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SUBJ: FRAMELESS WINDSCREEN SYSTEM
TAPER-LOC® SYSTEM DRY-GLAZE OR WET GLAZED

The Frameless Windscreen System with Taper-Loc® Dry Glaze or wet glazed utilizes tempered glass balustrade lights in an aluminum extruded base shoe to create wind screens and dividers. The system is intended for interior and exterior weather exposed (except to wood) applications and is suitable for use in all natural environments. The system may be used for residential, commercial and industrial applications. This is an engineered system designed for the following criteria:

The design loading conditions are:
Concentrated load = 200 lbs any direction, any location*
Uniform load = 50 plf perpendicular to glass*
Wind load = As stated for the application and components, 10 psf minimum.

*Refer to IBC Section 1607.7.1, applicable only when fall protection is required. Glass stresses are designed for a safety factor of of 4.0 for live loads (IBC 2407.1.1).

The system will meet or exceed all requirements of the 2000, 2003, 2006, 2009 and 2012 International Building Codes, 2010 and 2013 California Building Codes, 2007 and 2010 Florida Building Codes, Non-wind-borne debris regions only (as wind loading permits). Aluminum components are designed in accordance with the 2005 Aluminum Design Manuals. Stainless steel components are designed in accordance with SEI/ASCE 8-02 *Specification for the Design of Cold-Formed Stainless Steel Structural Members* or AISC Design Guide 27 *Structural Stainless Steel*. Wood anchorage designed per the *National Design Specification for Wood Construction* (NDS).

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Typical Installations:
Residential, Commercial and Industrial Applications:

Surface mounted to steel

1/4” cap screw to 3/16” minimum tapped steel at 12” on center.
Glass strength will control allowable loads

1/4” anchors to concrete

1/4” x 3” Powers Fastener Wedge-Bolt into 3,000 psi min. concrete strength

Anchor spacing	Allowable wind load*		
	24” Height	36” HT	42” HT
12” o.c.	48.3 psf	21.5 psf	15.8 psf
8” o.c. 3/8” glass	67 psf	29.8 psf	21.9 psf
8” o.c. 1/2” glass	72.4 psf	32.2 psf	23.7 psf
6” o.c. 1/2” glass	96.6 psf	42.9 psf	31.5 psf

For other wind screen heights refer to graphs on pages 15 and 16.

Maximum wind screen heights for installation to concrete when fall protection is required*:
12” o.c.: H = 23 3/16”
8” o.c.: H = 32 1/8” For 3/8” glass
8” o.c.: H = 34 3/4” For 1/2” glass
6” o.c.: M_a = (12/6)*96.6#’/ft*12/50plf = 46 3/8” (1/2” glass only)
*A top rail of sufficient strength is required when used as a guard.
This system is not recommended for guard applications, refer to CRL GRS system for guard applications.

Attachment to Wood

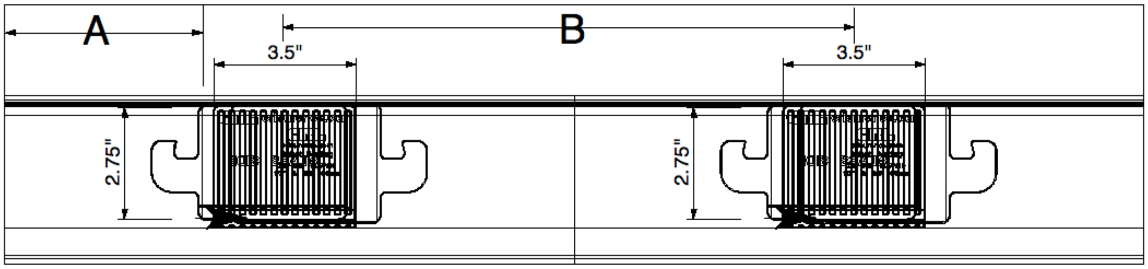
1/4”x4” Lag Screw to solid wood with G ≥ 0.5 or manufactured wood beam of equivalent lag screw withdrawal resistance. These recommendations are applicable when installed on wood with specific gravity, G ≥ 0.5 and protected from wetting so that moisture content MC ≤ 19% at all times.

Anchor spacing	Allowable wind load*		
	18” Height	24” HT	36” HT
12” o.c.	46.5 psf	26.1 psf	11.6 psf
6” o.c.	84.3 psf	47.4 psf	21.0 psf

For other wind screen heights refer to graphs on page 18.

Maximum wind screen heights for installation to wood when fall protection is required*:
12” o.c.: H = 12 1/2”
6” o.c.: H = 22 3/4”

Taper-Loc® System Typical Installation



For 3/8” or 1/2” Fully Tempered Glass and maximum glass light height = 42”:
Edge Distance: 2” ≤ A ≤ 8 5/8”; 51mm ≤ A ≤ 219mm
Center to center spacing: 7” ≤ B ≤ 14”: 178mm ≤ B ≤ 356mm

Panel Width/Required quantity of Taper-Loc® Plates:

6” to 14” (152 to 356mm)	1 TL Plate
14” to 28" (356 to 711 mm)	2 TL Plates
28" to 42" (711 to 1,067 mm)	3 TL Plates
42" to 56" (1,067 to 1,422 mm)	4 TL Plates

Minimum Glass Lite Width = 6” when top rail/guardrail is continuous, welded corners or attached to additional supports at rail ends.

NOTES:
1. For glass light heights over 42” A_{max} and B_{max} shall be reduced proportionally.
   A_{max} = 8 5/8*(42/h)
   B_{max} = 14*(42/h)

2. For glass light heights under 42” A_{max} and B_{max} shall not be increased.

3. A_{min} and B_{min} are for ease of installation and can be further reduced as long as proper installation is achieved.

