

Generating Ruling Span Sag-Tension Runs in PLS-CADD/Lite

Introduction

This TechNote describes how to use PLS-CADD/Lite to make stand-alone sag-tension runs. Please keep in mind that this practice is redundant as the same sag-tension routines can be used interactively in PLS-CADD to calculate sag-tension data, make required checks (such as galloping, tension limits, etc.) and produce stringing charts. However, many transmission engineers still need to create sag-tension charts, so here is how to do it.

Process

1. Start by opening PLS-CADD.
2. Select **File/ New/ PLS-CADD/Lite** menu item.
3. An "Untitled.lob" file will be opened, and you will be presented with the PLS-CADD/Lite New Project Wizard/dialog box as shown.

- **Criteria Options:** Select the option to use your own predefined criteria library, download and use one from our website [here](#), or select the option to create a new criteria library. We recommend that you start with one of our NESC criteria libraries as opposed to creating a new one completely from scratch.

- **Structure Options:** Select "Type attachment XYZ coordinates in directly instead of using a structure file" (unless you have a structure file set up in PLS-POLE or TOWER that you would like to link to). Also specify the number of wires to string in (noting that each Ahead or Back span wire counts as 1 wire, so for example 3 phases both ahead and back spans you would need 6 wires).

PLS-CADD/Lite New Project

Criteria Options:

Use predefined criteria library users\public\documents\pls\pls_cadd\examples\projects\2017_nesc_medium_grade_t
 Create new criteria library Typical 2017 NESC C2-2017 Criteria File for PLS-CADD Created September 5, 2017 Ve

Download from Web

Assumed NESC Medium Combined Ice and Wind District Loading (Rule 250B)
Assumed 90 MPH Extreme Wind Loading (Rule 250C); To be verified by the Engineer c
Assumed 3/4" Extreme Ice with 30 MPH Concurrent Wind Loading (Rule 250D); To be
Assumed Maximum Operating Temperature of 212 F; To be verified by the Engineer of E

Structure Options:

Type attachment XYZ coordinates in directly instead of using a structure file
Number of wires to string

Use a predefined structure file
 Create a new structure file using an existing one as a template
 Create new structure file using PLS-POLE Framing Wizard
 Create new structure file using PLS-POLE

Span Geometry Options:

Enter XYZ coordinates for span end
 Enter span Azimuth, Length and Elevation change
 Enter Wind and Weight Spans
 Enter ground elevation at span end (required for height adjustment of wind on non level terrain)

How do you want to Sag wires:

Enter Tension
 Enter Catenary Constant
 Enter MidSpan Sag
 Enter coordinates of a surveyed point on a wire
 Have program calculate maximum permissible tension based on limits in criteria library

OK Cancel

- **Span Geometry Options:** Select the "Enter span Azimuth, Length, and Elevation change".
- **How do you want to sag wires option:** Select the "Have program calculate maximum permissible tension based on limits in criteria library", assuming that you have properly filled out the Automatic Sagging table in your criteria library file (it is set up this way in our downloadable NESC criteria files).
- Click the **OK** button.

4. You will now be taken to the Model Setup dialog, where PLS-CADD/Lite has started you off with basic information for setting three 250' spans ahead and three 250' spans back of Drake conductor (if you chose to string in 6 wires in the previous Wizard), based on a 250' ruling span. You can modify all six rows, delete entire rows, or even add rows depending on how many sag-tension runs you want and if you need any sag coordination, phase-to-phase clearances, or galloping checks. Simply change this default information by:

Model Setup

Select the options you want to use to define the span. The table below will only include those columns needed for the options you select.

Structure Settings
 Use Existing Structure File

Base Z: (ft) _____

Bearing of Transverse Axis: (deg) 180

Coord Sys: (Unknown or Unavailable)

Span End Attachment Point
 XYZ Coordinates
 Azimuth and Span Length
 Wind and Weight Span
 Ground elevation
 (for height adjustment of wind on non level terrain)

Spanning Options
 Tension
 Catenary Constant
 Mid Span Sag
 Surveyed Point on Cable
 Tension from Automatic Sagging Criteria

