Pole Loading Calculation (Ground Line Moment) for Trailer Pole

Assumptions:

- Calculations use NESC Grade C Load Factors, for NESC Heavy Loading Zone
- Wind effect on pole will be same as wind effect on class 2 pole. No consideration of wind effect on trailer or trailer support.
- Single 8 foot crossarm with two phases on one side and one phase on other side.
- Crossarm is installed at 40 ft. above grade
- 477 AAC conductor, 100 ft. ruling span at full tension, as shown in Sag Table 11L.
- No line angles – the adjacent poles are in line with and the wire attachment is at the same height.
- Pole is connected to a span on each side, both spans are 100 ft.
- Pole height above ground is 40 ft.
- No neutral conductor attached.
- No equipment, M_{we}=0

From ESP 5.3.2.4, Section 5.1:

Total Ground Line Moment (M_g) from loads:

$$M_g = M_{wp} + M_{wc} + M_{tc} + M_{vo} + M_{we}$$

M_{wp} = moment at the ground-line due to wind acting on the exposed surfaces of the pole

$$M_{wp} = LF\ x\ W_p\ x \left[\frac{(2\ X\ Ct) + Cg}{72\ x\ \pi}\right] x\ H_p^2$$

LF (load factor, wind, Grade C) = 2.20
H_p = 40 feet
Ct = circumference at top, assuming class 2 pole=25 inches
Cg = circumference at base = 40 inches*
W_p= NESC Wind Pressure, Heavy Loading Zone = 4 lb/ft^2

$$M_{wp} = 2.2\ x\ 4\ x \left[\frac{(2\ X\ 25) + 40}{72\ x\ \pi}\right] x\ 1600$$

M_{wp}= 5602 ft-lbs

*Base circumference for 45 foot, class 2 pole

M_{wc} = sum of moments at ground line due to wind acting on the conductors

$$M_{wc} = \sum (W_{pf}\ x\ H) x L_{eff-wind}$$

where

$$W_{pf} = LF\ x \left(\frac{D_c + (Ice\ x\ 2)}{12}\right) x\ W_p$$

LF (load factor, wind, Grade C) = 2.20
H = 40 feet
Ice = NESC radial ice thickness (inches) for Heavy Loading Zone = ½ inch
W_p= NESC Wind Pressure, Heavy Loading Zone = 4 lb/ft^2 (40 MPH wind)
D_c= Conductor Diameter for 477AAC = 0.793 inch
$L_{eff-wind}$ = Effective wind span = 100 ft

$$W_{pf} = 2.2\ x \left(\frac{0.793 + (1/2\ x\ 2)}{12}\right) x\ 4 = 1.315$$

$$M_{wc} = \sum 3\ conductors\ x\ (1.315\ x\ 40) x 100\ = 15780\ ft - lbs$$

M_{wc}= 15,780 ft-lbs

M_{tc} = sum of moments due to tension on each conductor

$$M_{tc} = 2\ x\ \sin\frac{\theta}{2}\ x\ \sum (LF\ x\ T\ x\ H)$$

LF (load factor, wire tension, Grade C) = 1.30
H = distance to ground from mounting height = 40 feet
θ = Line angle = 0 (assume pole trailer is in line with existing poles)
T = conductor tension at 0° with ½" ice and 40 MPH wind,100 ft ruling span = 2608 lbs per conductor

$$M_{tc} = 2\ x\ \sin\frac{0}{2}\ x\ \sum 3(LF\ x\ T\ x\ H) = 0$$

M_{tc}= 0 ft-lbs

M_{vo} = sum of moments at ground line due to conductor offset

$$M_{vo} = \sum (LF\ x\ W_{c+ice}\ x\ Offset_c) x L_{eff-weight}$$

where

$$W_{c+ice} = W_v\ x\ \left((D_c + (2\ x\ Ice))^2 - D_c{}^2 \right) + W_c$$

LF (load factor, vertical load, Grade C) = 1.90
W_{c+ice} = weight of an ice covered conductor
Ice = Radial thickness of ice, for heavy loading zone = 0.5 in,
D_c= Conductor Diameter for 477AAC = 0.793 inch
W_c= Conductor Weight for 477AAC = 0.448 lb/ft
$L_{eff-weight}$ = Effective weight span, the distance from the pole to the low point in the sag for the span = 100 ft
$Offset_c$ = Offset of conductor from center of pole. The conductors at the ends of the arms offset each other, so only the phase 20" from the center of the pole is included in the equation below.
Ice is assumed to weigh 57 lb/ft^3
Volume of a hollow cylinder= π x height x ($R_{outside}{}^2 - R_{inside}{}^2$)
W_v = π/4 x $57/12^2$ = 0.311

$$W_{c+ice} = .311\ x\ ((1.793)^2 - 0.793^2) + 0.448 = 1.25\ lb/ft$$

$$M_{vo} = \sum (1.9\ x\ 1.25\ x\ 20/12) x 100 = 396\ ft - lbs$$

M_{vo}=396 ft-lbs

$$M_g = 5602 + 15{,}780 + 0 + 396 + 0 = 21{,}778\ ft - lbs$$