

Oblique Wind on Structures

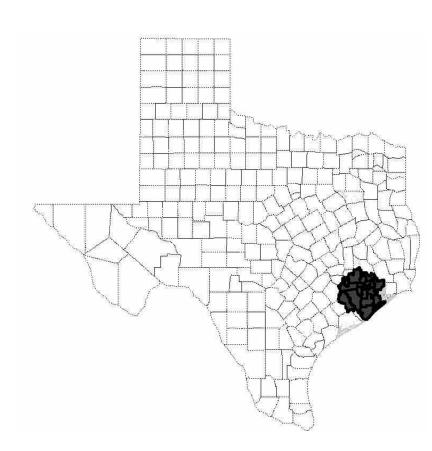
an inconvenient truth

By: George T Watson, Staff Engineer CenterPoint Energy

- formerly Reliant Energy
- formerly Houston Industries Inc.
- formerly Houston Lighting & Power

Small Service Area (2.5%) Big Electrical Load (25%)





Texas Peak Load for 2006 was 62,000mw

CNP Peak Load for 2006 was 15,700mw

(25% of Texas Total)

Typical Houston house



with 11 Car Garage (now for sale)

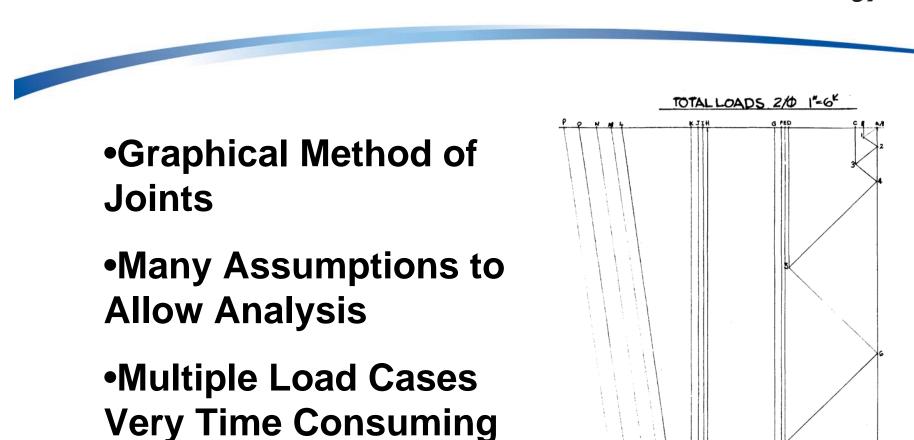


61,000 Square Feet on an 11 Acre Lot

Ancient Tower Design Tools



e-×LL/O	.999		.996,
	11		
1/X CI X C X D VX R1 VX R2 eX LLO			
	1.001	0 0	1.003 1.004
		(* *	
109X L LL/1 e-X LL/2 LL/3 TT	httilin 435 inhudandaabadaabadaabadaabadaabadaabadaabad	20 15 15	ມປະປະເທດໃຫຍ່ປະປະເທດໃຫ້ເປັນປະການເປັນເປັນປະປະທານມານີ້ ແມ່ນເປັນເປັນເປັນເປັນເປັນເປັນເປັນເປັນເປັນເປັ
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Early Stress Analysis



Calculator from 1973 (\$2,000)













252D Simultaneous Application of Loads

Where a combination of vertical, transverse, or longitudinal loads may occur simultaneously, the structure shall be designed to withstand the simultaneous application of these loads.

Note: Under the extreme wind conditions of Rule 250C, an oblique wind may require greater structural strength than that computed by Rules 252B and 252C.





Rules 261A1c, 261A2e, and 261A3d

All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure.

Do You Have a Problem?



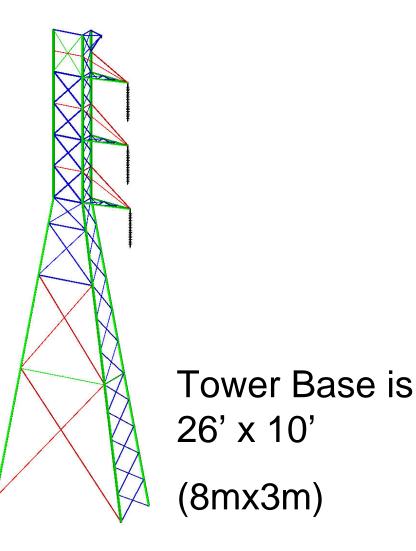
Rectangular Tangent Towers Can be Susceptible to Oblique Wind Leg Overload



An Example to Consider



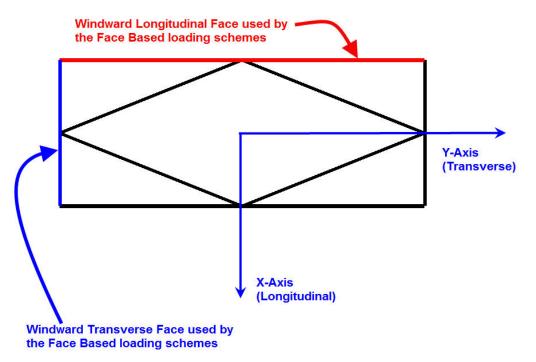
All Redundants must be Accounted for in the Drag Area Calculations





