Product Approval Supporting Calculations
Alternative Anchorage Analysis & Design

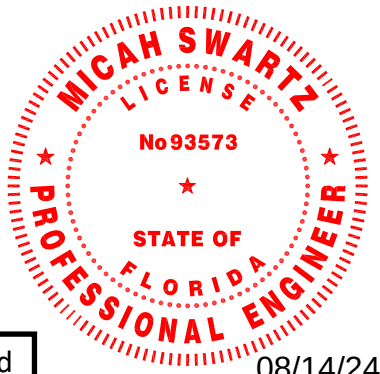
Project Number: MS24-08007

Drawing Number: 364-1

Reference Test Report: N4811.01-901-44 R0

Product Name: ID 364 HLOS HP - Envision 44x101.5

Prepared for:
VPI Quality Windows
3420 E. Ferry Avenue
Spokane, WA 99202



Prepared by:
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08/14/24

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Scope:

Micah Swartz, P.E. is contracted by Jeld-Wen Windows & Doors to evaluate alternative anchorage for the product: ID 364 HLOS HP - Envision 44x101.5. This evaluation is based on testing performed by Intertek Building & Construction in Kent, WA, test report no.: N4811.01-901-44 R0 and dated 8/19/22.

This evaluation does not include the air infiltration, water resistance or water penetration of the installation method or the installed product. In addition, the design of the building substrate to resist the superimposed loads is by others.

Reference Standards:

Florida Building Code, Building, 2023 Edition

ANSI/AWC NDS 2018 - National Design Specification (NDS) for Wood Construction

AISI S100-16 (2020) North American Specification for the Design of Cold-Formed Steel Structural Members

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

NOA 24-0102.06 Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology

Certification of Independence:

In accordance with Rule 61G20-3 Florida Administrative Code, Micah Swartz, P.E. hereby certifies the following:

(1) Micah Swartz, P.E. 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.

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(4) Micah Swartz, P.E. does not have, nor will acquire, a financial interest in any other entity involved in the approval process of the product.

Design Summary:

The table below summarizes the product: ID 364 HLOS HP - Envision 44x101.5 and their corresponding performance levels as established by testing.

Table 1: Summary of Test Results

Series/Model	Test Report Number	Size (W x H)	Performance
ID 364 HLOS HP - Envision 44x101.5	N4811.01-901-44 R0 (8/19/22)	44" x 101.5"	+40 psf / -40 psf

As Tested Design:

Screw Information:

Screw Size: 8 Screw Embed: 1.5 in Edge Distance: 3/4 in (minimum)

Wood Screw Lateral: **106** lbs

Alternative Fasteners:

Screw Information:

Screw Size: 10 Screw Embed: 1.5 in Edge Distance: 3/4 in (minimum)

Wood Screw Lateral: **149** lbs

TEK Screw Information:

Screw Size: 10-16

TEK Withdrawal: **145** lbs

TEK Lateral: **147** lbs

Tapcon Information:

Tapcon Size: 1/4 Embedment: 1-1/4 in (minimum) Edge Distance: 2-1/2 in (minimum)

Tapcon Lateral (Concrete): **203** lbs

Tapcon Lateral (CMU): **161** lbs

Subject: As Tested - Wood Screw Lateral Design - Single Shear

Input:
Calculation:

Screw Information:

Screw Size: 8 Root Diameter: 0.131 in
Screw Embed: 1.5 in

Main Member Type: S-P-F G: 0.42 F_{em}: 3,350 psi thickness (t_m): 1.5 in

Side Member Type: Steel G: N/A F_{es}: 36,000 psi thickness (t_s): 0.06 in

Lateral Design Factors - Table 12.3.1A (NDS 2018)

D:	0.131	in	Diameter
F_{yb}:	100	ksi	Dowel Bending Yield Strength
F_{em}:	3,350	psi	Main Member dowel bearing strength
F_{es}:	36,000	psi	Side Member dowel bearing strength
l_m:	1.5	in	Main Member dowel bearing length
l_s:	0.06	in	Side Member dowel bearing length
R_d:	2.2		Reduction term - Table 12.3.1B (NDS 2018)
R_e:	0.0931		$= F_{em}/F_{es}$
R_t:	25.0		$= l_m/l_s$
k_1:	0.939		See Table
k_2:	0.538		See Table

Reference Lateral Design Values - Table 12.3.1A (NDS 2018)

Z_{Im}: 299 lbs $Z_{I_m} = \frac{Dl_m F_{em}}{R_d}$ (EQ 12.3 − 1)

Z_{II}: 121 lbs $Z_{II} = \frac{k_1 D l_s F_{es}}{R_d}$ (EQ 12.3 − 3)

Z_{IIIm}: 136 lbs $Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1+2R_e)R_d}$ (EQ 12.3 − 4)

Z_{IV}: 112 lbs $Z_{IV} = \frac{D^2}{R_d}\sqrt{\frac{2F_{em}F_{yb}}{3(1+R_e)}}$ (EQ 12.3 − 6)

Z_{MIN}: 112 lbs

Note: Side member is part of the Jeld-Wen assembly and verified during testing. Modes Z_{Is} and Z_{IIIs} are not applicable to the calculation.

