Power Line Systems

IT'S ALL ABOUT YOUR POWER LINES

2019 PLS-CADD Advanced Training and User Group

Wind Directions for Distribution Modeling

by

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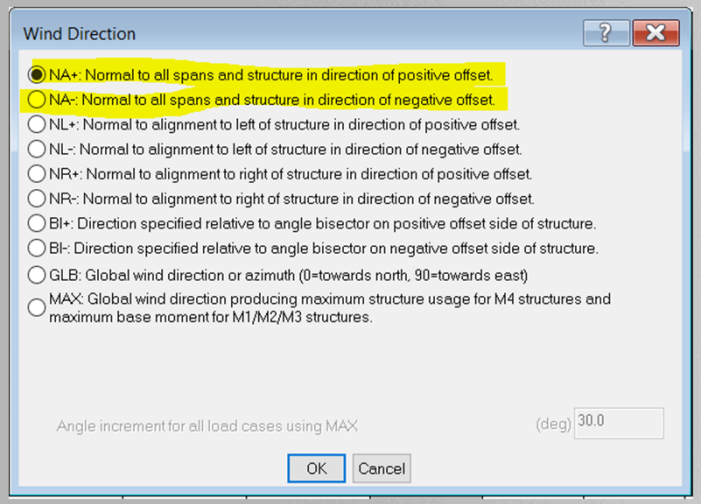
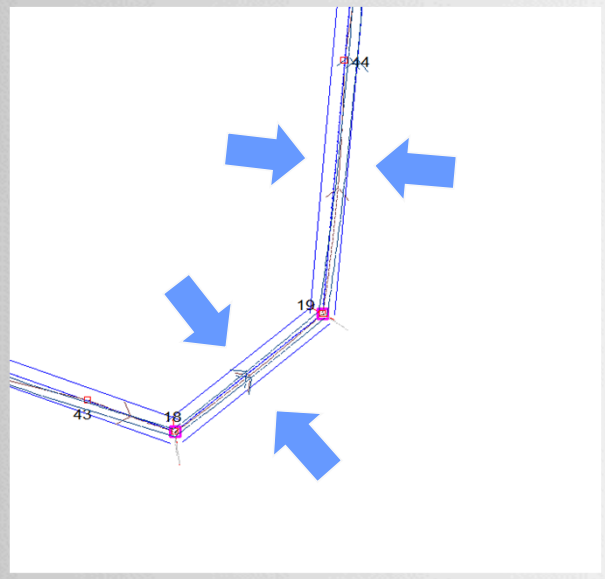
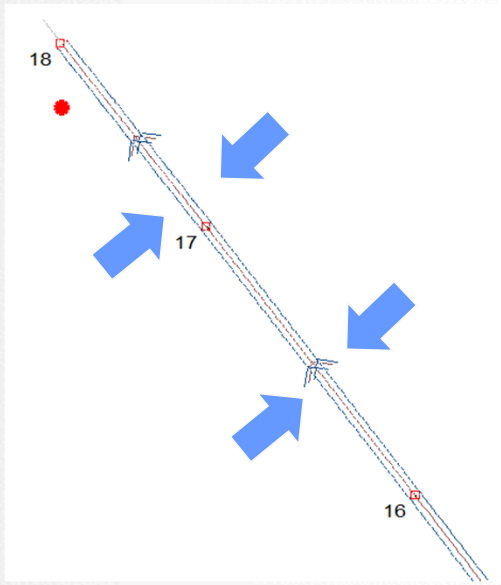
NV5, Inc.

Wind Direction (NA+/NA-)







Why NA+/-?

- Generally Conservative
- NESC Requirement:

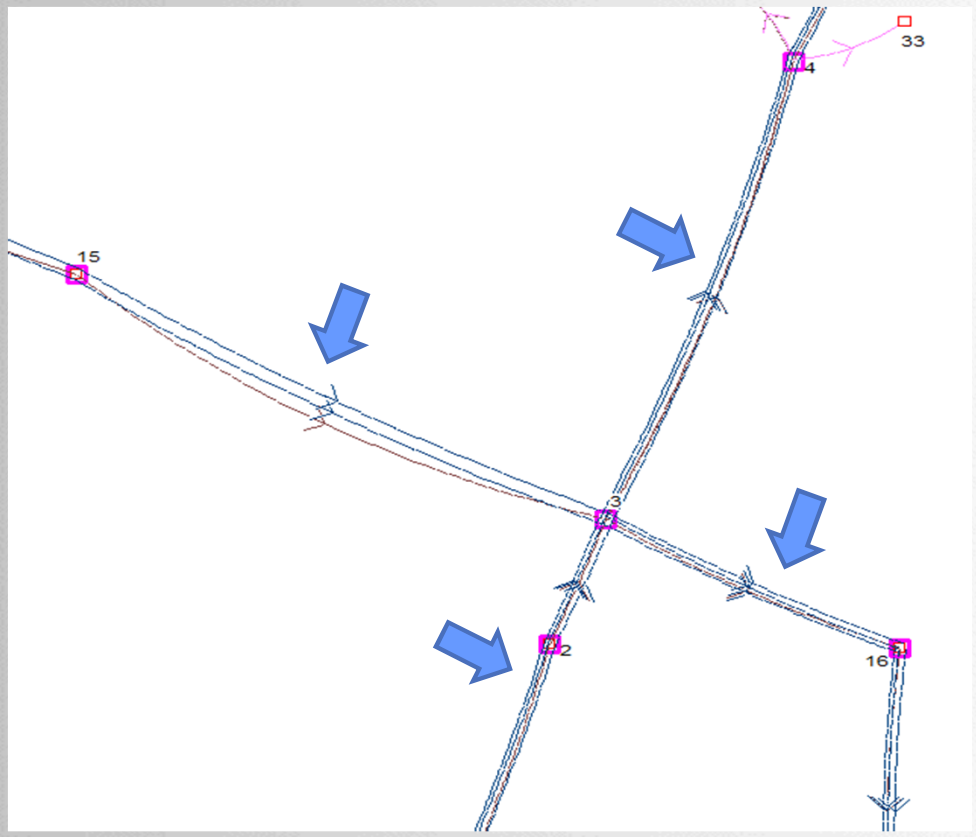
From NESC C2-2017

251.B.2.

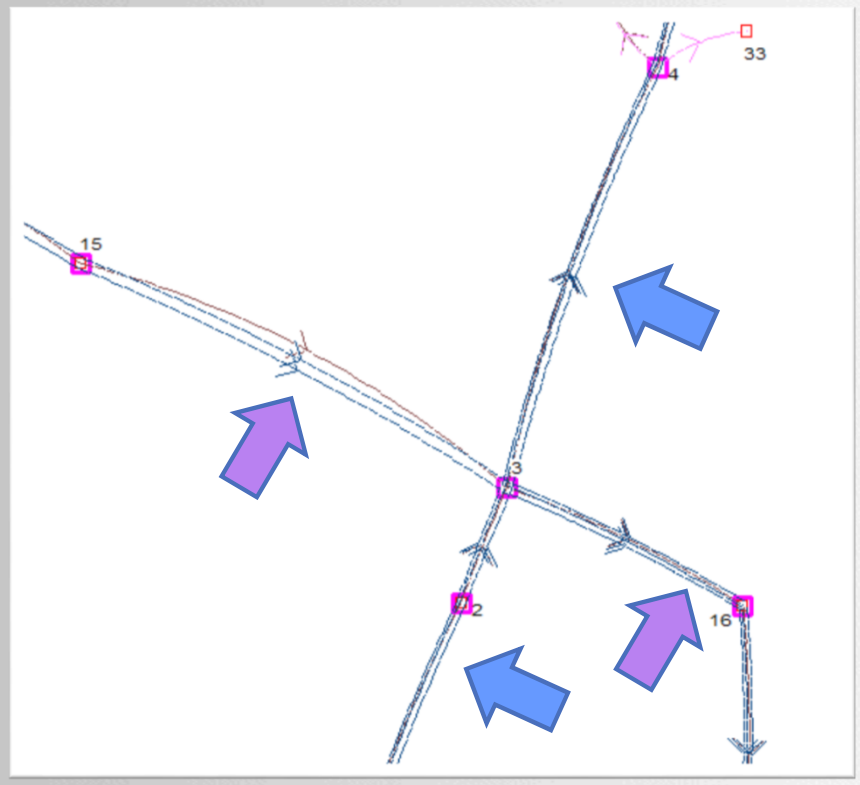
2. Horizontal load component

The horizontal load shall be the horizontal wind pressure of determined under Rule 250 applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors spacers, or equipment that it supports, ice covered where required by Rule 250.

