2022 PLS-CADD Advanced Training and User Group

Common Support Questions for TOWER

by

Tim Cashman

Power Line Systems

Topics

- Modeling channels or other non-angle members
- Crossing diagonals with redundants
- Wind face ID warning
- Section load case information
- Planar joints
- Potentially damaging moments
- Family manager

Modeling Channels and Other Non-Angle Sections

- Can add non-angle sections to Angle Components library file
- Ensure unit weight, gross area and wind width are accurate. Also leg lengths if applying ice to members.
- Other physical properties are used for angle strength calculations and not significant for non-angle sections

Modeling Channels and Other Non-Angle Sections

- Design codes in TOWER only calculate capacities of angles and rounds
- Capacities of other members are not accurate and must be calculated outside of TOWER
- User calculated capacities can be entered in Capacities and Overrides table, if desired

Crossing Diagonals

- Crossing diagonal design check can accommodate redundants connected to the diagonals
  - Introduced in v16.20 in January 2020
- Crossing diagonal segments must be collinear in order for design check to work
- **Geometry/Members/Intersection** & **Geometry/Members/Split** commands will ensure collinear segments

Crossing Diagonals – Warning Message

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Angle member 'X5-DP' in group 'X5' is of type 'Crossing Diagonal', but cannot find the diagonal it crosses ??
Angle member 'X5-DX' in group 'X5' is of type 'Crossing Diagonal', but cannot find the diagonal it crosses ??
Angle member 'X5-DXY' in group 'X5' is of type 'Crossing Diagonal', but cannot find the diagonal it crosses ??
Angle member 'X5-DY' in group 'X5' is of type 'Crossing Diagonal', but cannot find the diagonal it crosses ??
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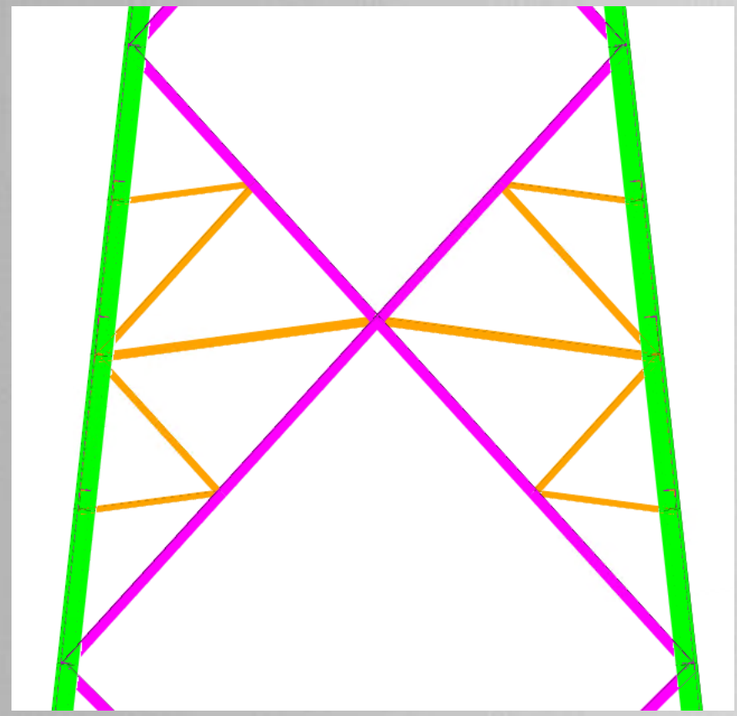


