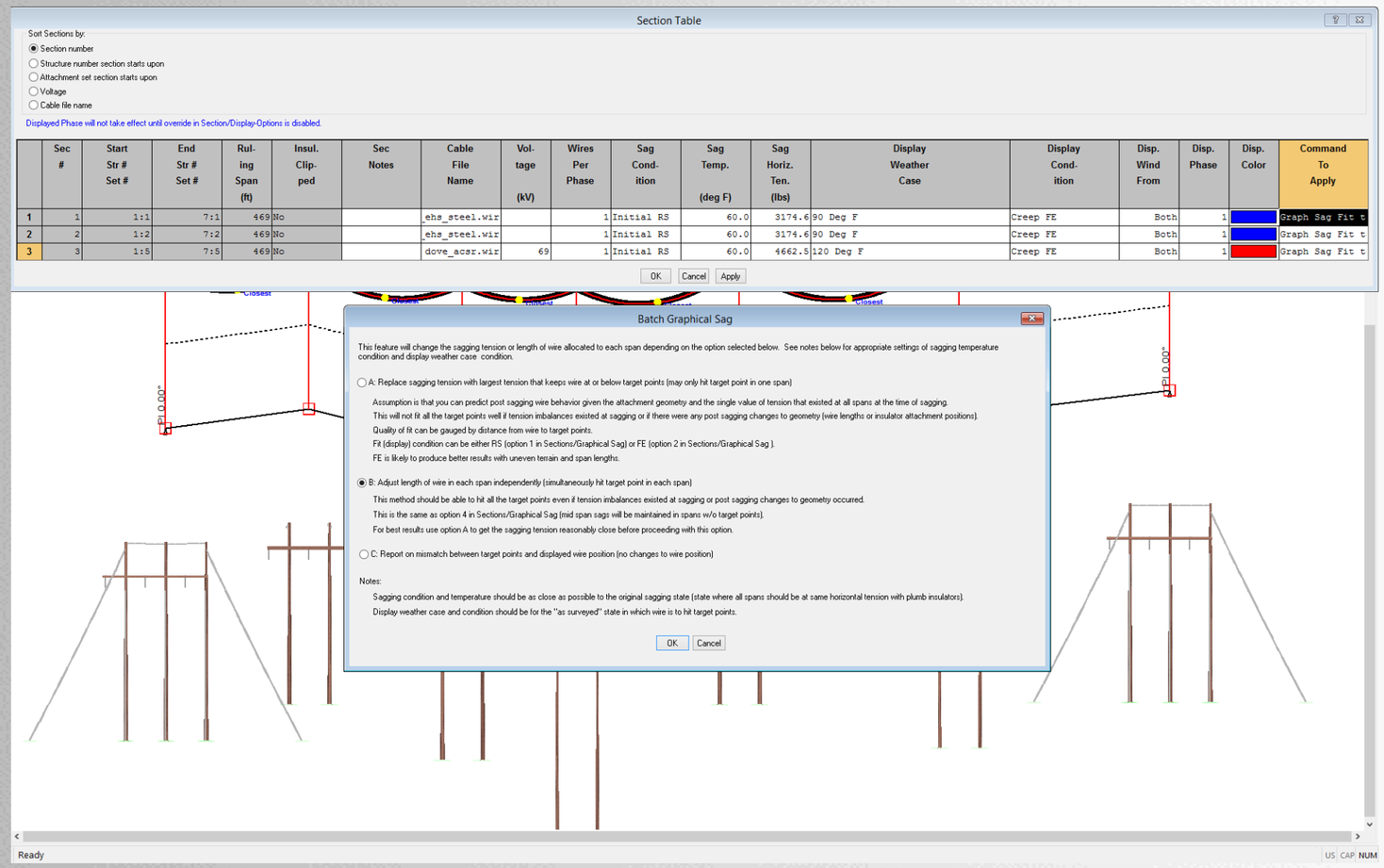
- Using the command to apply column again in **Sections/Table…** the graph sag fit to points command gives 2 options. Choose the A type fit first



*Note: Wires are displayed at survey conditions and the cable condition is set to Creep FE. When we perform the ruling span graphical sag “fit mode A” it will be the equivalent of option 2 in **Sections/Graphical Sag...** This means it’s more accurate because it looks for the 60 Degree plumb condition tension that yields the wire display at surveyed conditions in FE.

