



**Project No.:** 28227.05-107-16  
**Project Name:** Energy Saver Steel Wood Edge  
Glazed X  
**Date:** 3/21/2024  
Page 1 of 14

## PRODUCT APPROVAL SUPPORTING CALCULATIONS

**Series/Model:** Energy Saver Steel Wood Edge Glazed X

**REPORT NO.:** 28227.05-107-16

**RENDERED TO:** Jeld-Wen Windows & Doors  
3737 Lakeport Blvd  
Klamath Falls, Oregon

**PREPARED BY:** Michael D. Stremmel, P.E.  
Molimo, LLC  
1410 Eden Road  
York, Pennsylvania 17402

**DATE:** 3/21/2024

This item has been digitally signed and sealed by Michael D. Stremmel, PE on the date adjacent to the seal.

Printed copies of this document are not considered signed and sealed and the signature must be verified on electronic copies.

---

Michael D. Stremmel, P.E.  
Senior Project Engineer  
FL PE 65868  
FL REG 37122

*It is a violation to alter this document in any way unless acting under the direction of a licensed professional engineer.*



**Project No.:** 28227.05-107-16  
**Project Name:** Energy Saver Steel Wood Edge  
Glazed X  
**Date:** 3/21/2024  
Page 2 of 14

**SCOPE:**

Molimo, LLC was contracted by Jeld-Wen Windows & Doors to evaluate alternate installation methods for their Energy Saver Steel Wood Edge Glazed X. The evaluation is based on physical testing and product certifications.

Reference standards utilized in this project include:

*Florida Building Code.* International Code Council.

*ANSI/AWC National Design Specification (NDS) for Wood Construction.* American Wood Council.

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

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

NOA 21-0201.06 *Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology.* Miami-Dade County Product Control Section.

The anchorage analysis presented herein does 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.



**Project No.:** 28227.05-107-16  
**Project Name:** Energy Saver Steel Wood Edge  
Glazed X  
**Date:** 3/21/2024  
Page 3 of 14

### 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 Energy Saver Steel Wood Edge Glazed X products and their corresponding performance levels which have been established by testing or product certification.

**Table 1:** Summary of Test Results

Series/Model	Test Report Number	Size (W x H)	Performance
Jeld-Wen Energy Saver Steel Wood Edge Inswing/Outswing Opaque O/X	National Certified Test Lab Report No. SJW2010-001 (2/5/2010)	38" x 82"	+50 / -50 psf

Testing documented in Table 1 was conducted by National Certified Testing Laboratories of Everett, Washington (Florida Department of Business & Professional Regulation Test Lab No. TST9341 – laboratory was approved at the time of testing). The testing documented above is certified by NAMI under certification number NI010126.01-R10 (Expires 1/31/2026).

**As-Tested Installation Analysis**

For air/water/structural testing, the test specimen was secured to a Douglas-Fir wood test buck with #10 wood screws (1-1/2" min. embedment) at the head, sill, and jambs. The as tested installation method is evaluated on Pages 5 and 6. These capacities will be used to prove acceptable anchors and substrates for the product.

**Alternate Anchorages**

Calculations on Pages 7 through 13 determine the design capacity of alternate installation anchorages for the product.

**Anchorages Requirements**

As-tested spacing must be maintained. It must be determined that the anchorages are not overloaded for the approved product size and design pressures. Calculations presented on Page 14 show the alternate anchorages are acceptable for the established product performance.

Anchorage requirements established by this report are accurately presented in Drawing D1000382.



Project No.: 28227.05-107-16  
Project Name: Energy Saver Steel Wood Edge  
Glazed X  
Date: 3/21/2024  
Page 5 of 14

**As-Tested Installation – Through Frame to Wood**

Anchor: #10 x 2-1/2" Wood Screw  
(1-1/2" min embedment})

Details: 0.719" thick wood frame (G = 0.42)  
No shim space was utilized

Substrate: Spruce-Pin-Fir wood test buck (G = 0.42)

**Wood Screw Capacity (Shear)**

Z' = 131 lb

(See Following Page)

**Design Capacity of the Connection = 131 lb**

## Lateral Design Strength of Wood Connections

### Data

<b>Fastener</b>	
Fastener	= #10 Wood Screw
Shank Dia	= 0.190 in.
Root Dia.	= 0.152 in.
$F_{yb}$	= 80,000 psi
Fastener length	= 2.500 in.

<b>Project:</b>	Energy Saver Steel Wood Edge Glazed X
<b>Comments:</b>	1-1/2" min embedment

<b>Main Member</b>	
Material	= SPF
G	= 0.42
$\theta$	= 90
$F_e$	= 3,350 psi
Thickness	= 1.500 in.

<b>Side Member</b>	
Material	= SPF
G	= 0.42
$\theta$	= 90
$F_{es}$	= 3,350 psi
Thickness	= 0.719 in.

