

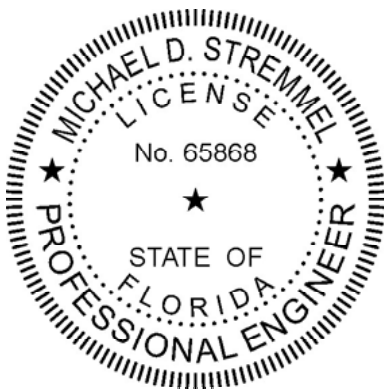
## PRODUCT APPROVAL SUPPORTING CALCULATIONS

### 1618 Sliding Glass Doors – Finless Install at Sill

REPORT TO:

**MI WINDOWS AND DOORS, LLC  
702 WEST MARKET ST  
GRATZ, PENNSYLVANIA 17030**

REPORT NUMBER: 27488.02b-107-16  
REPORT DATE: 12/11/23



2023.12.11 09:17:40 -05'00'

A handwritten signature in black ink, appearing to read "Michael D. Stremmel".

Micheal D. Stremmel, PE  
FL PE 65868  
FL REG 37122

This item has been digitally signed and sealed by Michael D. Stremmel, PE 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 electronic copies.

### **Scope**

Molimo, LLC was contracted by MI Windows and Doors, LLC to evaluate alternate installation methods for their Series 1618 Sliding Glass Doors. The evaluation is based on physical testing and product certifications. This report also addresses the hybrid installation condition of fin installation at the head and jambs but finless installation at the sill. Reference standards utilized in this project include:

*Florida Building Code, Building, 8<sup>th</sup> Edition (2023). International Code Council, 2023.*

*ANSI/AWC NDS-2018 National Design Specification (NDS) for Wood Construction. American Wood Council, 2018.*

*ADM1-2020 2020 Aluminum Design Manual. The Aluminum Association, Inc., 2020.*

*AISI S100-16 North American Specification for the Design of Cold-Formed Steel Structural Members, 2016. American Iron and Steel Institute, 2016.*

*ICC-ES Report ESR-1976 ITW Buildex TEKS Self-Drilling Fasteners. ICC Evaluation Service. 07/2016.*

*NOA 21-0201.6 Tapcon Concrete and Masonry Anchors with Advanced Threadform Technology. Miami-Dade County Product Control Section. 02/01/21.*

*AAMA TIR A9-14 Design Guide for Metal Cladding Fasteners. American Architectural Manufacturers Association, 2014.*

The anchorage analyses presented herein do 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 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 is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- Micheal 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.
- Micheal 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

The following table summarizes the various 1618 Sliding Glass Door 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                                                           | Product Certification | Size (W x H) | Performance                            |
|----------------|------------------------------------------------------------------------------|-----------------------|--------------|----------------------------------------|
| 1618 SGD (OXX) | 2081.02-106-12<br>(Rev. -, 10/14/19)                                         | CPD 18526             | 140" x 96"   | +25/-30 psf                            |
| 1618 SGD (OXX) | 2081.02-106-12<br>(Rev. -, 10/14/19)                                         | CPD 18524             | 140" x 96"   | +/- 30 psf                             |
| 1618 SGD (OXX) | 2081.03-106-12<br>(Rev. -, 10/14/19)                                         | CPD 18522             | 144" x 96"   | +35/-50 psf                            |
| 1618 SGD (OXX) | 2081.03-106-12<br>(Rev. -, 10/14/19)                                         | CPD 18525             | 144" x 96"   | +/- 50 psf                             |
| 1618 SGD (OXX) | 2081.03-106-12<br>(Rev. -, 10/14/19)<br>2081.04-106-12<br>(Rev. -, 10/14/19) | CPD 18523             | 144" x 96"   | +/- 50 psf<br>Missile D<br>Wind Zone 3 |

Testing documented in Table 1 was conducted by Molimo, LLC in York, Pennsylvania (Florida Department of Business & Professional Regulation Test Lab No. TST11282).

### As-Tested Installation Analysis

For air/water/structural testing and hurricane impact testing, the test specimens were secured to a pine buck as summarized in Table 2. The as-tested installation methods are evaluated on page 7 to page 11 and the established design capacities are presented in Table 2.