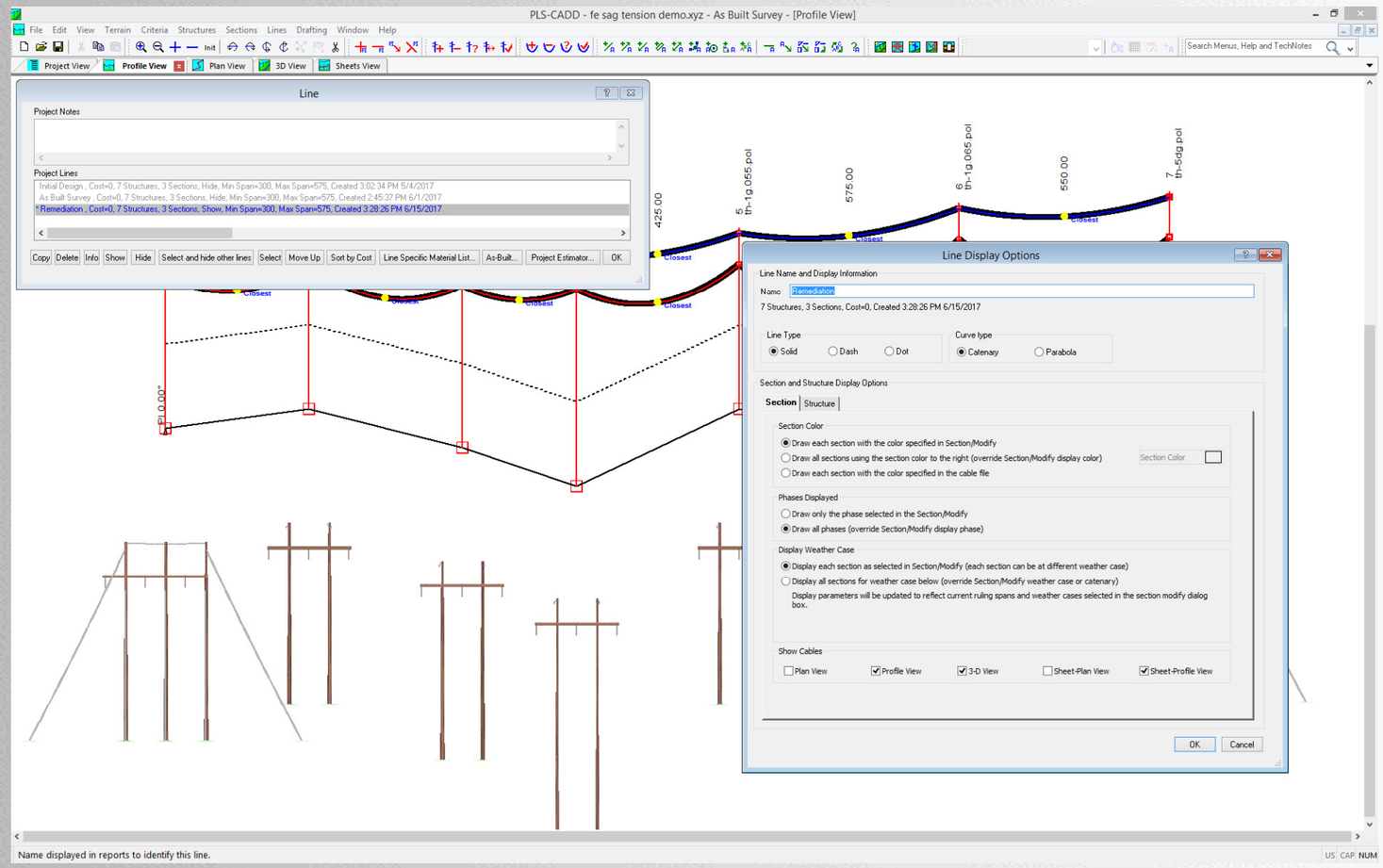
Step 9: Perform finite element fit mode B

- Follow up using the same command but choosing fit mode B, which is a FE fit equivalent to Option 4 in **Sections/Graphical Sag…**



Step 10: Create line model copy for remediation

- Create another line model copy in **Lines/Edit…** to store remediation work to fix a clearance problem