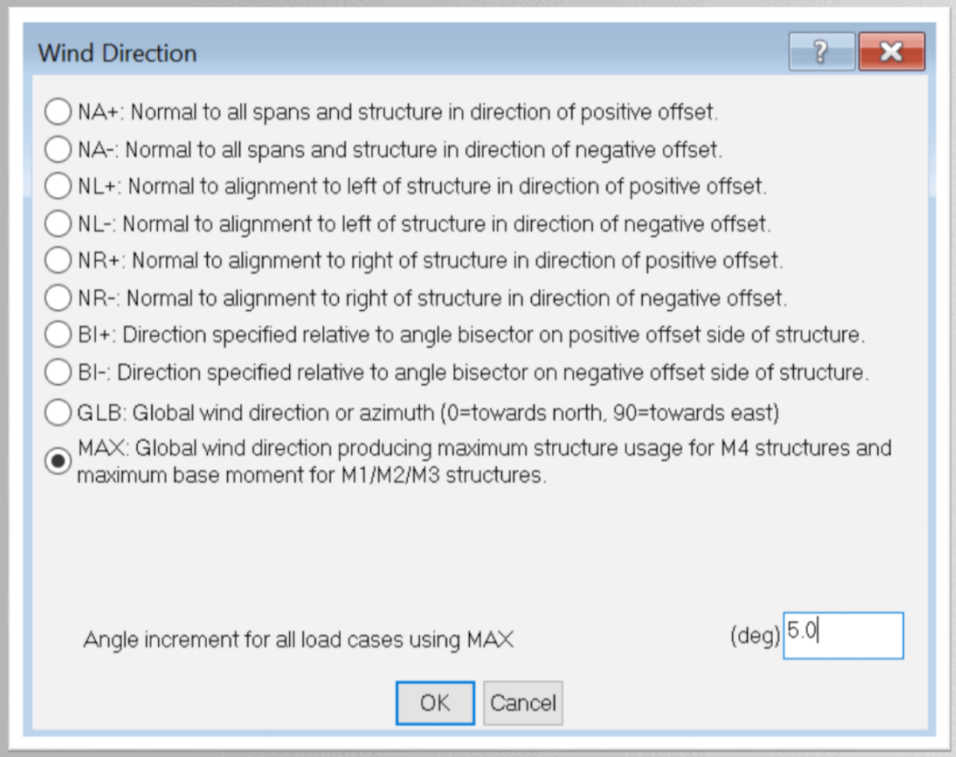
Wind Direction (NA+/NA-)

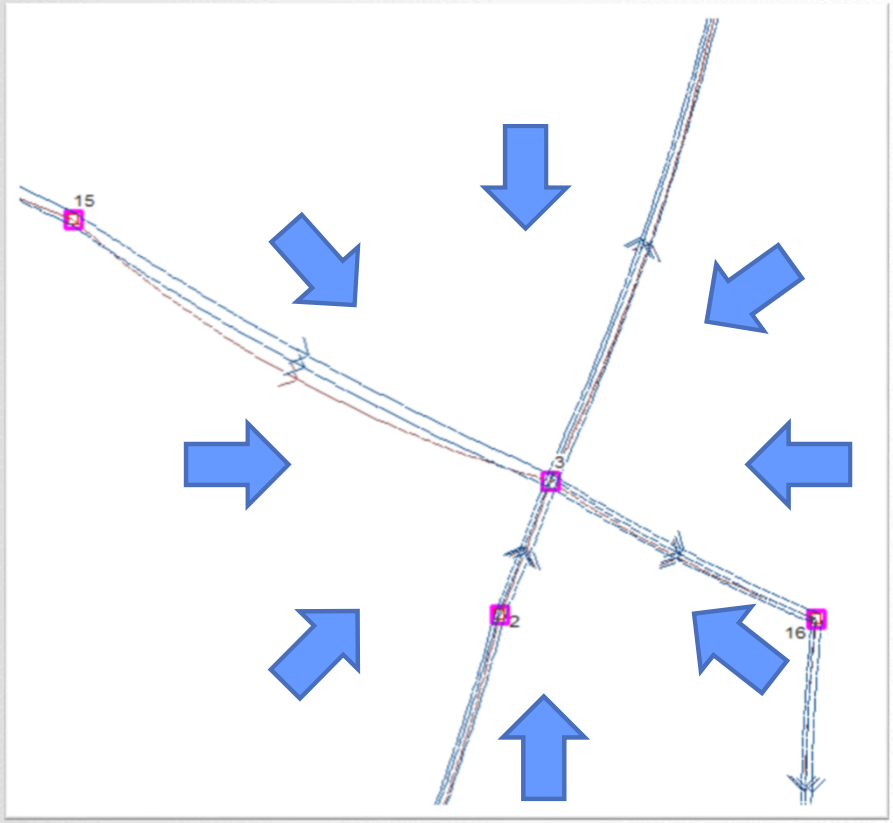


Wind Direction (NA+/NA-)

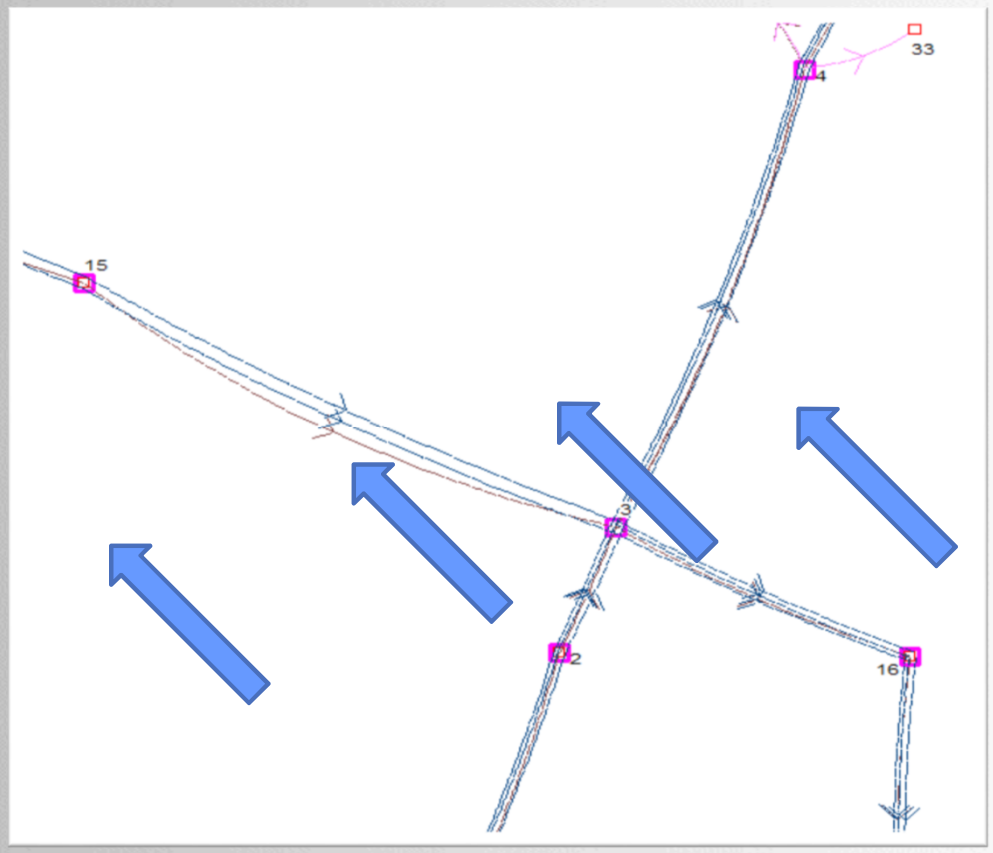


Wind Direction (Global)