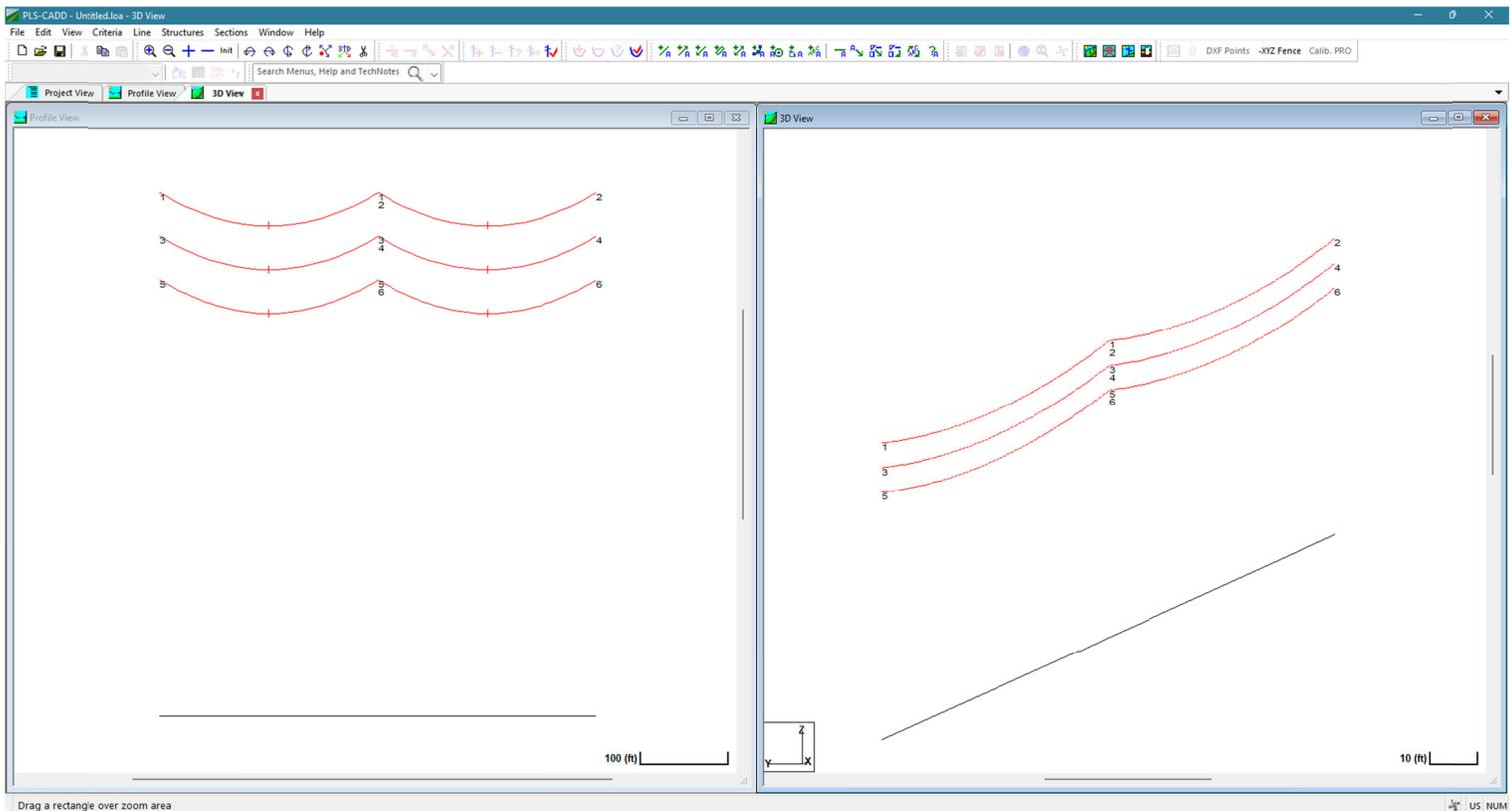
Overview Report
 Picture: Structure Picture File
 Line Notes: _____
 Structure: _____
 Location Notes: _____
 Comments: _____