The diagonals look straight to me, but not to TOWER

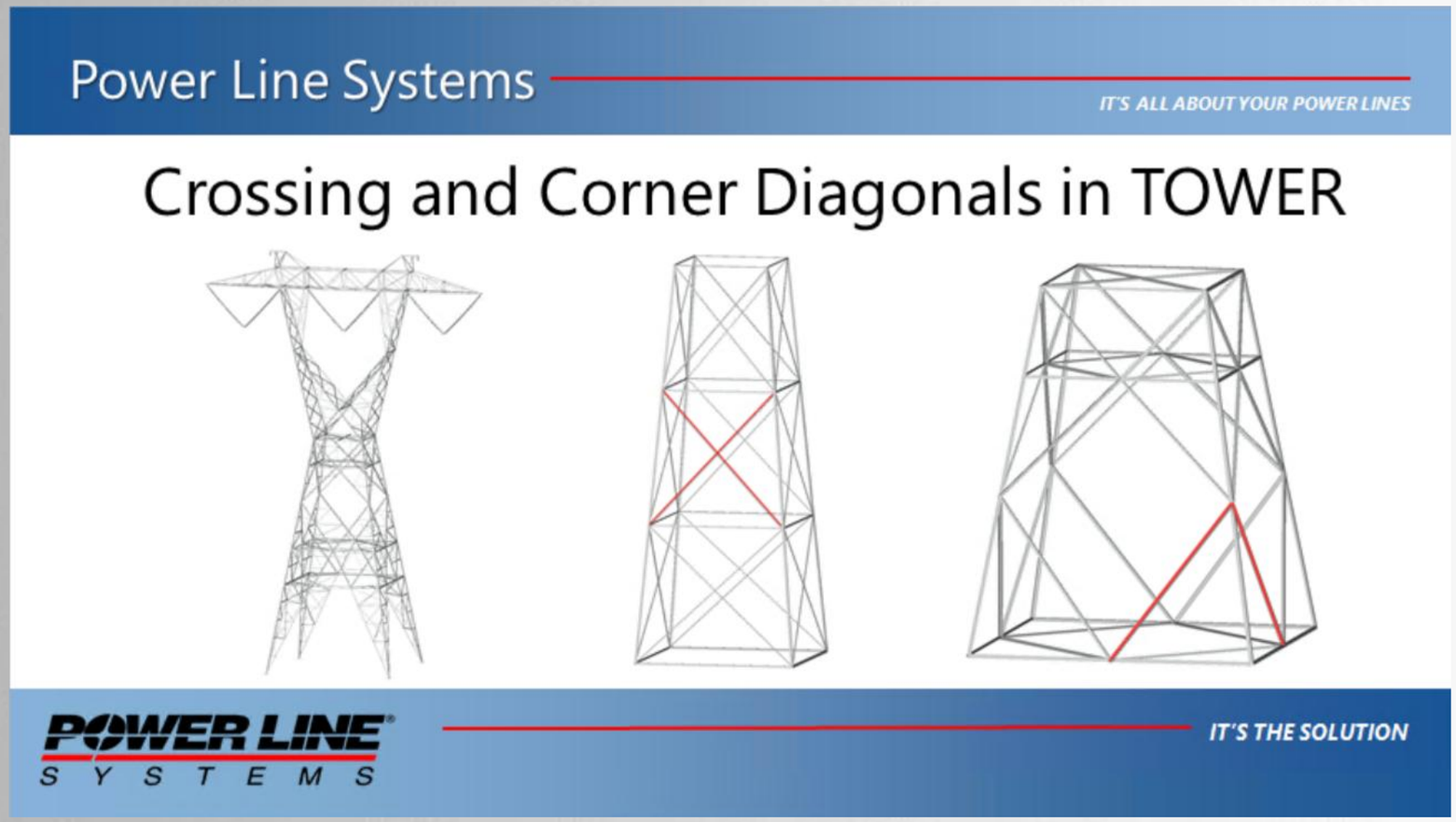
Crossing Diagonals - Report

Crossing Diagonal Check for Load Case "ASCE 74-2020,S NA+" (RLOUT controls):

Comp. Member Label	Tens. Member Label	Connect Leg for Comp. Member	Force In Comp. Member (kN)	Force In Tens. Member (kN)	Original Supported L/R Cap. (kN)	Original Supported RLX	Original Supported RLY	Original Supported RLZ	Original Supported L/R	Original Supported KL/R	Original Supported Curve No.	Alternate Unsupported L/R Cap. (kN)	Alternate Unsupported RLOUT	Alternate Unsupported L/R	Alternate Unsupported KL/R	Alternate Unsupported Curve No.
X5-AP	X5-AX	Short only	-4.86	7.95	156.95	2.000	2.000	1.000	108.86	1.15	2	95.29	2.547	138.64	1.60	8
X5-AXY	X5-AY	Short only	-6.64	0.82	156.95	2.000	2.000	1.000	108.86	1.15	2	66.29	3.432	186.78	1.97	8
X5-BP	X5-BX	Continuous	-8.51	8.33	156.09	2.000	2.000	1.000	108.82	1.14	2	94.82	2.548	138.64	1.59	8
X5-BXY	X5-BY	Continuous	-2.42	1.72	156.09	2.000	2.000	1.000	108.82	1.14	2	94.82	2.548	138.64	1.59	8
X5-CP	X5-CX	Continuous	-9.34	8.42	120.22	2.000	2.000	1.000	138.66	1.37	6	94.81	2.000	138.66	1.59	8
X5-CXY	X5-CY	Continuous	-2.37	0.06	120.22	2.000	2.000	1.000	138.66	1.37	6	62.69	2.803	194.32	2.03	8
X5-DP	X5-DX	Short only	-8.80	10.98	120.80	2.000	2.000	1.000	138.62	1.38	6	95.29	2.000	138.64	1.60	8
X5-DXY	X5-DY	Short only	-5.22	-6.72	120.80	2.000	2.000	1.000	138.62	1.38	6	95.29	2.000	138.64	1.60	8
X5-DY	X5-DXY	Short only	-6.72	-5.22	120.80	2.000	2.000	1.000	138.62	1.38	6	44.94	3.571	247.48	2.45	8

Crossing Diagonals - Video

For more information on crossing diagonals, see video on PLS YouTube Channel



Wind Face ID Warning

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Section "2A" has a transverse face gross area of 0.0, wind loads will not be calculated correctly for this section ??
Gross area of transverse face for section "2A" was zero: wind loads may be incorrect (load case "LC1 - NESC HEAVY DOUBLE").  ??
      Transverse face area for section "2A" was zero: wind loads may be incorrect (load case "LC1 - NESC HEAVY DOUBLE").  ??
      Could not compute a valid transverse solidity ratio for section "2A" wind loads may be incorrect (load case "LC1 - NESC HEAVY DOUBLE"). ??
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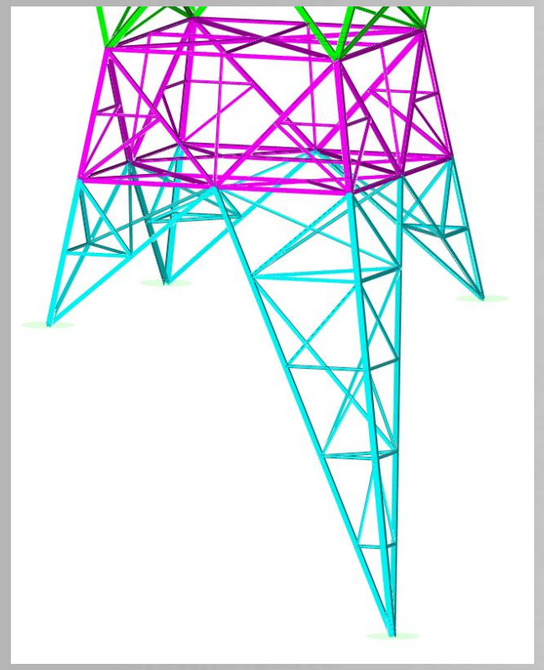