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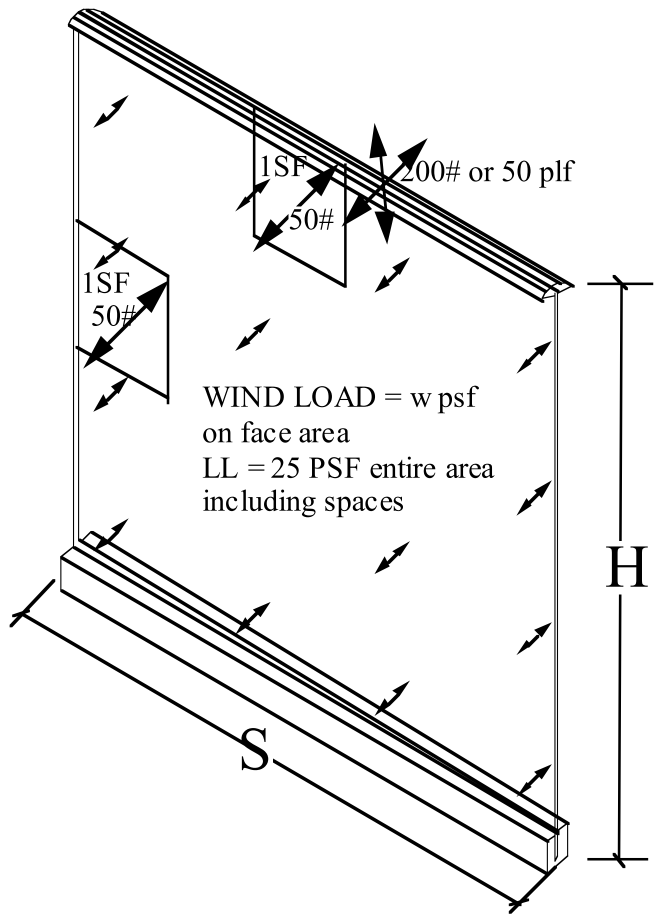
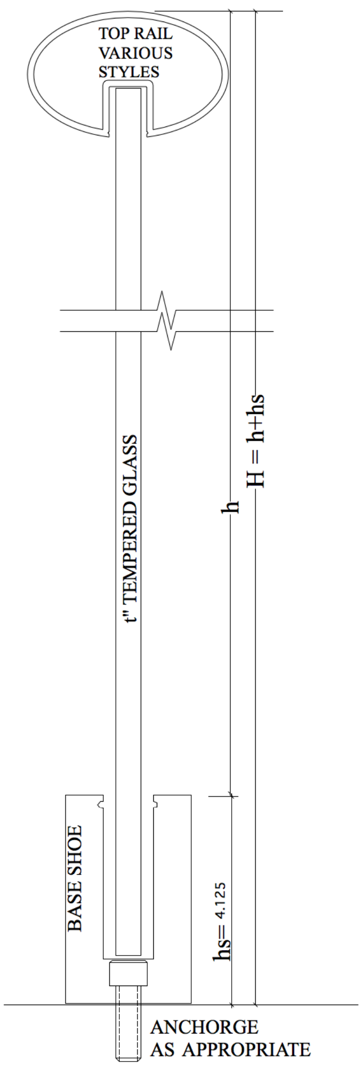
LOAD CASES:

Dead load = 6.5 psf for glass
1.8 plf top rail
3.0 plf for base shoe



Loading:
Horizontal load to base shoe
25 psf*H or W*H
Balustrade moments
M_i = 25 psf*H^2/2 or
M_w = w psf* H^2/2

For top rail loads:
M_c = 200#*H
M_u = 50plf*H



FOR WIND
SCREEN OR DIVIDER APPLICATIONS WHERE FALL PROTECTION IS NOT REQUIRED THE CAP RAIL MAY BE OMITTED.
THE 200# LOAD, 50 PLF LOAD AND 25 PSF LOAD CASES ARE APPLICABLE TO GUARD APPLICATIONS ONLY.
MINIMUM WIND LOAD IS 10 PSF
Two options for glass thickness:
1/2" glass, weight = 6.46 psf
3/8" glass, weight = 4.75 psf

WHEN INSTALLED WITHOUT A CAP RAIL THE GLASS LIGHTS SHALL BE EITHER BUTT GLAZED WITH STRUCTURAL SILICONE FULL HEIGHT OF THE JOINT OR A MALL FRONT CLAMP SHALL BE INSTALLED WITHIN 12" OF THE TOP AT ALL GLASS JOINTS TO LIMIT DIFFERENTIAL DEFLECTIONS.

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WIND LOADING

For wind load surface area is full area of guard:

Calculated in accordance with ASCE/SEI 7-05 Section 6.5.14 *Design Wind Loads on Solid Freestanding Walls and Solid Signs* **(or ASCE/SEI 7-10 Chapter 29.4)**. This section is applicable for free standing building guardrails, wind walls and balcony railings that return to building walls. Section 6.5.12.4.4 (29.6) *Parapets* may be applicable when the rail is along a roof perimeter. **Wind loads must be determined by a qualified individual for a specific installation.**

$p = q_p(GC_p) = q_zGC_f$ (ASCE 7-05 eq. 6-26 or 7-10 eq. 29.4-1)

G = 0.85 from section 6.5.8.2 (sec 26.9.4.)

$C_f = 2.5*0.8*0.6 = 1.2$ Figure 6-20 (29.4-1) with reduction for solid and end returns, will vary.

$Q_z = K_zK_{zt}K_dV^2I$ Where:

- I = 1.0
- K_z from Table 6-3 (29.3-1) at the height z of the railing centroid and exposure.
- $K_d = 0.85$ from Table 6-4 (Table 26-6).
- K_{zt} From Figure 6-4 (Fig 26.8-1) for the site topography, typically 1.0.
- V = Wind speed (mph) 3 second gust, Figure 6-1 (Fig 26.5-1A) or per local authority.

Simplifying - Assuming $1.3 \le C_f \le 2.6$ (Typical limits for fence or guard with returns.)

- For $C_f = 1.3$: $F = q_h*0.85*1.3 = 1.11\ q_h$
- For $C_f = 2.6$: $F = q_h*0.85*2.6 = 2.21q_h$

Wind Load will vary along length of fence in accordance with ASCE 7-05 Figure 6-20 (29.4-1).

Typical exposure factors for K_z with height 0 to 15' above grade:

Exposure	B	C	D
K_z =	0.70	0.85	1.03

Centroid of wind load acts at 0.55h on the fence.

Typical wind load range for I = 1.0 and K_{zt} = 1.0 ***Wind loads are ASD level.***

Table 1:	**Wind load in psf C_f = 1.3**			**Wind load in psf C_f = 2.60**		
Wind Speed	B	C	D	B	C	D
V	$0.00169V^2$	$0.00205V^2$	$0.00249V^2$	$0.00337V^2$	$0.00409V^2$	$0.00495V^2$
85	12.2	14.8	17.9	24.3	29.5	35.8
90	13.7	16.6	20.2	27.3	33.1	40.1
100	16.9	20.5	24.9	33.7	36.9	49.5
110	20.5	24.8	30.1	40.7	49.5	59.9
120	24.3	29.6	35.8	48.5	58.9	71.3
130	28.6	34.7	42.0	56.9	69.1	83.7
140	33.1	40.2	48.8	66.0	80.1	97.1

Where fence ends without a return the wind forces may be as much as 1.667 times C_f=2.6 value.

When I = 0.87 is applicable (occupancy category I) multiply above loads by 0.87.

For wind loads based on ASCE 7-10 wind speeds, figures 26.5-1A, B and C, multiply the wind loads by 0.6 to convert to Allowable Stress Design loads or wind speed by 0.775 for ASD speed.

For example - Exp B with C_f = 1.3; 7-05 wind speed = 85 mph w= 12.2 psf:

7-10 wind speed= 110mph w = 0.6*20.5 = 12.3 psf (ASD wind loads typically used herein)

MINIMUM WIND LOAD TO BE USED IS 10 PSF.

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GLASS STRENGTH

All glass is fully tempered glass conforming to the specifications of ANSI Z97.1, ASTM C 1048-97b and CPSC 16 CFR 1201. For the 1/2" glass the average Modulus of Rupture F_r is 24,000 psi.
Allowable glass bending stress: 24,000/4 = 6,000 psi. – Tension stress calculated for live loads.
For wind loads = 10,600 psi from ASTM E1300, 9,600 psi maximum recommended.