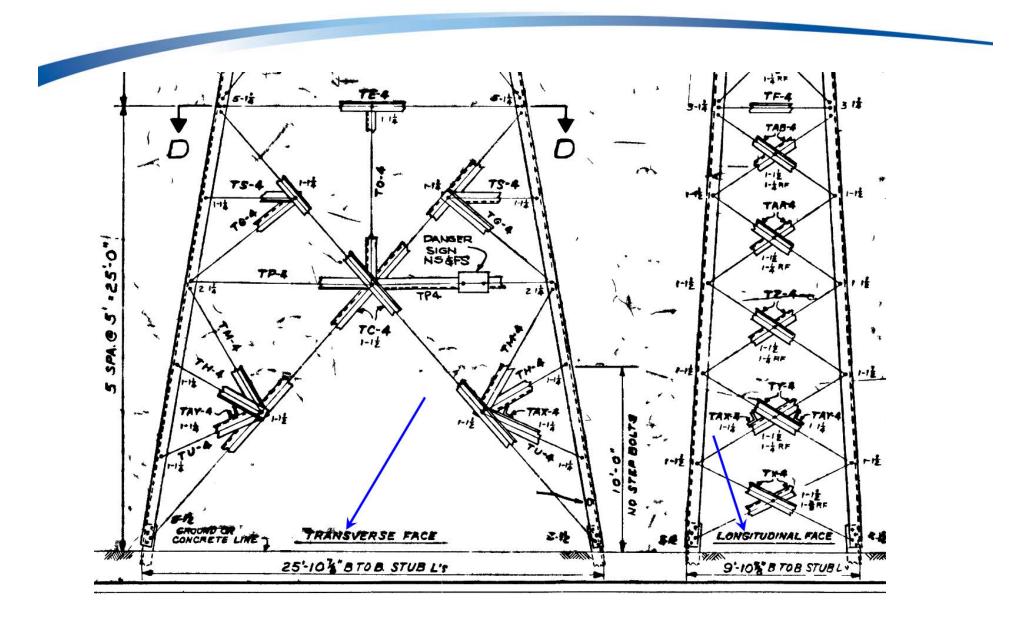


The windward transverse face is that on which a positive transverse wind (in the positive Y-direction) would blow.



Common Face Designation





Adjust Drag Factors



ctio	ns							
Z					No.	del Check Report errors or relev Adjust Drag Factors	vant warnings d	letected.
	900							
	Section	Section	Joint	Dead	Transverse	Longitudinal	Transverse	Longitudin
	Section	Section Color		Dead Load		Longitudinal Drag x Area	Transverse Area Factor	
			Joint Defining Section		Transverse Drag x Area Factor	Longitudinal Drag x Area Factor		Area Facto
			Defining	Load	Drag x Area	Drag x Area	Area Factor	Area Facto
1			Defining Section	Load Adjust.	Drag x Area Factor	Drag x Area Factor	Area Factor (CD From	Longitudin Area Facto (CD From Code) 1.000
1	Label		Defining Section Bottom	Load Adjust. Factor	Drag x Area Factor For Face	Drag x Area Factor For Face	Area Factor (CD From Code)	Area Facto (CD From Code)
14230	Label Cage		Defining Section Bottom 11P	Load Adjust. Factor 1.310	Drag x Area Factor For Face 3.200	Drag x Area Factor For Face 3.200	Area Factor (CD From Code) 1.000	Area Facto (CD From Code) 1.000

DESIGN CONDITIONS:



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •140 mph Hurricane Wind (63 m/sec)
- •2 Circuits of 795 ACSR Drake Wire (2 per Phase)
- •Span Length = 777.5 feet (237 meters)



Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength		Max Use In Comp.	Comp. Control Member	Comp. Force I	Comp. Control Load Case	
				(ksi)	8	8		(kips)		
TA5	LEG1	SAE	3.5X3.5X0.25	36.0	94.85	94.85	9P	-49.789H	urricane	
TB4	LEG2	SAE	4X4X0.25	50.0	100.00	100.00	13P	-65.480H	irricane	NG
Τ4	LEG3	SAE	4X4X0.3125	50.0	98.69	98.69	15P	-74.161H	urricane	

CenterPoint_®

Energy

Add Wind at Oblique Angles



	Description	Weather case	Cable	Wind	Bisector
			condition	Direction	Wind Dir
					(deg)
	_				
1	Hurr -90	Hurricane	Initial RS	BI+	-90.00
2	Hurr -89	Hurricane	Initial RS	BI+	-89.00
3	Hurr -88	Hurricane	Initial RS	BI+	-88.00
4	Hurr -87	Hurricane	Initial RS	BI+	-87.00
5	Hurr -86	Hurricane	Initial RS	BI+	-86.00
6	Hurr -85	Hurricane	Initial RS	BI+	-85.00
7	Hurr -84	Hurricane	Initial RS	BI+	-84.00
8	Hurr -83	Hurricane	Initial RS	BI+	-83.00
9	Hurr -82	Hurricane	Initial RS	BI+	-82.00
10	Hurr -81	Hurricane	Initial RS	BI+	-81.00
11	Hurr -80	Hurricane	Initial RS	BI+	-80.00

Legs Overstressed by 21%



Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength	03359	Max Use In Comp.	Comp. Control Member	Comp. Force	Comp. Control Load Case	
				(ksi)	8	8		(kips)		
TA5	LEG1	SAE	3.5X3.5X0.25	36.0	108.57	108.57	10¥	-56.991H	urr -28,I	NG
TB4	LEG2	SAE	4X4X0.25	50.0	121.46	121.46	13¥	-79.531H	urr -30,I	NG
T4	LEG3	SAE	4X4X0.3125	50.0	118.05	118.05	16Y	-88.706H	urr -35,I	NG

