

PRODUCT APPROVAL SUPPORTING CALCULATIONS

Series/Model 1630 PVC HS Window (OX)

REPORT NO.: 30337.01-107-16

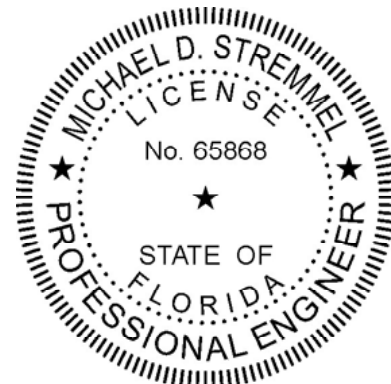
RENDERED TO: MI Windows and Doors
702 West Market Street
Gratz, Pennsylvania 17030

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REPORT DATE: 3/20/2025

This item has been digitally signed and sealed
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A handwritten signature in black ink, appearing to read "Michael D. Stremmel".

Michael D. Stremmel, P.E.
Senior Project Engineer
FL PE 65868
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It is a violation to alter this document in any way unless acting under the direction of a licensed professional engineer.

SCOPE:

Molimo, LLC was contracted by MI Windows and Doors to evaluate alternate installation methods for their 1630 PVC HS Window (OX) window. The evaluation is based on physical testing and product certifications.

Reference standards utilized in this project include:

Florida Building Code, Building, 8th Edition (2023). International Code Council, 2023.

ANSI/AWC NDS-2018 National Design Specification (NDS) for Wood Construction. American Wood Council, 2018.

AISI S100-16 North American Specification for the Design of Cold-Formed Steel Structural Members, 2016. American Iron and Steel Institute, 2016.

2020 Aluminum Design Manual. The Aluminum Association, Inc. 2020.

ICC-ES Report ESR-1976 ITW Buildex TEKS Self-Drilling Fasteners. ICC Evaluation Service. 07/2016.

The anchorage analysis presented herein do not address the water resistance, water penetration, or air infiltration performance of the installation method or the installed product. In addition, the analyses rely on the assumption that the building substrate is capable of withstanding the incurred loads.

Certification of Independence

In accordance with Rule 61G20-3 Florida Administrative Code, Molimo, LLC hereby certifies the following:

- Molimo, LLC does not have, nor does it intend to acquire or will it acquire, a financial interest in any company manufacturing or distributing products tested or labeled by the agency.
- Molimo LLC is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- Michael D. Stremmel, P.E. does not have nor will acquire, a financial interest in any company manufacturing or distributing products for which the reports are being issued.
- Michael D. Stremmel, P.E. does not have, nor will acquire, a financial interest in any other entity involved in the approval process of the product.

ANALYSES:

Summary of Test Results

Table 1 summarizes the various 1630 PVC HS Window (OX) Window products and their corresponding performance levels which have been established by testing of product certification.

The products considered in this report satisfy the requirements of the *Florida Building Code* for the overall sizes and design pressures of the following product certifications and their installation methods presented in this report.

Table 1: Summary of Product Certifications and Limitations of Use

Series/Model	Test Report Number	Product Certification	Size (W x H)	Performance
1630	27142.05-106-12-R2 (Rev. 2, 7/20/23)	--	110" x 63" (XOX)	±50 psf Wind Zone 3 Missile Level D
		CPD 21888	74" x 63" (OX)	±50 psf Wind Zone 3 Missile Level D

Note: The above test report of a XOX product is used to qualify the approval of the XO product included in the above referenced CPD certification.

Testing documented in Table 1 was conducted by Molimo, LLC of York, Pennsylvania (Florida Department of Business & Professional Regulation Test Lab No. TST11282, IAS Certificate of Accreditation TL-678).

