

SWARTZ
CONSULTING ENGINEERS LLC

Project Number:	SCE 25-05011
Project Name:	511 Endurance
Date:	6/20/2025
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Product Approval Supporting Calculations Alternative Anchorage Analysis & Design

Project Number: SCE 25-05011

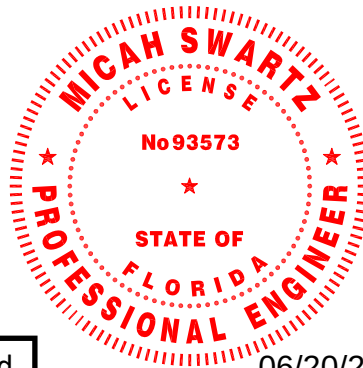
Drawing Number: ID_296-1

Reference Test Report: L9164.01-901-44 R0

Product Name: 511 Endurance 108" x 96"

Prepared for:

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



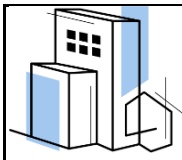
06/20/25

Prepared by:
Swartz Consulting Engineers LLC

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This item has been digitally signed and sealed by Micah Swartz, P.E. on the date adjacent to the seal.

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Scope:

Swartz Consulting Engineers LLC is contracted by Jeld-Wen Windows & Doors to evaluate alternative anchorage for the product: 511 Endurance 108" x 96". This evaluation is based on testing performed by Intertek in Kent, WA, test report no.: L9164.01-901-44 R0 and dated 03/10/21.

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:

Current edition of the Florida Building Code, Building

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

AISI S100 North American Specification for the Design of Cold-Formed Steel Structural Members

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

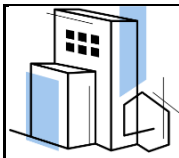
ICC-ES Report ESR-2196 Hilti Self Drilling Screws to connect cold-formed steel

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, Swartz Consulting Engineers LLC hereby certifies the following:

- (1) Swartz Consulting Engineers 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
- (2) Swartz Consulting Engineers LLC is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- (3) Micah Swartz, 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.
- (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: 511 Endurance 108" x 96" 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
511 Endurance 108" x 96"	L9164.01-901-44 R0 (03/10/21)	108" x 96"	+30 psf / -30 psf

As Tested Design:

Applied Load (psf): 30 psf Trib: 54 in Height: 96 in
Max Mullion Reaction: 540.0 plf

Screw Information:

Screw Size: 8 Screw Embed: 1.25 in Edge Distance: 3/4 in (minimum)
qty: 4 Spacing: 12 in O.C. (Jamb distributes over 12")

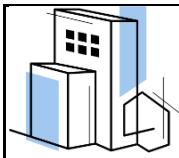
Wood Screw Withdrawal: 164 lbs Per ft. Capacity: 656 plf Unity: 0.82

Alternative Fasteners:

Screw Information:

Screw Size: 8 Screw Embed: 1.25 in Edge Distance: 3/4 in (minimum)
qty: 4 Spacing: 12 in O.C. (Masonry Strap)

Wood Screw Lateral: 140 lbs Per ft. Capacity: 559 plf Unity: 0.97



Design Summary Continued:

TEK Screw Information:

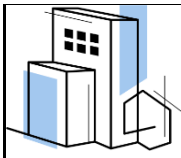
Screw Size: 10-16 qty: 4 Spacing: 12 in O.C. (Masonry Strap)
 qty: 4 Spacing: 12 in O.C. (Nailfin/Sill)

TEK Withdrawal:	145 lbs	Per ft. Capacity:	580 plf	Unity:	0.93
TEK Lateral:	147 lbs	Per ft. Capacity:	589 plf	Unity:	0.92

Tapcon Information:

Tapcon Size: 1/4 Embedment: 1-1/4 in (minimum) Edge Distance: 2-1/2 in (minimum)
 qty: 4 Load is Distributed over two (2) anchors.

Tapcon Lateral (Concrete):	203 lbs	Per ft. Capacity:	810 plf	Unity:	0.67
Tapcon Lateral (CMU):	161 lbs	Per ft. Capacity:	644 plf	Unity:	0.84



Subject: Wood Screw Withdrawal

Input:

Calculation:

Screw Information:

Screw Size: 8

Root Diameter: 0.131 in

Screw Embed: 1.25 in

Main Member Type: S-P-F

G: 0.42

F_{em}: 3,350 psi

$$W' = W * C_D * C_M^2 * C_t - \text{As per table 11.3.1 NDS}$$

C_D: 1.6 Load Duration Factor - Table 2.3.2 (NDS)

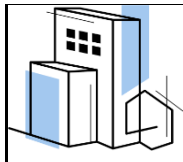
C_M: 1.0 Wet Service Factor - Table 11.3.3 (NDS)

C_t: 1.0 Temperature Factor - Table 11.3.4 (NDS)

W: 82 lbs/in - Table 12.2B (NDS)

W: 103 lbs

W': 164 lbs



Subject: Wood Screw Lateral Design - Single Shear

Input:

Calculation:

Screw Information:

Screw Size: 8

Root Diameter: 0.131 in

Screw Embed: 1.25 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)

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 :	1.25 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)
R_e :	0.0931	$= F_{em}/F_{es}$
R_t :	20.8	$= l_m/l_s$
k_1 :	0.783	See Table
k_2 :	0.564	See Table