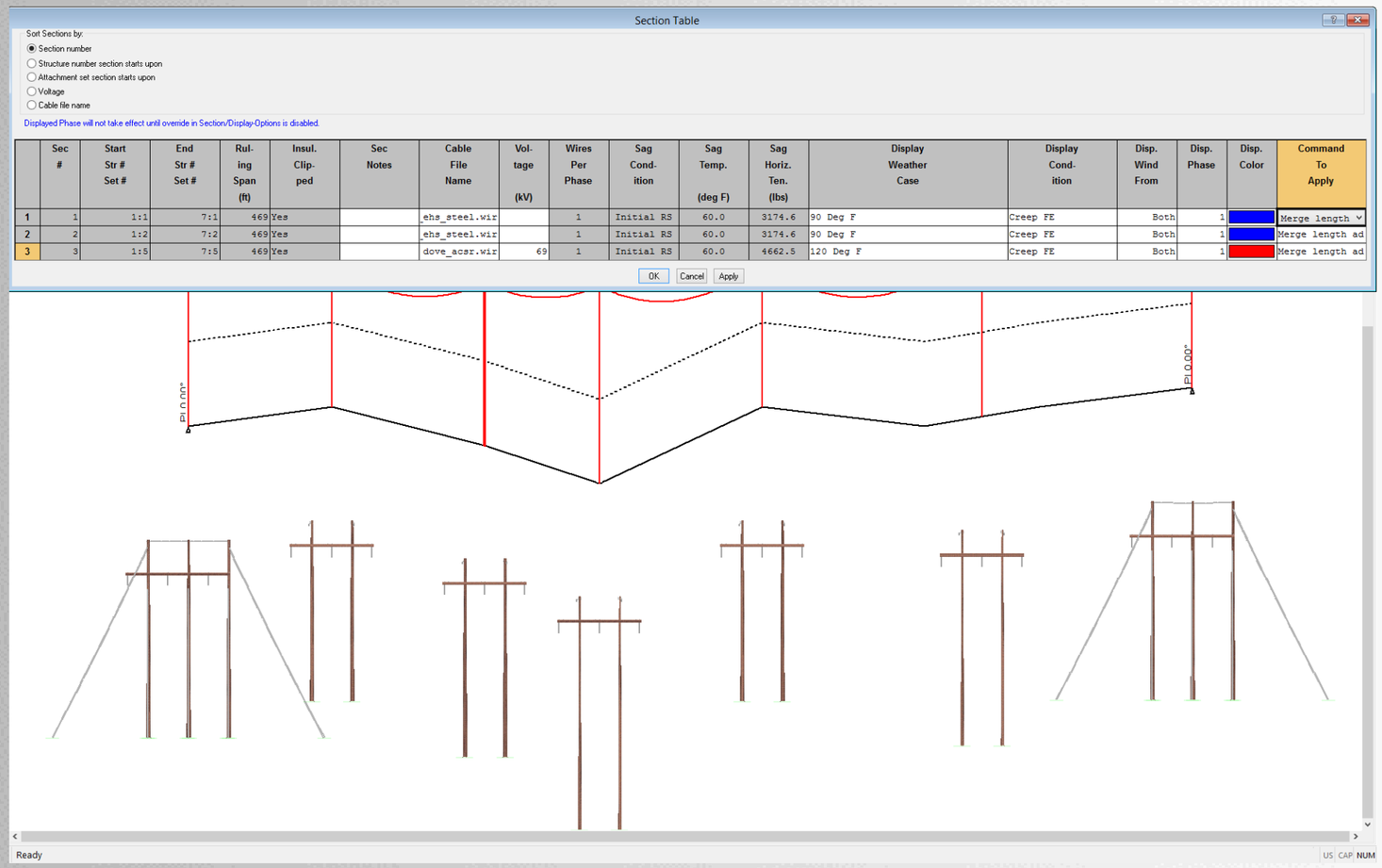


Step 11: Merge unstressed lengths

- In **Sections/Table…** use the command to apply column and select the Merge length adjustment command. This takes any FE unstressed length changes from graphical sagging and adds them to the unstressed length column leaving a nice blank slate in the change column for keeping track of changes made to fixed lengths in future steps.

