Distribution Engineering Reference Manual (DERM)

Section 4 – Overhead Line Design

ADDENDUM FOR EXTREME WIND LOADING

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Storm Secure

Distribution Overhead Line Design for Extreme Wind Loading

ADDENDUM TO
DISTRIBUTION ENGINEERING REFERENCE MANUAL (DERM)

Introduction

In 2006, FPL introduced the concept of "STORM SECURE". One part of this concept is to harden the electrical system by adopting new standards based on extreme wind velocity criteria. The Florida Public Service Commission and the Florida Administrative Code have adopted the 2007 NESC for the applicable standard of construction.

FPL designs its distribution facilities based on the loading as specified in the 2007 National Electrical Safety Code (NESC) using Grade B Construction. The NESC specifies three weather conditions to consider for calculating loads:

Rule 250 B. Combined ice and wind loading (FPL standard construction prior to 2007)
Rule 250 C. Extreme wind loading (FPL current standard construction)
Rule 250 D. Extreme ice with concurrent wind loading (this is a new loading condition in the 2007 NESC that will not impact FPL).

Prior to the hardening effort, FPL has been designing overhead distribution using the loads calculated under Rule 250 B. This addendum provides the designers the information needed to design projects using Rule 250 C, grade B (extreme wind loading) to calculate the loads, when it is determined that the particular pole line is to be designed to meet extreme wind loading (EWL) requirements. The NESC extreme wind map identifies 7 Basic Wind Speeds throughout Florida. In order to minimize the design effort to accommodate these 7 wind speeds, FPL has created 3 wind regions with designated wind speeds of 105 mph, 130 mph, and 145 mph. The Map shown in Figure 4.2.2-1 identifies the counties within our service territory that fall into the 3 wind regions. Whenever extreme wind designs are deployed, they will be designed to the identified wind speed for the location of the work to be done.

4.2.2 Poles Structures and Guying

A. Poles, General Information

1. *Pole Brands*

The pole brand includes the pole length & class, the type of treatment, the manufacturer, the date the pole was manufactured and FPL.
Wood Poles –This brand is located at 15' from the bottom of the pole.
Square (cast) Concrete poles – the brand up until 2007 was located 15' from the bottom. New specifications now require the brand to be at 20' from the bottom of the pole.
Distribution Spun Concrete poles – The brand information is on a metal tag that is located 20' from the bottom of the pole.

2. *Design Specifications*

The NESC specifies 3 Grades of construction: Grade B, Grade C, and Grade N with Grade B being the strongest of the three. These grades of construction are the basis for the required strengths for safety. FPL uses Grade B Construction for all distribution facilities. This means that the calculated loads must be multiplied by "Load Factors" and the calculated or specified strength of structures must be multiplied by "Strength Factors". The Strength multiplied by the Strength Factor (SF) must be equal to, or greater than the Load multiplied by the Load Factor (LF).

Equation 4.2.2-1

Strength x Strength Factor ≥ Load x Load Factor

Table 4.2.2 – 1 below lists the Load Factors and Strength Factors for Grade B Construction from NESC Table 253-1 and Table 261-1A.

Table 4.2.2 - 1 Extreme Wind Strength Factors & Load Factors

Strength of	Strength Factor
Wood Poles	0.75
Concrete Poles	1.00
Composite Poles	1.00
Support Hardware	1.00
Guy Wire	0.90
Guy Anchor and Foundation	1.00
	Load Factor
Extreme Wind Loads	1.00

FPL uses the NESC Extreme Wind Loading for its design criteria. As such, identify the wind speed for the job location and determine the load based on the following formula.

Equation 4.2.2-2

$$\text{Load in pounds} = 0.00256 \times (V_{mph})^2 \times k_z \times G_{RF} \times I \times C_f \times A(ft^2)$$

Where,

0.00256 - Velocity-Pressure Numerical Coefficient
V -Velocity of wind in miles per hour (3 second gust)
k_z -Velocity Pressure Exposure Coefficient
G_{RF} -Gust Response Factor
I -Importance Factor, 1.0 for utility structures and their supported facilities.
C_f - Force Coefficient (Shape Factor)
For Wood & Spun Concrete Poles = 1.0
For Square Concrete Poles = 1.6
A - Projected Wind Area, ft^2.

The NESC provides formulas for calculating k_z and G_{RF}. However, Tables are also provided and Table 4.2.2-2 below shows the values needed for most distribution structures.

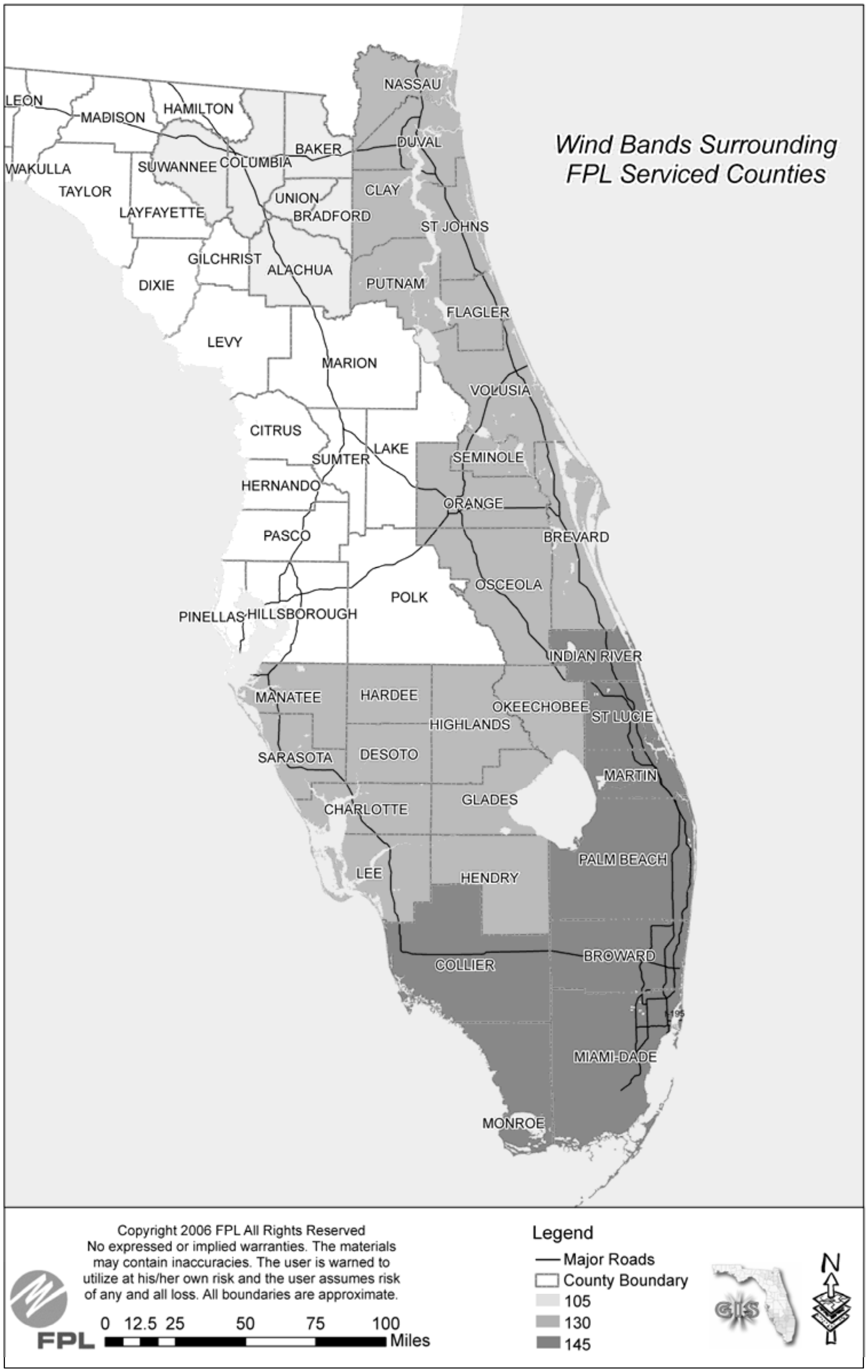
Table 4.2.2-2 Velocity pressure Exposure coefficient (k_z) and Gust Response Factors (G_{RF})

	Structure		Equipment		Wire		
Height (h)	k_z [1]	G_{RF} [4]	k_z [2]	G_{RF} [5]	k_z [3]	G_{RF} [4] (L ≤ 250 ft)	G_{RF} [4] (250 < L ≤ 500 ft)
≤ 33	0.9	1.02	1.0	1.02	1.0	0.93	0.86
>33 to 50	1	0.97	1.1	0.97	1.1	0.88	0.82
>50 to 80	1.1	0.93	1.2	0.93	1.2	0.86	0.80

1. h for the pole k_z is to be the height of the pole above ground
2. h for the equipment k_z is the height of the center of the area of the equipment above ground
3. h for the wire k_z is the height of the wire above ground
4. h for the G_{RF} is the height above ground for the structure and the wire
5. h for the G_{RF} for the equipment is based on the height of the structure above ground
6. L = design wind span (average of span on both sides of structure)

The wind speeds to be used are shown in Figure 4.2.2 – 1

Figure 4.2.2 –1 Wind Regions by County



3. Wood Pole Strength

The strength of wood poles is specified in the American National Standard – ANSI O5.1-2002. In addition to strength of wood poles, this standard specifies dimensions, shape, sweep spiral grain, knots, and many other characteristics of wood poles.

