

MHA Engineers Inc
1623 Wright Avenue
Sunnyvale California 94087
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HOMELAND VINYL - WIND LOAD CALCULATIONS

9/15/2004
Project: Homeland Vinyl
H100304A

**WIND RESISTANCE CALCULATIONS
WIND PRESSURE WITHOUT GUST LOADING
104 mph**

HOMELAND VINLY INC.

7/8" X 13" T & G PANELS

2x7 RAIL MASTER

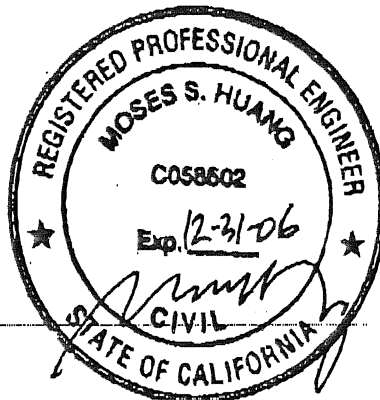
5x5x0.155 STANDARD POSTS

**8 FT SPAN, 6FT HIGH FENCES WITH
CONCRETE PIER FOUNDATION DESIGN.**

REPORT H100304A

BY

MHA CONSULTING ENGINEERS INC



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PANEL 7/8 x 13 T&G

(7)x 13 x 7/8" Interlocking T&G 5 FT RAIL TO RAIL with 8' span post to post

Calculate Section Properties

Post properties 5"x5" x 0.155 THK

$$t := 0.155 \text{ in} \quad b := 5.0 \text{ in} \quad h := b - 2 \cdot t \quad h = 4.69 \text{ in} \quad h1 := b - t \quad h1 = 4.845 \text{ in}$$

$$I1 := 2 \cdot b \cdot t \cdot \left(\frac{h1}{2}\right)^2 + 2 \cdot t \cdot \frac{h^3}{12} \quad I1 = 11.761 \text{ in}^4$$

$$\text{psf} := \frac{\text{lb}}{\text{ft}^2}$$

Fence is 72" to top of rail from ground (74" - 2")

Horizontal members

Rail Master 2x7 top & bottom

$$I2 := \left(0.09 \cdot 5.75 \cdot 1.2 + 2 \cdot 0.09 \cdot \frac{2^2}{6}\right) \cdot \text{in}^4 \quad I2 = 1.155 \text{ in}^4$$

rail section is closed section

Tongue and Groove Verticals 7/8" x 13"

13" wide x .05 Thk x 0.875" (depth) span 60" top to bottom rail

$$I4 := \left[2 \cdot 0.05 \cdot 13 \cdot (0.413)^2\right] \cdot \text{in}^4 + 6 \cdot 0.04 \cdot \frac{0.875^3}{12} \cdot \text{in}^4 \quad I4 = 0.235 \text{ in}^4$$

Wind load factor ASCE 7-98

104 mph maximum wind speed

Design for other structures and open buildings

Basic wind speed $V := 104$ mph

$I := 0.77$ **importance factor assume 1 Category 1 minor structures for fence**

Pressure equation $K_{zt} := 1$ **topographical assume level ground**

$K_d := 0.85$ **directionality assume normal to fence Table 6-6**
Struct type Solid signs

$K_z := 1.4$ **velocity-pressure exposure assume G**
open area

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$$qz := 0.00256 Kz \cdot Kzt \cdot Kd \cdot I \cdot V^2 \cdot \frac{\text{lb}}{\text{ft}^2} \quad qz = 25.371 \text{ lb ft}^{-2}$$

$$qf := qz \quad \text{No gust factor}$$

6ft fence at 8 feet post spacing

Loading to top & bot rails

$$P := qf \cdot 3 \cdot \text{ft} \quad P = 76.114 \text{ lb ft}^{-1}$$

Wind load for Panels

Post Case 1 8 ft spacing 6ft high

$$Wfp := 8 \cdot \text{ft} \cdot P \quad Wfp = 608.913 \text{ lb}$$

Panel Loading from Ground up

Post Moment Calculation with post considered fixed at ground and post as cantilever from ground level 0.0

$$Mw := Wfp \cdot (6 \cdot \text{ft}) + Wfp \cdot 25 \cdot \text{ft} \quad Mw = 3.806 \times 10^3 \text{ lb ft} \quad \text{psi} := \frac{\text{lb}}{\text{in}^2}$$

