# FLORIDA AND MIAMI DADE COUNTY NOA DATA

January 28, 2021

Mr. Chris Frederick
Product Control Section
Department of Regulatory and Economic Resources
Miami-Dade County
11805 S. W. 26 Street, Room 208
Miami, Florida, 33175-2474

Re: ClearView Glass Railings – Request for Notice of Acceptance (NOA) for Hercules Glass Panels

Dear Mr. Frederick,

This letter is written to request a Notice of Acceptance (NOA) for our Hercules Glass Panels product. This is a request for a NOA for a new product. Our Hercules Glass Panels are sold as interior and exterior glass railings, to be installed on commercial and residential buildings as guardrails. They meet Florida Building Code requirements for guardrails, including special requirements for all-glass railings.The panels have been tested and evaluated to withstand the 180 mph winds in the high wind coastal area.

Included in this submittal packet:

1. Application
2. Application review fee
3. Indication of labeling to meet Miami-Dade County Labeling Guideline.
4. Signed letter by Florida Licensed PE stating that the produce conforms to current FBC.
5. Signed letter by same Florida PE that he has no financial interest with the lab that performed the test or the product supplier.
6. Packet signed by Florida PE that includes evaluation of FBC requirements, testing data, and structural analysis of testing results.
7. Marked-up drawing identifying all components of specimens.

Sincerely,

John Ruprecht

CONSULTANTS
· ENVIRONMENTAL
· GEOTECHNICAL
· MATERIALS
· FORENSICS

AMERICAN ENGINEERING TESTING, INC.

Attachment 4

February 1, 2021

Mr. Chris Frederick
Product Control Section
Department of Regulatory and Economic Resources
Miami-Dade County
11805 Southwest 26th St.
Miami, FL 33175

Re: ClearView Glass Railings – Florida Code Review
AET Project #: 05-20608

Dear Mr. Frederick,

This letter provides our statement regarding the Hercules Glass Panel, produced by ClearView Glass Railings of Lakeland, Minnesota, conformance to the Florida State Building Code relative to Sections 1607 and 1609 for exterior guardrails and more specifically, all-glass guardrails. Our scope included reviewing physical testing performed by others and performing our own stress calculations using Finite Element Analysis methods. Based on our analysis and to the best of our knowledge, it is our opinion that the Hercules Glass Panels meet the applicable sections of the Florida State Building Code. This letter is accompanied by a packet of information that describes our services with this product.

Contact us for additional information or with questions that you might have.

Sincerely,
American Engineering Testing, Inc.

Chris Hartnett, PE*
Principal Engineer
*MN, WI, AL, MD, MO, NC, ND, OH, PA, TN VA
Phone: 651-647-2750
chartnett@amengtest.com

Daniel J. Larson, PE
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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
· ENVIRONMENTAL
· GEOTECHNICAL
· MATERIALS
· FORENSICS

Attachment 5

February 1, 2021

Department of Regulatory and Economic Resources – Product Control Section
Miami-Dade County
Stephen P. Clark Center
111 NW 1st St.
Miami, FL 33128

Re: "Hercules" Glass Guardrail Panel Testing – Statement of Non-Financial Interest
AET Project #: 05-20608

Dear Product Control Section,

This letter is written to support the application for a Notice of Acceptance (NOA) by Miami-Dade County, for Clear View Glass Railings (CVG) "Hercules" Glass Guardrail Panel. American Engineering Testing (AET) has been engaged by CVG to provide structural testing and engineering consulting services to address International Building Code (IBC) and Florida Building Code (FBC) requirements.

American Consulting Services and all subsidiaries including AET, officers and staff working on this project, have no financial interest in CVG or their products.

Sincerely,
American Engineering Testing, Inc.

Chris A Hartnett

Chris Hartnett, PE*
Principal Engineer
*MN, WI, AL, MD, MO, NC, ND, OH, PA, TN VA
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Attachment 6

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

# CLEARVIEW GLASS RAILINGS – STRUCTURAL ASSESSMENT

## FOR MIAMI-DADE COUNTY NOTICE OF ACCEPTANCE (NOA)

**AET Project No. 05-20608**

STRUCTURAL TESTING, FINITE ELEMENT ANALYSIS AND CODE EVALUATION

JANUARY 28, 2021

PREPARED FOR:
MR. JOHN RUPRECHT
CLEAR VIEW GLASS RAILINGS
737 QUENTIN AVENUE SOUTH
LAKELAND, MN 55043


PREPARED BY:
CHRIS HARTNETT, PE
DANIEL LARSON, PE


St. Paul, MN
Duluth, MN
Mankato, MN
Marshall, MN
Rochester, MN
Williston, ND
Pierre, SD
Rapid City, SD
Sioux Falls, SD
Wausau, WI
Sheridan, WY
Gillette, WY
Casper, WY

Attachment 6

February 1, 2021

Mr. John Ruprecht
Clear View Glass Railings
737 Quentin Avenue South
Lakeville, MN 55043

Re: Florida Wind Load Requirements for Wind-Borne Debris Regions, and Considerations for "Hercules" Glass Guardrail Panel
AET Project #: 05-20608

Dear Mr. Ruprecht,

This letter reports the findings of our review of the Florida Building Code (FBC) wind requirements for Wind-Borne Regions, as defined by the FBC. We compare these requirements to the published and tested strength of the Hercules Glass Guardrail Panel, model CVGR 1001 FWP, and provide conclusions regarding panel design requirements to meet specific portions of the FBC code.

Panel Construction

The Florida Building Code (FBC) Section 2407 addresses glass used in handrails and guards; it specifies materials, loads, support conditions and wind-borne debris regions. According to the FBC and in compliance with Category II of the Consumer Product Safety Commission (CPSC) and Class A of ANSI Z97.1, glass used in guardrails must be laminated glass constructed of fully tempered or heat strengthened glass and tested for its water penetration resistance, wind loading, impact, durability, thermal properties, and mechanical performance. It is our understanding that the panel is laminated and fully tempered.

Panel Support

FBC Section 2407.1.2 requires that all panels "shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one baluster panel fail". We interpret this to mean that the panels will require three spigot supports. The Hercules Glass Guardrail Panel is available with three spigots, where required by Florida Building Code.

