

Micah Swartz, P.E.	Project Number:	MS24-10007	
	Project Name:	ID 175 SH-SH-AT - Endurance	
	Date:	7/27/2025	Page: 1 of 13

**Product Approval Supporting Calculations
Alternative Anchorage Analysis & Design - R1 General Update**

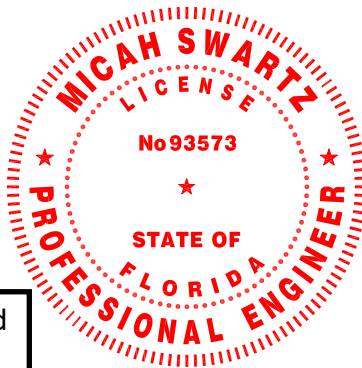
Project Number: MS24-10007

Drawing Number: 175

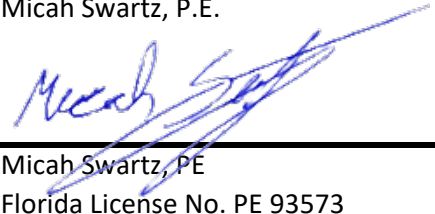
Reference Test Report: I2450.01-901-44 R0

Product Name: ID 175 SH-SH-AT - Endurance 88"x96"

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



Prepared by:
Micah Swartz, P.E.


Micah Swartz, PE
Florida License No. PE 93573

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.

07/27/25

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025 Page: 2 of 13

Scope:

Micah Swartz, P.E. is contracted by VPI Quality Windows to evaluate alternative anchorage for the product: ID 175 SH-SH-AT - Endurance 88"x96". This evaluation is based on testing performed by Intertek Building & Construction in Kent, WA, test report no.: I2450.01-901-44 R0 and dated 9/25/18.

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, 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.

(2) Micah Swartz, P.E. 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.

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025
	Page:	3 of 13

Design Summary:

The table below summarizes the product: ID 175 SH-SH-AT - Endurance 88"x96" 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 175 SH-SH-AT - Endurance 88"x96"	I2450.01-901-44 R0 (9/25/18)	88" x 96"	+45 psf / -45 psf

As Tested Design:

Geometry - Through Nail Flange

Screw Information:

Screw Size: 8 Screw Embed: 1 in Edge Distance: 3/4 in (minimum)
 qty: 1 Spacing: 4 in O.C.

Wood Screw Withdrawal: 131 lbs Per ft. Capacity: 394 plf

Geometry - Fender Washer over Nail Flange @ Header

See Intertek Report No. N2543.01-904-44 issued 3/15/22

Performance of Unit: -45 psf Load Applied to Header (Tributary Method): 135 plf

Load resisted by one (1) #8 screw w/ 1-1/8" embedment @ 12" o.c.

Screw Size: 8 Screw Embed: 1.125 in Edge Distance: 3/4 in (minimum)
 qty: 1 Spacing: 12 in O.C.

Wood Screw Withdrawal: 148 lbs Per ft. Capacity: 148 plf

Performance of Unit: 45 psf Load Applied to Header (Tributary Method): 180 plf

Load is resisted by #8 screws w/ 1" embedment @ 4" O.C. with a capacity of 394 plf as shown above.

Alternative Fasteners Cont. - See following sheets for detailed fastener analysis

Geometry - Through Nail Flange

TEK Screw Information:

Screw Size: 10-16
 qty: 1 Spacing: 4 in O.C.

TEK Withdrawal: 145 lbs Per ft. Capacity: 435 plf Unity: 0.90

Micah Swartz, P.E.

Project Number: MS24-10007

Project Name: ID 175 SH-SH-AT - Endurance

Date: 7/27/2025 Page: 4 of 13

Alternative Fasteners Cont. - See following sheets for detailed fastener analysis**Geometry - Masonry Straps**

Performance of Unit: 45 psf

Load Applied to Jamb (Tributary Method): 158 plf

Load resisted by masonry strap @ 12" o.c.