Bending strength of glass for the given thickness:

$$S_y = \frac{12\text{"}*(t)^2}{6} = 2*(t)^2 \text{ in}^3\text{/ft}$$

For 1/2" glass $S_y = 2*(0.469)^2 = 0.44$ in^3/ft
M_{al} = 6,000psi*0.44 in^3/ft = 2,640"#/ft = 220'#
M_{aw} = 9,600psi*0.44 in^3/ft = 4,224"#/ft = 352'#
For 3/8" glass $S_y = 2*(0.366)^2 = 0.268$ in^3/ft
M_{al} = 6,000psi*0.268 in^3/ft = 1,607"#/ft = 133.9'#
M_{aw} = 9,600psi*0.268 in^3/ft = 2,573"#/ft = 214.4'#

For cantilevered elements basic beam theory for cantilevered beams is used.
$M_w = W*L^2/2$ for uniform load W and span L or
$M_p = P*L$ for concentrated load P and span L,

GLASS PANELS LOADS:
From UBC Table 16-B or IBC 1607.7.1
At top – 200lb concentrated or 50 plf Any direction
Or On panel – 25 psf horizontal load

DETERMINE MAXIMUM PANEL HEIGHT:
For 50 plf distributed load:
$h = (M_{al}/w) = M_a/50$plf

For 200# load, not top rail:
$h = M_{al}*S/200\#$ where S = light length

For 25 psf live load
$h = (M_{al}*2/25 \text{ psf})^{1/2} = (M_a/12.5)^{1/2}$

For wind load
$h = (M_{aw}*2/W)^{1/2}$
maximum wind load for given light height:
$W = 2M_{aw}/h^2$

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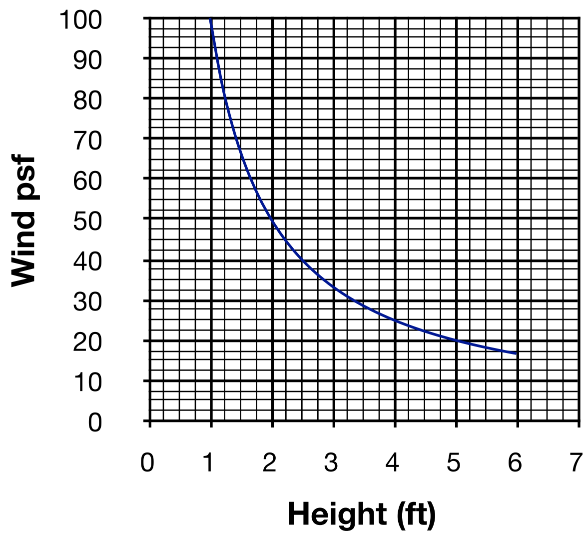
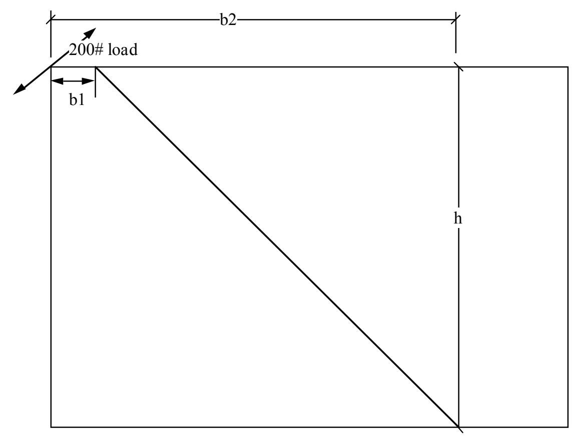
Determine height at which wind load will control over 50 plf top load:
$M_a = 50plf*h = W*h^2/2$
Solve for h:
h = 2*50/W = 100/W
or solve for W:
W = 100/h
or
W*h = 100
Relationship of wind to height where wind load controls over 50 plf top load (See graph)
Below line 50 plf top load will control design.



For 200 lb concentrated load
Worst case is load at end of panel top corner with no top rail:



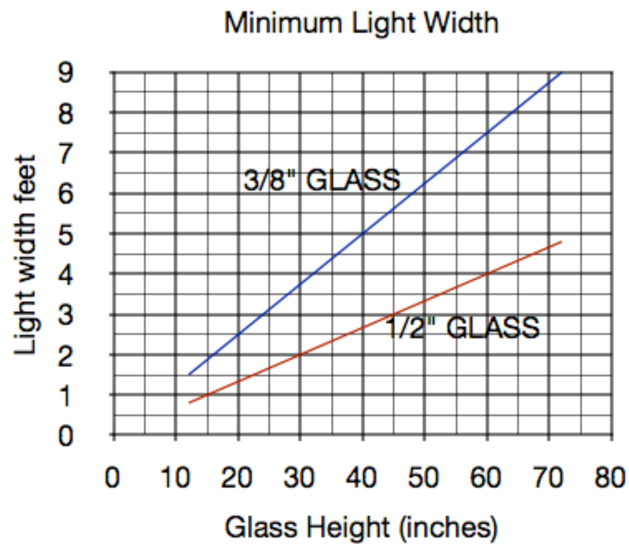
The load will be initially resisted by a strip = 8t
For 3/8" glass = 3"
The shear will transfer along the glass at a 45˚ angle to spread across the panel.
b2 = b1+h

@ 2" from top b2 = 3"+2" = 5"
M = 200#*2" = 400"#
S = 0.42*0.268 in^3 = 0.113 in^3
f_b = 400"#/0.113 in^3 = 3,540 psi

Determine minimum panel width S (ft) for height h (ft):

M = 200#*h = 8400"#
h = glass height in inches
$S_{yt} = S_y$ in^3/ft*S = $2*t^2*S$
$M_a = S_{yt}$*6,000psi
$S_{min} = M/(S_y*6{,}000) = 200*h/(2*t^2*6{,}000) = h/(60*t^2)$

For 3/8" glass:
$S_{min} = h/(60*0.366^2) = h/8$ in feet
For 1/2" glass:
$S_{min} = h/(60*0.5^2) = h/15$ in feet