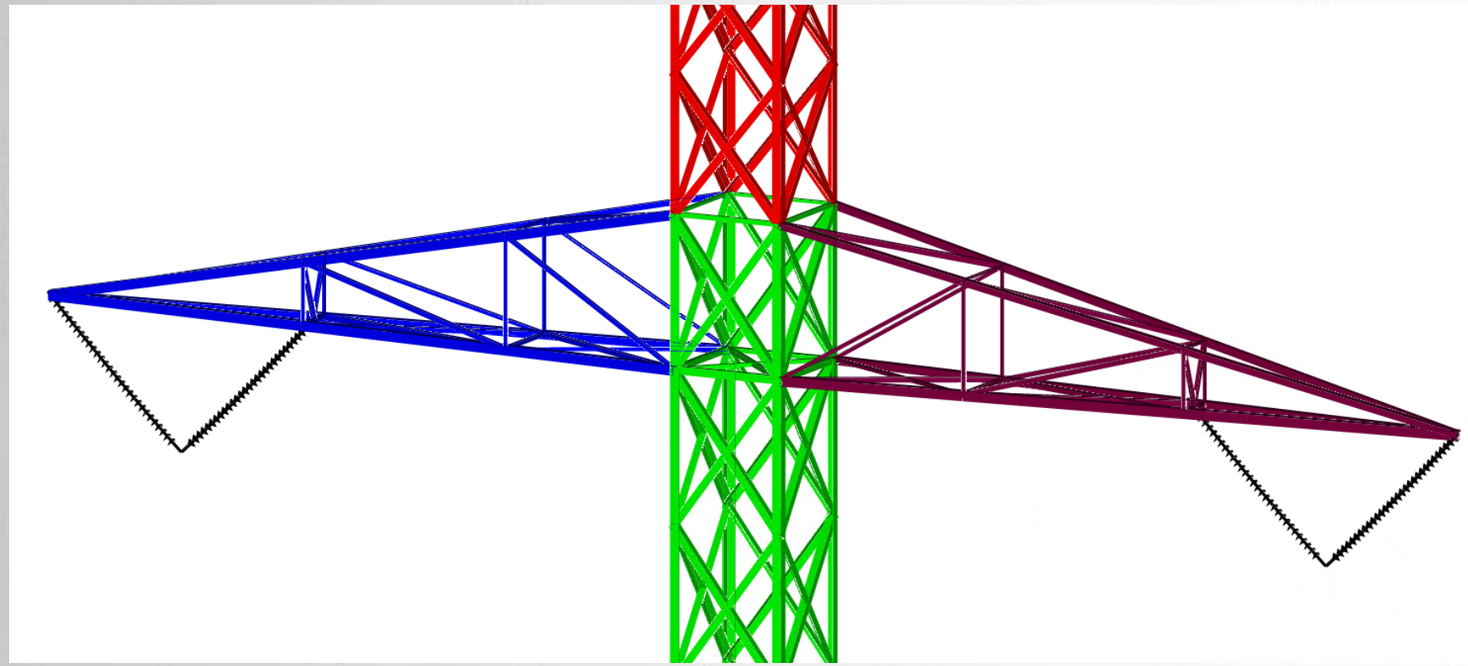

Wind Face ID Warning - Algorithm

- Find all joints in the section and sort by elevation
- Start at lowest joint and find horizontal extent to determine the “face width”
- Find the “face width” of the next joint up
- Calculate face area of the resulting trapezoid
- Repeat steps and sum the trapezoids until no more joints
- *Only joints at the top of the section are allowed to have a face width of zero*

Wind Face ID Warning – When does it apply?

- Face area needed for solidity ratio calculation
- Face area only calculated for Wind by Code methods
- Warning will not be generated for Wind on Face, Wind on All or SAPS Wind methods
- Face area still calculated when warning appears but solidity ratio may not be accurate so user should confirm

Wind Face ID Warning – Tips to avoid warning

- Define sections by elevation, not left or right side of tower
- Include left and right arms in same section along with body or cage between the arms
- Will occur on towers with differential legs so accept and review results
- Warning can be suppressed in **General/Output Options**

Section Load Case Information

- Valuable information about each section
  - Wind pressures
  - Section areas (Gross and face)
  - Solidity ratios
  - Drag coefficients (User entered or calculated)
  - Total wind forces
  - Structure ice weight
  - Kz and GRF values (Enabled with extended diagnostics)

Section Load Case Information – Code Based

Section Load Case Information (Code) for "EN50341-1:2001":

Section Label	Z of Top (m)	Z of Bottom (m)	Ave. Elev. Above Ground (m)	Res. Adj. Wind Pres. (Pa)	Tran Adj. Wind Pres. (Pa)	Tran Angle Face Area (m^2)	Tran Gross Area (m^2)	Tran Soli- dity Ratio	Tran Angle Drag Coef	Tran Wind Load (N)	Long Adj. Wind Pres. (Pa)	Long Angle Face Area (m^2)	Long Gross Area (m^2)	Long Soli- dity Ratio	Long Angle Drag Coef	Long Wind Load (N)	Ice Weight (N)	Total Weight (N)	
Peak	21.95	20.27	30.25	869.94	869.94	0.48	1.79	0.271	2.644	1114.5	0.00	2.37	24.28	0.098	3.445	0.0	0	7058	GRF = 1.050 Kz = 1.331
Crossarm	20.27	18.29	28.42	857.50	857.50	3.76	4.23	0.889	1.823	5873.1	0.00	17.22	43.50	0.396	2.221	0.0	0	51520	GRF = 1.050 Kz = 1.312
Window	18.29	2.74	19.66	785.75	785.75	22.26	56.86	0.392	2.233	39070.0	0.00	18.94	143.67	0.132	3.268	0.0	0	72349	GRF = 1.050 Kz = 1.202
Basic Body	2.74	0.00	10.52	671.14	671.14	5.52	15.47	0.357	2.338	8667.6	0.00	5.52	15.47	0.357	2.338	0.0	0	26760	GRF = 1.050 Kz = 1.027
30Leg	0.00	-9.14	4.57	653.56	653.56	0.00	0.00	0.000	4.009	0.0	0.00	0.00	0.00	0.000	4.009	0.0	0	11881	GRF = 1.050 Kz = 1.000
10Leg	0.00	-3.05	7.62	653.56	653.56	4.45	20.13	0.221	2.848	8290.5	0.00	4.45	20.13	0.221	2.848	0.0	0	13609	GRF = 1.050 Kz = 1.000