•At 35 degrees from Normal, Bottom Legs are overloaded

•At 30 degrees from Normal, Middle Legs are overloaded

Lacing Overstressed by 33%



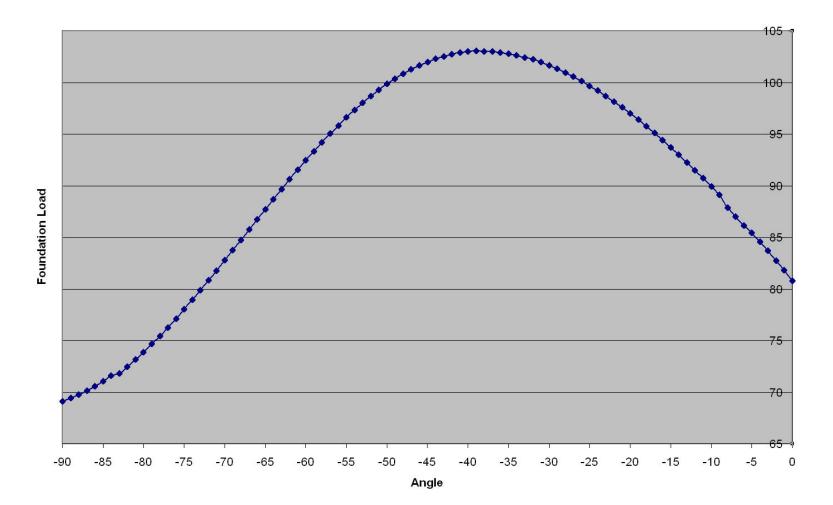
	Group	Group	Angle	Angle	Steel	Max	Max	Comp.	Comp.	Comp.
	Label	Desc.	Type	Size	Strength	Usage	Use In	Control	Force	Control
							Comp.	Member		Load Case
					(ksi)	÷	÷		(kips)	
	TE4	TGIR8	SAE	1.75X1.75X0.1875	36.0	133.18	133.18	32X	-7.620	Hurr -58,I BI+ (140mph
u	o Summa	ıry								
- 1			Angle	Àngle	Steel	Max	Max	Comp.	Comp.	Comp.
ul	Group	Group	Angle Type	Angle Size	Steel Strength	Max Usage	Max Use In	Comp. Control	Comp. Force	Comp. Control
u	Group	Group	- 10 			20.00			12.1	
u I	Group	Group	- 10 			20.00	Use In	Control	12.1	Control
5	Group	Group Desc.	- 10 		Strength (ksi)	Usage	Use In Comp. %	Control	Force	Control

•At 58, 59, and 61 degrees from Normal, Lacings are overloaded

Graph of Foundation Loads



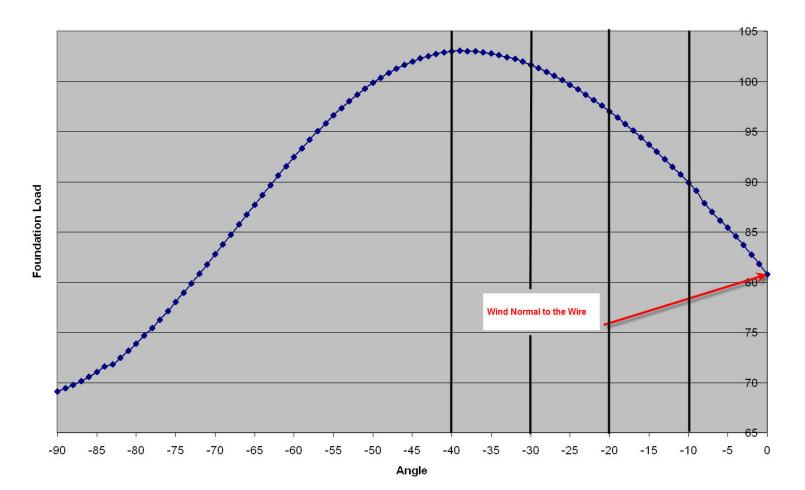
Wind Angle vs Foundation Reaction



Run 10 Degree Increments

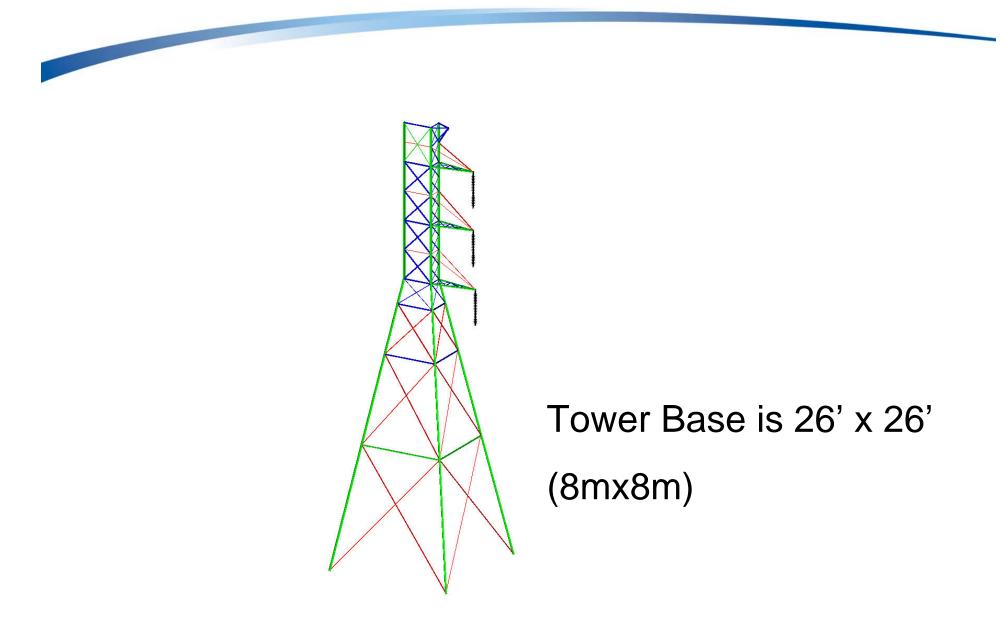


Wind Angle vs Foundation Reaction



Square Base Towers Behave Better than Rectangular Base





DESIGN CONDITIONS:



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •140 mph Hurricane Wind (63 m/sec)
- •2 Circuits of 795 ACSR Drake Wire (2 per Phase)
- •Span Length = 750 feet (229 meters)

Square Base Tower Legs are Overstressed by less than 7%



Group Summary (Compression Portion):

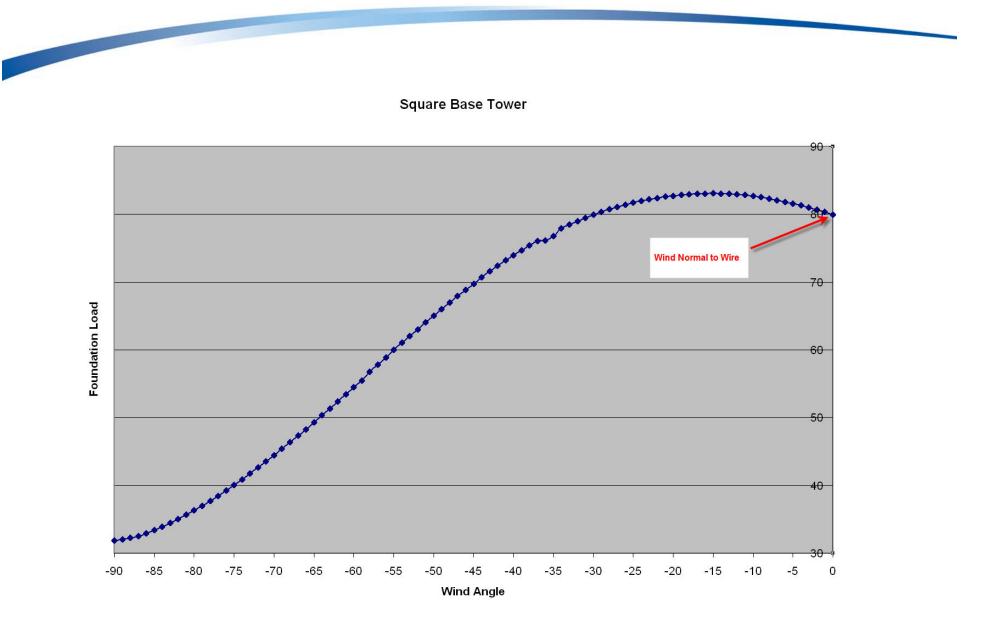
Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength		Max Use In Comp.	Comp. Control Member	Comp. Force I	Comp. Control .oad Case	
				(ksi)	8	~		(kips)		
TA5	LEG1	SAE	3.5X3.5X0.25	36.0	102.58	102.58	10¥	-53.848Hu	ırr -35,I	NG
TB4	LEG2	SAE	4X4X0.25	50.0	106.71	106.71	12¥	-69.186Hu	irr -35,I	NG
T4	LEG3	SAE	4X4X0.3125	50.0	103.87	103.87	14¥	-77.417Hu	irr -14,I	NG

•At 35 degrees from Normal, Middle Legs are overloaded by 6.71%

•At 14 degrees from Normal, Bottom Legs are overloaded by 3.87%











•The previous examples were for the Texas Gulf Coast or Florida.

•Do I need to consider Oblique Wind outside of Hurricane Zones?

DESIGN CONDITIONS:



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •90 MPH Wind (40 m/sec)
- •NESC Heavy Ice District
- •2 Circuits of 795 ACSR Drake Wire (3 per Phase)
- •Span Length = 1302 feet (397 meters)

Legs are at 100% for NESC 250B

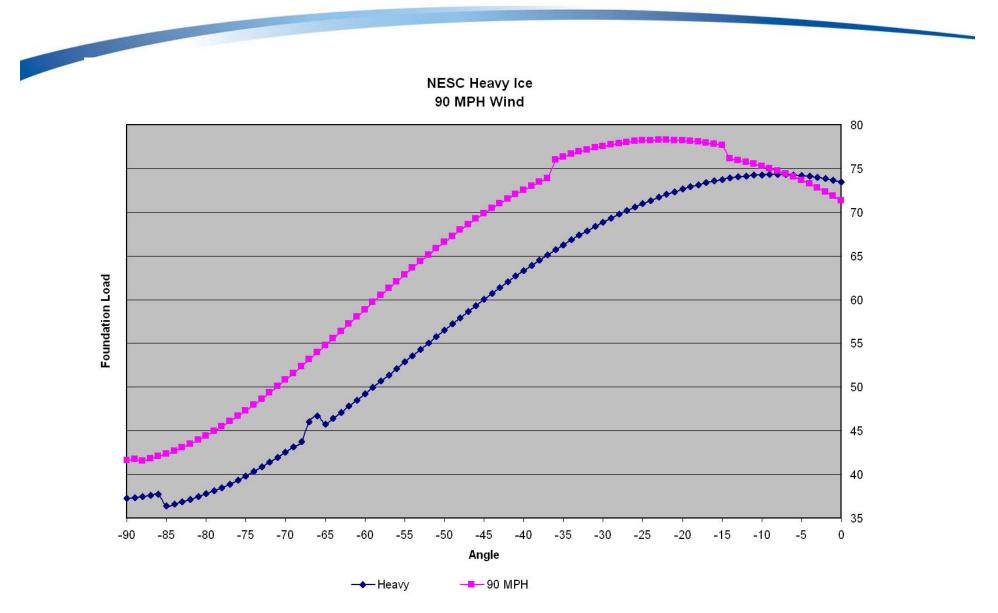


Group S	ummary	(Compre	ession Portion):						
Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength	Max Usage	Max Use In Comp.	Comp. Control Member	Comp. Force	Comp. Control Load Case
				(ksi)	\$	\$		(kips)	
TA5	LEG1	SAE	3.5X3.5X0.25	36.0	99.94	99.94	10X	-52.460N	ESC 250B
TB4	LEG2 LEG3	SAE SAE	4X4X0.25 4X4X0.3125		97.84 95.41	97.84		-64.065N	
T4	1.6.17.5	5 H P.	4X4X11.51Z5	511.11	95.41	95.41	1.5 P	= 71.59401	55U Z5UB