A change from previous calculations shown in the DERM for allowable pole strength is that the circumference to be used is now considered to be the ground line circumference rather than the "fixity" point circumference. Another change is the strength factor to be used. For extreme wind the strength factor for wood poles is 0.75 (see Table 4.2.2-1)

Example 4.2.2-1:
Determine the pole strength for wind loading on a 45'/2 wood pole that is set 7 feet.

Equation 4.2.2-3 $M_r = 0.000264fC^3$

Where

M_r = Moment (ultimate or long term bowing) measured in foot-pounds
f = Fiber Stress (8000 or 1000 psi for Southern Yellow Pine)
C = Circumference at ground Line

From Table G (DERM 4.2.2) circumference at Ground line = 40.1 inches

M_r = 0.000264 x (8,000) x $(40.1)^3$ = 136,184 ft.-lbs.

This is the strength for the 45'/2 wood pole. However for design, apply the NESC Strength Factor of 0.75.

The strength of the 45'/2 wood pole = 136,184 x 0.75 = 102,138 ft.-lbs.

4. Concrete Pole Strength

The strength of concrete poles is based on the application of a designated load at a specified location on the pole. This load is measured in KIPS = 1,000 pounds per KIP. A 5 KIP pole is rated based on applying 5,000 pounds of load at two feet below the top of the pole. Most distribution poles are rated by applying the load at two feet down from the top. However, for the type “O”, “S”, and “SU” poles, this load is applied at one foot down from the top. Like wood poles, concrete poles have a continuous rating (loads that are always on the pole) and a temporary rating (wind loads that come and go). Spun concrete poles (unlike other FPL distribution concrete poles) are designated by their KIP rating rather than a type (i.e., O, S, SU, III, III-G, III- H). Table 4.2.2-3 List the ratings (in KIPS) for the various concrete poles.

Table 4.2.2-3 Concrete Pole Ratings

Pole Type	Temporary Ratiing	Continuous Rating
O	0.85	0.26
S & SU	0.90	0.30
III	1.30	0.56
III-A	1.30	0.60
III-G	2.40	0.90
III-H 6 KIP	4.20	1.20
III-H 8 KIP	6.00	2.40
12 KIP Square	8.40	4.20
Spun Concrete		
4.0 KIP	NO LONGER USED	
4.7 KIP	4.70	1.73
5.0 KIP	5.00	2.00

To calculate the strength of the pole use the following:

For O, S, SU,

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 1 foot)

Example: 35’ Type SU for extreme wind loading

M_r = 0.9 KIPS x (35 – 7.5 - 1) = 23,850 ft-lbs

For III, III-A, III-G, III-H

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 2 feet)

Example: 50’ Type III-H (6 KIP) for extreme wind loading

M_r = 4.2 KIPS x (50 – 11.5 – 2)) = 153,300 ft-lbs

For Spun Concrete

M_r = Rating (Table 4.2.2-3) x (Pole Length – setting depth - 2 feet)

Example: 50'/ 4.7 KIP for extreme wind loading

M_r = 4.7 KIPS x (50 – 11 - 2) = 173,900 ft-lbs

For pre-stressed concrete poles, the NESC extreme wind strength factor = 1.0. The values calculated above will be the correct strength for concrete poles.

B. Wind Loading

1. *Wind Loading on poles.*

To calculate the wind load on the pole (see DERM 4.2.2 C3.a):

a. Calculate the area of the pole exposed to the wind

Equation 4.2.2-4 $$A = H_1\left(\frac{a+b}{2}\right)\left(\frac{1}{12}''\right)$$

A = projected area above ground line in square feet.
H_1 = the pole's height above the ground line in feet.

For wood and spun concrete poles,
a = diameter at top of pole in inches.
b = diameter of pole at ground line in inches.

For square concrete poles, dimensions a and b are the widths of one face at top and ground line respectively.

b. Calculate the center of the area.

Equation 4.2.2-5 $$H_{CA} = \frac{H_1(b+2a)}{3(b+a)}$$

H_{CA} is used to calculate the ground line moment due to the wind force.

c. Calculate the wind force acting on the area (see Equation 4.2.2-2 with explanation of terms)

Load in pounds = $0.00256 \cdot (V_{mph})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_f \cdot A(ft^2)$

<u>Example Calculation for Wood Pole</u>

Pole Length/Class = 45'/2
Setting depth = 7' (from DCS D-3.0)
Wind Region = 145 mph

$$Projected\ Area.\ A = H_1(ft.)\, x\, \frac{1\ ft}{12\, in}\, x \left[\frac{a+b(inches)}{2}\right]$$

From Table G, Page 71, *the circumference at the top of a* 45'/2 *pole is* 25",

$$a = \frac{25"}{\pi} = 7.96"$$

The circumference at 38 *ft. below the pole top* 40.1", $b = \frac{40.1"}{\pi} = 12.76"$

$$A = \frac{38}{12}\, x \left[\frac{7.96+12.76}{2}\right] = 32.81\, sq.\ ft.$$

$$Height\ of\ center\ of\ area,\ H_{CA} = \frac{H_1(b+2a)}{3(b+a)} = \frac{38(12.76+15.92)}{3(12.76+7.96)}$$

$$H_{CA} = Moment\ Arm = 17.53\ \ ft.$$

Wind Load on Pole =

0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.0 x 32.81 = **1713 lbs**

Where:

k_z is based on h = 38'; k_z = 1.0

G_{RF} is based on h = 38'; G_{RF} = 0.97

C_f = 1.0 for wood and spun concrete poles

C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

Equation 4.2.2-6

M_P = Wind Load x Load Factor x Moment Arm.

M_P = 1713 lbs x 1 x 17.53 ft. = 30,030 ft. lbs.

The strength of this pole, previously calculated is 102,138 ft.-lbs. The pole itself has used up 29% (30,030/102,138) of its capacity for 145 mph extreme wind. Subtracting the wind load from the strength leaves 72,108 ft-lbs (102,138 – 30,030) for conductors and other attachments.

Example Calculation for Square Concrete Pole

Pole Length/Class = 50'/III-H
Setting depth = 11.5' (from DCS D-3.0)
Wind Region = 145 mph

$$Projected\ Area.\ A = H_1(ft.)\ x \frac{1\ ft}{12\ in}\ x \left[\frac{a+b(inches)}{2}\right]$$

From Table H, the width of the pole at the top a = 9.00"
The width at ground line, b = 15.24"

$$A = \frac{38.5}{12}\ x \left[\frac{15.24+9.00}{2}\right] = 38.89\ sq.\ ft.$$

$$Height\ of\ center\ of\ area, H_{CA} = \frac{H_1(b+2a)}{3(b+a)} = \frac{38.5(15.24+18.00)}{3(15.24+9.00)}$$

$$H_{CA} = Moment\ Arm = 17.6\ \ ft.$$

Wind Load on Pole =
0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.6 x 38.89 = **3248 lbs**
Where:
k_z is based on h = 38.5'; k_z = 1.0
G_{RF} is based on h = 38.5'; G_{RF} = 0.97
C_f = 1.0 for wood and spun concrete poles
C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

M_P = Wind Load x Load Factor x Moment Arm.
M_P = 3248 lbs x 1 x 17.6 ft. = 57,163 ft. lbs.

The strength of this pole, previously calculated is 153,300 ft.-lbs. The pole itself has used up 37% (57,163/153,300) of its capacity for 145 mph extreme wind. Subtracting the wind load from the strength leaves 96,137 ft-lbs (153,300 – 57,163) for conductors and other attachments.

Example Calculation for Spun Concrete Pole

Pole Length/Class = 50'/4.7 KIP
Setting depth = 11' (from DCS D-3.0)
Wind Region = 145 mph

$$Projected\ Area.\ A = H_1(ft.)\, x\, \frac{1\ ft}{12\, inc.}\, x \left[\frac{a + b(inches)}{2}\right]$$

From Table H, the diameter of the pole at the top a = 9.55"
The diameter at ground line, b = 16.57"

$$So\ A = \frac{39}{12}\, x \left[\frac{9.55 + 16.57}{2}\right] = 42.45\, sq.\ ft.$$

$$Height\ of\ center\ of\ area, H_{CA} = \frac{H_1(b + 2a)}{3(b + a)} = \frac{39(16.57 + 19.1)}{3(16.57 + 9.55)}$$

$$H_{CA} = Moment\ Arm = 17.75\ \ ft.$$

Wind Load on Pole =
0.00256 x $(145)^2$ x 1.0 x 0.97 x 1.0 x 1.0 x 42.45 = **2,216 lbs**
Where:
k_z is based on h = 39'; k_z = 1.0
G_{RF} is based on h = 39'; G_{RF} = 0.97
C_f = 1.0 for wood and spun concrete poles
C_f = 1.6 for square concrete poles

This load must then be multiplied by the Load Factor, which for extreme wind equals 1.0 and the moment arm to obtain the Ground Line Moment (M_P) of the wind acting on the pole only.