Post Stress calculation for 5"x5"x0.155" thk section

$$St := Mw \cdot \frac{5 \cdot \text{in}}{11.2} \quad St = 9.707 \times 10^3 \text{ psi} \quad \text{OK} \sim 9756 \text{ psi Ultimate stress}$$

8 ft Post spacing, 5x5 post x0.135 wall

This is the limit of Utility posts. Tests of PVC flexural strength shows it to be 9756 psi using ASTM D790 procedures.

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Check Horizontals for max wind condition of 104 mph which is post limit

Top & Bottom Rails Calculation considered as simply support with the
Horizontal members as support beams for the 13" interlocking Panels
Horizontals spans 8 ft

Slotted rail 2"x7" 6 ft span at 104 mph

$$M_w := qf \cdot 5.5 \cdot \frac{\text{ft} \cdot (8\text{-ft})^2}{2 \cdot 8} \quad M_w = 558.171 \text{ lb ft}$$

$$St := M_w \cdot \frac{2 \cdot \frac{\text{in}}{2}}{I2} \quad St = 5.799 \times 10^3 \text{ psi} \quad \text{OK} \ll 9700 \text{ psi Ultimate stress}$$

Vertical Tongue & Groove 11.3" wide privacy panels

Max Span 5 ft for 7/8x13 T&G panels

$$w := 13 \cdot \text{in} \cdot qf \quad w = 27.486 \text{ lb ft}^{-1}$$

$$M := \frac{w \cdot (5\text{-ft})^2}{8} \quad M = 85.893 \text{ lb ft} \quad S_y := \frac{I4}{0.438 \cdot \text{in}}$$

$$\text{Stress} := \frac{M}{S_y} \quad \text{Stress} = 1.92 \times 10^3 \text{ psi}$$

Post is limiting at 104 mph in all cases other components are adequate

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Post Foundation Calculation

Based on 104 mph Florida fence wind speed criteria

12" diameter piers depth to be determined

Soils criteria, sandy clays

Generalized soil categories	cohesion	internal friction angle ϕ
Clean Gravel sand mixture	0	36 degrees
Sand-Silt Clay mixture	7 psi	32
Inorganic Clays	12psi	27

Rankine Formula for passive earth pressure

Pressure coefficient K_p without considering cohesion

$$\phi := 32 \text{ deg}$$

$$K_p := \tan\left(45 \text{ deg} + \frac{\phi}{2}\right)^2 \quad K_p = 3.255 \quad \gamma := 120 \frac{\text{lb}}{\text{ft}^3} \quad \text{soil density}$$

Passive pressure is a function of depth

$$d := 3.33 \text{ ft depth} \quad D_p := 1 \text{ ft pier diameter}$$

$$P_p := D_p K_p \gamma d \quad P_p = 1.301 \times 10^3 \text{ lb ft}^{-1}$$

Overturning moment at point of fixity (12" diameter pier)

point of fixity is where shear is zero

$$h := 6 \text{ ft fence height}$$

$$h_f := \left(\frac{W_{fp} \cdot 2}{D_p \cdot K_p \cdot \gamma}\right)^{0.5} \quad h_f = 1.766 \text{ ft} \quad \text{Rails loads top \& bot so } \times 2$$

$$OTM := W_{fp} \cdot \left(\frac{h}{2} + h_f\right) \quad OTM = 2.902 \times 10^3 \text{ lb ft}$$

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Soil restoring moment consider pier has effective resistance area of 2.5 diameters 30 deg spread

$$RM := Pp \cdot 2.5 \cdot \frac{d}{2} \cdot \frac{d}{3} \quad RM = 6.009 \times 10^3 \text{ lb ft} \quad SF := \frac{RM}{OTM} \quad SF = 2.071$$

Foundation requires o 3 ft - 4 in depth for a SF = 2.0 which is normal

Please note:

Foundation depth will vary with soil properties. The above are some typical values for generalized soil types as a basis of calculation.

Specific engineering calculations may be performed for fences installed in soils which have known properties.