Leg Loads Maximum for NESC 250B Heavy Ice (1/2" Radial and 40 MPH wind)

Foundation Reaction NESC Heavy and 90 MPH Wind









- •Based on this particular 26'x10' Tower Model
- •Oblique Wind Cases Never Controlled Leg Design
- •Foundation Loads were Slightly Higher for Oblique Winds at 90 MPH

ATLANTA, GEORGIA



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •100 MPH Wind (45 m/sec)
- •NESC Medium Ice District
- •2 Circuits of 795 ACSR Drake Wire (3 per Phase)
- •Span Length = 1135 feet (346 meters)

Normal 100 mph Wind Results



Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength			Comp. Control Member	Comp. Comp. Force Control Load Case
				(ksi)	8	8		(kips)
 TA5	LEG1	SAE	3.5X3.5X0.25	36.0	95.01	95.01	9XY	-49.875Hurricane
TB4	LEG2	SAE	4X4X0.25	50.0	99.99	99.99	13P	-65.468Hurricane
Т4	LEG3	SAE	4X4X0.3125	50.0	98.12	98.12	15XY	-73.719Hurricane

Legs at 99.99% for Wind Normal to Wires

Oblique 100 mph Wind Results



Group Summary (Compression Portion):

Group	Group	Angle	Angle	Steel	Max	Max	Comp.	Comp.	Comp.	
Label	Desc.	Туре	Size	Strength	Usage	Use In Comp.		Control oad Case		
			(ksi) % %	8	8	(kips)				
TAS	LEG1	SAE	3.5X3.5X0.25	36.0	98.05	98.05	10Y	-51.468Hu	rr -13,I	
TB4	LEG2	SAE	4X4X0.25	50.0	103.54	103.54	13¥	-67.792Hu	rr -11,I	NG
T4	LEG3	SAE	4X4X0.3125	50.0	102.55	102.55	15¥	-77.044Hu	rr -11,I	NG

At 11 degrees from Normal, Legs are overloaded by 3.5%

Foundation Reaction 100 MPH Wind



90 12% Increase in Foundation 85 Reaction 80 75 Foundation Load 70 65 60 55 50 45 -55 -45 -35 -30 -25 -20 -15 -5 -90 -85 -80 -75 -70 -65 -60 -50 -40 -10 0



BUT I DO NOT USE LATTICE TOWERS I HAVE WOOD H-FRAME LINES

(Wood is always Good)

DO I HAVE A PROBLEM?

Wood Is always Good?





Concrete H-Frame Failure





Hurricane Lilly damage in Louisiana.

H-Frame Structure



Class 2 Wood Pole Pole Length = 100' (30m) Height = 88' (27m)



H-Frame Analysis



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •140 MPH Wind (63 m/sec)
- •NESC Light Ice District
- •1 Circuit of 795 ACSR Drake Wire (1 per Phase)
- •Span Length = 443 feet (135 meters)





Summary of Wood Pole Usages:

Wood Pole	Maximum			- 80	Load Case	Segment	Weight
Label	Usage %					Number	(lbs)
Pole	99.07	Hurricane	NL-,I	NA-	(140mph)	17	5843.6
RPol	99.07	Hurricane	NL+,I	NA+	(140mph)	17	5843.6

140 MPH Wind Normal to Wires

H-Fram	ne Analysis			G	CenterP Energy	Point _®
Summary of	Wood Pole Vsages:					
Wood Pole	Maximum	Load	Case	Segment	Weight	
Label	Usage %			Number	(lbs)	
Pole	271.26 Hurr -90,I BI	+ (14)	Omph)	18	5843.6	NG
RPol	271.29 Hurr -90,I BI	+ (14)	Omph)	18	5843.6	NG

271% Overstress on Pole at 90° oblique angle with no Wire on Structure

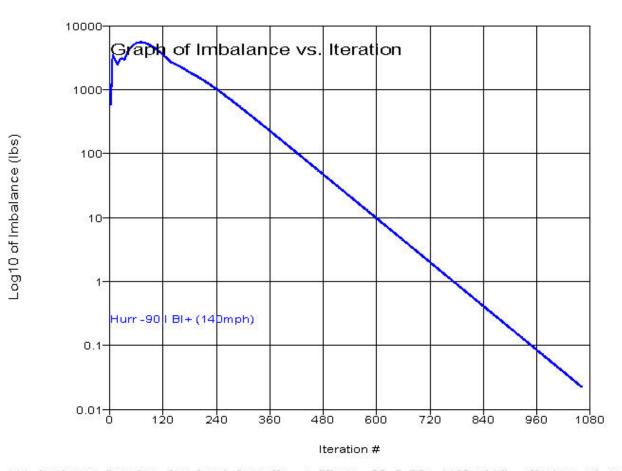
(Wind Along Line, NESC Rule 261A2e)

Too Many Iterations



*** Analysis Results:

Maximum element usage is 271.29% for Wood Pole "RPol" in load case "Hurr -90,I BI+ (140mph)" NG



*** Analysis Results for Load Case No. 1 "Hurr -90,I BI+ (140mph)" - Number of iterations in SAPS 1062

Frame Stabilization



Advanced Nonlinear Analysis Convergence Options



Alternate Convergence Process

Use the alternative convergence process if you have a highly nonlinear structure (one with swing brackets or a guyed mast) and are having convergence problems.