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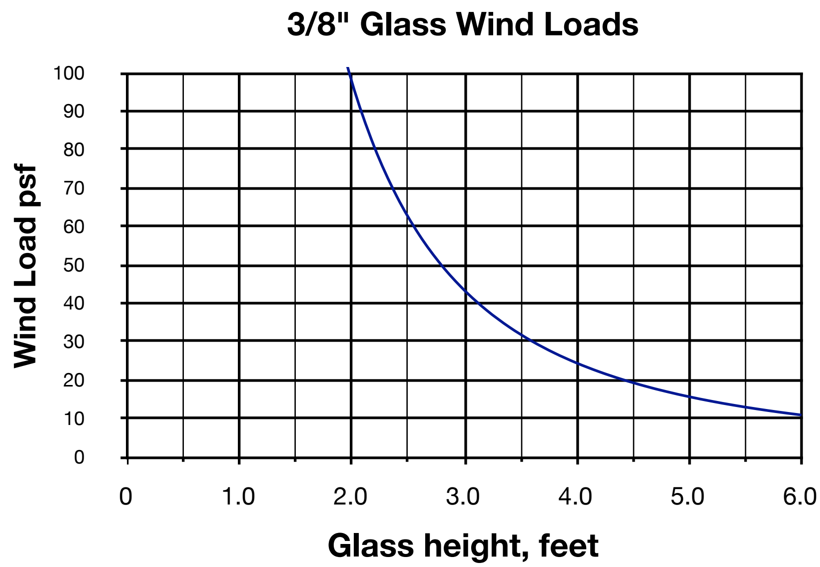
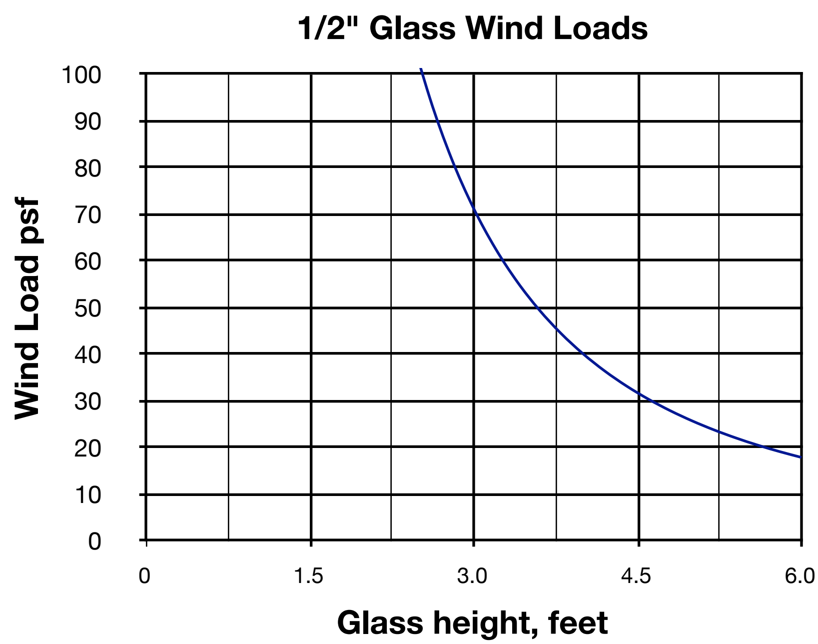
FOR 3/8” GLASS:
Determine relationship between allowable wind load and wind screen height:
For 50 plf distributed load:
h = 133.91/50plf = 2.678’
For 25 psf live load
$h = (133.91/12.5)^{1/2} = 3.27$’
For wind load
$h = (214.4/0.55W)^{1/2}$
$W = 214.4/0.55h^2$
Maximum Height at 25 psf live load = 3.27’

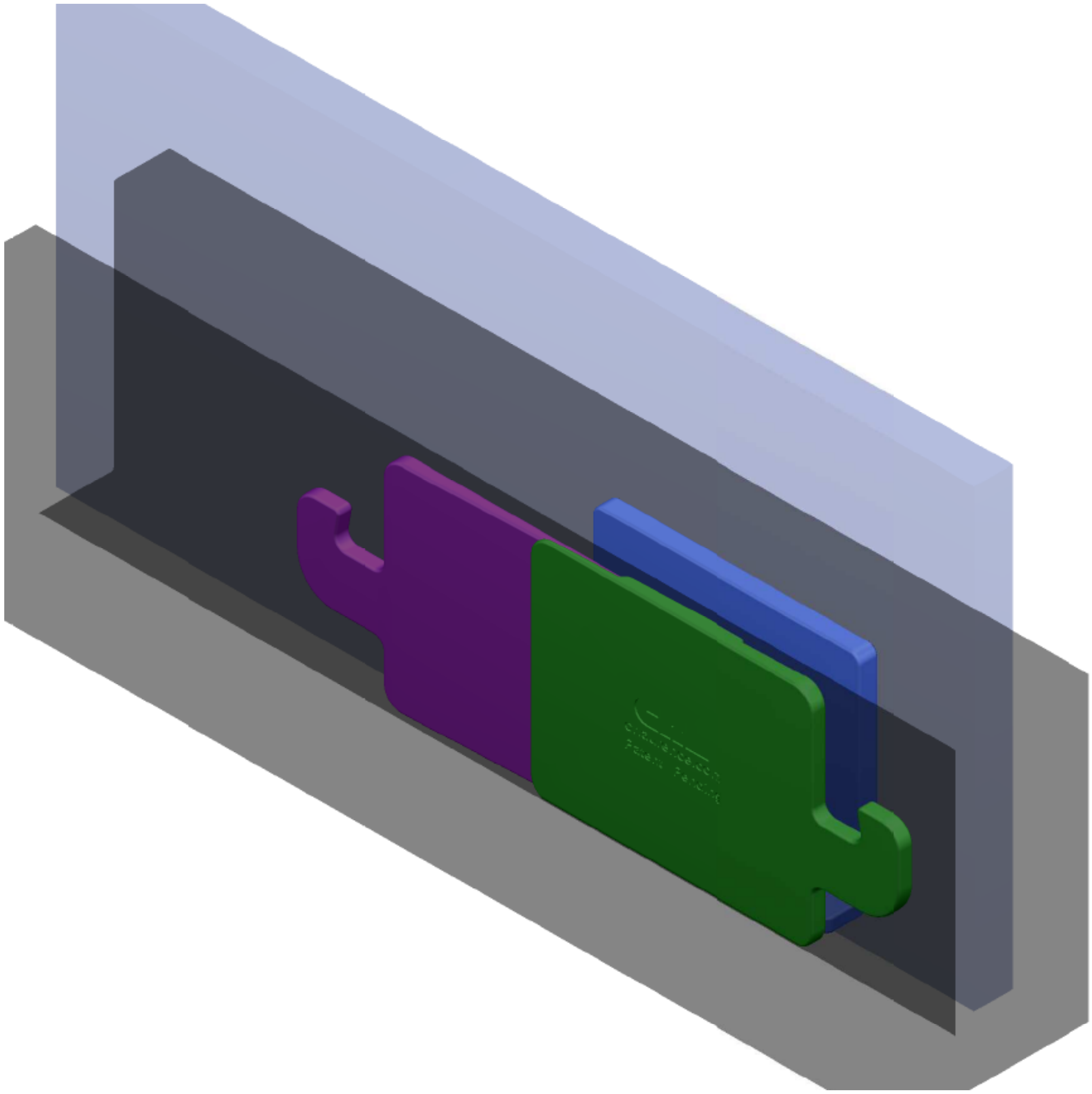


FOR 1/2” GLASS:
Determine relationship between allowable wind load and wind screen height:
For 50 plf distributed load:
h = 250/50plf = 5’
For 25 psf live load
$h = (250/12.5)^{1/2} = 4.47$’
For wind load
$h = (250*2/W)^{1/2}$
$W = 2*250/h^2$
Maximum Height at 25 psf load = 4.47’



NOTES:
Base Shoe anchorage may limit wind loads to less than that allowed by the glass strength.
Specifier shall be responsible to determine applicable load cases and wind load.

DRY-GLAZE TAPER-LOC® SYSTEM



Glass is clamped inside the aluminum base shoe by the Taper-Loc® Shoe Setting Plate (L shaped piece on the back side) and two Taper-Loc® Shim Plates (front side). The glass is locked in place by the compressive forces created by the Taper-Loc® shim plates being compressed together by the installation tool. Use of the calibrated installation tool assures that the proper compressive forces are developed. Until the shim plates are fully installed the glass may be moved within the base shoe for adjustment.