Section Load Case Information – Wind on All or Face

Section Load Case Information (Standard) for "Wind on All":

Section Label	Z of Top (m)	Z of Bottom (m)	Ave. Elev. Above Ground (m)	Res. Adj. Wind Pres. (Pa)	Tran Adj. Wind Pres. (Pa)	Tran Drag Coef	Tran Wind Load (N)	Long Adj. Wind Pres. (Pa)	Long Drag Coef	Long Wind Load (N)	Ice Weight (N)	Total Weight (N)
Peak	21.95	20.27	30.25	622.44	622.44	1.600	1809.5	0.00	1.600	0.0	0	7058
Crossarm	20.27	18.29	28.42	622.44	622.44	1.600	15889.1	0.00	1.600	0.0	0	51520
Window	18.29	2.74	19.66	622.44	622.44	1.600	37770.5	0.00	1.600	0.0	0	72349
Basic Body	2.74	0.00	10.52	622.44	622.44	1.600	12259.5	0.00	1.600	0.0	0	26760
30Leg	0.00	-9.14	4.57	622.44	622.44	1.600	6100.7	0.00	1.600	0.0	0	11881
10Leg	0.00	-3.05	7.62	622.44	622.44	1.600	6171.9	0.00	1.600	0.0	0	13609

Section Load Case Information – SAPS Wind

Section Load Case Information (SAPS) for "ASCE 74:2020M":

Section Label	Z of Top (m)	Z of Bottom (m)	Ave. Elev. Above Ground (m)	Res. Adj. Wind Pres. (Pa)	Angle Drag Coef	Round Drag Coef	Tran Wind Load (N)	Long Wind Load (N)	Vert Wind Load (N)	Ice Weight (N)	Total Weight (N)	
Peak	21.95	20.27	30.25	662.39	1.600	1.000	2525.0	-0.1	-1.2	0	7058	GRF = 0.842 Kz = 1.264
Crossarm	20.27	18.29	28.42	653.75	1.600	1.000	9719.3	-1.5	-16.1	0	51520	GRF = 0.842 Kz = 1.247
Window	18.29	2.74	19.66	604.94	1.600	1.000	31975.3	-2.2	136.8	0	72349	GRF = 0.842 Kz = 1.154
Basic Body	2.74	0.00	10.52	530.28	1.600	1.000	7125.3	-13.6	-54.7	0	26760	GRF = 0.842 Kz = 1.012
30Leg	0.00	-9.14	4.57	525.34	1.600	1.000	4337.2	270.7	-410.3	0	11853	GRF = 0.842 Kz = 1.002
10Leg	0.00	-3.05	7.62	525.34	1.600	1.000	5173.6	-120.3	98.5	0	13640	GRF = 0.842 Kz = 1.002

Planar Joints – What are they?

- A joint located at the intersection of members which all lie in one plane
- Joints are ideal, pin-connected, universal joints and thus have no stiffness in direction perpendicular to the plane of the members
- Create instability in model which can lead to incorrect results (especially in nonlinear analysis)

Planar Joints – How to deal with them?

- Planar joints more prevalent when including redundants in model
- Replace some Truss elements with Beam elements (preferred method)
- Leave Truss elements and exclude redundants from FE analysis (doesn’t work in all situations)
- Connect planer joint to stable joint with fictitious members (legacy method)

Potentially Damaging Moments

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A potentially damaging moment exists in the following members

(make sure your system is well triangulated to minimize moments): 129P_P 129Y_P  ??
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Potentially Damaging Moments – Why?

- Warning only occurs for Beam elements
- Occurs when the following is true

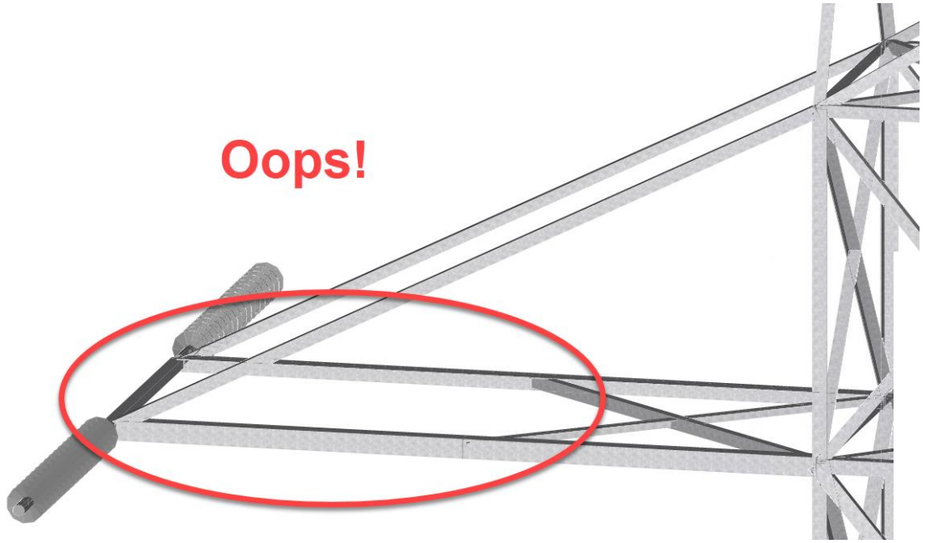
$$\frac{Calculated\ Resultant\ Moment}{S\ x\ Fy} > 100\%$$