M_P = Wind Load x Load Factor x Moment Arm.
M_P = 2,216 lbs x 1 x 17.75 ft. = 39,341 ft. lbs.

The strength of this pole, previously calculated is 173,900 ft.-lbs. The pole itself has used up 23% (39,341/173,900) of its capacity for 145 mph extreme wind. Subtract the wind load from the strength leaves 134,559 ft-lbs (173,900 – 39341) for conductors and other attachments.

Table 4.2.2-4 Lists the allowable groundline moments for various pole sizes.

Table 4.2.2-4 Allowable Ground Line Moments

Wood Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
35/5	6	32178	28738	26324
35/4	6	42429	38656	36007
40/5	6.5	36936	31956	28460
40/4	6.5	48263	42812	38986
40/3	6.5	61567	55646	51489
40/2	6.5	76998	70607	66119
45/3	7	66363	58624	53190
45/2	7	86391	78000	72108
50/2	7	93535	82611	74941
55/2	7.5	99693	86174	76682
60/1	8	131634	113020	99951

Table 4.2.2-4 Allowable Ground Line Moments (cont.)

Square Concrete Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
35/Type O	7	15426	11417	8602
35/SU	7.5	15323	10778	7588
35/III-G	9	48907	44275	41022
40/III-A	10	23777	17050	12327
40/III-G	9	56781	49950	45154
40/III-H (6 KIP)	11.5	96450	88537	82981
40/III-H (8 KIP)	11.5	144214	136334	130802
40/12 KIP	13	191480	181610	174681
45/III-A	10	24142	14146	7127
45/III-G	9	62676	52592	45511
45/III-H (6 KIP)	11.5	110053	98198	89874
45/III-H (8 KIP)	11.5	166860	155062	146779
45/12 KIP	13.5	222175	208520	198933
50/III-A	10	24111	10635	1173
50/III-G	9.5	67701	54539	45297
50/III-H (6 KIP)	11.5	123164	107106	95831
50/III-H (8 KIP)	11.5	189028	173056	161842
50/12 KIP	13.5	252789	233067	219219
55/III-G	9.5	72176	55004	42947
55/III-H (6 KIP)	12	133764	113283	98902
55/III-H (8 KIP)	12	207792	187431	173135
55/12 KIP	14	280155	254873	237121
60/III-H (6 KIP)	12	144138	117993	99637
60/III-H (8 KIP)	12	227254	201278	183040
60/12 KIP	14	308835	276454	253719
65/III-H (6 KIP)	12	149613	115197	91032
65/III-H (8 KIP)	12	241862	207685	183688

Spun Concrete Poles (in earth)				
Pole Size	Setting Depth	Allowable Moment for Attachments at Designated Wind Speeds		
		105 mph	**130 mph**	**145 mph**
50/4.7 KIP	11	153270	142277	134559
55'/4.7 KIP	12	167116	153482	143910
60'/5.0 KIP	12.5	190953	171477	157803
65'/5.0 KIP	13	202928	177845	160233
70'/5.0 KIP	13.5	214369	183392	161642

2. ***Wind Loading on conductors.***

The wind loading on conductors is calculated in a similar method to the wind loading on the pole. The load in pounds per conductor uses Equation 4.2.2-2 with the appropriate factors for the attachment heights a shown in Table 4.2.2-2.

To calculate the wind load on the conductor:

a. Determine the wind region (105 mph, 130 mph, or 145 mph)
b. Calculate the attachment height to determine the k_z *and* G_{RF} (Table 4.2.2-2)
c. The Importance Factor (I) and the Force Coefficient (C_f) are both equal to 1 for conductors.
d. Calculate the area per foot of conductor
e. Calculate the wind load per foot of conductor
f. Calculate the total wind load on the conductor for the length of conductor exposed to the wind (Average of the Spans on either side of the pole).

Example:
Determine the wind load on a 170 foot length [(180'span + 160'span)/2] of 568.3 ACAR conductor that is attached at 30 feet above the ground in the 145 mph wind region.
From Table 4.2.2-2:

$K_z = 1.0$
$G_{RF} = 0.93$

Calculate the area per foot of conductor
Diameter = 0.879 inches (ref DCS F-7.0.0)

For a 1 foot length of conductor:
Projected Area.

$$A = 1(ft.)x\left[\frac{Conductor\ Diameter(inches)}{12(inches/\ ft)}\right]$$

$$A = 1(ft.)x\left[\frac{0.879(inches)}{12(inches/\ ft)}\right]$$

A = 0.073 Square Ft. for each foot of span length

The wind load in pounds per foot of span length (from Equation 4.2.2-2) is

Load in pounds $= 0.00256\ x\ (Vmph)^2\ x\ k_z\ x\ G_{RF}\ x\ I\ x\ C_f\ x\ A(ft^2)$

Load in pounds = 0.00256 x $(145)^2$ x 1 x .93 x 1 x 1 x .073
Load = 3.667 pounds per foot

Total Load	=	Length of conductor x Load per foot of conductor
	=	170 x 3.667
Total Load	=	623.3 pounds

This is the load that the wind exerts on the conductor attached at 30 above ground. This load will have to be applied to the pole to determine if the pole has the strength to support the load.

The wind load per foot of conductor for the three wind regions can be found in Table 4.2.2-5, Table 4.2.2- 6 and Table 4.2.2-7.

3. *Wind Loading on equipment.*

The wind loading on equipment is calculated in a similar method to the wind loading on the pole and the conductors. The load in pounds uses Equation 4.2.2-2 with the appropriate factors for the attachment heights a shown in Table 4.2.2-2 and the area of the equipment.

To calculate the wind load on the equipment:

a. Determine the wind region (105 mph, 130 mph, or 145 mph)
b. Calculate the attachment height to determine the k_z (Table 4.2.2-2) (For equipment, use the top mounting hole of the equipment bracket.)
c. Use the height of the pole above ground to determine G_{RF} (Table 4.2.2-2)
d. The Importance Factor (I) is equal to 1.
e. The Force Coefficient (C_f) is equal to 1.0 for cylindrical equipment and 1.6 for rectangular equipment.
f. Calculate the area of the equipment
g. Calculate the wind load on the equipment

Example:
Determine the wind load on a 50 kVA transformer mounted at 28 feet on a pole that is 38 feet above the ground in the 145 mph wind region.

From Table 4.2.2-2:

K_z = 1.0 (Equipment ≤ 33' above ground)
G_{RF} = 0.97 (Equipment based on Pole height > 33' to 50' above ground)
C_f = 1.0
A = 4.44 square feet

The wind load in pounds from Equation 4.2.2-2 is

$$\textit{Load in pounds} = 0.00256 \times (V_{mph})^2 \times k_z \times G_{RF} \times I \times C_f \times A(ft^2)$$

Load in pounds = 0.00256 x $(145)^2$ x 1 x .97 x 1 x 1 x 4.44
Load = 231.8 pounds

This is the load that the wind exerts on the transformer attached at 28 feet above ground. This load will have to be applied to the pole to determine if the pole has the strength to support the load.
The wind load on equipment for the three wind regions can be found in Table 4.2.2-5 (105 mph), Table 4.2.2- 6 (130 mph) and Table 4.2.2-7 (145 mph).