ANALYSES: (Continued)

As-Tested Installation Analysis

For air/water/structural testing, the test specimen was secured to a pine wood test buck with #8 x 1-1/2" screws at the jambs. A structural test specimen with #8 x 1-1/2" screws through the integral PVC nail fin was also tested. The as tested installation methods are evaluated on Pages 8 through 12 and the established design capacities are summarized in Table 2.

Table 2: As-tested Anchorage Design Capacities

Test Specimen Installation Method	Connection Details	Capacity
Mounting Fin Install	<u>Head, Sill, and Jamb</u> #8 x 1-1/2" wood screws Located 3" from each corner, and spaced 12" on center through the nail fin into the wood buck	66.8 lb
Steel Clip Install	<u>Head and Sill Only</u> 18 ga metal strap, secured to the frame with (2) #10 x 1/2" PH Wood Screw and secured to the wood buck with (2) #8 x 1-1/4" Modified truss head screw. (1) strap located at each end of the meeting stile.	104 lb

The capacities presented in Table 2 will be used to prove acceptable alternate anchors and substrates for the windows.

ANALYSES: (Continued)

Alternate Anchorages

Calculations on Page 11 determine the design capacity of alternate mounting fin installation anchorages for the window. The alternate anchorage capacities are summarized in Table 3.

Table 3: Alternate Anchorage Capacities for Mounting Fin Installations

Substrate	Anchor	Capacity	Comments
18 Ga. Steel Stud	#10-16 TEKS Screw	104 lb	1. 33 KSI yield strength stud 2. Full penetration +3 threads 3. Limited by pullout capacity

Calculations on Page 12 determine the design capacity of alternate through-frame installation anchorages for the window. The alternate anchorage capacities are summarized in Table 4.

Table 4: Alternate Anchorage Capacities for Steel Strap Installations

Substrate	Anchor	Capacity	Comments
18 Ga. Steel Stud	Steel Strap with (2) #10-16 TEKS Screw	168 lb	1. 33 KSI yield strength stud 2. Full penetration +3 threads 3. Limited by bending capacity

ANALYSES: (Continued)**Anchorage Requirements**

It must be determined the anchorages are not overloaded for the approved window size and design pressures. Calculations presented on Page 13 shows the following:

1. Mounting Fin Installation Method: The as-tested spacing is adequate for the minimum anchor capacity reported in this report when the windows are subjected to the maximum design pressures of the products at their approved maximum sizes.

Based on the calculations, Table 5 shows the maximum anchor spacing for each installation method. The anchor spacings shown in the following table apply to all substrates and anchor types.

Table 5: Anchorage Spacing Requirements

Installation Method	Maximum Anchor Spacing
Mounting Fin	3" from each corner, and spaced a maximum of 12" on center, through the mounting fin into the building substrate
	One steel strap must be utilized at each end of the fixed meeting stile

As-Tested Installation – Nail Fin to Wood

Anchor: #8 x 1-5/8" Wood Screw

Details: Through the PVC Nail Fin

Substrate: SPF wood test buck (G = 0.42 min.)

Wood Screw Capacity (Tension)

$W = 1.6(1.50" - 0.062")(82 \text{ lb/in})$ (NDS, Table 12.2B)

$W = \underline{189 \text{ lb}}$

Pull-over of Wood Screw

Pull-over of the wood screw is validated by the test

As-tested spacing: 12" on center

As-tested Anchor head size: 0.332"

Anchor Placement: 3" from corner; 12" on center

Anchor Quantities:

Jambs: 6 per Jamb

Head: 10

Sill: 10

Total: 32

Load to Anchors: $(110")(63")(50 \text{ psf} / 144) = 2,406 \text{ lb}$

Individual Anchor Load: $(2,406 \text{ lb}) / (32 \text{ anchors}) = 75.2 \text{ lb} (< \text{withdrawal capacity})$

Design Capacity of the Connection = 75.2 lb

As-Tested Installation – Steel Strap Anchor to Wood

Anchor: (2)#8 x 1-1/4" FH Wood Screw (strap to steel stud)
(2) #8 x 1" screws (strap to window frame)

Details: Strap Anchor (18 ga., 0.048")
- 3/8" max shim space

Substrate: SPF wood test buck (G = 0.42 min.)