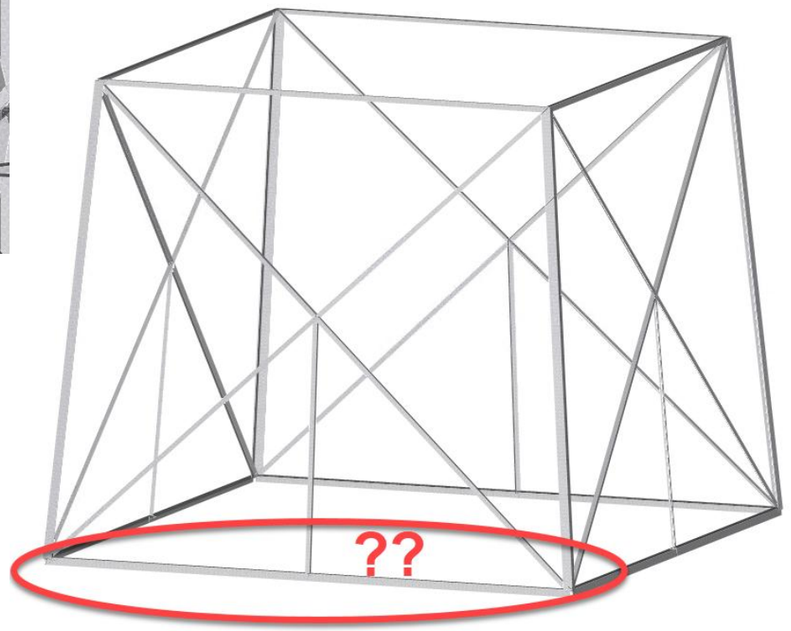
- S can be input in Angle Properties table, or
- S is approximated as $\frac{Gross\ Area\ x\ 2(rz)}{0.5\ x\ Long\ Leg\ Length}$

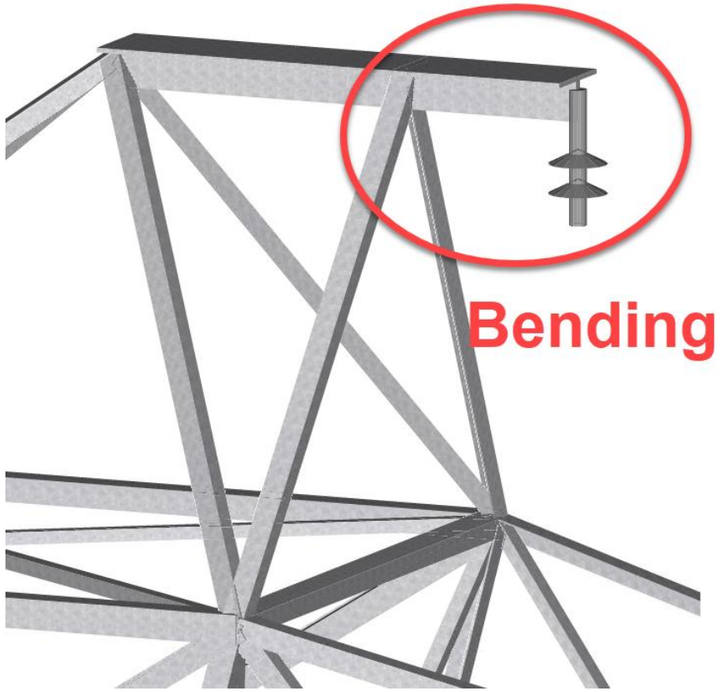
Potentially Damaging Moments - Purpose

- Used to detect possible gross modeling errors
- Moments in TOWER are determined based on arbitrary member orientations and insufficient connection details and should not be used for design stress calculations
- If you feel the moments are substantial you should check outside of TOWER program