Table 4.2.2-5 Wind Force on Conductors & Equipment

Wind Speed = 105 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	1.923	2.001	2.134
3/0 AAAC	0.502	1.098	1.143	1.218
1/0 AAAC	0.398	0.871	0.906	0.966
#4 AAAC	0.250	0.547	0.569	0.607
3/0 TPX	1.238	2.708	2.819	3.005
1/0 TPX	1.026	2.244	2.336	2.490
6 DPX	0.496	1.085	1.129	1.204
CATV				
Feeder w/1/4"Msgnr	0.750	1.641	1.708	1.820
Trunk w/1/4"Msgnr	1.000	2.187	2.277	2.427
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	2.100	2.186	2.330
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	5.020	5.225	5.571

Wind Speed = 105 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.75	108.0	112.9	118.1	102.7
50	4.44	127.8	133.7	139.9	121.6
75	4.81	138.5	144.9	151.5	131.7
100	6.55	188.6	197.3	206.3	179.3
167	10.83	311.8	326.1	341.1	296.5
Capacitors					
Switched (1)	19.91	573.2	599.6	627.1	545.1
Fixed (1)	16.89	486.2	508.6	532.0	462.4
Reclosers					
1 phase	4.00	115.2	120.5	126.0	109.5
3 phase (1)	16.89	486.2	508.6	532.0	462.4
Automation Switches					
Joslyn	8.89	255.9	267.7	280.0	243.4
Cooper	10.56	304.0	318.0	332.6	289.1
S&C	15.60	449.1	469.8	491.4	427.1
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.19	5.4	5.6	5.9	5.1
5" U-Guard	0.46	12.8	13.8	14.4	13.2

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

Table 4.2.2-6 Wind Force on Conductors & Equipment

Wind Speed = 130 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	2.947	3.068	3.270
3/0 AAAC	0.502	1.683	1.752	1.868
1/0 AAAC	0.398	1.334	1.389	1.481
#4 AAAC	0.250	0.838	0.872	0.930
3/0 TPX	1.238	4.151	4.321	4.606
1/0 TPX	1.026	3.440	3.581	3.817
6 DPX	0.496	1.663	1.731	1.845
CATV				
Feeder w/1/4"Msgnr	0.750	2.515	2.617	2.791
Trunk w/1/4"Msgnr	1.000	3.353	3.490	3.721
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	3.219	3.350	3.572
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	7.695	8.009	8.539

Wind Speed = 130 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.75	165.5	173.1	181.1	157.4
50	4.44	195.9	205.0	214.4	186.3
75	4.81	212.3	222.0	232.2	201.9
100	6.55	289.0	302.4	316.3	274.9
167	10.83	477.9	499.9	522.9	454.5
Capacitors					
Switched (1)	19.91	878.6	919.1	961.3	835.5
Fixed (1)	16.89	745.3	779.7	815.5	708.8
Reclosers					
1 phase	4.00	176.5	184.7	193.1	167.9
3 phase (1)	16.89	745.3	779.7	815.5	708.8
Automation Switches					
Joslyn	8.89	392.3	410.4	429.2	373.1
Cooper	10.56	466.0	487.5	509.9	443.2
S&C	15.60	688.4	720.1	753.2	654.7
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.19	8.3	8.7	9.1	7.9
5" U-Guard	0.46	20.2	21.2	22.1	19.2

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

ADDENDUM FOR EXTREME WIND LOADING

Table 4.2.2-7 Wind Force on Conductors & Equipment

Wind Speed = 145 mph
CONDUCTORS

		Force in pounds per foot Conductor Height Above Ground		
Conductor	Diameter	≤33'	>33' to 50'	>50' to 80'
568.3 MCM ACAR	0.879	3.667	3.816	4.069
3/0 AAAC	0.502	2.094	2.180	2.324
1/0 AAAC	0.398	1.660	1.728	1.842
#4 AAAC	0.250	1.043	1.085	1.157
3/0 TPX	1.238	5.164	5.375	5.731
1/0 TPX	1.026	4.280	4.455	4.749
6 DPX	0.496	2.069	2.154	2.296
CATV				
Feeder w/1/4"Msgnr	0.750	3.129	3.256	3.472
Trunk w/1/4"Msgnr	1.000	4.171	4.342	4.629
Telephone				
100 pr (24 GA BKMS) Self-Support	0.960	4.005	4.168	4.444
600 pr (24 GA BKMA w/3/8" Msgnr	2.295	9.573	9.964	10.623

Wind Speed = 145 mph
EQUIPMENT

		Pole Height in same range as Equipment Force in pounds at top mounting Bolt Height Above Ground			Pole height >33' to 50' Equipment Ht
Transformers	Sq. Ft.	≤33'	>33' to 50'	>50' to 80'	≤33'
25	3.750	205.9	215.4	225.3	195.8
50	4.440	243.8	255.0	266.7	231.8
75	4.810	264.1	276.2	288.9	251.1
100	6.550	359.6	376.2	393.4	342.0
167	10.830	594.6	622.0	650.5	565.4
Capacitors					
Switched (1)	19.910	1093.1	1143.4	1195.9	1039.5
Fixed (1)	16.890	927.3	970.0	1014.5	881.8
Reclosers					
1 phase	4.000	219.6	229.7	240.3	208.8
3 phase (1)	16.890	927.3	970.0	1014.5	881.8
Automation Switches					
Joslyn	8.890	488.1	510.6	534.0	464.1
Cooper	10.560	579.7	606.5	634.3	551.3
S&C	15.600	856.4	895.9	937.1	814.5
Riser - PVC U-Guard		Force in pounds per foot of riser Height Above Ground			
2" U-Guard	0.188	10.3	10.8	11.3	9.8
5" U-Guard	0.458	25.2	26.3	27.5	23.9

(1) The 1.6 C_f factor for rectangular shape is included in the Area shown for Capacitors and 3 Phase Recloser

The methodology to determine if a pole has the strength for a specific design or to determine the maximum span distance a specific size pole can support for framing, is the same as shown in the DERM 4.2.2 pages 12-15. The examples shown below show the calculations based on using the new tables for extreme wind loading. Note that the ground line is now the point used for the calculations rather than the "fixity" point.

Example:

Conductor:	3-568.3 MCM ACAR and #3/0 AAAC - Neutral
Framing: phase	DCS page E-5.0.0 (Modified Vertical) and I-41.0.1 (for single transformer)
Transformer:	50 kVA
CATV:	Trunk
Telephone:	1-600 pair, 24 gauge, BKMA

Average Span Length = 150 feet

Attachment heights must be calculated using the framing identified and the pole setting depths as shown in the Revised DCS page D-3.0.0

Case I: Determine if a 45'/2 wood pole is strong enough for this design.

Calculate the moments on the pole.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	39	=	22324
568	1	x	3.816	x	150	x	36.6	=	20950
568	1	x	3.816	x	150	x	33.9	=	19404
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	28.8	=	9046
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	122653
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
45'/2 Wood Pole			**TOTAL ALL MOMENTS**					=	**129,583 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 45'/2 wood pole in a 145 mph wind region is 72,108 ft-lbs. A 45'/2 wood pole cannot be used.

Case II: Determine if a 50'/III-H square concrete pole is strong enough for this design

DCS D-3.0.0 shows a revised setting depth for square concrete poles. The new setting depth is generally 5 feet deeper than previous. A 50'/III-H square concrete pole is set 11.5 feet deep.

Re-calculate the moments based on attachment heights.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	39.5	=	22610
568	1	x	3.816	x	150	x	37.1	=	21236
568	1	x	3.816	x	150	x	34.4	=	19691
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	29.3	=	9203
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	123668
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
50 III-H Square Concrete Pole			**TOTAL ALL MOMENTS**					=	**130,599 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 50'/III-H 6 KIP square concrete pole in a 145 mph wind region is 95,831 ft-lbs and cannot be used. The allowable moment for attachments to a 50'/III-H 8 KIP square concrete pole in a 145 mph wind region is **161,842 ft-lbs** and can be used.

Case III: Determine if a 50'/4.7 KIP spun concrete pole is strong enough for this design.

DCS D-3.0.0 shows the setting depths for spun concrete poles. A 50'/4.7 KIP spun concrete pole is set 11 feet deep.

Re-calculate the moments based on attachment heights.

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	150	x	40	=	22896
568	1	x	3.816	x	150	x	37.6	=	21522
568	1	x	3.816	x	150	x	34.9	=	19977
Neut., Sec., St Lt									
3/0	1	x	2.094	x	150	x	29.8	=	9360
CATV - PROPOSED									
Trunk	1	x	4.171	x	150	x	25.4	=	15892
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	150	x	24.4	=	35037
			TOTAL MOMENT DUE TO CONDUCTORS					=	124684
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
50' - 4.7 KIP Spun Concrete Pole									
			TOTAL ALL MOMENTS					=	**131,615 ft.-lb.**

From Table 4.2.2-4, the allowable moment for attachments to a 50'/4.7 KIP spun concrete pole in a 145 mph wind region is 134,559 ft-lbs. A 50'/4.7 KIP spun concrete pole can be used.

Using similar calculations from DERM 4.2.2 page 13, the maximum span distance for each of the poles above can be determined.

Determine the moment due to 1 foot of conductor moments
Subtract the moment due to the transformer from the total allowable moment
Divide the remaining allowable moment by the total 1 foot conductor moments.

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	39	=	149
568	1	x	3.816	x	1	x	36.6	=	140
568	1	x	3.816	x	1	x	33.9	=	129
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	28.8	=	60
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	818

EQUIPMENT		Wind Load Force in lbs		Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)					
1 Phase	50 KVA	231.8	x	29.9	=	6931
		TOTAL MOMENT DUE TO EQUIPMENT			=	6931 ft.-lb.

45'/2 Wood Pole

TOTAL ALL MOMENTS = 7,749 ft.-lb.