Load resisted by each strap: 158 lbs

Screw Information:Screw Size: 10
qty: 2Screw Embed: 1 in
Spacing: 12 in O.C.

Edge Distance: 3/4 in (minimum)

Wood Screw Lateral: 149 lbs

Per ft. Capacity: 297 plf Unity: 0.53

TEK Screw Information:Screw Size: 10-16
qty: 2

Spacing: 12 in O.C.

TEK Lateral: 206 lbs

Per ft. Capacity: 413 plf Unity: 0.38

Tapcon Information:Tapcon Size: 1/4
qty: 1Embedment: 1-1/4 in (minimum)
Spacing: 12 in O.C.

Edge Distance: 2-1/2 in (minimum)

Tapcon Lateral (Concrete): 237 lbs

Per ft. Capacity: 237 plf Unity: 0.66

Tapcon Lateral (CMU): 161 lbs

Per ft. Capacity: 161 plf Unity: 0.98

Geometry - Sill Angle (See TEK screw withdrawal and Tapcon Capacities above)**TEK Screw Information:**

Note: Fastener into sill does NOT span shim gap.

Screw Size: 10-16
qty: 1

Spacing: 4 in O.C.

TEK Lateral: 206 lbs

Per ft. Capacity: 619 plf Unity: 0.64

Tapcon Information:Tapcon Size: 3/16
qty: 1Embedment: 1-1/4 in (minimum)
Spacing: 4 in O.C.

Edge Distance: 2-1/2 in (minimum)

Tapcon Lateral (Concrete): 181 lbs

Per ft. Capacity: 543 plf Unity: 0.72

Tapcon Lateral (CMU): 135 lbs

Per ft. Capacity: 405 plf Unity: 0.97

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025

Subject: As Tested - Wood Screw Withdrawal (Fender Washer)

Input:

Calculation:

Screw Information:

Screw Size: Root Diameter: in

Screw Embed: in

Main Member Type: G: F_{em}: psi

$W' = W * C_D * C_M^2 * C_t$ – As per table 11.3.1 NDS

C_D: Load Duration Factor - Table 2.3.2 (NDS)

C_M: Wet Service Factor - Table 11.3.3 (NDS)

C_t: Temperature Factor - Table 11.3.4 (NDS)

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

W: lbs

W': lbs

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025 Page: 6 of 13

Subject: Wood Screw Lateral Design - Single Shear

Input:
 Calculation:

Screw Information:

Screw Size: 10
 Screw Embed: 1 in

Root Diameter: 0.152 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): 0.063 in

Lateral Design Factors - Table 12.3.1A (NDS)

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	in	Main Member dowel bearing length
l _s :	0.063	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 :	15.9		= l _m /l _s
k ₁ :	0.599		See Table
k ₂ :	0.636		See Table

Reference Lateral Design Values - Table 12.3.1A (NDS)

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

Z_{Im}:

231

lbs

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

Z_{II}:

94

lbs

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

Z_{III_m}:

124

lbs

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

Z_{IV}:

142

lbs

$Z_{MIN} = 94 \text{ lbs}$

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.

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025 Page: 7 of 13

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

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': 150 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

$$\frac{F_{yb}}{\Omega} = \frac{M}{S} = \frac{16ZL}{\pi D^3} \Leftrightarrow Z = \frac{F_{yb}\pi D^3}{16\Omega L}$$
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:	16	GA
t:	0.060	in thickness of strap
D:	0.152	in

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

P_{nv}/Ω: 270 lbs

Micah Swartz, P.E.	Project Number:	MS24-10007	
	Project Name:	ID 175 SH-SH-AT - Endurance	
	Date:	7/27/2025	Page: 8 of 13

Subject: TEK Withdrawal

Input:
Calculation:

Tensile Strength of Fastener - ESR 1976

Screw Size:

P_{nv}/Ω : lbs See ESR-1976

Tensile Pullout - ESR 1976

Screw Size:

F_u : ksi Tensile Strength of material NOT in contact with screw head

t: GA

t: in Thickness of material NOT in contact with screw head

P_{nv}/Ω : lbs See ESR-1976

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: Tested fastener is a

Head Size: in

TEK Screw Head Size:

Screw Size:

Head Size: in

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025 Page: 9 of 13

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

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

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

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

P_n/Ω : 206 lbs

Micah Swartz, P.E.	Project Number:	MS24-10007	
	Project Name:	ID 175 SH-SH-AT - Endurance	
	Date:	7/27/2025	Page:10 of 13

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:	16	GA		
t:	0.0598	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: 245 lbs

Micah Swartz, P.E.

Project Number: MS24-10007

Project Name: ID 175 SH-SH-AT - Endurance

Date: 7/27/2025 Page: 11 of 13

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

D_{sh}: 0.19 in Shank Diameter of TapconF_{yb}: 100 ksi Yield Strength of Tapcon

Ω: 3.00

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

Where $M = \frac{P_n L}{2}$ (Guided Bending)P_n/Ω: 539 lbs**Bearing Strength of Masonry Straps - AISI S100**

Size: 1/4 Tapcon Size

D_{sh}: 0.19 in Shank Diameter of Tapcon ScrewF_u: 33 ksi Tensile Strength of Masonry Strap

t: 16 GA

t: 0.0598 in Thickness of Masonry Strap

Ω: 3.00

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

P_{nv}/Ω: 337 lbs

Micah Swartz, P.E.

Project Number: MS24-10007

Project Name: ID 175 SH-SH-AT - Endurance

Date: 7/27/2025 Page: 12 of 13

Subject: Tapcon Lateral Design

Input:

Calculation:

Tapcon Size:

Size: 3/16

D: 0.1875 in Nominal Diameter

D_{sh}: 0.145 in Shank Diameter**Fastener Shear Capacity - 3,000 psi Concrete**P_{nv}/Ω: 181 lbs See Table 1B of NOA 24-0102.06**Fastener Shear Capacity - Medium-Weight CMU**P_{nv}/Ω: 135 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

D_{sh}: 0.145 in Shank Diameter of TapconF_{yb}: 100 ksi Yield Strength of Tapcon

Ω: 3.00

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

Where $M = \frac{P_n L}{2}$ (Guided Bending)P_n/Ω: 239 lbs**Bearing Strength of Masonry Straps - AISI S100**

Size: 3/16 Tapcon Size

D_{sh}: 0.145 in Shank Diameter of Tapcon ScrewF_u: 33 ksi Tensile Strength of Masonry Strap

t: 16 GA

t: 0.0598 in Thickness of Masonry Strap

Ω: 3.00

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

P_{nv}/Ω: 258 lbs

Micah Swartz, P.E.	Project Number:	MS24-10007
	Project Name:	ID 175 SH-SH-AT - Endurance
	Date:	7/27/2025
	Page:	13 of 13

Subject: Sill Angle Design

Input:

Calculation:

Plate Bending - Steel: AISI S100-16

Bending Condition: Cantilever

Moment Equation: $M_u = P \cdot l$

Applied Load (P): 0.015 kips

Length (l): 0.75 in

Applied Moment (Mu): 0.011 kip-in

Thickness (t): 0.063 in

Width (b): 1.000 in

Yield Strength (F_y): 45 ksi

Modulus of Elasticity (E): 29,000 ksi

Moment of Inertia (I_x): 0.000020 in⁴

Section Modulus (S_{fy}): 0.000977 in³

Ω: 1.67

Moment Capacity (Mn): 0.044 kip-in

Mn/Ω: 0.026 kip-in

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

Unity: 0.43

Deflection (Δ): 0.0035752 in