Glass may be extracted by reversing the installation tool to extract tapers.

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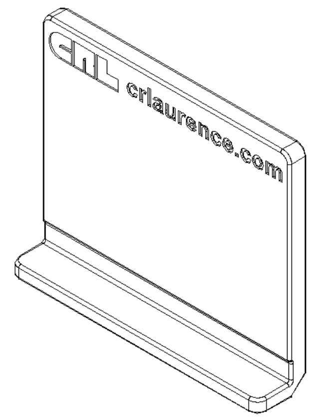
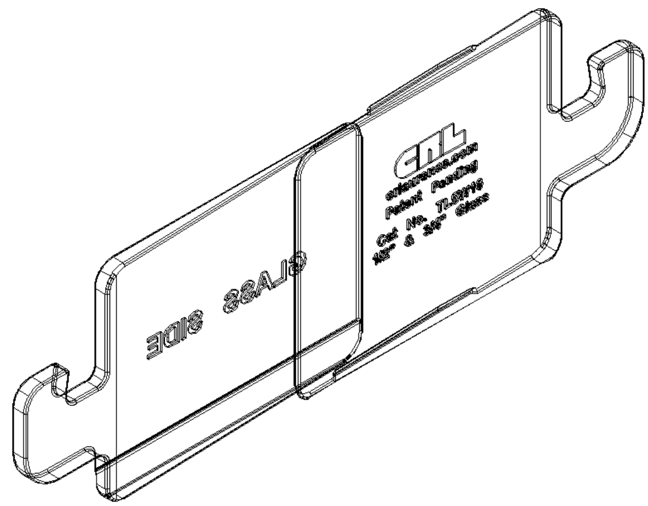


The Taper-Loc® setting plate is bonded to the glass by adhesive tape to hold it in place during installation and to improve glass retention in the base shoe.

Surface area of the setting plate adhered to the glass:
$A = 2\text{”}*2.5\text{”} = 5\ in^2$
adhesive shear strength $\geq$ 80 psi
3M™ VHB Tape
$Z = (2/3)*5\ in^2*80 = 267\#$ minimum

setting plate locks into place in the base shoe by friction created by the compression generated when the shim plates are locked into place.



Installation force:
$T_{des} = 250\#\text{”}$ design installation torque
$T_{max} = 300\#\text{”}$ maximum installation torque
Compressive force generated by the installation torque:
$C = (0.2*250\#\text{”}/1.0\text{”})/\sin(1.76^{\circ})$
$C = 1{,}628\#$

Frictional force of shims and setting plate against aluminum base shoe:
coefficient of friction, $\mu = 0.65$
$f = 2*(1{,}628\#0.65) = 2{,}117\#$

Frictional force of shims against glass:
$\mu = 0.20$
$f = 1{,}628*0.20 = 326\#$

Resistance to glass pull out:
$U = 267\#+326\# = 593\#$

Safety factor for 200# pullout resistance = 2*593/200 = 5.93
Based on two taper sets
Minimum recommended installation torque:
$4/5.93*250 = 169\#\text{”}$

Extraction force required to remove tapers after installation at design torque:

$T = 250*(0.7/0.2) = 875\#\text{”}$

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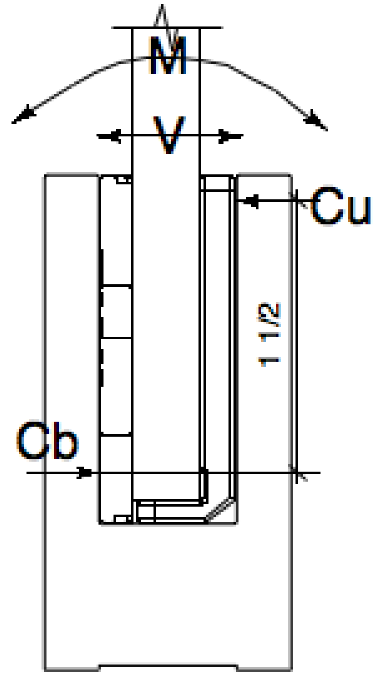

Glass anchorage against overturning:
Determine reactions of Taper-Loc® plates on the glass:
Assuming elastic bearing on the nylon parts the reactions will have centroids at approximately 1/6*1.80" from the upper and lower edges of the bearing surfaces:
R_{CU} @ 1/6*1.80 = 0.30"

From ∑M about R_{CU} = 0
0 = M+V*(0.3"0.5") - R_{CB} *1.5"
Let M = V*40" (42" total height)
M_a = 250#' for 1/2" glass
V = 250/3.33' = 75#
substitute and simplify:
0 = V*41.5" - R_{CB} *1.5"
Solving for - R_{CB}
R_{CB} = 75*41.5/1.5 = 2,075#
For C_B = 3,000 psi:
R_{CB} = 3.5"*(1.8"/2)*3,000 psi/2 = 4,725# > 2,075#
Bearing strength is okay
M_a = 2,075*(2/3*1.8") = 2,490#"
R_{CB} = R_{CB} +V = 2,075+75# = 2,215#

At maximum allowable moment determine bending in base shoe legs:

M_i = C*(0.188+1.8"/3)
M_s = R_{CB} [0.188+(1.8*2/3]
M_i = 1,628*(0.788) = 1,283#"
M_s = 2,215 *(1.388) = 3,074#"

Strength of leg 14" length = 3,086#"*14/12 = 3,600#"

Adjustment to allowable load based on base shoe strength:
M_s =3,086"# from page 13
M_a = 3,086/3,074*250'# = 251'#

<u>Allowable moment on system is limited to 250'# based on maximum allowable glass moment for 1/2" glass.</u>

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GLASS STRESS ADJUSTMENTS FOR THE TAPER-LOC® SYSTEM

The Taper-Loc® System provides a concentrated support:
Stress concentration factor on glass based on maximum 14” glass width to each Taper-Loc® set.

Moment concentration factor
Full scale tests and numerous FEA models indicate that there is no appreciable bending stress concentration associated with the concentrated spot supports that the Taper-loc® system employs. This is because of the purely elastic behavior of the glass for short duration loads up to failure combined with the ratio of the glass height to clear spacing between supports being greater than 2. The glass curvature must be nearly constant across the width of the glass so bending stress must be nearly constant. Thus bending stress will be accurately modeled as constant across the glass width.
F_b = 6,000 Allowable bending stress based on an SF = 4.0

Shear concentration factor:
Accounts for effect of point support
C_V = 14”/3.5”*(2-3.5/14) = 7.0
F_{Va} = 3,000 psi maximum allowable shear stress

Allowable Glass Loads:
M_a = S*6,000
V_a = t*b/7.0

For 1/2” glass, 12” width:
M_a = 0.5*6,000 = 3,000#” = 250#’
V_a = 0.5*12*3,000/7.0 = 2,571#

Since shear load in all scenarios is under 10% of allowable it can be ignored in determining allowable bending since it has less than 1% impact on allowable bending loads or rail heights.

