PRODUCT APPROVAL SUPPORTING CALCULATIONS

Series/Model 25 ga Steel Wood Edge Glazed and Opaque Doors w/ Glazed Sidelites OXXO

REPORT NO.: 27206.04-107-16

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

PREPARED BY: Michael D. Stremmel, P.E.

Molimo, LLC
1410 Eden Road
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DATE: 9/22/2023

MICHAEL D. STREMMEL
LICENSE
No. 65868
STATE OF FLORIDA
PROFESSIONAL ENGINEER

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

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SCOPE:
Molimo, LLC was contracted by Jeld-Wen Windows & Doors to evaluate alternate installation methods for their 25 ga Steel Wood Edge Glazed and Opaque Doors w/ Glazed Sidelites OXXO. 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.

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 s is not owned, operated or controlled by any company manufacturing or distributing products it tests orlabels.
- 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 25 ga Steel Wood Edge Glazed and Opaque Doors w/ Glazed Sidelites OXXO 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
25 ga Steel Wood Edge Glazed and Opaque Doors w/ Glazed Sidelites	NCTL Report No. NCTL-210-3804-1 (Rev. 0, 3/01/12)	148-7/8" x 81-3/4"	+35 / -35 psf (non-impact)

Testing documented in Table 1 was conducted by National Certified Testing Laboratories of Orlando, Florida (Florida Department of Business & Professional Regulation Test Lab No. TST1589 – laboratory was approved at the time of testing). The testing documented above is certified by NAMI under certification number NI011065-R5 and NI011065.01-R6 (Expires 4/30/2028).

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 and jambs and a continuous bed of silicone at the sill. 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 D1000350.

As-Tested Installation – Through Frame to Wood

Anchor: #10 Wood Screw (1-1/2” Min Embedment)

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

Substrate: Douglas-Fir wood test buck (G = 0.46)

Wood Screw Capacity (Shear)

Z' = 136 lb (See Following Page)

Design Capacity of the Connection = 136 lb

Lateral Design Strength of Wood Connections

Data

Project:	Contours Steel ISW
Comments:	1-1/2" min embedment

Fastener

Fastener	=	#10 Wood Screw	
Shank Dia	=	0.190	in.
Root Dia.	=	0.152	in.
F_{yb}	=	80,000	psi
Fastener length	=	2.250	in.

Main Member

Material	=	Douglas Fir (South)	
G	=	0.46	
θ	=	90	
F_e	=	4,000	psi
Thickness	=	1.500	in.

Side Member

Material	=	SPF	
G	=	0.42	
θ	=	90	
F_{es}	=	3,350	psi
Thickness	=	0.719	in.

Calculations

Lateral Bearing Factors

D	=	0.152	in.	k_1	=	0.7213	
ℓ_m	=	1.326	in.	k_2	=	1.2321	
K_θ	=	1.25		k_3	=	1.36	
K_D	=	2.20		R_d	=	2.20	(Mode I_m, I_s)
R_e	=	1.194		R_d	=	2.20	(Mode II)
R_t	=	1.84		R_d	=	2.20	(Mode III_m, III_s, IV)

Lateral Design Values, Z

Mode I_m	=	366	lbf	
Mode I_s	=	166	lbf	
Mode II	=	120	lbf	
Mode III_m	=	133	lbf	
Mode III_s	=	85	lbf	<== Minimum Value
Mode IV	=	104	lbf	

Adjustment Factors

C_D	=	1.6	C_Δ =	1.0
Wet Service Factor			Is fastener installed in end grain?	No
Fabrication/In-Service		Dry/Dry	C_{eg} =	1.00
C_M	=	1.0	Is fastener part of a diaphragm?	No
In service temperature		T≤100˚F	C_{di} =	1.0
C_t	=	1.0	Is fastener toe-nailed?	No
C_g	=	1.0	C_{tn} =	1.00

Adjusted Design Value, Z

Z' = **136** lbf

Alternate Installation – Strap Anchor to Wood

Anchor: (2)#8 x 1-1/2" Flat head screw securing the strap to the substrate
1/4" max shim space

Details: 20 gauge (0.036" thick) 33 KSI steel strap anchor w/ two #8 screws securing the strap to the frame
0.719" thick wood frame

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

Wood Screw Capacity (Shear)

Z' = 125 lb (See Following Page)

Bending of #8 x 1-1/2" flat head screw

L = 1/4" (maximum shim space)

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

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

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

$V = 2 S F_b / L = (2)(0.000221 \text{ in3})(70{,}200 \text{ psi}) / 1/4"$

V = 124 lb

Bearing Capacity (of #8 screw on frame)

$P_b = F_e D t / K_D = (3{,}350 \text{ psi})(0.164")(0.719")/(10(0.164) + 0.5) =$ 184 lb

Bearing Capacity (of strap anchor)

$P_b = 2.7 D t F_{tu} = 2.7(0.164")(0.036")(45{,}000 \text{ psi}) = 717 \text{ lb}$

$P_{allow} = 717 \text{ lb} / 3.0 =$ 239 lb

Design Capacity of the Connection = 125 lb x 2 = 250 lb

Lateral Design Strength of Wood Connections

Project:	Contours Steel ISW
Comments:	Strap Anchor 1-1/2" min embedment

Data

Fastener

Fastener	=	#8 Wood Screw	
Shank Dia	=	0.164	in.
Root Dia.	=	0.131	in.
F_{yb}	=	90,000	psi
Fastener length	=	1.500	in.

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	=	0.036	in.