Potentially Damaging Moments - Examples

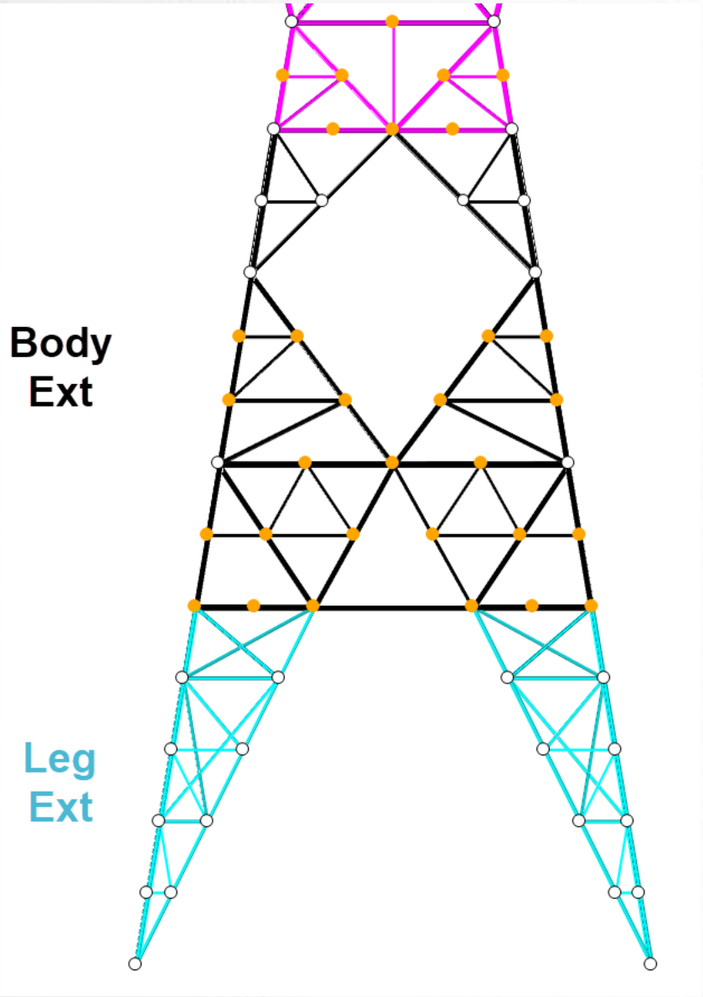






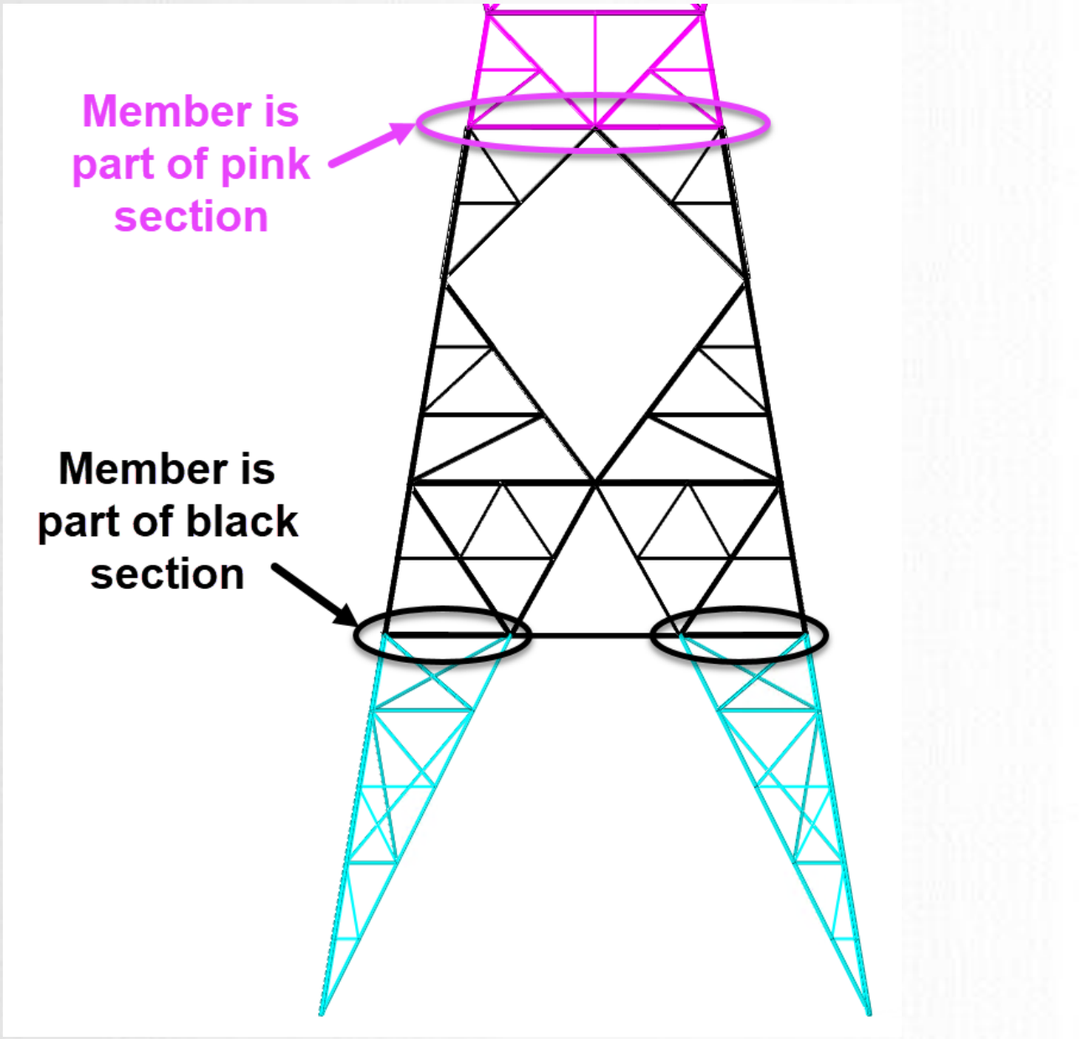
Family Manager – Secondary Joints

- Secondary joints must reference joints within the extension, otherwise will be converted to primary joints
- All secondary joints in leg extensions will be converted to primary



Family Manager – Members at Interface

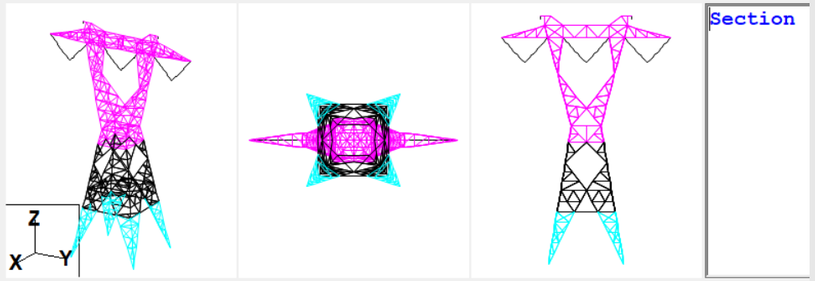
- Horizontal members at the interface planes will be assigned to the upper section
- If horizontal member varies depending on lower section, then create multiple variations of the upper section