**Table 2** As-tested Anchorage Design Capacities

| Test                                  | Connection                                                                                                                                         | Capacity |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1618 SGD<br>Air/Water/Structural Test | <u>Head, Sill and Jambs</u><br>Nail fin with #6 x 1-5/8" wood screw. Placed 4-1/2" from each corner and 7-1/4" on center.                          | 60 lb    |
|                                       | <u>Head and Sill</u><br>Twist-in strap anchor placed 3-1/4" from each end and 12" on center. Secured to wood buck with one #8 x 1-1/2" wood screw. | 124 lb   |
|                                       | <u>Head</u><br>#8 x 2-3/4" wood screw through frame track to wood buck; 5 total.                                                                   | 124 lb   |
|                                       | <u>Jambs</u><br>#8 x 2-3/4" wood screw through frame track to wood buck. Placed 8-1/2" from each end and 16" on center.                            | 124 lb   |
| 1618 SGD<br>Hurricane Impact Test     |                                                                                                                                                    |          |

The capacities presented in Table 2 will be used to prove acceptable alternate anchors and substrates for the doors.

### Alternate Anchorages

Calculations on page 12 determine the design capacity of alternate nail fin installation anchorages for the door. The alternate anchorage capacities are summarized in Table 3.

**Table 3** Alternate Anchorage Capacities for Nail Fin Installations

| Substrate           | Anchor            | Capacity | Comments                                                                                               |
|---------------------|-------------------|----------|--------------------------------------------------------------------------------------------------------|
| 18 Gauge Steel Stud | #10-16 TEKS Screw | 60 lb    | 1. 33 KSI yield strength stud.<br>2. Full penetration +3 threads.<br>3. Limited by pull-over capacity. |

Calculations on page 13 through page 15 determine the design capacity of alternate through-frame installation anchorages for the door. The alternate anchorage capacities are summarized in Table 4.

**Table 4** Alternate Anchorage Capacities for Through-Frame Installation

| Substrate           | Anchor            | Capacity | Comments                                                                                                                                                    |
|---------------------|-------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18 Gauge Steel Stud | #10-16 TEKS Screw | 155 lb   | 1. 33 KSI yield strength stud.<br>2. Full penetration +3 threads.<br>3. Limited by bending capacity.                                                        |
| Concrete            | 3/16" Tapcon      | 170 lb   | 1. Minimum $f'_c = 3,000$ psi.<br>2. 1-1/2" Minimum Embedment.<br>3. 2" Min. Edge Distance.<br>4. Limited by bearing at frame.<br>5. Maximum 1x buck strip. |
| CMU                 | 3/16" Tapcon      | 135 lb   | 1. Minimum ASTM C90 CMU.<br>2. 1-1/2" Minimum Embedment.<br>3. 2" Min. Edge Distance.<br>4. Limited by shear capacity.<br>5. Maximum 1x buck strip.         |

Note: Maximum available length of 3/16" Tapcon anchor is 3-1/4". Use 1/4" x 4" Tapcon anchors for through-frame installations with 1x buck strip.

Calculations on page 16 through page 18 determine the design capacity of alternate strap anchor installation anchorages for the door. The alternate anchorage capacities are summarized in Table 5.

**Table 5** Alternate Anchorage Capacities for Strap Anchor Installation

| Substrate           | Anchor            | Capacity | Comments                                                                                                                                                  |
|---------------------|-------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18 Gauge Steel Stud | #10-16 TEKS Screw | 155 lb   | 1. 33 KSI yield strength stud.<br>2. Full penetration +3 threads.<br>3. Limited by bending capacity.                                                      |
| Concrete            | 3/16" Tapcon      | 186 lb   | 1. Minimum $f'_c = 3,000$ psi.<br>2. 1-1/2" Minimum Embedment.<br>3. 2" Min. Edge Distance.<br>4. Limited by shear capacity.<br>5. Maximum 1x buck strip. |
| CMU                 | 3/16" Tapcon      | 135 lb   | 1. Minimum ASTM C90 CMU.<br>2. 1-1/2" Minimum Embedment.<br>3. 2" Min. Edge Distance.<br>4. Limited by shear capacity.<br>5. Maximum 1x buck strip.       |

Note: 18-gauge steel strap anchor (part 9859).

### **Anchorage Requirements**

It must be determined the anchorages are not overloaded for the approved door size and design pressures. Calculations presented on page 19 show the as-tested anchorage is adequate for the minimum anchor capacity reported in this report when the doors are subjected to the maximum design pressures of the products at their approved maximum sizes.