Use alternative convergence process

Longitudinal Frame Stabilization

Use artificial longitudinal frame stabiliziation if you have a frame or guyed pole with all guys in the transverse plane that is longitudinally unstable unless its shield wires are included in the model.

When selected the program will insert fictitious ground wires that will not contribute load to the structure, but that will provide some longitudinal stability.

Note that this approximation is only valid if the structure is placed in a line with structures that actually provide sufficient longitudinal support.

Use longitudinal frame stabilization -

Longitudinal 2-part Stabilization

Use longitudinal 2-part stabilization when you have horizontal V type 2-part insulators that "flip" across your structure. The stabilization is provided by an artificial spring. Enter the spring constant below.

Use longitudinal 2-part stabilization

(lbs/ft) 0.000

General-General Data-Conv. Options

Check this box if you have OHGW attached to the poles for the load case.

Uncheck this box when no wire is on the structure for Rule 261A load cases

OK Cancel

90 MPH H-Frame Analysis



- •No Line Angle
- •NESC 2007 Wind Load Convention
- •90 MPH Wind (45 m/sec)
- •NESC Medium Ice District
- •1 Circuit of 795 ACSR Drake Wire (3 per Phase)
- •Span Length = 770 feet (235 meters)





Summary of Wood Pole Usages:

Wood Pole Label	Maximum Usage %			L)ad Case	Segment Number	2257
Pole RPol		Hurricane Hurricane	222		31 XXXXXX		5843.6 5843.6

90 MPH Wind Load Normal to Wires

H-Frame Analysis



Summary of	Wood Pole Usages:				
Wood Pole Label	Maximum Usage %	Load Case	Segment Number	373	
Pole	150.74 Hurr -90,	I BI+ (90mph)	16	5843.6	NG
RPol	150.82 Hurr -90,	I BI+ (90mph)	16	5843.6	NG

151% Overstress on Pole at 90° oblique for 90 MPH Wind Load (45 m/s) with no wire on structure.

Oblique Wind Conclusions



•90 MPH did not show a significant increase in Foundation and Leg Loads for Towers

- •100 150 MPH Winds do show a significant increase in Foundation and Leg Loads
- •Research is Based on a Specific 26'x10' Tower
- •10° Increments in Wind Angle can effectively bracket the maximum value
- •Your Results May Vary

Oblique Wind Conclusions H-Frame



•Longitudinal Wind May Be a Big Problem for 90MPH to 150MPH Winds with no wire on structure

•Oblique Wind is a Problem in 100 – 150 MPH Zones

- •Analysis Considered New Wood Poles
- •In-Line Guys Solve the Oblique Wind Problem

PLS-CADD WIND FACTORS





Available Wind on Tower Methods

- •Code Based Methods do include any factors in the codes listed
- •WIND ON ALL does not include any factors for flat
- •WIND ON FACE does not include any factors for flat or shielding
- •ASCE 74-1991 based on Fastest Mile wind speed
- •ASCE 74-2006M and ASCE 2006F are proposed methods



ectio	15														
z x						fodel Check Report		etected.							
	Section Label	Section Color	Joint Defining Section Bottom	Dead Load Adjust. Factor	Transverse Drag x Area Factor For Face		Transverse Area Factor (CD From Code)	Longitudinal Area Factor (CD From Code)	Af Flat Factor For Face EIA Only	Ar Round Factor For Face EIA Only	Transverse Drag x Area Factor For All	Longitudinal Drag x Area Factor For All	SAPS Angle Drag x Area Factor	SAPS Round Drag x Area Factor	For So. Fa
			11P	1.310	3.200	3.200	1.000	1.000	0.000	0.000	1.600	1.600	1.600	1.000	None
1	Cage		TIP	11.010	7.43.4-33.4.17.28.9.A								The second second second		1
1 2	<mark>Cage</mark> Body3		0.03.050.	1.310	3.200	3.636	1.000	1.136	0.000	0.000	1.600	1.818	1.709	1.000	Non
1.199798			145	1979 - 1979 - 1999 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 - 1979 -	20425-00417.08464	3.636 4.114	1.000 1.000	1.136 1.286	2000 - 2000 - 200 	0.000	1.600 1.600	1.818 2.057		1.000 1.000	Nor Nor

Geometry – Sections – Define Table

Modify Drag Factors to account for missing redundants



Changing Wind Methods can be Dangerous If columns are blank, no wind on tower will be applied when that column becomes active



ectio	ns							
z					Model Check Report No errors or relevant warnings detected. Adjust Drag Factors			
	Section	Section	Joint	Dead	Transverse	Longitudinal	Transverse	Longitudina
ſ	Label	Color	Defining Section Bottom	Load Adjust. Factor	Drag x Area Factor For Face	Drag x Area Factor For Face	Area Factor (CD From Code)	Area Factor (CD From Code)
1		Color	Section	Adjust.	Factor	Factor	(CD From	(CD From
1	Label	Color	Section Bottom	Adjust. Factor	Factor For Face	Factor For Face	(CD From Code)	(CD From Code)
36920	Label Cage	Color	Section Bottom 11P	Adjust. Factor 1.310	Factor For Face 3.200	Factor For Face 3.200	(CD From Code) 1.000	(CD From Code) 1.000

CD From Code is used for NESC 2002, NESC 2007 and ASCE 74-2006F



	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	Cage		11P	1.310	3.200	3.200
2	Body3		145	1.310	3.200	3.636
3	Body2		175	1.310	3.200	4.114
4	Body1		22P	1.310	3.200	4.960

Factor For Face is used by the "WIND ON FACE" method and does not include any height adjustments



Transverse	Longitudinal
Drag x Area	Drag x Area
Factor	Factor
For All	For All
1.600	1.600
1.600	1.818
1.600	2.057
1.600	2.480

Factor For All is used for "WIND ON ALL" method and does not include height adjustments