Family Manager – Defining Sections

- Define sections by member, not by joints

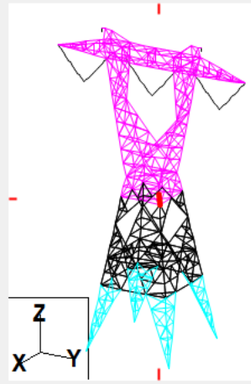
Sections



	Section Label	Section Color	Joint Defining Section Bottom	Dead Load Adjust. Factor	Transverse Drag x Area Factor For Face	Longitudinal Drag x Area Factor For Face
1	Peak			1.200	3.840	3.840
2	Crossarm			1.200	3.840	3.840
3	Window			1.200	3.840	3.840
4	Basic Body			1.200	3.840	3.840
5	20Body			1.200	3.840	3.840
6	40Body			1.200	3.840	3.840
7	30Leg			1.200	3.840	3.840
8	27.5Leg			1.200	3.840	3.840
9	25Leg			1.200	3.840	3.840
10	22.5Leg			1.200	3.840	3.840
11	20Leg			1.200	3.840	3.840
12	17.5Leg			1.200	3.840	3.840
13	15Leg			1.200	3.840	3.840
14	12.5Leg			1.200	3.840	3.840
15	10Leg			1.200	3.840	3.840
16	7.5Leg			1.200	3.840	3.840
17	5Leg			1.200	3.840	3.840

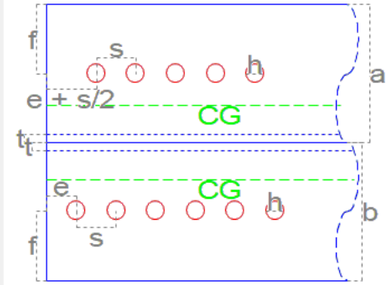
Angle Member Connectivity

Isometric View




```
Angle '1P'
Group '2' Leg
A572-50
SAE 5X5X0.3125
Dimensions (cm)
b = 12.7000
a = 12.7000
t = 0.7937
L = 140.92
5/8 A394 TYPE0 N
nb = 11
nh = 3.0000
d = 1.5875
h = 1.9050
e = 2.8575
s = 3.8100
f = 6.3500
g = 0.0000
Wgt = 211.8 (N)
Capacities (kN)
Comp.    = 519.550
C-Control= L/r
```