Maximum Allowable Moment on 45'/2 pole =	72108
Transformer Moment =	6931
Available for Conductors =	65177
Conductor Moments per foot of span =	818
Maximum Span Distance =	**80 FT**

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	39.5	=	151
568	1	x	3.816	x	1	x	37.1	=	142
568	1	x	3.816	x	1	x	34.4	=	131
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	29.3	=	61
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	824

EQUIPMENT		Wind Load Force in lbs		Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)					
1 Phase	50 KVA	231.8	x	29.9	=	6931
		TOTAL MOMENT DUE TO EQUIPMENT			=	6931 ft.-lb.

50 III-H Square Concrete Pole

TOTAL ALL MOMENTS = 7,755 ft.-lb.

Maximum Allowable Moment on 50/IIIH 6 KIP p	95831
Transformer Moment =	6931
Available for Conductors =	88900
Conductor Moments per foot of span =	824
Maximum Span Distance =	**108 FT**

Maximum Allowable Moment on 50/IIIH 8 KIP p	161842
Transformer Moment =	6931
Available for Conductors =	154911
Conductor Moments per foot of span =	824
Maximum Span Distance =	**188 FT**

ADDENDUM FOR EXTREME WIND LOADING

CONDUCTORS	Number of Conductors	x	Wind Load Per Ft. Table 4.2.2-7	x	Avg. Span Length	x	Height Above Ground	=	MOMENT (ft.-lb.)
Primary									
568	1	x	3.816	x	1	x	40	=	153
568	1	x	3.816	x	1	x	37.6	=	143
568	1	x	3.816	x	1	x	34.9	=	133
Neut., Sec., St Lt									
3/0	1	x	2.094	x	1	x	29.8	=	62
CATV - PROPOSED									
Trunk	1	x	4.171	x	1	x	25.4	=	106
TELEPHONE									
600 pr 24 Ga BKMA	1	x	9.573	x	1	x	24.4	=	234
			TOTAL MOMENT DUE TO CONDUCTORS					=	831
EQUIPMENT			Wind Load Force in lbs				Height Above Ground	=	MOMENT (ft.-lb.)
TRANSFORMERS	LE FOR INSTRUCTIONS)								
1 Phase	50 KVA		231.8		x		29.9	=	6931
			TOTAL MOMENT DUE TO EQUIPMENT					=	6931 ft.-lb.
50' - 4.7 KIP Spun Concrete Pole									
					TOTAL ALL MOMENTS			**=**	**7,762 ft.-lb.**

Maximum Allowable Moment on 50/4.7KIP pol	134559
Transformer Moment =	6931
Available for Conductors =	127628
Conductor Moments per foot of span =	831
Maximum Span Distance =	**154 FT**

Maximum span distances for Modified Vertical Framing with various pole sizes and types, conductor sizes, CATV and Telephone Cables are listed in Table 4.2.2-8 (105 mph), Table 4.2.2-9 (130 mph), and Table 4.2.2-10 (145 mph). These Tables are for reference only. New computer programs are available that provide a more detailed analysis and can be used in lieu of the tables. The span distances shown were calculated using 95% of the span distance calculated using the KEMA" Pole Design Calculation Toolkit" program. This will allow for slight variation in field conditions and rounding of values. Using the calculations described in this document may be slightly different than the table values. In some cases, the limiting factor is not the wind loading, but the required clearance above the ground and above other conductors or cables. For all joint use clearance calculations, the top joint user is considered to be attached at 23 feet above ground. When clearance is the limiting factor, the maximum span length for a specific pole is shown in bold italics. In some cases, the joint use clearance criteria cannot be met using the pole height indicated.

One other criterion incorporated in the tables is a maximum design span of 350 feet. Longer spans may be achieved, but need to be addressed on an individual basis.

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-568 ACAR & 3/0 AAAC-N	**FPL Only**	296	281	350	342	324	350
	FPL With						
	1-100 pair	*100*	211	*250*	275	259	307
	1-600 pair	*100*	165	216	200	191	223
	1-CATV	*100*	209	*250*	273	257	304
	1-100 pair & 1 CATV	*100*	176	230	213	202	255
	1-600 pair & 1 CATV	*100*	144	188	174	166	194
3-568 ACAR & 3/0 AAAC-N & 3/0 TPX	**FPL Only**	206	195	273	256	224	283
	FPL With	(2)					
	1-100 pair		*150*	*150*	202	191	224
	1-600 pair		137	*150*	166	158	184
	1-CATV		*150*	*150*	200	190	222
	1-100 pair & 1 CATV		144	*150*	175	166	194
	1-600 pair & 1 CATV		123	*150*	148	142	164
3-3/0 & 1/0 N	**FPL Only**	350	350	350	350	350	350
	FPL With						
	1-100 pair	*100*	*250*	*250*	350	350	350
	1-600 pair	*100*	223	*250*	290	276	322
	1-CATV	*100*	*250*	*250*	350	350	350
	1-100 pair & 1 CATV	*100*	*250*	*250*	350	300	350
	1-600 pair & 1 CATV	*100*	186	*250*	283	215	268
3-3/0 & 1/0 N & 3/0 TPX	**FPL Only**	*250*	299	350	350	344	350
	FPL With	(2)					
	1-100 pair		*150*	*150*	*250*	276	323
	1-600 pair		*150*	*150*	212	201	234
	1-CATV		*150*	*150*	*250*	275	320
	1-100 pair & 1 CATV		*150*	*150*	225	214	268
	1-600 pair & 1 CATV		143	*150*	172	164	190

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*100*	*250*	*250*	350	350	350
	1-600 pair	*100*	*250*	*250*	325	311	350
	1-CATV	*100*	*250*	*250*	350	350	350
	1-100 pair & 1 CATV	*100*	*250*	*250*	350	340	350
	1-600 pair & 1 CATV	*100*	205	*250*	265	237	295
3-1/0	**FPL Only**	*250*	348	350	350	350	350
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		*150*	*150*	*250*	311	350
	1-600 pair		*150*	*150*	232	220	275
	1-CATV		*150*	*150*	*250*	308	350
	1-100 pair & 1 CATV		*150*	*150*	*250*	236	295
	1-600 pair & 1 CATV		*150*	*150*	199	189	219
2-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*150*	350	350	350	350	350
	1-600 pair	*150*	290	350	350	333	350
	1-CATV	*150*	350	350	350	350	350
	1-100 pair & 1 CATV	*150*	322	350	350	350	350
	1-600 pair & 1 CATV	*150*	214	301	284	266	308
2-1/0	**FPL Only**	*300*	350	350	350	350	350
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		*200*	*200*	*300*	333	350
	1-600 pair		198	*200*	262	229	285
	1-CATV		*200*	*200*	*300*	331	350
	1-100 pair & 1 CATV		*200*	*200*	281	265	308
	1-600 pair & 1 CATV		167	*200*	204	193	224
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	*250*	350	350	350	350	350
	1-600 pair	*250*	306	350	350	350	350
	1-CATV	*250*	350	350	350	350	350
	1-100 pair & 1 CATV	*250*	345	350	350	350	350
	1-600 pair & 1 CATV	235	218	307	291	274	317
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
& 3/0 TPX	1-100 pair	*150*	*250*	*250*	*300*	350	350
	1-600 pair	*150*	202	*250*	268	234	294
	1-CATV	*150*	*250*	*250*	*300*	350	350
	1-100 pair & 1 CATV	*150*	220	*250*	290	273	317
	1-600 pair & 1 CATV	*150*	168	219	207	194	226

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

SFHHA 010226
FPL RC-16

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	45IIIH	50IIIH	55IIIH	60IIIH
3-568 & 3/0 N	FPL Only	274	350	350	350	350
	FPL With					
	1-100 pair	208	*100*	*250*	350	350
	1-600 pair	165	*100*	*250*	305	289
	1-CATV	206	*100*	*250*	350	350
	1-100 pair & 1 CATV	176	*100*	*250*	325	307
	1-600 pair & 1 CATV	144	*100*	*250*	266	235
3-568 & 3/0 N & 3/0 TPX	FPL Only	192	*250*	*300*	350	339
	FPL With	(2)	(2)			
	1-100 pair			*150*	*250*	289
	1-600 pair			*150*	237	223
	1-CATV			*150*	*250*	287
	1-100 pair & 1 CATV			*150*	*250*	235
	1-600 pair & 1 CATV			*150*	211	200
3-3/0 & 1/0 N	FPL Only	350	350	350	350	350
	FPL With					
	1-100 pair	*200*	*100*	*300*	*350*	*350*
	1-600 pair	*200*	*100*	*300*	*350*	*350*
	1-CATV	*200*	*100*	*300*	*350*	*350*
	1-100 pair & 1 CATV	*200*	*100*	*300*	*350*	*350*
	1-600 pair & 1 CATV	187	*100*	*300*	*350*	325
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	297	*250*	350	350	350
	FPL With		(2)			
	1-100 pair	*100*		*150*	*250*	350
	1-600 pair	*100*		*150*	*250*	305
	1-CATV	*100*		*150*	*250*	350
	1-100 pair & 1 CATV	*100*		*150*	*250*	325
	1-600 pair & 1 CATV	*100*		*150*	*250*	266
3-1/0 & 1/0 N	FPL Only	350	350	350	350	350
	FPL With					
	1-100 pair	*200*	*100*	*300*	350	350
	1-600 pair	*200*	*100*	*300*	350	350
	1-CATV	*200*	*100*	*300*	350	350
	1-100 pair & 1 CATV	*200*	*100*	*300*	350	350
	1-600 pair & 1 CATV	*200*	*100*	*300*	350	350
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	350	*250*	350	350	350
	FPL With		(2)			
	1-100 pair	*100*		*150*	*250*	350
	1-600 pair	*100*		*150*	*250*	350
	1-CATV	*100*		*150*	*250*	350
	1-100 pair & 1 CATV	*100*		*150*	*250*	350
	1-600 pair & 1 CATV	*100*		*150*	*250*	297