SAPS Angle
Drag x Area
Factor
-
1.600
1.709
1.829
2.040

SAPS Angle Factor is used for the SAPS method and the ASCE 74-2006M method for non-round members

The shape factor for angles is NOT included and must be added

Method is based in Fluid Mechanics and does not account for any shielding

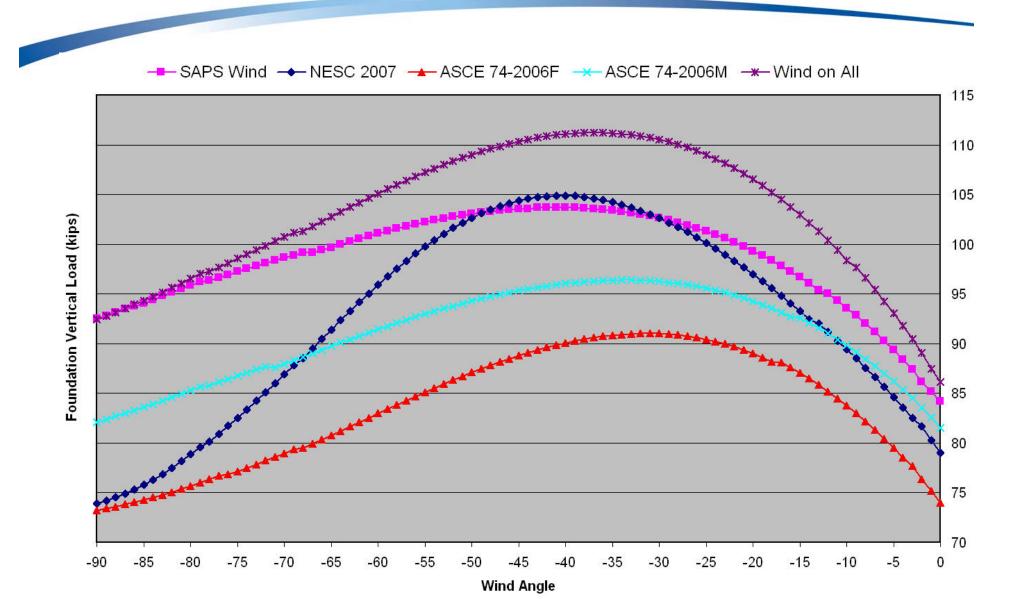


SAPS Round Drag x Area Factor 1.000 1.000 1.000 1.000 SAPS Round Factor is used for the SAPS method and the ASCE 74-2006M method for round members

Method is based in Fluid Mechanics and does not account for any shielding

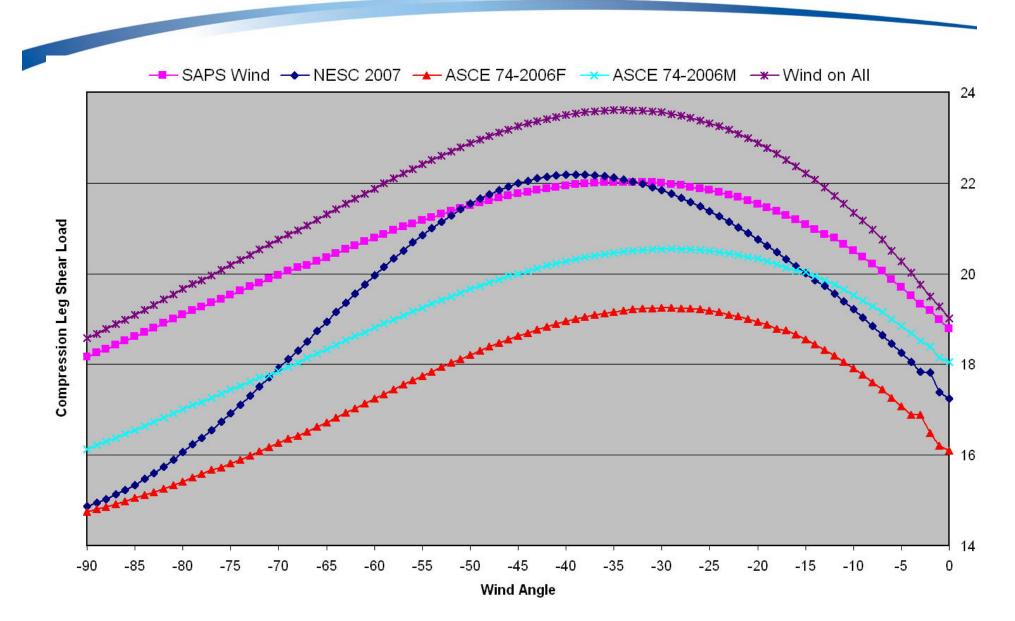
WIND METHOD COMPARISON Foundation Loads





WIND METHOD COMPARISON Shear Load





Wind Method Graphs



		Loading Method Parameters
ector Load Cases - [From PLS-CADD] Image: Wind loads on insulators and insulator weights in Edit Loading Method Parameters Image: Book of the example of the examp	cluded in Point Loads ands for Strength Factor, NOT Safety Factor Dead Wind SF for Load Area Steel Poles Factor Factor Tubular Arms and Towers	Note that when changing the terrain category, you may also need to change the wind pressure and must recalculate al point loads. The ground elevation shift is used when the structure is not resting on the ground, but on top of something like a concrete pier. It is added to the height used for calculating wind height adjustment. Ground elevation shift (ft) 0.000 ASCE 74 Terrain Category C I 1991: Input wind pressure is one minute average (close to fastest mile). 2006: Input wind pressure is three second gust for category B. CENELEC (EN50341) Terrain Category 2 Input wind pressure is two second gust for terrain category 2.
		Terrain Category B Input wind pressure is ten minute average (based on VRB*Kr). SAPS 0.142857 Wind Power 0.142857 Reference Height (ft) 32.808 TPNZ Input wind pressure is three second gust (based on VRB*Kr). ESAA C(b)1 2003 Input wind pressure is three second gust (based on VRB*Kr). ESAA C(b)1 2003 Input wind pressure is three second gust (based on VRB*Kr). Create Graphs Estate Content of the second gust (based on VRB*Kr).