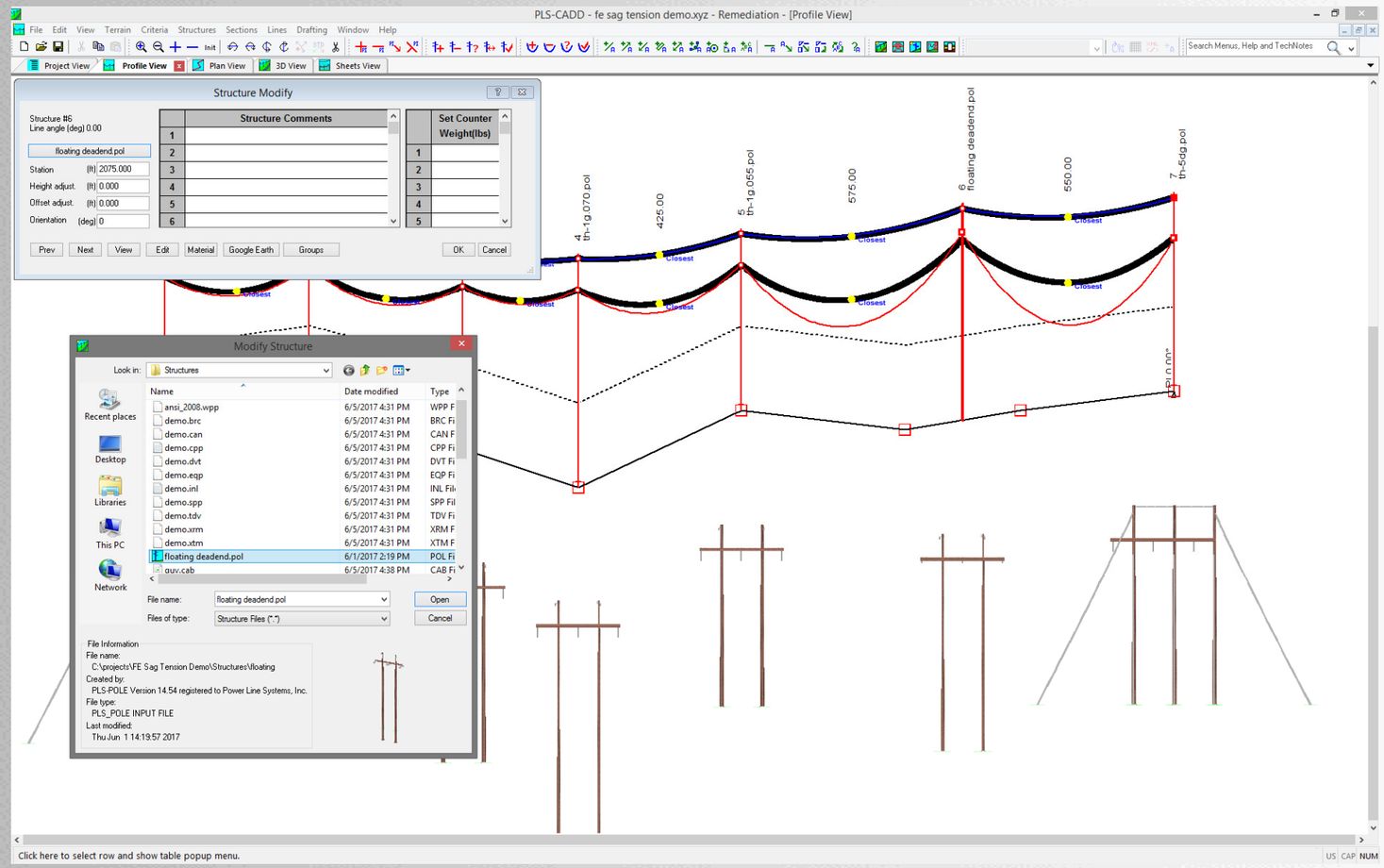
*Note: Check the ahead span unstressed length change column. If large values are present, i.e. >1 foot, it's a good indication that an initial RS fit (A mode) wasn't performed and the creep elongation calculations will be off since the sagging data tension didn't get set properly.

*Note: The ahead span unstressed length and unstressed length change columns are added together to represent the total length of wire in a span. The change column exists to easily keep track of changes made. Merging the values prior to remediation work makes this much easier and more useful.