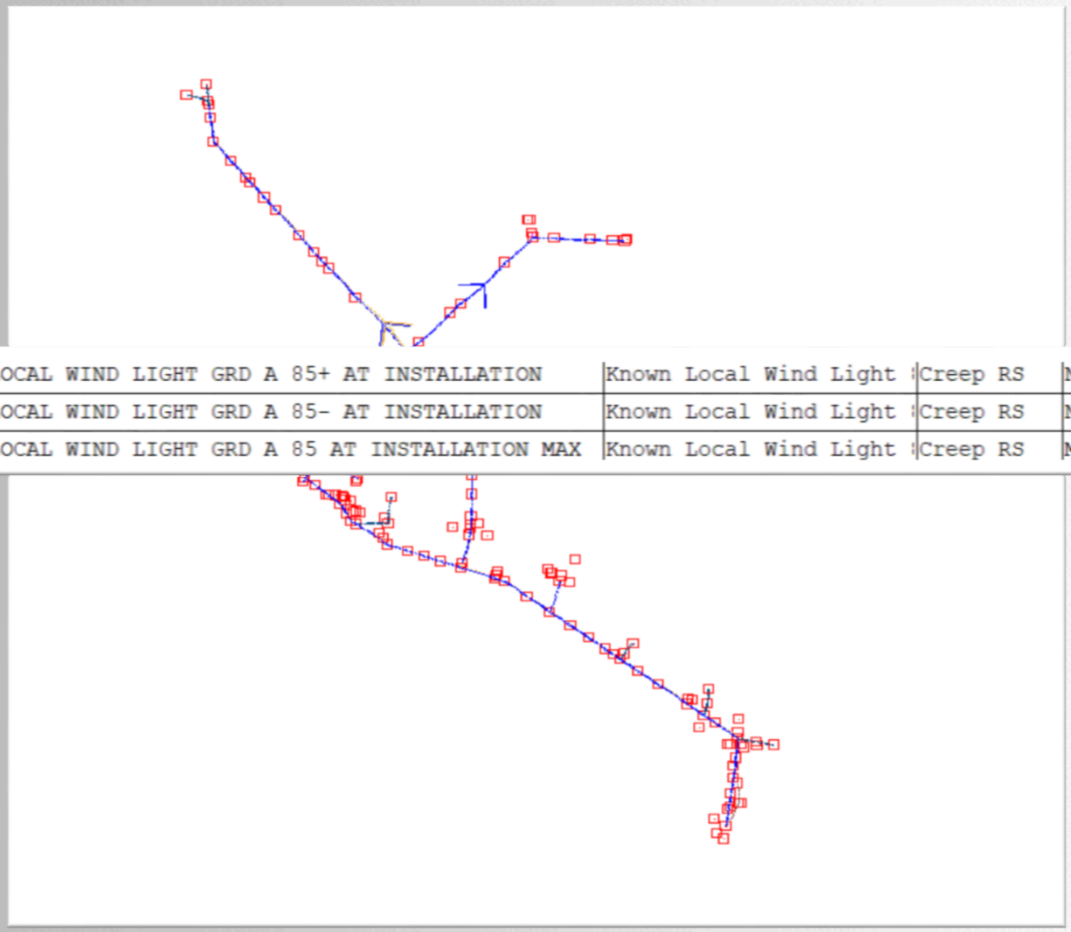




Wind Direction (Global)