Subject: As Tested - Wood Screw Lateral Design - Single Shear Cont.

Adjusted Lateral Design Values

$$Z' = Z * C_D * C_M * C_t * C_g * C_\Delta \ - As\ per\ table\ 11.3.1\ NDS\ 2018$$

C_D:	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C_M:	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C_t:	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)
C_g:	1.0	Group Action Factor - Section 11.3.6 (NDS 2018)
C_Δ:	1.0	Geometry Factor - Section 12.5.1.1 (NDS 2018)

Z': **178** lbs

Fastener Bending Across Shim Space

Ω:	1.67		
L:	0.25	in	Maximum Shim Gap
D:	**0.131**	in	Diameter
F_{yb}:	**100**	ksi	Dowel Bending Yield Strength

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16ZL}{\pi D^3} \Leftrightarrow Z = \frac{F_{yb}\pi D^3}{16\Omega L} \qquad Where\ M = \frac{ZL}{2}\ (Guided\ Bending)$$

Z_n/Ω: **106** lbs

Bearing on Masonry Strap

Ω:	3.00		
F_u:	33	ksi	Tensile Strength of strap
t:	20	GA	
t:	**0.036**	in	thickness of strap
D:	**0.131**	in	

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u \ - (EQ.J4.3.1 - 4, AISI\ S100)$$

P_{nv}/Ω: **140** lbs

Subject: Wood Screw Lateral Design - Single Shear

Input:
Calculation:

Screw Information:

Screw Size: 10 Root Diameter: 0.152 in
Screw Embed: 1.5 in

Main Member Type: S-P-F G: 0.42 F_{em}: 3,350 psi thickness (t_m): 1.5 in

Side Member Type: Steel G: N/A F_{es}: 36,000 psi thickness (t_s): 0.06 in

Lateral Design Factors - Table 12.3.1A (NDS 2018)

D:	0.152	in	Diameter
F_{yb}:	90	ksi	Dowel Bending Yield Strength
F_{em}:	3,350	psi	Main Member dowel bearing strength
F_{es}:	36,000	psi	Side Member dowel bearing strength
l_m:	1.5	in	Main Member dowel bearing length
l_s:	0.06	in	Side Member dowel bearing length
R_d:	2.2		Reduction term - Table 12.3.1B (NDS 2018)
R_e:	0.0931		$= F_{em}/F_{es}$
R_t:	25.0		$= l_m/l_s$
k_1:	0.939		See Table
k_2:	0.551		See Table

Reference Lateral Design Values - Table 12.3.1A (NDS 2018)

Z_{Im}: 347 lbs $Z_{I_m} = \frac{Dl_m F_{em}}{R_d}$ (EQ 12.3 − 1)

Z_{II}: 140 lbs $Z_{II} = \frac{k_1 D l_s F_{es}}{R_d}$ (EQ 12.3 − 3)

Z_{IIIm}: 161 lbs $Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1+2R_e)R_d}$ (EQ 12.3 − 4)

Z_{IV}: 142 lbs $Z_{IV} = \frac{D^2}{R_d}\sqrt{\frac{2F_{em}F_{yb}}{3(1+R_e)}}$ (EQ 12.3 − 6)

Z_{MIN}: 140 lbs

Note: Side member is part of the Jeld-Wen assembly and verified during testing. Modes Z_{Is} and Z_{IIIs} are not applicable to the calculation.

Subject: Wood Screw Lateral Design - Single Shear Cont.

Adjusted Lateral Design Values

$$Z' = Z * C_D * C_M * C_t * C_g * C_\Delta \ - As\ per\ table\ 11.3.1\ NDS\ 2018$$

C_D:	1.6	Load Duration Factor - Table 2.3.2 (NDS 2018)
C_M:	1.0	Wet Service Factor - Table 11.3.3 (NDS 2018)
C_t:	1.0	Temperature Factor - Table 11.3.4 (NDS 2018)
C_g:	1.0	Group Action Factor - Section 11.3.6 (NDS 2018)
C_Δ:	1.0	Geometry Factor - Section 12.5.1.1 (NDS 2018)