Step 12: Swap out tangent structure to floating DE

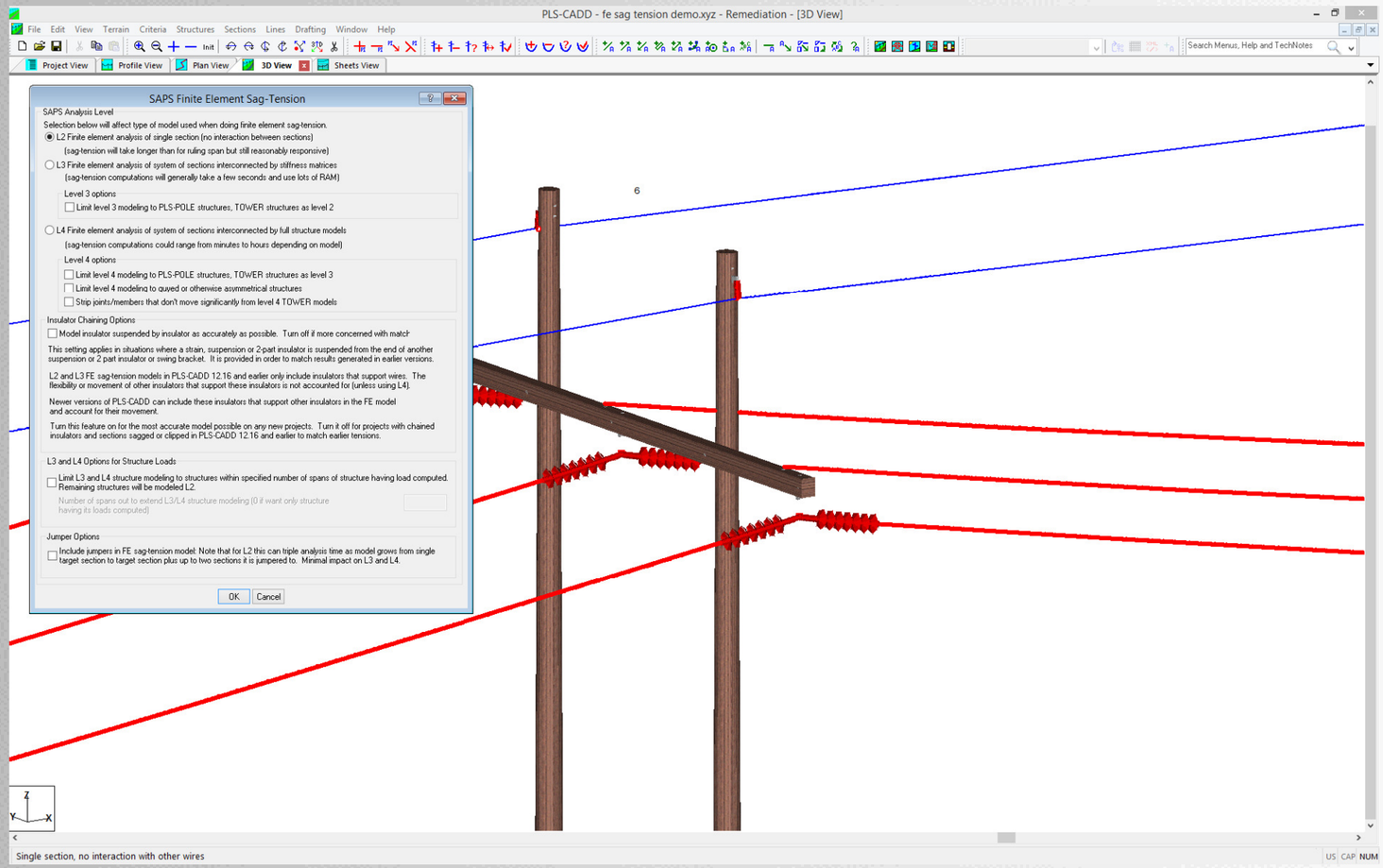
- Change display conditions to reflect a typical construction condition. Most choose 60 Deg F. and assume creep.
- Create a floating dead end structure and substitute it at the structure location needed



*Note: Extra sag in wires in spans adjacent to floating dead end caused by inserting strain insulators into the span

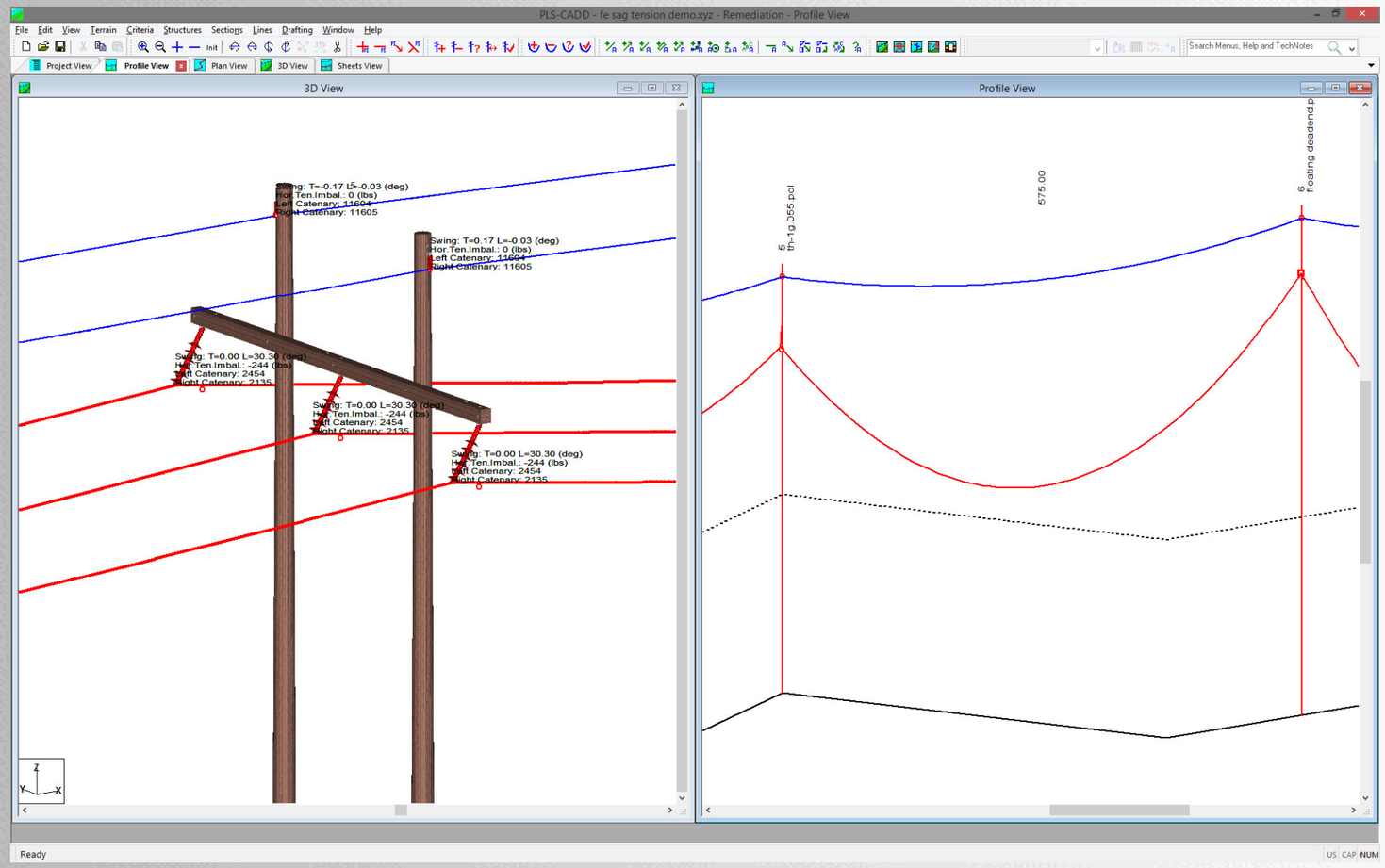
Step 13: Uncheck option for chained insulators