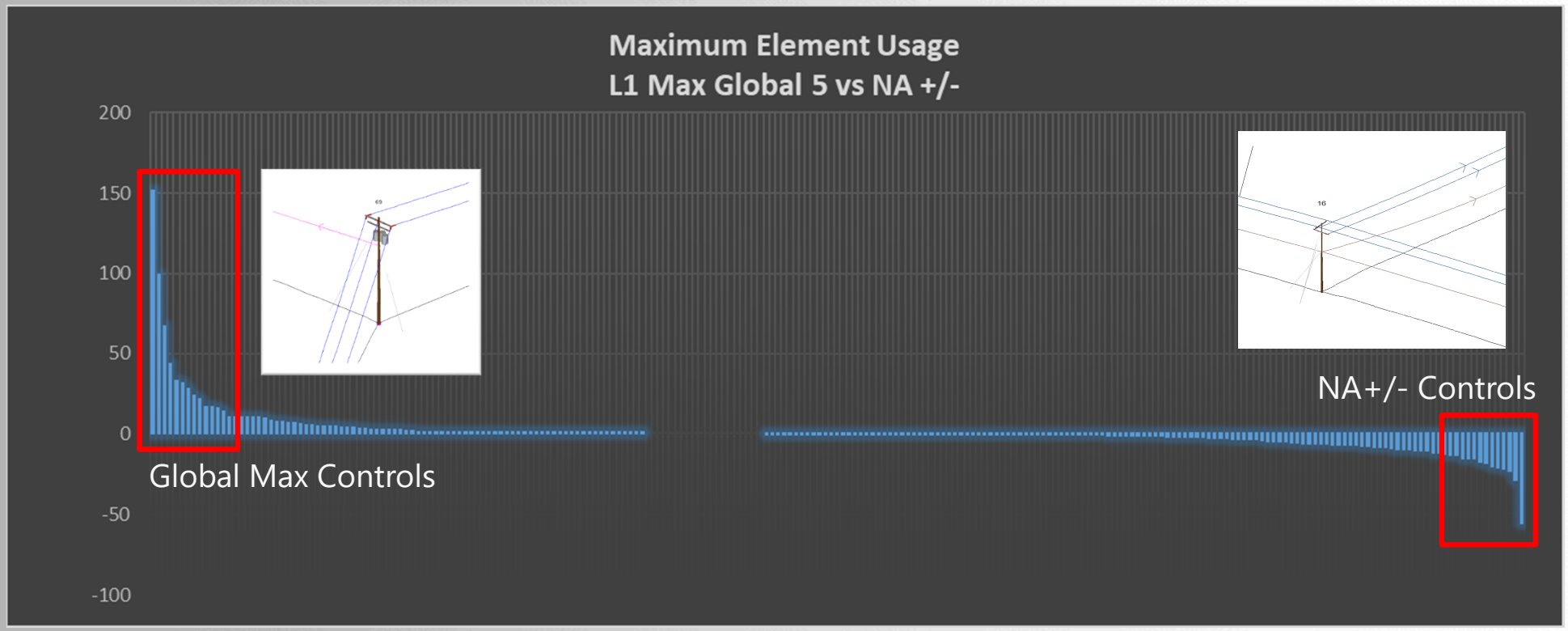


Analysis – Set Up



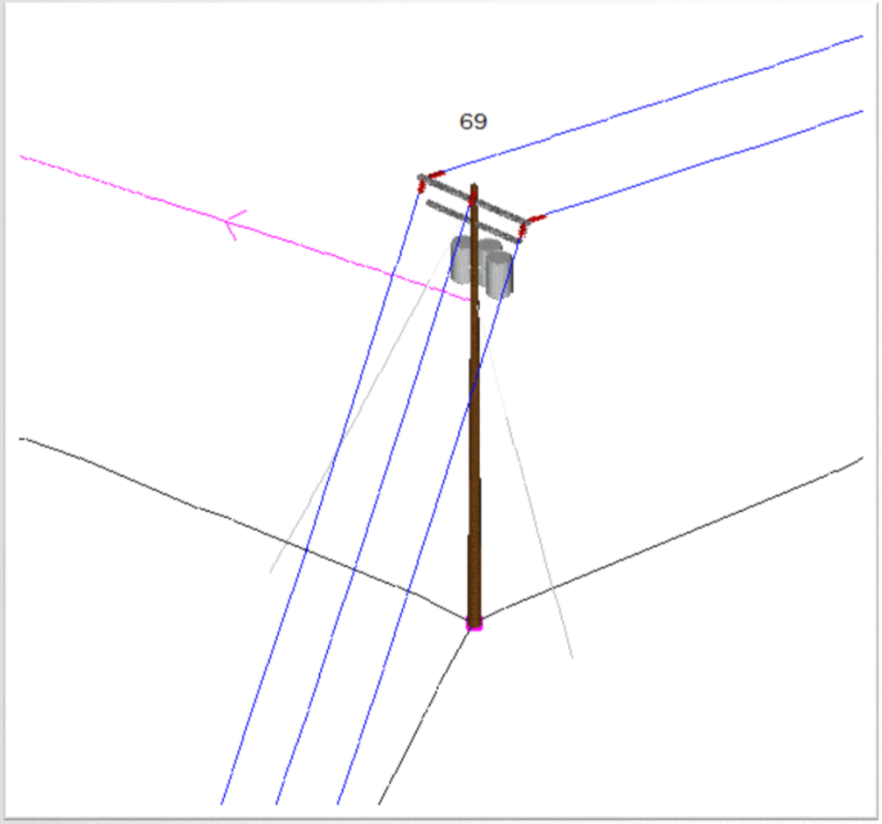
3	KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION	Known Local Wind Light	Creep RS	NA+
4	KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION	Known Local Wind Light	Creep RS	NA-
5	KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX	Known Local Wind Light	Creep RS	Max

Analysis - Results

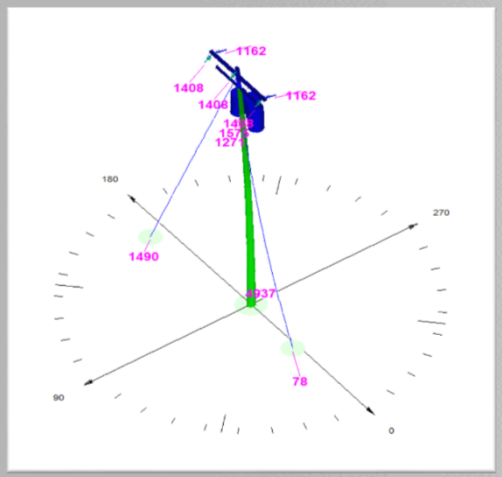


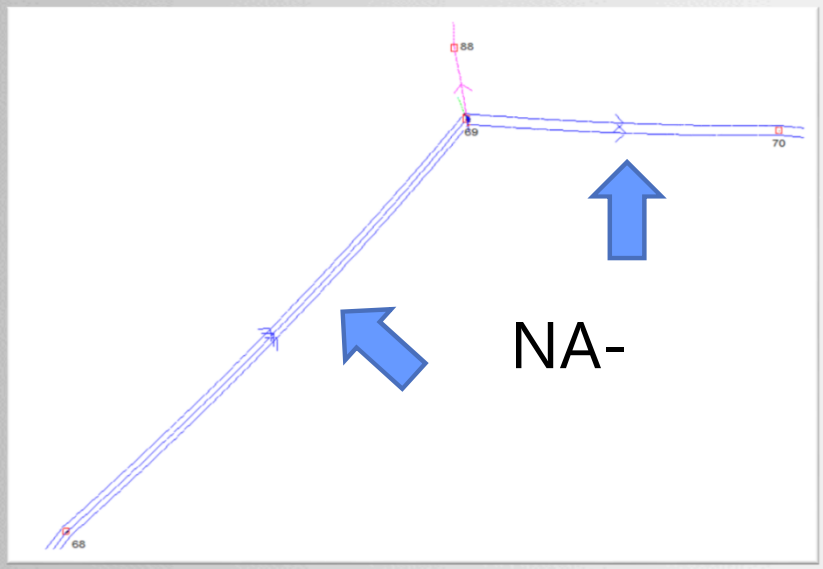
A Max Global Wind Controlling Case Large Line Angles w/ a Bisect Guy

- For Large Line Angles with bisect guys (>30 degrees) Max Global Wind controls when wind direction splits the line angle and the guy angle due to load imbalance in unbraced direction

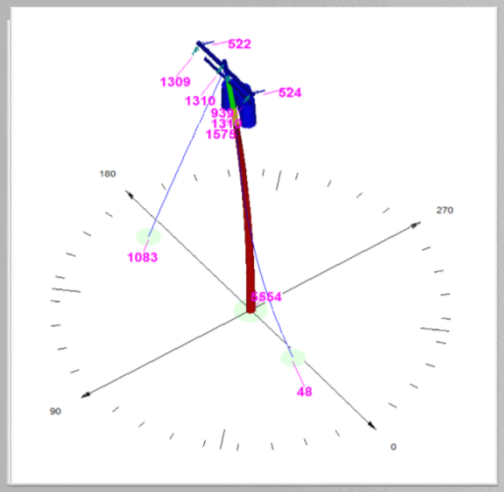


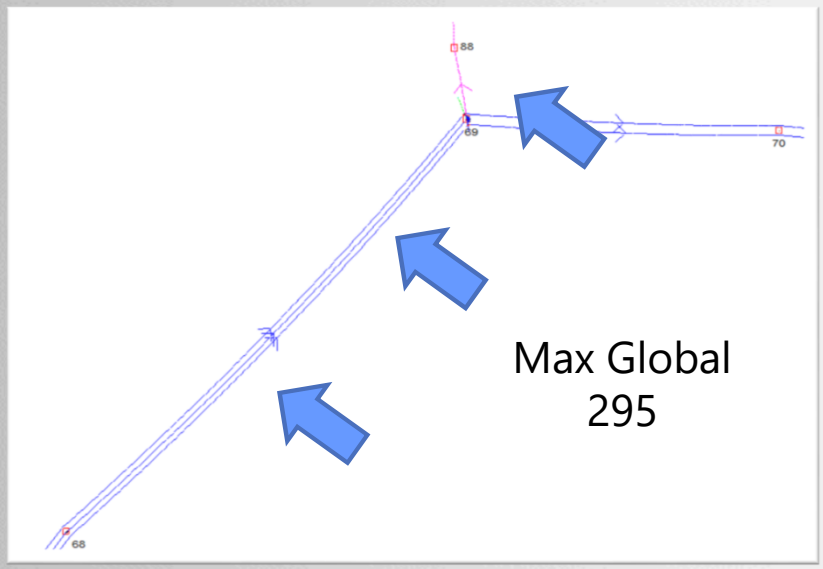
A Max Global Wind Controlling Case
Large Line Angles w/ a Bisect Guy