Reference Lateral Design Values - Table 12.3.1A (NDS)

$$Z_{Im}: 249 \text{ lbs} \quad Z_{Im} = \frac{D l_m F_{em}}{R_d} \text{ (EQ 12.3 - 1)}$$

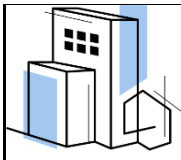
$$Z_{II}: 101 \text{ lbs} \quad Z_{II} = \frac{k_1 D l_s F_{es}}{R_d} \text{ (EQ 12.3 - 3)}$$

$$Z_{III_m}: 119 \text{ lbs} \quad Z_{III_m} = \frac{k_2 D l_m F_{em}}{(1 + 2R_e) R_d} \text{ (EQ 12.3 - 4)}$$

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

$$Z_{MIN}: 101 \text{ lbs}$$

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



Subject: Wood Screw Lateral Design - Single Shear Cont.

Adjusted Lateral Design Values

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

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

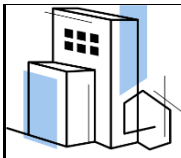
$$Z': 161 \text{ lbs}$$

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

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

$$P_{nv}/\Omega: 140 \text{ lbs}$$



Subject: TEK Withdrawal

Input:

Calculation:

Shear Strength of Fastener - ESR 1976

Screw Size: 10-16

P_{nv}/Ω : 885 lbs See ESR 2196

Tensile Pullout - ESR 1976

Screw Size: 10-16

F_u : 45 ksi

t: 16 GA

t: 0.0598 in

Tensile Strength of material NOT in contact with screw head

Thickness of material NOT in contact with screw head

P_{nv}/Ω : 145 lbs See ESR 2196

Tensile Pullover

Note: The tensile pullover analysis checks the material IN contact with the screw head. This material is part of the Jeld-Wen assembly and has been verified by testing. Below is a check to ensure the head size of the TEK screw is equal to or larger than the head of the tested fastener, ensuring compliance.

Tested Fastener Head Size:

Screw Size: 8

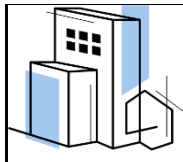
Head Size: 0.312 in

Tested fastener is a

TEK Screw Head Size:

Screw Size: 10-16

Head Size: 0.365 in



Subject: TEK Lateral Design

Input:

Calculation:

Shear Strength of Fastener - ESR 1976

Screw Size: 10-16

P_{nv}/Ω : 573 lbs See ESR 2196

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 $\frac{P_{nv}}{\Omega} = \text{smallest of } \frac{P_{nv1}}{\Omega} \text{ and } \frac{P_{nv2}}{\Omega}$

Bearing Strength of Material IN in Contact with Screw Head

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

Fastener Bending Across Shim Space

L: 0.25 in Maximum Shim Gap

Ω : 3.00

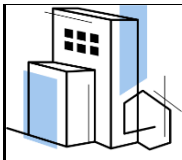
D: 0.138 in Root Diameter of TEK Screw

F_{yb} : 100 ksi Yield Strength of TEK Screw

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_n L}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb} \pi D^3}{16 \Omega L}$$

$$\text{Where } M = \frac{P_n L}{2} \text{ (Guided Bending)}$$

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

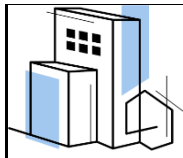
t: 20 GA

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:
D: in Nominal Diameter
D_{sh}: in Shank Diameter

Fastener Shear Capacity - 3,000 psi Concrete

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

Fastener Shear Capacity - Medium-Weight CMU

P_{nv}/Ω: 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: in Maximum Shim Gap
D_{sh}: in Shank Diameter of Tapcon
F_{yb}: ksi Yield Strength of Tapcon

Ω:

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16P_n L}{\pi D^3} \Leftrightarrow P_n = \frac{F_{yb} \pi D^3}{16 \Omega L}$$

Where $M = \frac{P_n L}{2}$ (Guided Bending)

P_n/Ω: lbs

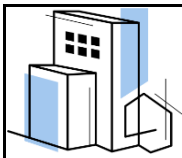
Bearing Strength of Masonry Straps - AISI S100

Size: Tapcon Size
D_{sh}: in Shank Diameter of Tapcon Screw
F_u: ksi Tensile Strength of Masonry Strap
t: GA
t: in Thickness of Masonry Strap

Ω:

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

P_{nv}/Ω: lbs



Subject: Sill Angle Design

Input:

Calculation:

Plate Bending - Steel: AISI S100

Bending Condition: Cantilever

Moment Equation: $M_u = P * l$

Applied Load (P): 0.045 kips

Length (l): 0.75 in

Applied Moment (Mu): 0.034 kip-in

Thickness (t): 0.063 in

Width (b): 3.000 in

Yield Strength (F_y): 45 ksi

Modulus of Elasticity (E): 29,000 ksi

Moment of Inertia (I_x): 0.000061 in⁴

Ω : 1.67

Section Modulus (S_{fy}): 0.002930 in³

Moment Capacity (Mn): 0.132 kip-in

Mn/ Ω : 0.079 kip-in

$$M_n = M_y = S_{fy} * F_y \text{ (Eq. F2.1 - 2)}$$

Unity: 0.43

Deflection (Δ): 0.0035752 in