- Navigate to **Criteria/SAPS Finite Element Sag-Tension...** to uncheck the chained insulator option so the small suspension insulator at the floating dead end remains vertical and doesn't swing while adjusting lengths in further steps.



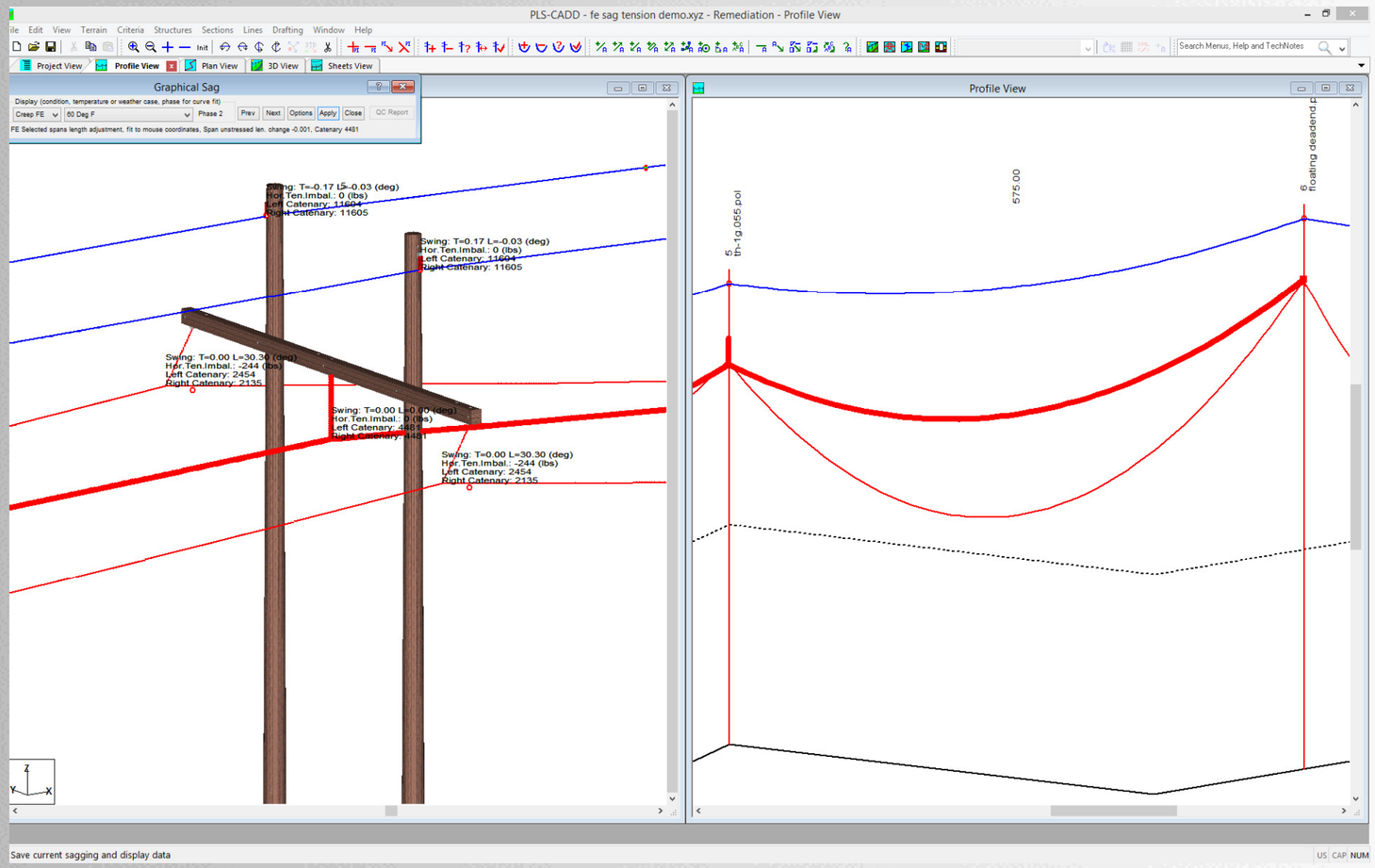
Step 14: Set up views to see tension imbalance