A Max Global Wind Controlling Case
Large Line Angles w/ a Bisect Guy





A Max Global Wind Controlling Case
Large Line Angles w/ a Bisect Guy

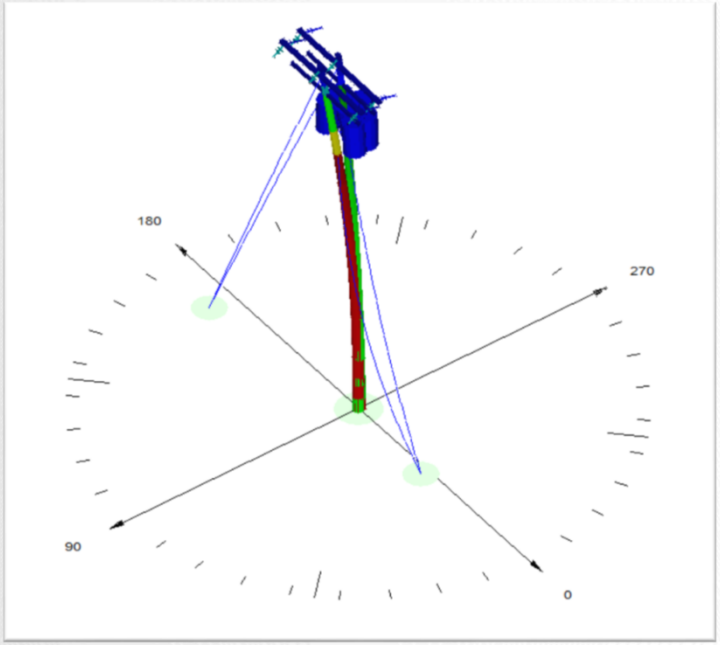
Summary of Steel Pole Usages by Load Case:

Load Case	Maximum Steel Pole Usage %	Label	Segment Number	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	64.31	P	14	
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	71.57	P	16	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	138.17	P	17	NG

Foundation Design Forces For All Load Cases:

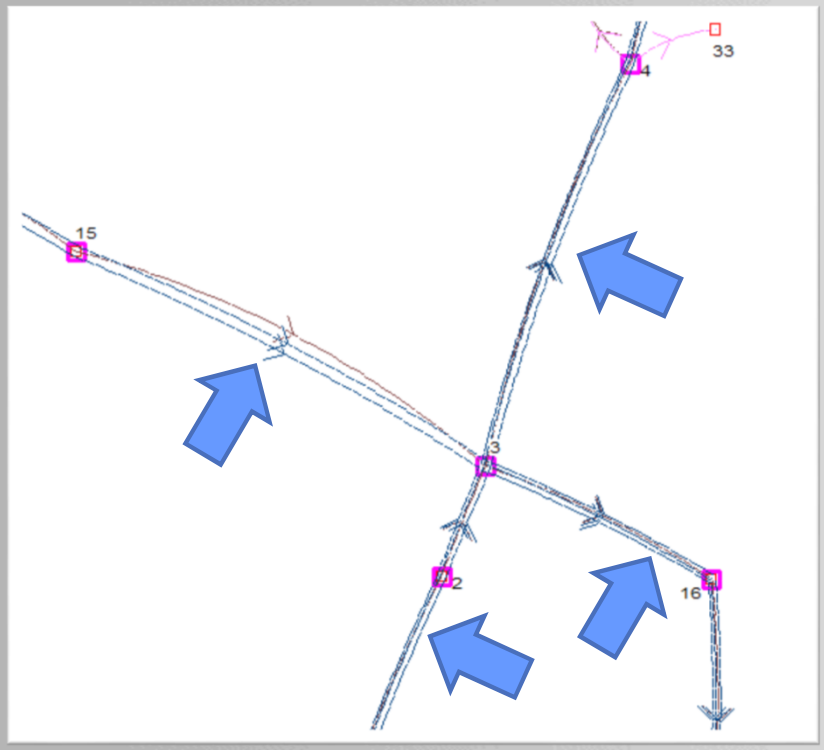
Note: loads are factored.

Load Case	Foundation Description	Axial Force (kips)	Shear Force (kips)	Bending Moment (ft-k)	Foundation Usage %
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	P:g	9.29	1.06	60.24	0.00
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	$Gnd1	-6.11	3.07	0.00	0.00
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	$Gnd2	-0.03	0.01	0.00	0.00
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	P:g	4.55	1.92	74.43	0.00
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	$Gnd1	-1.34	0.65	0.00	0.00
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	$Gnd2	-0.07	0.04	0.00	0.00
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	P:g	4.22	3.61	145.92	0.00
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	$Gnd1	-0.97	0.49	0.00	0.00
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	$Gnd2	-0.04	0.03	0.00	0.00



Non Standard Stringing Directions
Line & Tap – Case 1

Independent Alignment 1

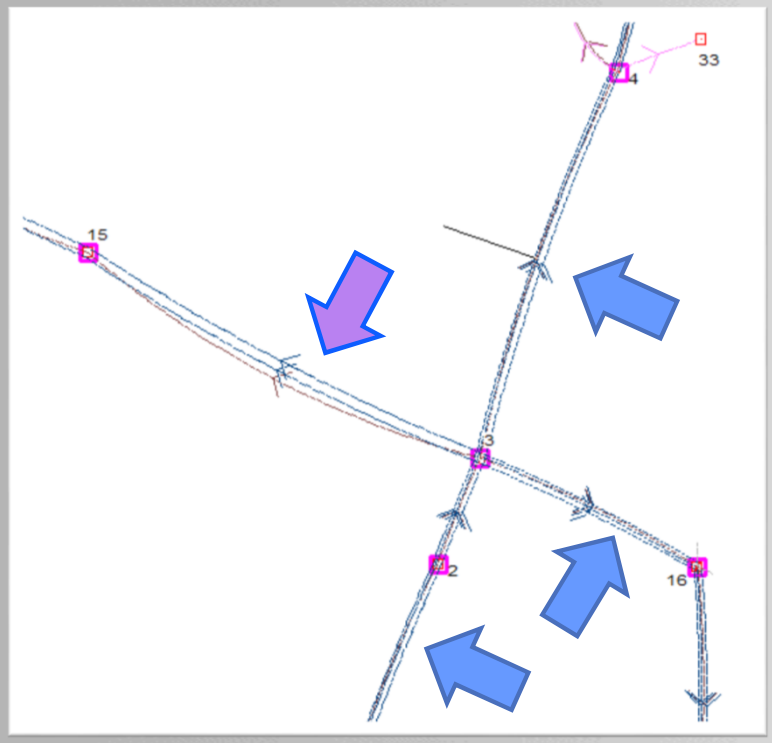


Summary of Steel Pole Usages by Load Case:

Load Case	Maximum Usage %	Steel Pole Label	Segment Number	
GO95LT GRD A+ AT INSTALLATION,I NA+	38.17	EP	14	
GO95LT GRD A- AT INSTALLATION,I NA-	81.08	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	57.82	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	119.67	EP	14	NG
GO95LT GRD A AT INSTALLATION MAX (wind towards 295),I Max	74.48	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	101.23	EP	14	NG