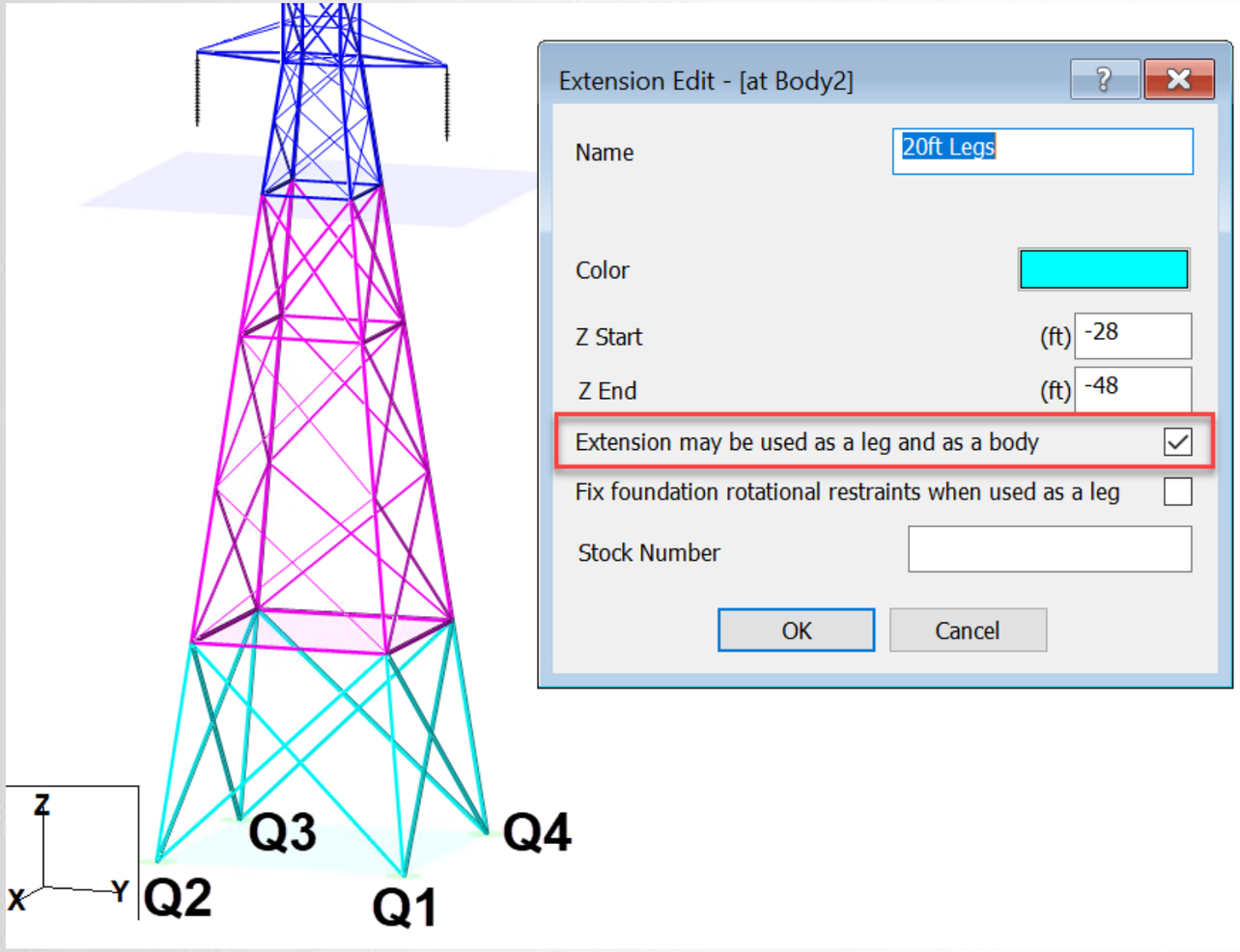
Connection View



	Member Label	Group Label	Section Label	Symmetry Code	Origin Joint	End Joint
190	40BE-D2	40BE-15	40Body	XY-Symmetry	40B-R17S	40B-4S
191	40BE-R21	40BE-F	40Body	XY-Symmetry	40B-2P	40B-R17S
192	40BE-R22	40BE-G	40Body	Y-Symmetry	40B-R17S	40B-R17X
193	40BE-R25	40BE-15	40Body	XY-Symmetry	40B-5S	40B-R18S
194	40BE-D3	40BE-15	40Body	XY-Symmetry	40B-R18S	40B-6S
195	40BE-R23	40BE-D	40Body	XY-Symmetry	40BS	40B-R18S
196	30L-1	LE-12	30Leg	None	FP	30LE-R4P
197	30L-2	LE-12	30Leg	None	30LE-R4P	30LE-R3P
198	30L-3	LE-12	30Leg	None	30LE-R3P	30LE-R2P
199	30L-4	LE-12	30Leg	None	30LE-R2P	30LE-R1P

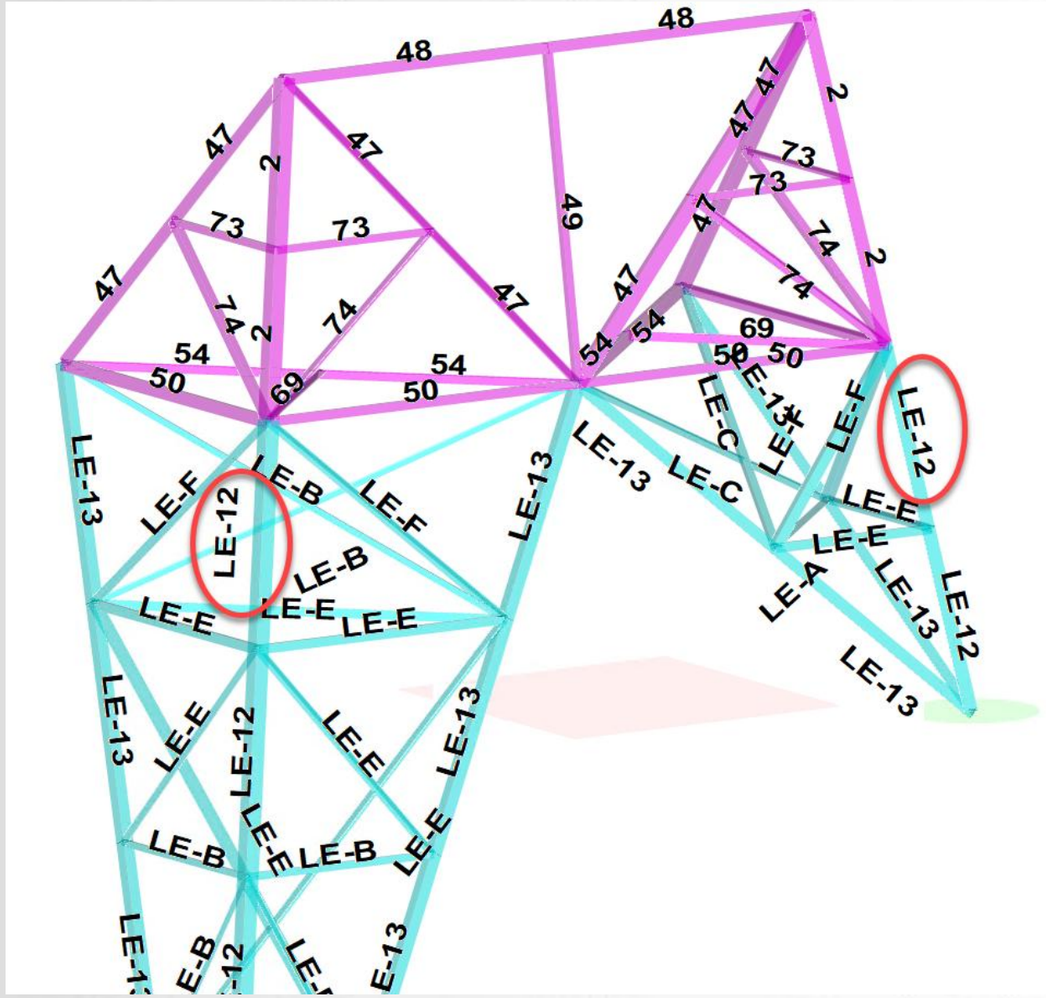
Family Manager – Leg Extensions

- All joints and members of a leg extension must be within a quadrant
- If portions of legs extend beyond a single quadrant, define legs as a body extension



Family Manager – Group Labels

- Best practice is to use unique Group Labels within each body or leg extension
- Duplicate Group Labels can cause confusion when trying to change properties of groups



Advanced Sag & Tension
IEC
FAC 008/009
Materials Management
NESC
PLS-CADD ®
LiDAR Modeling
Structural Analysis
CSA
Distribution
Pole Analysis
CENELEC
Transmission
NERC Ratings
Line Optimization

Questions

Project Estimating
FAC 003
ASCE
Joint Use
PLS-POLE
GO95
Vegetation Management
1000+ Users in 100+ Countries
Storm Hardening
IEEE
Line Ratings
TOWER
Drafting