### Calculations

#### Lateral Bearing Factors

D	= 0.152 in.
$l_m$	= 1.451 in.
$K_\theta$	= 1.25
$K_D$	= 2.20
$R_e$	= 1.000
$R_t$	= 2.02

$k_1$	= 0.6847	
$k_2$	= 1.1271	
$k_3$	= 1.48	
$R_d$	= 2.20	(Mode I <sub>m</sub> , I <sub>s</sub> )
$R_d$	= 2.20	(Mode II)
$R_d$	= 2.20	(Mode III <sub>m</sub> , III <sub>s</sub> , IV)

#### Lateral Design Values, Z

Mode I <sub>m</sub>	= 336 lbf
Mode I <sub>s</sub>	= 166 lbf
Mode II	= 114 lbf
Mode III <sub>m</sub>	= 126 lbf
Mode III <sub>s</sub>	= 82 lbf
Mode IV	= 99 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

$C_\Delta$	= 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

$Z'$	= 131 lbf
------	-----------

### Alternate Installation – Strap Anchor to Wood

Anchor: (2) #10 x 1-1/2" Flat head screws securing the strap to the substrate  
1/4" max shim space

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #10 screws securing the  
strap to the frame  
1-1/2" thick wood frame

Substrate: Spruce-Pine-Fir 2x Wood Substrate (G = 0.42 min.)

#### Wood Screw Capacity (Shear)

$$Z' = \underline{155 \text{ lb}}$$

(See Following Page)

#### Bending of #10 x 1-1/2" flat head screw

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.190")^3 / 32 = 0.000673 \text{ in}^3$$

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

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

$$V = 2 S F_b / L = (2)(0.000221 \text{ in}^3)(70,200 \text{ psi}) / 1/4"$$

$$V = \underline{378 \text{ lb}}$$

#### Bearing Capacity (of #10 screw on frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.190")(0.719") / (10(0.190) + 0.5)$$

$$= \underline{191 \text{ lb}} \text{ per screw}$$

#### Bearing Capacity (of strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.190")(0.033")(45,000 \text{ psi}) = 761 \text{ lb}$$

$$P_{\text{allow}} = 761 \text{ lb} / 3.0 = \underline{254 \text{ lb}} \text{ per screw}$$

**Design Capacity of the Connection = 155 lb**

## Lateral Design Strength of Wood Connections

### Data

<b>Fastener</b>	
Fastener	= #10 Wood Screw
Shank Dia	= 0.190 in.
Root Dia.	= 0.152 in.
$F_{yb}$	= 80,000 psi
Fastener length	= 1.500 in.

<b>Project:</b>	Energy Saver Steel Wood Edge Glazed X
<b>Comments:</b>	Steel Strap Installation 1-1/2" min embedment

<b>Main Member</b>	
Material	= SPF
G	= 0.42
$\theta$	= 90
$F_e$	= 3,350 psi
Thickness	= 1.500 in.

<b>Side Member</b>	
Material	= ASTM A 653, Grade 33 Steel
G	= N/A
$\theta$	= 90
$F_{es}$	= 61,850 psi
Thickness	= 0.033 in.

### Calculations

#### Lateral Bearing Factors

D	= 0.152 in.
$l_m$	= 1.277 in.
$K_\theta$	= 1.25
$K_D$	= 2.20
$R_e$	= 0.054
$R_t$	= 38.70

$k_1$	= 0.8550	
$k_2$	= 0.5357	
$k_3$	= 26.07	
$R_d$	= 2.20	(Mode I <sub>m</sub> , I <sub>s</sub> )
$R_d$	= 2.20	(Mode II)
$R_d$	= 2.20	(Mode III <sub>m</sub> , III <sub>s</sub> , IV)

#### Lateral Design Values, Z

Mode I <sub>m</sub>	= 296 lbf
Mode I <sub>s</sub>	= 141 lbf
Mode II	= 121 lbf
Mode III <sub>m</sub>	= 143 lbf
Mode III <sub>s</sub>	= 97 lbf
Mode IV	= 137 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

$C_\Delta$	= 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

$Z'$	= 155 lbf
------	-----------



**Alternate Installation – Through-Frame to Concrete**

Anchor: 3/16" Tapcon Anchor  
- 1-1/4" min embedment  
- 2-1/2" min edge distance  
- 4" min anchor spacing  
- 1/4" max shim space

Details: Through the Wood Frame  
- 1" thick

Substrate: 3,000 psi Concrete

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{181 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of Wood frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.170")(1.00") / (10(0.170) + 0.5) = \underline{259 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

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

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 181 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Through-Frame to CMU Block**

Anchor: 3/16" Tapcon Anchor  
- 1-1/4" min embedment  
- 2-1/2" min edge distance  
- 4" min anchor spacing  
- 1/4" max shim space

Details: Through the Wood Frame  
- 1" thick

Substrate: CMU Block

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{135 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of Wood frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.170")(1.00") / (10(0.170) + 0.5) = \underline{259 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

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

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 135 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Strap Anchor to Concrete**