FBC Section 2407.1.2 also includes an exception that states, "A top rail shall not be required where the glass balusters are laminated glass with two or more glass plies of equal thickness and the same glass type when approved by the building official". We understand the panel meets this exception; therefore, a top rail is not required.

Wind Loading vs. Panel Capacity

The FBC follows the International Building Code (IBC) requirements for wind loads, with ultimate (factored) wind speeds up to 180 mph; Table 1609.3.1 converts this to 139 psf for unfactored loading, which was used in the analysis. See Attachment 1 for nominal ground wind speed reference maps from the Florida Building Code.

The American Society of Civil Engineers (ASCE) Standard 7-10, Chapter 29, provides the analysis method to convert wind speed (in mph) to pressure (psf) against the glass panel. Using Exposure Category C (open terrain) and a height of 100 feet above ground; a 139 mph wind produces a calculated pressure of 81psf. See Attachment 2. The three distinct support points, "spigots", for these panels creates stress concentrations around the supports that are best modeled using a finite element model (FEM). A FEM model was created for this panel using Risa-3D software (version 10.0.1), that modeled a 60" wide x 39" tall x 13mm thick tempered and laminated panel, with a 81psf surface load applied. The model generated a 15,979 psi principal axis stress ($\sigma$) in the panel. See Attachment 3.

The glass used in the panels was tested to determine its structural capacity, using a static load applied to a test specimen. The specimen was loaded to failure, and the loading was applied to the FEM to determine the equivalent stresses. The failure stress was 35,767 psi. This modeling shows that the panels have calculated factor-of-safety of 2.24. See Attachment 4.

Impact Resistance

For building envelope glazing in wind-borne debris regions, glass that is part of a building envelope must be tested for impact resistance in accordance with American Society for Testing and Materials (ASTM) E1996. This requirement protects a closed building envelope from being penetrated and prevents high wind pressures from filling the building, potentially blowing out windows and lifting the roof off the building. Because these panels are not part of the building enclosure, damage from wind-borne debris would not penetrate the enclosure and its structural elements. Therefore, this test is not required for the panels used as a guardrail system.

Summary

In summary, based on our understanding of the FBC requirements, our conclusions are as follows:

1. Each panel is constructed of fully tempered, laminated glass.
2. Each panel is secured to the structure with three supports.
3. A top rail is not required for these panels.
4. Wind pressure – previous testing confirms that the panels meet the 180 mph factored wind speed requirement, with a calculated factor-of-safety of 2.24.
5. The panels do not require wind debris projectile testing.

Please call or e-mail us to discuss this analysis or any portion of the project to evaluate your panels.

Sincerely,
American Engineering Testing, Inc.

Chris Hartnett, PE*
Principal Engineer
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Attachment 1: Florida Building Code Figure 1609.1 – Ultimate Wind Design Speed.
Attachment 2: ASCE 7-10 Wind & Pressure Calculations.
Attachment 3. Finite Element Modelling.
Attachment 4: Physical Testing

# 1609.3 Ultimate Design Wind Speed

The ultimate design wind speed, $V_{ult}$, in mph, for the determination of the wind loads shall be determined by Figures 1609.3(1), 1609.3(2) and 1609.3(3). The ultimate design wind speed, $V_{ult}$, for use in the design of Risk Category II buildings and structures shall be obtained from Figure 1609.3(1). The ultimate design wind speed, $V_{ult}$, for use in the design of Risk Category III and IV buildings and structures shall be obtained from Figure 1609.3(2). The ultimate design wind speed, $V_{ult}$, for use in the design of Risk Category I buildings and structures shall be obtained from Figure 1609.3(3). The ultimate design wind speed, $V_{ult}$, for the special wind regions indicated near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. The ultimate design wind speeds, $V_{ult}$, determined by the local jurisdiction shall be in accordance with Section 26.5.1 of ASCE 7. The exact location of wind speed lines shall be established by local ordinance using recognized physical landmarks such as major roads, canals, rivers and lake shores wherever possible.

In nonhurricane-prone regions, when the ultimate design wind speed, $V_{ult}$, is estimated from regional climatic data, the ultimate design wind speed, $V_{ult}$, shall be determined in accordance with Section 26.5.3 of ASCE 7.