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-8

Transverse Pole Loading due to Extreme Wind - 105 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	55' 4.7kip	60' 5kip	65' 5kip
3-568 & 3/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	350
	1-600 pair	*250*	350	350	350
	1-CATV	*250*	350	350	350
	1-100 pair & 1 CATV	*250*	350	350	350
	1-600 pair & 1 CATV	*250*	333	339	321
3-568 & 3/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	*300*	350
	1-600 pair	*150*	*250*	*300*	305
	1-CATV	*150*	*250*	*300*	350
	1-100 pair & 1 CATV	*150*	*250*	*300*	321
	1-600 pair & 1 CATV	*150*	*250*	288	272
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	350	350	350
	1-600 pair	*300*	350	350	350
	1-CATV	*300*	350	350	350
	1-100 pair & 1 CATV	*300*	350	350	350
	1-600 pair & 1 CATV	*300*	429	438	411
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	*350*	350
	1-600 pair	*150*	*250*	*350*	350
	1-CATV	*150*	*250*	*350*	350
	1-100 pair & 1 CATV	*150*	*250*	*350*	350
	1-600 pair & 1 CATV	*150*	*250*	*350*	334
3-350 CU & 2/0 CU N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	350
	1-600 pair	*250*	350	350	350
	1-CATV	*250*	350	350	350
	1-100 pair & 1 CATV	*250*	350	350	350
	1-600 pair & 1 CATV	*250*	350	350	350
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*200*	*250*	*350*	350
	1-600 pair	*200*	*250*	*350*	343
	1-CATV	*200*	*250*	*350*	350
	1-100 pair & 1 CATV	*200*	*250*	*350*	350
	1-600 pair & 1 CATV	*200*	*250*	323	302

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	WOOD POLE HEIGHT AND CLASS					
		40/3	45/3	45/2	50/2	55/2	60/1
3-568 & 3/0 N	FPL Only	162	151	201	183	170	200
	FPL With						
	1-100 pair	*100*	122	162	147	137	160
	1-600 pair	*100*	95	127	115	107	125
	1-CATV	*100*	121	161	146	136	159
	1-100 pair & 1 CATV	*100*	102	135	123	114	133
	1-600 pair & 1 CATV	91	83	111	100	94	108
3-568 & 3/0 N & 3/0 TPX	FPL Only	122	112	149	137	126	148
	FPL With	(2)					
	1-100 pair		95	127	116	107	125
	1-600 pair		79	105	96	89	104
	1-CATV		95	126	116	107	124
	1-100 pair & 1 CATV		83	110	101	93	108
	1-600 pair & 1 CATV		70	94	86	80	92
3-3/0 & 1/0 N	FPL Only	295	274	364	333	308	350
	FPL With						
	1-100 pair	*100*	181	*250*	219	203	237
	1-600 pair	*100*	128	171	155	145	167
	1-CATV	*100*	179	*250*	216	201	234
	1-100 pair & 1 CATV	*100*	140	186	168	158	182
	1-600 pair & 1 CATV	*100*	107	143	128	121	139
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	175	161	214	198	181	211
	FPL With	(2)					
	1-100 pair		128	171	157	145	168
	1-600 pair		101	134	122	113	131
	1-CATV		127	169	156	143	166
	1-100 pair & 1 CATV		106	143	130	121	139
	1-600 pair & 1 CATV		87	117	105	99	113
3-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	*100*	214	*250*	278	258	301
	1-600 pair	*100*	144	193	174	163	188
	1-CATV	*100*	211	*250*	275	256	297
	1-100 pair & 1 CATV	*100*	159	212	191	180	207
	1-600 pair & 1 CATV	*100*	118	158	142	133	153

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	WOOD POLE HEIGHT AND CLASS					
		40/3	**45/3**	**45/2**	**50/2**	**55/2**	**60/1**
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	203	186	267	230	211	264
	FPL With	(2)					
	1-100 pair		144	*150*	177	163	189
	1-600 pair		110	146	134	124	143
	1-CATV		143	*150*	175	162	187
	1-100 pair & 1 CATV		118	*150*	143	133	153
	1-600 pair & 1 CATV		94	126	114	106	123
2-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	*200*	265	*350*	325	298	348
	1-600 pair	170	155	206	192	175	202
	1-CATV	*200*	261	347	318	294	340
	1-100 pair & 1 CATV	189	172	230	213	195	225
	1-600 pair & 1 CATV	136	123	163	153	139	161
2-1/0 & 1/0 N & 3/0 TPX	FPL Only	226	208	298	276	236	296
	FPL With	(2)					
	1-100 pair		155	*200*	191	175	203
	1-600 pair		114	151	142	129	149
	1-CATV		153	204	189	173	201
	1-100 pair & 1 CATV		123	163	151	139	161
	1-600 pair & 1 CATV		96	128	118	109	125
1-1/0 & 1/0 N	FPL Only	350	350	350	350	350	350
	FPL With						
	1-100 pair	*250*	308	*350*	*350*	349	*350*
	1-600 pair	179	163	218	202	186	216
	1-CATV	*250*	348	*350*	*350*	*350*	*350*
	1-100 pair & 1 CATV	222	203	292	271	232	288
	1-600 pair & 1 CATV	147	134	179	166	153	177
1-1/0 & 1/0 N & 3/0 TPX	FPL Only	274	257	341	309	285	333
	FPL With						
	1-100 pair	*150*	166	221	202	187	217
	1-600 pair	126	117	156	143	132	153
	1-CATV	*150*	178	*250*	217	200	233
	1-100 pair & 1 CATV	146	135	181	166	152	177
	1-600 pair & 1 CATV	110	102	135	125	115	133

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria

(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	45IIIH	50IIIH	55IIIH	60IIIH
3-568 & 3/0 N	FPL Only	143	308	290	268	227
	FPL With					
	1-100 pair	115	*100*	216	200	182
	1-600 pair	90	*100*	170	156	143
	1-CATV	114	*100*	215	198	181
	1-100 pair & 1 CATV	96	*100*	181	166	153
	1-600 pair & 1 CATV	79	*100*	148	136	125
3-568 & 3/0 N & 3/0 TPX	FPL Only	105	213	200	186	169
	FPL With	(2)	(2)			
	1-100 pair			*150*	158	143
	1-600 pair			141	130	119
	1-CATV			*150*	157	143
	1-100 pair & 1 CATV			147	137	124
	1-600 pair & 1 CATV			125	116	106
3-3/0 & 1/0 N	FPL Only	259	350	350	350	350
	FPL With					
	1-100 pair	171	*100*	*300*	318	291
	1-600 pair	123	*100*	228	210	194
	1-CATV	169	*100*	*300*	314	287
	1-100 pair & 1 CATV	133	*100*	267	228	210
	1-600 pair & 1 CATV	103	*100*	190	174	162
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	152	*150*	308	286	259
	FPL With	(2)	(2)			
	1-100 pair			*150*	213	194
	1-600 pair			*150*	165	151
	1-CATV			*150*	211	192
	1-100 pair & 1 CATV			*150*	176	161
	1-600 pair & 1 CATV			*150*	143	131
3-1/0 & 1/0 N	FPL Only	332	350	350	350	350
	FPL With					
	1-100 pair	*200*	*100*	*300*	350	345
	1-600 pair	138	*100*	277	236	218
	1-CATV	200	*100*	*300*	350	340
	1-100 pair & 1 CATV	151	*100*	*300*	280	257
	1-600 pair & 1 CATV	113	*100*	210	192	178
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	177	*250*	350	334	302
	FPL With	(2)	(2)			
	1-100 pair			*150*	*250*	218
	1-600 pair			*150*	181	166
	1-CATV			*150*	237	216
	1-100 pair & 1 CATV			*150*	194	178
	1-600 pair & 1 CATV			*150*	155	143