Wood Screw Capacity (Shear)

$Z' = \underline{128 \text{ lb}}$ per screw

(Reference the following page)

Bearing Capacity (of PVC frame)

$P_b = D t F_{tu} = (0.164")(0.080")(10,000 \text{ psi})$

$P_b = \underline{131 \text{ lb}}$ per screw

Bearing Capacity (Steel Strap Anchor)

$P_B = 2.7 d t F_{tu} = 2.7 (0.164")(0.048")(45,000 \text{ psi}) = 797 \text{ lb}$

$P_{ALLOW} = 797 \text{ lb} / 3.0 = \underline{265 \text{ lb}}$ per screw

Bending Capacity (of Wood Screw)

$L = 3/8"$ (maximum shim space)

$S = \pi d^3 / 32 = \pi (0.112")^3 / 32 = 0.000138 \text{ in}^3$

$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(90,000 \text{ psi}) = 70,200 \text{ psi}$ (1.3 for weak axis bending)

$F_b = M / S = (V) (L/2) / S$ (L/2 for guided bending)

$V = 2 S F_b / L = (2)(0.000138 \text{ in}^3)(70,200 \text{ psi}) / 3/8"$

$V = \underline{52 \text{ lb}}$ per screw

Design Capacity of the Connection = 52 lb x 2 = 104 lb

Lateral Design Strength of Wood Connections

Data

Fastener

Fastener	=	#8 Wood Screw
Shank Dia	=	0.164 in.
Root Dia.	=	0.131 in.
F_{yb}	=	90,000 psi
Fastener length	=	1.250 in.

Project: 1630 PVC Sliding Window
Comments: As Tested Thru Frame
 1-1/4" min embedment

Main Member

Material	=	SPF
G	=	0.42
θ	=	90
F_e	=	3,350 psi
Thickness	=	1.500 in.

Side Member

Material	=	ASTM A 36 Steel
G	=	N/A
θ	=	90
F_{es}	=	87,000 psi
Thickness	=	0.048 in.

Calculations

Lateral Bearing Factors

D	=	0.131 in.
ℓ_m	=	1.038 in.
K_θ	=	1.25
K_D	=	2.20
R_e	=	0.039
R_t	=	21.63

k_1	=	0.3479
k_2	=	0.5441
k_3	=	17.05
R_d	=	2.20 (Mode I _m , I _s)
R_d	=	2.20 (Mode II)
R_d	=	2.20 (Mode III _m , III _s , IV)

Lateral Design Values, Z

Mode I _m	=	207 lbf
Mode I _s	=	249 lbf
Mode II	=	87 lbf
Mode III _m	=	105 lbf
Mode III _s	=	80 lbf
Mode IV	=	109 lbf

<== Minimum Value

Adjustment Factors

C_D	=	1.6
Wet Service Factor		
Fabrication/In-Service		Dry/Dry
C_M	=	1.0
In service temperature		T ≤ 100°F
C_t	=	1.0
C_g	=	1.0

C_Δ	=	1.0
Is fastener installed in end grain?		No
C_{eg}	=	1.00
Is fastener part of a diaphragm?		No
C_{di}	=	1.0
Is fastener toe-nailed?		No
C_{tn}	=	1.00

Adjusted Design Value, Z

Z'	=	128 lbf
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Alternate Installation – Nail Fin to Steel Stud

Anchor: #10-16 TEKS Screw

Details: Through the PVC Nail Fin

Substrate: 18 ga steel stud (33 ksi, 0.043" thick)