Attachment 1

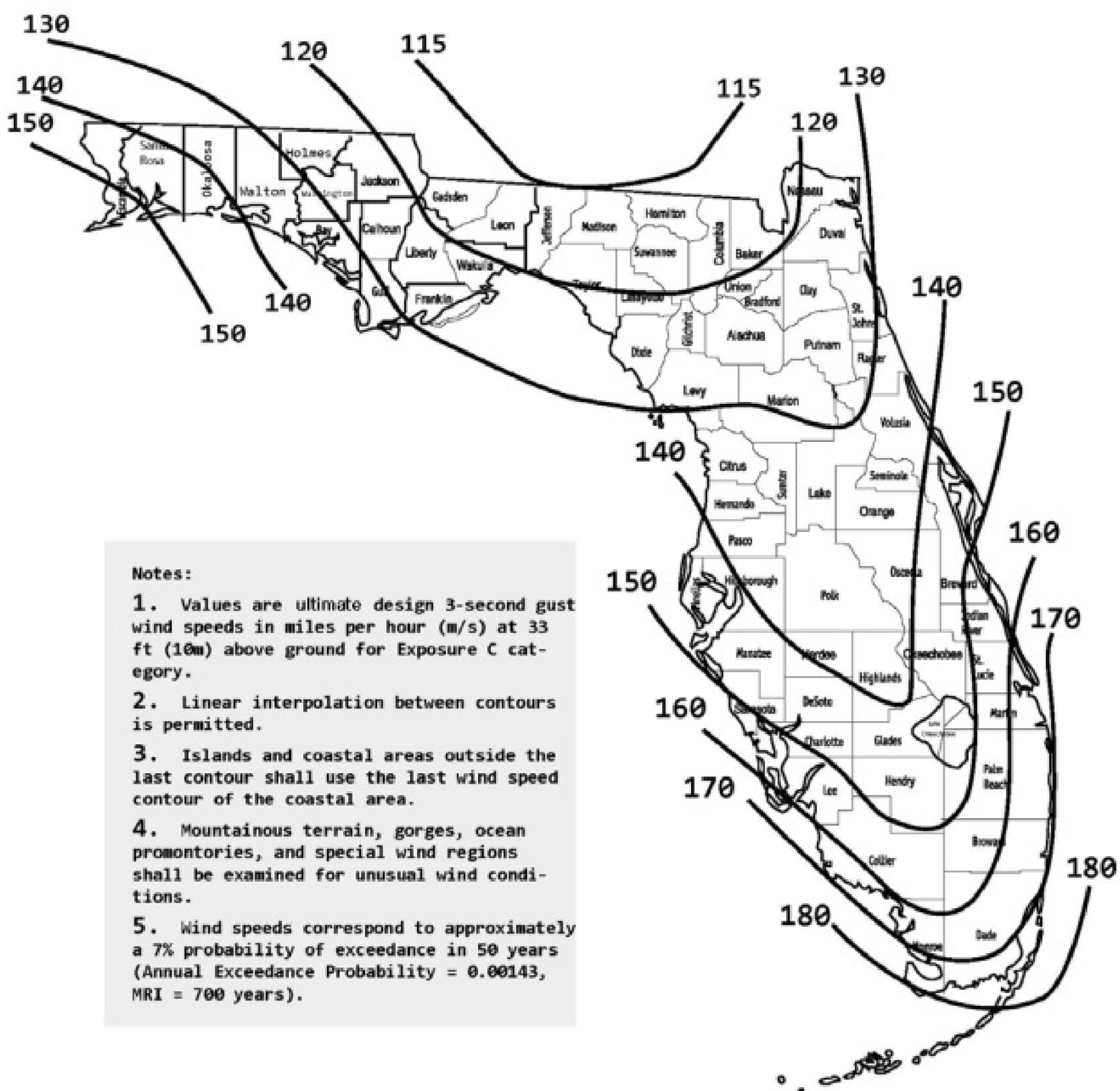



**FIGURE 1609.3(1)**

**ULTIMATE DESIGN WIND SPEEDS, $V_{ULT}$, FOR RISK CATEGORY II BUILDINGS AND OTHER STRUCTURES**

## Attachment 1

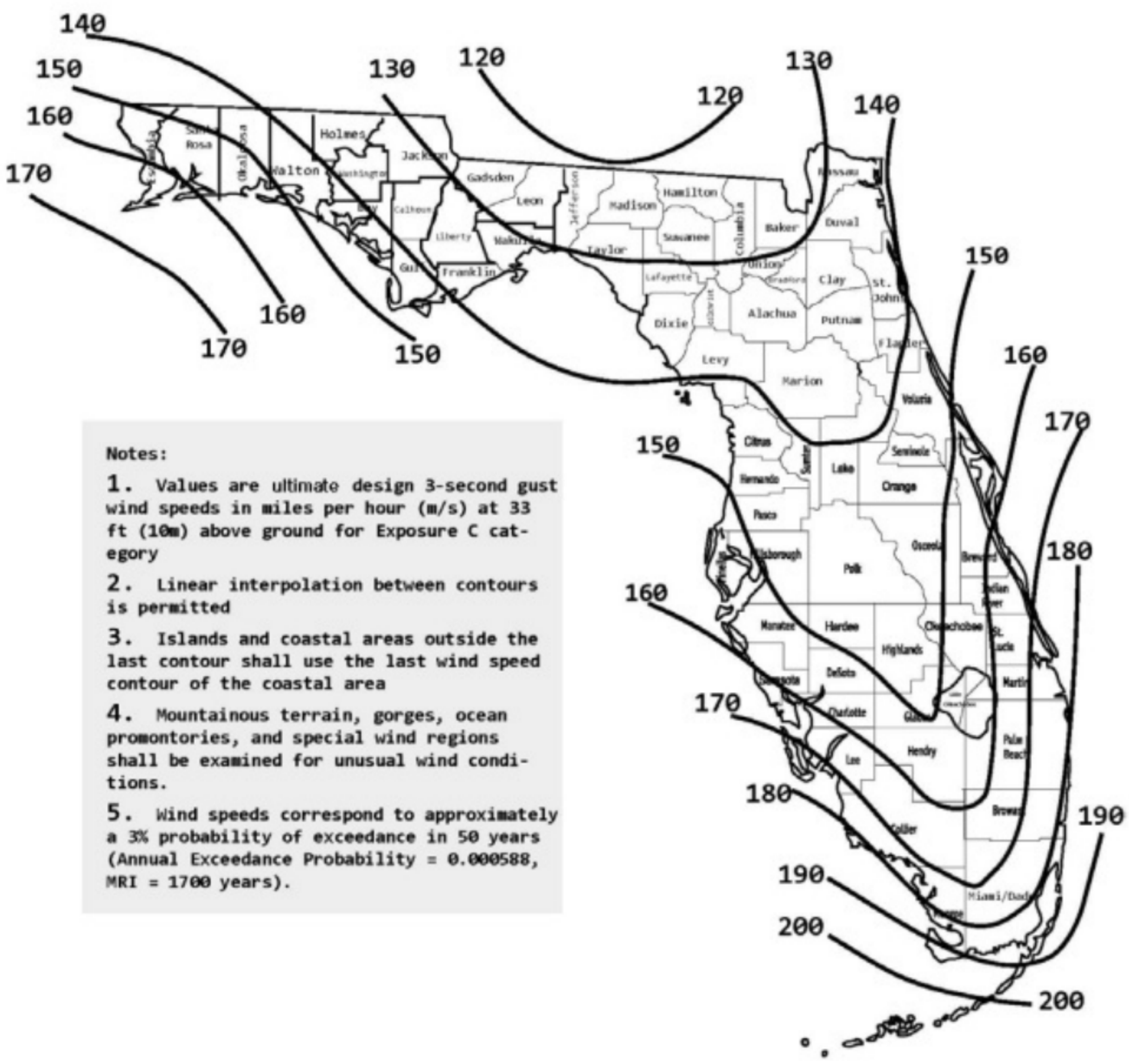



**FIGURE 1609.3(2)**

**ULTIMATE DESIGN WIND SPEEDS, $V_{ULT}$, FOR RISK CATEGORY III AND IV BUILDINGS AND OTHER STRUCTURES**

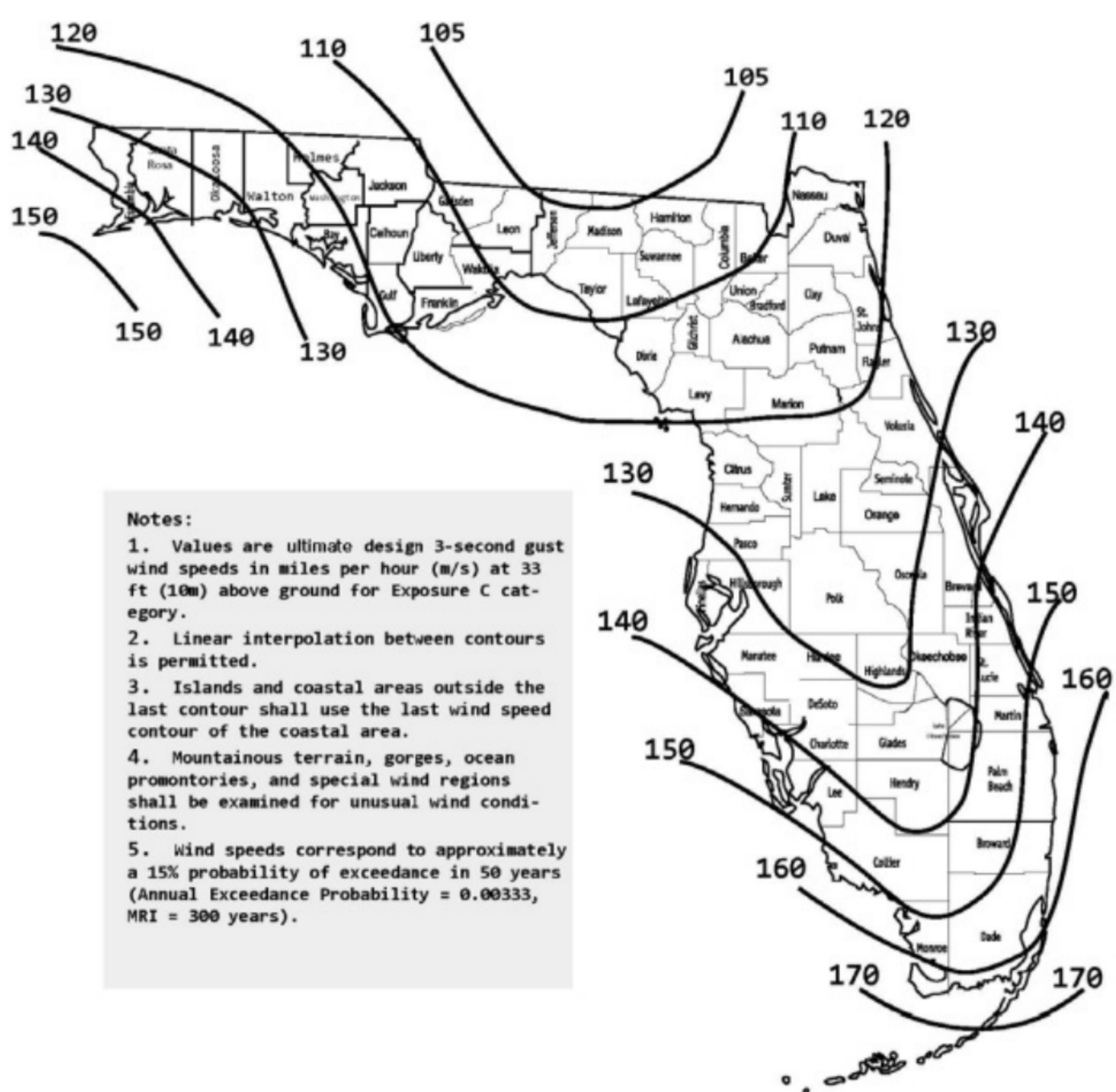



**FIGURE 1609.3(3)**

**ULTIMATE DESIGN WIND SPEEDS, $V_{ULT}$, FOR RISK CATEGORY I BUILDINGS AND OTHER STRUCTURES**

**1609.3.1 Wind Speed Conversion**

When required, the ultimate design wind speeds of Figures 1609.3(1), 1609.3(2) and 1609.3(3) shall be converted to nominal design wind speeds, $V_{asd}$, using Table 1609.3.1 or Equation 16-33.

$$V_{asd} = V_{ult}\sqrt{0.6}$$

**where:** **(Equation 16-33)**

***$V_{asd}$* = Nominal design wind speed applicable to methods specified in Exceptions 4 and 5 of Section 1609.1.1.**

***$V_{ult}$* = Ultimate design wind speeds determined from Figures 1609.3(1), 1609.3(2) or 1609.3(3).**

**TABLE 1609.3.1**

**WIND SPEED CONVERSIONS[a, b, c]**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_{ult}$ | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 |
| $V_{asd}$ | 78 | 85 | 93 | 101 | 108 | 116 | 124 | 132 | 139 | 147 | 155 |

For SI: 1 mile per hour = 0.44 m/s.

a. Linear interpolation is permitted.

b. $V_{asd}$ = nominal design wind speed applicable to methods specified in Exceptions 1 through 5 of Section 1609.1.1.

c. $V_{ult}$ = ultimate design wind speeds determined from Figure 1609.3(1), 1609.3(2) or 1609.3(3).

# Attachment 1

**IBC Wind Load Calculations**

Project: CVG Railings - Florida High Wind Region
Project #: 05-20608
11/5/2020
Code: Florida Building Code
Source Document: ASCE 7-10, Chapter 29