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-9

Transverse Pole Loading due to Extreme Wind - 130 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	**55' 4.7kip**	**60' 5kip**	**65' 5kip**
3-568 & 3/0 N	FPL Only	350	350	350	337
	FPL With				
	1-100 pair	*250*	294	289	270
	1-600 pair	223	214	213	197
	1-CATV	*250*	292	287	268
	1-100 pair & 1 CATV	*250*	227	225	209
	1-600 pair & 1 CATV	195	185	185	170
3-568 & 3/0 N & 3/0 TPX	FPL Only	284	274	269	232
	FPL With				
	1-100 pair	*150*	216	213	197
	1-600 pair	*150*	178	176	162
	1-CATV	*150*	215	211	196
	1-100 pair & 1 CATV	*150*	187	184	170
	1-600 pair & 1 CATV	*150*	159	158	144
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	350	350	350
	1-600 pair	*300*	310	307	282
	1-CATV	*300*	350	350	350
	1-100 pair & 1 CATV	*300*	336	333	307
	1-600 pair & 1 CATV	270	257	256	219
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*150*	*250*	307	283
	1-600 pair	*150*	226	224	205
	1-CATV	*150*	*250*	305	280
	1-100 pair & 1 CATV	*150*	*250*	256	219
	1-600 pair & 1 CATV	*150*	196	195	178
3-350 CU & 2/0 CU N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*250*	350	350	328
	1-600 pair	*250*	267	266	228
	1-CATV	*250*	350	350	325
	1-100 pair & 1 CATV	*250*	287	284	263
	1-600 pair & 1 CATV	221	211	211	194
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	339	328	321	298
	FPL With				
	1-100 pair	*200*	*250*	266	228
	1-600 pair	*200*	201	200	183
	1-CATV	*200*	*250*	262	226
	1-100 pair & 1 CATV	*200*	213	210	194
	1-600 pair & 1 CATV	184	177	176	161

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-568 ACAR & 3/0 AAAC-N	**FPL Only**	121	110	150	134	122	143
	FPL With						
	1-100 pair	98	88	121	107	98	114
	1-600 pair	78	69	94	84	77	88
	1-CATV	97	87	120	106	97	113
	1-100 pair & 1 CATV	83	74	101	89	82	94
	1-600 pair & 1 CATV	68	61	83	73	67	77
3-568 ACAR & 3/0 AAAC-N & 3/0 TPX	**FPL Only**	90	82	111	100	90	105
	FPL With	(2)					
	1-100 pair		69	94	85	77	89
	1-600 pair		57	78	69	64	73
	1-CATV		69	94	85	76	88
	1-100 pair & 1 CATV		61	82	73	67	77
	1-600 pair & 1 CATV		51	70	62	57	66
3-3/0 & 1/0 N	**FPL Only**	203	186	272	226	205	257
	FPL With						
	1-100 pair	146	131	179	160	145	168
	1-600 pair	105	93	127	113	104	119
	1-CATV	144	130	177	158	143	166
	1-100 pair & 1 CATV	114	102	138	123	113	129
	1-600 pair & 1 CATV	88	78	106	94	86	99
3-3/0 & 1/0 N & 3/0 TPX	**FPL Only**	130	117	159	143	130	150
	FPL With	(2)					
	1-100 pair		93	127	114	104	120
	1-600 pair		73	100	88	81	93
	1-CATV		93	126	113	103	119
	1-100 pair & 1 CATV		78	105	95	86	99
	1-600 pair & 1 CATV		64	86	77	70	81

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet
Modified Vertical Construction (DCS E-5.0.0)

Conductors		Wood Pole Height and Class					
		40/3	45/3	45/2	50/2	55/2	60/1
3-1/0	**FPL Only**	282	256	348	311	282	330
& 1/0 N	FPL With						
	1-100 pair	***100***	156	212	188	173	200
	1-600 pair	***100***	105	143	126	117	134
	1-CATV	***100***	154	209	186	170	197
	1-100 pair & 1 CATV	***100***	116	157	140	128	146
	1-600 pair & 1 CATV	98	86	117	104	95	108
3-1/0	**FPL Only**	151	136	184	167	151	174
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		105	143	128	117	134
	1-600 pair		80	108	97	89	102
	1-CATV		105	142	127	116	133
	1-100 pair & 1 CATV		86	117	105	95	108
	1-600 pair & 1 CATV		68	93	84	76	86
2-1/0	**FPL Only**	350	334	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	200	180	262	220	199	230
	1-600 pair	126	113	153	140	125	143
	1-CATV	196	177	258	217	195	226
	1-100 pair & 1 CATV	141	125	170	155	140	161
	1-600 pair & 1 CATV	101	89	122	111	100	114
2-1/0	**FPL Only**	168	152	206	187	169	196
& 1/0 N	FPL With	(2)					
& 3/0 TPX	1-100 pair		113	153	140	125	144
	1-600 pair		83	112	103	92	105
	1-CATV		111	151	138	124	143
	1-100 pair & 1 CATV		89	122	110	100	114
	1-600 pair & 1 CATV		70	95	86	78	89
1-1/0	**FPL Only**	350	350	350	350	350	350
& 1/0 N	FPL With						
	1-100 pair	231	208	305	276	232	288
	1-600 pair	133	119	162	147	133	154
	1-CATV	226	203	297	270	227	282
	1-100 pair & 1 CATV	150	135	182	167	151	174
	1-600 pair & 1 CATV	103	91	124	114	103	118
1-1/0	**FPL Only**	188	174	237	210	191	221
& 1/0 N	FPL With						
& 3/0 TPX	1-100 pair	133	122	164	147	134	154
	1-600 pair	94	86	116	105	94	108
	1-CATV	131	120	162	146	132	152
	1-100 pair & 1 CATV	103	92	125	114	103	118
	1-600 pair & 1 CATV	78	70	96	87	78	90

(1) Span Lengths Shown in ***Italic*** are Limited by Clearance Criteria
(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SQUARE CONCRETE POLE HEIGHT AND CLASS				
		45IIIG	45IIIH	50IIIH	55IIIH	60IIIH
3-568 & 3/0 N	FPL Only	99	209	193	174	154
	FPL With					
	1-100 pair	80	*100*	155	139	124
	1-600 pair	63	*100*	122	109	97
	1-CATV	79	*100*	154	138	123
	1-100 pair & 1 CATV	67	*100*	129	116	104
	1-600 pair & 1 CATV	55	*100*	105	95	85
3-568 & 3/0 N & 3/0 TPX	FPL Only	73	157	143	130	114
	FPL With	(2)	(2)			
	1-100 pair			122	110	97
	1-600 pair			101	90	81
	1-CATV			121	109	97
	1-100 pair & 1 CATV			105	95	85
	1-600 pair & 1 CATV			90	81	72
3-3/0 & 1/0 N	FPL Only	167	350	349	314	278
	FPL With					
	1-100 pair	119	*100*	230	206	184
	1-600 pair	85	*100*	163	146	131
	1-CATV	118	*100*	227	204	181
	1-100 pair & 1 CATV	92	*100*	178	159	143
	1-600 pair & 1 CATV	71	*100*	136	122	109
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	105	225	204	186	164
	FPL With	(2)	(2)			
	1-100 pair			*150*	148	131
	1-600 pair			127	115	103
	1-CATV			*150*	147	130
	1-100 pair & 1 CATV			136	123	109
	1-600 pair & 1 CATV			111	100	89
3-1/0 & 1/0 N	FPL Only	214	350	350	350	350
	FPL With					
	1-100 pair	142	*100*	294	264	219
	1-600 pair	96	*100*	184	164	147
	1-CATV	140	*100*	290	260	215
	1-100 pair & 1 CATV	105	*100*	202	181	162
	1-600 pair & 1 CATV	79	*100*	150	134	121
3-1/0 & 1/0 N & 3/0 TPX	FPL Only	123	*250*	257	218	191
	FPL With		(2)			
	1-100 pair	96		*150*	167	147
	1-600 pair	73		140	126	112
	1-CATV	95		150	165	146
	1-100 pair & 1 CATV	78		150	135	121
	1-600 pair & 1 CATV	63		121	108	96

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria

(2) Required clearance cannot be met with Pole length

Table 4.2.2-10

Transverse Pole Loading due to Extreme Wind - 145 MPH
Maximum Span Length in Feet

Modified Vertical Construction (DCS E-5.0.0)