- Open a 3D view and profile view side by side and press the F1 key and go to **F1/SAPS Finite Element Sag-Tension/Label insulator swings, attachment displacements and/or loads...** to turn on labels for insulator swing angles, imbalance in horizontal tension, and catenary constants



Step 15: Graphical sag to fix tension imbalance

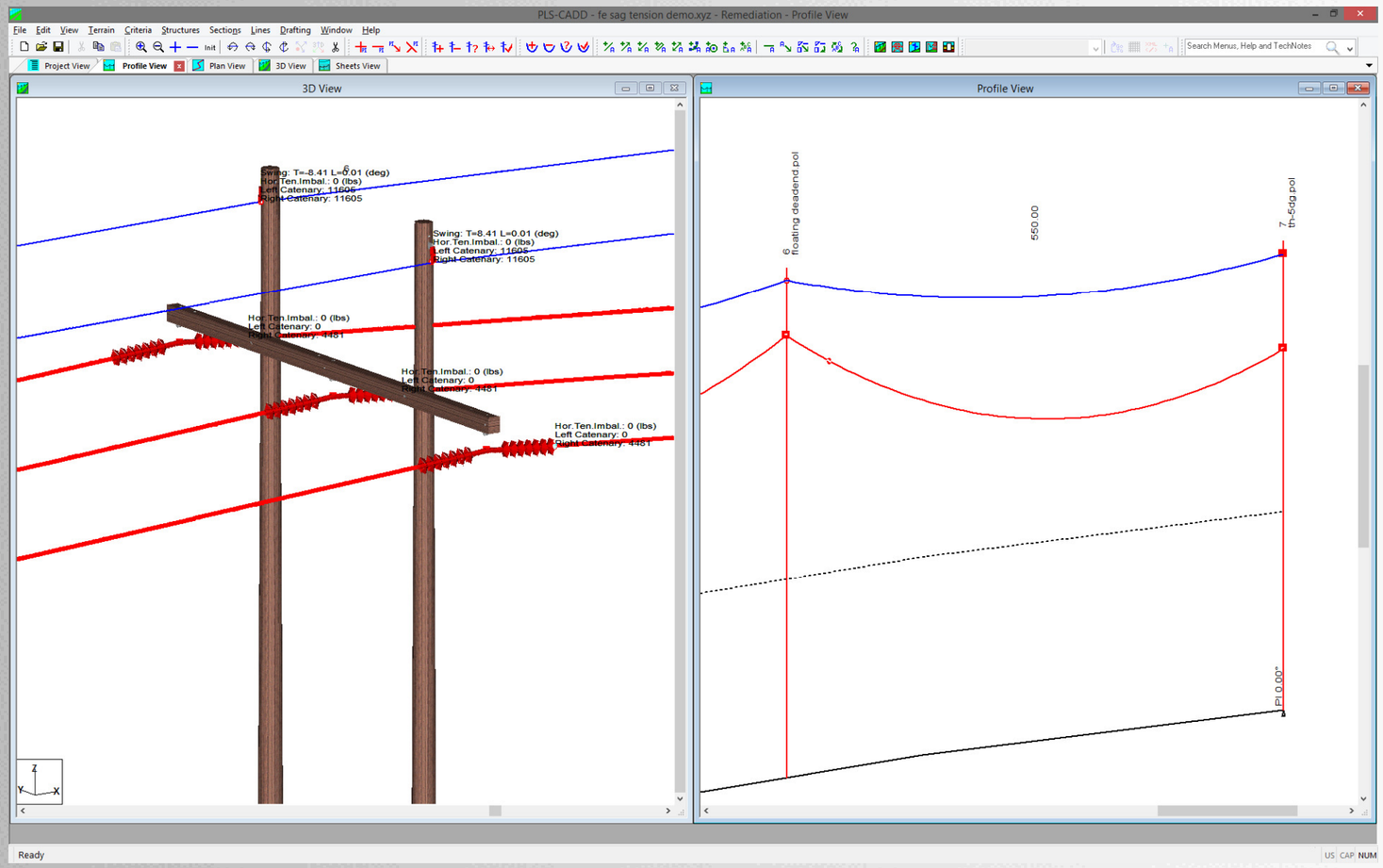
- Using **Sections/Graphical Sag…** option 3, adjust the sag in the profile view and watch the imbalance at the adjacent structure until it's nearly 0, then click apply and repeat for all phases.