Non Standard Stringing Directions
Line & Tap – Case 1

Two Branch Alignments

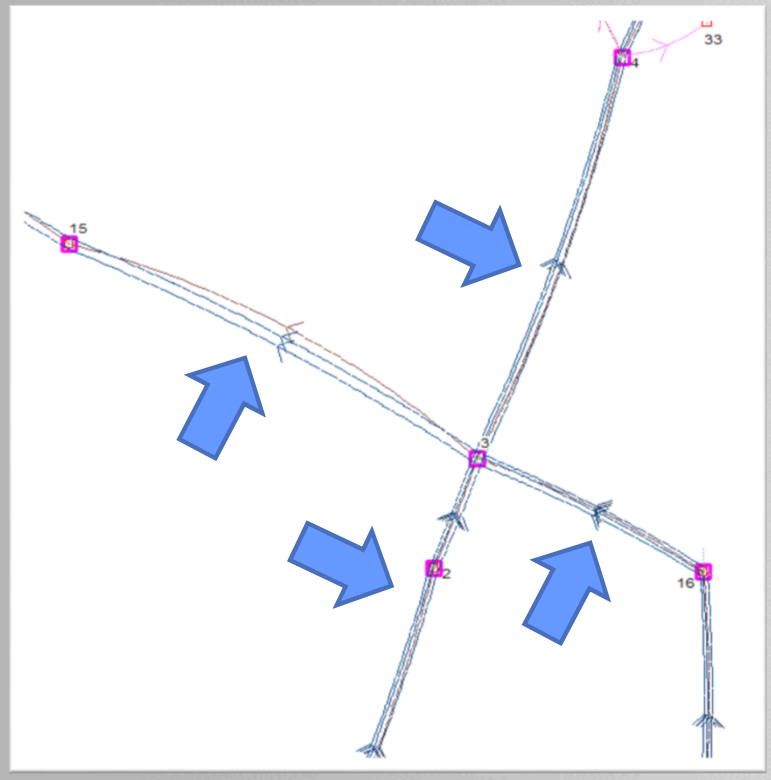


Summary of Steel Pole Usages by Load Case:

Load Case	Maximum Usage %	Steel Pole Label	Segment Number	
GO95LT GRD A+ AT INSTALLATION,I NA+	58.02	EP	14	
GO95LT GRD A- AT INSTALLATION,I NA-	66.69	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	90.14	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	93.51	EP	14	
GO95LT GRD A AT INSTALLATION MAX (wind towards 295),I Max	74.38	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	101.23	EP	14	NG

Non Standard Stringing Directions
Line & Tap – Case 1

Independent Alignment 2

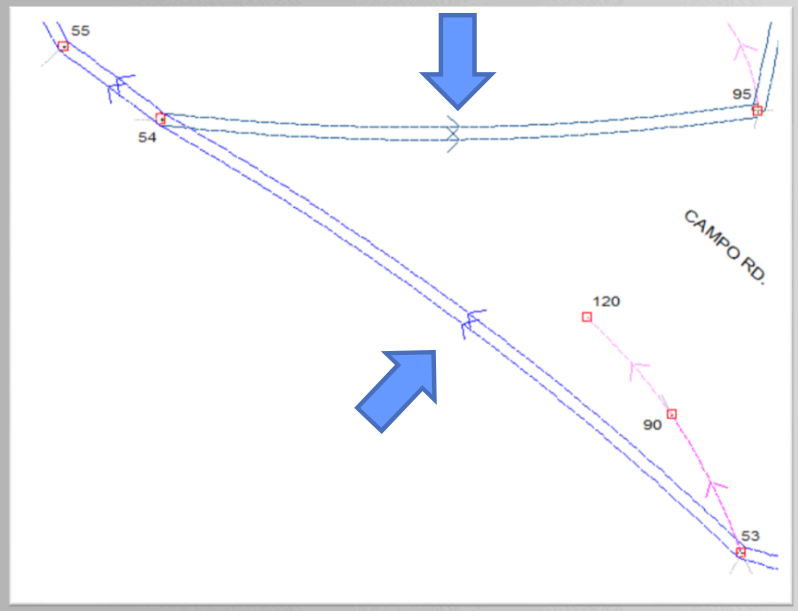


Summary of Steel Pole Usages by Load Case:

Load Case	Maximum Steel Pole Usage %	Label	Segment Number	
GO95LT GRD A+ AT INSTALLATION,I NA+	71.34	EP	14	
GO95LT GRD A- AT INSTALLATION,I NA-	58.86	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	113.48	EP	14	NG
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	81.14	EP	14	
GO95LT GRD A AT INSTALLATION MAX (wind towards 295),I Max	74.48	EP	14	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 295),C Max	101.23	EP	14	NG

Non Standard Stringing Directions
Line & Tap - Case 2

String From Main Alignment Towards the Branch

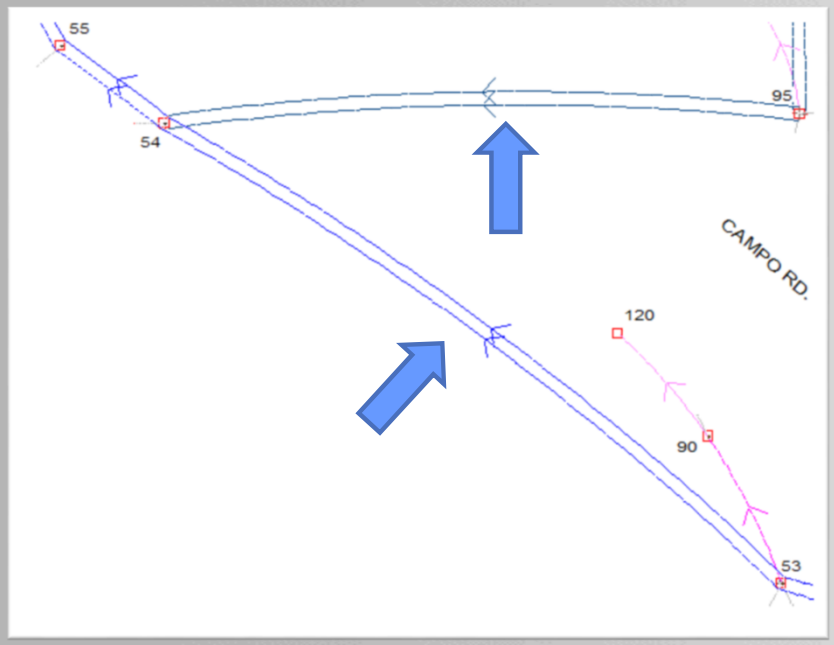


Summary of Wood Pole Usages by Load Case:

Load Case	Maximum Usage %	Wood Pole Label	Segment Number	
GO95LT GRD A+ AT INSTALLATION,I	NA+ 43.07	P	15	
GO95LT GRD A- AT INSTALLATION,I	NA- 47.89	P	15	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C	NA+ 36.57	P	15	
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C	NA- 39.18	P	15	
GO95LT GRD A AT INSTALLATION MAX (wind towards 190),I	Max 97.38	P	15	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 190),C	Max 109.63	P	15	NG