Anchor: 3/16" TapCon Anchor  
 - 1-1/4" min embedment  
 - 2-1/2" min edge distance  
 - 4" min anchor spacing  
 - 1/4" max shim space

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
 1.00" thick wood frame

Substrate: 3,000 psi Concrete

Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{181 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

Bearing Capacity (of 3/16" Tapcon on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.170")(0.033")(45,000 \text{ psi}) = 681 \text{ lb}$$

$$P_{\text{allow}} = 681 \text{ lb} / 3.0 = \underline{227 \text{ lb}}$$

Bearing Capacity (of #8 screws on frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

Bearing Capacity (of #8 screws on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

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

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 181 lb (one concrete anchor per strap)**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

### Alternate Installation – Strap Anchor to CMU Block

**Anchor:** 3/16" Tapcon Anchor  
 - 1-1/4" min embedment  
 - 2-1/2" min edge distance  
 - 4" min anchor spacing  
 - 1/4" max shim space

**Details:** 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
 1.00" thick wood frame

**Substrate:** CMU Block

#### Anchor Capacity (Shear of 3/16" Tapcon)

$$P_{ss} / \Omega = \underline{135 \text{ lb}} \quad (\text{NOA-No. 16-1222.06})$$

#### Bearing Capacity (of 3/16" Tapcon on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.170")(0.033")(45,000 \text{ psi}) = 681 \text{ lb}$$

$$P_{\text{allow}} = 681 \text{ lb} / 3.0 = \underline{227 \text{ lb}}$$

#### Bearing Capacity (of #8 screw on frame)

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

#### Bearing Capacity (of #8 screw on strap anchor)

$$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

#### Bending Capacity (of 3/16" Tapcon)

$$L = 1/4" \text{ (maximum shim space)}$$

$$S = \pi d^3 / 32 = \pi (0.170")^3 / 32 = 0.000482 \text{ in}^3$$

$$F_b = (1.3)(0.6 F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \quad (1.3 \text{ for weak axis bending})$$

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

$$V = 2 S F_b / L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi}) / 1/4"$$

$$V = \underline{412 \text{ lb}}$$

**Design Capacity of the Connection = 135 lb (one concrete anchor per strap)**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment**

**Alternate Installation – Strap Anchor to Wood (Cap Installation)**

Anchor: Two #8 x 1-1/2" Flat head screw securing the strap to the substrate

Details: 20 gauge (0.033" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame  
1.00" thick wood frame  
1/4" max shim space

Substrate: Spruce-Pine-Fir 2x Wood Substrate (G = 0.42 min.)

**Wood Screw Capacity (Withdrawal)**

$$W' = 1.6(82 \text{ lb/in})(1.5 \text{ in}) = \underline{197 \text{ lb}}$$

**Pull-over Capacity (of #8 screw on strap)**

$$P_{\text{nov}} = 1.5 t d F_{\text{tu}} = 1.5 (0.033")(0.332")(45,000 \text{ psi}) = 739 \text{ lb}$$

$$P_{\text{allow}} = 739 \text{ lb} / 3.0 = \underline{246 \text{ lb}}$$

**Bearing Capacity (of #8 screw on frame)**

$$P_b = F_e D t / K_D = (3,350 \text{ psi})(0.164")(1.00") / (10(0.164) + 0.5) = \underline{257 \text{ lb}}$$

**Bearing Capacity (of #8 screw on strap anchor)**

$$P_b = 2.7 D t F_{\text{tu}} = 2.7(0.164")(0.033")(45,000 \text{ psi}) = 657 \text{ lb}$$

$$P_{\text{allow}} = 657 \text{ lb} / 3.0 = \underline{219 \text{ lb}}$$

**Design Capacity of the Connection = 197 lb (one screw)**

**Design Capacity of the Connection = 394 lb (two screws)**

### Anchorage Requirements

Series/Model: Energy Saver Steel Wood Edge Glazed X  
Test Unit Size: 38" x 82"  
Design Pressure: +50.0 / -50.0 psf

### Through-Frame Installation Method

Through frame installation method is validated by the test

Through Frame Anchor Capacity = 131 lb

### Alternate Installation Methods

Strap Anchor to Wood = 244 lb

Through-Frame to Concrete = 181 lb

Through-Frame to CMU Block = 135 lb

Strap Anchor to Concrete = 181 lb

Strap Anchor to CMU Block = 135 lb

Strap Anchor to Wood (Cap Installation) = 197 lb

Minimum Alternate Installation Capacity = 135 lb

135 lb > 131 lb

**Alternate Anchorages OK at tested spacing**



**Project No.:** 28227.05-107-16  
**Project Name:** Energy Saver Steel Wood Edge  
Glazed X  
**Date:** 3/21/2024

### Revision Log

<b>Rev. #</b>	<b>Date</b>	<b>Page(s)</b>	<b>Revision(s)</b>
0	3/21/2024	All	Original Report Issue