Worksheet – Open / Mostly Solid / Solid Fencing – Wind and Wind & Ice Loading

Site Location: **FenceDesign.com**

Customer:

Site and Geometrical Variables

IBC_____ ASCE 7-_____ Risk Category_____ Frost Depth_____ ft

Basic Wind Speed, V_w = _____ mph Nominal Ice Thickness, t = _____ in

Gust / Concurrent Wind Speed for Ice Loading, V_i = _____ mph

Wind Pressure, q_w = _____ psf Wind on Ice Pressure, q_i = _____ psf

Exposure Category _____ Topographical Factor, K_{zt} = _____

Site Elevation, Z_e = ________ ft Elevation Factor, K_e = _____

Height of fence, h = _____ ft Gap at bottom of fence, g = _____ ft (zero if no gap)

Height of fencing material, s = h - g = _____ ft

Velocity Pressure Exposure Coefficient, K_z = _____

Wind & Axial Loading

Fence Run #____ Length of Fence, B = ____ ft Post spacing, L = ____ ft

Post Type: Line Posts ( ) Post near end or corner ( )

Solidity Ratio, ε = ____ Inverted Fence Opening Reduction Factor, R_{1w} = ____

Case C Reduction Factor, R_{2w} = ____ Return Corner Reduction Factor, R_{3w} = ____

Force Height Adjustment Factor, F_{hw} = ____ Wind Force Coefficient, C_{fw} = ____

Expected Post Diameter or Width, $\varnothing_p$ = ____ in (Set to Zero for solid / mostly solid fencing)

Top Rail Diameter or Width, $\varnothing_r$ = ____ in Mid Rail Diameter or Width, $\varnothing_p$ = ____ in

($\varnothing_r$ & $\varnothing_m$ – set to Zero if not applicable for rails or for solid / mostly solid fencing)

Wind Area of Post, $A_p = \varnothing_p / 12 \times h$ = ____ ÷ 12 × ____ = ____ ft^2
(A_p = 0 for solid / mostly solid fencing) $\varnothing_p$ h A_p

Wind Area of Rails, $A_r = (\varnothing_r / 12) \times 2 \times L + (\varnothing_m / 12) \times L$ (A_r = 0 for solid / mostly solid fencing)

A_r = (____ ÷ 12 × 2 × ____) + (____ ÷ 12 × ____) = ____ ft^2
$\varnothing_r$ L $\varnothing_m$ L A_r

Wind area tributary to the post, $A_w = \varepsilon\, s\, L + A_p + A_r$ = ____ × ____ × ____ + ____ + ____ = ____ ft^2
ε s L A_p A_r A_w

Dead Load of fencing materials, D_m ___ psf

Lateral and Axial Forces for Wind Loading

Minimum wind force to the post, $f_{min} = (0.6)\ 16.0\ A_w = 9.6 \times$ _____ = _______ lbs
A_w f_{min}

Calculated Wind Force to the post, $f_w = q_w K_z K_{zt} K_e R_{1w} F_{hw} C_{fw} A_w$

f_w = ____ × ____ × ____ × ____ × ____ × ____ × ____ × ____ = ________ lbs
q_w K_z K_{zt} K_e R_{1w} F_{hw} C_{fw} A_w f_w

Maximum wind force to the post, f_w' = maximum value of either f_{min} or f_w = ________ lbs
f_w'

The Axial Force supported by the post, $p_a = D_w\, s\, L$

P_w = _____ × _____ × _____ = _______ lbs
D_w s L p_w

5 × p_w = ________ lbs (used for stability check)

Wind on Ice Loading

Fence Run #____ Length of Fence, B = ____ ft Post spacing, L = ___ ft

Post Type: Line Posts( ) Post near end or corner( )

Wind on Ice Force Variables

Iced Solidity Ratio, ε' = ____ Inverted Fence Opening Reduction Factor, R_{1i} = ____

Case C Reduction Factor, R_{2i} = ____ Return Corner Reduction Factor, R_{3i} = ____

Force Height Adjustment Factor, F_{hi} = ____ Wind Force Coefficient, C_{fi} = ____

Dead Load of Ice, D_i = ____ psf

Wind area tributary to the post in the iced condition, $A_i = \varepsilon' \, s \, L$

A_i = ____ (ε') × ____ (s) × ____ (L) = ____ (A_i) ft²

Wind on Ice Force to the post, $f_i = q_i \, K_z \, K_{zt} \, K_e \, R_{1i} \, F_{hi} \, C_{fi} \, A_i$

F_i = ____ (q_i) × ____ (K_z) × ____ (K_{zt}) × ____ (K_e) × ____ (R_{1i}) × ____ (F_{hi}) × ____ (C_{fi}) × ____ (A_i) = _____ (F_i) lbs

Axial Force supported by the post, $p_i = (D_w + D_i) \, s \, L$

p_i = (_____ (D_w) + ____ (D_i)) × _____ (s) × _____ (L) = _______ (p_i) lbs

5 × p_i = ________ lbs (used for stability check)

Post Selection

Using the diameter of the desired post size, O.D., and the Fence Height, h, look through the post charts for post types that have F_a values larger than the f_w' & f_i values, and P_a values larger than the p_w & p_i values. If the post has an * next to the P_a value, only use it if the P_a value is $\geq 5 \times p_i$ due to stability requirements.