**Other Structures (Section 6.5.13)**

**Coefficients**

| Coefficient | value | source |
|---|---|---|
| Risk Category | ii | Table 1.5-1 |
| V (mph): | 139 | Figures 26.5-1A-C. All of US e: |
| Exposure: | c | para 26.7 |
| direction factor, Kd: | 0.85 | Table 26.6-1 |
| topography fact , Kzt | 1 | para 26.8 |
| gust factor, G | 0.85 | Section 26.9 |
| Larger dimension of sign, M (ft) | 5 | Table 6-11 |
| Smaller dimension of sign, N (ft) | 3 | Table 6-11 |
| Net force coefficients, Cf | 1.8 | Figure 29.4-1 through 29.5-3 |
| Average height above ground, (ft) | 100 | |
| velocity pres. Expose coeff, Kz | | Table 29.3-1 |
| Building height (ft): | | |
| 0-15 | 0.85 | |
| 20 | 0.9 | |
| 25 | 0.94 | |
| 30 | 0.98 | |
| 40 | 1.04 | |
| 50 | 1.09 | |
| 60 | 1.13 | |
| 70 | 1.17 | |
| 80 | 1.21 | |
| 90 | 1.24 | |
| 100 | 1.26 | Kh (K @ mean roof ht |
| | | |
| velocity pres. Expose coeff, Kh | 1.26 | Choose highest value of Kz |
| Velocity pressure, qz | 52.97 | qz=.00256*Kz*Kzt*Kd*V^2 |
| Projected area normal to wind, Af (sq ft) | 15 | =M*N |

| | | |
|---|---|---|
| Total Force on Supports, F (kips) | 1.22 | F=qz*G*Cf*Af |
| Equivalent pressure, P (psf) | 81.0 | P=F/(M*N) |

**Attachment 3: Finite Element Modelling**

A finite-element-model (FEM) was created to model the Hercules Glass Panel. The model measures 60” x 39” x 13mm (0.51”) thick, and includes 960 elements sized approximately 1.5” square x 13mm (0.51”) thick. The model is supported at three points, at the panel “spigots. The spigots are approximately 4” tall x 3” wide. See Figure 1 below.

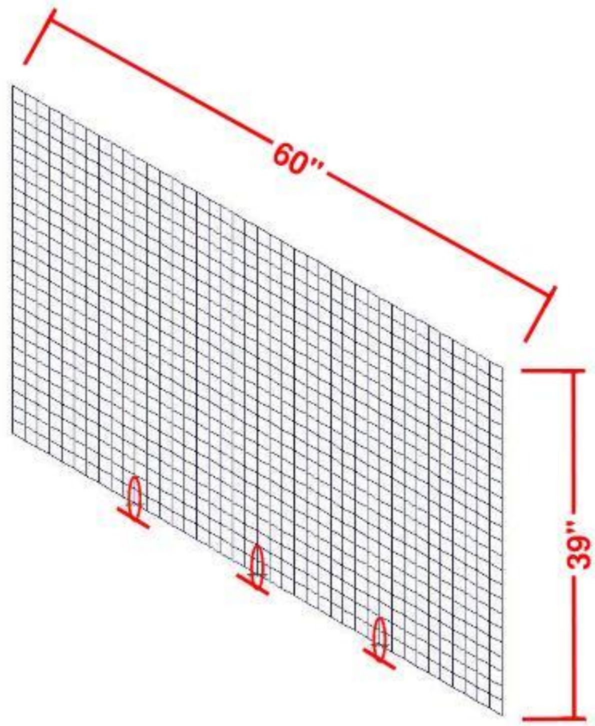



Figure 1: Panel Configuration

The highest stresses caused by a lateral wind load are experienced at the elements around the spigots. Figure 2 shows the element numbers of the panel and a close-up of the elements around the spigots. Note that the elements supported directly by the spigots are blanked out because they are supported by the spigots and are not stressed.

| Left spigot | Middle spigot | Right spigot |
|---|---|---|
| Element 899 | 919 | 939 |
| 897 | 917 | 937 |
| 819 | 839 | 859 |
| 820 | 840 | 860 |
| 823 | 842 | 863 |
| 824 | 844 | 864 |
| 902 | 922 | 942 |
| 904 | 924 | 944 |

**Attachment 3: Finite Element Modelling**

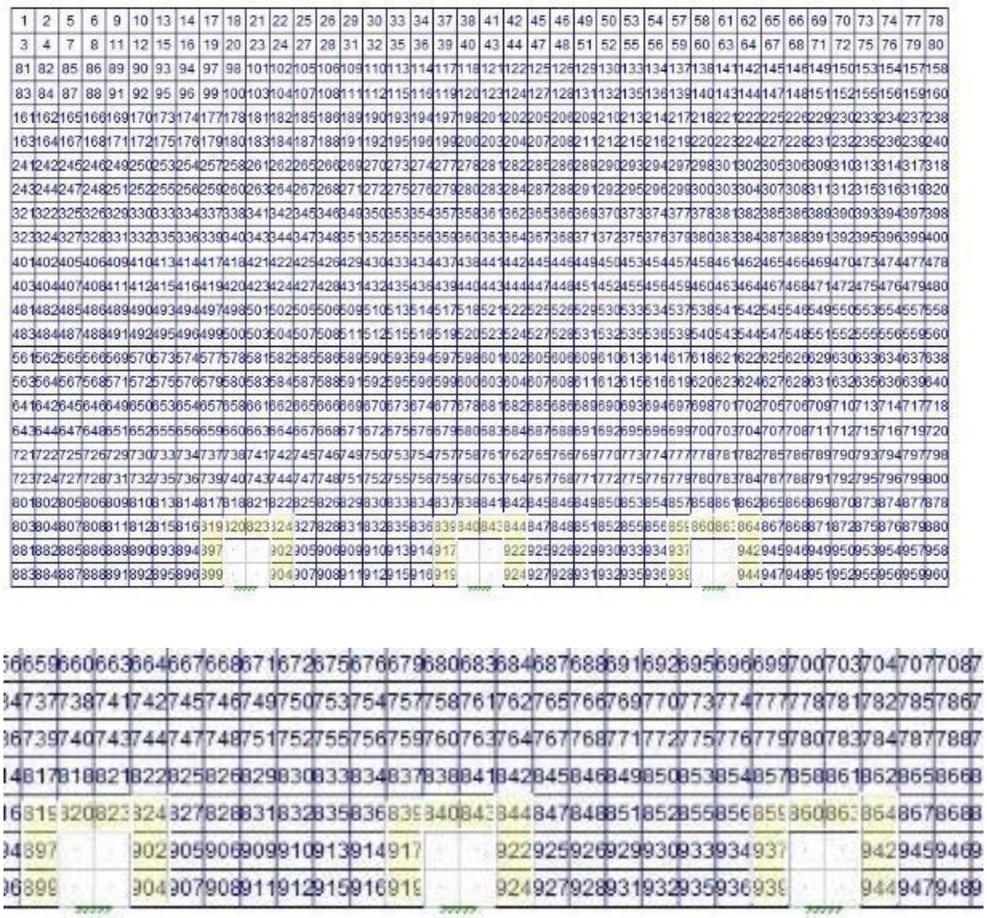


Figure 2: Element numbering – full panel and close-up of elements surrounding three spigots

Two load cases were run to estimate the stresses surrounding the spigot:

1. An 81 psf wind load that is equivalent to a 139 mph unfactored load (180 psf factored load). Figure 3;
2. The loading-to-failure test: 820# loaded at 42” above the spigots (see attachment 4 for an explanation of this). Figure 4.