Because all alternate anchorages evaluated by this report have higher design capacities than the tested anchorages, the alternate anchorages proposed by this report may be used for the doors at the as-tested spacing.

The capacity of the strap and frame anchors is 5,084 lb which is greater than the maximum applied load. This permits a finless install of the non-Impact doors.

Calculations on page 19 also validate the hybrid installation condition of fin installation at the head and jambs but finless installation at the sill.

### **Attachments**

Appendix A – Revision Log (1 page)

**As-Tested Installation – Nail Fin to Wood**

#6 x 1-5/8" Wood Screw

PVC Nailing Fin

Spruce-Pine-Fir Wood Substrate Minimum (G=0.42)

**Allowable Tension of #6 x 1-5/8" Wood Screw**

$$W = 1.6(1.625'' - 0.080'')(69 \text{ lb/in}) \quad (\text{NDS, Table 12.2B})$$
$$W = 171 \text{ lb}$$

**Pull-Over of #6 x 1-5/8" Wood Screw**

Validated by Testing

|                    |        |
|--------------------|--------|
| Test Pressure:     | 50 psf |
| Panel Width:       | 48"    |
| As-tested Spacing: | 7-1/4" |

$$\text{Test Anchor Load:} \quad (50 \text{ psf}/144)(48''/2)(7.25'') = 60 \text{ lb}$$

Must maintain anchor spacing and anchor head size

|                             |                  |
|-----------------------------|------------------|
| As-tested spacing:          | 7-1/4" on center |
| As-tested anchor head size: | 0.263"           |

**Capacity of Connection is 60 lb**

**As-Tested Installation – Strap Anchor to Wood**

#8 x 1-1/2" Wood Screw securing strap anchor to wood

18 gauge (0.043" thick) steel strap anchor ( $F_y = 33,000$  psi,  $F_u = 45,000$  psi)

1/4" Maximum Shim Space

Spruce-Pine-Fir Wood Substrate Minimum ( $G=0.42$ )

**Allowable Shear of #8 x 1-1/2" Wood Screw**

$Z' = 124$  lb (Limited by Mode III<sub>s</sub>, See Following 2 Pages)

**Bending of #8 x 1-1/2" Wood Screw**

$L = 1/4$ " (maximum shim space)

$S = \pi d^3/32 = \pi(0.131)^3/32 = 0.000221$  in<sup>3</sup>

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

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

$V = 2SF_b/L = (2)(0.000221$  in<sup>3</sup>)(70,200 psi)/0.25" = 124 lb.

**Capacity of Connection is 124 lb**

## As-Tested Installation – Strap Anchor to Wood (Continued)

### Lateral Design Strength of Wood Connections

#### Data

|                    |   |                            |                                          |
|--------------------|---|----------------------------|------------------------------------------|
| <b>Fastener</b>    |   |                            |                                          |
| Fastener           | = | #8 Wood Screw              |                                          |
| Shank Dia          | = | 0.164                      | in.                                      |
| Root Dia.          | = | 0.131                      | in.                                      |
| F <sub>yb</sub>    | = | 90,000                     | psi                                      |
| Fastener length    | = | 1.500                      | in.                                      |
| <b>Main Member</b> |   |                            |                                          |
| Material           | = | SPF                        |                                          |
| G                  | = | 0.42                       |                                          |
| θ                  | = | 90                         | <= (Angle of load to grain 0° ≤ θ ≤ 90°) |
| F <sub>e</sub>     | = | 3,350                      | psi                                      |
| Thickness          | = | 1.500                      | in.                                      |
| <b>Side Member</b> |   |                            |                                          |
| Material           | = | ASTM A 653, Grade 33 Steel |                                          |
| G                  | = | N/A                        |                                          |
| θ                  | = | 90                         | <= (Angle of load to grain 0° ≤ θ ≤ 90°) |
| F <sub>es</sub>    | = | 61,850                     | psi                                      |
| Thickness          | = | 0.043                      | in.                                      |

#### Calculations

##### Lateral Bearing Factors

|                |   |        |     |
|----------------|---|--------|-----|
| D              | = | 0.131  | in. |
| ℓ <sub>m</sub> | = | 1.129  | in. |
| K <sub>θ</sub> | = | 1.25   |     |
| K <sub>D</sub> | = | 2.20   |     |
| R <sub>e</sub> | = | 0.054  |     |
| R <sub>t</sub> | = | 26.26  |     |
| k <sub>1</sub> | = | 0.5823 |     |
| k <sub>2</sub> | = | 0.5413 |     |
| k <sub>3</sub> | = | 18.50  |     |