Maximum edge distance for edge of glass to centerline of Taper-Loc® plates:
e_{des} = 14/2 = 7” for design conditions (no reduction in allowable loads)
e_{max} = e + e_{des}/2: (25*e*3.5’)+25*1.17*3.5^2/2 = 229.6 : solve for e
e_{max} = 3.5” + [229.6 - 25*1.17*3.5^2/2]/(25*3.5) = 10.4” (to CL of Taper-Loc® plates)

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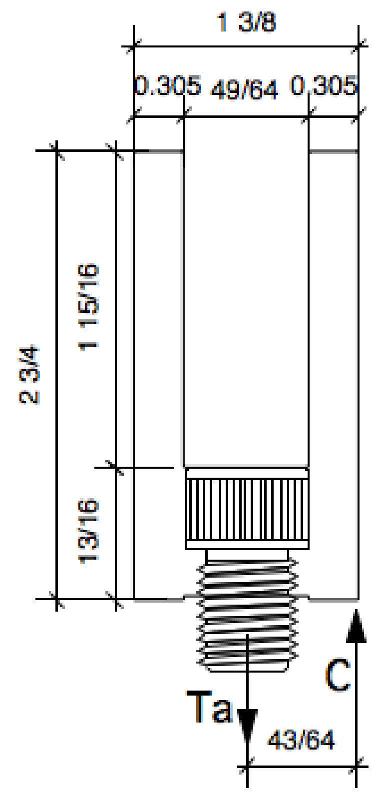

FRAMELESS WINDSCREEN BASE SHOE
6063-T52 Aluminum extrusion

Fully tempered glass glazed in place, using the Taper-Loc® dry-glazing system.

Shoe strength – Vertical legs:
Glass reaction by bearing on legs to form couple. Allowable moment on legs ADM Part 1B 3.4.4, 3.4.13 and 4.4
$M_a = S*øF_L$ or
$øF_L = 1.3*0.95*F_{cy} = 1.235*16\text{ksi} = 19.76$ ksi or
$øF_L = 1.42*0.85*F_u = 1.207*22\text{ksi} = 26.55$ ksi
$S_y = 12"*0.305"^2*/6 = 0.186\ in^3/ft$
$Z_y = 12"*0.305"^2*/4 = 0.279\ in^3/ft$
$øM_n =$ 26.55ksi*0.186 in^3/ft = 4,938#"/ft or (controls)
$øM_n =$ 19.76ksi*0.279 in^3/ft = 5,513#"/ft

Service moment on base shoe:
$M_s = øM_n/\lambda = øM_n/1.6$
M_s = 4,938#"/ft/1.6 = 3,086#"

Leg shear strength @ bottom
t_{min} = 0.305"
$øF_{Ls}$= 0.95*16 ksi/√3 = 8.775 ksi
V_{all} = 0.305"*12"/ft*8.775 ksi = 32.12 k/ft

Base shoe anchorage:
Typical windscreen design moment = 250#' = 3,000#" (maximum allowable moment)

Typical Anchor load – 12" o.c. – T_a = 3,000"#/(43/64") = 4,465#

For attachment to steel:
For 1/4" cap screw to tapped steel, F_u = 120 ksi
$T_n = A_{sn}*t_c*0.6*F_{tu}$
where t_c = 0.25"; A_{sn} = 0.539" and F_{tu} = 58 ksi (A36 steel plate)
T_n = 0.539"*0.25*0.6*58 ksi = 4,689 k
Bolt tension strength = 120 ksi*0.0318 in^2 = 3.816 k
Maximum service load: 0.75*3.816k/1.6 = 1,789#
Maximum allowable moment for 12" on center spacing and direct bearing of base shoe on steel:
M_a = 1,789#*[43/64-0.5*1,789/(30ksi*12)] = 1,198#" = 100#' per anchor
Spacing required for full strength: $S_{1/2}$ = 12/(250/100) = 4.8" o.c.
Spacing for full 3/8" glass strength: $S_{3/8}$ = 12/(133.91/100) = 8.96" say 9" o.c.

For attachment to concrete:

1/4" x 3" screw in anchor into 3-1/2" deep holes. CRL Part # WBA14x3 manufactured by Hilti (KWIK HUS-EZ). Allowable loads based on ESR-3027 and ACI 318-08 Appendix D.

$øN_{sa}$ = 0.65*4,400# = 2,860#

For concrete breakout strength:

$N_{cb} = [A_{Nc}/A_{Nco}]\varphi_{ed,N}\varphi_{c,N}\varphi_{cp,N}N_b$

A_{Nc}= (1.5*2.25"*2)*(1.5*2.5*2) = 45.56in^2 Minimum edge distance is 3 3/8"

A_{Nco}= 9*2.5^2 = 45.56in^2

$S_{c,amin}$ = 1.5*2.5" = 3.75

S_{ac} = 2.5*2.5" = 6.25

$\varphi_{ed,N}$ = 1.0

$\varphi_{c,N}$ = 1.0 (from ESR-3027)

$\varphi_{cp,N}$= 1.0 (from ESR-3027)

$N_b = 24*1.0*\sqrt{3000}*2.25^{1.5}$ = 4,437#

N_{cb} = 45.56/45.56*1.0*1.0*1.0*4,437 = 4,437#

From ESR-3027 anchor pull out does not control design

$øN_n$ = 0.65*4,437# = 2,884#

Anchor steel strength controls; øN = 2,860#

Moment resistance of each anchor:

$øM_n$ = 2,860#*[43/64-0.5*2,860/(2*0.85*3ksi*12)] = 1,855#" = 154.6#' per anchor

$M_a = øM_n/\lambda$ = 154.6/1.6 = 96.6#'

For 1/2" glass:

$M_{u1/2} = \lambda M$ = 1.6*250 = 400#'

$S_{1/2}$ = 12/(400/154.6) = 4 5/8" o.c.

For 3/8" glass:

$M_{u3/8} = \lambda M$ = 1.6*133.91 = 214.3#'

$S_{3/8}$ = 12/(214.3/154.6) = 8 5/8" o.c.

Minimum anchor spacing for full tension strength:

2.25"*2.5 = 5 5/8"

Since anchor strength is nearly the same between the steel and concrete anchorage systems determine allowable loading on system based on the concrete anchorage case.

Check based on three spacing distances:

12" o.c.: M_a = 96.6#'/ft

8" o.c.: M_a = (12/8)*96.6#'/ft = 144.9#'

6" o.c.: M_a = (12/6)*96.6#'/ft = 193.2#'