The wind load created a surface tensile stress ($\sigma$, pulling the face of the glass apart, which is the failure mechanism for a brittle material) of 15,979 psi. See Figure 3. The test-to-failure created tensile stress of 35,767 psi. This shows the panel has a factor of safety of 2.24 against failure due to Florida’s highest winds of 180 mph (factored). See Figure 4.

The FEM model is available for review, upon request.

## Attachment 3: Finite Element Modelling

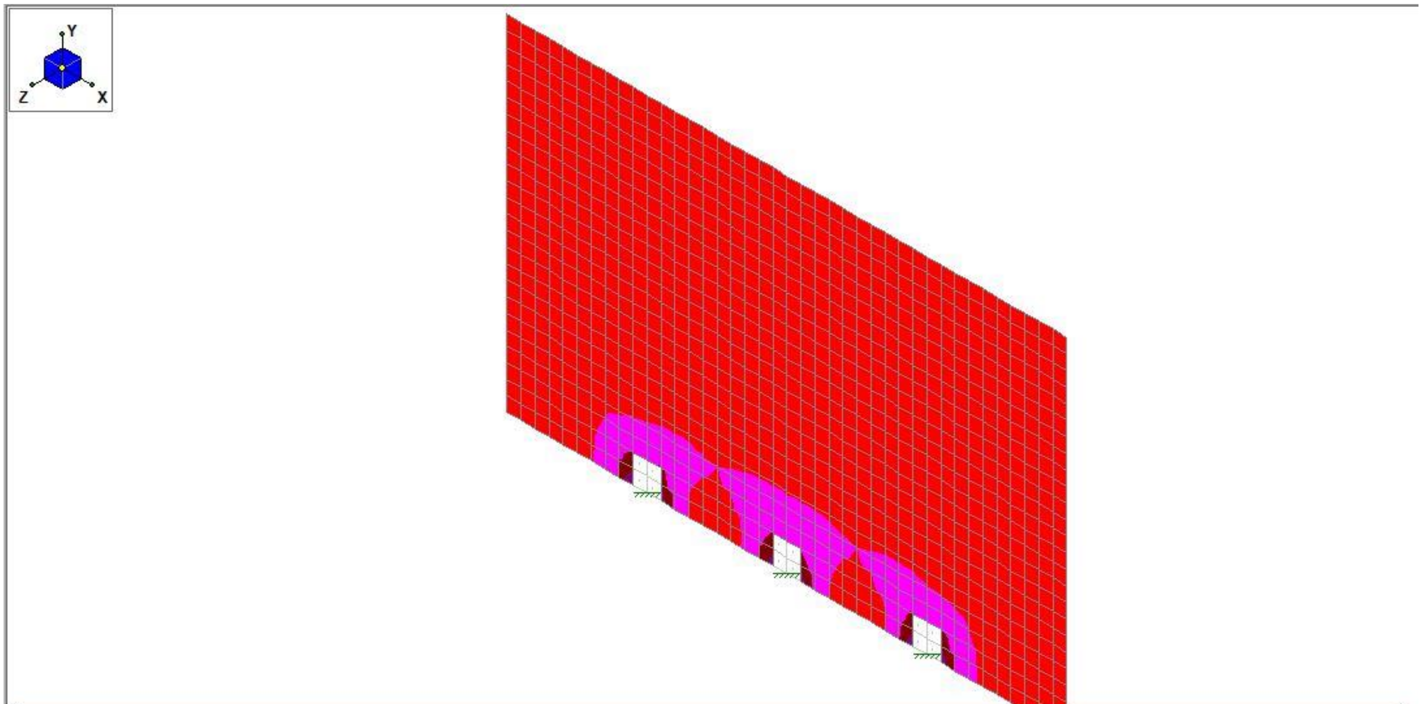



Plate Principal Stresses (By Combination)

| | L... | Plate Label | Loc | Sigma1[ksi] | Sigma2[ksi] | Tau Max[ksi] | Angle[rad] | Von Mises[ksi] |
|---|---|---|---|---|---|---|---|---|
| 1 | 8 | 899 | T | 8.475 | -15.979 | 12.227 | .743 | 21.507 |
| 2 | | | B | 15.979 | -8.475 | 12.227 | 2.314 | 21.507 |
| 3 | 8 | 944 | T | 8.475 | -15.979 | 12.227 | -.743 | 21.507 |
| 4 | | | B | 15.979 | -8.475 | 12.227 | .828 | 21.507 |
| 5 | 8 | 919 | T | 6.849 | -14.29 | 10.569 | .738 | 18.681 |
| 6 | | | B | 14.29 | -6.849 | 10.569 | 2.309 | 18.681 |
| 7 | 8 | 924 | T | 6.849 | -14.29 | 10.569 | -.738 | 18.681 |
| 8 | | | B | 14.29 | -6.849 | 10.569 | .833 | 18.681 |
| 9 | 8 | 939 | T | 6.245 | -14.211 | 10.228 | .74 | 18.158 |
| 10 | | | B | 14.211 | -6.245 | 10.228 | 2.311 | 18.158 |
| 11 | 8 | 904 | T | 6.245 | -14.211 | 10.228 | -.74 | 18.158 |

Results for LC 8, 81 psf

Figure 3: Stresses due to 81 psf (180 mph factored winds)

