



**SWARTZ**  
CONSULTING ENGINEERS LLC

Project Number: SCE 25-05008

Project Name: 511 Endurance

Date: 6/20/2025

Page: 1 of 12

## Product Approval Supporting Calculations Alternative Anchorage Analysis & Design

**Project Number:** SCE 25-05008

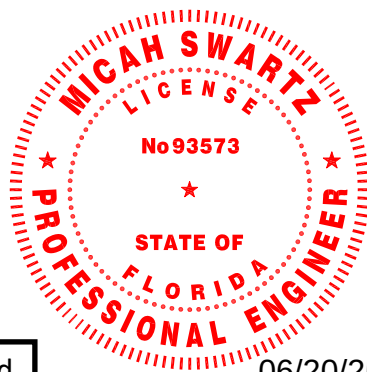
**Drawing Number:** ID\_156-1

**Reference Test Report:** J1819.01-901-44-R0

**Product Name:** 511 Endurance 120" X 96"

**Prepared for:**

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



06/20/25

Prepared by:

Swartz Consulting Engineers LLC

Micah Swartz, PE

Florida License No. PE 93573

Florida Registry No. 38420

This item has been digitally signed and sealed by Micah Swartz, P.E. 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 any electronic copies.



**Scope:**

Swartz Consulting Engineers LLC is contracted by Jeld-Wen Windows & Doors to evaluate alternative anchorage for the product: 511 Endurance 120" X 96". This evaluation is based on testing performed by Intertek in Kent, WA, test report no.: J1819.01-901-44-R0 and dated 05/16/19.

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 120" 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 120" X 96" | J1819.01-901-44-R0<br>(05/16/19) | 120" X 96"   | +40 psf / -40 psf |

**As Tested Design:**

Applied Load (psf): 40 psf Trib: 40 in Height: 96 in  
Max Mullion Reaction: 533.3 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: 0.81

**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: 0.95



Date: 6/20/2025 Page: 4 of 12

Unity: 0.99



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<sub>em</sub>: 3,350 psi

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

C<sub>D</sub>: 1.6 Load Duration Factor - Table 2.3.2 (NDS)

C<sub>M</sub>: 1.0 Wet Service Factor - Table 11.3.3 (NDS)

C<sub>t</sub>: 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)**

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

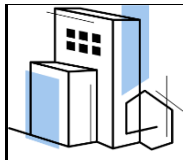
$$Z_{II}: 101 \text{ lbs} \quad Z_{II} = \frac{k_1 D l_s F_{es}}{R_d} \text{ (EQ 12.3 - 3)}$$

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

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

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

Note: Side member is part of the Jeld-Wen assembly and verified during testing. Modes  $Z_{Is}$  and  $Z_{III_s}$  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) |
| $C_{\Delta}$ : | 1.0 | Geometry Factor - Section 12.5.1.1 (NDS)   |

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

**Bearing on Masonry Strap**

|            |       |                               |
|------------|-------|-------------------------------|
| $\Omega$ : | 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

$P_{nv}/\Omega$ : 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

$P_{nv}/\Omega$ : 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

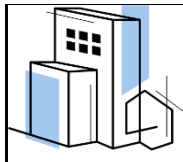
Head Size: 0.312 in

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

$P_{nv}/\Omega$ : 573 lbs See ESR 2196

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

Screw Size: 10-16

$\Omega$ : 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

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

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

$P_{nv1}/\Omega$ : 267 lbs

$P_{nv2}/\Omega$ : 245 lbs

$P_{nv}/\Omega$ : 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

$\Omega$ : 3.00

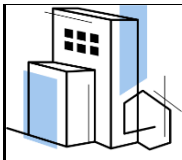
D: 0.138 in Root Diameter of TEK Screw

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

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

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

$P_n/\Omega$ : 206 lbs



**Bearing Strength of Masonry Straps - AISI S100**

Screw Size: 10-16

TEK Screw

$\Omega$ : 3.00

D: 0.138 in

Root Diameter of TEK Screw

$F_u$ : 33 ksi

Tensile Strength of Masonry Strap

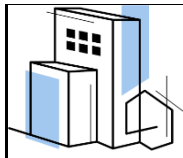
t: 20 GA

t: 0.0359 in

Thickness of Masonry Strap

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

$P_{nv}/\Omega$ : 147 lbs



Subject: Tapcon Lateral Design

Input:   
Calculation:

**Tapcon Size:**

Size:   
D:  in Nominal Diameter  
D<sub>sh</sub>:  in Shank Diameter

**Fastener Shear Capacity - 3,000 psi Concrete**

P<sub>nv</sub>/Ω:  lbs See Table 1B of NOA 24-0102.06

**Fastener Shear Capacity - Medium-Weight CMU**

P<sub>nv</sub>/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<sub>sh</sub>:  in Shank Diameter of Tapcon  
F<sub>yb</sub>:  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<sub>n</sub>/Ω:  lbs

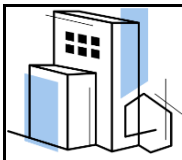
**Bearing Strength of Masonry Straps - AISI S100**

Size:  Tapcon Size  
D<sub>sh</sub>:  in Shank Diameter of Tapcon Screw  
F<sub>u</sub>:  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<sub>nv</sub>/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): 0.044 kips

Length (l): 0.75 in

Applied Moment (Mu): 0.033 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 in<sup>4</sup>

$\Omega$ : 1.67

Section Modulus ( $S_{fy}$ ): 0.002930 in<sup>3</sup>

Moment Capacity (Mn): 0.132 kip-in

Mn/ $\Omega$ : 0.079 kip-in

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

Unity: 0.42

Deflection ( $\Delta$ ): 0.003531 in