Cable Color

	Description	Cable File Name	Orig. X (ft)	Orig. Y (ft)	Orig. Z (ft)	Span Horiz. Proj. (ft)	Span Vert. Proj. (ft)	Span Azimuth (deg)	Wires in Bundle	Ruling Span (ft)	Sagging Condition	Wire Temp. (deg F)	Display Weather Case	Display Condition	Display Color	Insul. Counter Weight (lbs)	Voltage (kV)
1	1:Back	drake			60	250		90.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
2	1:Ahead	drake			60	250		270.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
3	2:Back	drake			55	250		90.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
4	2:Ahead	drake			55	250		270.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
5	3:Back	drake			50	250		90.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
6	3:Ahead	drake			50	250		270.00	1		Initial RS	60.0	No Wind (SWING 1)	Creep RS			
7												32.0					
8												32.0					
9												32.0					
10												32.0					
11												32.0					
12												32.0					
13												32.0					
14												32.0					
15												32.0					
16												32.0					
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19												32.0					
20												32.0					
21												32.0					
22												32.0					
23												32.0					
24												32.0					
25												32.0					

OK Cancel Apply

- Selecting the applicable **cable file name(s)**. You can download over 8000 cable models from our website [here](#) or develop your own cables with data provided by your manufacturer.
 - Modifying the **origin X, Y, and Z values of each span** - accept the defaults if you are just interested in obtaining a basic sag-tension run. Remember that if you are using NESC or any of the other ASCE variable wind functions in your criteria file, the elevation (Z) will impact the effective wind pressure in accordance with those codes. You can enter "0" for Z if you want to negate those effects.
 - Changing your **Span Projections**, where horizontal is the horizontal span distance and the vertical accounts for inclined spans (positive values indicate a rise from the origin spans - you can double check your span geometry after you press "OK" and you will have plenty of opportunities to come back into this screen and change your entries later).
 - The **azimuths** are set for 90 (back) and 270 (ahead). This provides for a coordinate system consistent with structure files and the full PLS-CADD should you be using them. Change these values if you want to model a line angle, but this is not necessary to develop a simple sag-tension report. This will only be a factor if you want to further develop a loading tree for a structure or link in a PLS-POLE or TOWER model.
 - **Wires in Bundle** can be left at one unless again, you want to develop a loading tree for a structure or perform a direct structure analysis by linking in a PLS-POLE or TOWER model. This has no effect on a simple sag-tension report.
 - **Ruling Span** should be the same as your Horizontal Span Projection value as described above, unless you do have a situation where you want to calculate sags and tensions of a section of conductor that in reality is a small part of a different ruling span.
 - The Display Weather Case, Condition, and Color will have no bearing on any sag or tension calculations but will be the settings used to show your wires in the graphics views. If you want to see how multiple wires at different conditions interact with each other, you can select different conditions for each wire. If you are just interested in running a sag-tension report, there is no reason to modify these from the defaults.
 - Insulator/Counter Weight is self-explanatory, but this is also not required to just develop a sag-tension report. This would only be relevant if you want to calculate phase-to-structure clearances, insulator swing angles, or use any other function that considers counterweights (such as galloping).
 - Voltage of wire. Defaults to 0. Used by some codes to identify ground wires (0 kV) and adjust their properties. For example: CAN/CSA-C22.3 No. 60826-10 adjusts groundwire ice to match conductor ice weight. IS 802 1995 adjusts groundwire drag coefficients.
 - Click the **OK** button.
5. You will now see the screen refresh with your wires shown on the left-hand side in the profile view and on the right-hand side in a 3D view. All the PLS-CADD functions such as zooming, and rotating are available should you want to see these views in different perspectives.



6. Save your file through **File/ Save** or **File/ Save As...** You will be presented with the option to specify a folder and name of your PLS-CADD/Lite project (which should have a ".loa" extension - LOA stands for "loads" and indicates this is a PLS-CADD/Lite project).
7. To generate a sag-tension report, simply select **Sections/Sag-Tension...** then click on one of the wires. To make sure you have clicked on the appropriate wires you can click on the Next button until the desired section is selected. Then click on the report button and you will be presented with a full sag-tension report ready for printing or copying into another program such as Word or Excel.

Additional Capabilities

That is all it takes to create a sag-tension report. Of course, there are quite a few other options in PLS-CADD/Lite that you might want to take advantage of such as:

- Stringing Charts, Galloping, Wire and Structure Clearances (all under the Sections submenu).
- **Structures/ Loads/ Report** will generate a loading tree report, ready to print or e-mail to your structure manufacturer for use in designing your structures. These loads are generated for the conductors, tensions, line angles, and overload factors you entered (open **Criteria/ Structure Loads (methods 3,4)...** to see the table and edit the weather conditions, overload factors and other information needed to develop proper loading trees).
- **Lines/ Report** will give you much of the above information in a single report.