Non Standard Stringing Directions
Line & Tap - Case 2

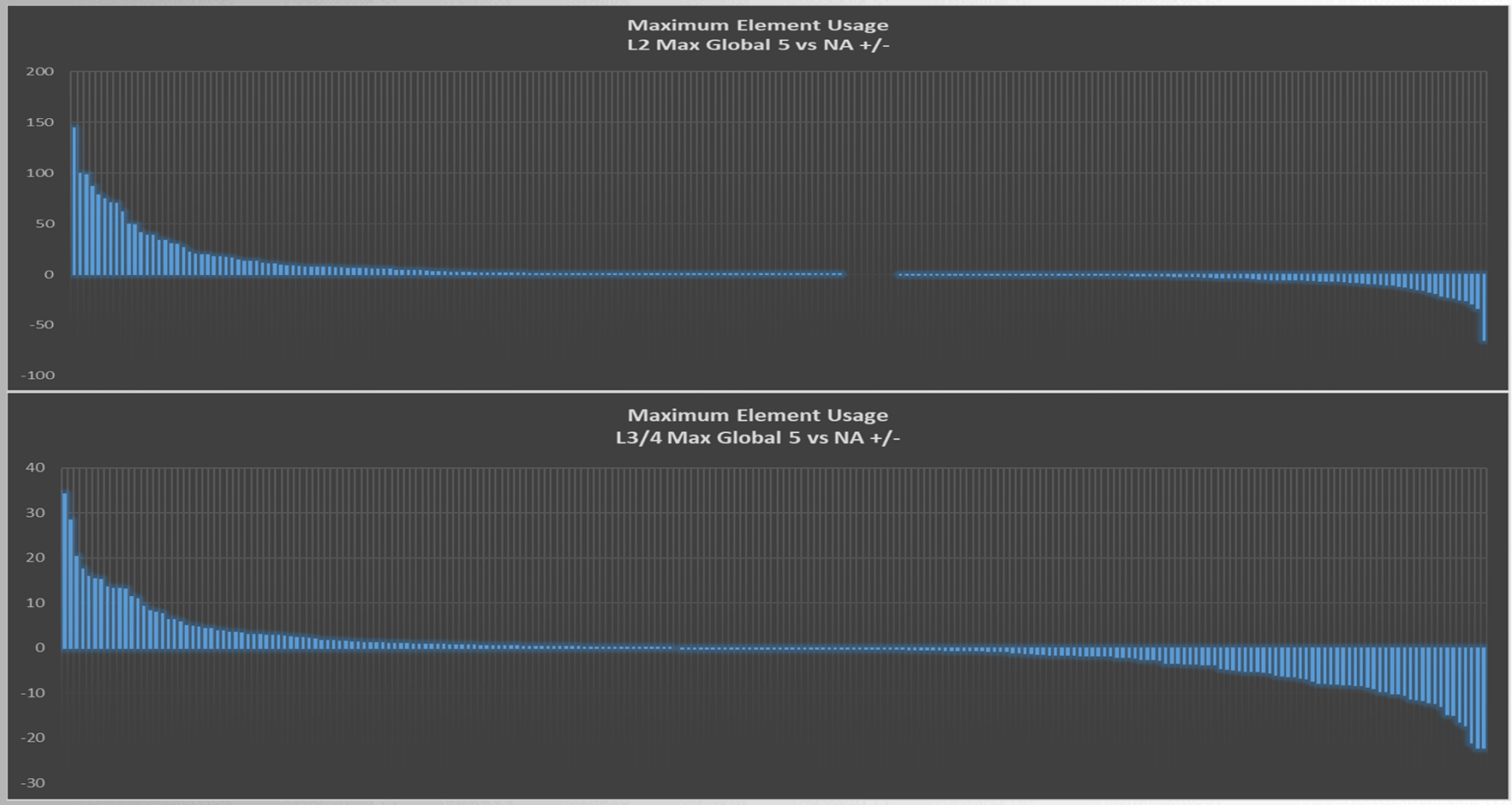
String From the Branch Towards Main Alignment



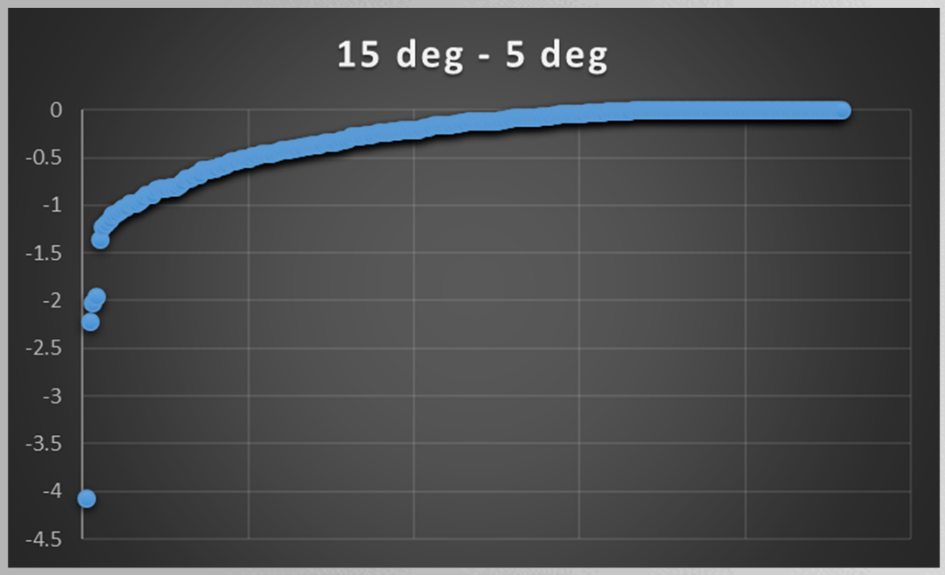
Summary of Wood Pole Usages by Load Case:

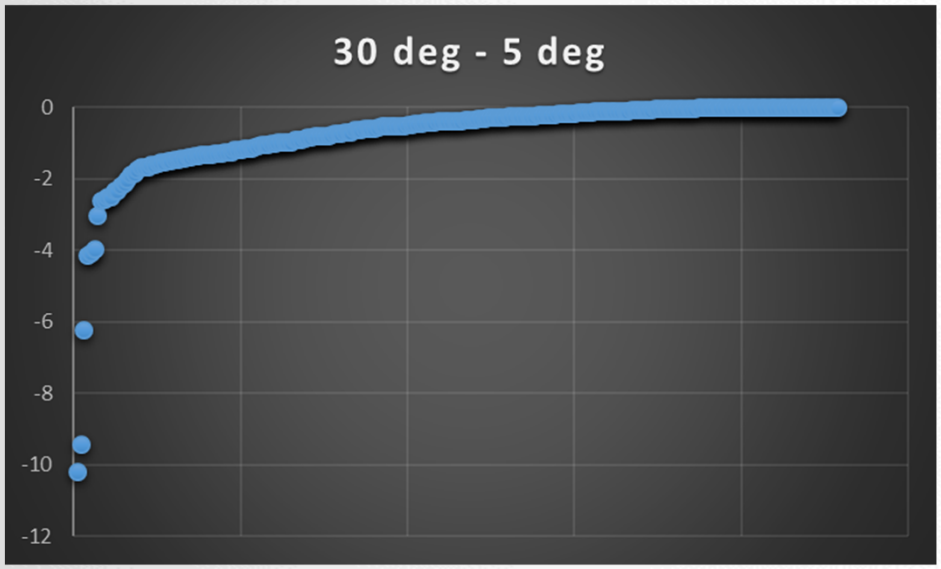
Load Case	Maximum Usage %	Wood Pole Label	Segment Number	
GO95LT GRD A+ AT INSTALLATION,I NA+	90.18	P	15	
GO95LT GRD A- AT INSTALLATION,I NA-	95.66	P	15	
KNOWN LOCAL WIND LIGHT GRD A 85+ AT INSTALLATION,C NA+	78.72	P	14	
KNOWN LOCAL WIND LIGHT GRD A 85- AT INSTALLATION,C NA-	80.40	P	15	
GO95LT GRD A AT INSTALLATION MAX (wind towards 190),I Max	97.38	P	15	
KNOWN LOCAL WIND LIGHT GRD A 85 AT INSTALLATION MAX (wind towards 190),C Max	109.63	P	15	NG

How do FE levels impact results?