*Note: The catenary constant after adjustment is 4481 ft.

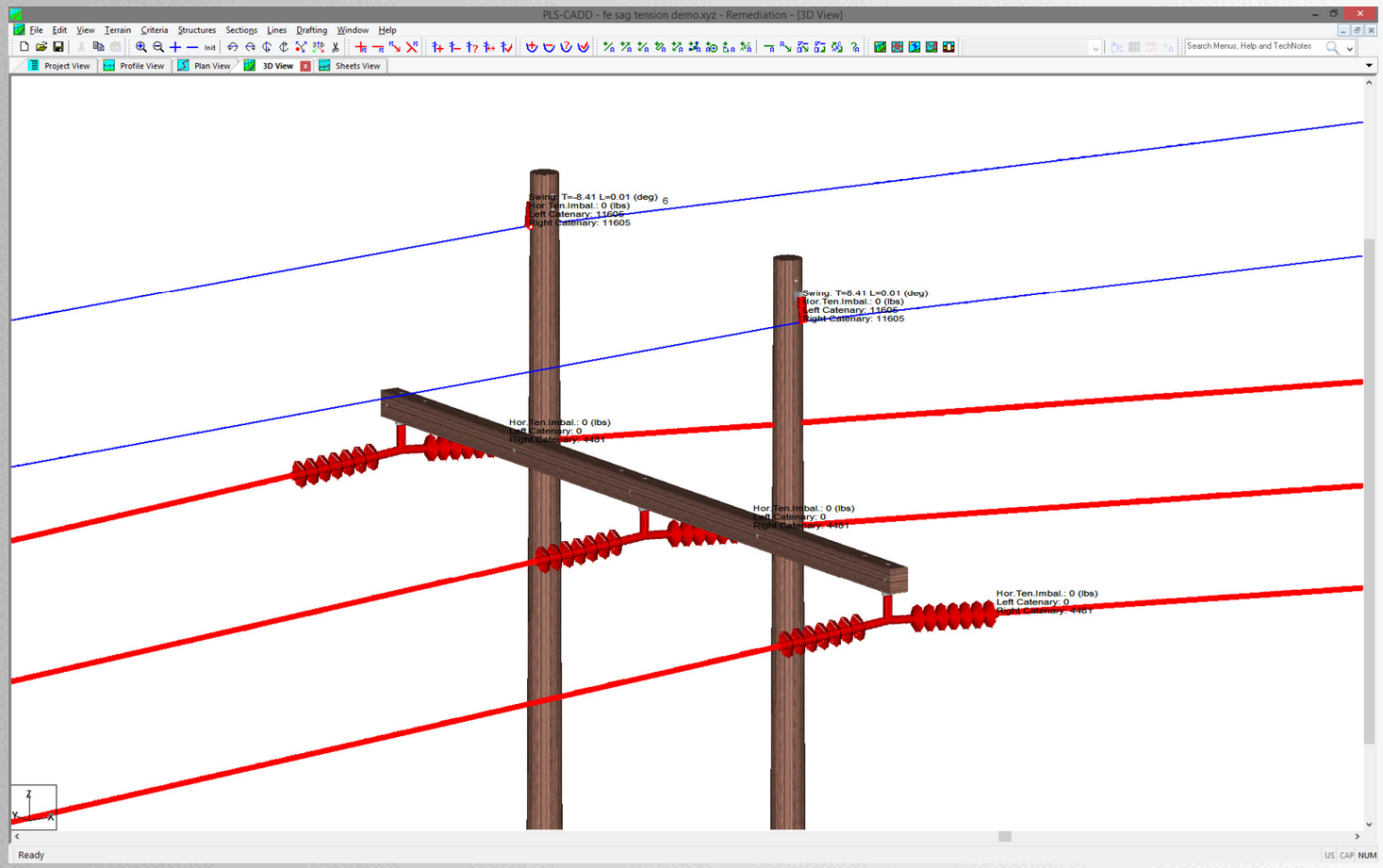
Step 16: Repeat process for other adjacent span

- Using the same process for the other span but this time using the catenary constant and making sure it matches what the previous span of 4481 ft had since this span is dead end to dead end.



Step 17: Switch back on chained insulators

- Now that the lengths are all adjusted properly you can switch back on the chained insulator feature and perform any structural or clearance analyses needed.



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