Wood Screw Capacity (Tension)

$$P_{ss} / \Omega = \underline{885 \text{ lb}} \quad (\text{ESR-1976})$$

Pull-over of #10-16 TEKS Screw

$$\text{Anchor head size} = 0.365" > 0.330" \quad (\text{maintain as tested spacing})$$

Pull-out of #10-16 TEKS Screw

$$P_{\text{not}} = 0.85 t_c d F_{tu} = 0.85(0.043")(0.190")(45,000 \text{ psi}) = 312 \text{ lb}$$

$$P_{\text{allow}} = 312 \text{ lb} / 3.0 = \underline{104 \text{ lb}}$$

Design Capacity of the Connection = 104 lb

Alternate Installation – Steel Strap Anchor to Steel Stud

Anchor: (2) #10-16 TEKS Screw (strap to steel stud)
 (2) #8 x 1" screws (strap to window frame)

Details: Steel Strap Anchor (18 ga, 0.048" thick)
 - 3/8" max shim space

Substrate: 18 ga steel stud (33 ksi, 0.043" thick)

Anchor Capacity (Shear of #1/4" TEKS)

$$P_{ss} / \Omega = \underline{1,075 \text{ lb}} \text{ per screw} \quad (\text{AAMA TIR-A9-14, Table 20.3})$$

Bearing Capacity (of PVC frame)

$$P_b = D t F_{tu} = (0.164")(0.080")(10,000 \text{ psi})$$

$$P_b = \underline{131 \text{ lb}} \text{ per screw}$$

Bearing Capacity (of Steel Strap Anchor)

$$P_B = 2 d t F_{tu} = 2 (0.164")(0.048")(45,000 \text{ psi}) = 708 \text{ lb}$$

$$P_{ALLOW} = 708 \text{ lb} / 3.0 = \underline{236 \text{ lb}} \text{ per screw}$$

Bearing/Tilting Capacity (of steel stud)

$$P_b = 2.7 D t F_{tu} = 2.7(0.190")(0.043")(45,000 \text{ psi}) = 992 \text{ lb}$$

$$P_b = 4.2 (D t^3)^{1/2} F_{tu} = 4.2[(0.190")(0.043")^3]^{1/2}(45,000 \text{ psi}) = 734 \text{ lb}$$

$$P_{allow} = 734 \text{ lb} / 3.0 = \underline{244 \text{ lb}} \text{ per screw}$$

Bending Capacity (of #10-16 TEK)

$$L = 3/8" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.131")^3 / 32 = 0.000221 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(92,000 \text{ psi}) = 71,760 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

$$F_b = M / S = (V) (L/2) / S \quad (L/2 \text{ for guided bending})$$

$$V = 2 S F_b / L = (2)(0.000221 \text{ in}^3)(71,760 \text{ psi}) / 3/8"$$

$$V = \underline{84 \text{ lb}} \text{ per screw}$$

Design Capacity of the Connection = 84 lb x 2 = 168 lb

Alternate Requirements

Series/Model: 1630 PVC Horizontal Sliding Window (XOX)
Test Unit Size: 74" x 63"
Design Pressure: ± 50 psf

Mounting Fin Installation Method

Anchor Placement: 3" from corners and 12" on center
Anchor Quantities: Head / Sill = 7 per
Jambs = 6 per
Total = 26

Load to the Anchors = $(74")(63")(50 \text{ psf} / 144) = 1,619 \text{ lb}$

Individual Anchor Load = $1,619 \text{ lb} / 26 \text{ anchors} = 62.3 \text{ lb}$

Least Anchor Capacity = 104 lb (Steel Stud) > 62.3 lb

Tested Anchor Spacing Governs

Steel Strap Anchor

Anchor Placement: Head/Sill at the Meeting Rail end

Tested Strap Anchor Capacity = 104 lb

Alternate Substrate Strap Anchor Capacity = 168 lb

168 lb > 104 lb

Tested Anchor Spacing Governs

Revision Log

Rev. #	Date	Page(s)	Revision(s)
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