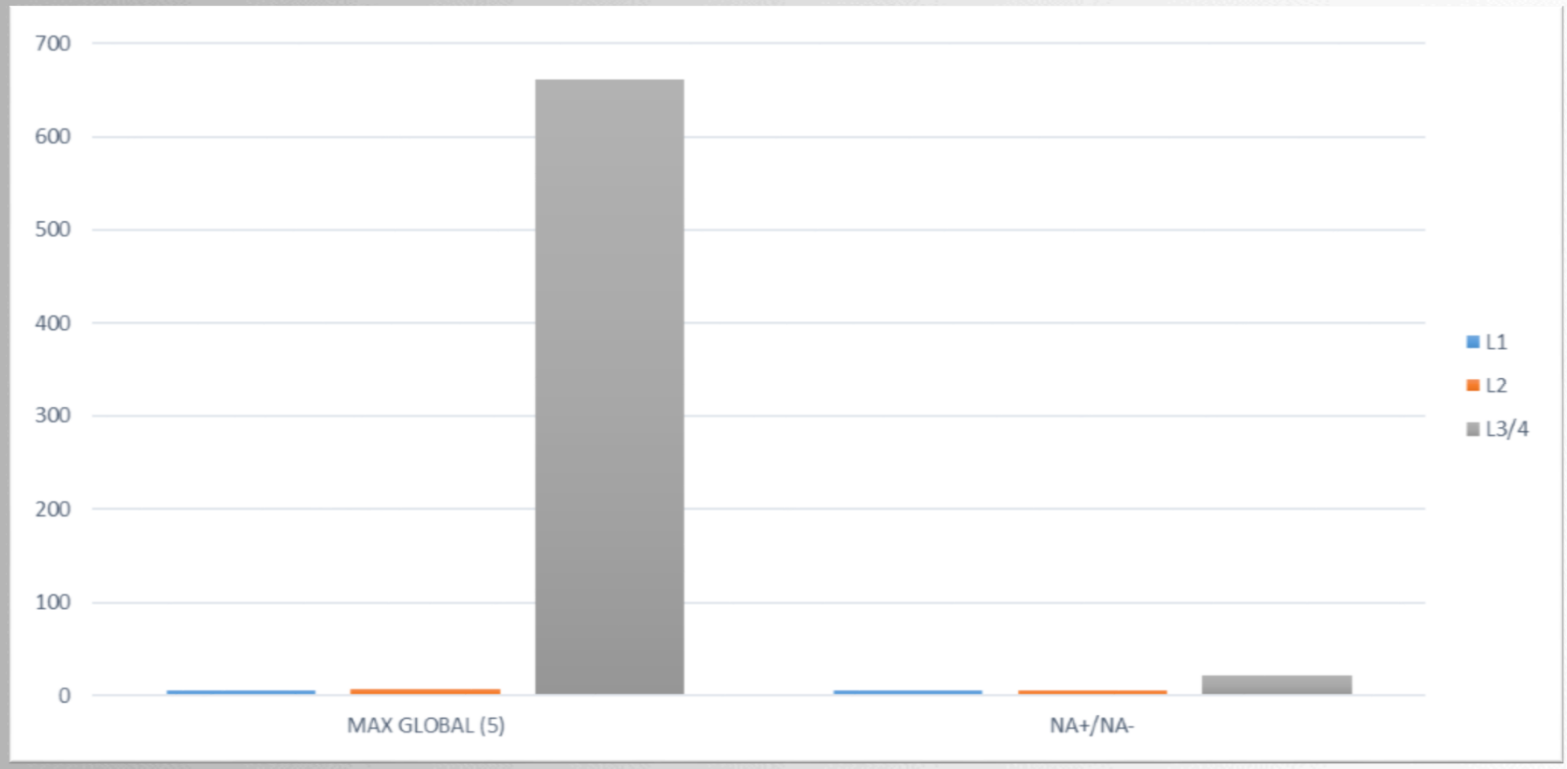


Global Wind Degree Increments

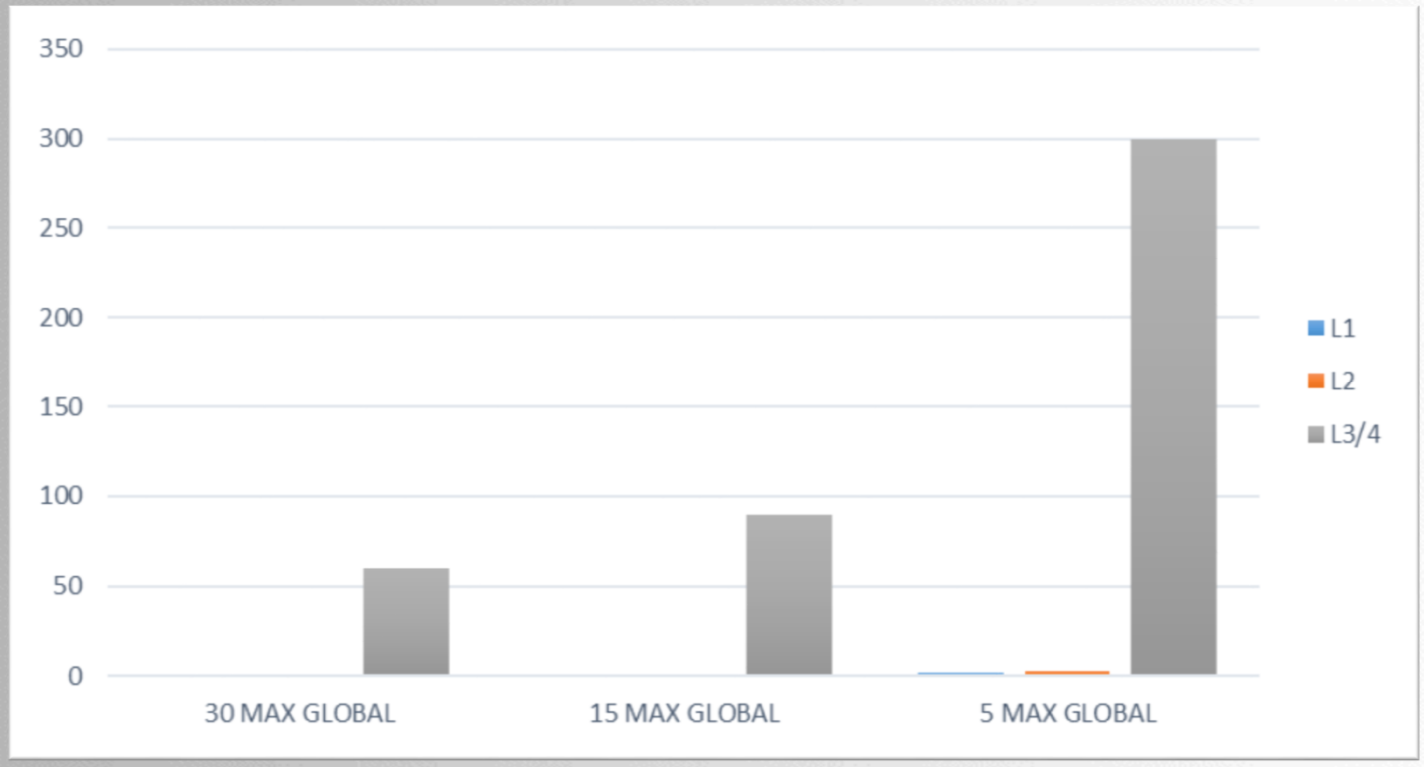




Impact on Run Times
Max Global (5 deg) vs NA+/NA-



Impact on Run Times
Max Global: (5 deg) vs (15 deg) vs (30 deg)



Conclusion and Recommendation

- Be aware of stringing directions and what NA+/- is checking
- Create a structure group for Global Wind
  - Large line angle structures with bisect only guys
  - Structures with taps or unique stringing directions

Questions?

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