Z': **224** lbs

Fastener Bending Across Shim Space

Ω:	1.67		
L:	0.25	in	Maximum Shim Gap
D:	**0.152**	in	Diameter
F_{yb}:	**90**	ksi	Dowel Bending Yield Strength

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16ZL}{\pi D^3} \Leftrightarrow Z = \frac{F_{yb}\pi D^3}{16\Omega L} \qquad Where\ M = \frac{ZL}{2}\ (Guided\ Bending)$$

Z_n/Ω: **149** lbs

Bearing on Masonry Strap

Ω:	3.00		
F_u:	33	ksi	Tensile Strength of strap
t:	20	GA	
t:	**0.036**	in	thickness of strap
D:	**0.152**	in	

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u \ - (EQ.J4.3.1 - 4, AISI\ S100)$$

P_{nv}/Ω: **162** lbs

Subject: TEK Lateral Design

Input:
Calculation:

Shear Strength of Fastener - ESR 1976

Screw Size: **10-16**

P_{nv}/Ω: **573** lbs See ESR-1976

Bearing Strength of Material NOT in Contact with Screw Head - AISI S100

Screw Size: **10-16** Ω: 3.00

D:	**0.138**	in	Root Diameter of TEK Screw
F_u:	45	ksi	Tensile Strength of material NOT in contact with screw head
t:	18	GA	
t:	**0.0478**	in	Thickness of material NOT in contact with screw head

$$\frac{P_{nv1}}{\Omega} = 2.7 * t * D * F_u \ -(EQ.J4.3.1-3, AISI\ S100)$$

$$\frac{P_{nv2}}{\Omega} = 4.2\sqrt{t^3 * D} * F_u \ -(EQ.J4.3.1-1, AISI\ S100)$$

P_{nv1}/Ω: **267** lbs

P_{nv2}/Ω: **245** lbs

P_{nv}/Ω: **245** lbs $\frac{P_{nv}}{\Omega} = smallest\ of\ \frac{P_{nv1}}{\Omega}\ and\ \frac{P_{nv2}}{\Omega}$

Bearing Strength of Material IN in Contact with Screw Head

Note: Material IN contact with the screw head is part of the VPI assembly and has been verified by testing.

Fastener Bending Across Shim Space

Ω: 3.00

L:	0.25	in	Maximum Shim Gap
D:	**0.138**	in	Root Diameter of TEK Screw
F_{yb}:	100	ksi	Yield Strength of TEK Screw

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_nL}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb}\pi D^3}{16\Omega L} \qquad Where\ M = \frac{P_nL}{2}\ (Guided\ Bending)$$

P_n/Ω: **206** lbs

Bearing Strength of Masonry Straps - AISI S100

Screw Size:	10-16		TEK Screw	Ω: 3.00
D:	0.138	in	Root Diameter of TEK Screw	
F_u:	33	ksi	Tensile Strength of Masonry Strap	
t:	20	GA		
t:	0.0359	in	Thickness of Masonry Strap	

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u \ -(EQ.J4.3.1-3, AISI\ S100)$$

P_{nv}/Ω: 147 lbs

Subject: Tapcon Lateral Design

Input:
Calculation:

Tapcon Size:

Size:	1/4		
D:	0.25	in	Nominal Diameter
D_{sh}:	0.19	in	Shank Diameter

Fastener Shear Capacity - 3,000 psi Concrete

P_{nv}/Ω: 237 lbs See Table 1B of NOA 24-0102.06

Fastener Shear Capacity - Medium-Weight CMU

P_{nv}/Ω: 161 lbs See Table 3 of NOA 24-0102.06

Note:
- Critical anchor spacing is 16D
- Minimum Anchor Embedment is 1-1/4"
- Minimum Edge Distance is 2-1/4"

Fastener Bending Across Shim Space

L:	0.25	in	Maximum Shim Gap	Ω: 3.00
D_{sh}:	0.19	in	Shank Diameter of Tapcon	
F_{yb}:	100	ksi	Yield Strength of Tapcon	

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_nL}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb}\pi D^3}{16\Omega L} \qquad Where\ M = \frac{P_nL}{2}\ (Guided\ Bending)$$

P_n/Ω: 539 lbs

Bearing Strength of Masonry Straps - AISI S100

Size:	1/4		Tapcon Size	Ω: 3.00
D_{sh}:	0.19	in	Shank Diameter of Tapcon Screw	
F_u:	33	ksi	Tensile Strength of Masonry Strap	
t:	20	GA		
t:	0.0359	in	Thickness of Masonry Strap	

$$\frac{P_{nv}}{\Omega} = 2.7 * t * D * F_u\ -(EQ.J4.3.1-3, AISI\ S100)$$

P_{nv}/Ω: 203 lbs