**Attachment 3: Finite Element Modelling**

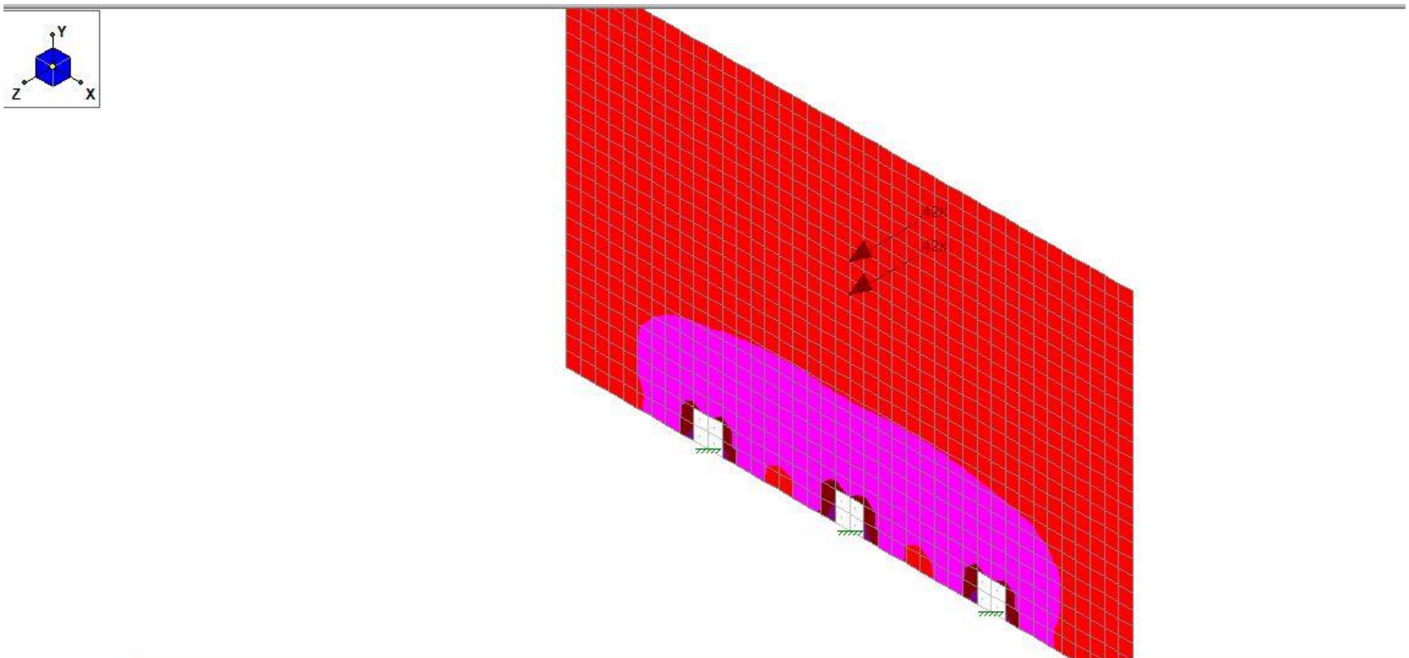



Plate Principal Stresses (By Combination)

| | L... | Plate Label | Loc | Sigma1[ksi] | Sigma2[ksi] | Tau Max[ksi] | Angle[rad] | Von Mises[ksi] |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 943 | T | 8.444 | -35.767 | 22.106 | -.277 | 40.653 |
| 2 | | | B | 35.767 | -8.444 | 22.106 | 1.293 | 40.653 |
| 3 | 5 | 900 | T | 8.444 | -35.767 | 22.106 | .277 | 40.653 |
| 4 | | | B | 35.767 | -8.444 | 22.106 | 1.848 | 40.653 |
| 5 | 5 | 899 | T | 8.435 | -12.214 | 10.324 | .676 | 17.982 |
| 6 | | | B | 12.214 | -8.435 | 10.324 | 2.247 | 17.982 |
| 7 | 5 | 944 | T | 8.435 | -12.214 | 10.324 | -.676 | 17.982 |
| 8 | | | B | 12.214 | -8.435 | 10.324 | .895 | 17.982 |
| 9 | 5 | 939 | T | 6.371 | -11.874 | 9.122 | .724 | 16.038 |
| 10 | | | B | 11.874 | -6.371 | 9.122 | 2.295 | 16.038 |
| 11 | 5 | 904 | T | 6.371 | -11.874 | 9.122 | -.724 | 16.038 |

Loads: BLC 5, 820#@28"
Results for LC 5, 820@28"

Figure 4: Stresses due to failure load (820 psf @ 28”)

**Attachment 4: Physical Testing**

**July 13, 2020**

**Building Code Requirements**

The International Building Code (IBC) and International Residential Code (IRC) are “model codes” created by the International Code Council, intended to be used by states and municipalities as they publish their own building codes. Section 1607.8 of the IBC requires that “handrails and guards shall be designed to resist a linear load of 50 plf.” It also requires the system to resist a 200# concentrated load that produces the “maximum load effect” on any element within the system. The 2018 IRC Table R201.5 extends this requirement into residential construction. It is understood within the building design industry that loads applied to the top of the panel create the maximum load effect; structural design assumes this loading condition.

Section 1607.8 of the IBC also refers to IBC section 2407 that adds a requirement for all-glass handrails and guards to “be laminated glass constructed of fully tempered or heat-strengthened glass”; this requirement was added in the 2015 IBC code cycle. Section 2407.1.1 adds the significant requirement: “a design factor of four shall be used for safety”. This addition bumps up the linear load to 200 plf and the concentrated load to 800#. Presumably, this is intended to prevent the glass from shattering and injuring people below.

Exterior glass guardrail panels are designed to resist two load types: wind loads, and “live” loads such as a person or object pushing on or striking the panel from the side or from above. Wind loading on a panel can vary greatly based on location, terrain (wooded vs open) and elevation above ground; these are governed by publication ASCE 7 (American Society of Civil Engineers <u>Minimum Design Loads for Buildings and Other Structures)</u>. Wind speeds of 115 psf are used to calculate wind pressures against the glass, which generally vary from 17 psf (2$^{nd}$ story in wooded area) to 35 psf (30 stories tall in open terrain). The wind speeds required to match the stresses created by the 800# point load are 192 mph for the 42” tall panel and 215 mph for the 36” tall panel; these are only seen in a Category 5 hurricane or a tornado. Therefore, the 800# horizontal point load is the worst-case scenario for the panels. Note: panel design in “high wind” regions such as the coastal Southeast US are designed to resist flying debris and are subject to different loading requirements. Calculation methods to arrive at these values include computer modeling using finite element analysis; criteria specific to Clear View’s panels and support configuration were used.