Wind On Tower Methods



Wind Method Comparison

METHOD	Gust Response	Wind Pressure on Tower	Drag Coeff
SAPS Wind	NOT APPLICABLE	User Defined	User Defined Constant
NESC 2007	Variable with Height	Constant at 2/3 Height	3.2 x User Defined
ASCE 74-2006F	Variable with Height	Variable with Section Height	Variable with Solidity
ASCE 74-2006M	Variable with Height	Variable with Member Height	User Defined Constant
Wind on All	NOT APPLICABLE	Constant	User Defined Constant

PLS-CADD Criteria File



Weather Cases

See Criteria/Code Specific Wind and Terrain Parameters for more information on height adjustments and gust response factors

	Description	Air	Wind	Wind	Wire	Wire
		Density	Velocity	Pressure	Ice	Ice
		Factor	(mph)	(psf)	Thickness	Density
		(Q)			(in)	lbs/ft^3)
-		(psf/mph^2)	2	2		-
11	Hurricane	0.00256	140	50.176	0	O
12	NESC LIGHT	0.00256	59.2927	9	0	0
13	NESC Medium	0.00256	39.5285	4	0.25	57
14	NESC Heavy	0.00256	39.5285	4	0.5	57
15	Rule 250 D	0.00256	30	2.304	0.5	57

PLS-CADD Criteria File



	Description	Weather case	Cable	Wind	Bisector
			condition	Direction	Wind Dir
					(deg)
-					
26	Hurr -90	Hurricane	Initial RS	BI+	-90.0
27	Hurr -80	Hurricane	Initial RS	BI+	-80.0
28	Hurr -70	Hurricane	Initial RS	BI+	-70.0
29	Hurr -60	Hurricane	Initial RS	BI+	-60.0
30	Hurr -50	Hurricane	Initial RS	BI+	-50.0
31	Hurr -45	Hurricane	Initial RS	BI+	-45.0
32	Hurr -40	Hurricane	Initial RS	BI+	-40.0
33	Hurr -30	Hurricane	Initial RS	BI+	-30.0
34	Hurr -20	Hurricane	Initial RS	BI+	-20.0
35	Hurr -10	Hurricane	Initial RS	BI+	-10.0
36	Hurr 10	Hurricane	Initial RS	BI+	10.0
37	Hurr 20	Hurricane	Initial RS	BI+	20.0
38	Hurr 30	Hurricane	Initial RS	BI+	30.0
39	Hurr 40	Hurricane	Initial RS	BI+	40.0
40	Hurr 45	Hurricane	Initial RS	BI+	45.0
41	Hurr 50	Hurricane	Initial RS	BI+	50.0
42	Hurr 60	Hurricane	Initial RS	BI+	60.0
43	Hurr 70	Hurricane	Initial RS	BI+	70.0
44	Hurr 80	Hurricane	Initial RS	BI+	80.0
45	Hurr 90	Hurricane	Initial RS	BI+	90.0

Structure Loading Criteria.

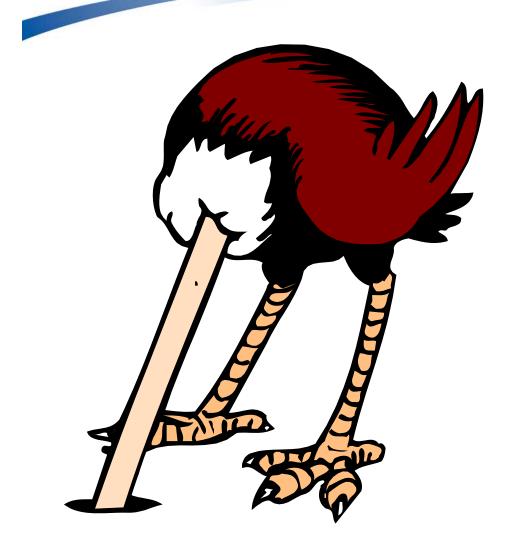
39 wind cases added to this table will provide oblique wind on structures.





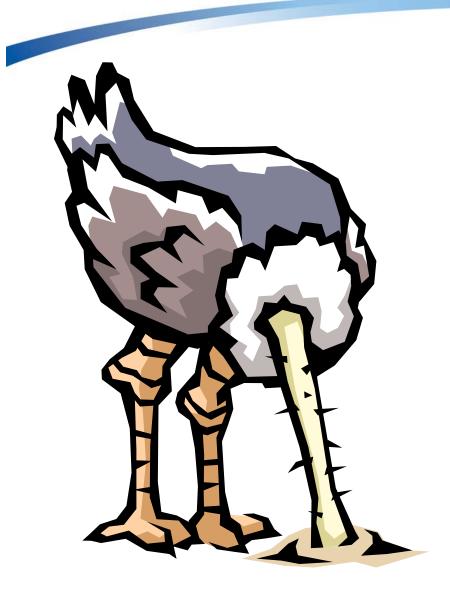
"I Don't Have a Problem. All my structures are fine when the wind blows in the direction I want it to."





"I Don't Have a Problem. My wood H-Frame line is in Missouri in the 90 mph zone."





"I don't have time to evaluate all the wind cases. The cost savings now will pay for the restoration later."





"We have had structures in the field for 50 years and have not seen any failures yet. Besides, the wind does not blow on the bottom 60 feet."



QUESTIONS?

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