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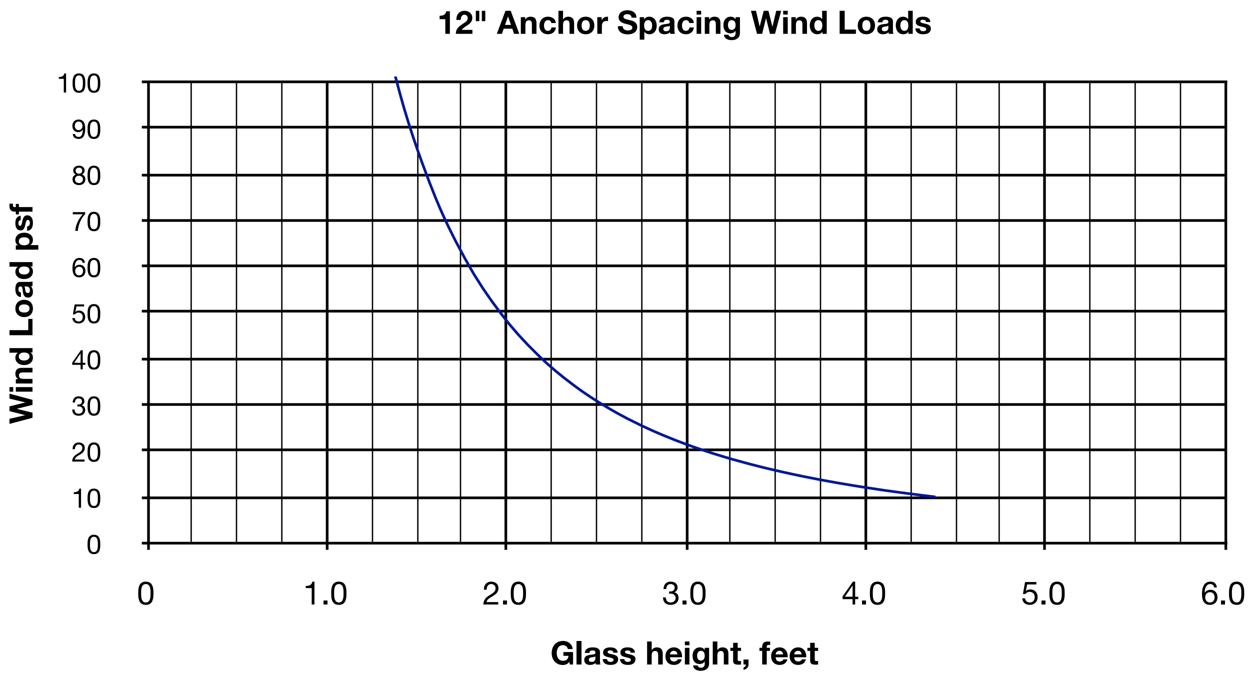
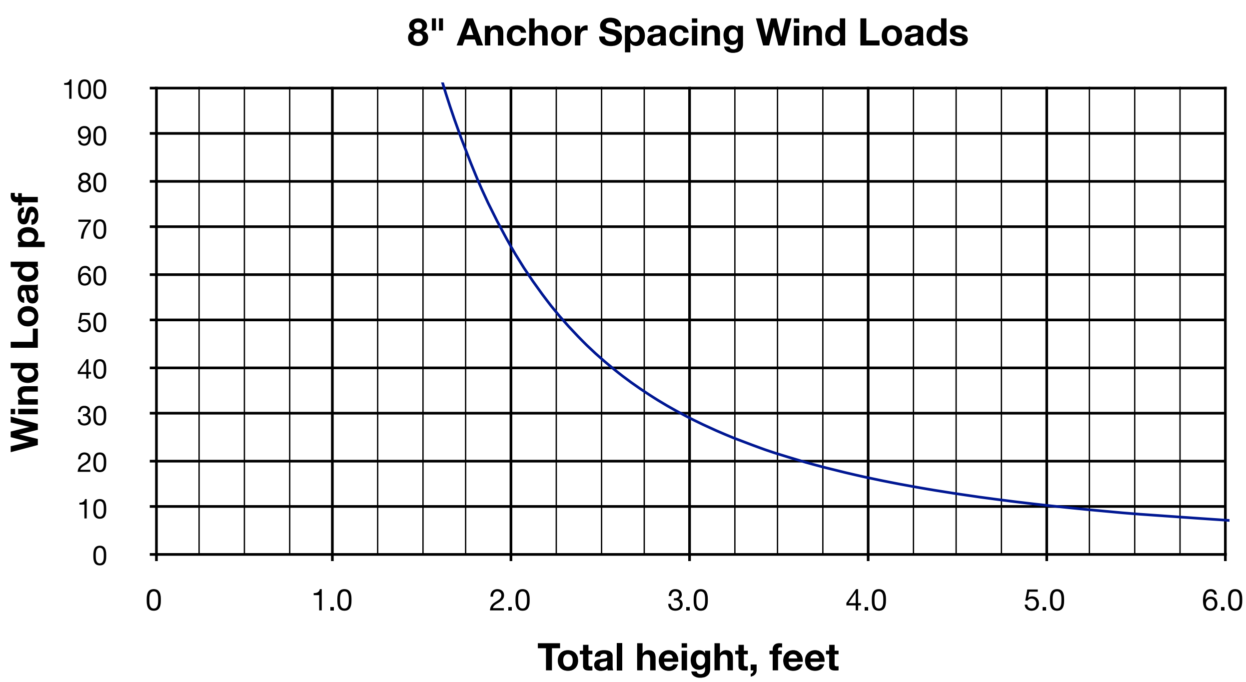
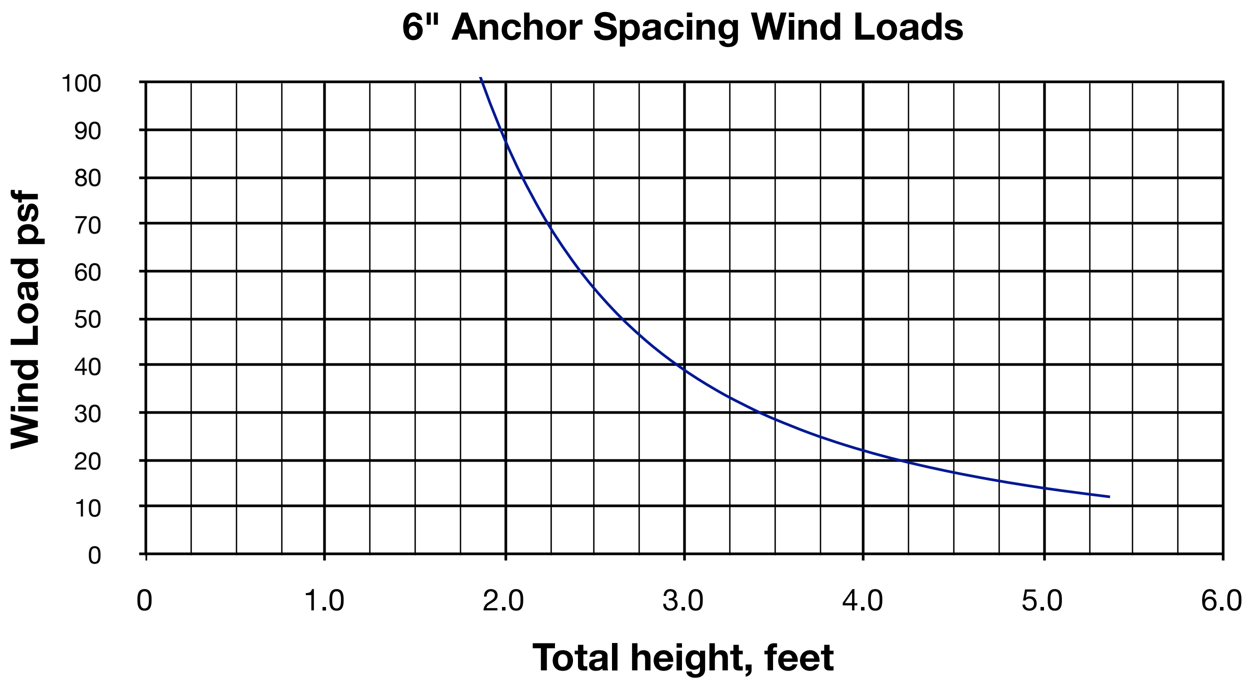