To make any changes to your model, simply go back into **Line/ Setup...** and make whatever modifications you need to.

Structure Loads Report

Wire and Structure Loads

Wire loads expressed in span coordinate system (Longitudinal axis is line connecting attach. points)
 Structure loads expressed in structure coordinate system
 Note: Loads in this report do not include load from counter weights, insulator weight or insulator wind area

LC #	WC #	Load Case Description	Wire Attach. No.	Joint Labels	---Structure Loads---	---Wire Loads---
					Vert. Trans. (lbs)	Long. (lbs)
1	1	RULE 250B GRADE	1		284	14919
1	1		2		284	-14919
1	1		3		284	14919
1	1		4		284	-14919
1	1		5		284	14919
1	1		6		284	-14919

Sag-Tension Report

#	Description	---Cable Load---			---R.S. Initial Cond.---			---R.S. Final Cond.---			---R.S. After Creep---					
		Hor. (lbs)	Vert. (lbs)	Res. (ft)	Max. Tens. (lbs)	Hori. Max (ft)	R. Sag (ft)	Max. Tens. (lbs)	Hori. Max (ft)	R. Sag (ft)	Max. Tens. (lbs)	Hori. Max (ft)	R. Sag (ft)			
1	NESC Medium District Loading (2503)	0.54	1.52	1.81	9045	9042	29	5001	1.56	8391	8388	27	4639	1.68	8827	882
2	NESC Extreme Wind (250C)	1.68	1.09	2.00	7234	7230	23	3611	2.16	6108	6102	19	3048	2.56	6423	641
3	NESC Concurrent Ice and Wind (250D)	0.50	2.83	2.87	9704	9697	31	3378	2.31	9324	9318	30	3246	2.41	9704	965
4	Extreme Ice	0.00	2.09	2.09	8559	8555	27	4086	1.91	7747	7742	25	3698	2.11	8138	813
5	Cold Uplift	0.00	1.09	1.09	9671	9670	31	8839	0.88	9303	9302	30	8502	0.92	9669	966
6	Maximum Operating	0.00	1.09	1.09	2247	2243	7	2050	3.81	2230	2226	7	2035	3.84	2247	224
7	NESC Tension Limit (261H1c)	0.00	1.09	1.09	8712	8711	28	7962	0.98	7872	7871	25	7195	1.09	8343	834
8	NESC Blowout 6FSF	0.55	1.09	1.23	6626	6624	21	5402	1.45	5140	5137	16	4189	1.86	5510	555
9	No Wind (SWING 1)	0.00	1.09	1.09	6530	6528	21	5967	1.31	4973	4971	16	4544	1.72	5359	535
10	Moderate Wind (SWING 2)	0.55	1.09	1.23	7957	7956	25	6488	1.20	6821	6820	22	5561	1.40	7258	725
11	Moderate Wind (SWING 3)	0.55	1.09	1.23	6626	6624	21	5402	1.45	5140	5137	16	4189	1.86	5510	555

Don't forget that if you first model your structure in PLS-POLE or TOWER, you can check the "Use Existing Structure File" option and then you will not need to input the Origin XYZ values (since they will come from the structure file). Once you click OK and exit this table, the geometry view is updated, and you can use the **Structures/ Check** menu item to check your PLS-POLE or TOWER structure. You will receive results in both reports and graphics views that will show you if you had any failures, where those failures occurred and how much stress was applied to each part of the structure (and insulator) for each load case. You can even click on the **Structures/ Generate Allowable Spans...** menu item and PLS-CADD/Lite will report the maximum wind and weight spans that your structure is capable of supporting given the current set of loading conditions and parameters.

Additionally, PLS-CADD/Lite allows you to string up to 60 cables with any relationship to each other and then to perform cable to cable clearance checks under varying conditions. So, if you've got that ADSS cable that your cable supplier is just telling you to string up at "1% sag" and you are concerned about the clearances when your conductors are operating at high temperatures you can model both and check it! Better to do it now than to end up with wrapping problems in the field later.