Conductors	Attachments	SPUN CONCRETE POLE HEIGHT AND CLASS			
		50' 4.7kip	55' 4.7kip	60' 5kip	65' 5kip
3-568 & 3/0 N	FPL Only	291	276	267	227
	FPL With				
	1-100 pair	217	205	200	181
	1-600 pair	170	161	157	143
	1-CATV	215	203	198	181
	1-100 pair & 1 CATV	181	171	166	151
	1-600 pair & 1 CATV	148	140	137	124
3-568 & 3/0 N & 3/0 TPX	FPL Only	200	192	184	168
	FPL With				
	1-100 pair	*150*	162	157	143
	1-600 pair	141	134	130	118
	1-CATV	*150*	162	156	142
	1-100 pair & 1 CATV	147	141	137	124
	1-600 pair & 1 CATV	125	120	116	105
3-3/0 & 1/0 N	FPL Only	350	350	350	350
	FPL With				
	1-100 pair	*300*	328	317	288
	1-600 pair	229	217	212	191
	1-CATV	*300*	324	314	285
	1-100 pair & 1 CATV	267	235	230	207
	1-600 pair & 1 CATV	191	180	177	158
3-3/0 & 1/0 N & 3/0 TPX	FPL Only	309	296	283	257
	FPL With				
	1-100 pair	*150*	219	212	191
	1-600 pair	*150*	170	165	148
	1-CATV	*150*	218	210	189
	1-100 pair & 1 CATV	*150*	181	176	158
	1-600 pair & 1 CATV	*150*	147	143	128
3-350 CU & 2/0 CU N	FPL Only	350	350	341	313
	FPL With				
	1-100 pair	*250*	269	259	220
	1-600 pair	198	187	182	165
	1-CATV	*250*	266	257	219
	1-100 pair & 1 CATV	212	200	196	177
	1-600 pair & 1 CATV	168	159	156	140
3-350 CU & 2/0 CU N & 3/0 TPX	FPL Only	257	230	220	200
	FPL With				
	1-100 pair	198	189	182	165
	1-600 pair	159	151	147	132
	1-CATV	196	187	181	164
	1-100 pair & 1 CATV	168	161	156	140
	1-600 pair & 1 CATV	141	133	130	116

(1) Span Lengths Shown in *Italic* are Limited by Clearance Criteria

(2) Required clearance cannot be met with Pole length

C. *Storm Guying*

One method to overcome the overload on a pole due to transverse wind load is to add storm guys. Storm guys are installed in pairs(back to back) – one on each side of the pole perpendicular to the pole line. These guys should typically be installed 6 inches to 2 feet below the primary attachments.

Calculating the size of the guy wire is very much like calculating a deadend guy.

1. Calculate the transverse wind load on the pole, conductors and all attachments and equipment.
2. The load is then used to size the guy wire based on the load, the attachment height and lead length.
3. A final check should be made to verify that the strength of the pole above the guy attachment is adequate.

Using the example of Case I above for the 45'/2 pole, calculate the size of the storm guys and anchors required for extreme wind loading.

1. Transverse wind loads:

Pole	=	Wind load on pole
Primary	=	Wind Load per ft x span length x number of conductors
Neutral	=	Wind Load per ft x span length
CATV	=	Wind Load per ft x span length
Telephone	=	Wind Load per ft x span length
Transformer	=	Wind Load

Load on Pole	=							1713	pounds
Primary	=	3.816	x	170	x	3	=	1946	pounds
Neutral	=	2.094	x	170	x	1	=	356	pounds
CATV	=	4.171	x	170	x	1	=	709	pounds
Telephone	=	9.573	x	170	x	1	=	1627	pounds
Transformer	=	231.8	x	1			=	232	pounds
				Total Load			=	6583	pounds

2. Determine the guy wire size and anchor size required for this installation.

   To calculate the tension in the guy wire use the equation below

Equation 4.2.2-7 $$T_{DG} = \frac{T_{TWL}}{L} x \sqrt{{H_G}^2 + L^2}$$

Where:

T_{DG} = Tension in down guy
T_{TWL} = Transverse Wind Load
L = The down guy Lead length
H_G = The attachment Height of the down guy

Use the total transverse wind load for the load to be guyed with the guy attached 6 inches below C phase primary (34.1') and a lead length of 20 feet.

$$T_{DG} = \frac{6583}{20}\sqrt{(34.1)^2 + (20)^2}$$

T_{DG} = 13,013 Pounds

For extreme wind loading, the required strength of the guy wire is equal to the rated breaking strength of the guy wire x 0.9.

Table 4.2.2-11 Storm Guy Strength

Guy Size	Rated Breaking Strength (RBS)	Allowable Guy Tension .9 X RBS
5/16	11200	10080
7/16	20800	18720
9/16	33700	30330

For this example, a 7/16" guy will be installed in each direction perpendicular to the pole line. Use the tension in the down guy to select the appropriate anchor from DCS D-4.0.2. In this case, a 10" screw anchor will do the job.

3. One final check is to be sure that the pole length above the storm guy attachment has sufficient strength to support the load above it. Basically, this is just like calculating the strength of the total pole but now the "ground line" is at the storm guy attachment height and all of the facilities above this point will create a moment here.

With the top of the pole at 38' and the down guy at 34.1 feet, the length of pole exposed to the wind is now 38-34.1 = 3.9 ft.

Use equation 4.2.2-3 to determine the strength of this section of pole.

From Table G (DERM 4.2.2) circumference at 3.9 feet down from the top of the pole = 26.5 inches

M_r = 0.000264 x (8,000) x $(26.5)^3$ x 0.75 = 29,478 ft.-lbs.

Use equation 4.2.2-4 to find the area of this section of pole

$$A = 3.9\left(\frac{25+26.5}{2}\right)\left(\frac{1}{12}''\right) = 2.66 sqft$$

Use equation 4.2.2-5 to find the center of the area of this section of pole

$$Height\ of\ center\ of\ area, H_{CA} = \frac{3.9(8.44+2(7.96))}{3(8.44+7.96)} = 1.93\ ft$$

Use equation 4.2.2-2 to find the wind load on this section of pole

Load in pounds = 0.00256 x $(145)^2$ x1.0 x0.97 x 1 x 1x 2.66= 139 pounds

Use equation 4.2.2-6 to determine the moment due to the wind load on this section of the pole at the guy attachment point

Moment = 1.93 x 139 = 269 ft lbs

Determine the moment created by the wind load on the conductors

Primary	=	3.816	x	170	x	1	x	4.9	=	3179	Ft-Lbs
	=	3.816	x	170	x	1	x	2.5	=	1622	Ft-Lbs
	=	3.816	x	170	x	1	x	0.5	=	324	Ft-Lbs
										5125	Ft-Lbs

Total Moment = 269 + 5125 = 5393 Ft-Lbs

This load is well under the strength calculated above and the design using storm guys will meet requirements.

4.2.3 Pole Framing

A. Slack Span Construction

Slack span construction is employed where it is impractical to follow conventional guying practices. The proper application is a pull-off from either a tangent pole or a properly guyed deadend pole to another properly guyed deadend pole. The intent is not to slack span to a stand alone (self-support) pole unless that pole has been properly sized for this application. Improper use of slack span construction can cause a pole to bow or lean which then can cause more slack in the conductors. More slack in the conductors can result in improper clearances and increased potential for conductors to make contact with each other.

DERM 4.4.5 page 1 shows the initial sag to be used when installing slack spans. The amount of sag shown, limits the per conductor tension to 50 pounds.

Slack Span design criteria:

1. Vertical construction is preferred for two and three phase installations (DCS E-5.7.1).
   Maintain 36” separation between phases at the poles.
2. Limit the span lengths to

Table 4.2.2-12 Slack Span Length & Sag

SLACK SPAN		
CONDUCTOR	MAXIMUM LENGTH	INITIAL SAG
568.3 ACAR	50'	3'-7"
3/0 AAAC	75'	2'-9"
1/0 AAAC	95'	2'-10"

3. Use class 2 poles minimum.
4. If crossarm construction is used, use the 9 foot heavy duty wood crossarms or the 8’6” steel crossarm for added horizontal spacing (DCS E-29.0.0 and E-29.1.0).

B. ***Targeted Poles***

There are many poles in the distribution system identified as Targeted Poles. These poles are deemed critical by virtue of the equipment mounted on them or their importance to maintaining the system. As stated in The Distribution Design Guide "The following list comprises what will be considered targeted poles. When installing and/or replacing an accessible targeted pole, use a III-H concrete pole or a spun concrete pole for spans greater than 300 feet. If the pole is inaccessible, use a Class 2 pole, or consider relocating the equipment to an accessible concrete pole."

Targeted Critical Pole List

"01" Feeder Switch Poles (first pole outside the substation)
Automated Feeder Switches
Interstate/Highway Crossings
Capacitor Banks
Multiple Primary Risers
3 Phase Reclosers (or three single phase Reclosers)
Aerial Auto Transformers
Multiple Circuits
3 phase Transformer Banks (3-100 kVA and larger)
Regulators
Primary Meter

The targeted pole also should meet the design criteria for wind loading as previously shown.

C. ***Distribution Design Guidelines***

The Storm Secure Organization has developed a set of guidelines for Distribution Designers to use when designing or maintaining distribution facilities. The designer can go online to see the most current version.