Put in the O.D, post type, weight per foot, D_p and fence height, h and calculate p_w' and p_i' to include the weight of the post. Add any additional weight if needed.

f_w' / F_a is the bending strength ratio for Wind.
p_w' / P_a is the axial strength ratio for Wind.

f_i / F_a is the bending strength ratio for Wind & Ice.
p_i' / P_a is the axial strength ratio for Wind & Ice.

If the sum of the bending strength and axial strength ratios for both Wind and Wind & Ice loading are ≤ 1.0, the post is acceptable.

O.D.	Post Type	D_p (lb/f)	h (ft)	$p_w' = p_w + (D_p \times h)$	$p_i' = p_i + (D_p \times h)$
				p_w' =	p_i' =
Wind					
$\dfrac{f_w' =}{F_a =}$ =			$\dfrac{p_w' =}{P_a =}$ =		$\dfrac{f_w'}{F_a} + \dfrac{p_w'}{P_a} =$
Wind & Ice					
$\dfrac{f_i =}{F_a =}$ =			$\dfrac{p_i' =}{P_a =}$ =		$\dfrac{f_i}{F_a} + \dfrac{p_i'}{P_a} =$

O.D.	Post Type	D_p (lb/f)	h (ft)	$p_w' = p_w + (D_p \times h)$	$p_i' = p_i + (D_p \times h)$
				p_w' =	p_i' =
Wind					
$\dfrac{f_w' =}{F_a =}$ =			$\dfrac{p_w' =}{P_a =}$ =		$\dfrac{f_w'}{F_a} + \dfrac{p_w'}{P_a} =$
Wind & Ice					
$\dfrac{f_i =}{F_a =}$ =			$\dfrac{p_i' =}{P_a =}$ =		$\dfrac{f_i}{F_a} + \dfrac{p_i'}{P_a} =$

Footing Sizing (non-constrained footings)

Design Footing Depth, D = ____ ft Footing Diameter, b = ____ ft

Lateral Bearing Pressure per foot of depth, S = ____ psf / ft per geotechnical analysis or table 1806.2

Maximum Wind Force, P = maximum value of f_w' or f_i = ____ lbs Post Height, h = ____ ft

Modifier for Isolated Posts, M = 2.0 per IBC §1086.3.4

Allowable Lateral Soil Bearing Pressure for non-constrained footings, $S_1 = ⅓\, D\, S\, M$

S_1 = ⅓ × ____ (D) × ____ (S) × 2.0 (M) = ______ (S_1) psf per IBC §1807.3.2.1

Soil Bearing Factor, $A = 2.34\, P / (S_1\, b)$ per IBC §1807.3.2.1

A = 2.34 × ____ (P) ÷ (____ (S_1) × ____ (b)) = ____ (A)

Minimum Depth, $d = \frac{1}{2} A \left(1 + \sqrt{1 + \frac{4.36\ \frac{1}{2}h}{A}}\right)$ per Eq. 18-1, modified for fencing

$d = \frac{1}{2} \times$ ____ (A) $\times \left(1 + \sqrt{1 + (4.36 \times \frac{1}{2} \times \text{\_\_\_\_ (h)} \div \text{\_\_\_\_ (A)})}\right)$ = ____ (d) ft

Area of the bottom of the footing, $A_f = \pi\, (\frac{1}{2}\, b)^2$ = 3.14 × (½ × ____ (b))^2 = ____ (A_f) ft^2

Footing Volume, $V = A_f\, D$ = ____ (A_f) × ____ (D) = ____ (V) ft^3

Weight of footing, $D_f = 150\, V$ = 150 × ____ (V) = ____ (D_f) lbs (Typical Concrete weight is 150 lbs / ft^3)

Axial Dead Load, $D_{max} = D_f + p_i'$ for fencing plus ice loading. $D_{max} = D_f + p_w'$ if there is no ice loading

D_{max} = ____ (D_f) + ______ (p_i' or p_w') = ______ (D_{max}) lbs

Maximum Vertical Foundation Pressure, S_y = _____ psf per geotechnical analysis or table 1806.2

Maximum Axial Pressure on the soil, $s_y = D_{max} / A_f$ = _____ (D_{max}) ÷ _____ (A_f) = _____ (s_y) psf

Actual to Allowable Soil Strength Ratio, s_y / S_y = _____ (s_y) ÷ _____ (S_y) = ____ ≤ 1.0 is OK

s_y / S_y must be less than 1.0. If not, start over with a larger footing diameter, b