Above graphs are for attachment to concrete



Maximum wind screen heights when fall protection is required:

12” o.c.: H = (96.6#’/ft*12)/50plf = 23 3/16”
8” o.c.: H = 133.91#’/ft*12/50plf = 32 1/8” (3/8” glass)
8” o.c.: H = (12/8)*96.6#’/ft*12/50plf = 34 3/4” (1/2” glass only)
6” o.c.: M_a = (12/6)*96.6#’/ft*12/50plf = 46 3/8” (1/2” glass only)

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Installation to wood:

1/4” x 4” lag screws into solid wood, Douglas Fir or Southern Pine or equivalent density wood.
Typical anchor to wood: 1/4” lag screw. Withdrawal strength of the lags from *National Design Specification For Wood Construction* (NDS) Table 11.2A.
For Doug-Fir Larch or denser, G = 0.50
W = 225#/in of thread penetration.
C_D = 1.33 for guardrail live loads, or = 1.6 for wind loads.
C_m = 1.0 for weather protected supports (lags into wood not subjected to wetting).
$T_b = WC_DC_ml_m$ = total withdrawal load in lbs per lag
$W' = WC_DC_m$ =225#/”*1.33*1.0 = 300#/in
Lag screw design strength – 3/8” x 4” lag, l_m = 4”-0.375”-7/32” = 3.4”
T_b = 300*3.4” = 1,020#
Steel strength = 70ksi*A_t/1.67 = 41.9ksi*0.0351in^2 = 1,472# > 1,020#
Z_{ll} = 210# per lag, (horizontal load) NDS Table 11K
Z'_{ll} = 210#*1.33*1.0 = 280#
Z_T = 150# per lag, (vertical load)
Z_T = 150#*1.33*1.0 = 200#

Determine moment strength of anchorage:
For pivoting about edge of base shoe:
Required compression area based on wood strength:
F_{cT} = 560psi; $F'_{cT}*C_d*C_b$ = 560psi*1.33 = 745psi
For C = T =1,020#
A = 1,020#/745psi = 1.369in^2
b = A/(12”) = 1.369/(12) = 0.114”
M_a = 1,020#*(43/64-0.114/2) = 627.2#” = 52.27#’ For 12” o.c. spacing
Maximum height for 50 plf top load:
H = 627.2#”/50 = 12 1/2”
For wind load see graph on next page

For 6” spacing:
M_a = 2*1,020*(43/64-2*0.114/2) = 1,138#” = 94.8#’ For 6” o.c. spacing
Maximum height for 50 plf top load:
H = 1,138#”/50 = 22 3/4”
For wind load see graph on next page.

The Frameless Windscreen System when anchored to wood shall only be directly installed on wood that is protected from the weather and won’t have at any time an in service moisture content over 19%. Installations to wood exposed to the weather where moisture content may exceed 19%, MC > 19, require project specific design and are outside of the scope of this report.

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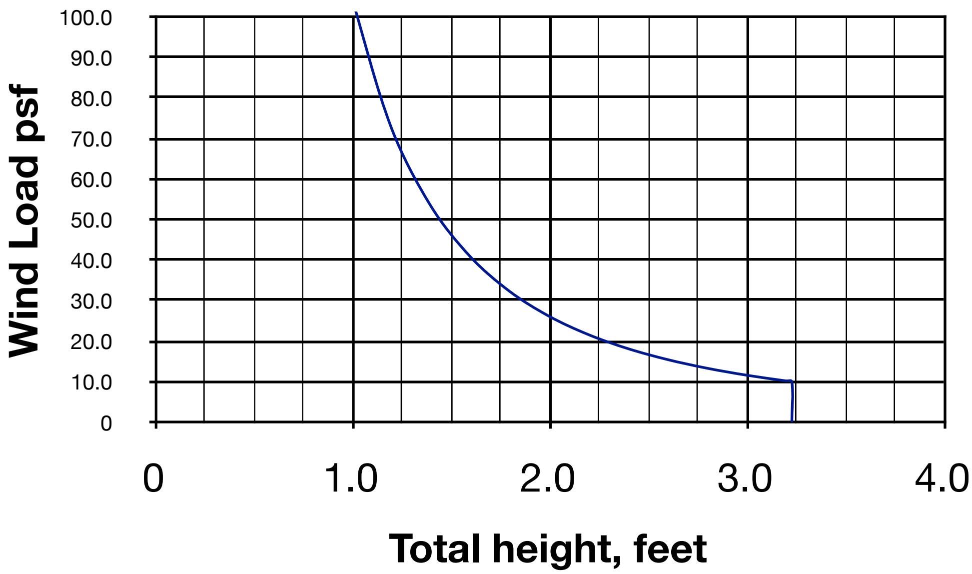
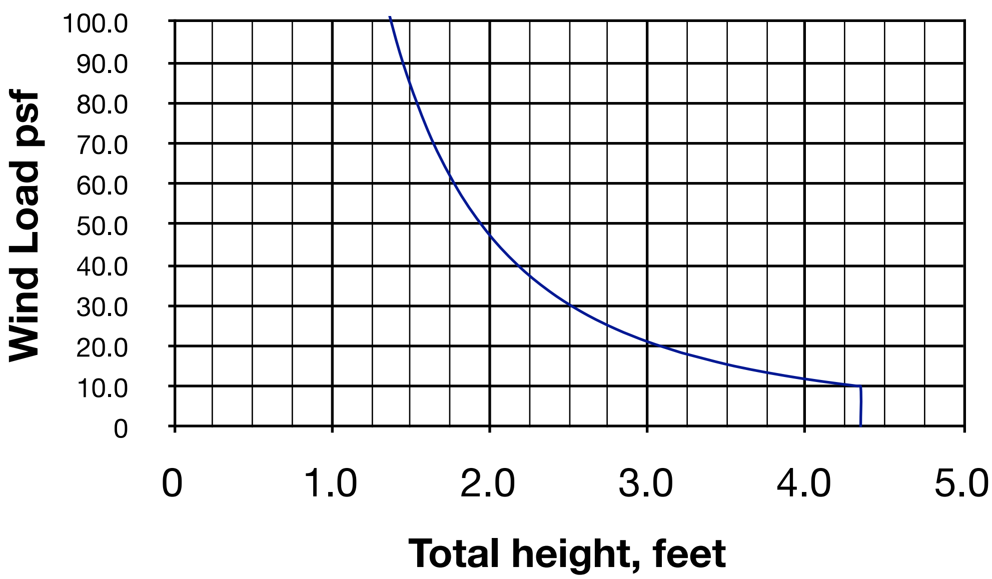
Lag Screws @ 12" O.C. Wind Loads



Lag Screws @ 6" O.C. Wind Loads



Above graphs are applicable when installed on wood with specific gravity, G ≥ 0.5 and protected from wetting so that moisture content MC ≤ 19% at all times.

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