Calculations

Lateral Bearing Factors

D	=	0.131	in.	k_1	=	0.5714	
ℓ_m	=	1.300	in.	k_2	=	0.5076	
K_θ	=	1.25		k_3	=	22.18	
K_D	=	2.20		R_d	=	2.20	(Mode I_m, I_s)
R_e	=	0.039		R_d	=	2.20	(Mode II)
R_t	=	36.11		R_d	=	2.20	(Mode III_m, III_s, IV)

Lateral Design Values, Z

Mode I_m	=	259	lbf	
Mode I_s	=	186	lbf	
Mode II	=	107	lbf	
Mode III_m	=	122	lbf	
Mode III_s	=	78	lbf	<== Minimum Value
Mode IV	=	109	lbf	

Adjustment Factors

C_D	=	1.6	C_Δ	=	1.0
Wet Service Factor			Is fastener installed in end grain?		No
Fabrication/In-Service		Dry/Dry	C_{eg}	=	1.00
C_M	=	1.0	Is fastener part of a diaphragm?		No
In service temperature		T≤100˚F	C_{di}	=	1.0
C_t	=	1.0	Is fastener toe-nailed?		No
C_g	=	1.0	C_{tn}	=	1.00

Adjusted Design Value, Z

Z' = **125** **lbf**

Alternate Installation – Through-Frame to Concrete

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

Details: Through the Wood Frame
- 0.719" thick

Substrate: 3,000 psi Concrete

Anchor Capacity (Shear of 3/16" Tapcon)

P_{ss} / Ω = 181 lb (NOA-No. 16-1222.06)

Bearing Capacity (of Wood frame)

$P_b = F_e D t / K_D$ = (3,350 psi)(0.170")(0.719")/(10(0.170) + 0.5) = 194 lb

Bending Capacity (of 3/16" Tapcon)

L = 1/4" (maximum shim space)

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

$F_b = (1.3)(0.6 F_y)$ = (1.3)(0.6)(137,000 psi) = 106,860 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)(0.000482 in3)(106,860 psi) / 1/4"

V = 412 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
- 3" min anchor spacing
- 1/4" max shim space

Details: Through the Wood Frame
- 0.719" thick

Substrate: CMU Block

Anchor Capacity (Shear of 3/16" Tapcon)

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

Bearing Capacity (of Wood frame)

$P_b = F_e\, D\, t / K_D = (3{,}350 \text{ psi})(0.170")(0.719")/(10(0.170) + 0.5) = 194$ lb

Bending Capacity (of 3/16" Tapcon)

L = 1/4" (maximum shim space)

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

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

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

$V = 2\, S\, F_b / L = (2)(0.000482 \text{ in3})(106{,}860 \text{ psi}) / 1/4"$

V = 412 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
- 3" 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} / Ω = 181 lb (NOA-No. 16-1222.06)

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

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

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

Bearing Capacity (of #8 screw on frame)

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

Bearing Capacity (of #8 screw on strap anchor)

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

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

Bending Capacity (of 3/16" Tapcon)

L = 1/4" (maximum shim space)

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

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

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

$V = 2\ S\ F_b / L = (2)(0.000482\ in3)(106{,}860\ psi) / 1/4"$

V = 412 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
- 3" 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} / Ω = 135 lb (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 psi) = 681 lb

P_{allow} = 681 lb / 3.0 = 227 lb

Bearing Capacity (of #8 screw on frame)

$P_b = F_e\ D\ t\ /K_D$ = (3,350 psi)(0.164")(1.00")/(10(0.164) + 0.5) = 257 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 psi) = 657 lb

P_{allow} = 657 lb / 3.0 = 219 lb

Bending Capacity (of 3/16" Tapcon)

L = 1/4" (maximum shim space)

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

$F_b = (1.3)(0.6\ F_y)$ = (1.3)(0.6)(137,000 psi) = 106,860 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)(0.000482 in3)(106,860 psi) / 1/4"

V = 412 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: (2) #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
0.719" 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 lb/in)(1.5 in) = 197 lb

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

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

P_{allow} = 739 lb / 3.0 = 246 lb

Bearing Capacity (of #8 screw on frame)

P_b = F_e D t /K_D = (3,350 psi)(0.164")(0.719")/(10(0.164) + 0.5) = 184 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 psi) = 657 lb

P_{allow} = 657 lb / 3.0 = 219 lb

Design Capacity of the Connection = 184 lb (one screw)

Design Capacity of the Connection = 368 lb (two screws)

Anchorage Requirements

Series/Model: Steel 25 GA W.E. Double Door with Fixed Sidelites

Test Unit Size: 184-7/8" x 81-3/4"

Design Pressure: +35.0 / -35.0 psf

Through-Frame Installation Method

Through frame installation method is validated by the test

Through Frame Anchor Capacity = 136 lb / anchor

Alternate Installation Methods

Strap Anchor to Wood = 250 lb / anchor strap (Two wood screws per strap)

Through-Frame to Concrete = 181 lb / anchor

Through-Frame to CMU Block = 135 lb / anchor

Strap Anchor to Concrete = 181 lb / anchor

Strap Anchor to CMU Block = 135 lb / anchor

Strap Anchor to Wood (Cap Installation) = 184 lb / anchor

Minimum Alternate Installation Capacity = 135 lb / anchor

135 lb < 136 lb
- Approximately 0.8% difference, alternate anchorage is deemed equivalent

Alternate Anchorages OK at tested spacing

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	9/22/2023	All	Original Report Issue