**Hercules Glass Testing**

Testing was performed on the Hercules Glass panel by Clear View’s glass supplier, to simulate the forces created by 800# horizontal and vertical point loads on the panel (loads are not required to be simultaneous). The vertical load test is straightforward and is shown in photo 1. Note: the intent was to load the panel to failure; however, the testers ran out of sandbags at 2,520 pounds, without failure. Given the difficulty of pushing an 800# load horizontally against the panel, a test rig was set up that supports the panel on its side and places sandbags vertically on the panel. The panel is supported 28” from the top of panel (creating a 28” cantilever), with a heavy counterweight holding down the bottom of the panel mounted in its spigots. Sandbags were placed at the top edge of the panel until failure. See Diagram 1 and photo 2. The panel failed after one minute with 820 pounds loaded on its edge, which is equivalent to 547 pounds for a 42” tall panel. Due to the laminate construction of the panels (similar to a vehicle windshield), the panel broke into small pieces that were retained within the panel, preventing dangerous flying glass debris. See photo 3. This test shows that the panel meets the intent to create a strong and safe barrier that can withstand reasonable loading (factor of safety of 2.5), and does not explode with dangerous glass shards during excessive loading.


**Photo 1: Panel loaded vertically with 2,520 pounds.**


**Photo 2: Loading of panel with sandbags, simulating horizontal force**

**Attachment 4: Physical Testing**

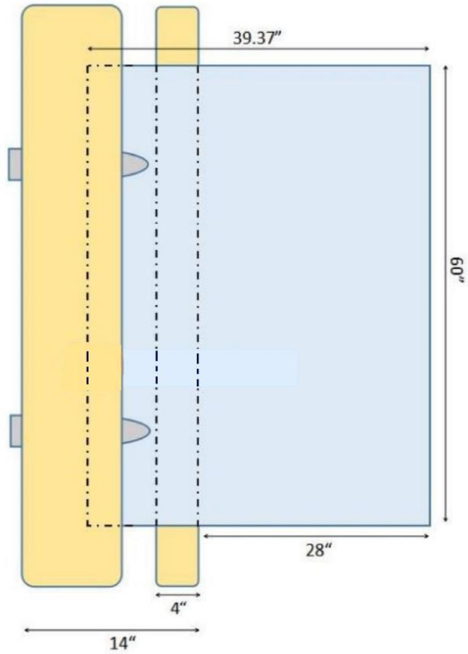
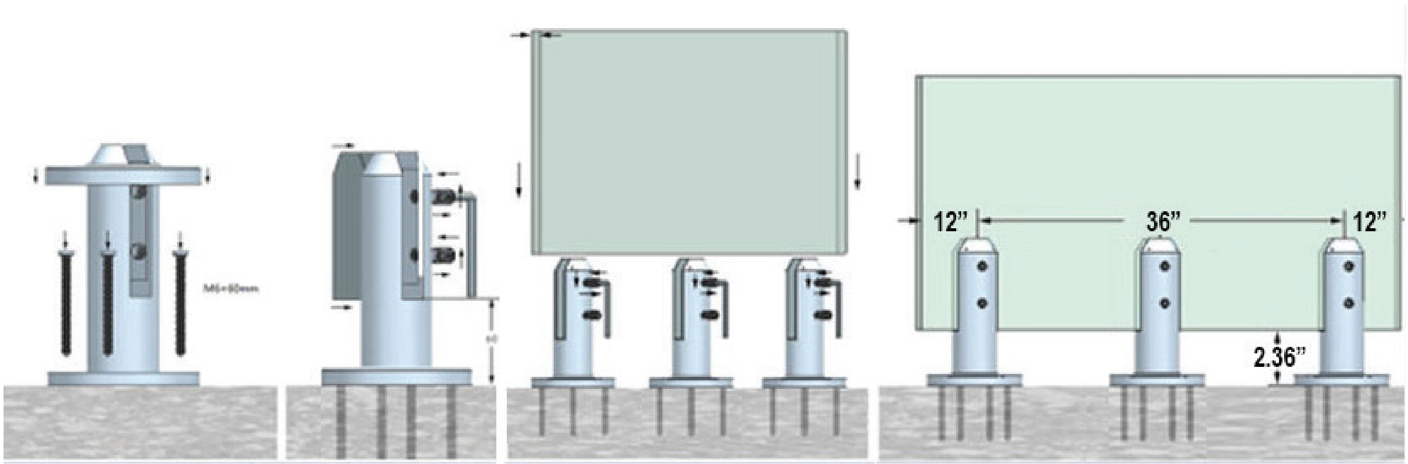



**Diagram 1: Test rig lying on its side, looking from above, showing panel supported at 28" and at bottom of panel**

**Photo 3: Panel after failure, showing all glass intact within laminate structure.**

# INSTALLATION WITH THREE SPIGOTS




| | |
|---|---|
| **Part Number** | CVGR 316 SSOD48-180 Satin Finish |
| **Product Name** | Round Deck Mount Spigot |
| **Spigot Size** | 1.9” diameter x 7.1” tall |
| **Spigot Weight** | 5.5 lbs. |
| **Glass Thickness/ Dimensions/Weight (per panel)** | 13mm/ 60” width x 39.37” height/98.5 lbs. |
| **Accessories Included** | Base Cover, Rubber Gasket |

### Wood Deck Installation

The hold down force for each spigot is 2,500 lbs. We suggest using 3/8” diameter x 3.5” A354 structural bolts as they have sufficient capacity to resist this force. Use with flat washer to fasten spigots to wood deck. A354 structural bolts and washer should be cadmium plated or stainless steel so they do not rust.

Lag bolts must be installed into rim joists or lam beam or properly blocked sub structure. If lag bolts are attached to deck planks only failure will occur as a result of improper installation. Improper installation and failure may result in injuries or death. Do it once and do it right!

### Helpful Installation Tips

- Apply a bit of talcum powder to the inside of the spigot rubber boot to help the glass slide in the rubber boot, not grab the rubber boot.
- Mark spigot location on glass panels with a crayon or wax marker. This allows for fast and easier installation of panel in proper location.
- Some clients have suggested screwing the rim joist to the joist as the screws will hold the rim joist tight to the joist where as nails may not.

ClearView
GLASS RAILINGS

# SPIGOT SPECS