### As-Tested Installation – Strap Anchor to Wood (Continued)

| Yield Mode                               | R <sub>d</sub> |
|------------------------------------------|----------------|
| I <sub>m</sub> , I <sub>s</sub>          | 2.20           |
| II                                       | 2.20           |
| III <sub>m</sub> , III <sub>s</sub> , IV | 2.20           |

#### Lateral Design Values, Z

|                       |   |     |     |
|-----------------------|---|-----|-----|
| Mode I <sub>m</sub>   | = | 225 | lbf |
| Mode I <sub>s</sub>   | = | 158 | lbf |
| Mode II               | = | 92  | lbf |
| Mode III <sub>m</sub> | = | 110 | lbf |
| Mode III <sub>s</sub> | = | 77  | lbf |
| Mode IV               | = | 108 | lbf |
| C <sub>D</sub>        | = | 1.6 |     |

<===== Minimum Value

#### Wet Service Factor

Fabrication/In-Service **Dry/Dry**

C<sub>M</sub> = 1.0

In service temperature **T≤100°F**

C<sub>t</sub> = 1.0

C<sub>g</sub> = 1.0

C<sub>Δ</sub> = 1.0

Is fastener installed in end grain?

No

C<sub>eg</sub> = 1.00

Is fastener part of a diaphragm?

No

C<sub>di</sub> = 1.0

Is fastener toe-nailed?

No

C<sub>tn</sub> = 1.00

**Z' = 124 lbf**

**As-Tested Installation – Through-Frame to Wood**

#8 x 2-3/4" Wood Screw through-frame to wood

PVC Frame; 0.100" thickness at fastener location

1/4" Maximum Shim Space

Spruce-Pine-Fir Wood Substrate Minimum (G=0.42)

**Allowable Shear of #8 x 2-3/4" Wood Screw**

$Z' = 124 \text{ lb}$  (See previous 2 Pages)

**Bearing of #8 x 2-3/4" Wood Screw on Frame**

$$V_a = DtF_p$$

$$V_a = (0.164")(0.100")(10,000 \text{ psi})$$

$$V_a = 164 \text{ lb}$$

**Bending of #8 x 2-3/4" Wood Screw**

$$L = 1/4" \text{ (maximum shim space)}$$

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

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

$$F_b = M/S = (VL/2)/S \text{ (L/2 for guided bending)}$$

$$V = 2SF_b/L = (2)(0.000221 \text{ in}^3)(70,200 \text{ psi})/0.25" = 124 \text{ lb.}$$

**Capacity of Connection is 124 lb**

**Alternate Installation – Nail Fin to Steel Stud**

#10-16 TEKS Screw

PVC Nailing Fin

Minimum 18 gauge 33 KSI Steel Stud

**Allowable Tension of #10-16 TEKS Screw**

$$P_{ts}/\Omega = 885 \text{ lb} \quad (\text{ESR-1976})$$

**Pull-Over of #10-16 TEKS Screw**

Anchor head size: 0.365" > 0.263"      Maintain as-tested spacing.  
Do not exceed 60 lb

**Pull-Out of #10-16 TEKS Screw**

$$\begin{aligned} P_{\text{not}} &= 0.85t_c d F_{u2} / \Omega \\ P_{\text{not}} &= 0.85(0.0428")(0.190")(45,000 \text{ psi}) / 3.0 \\ P_{\text{not}} &= 104 \text{ lb} \end{aligned}$$

**Capacity of Connection is 60 lb**

## Alternate Installation – Trough-Frame to Steel Stud

#10-16 TEKS Screw

PVC Frame; 0.100" thickness at fastener location

1/4" Maximum Shim Space

Minimum 18 gauge 33 KSI Steel Stud

### Allowable Shear of #10-16 TEKS Screw

$$P_{ss}/\Omega = 573 \text{ lb (ESR-1976)}$$

### Bearing of #10-16 TEKS Screw on Frame

$$\begin{aligned} V_a &= DtF_p \\ V_a &= (0.190")(0.100")(10,000 \text{ psi}) \\ V_a &= 190 \text{ lb} \end{aligned}$$

### Bearing of #10-16 TEKS Screw on Steel Stud

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.0428")(45,000 \text{ psi})/3.0 \\ V_a &= 329 \text{ lb.} \end{aligned}$$

### Tilting of #10-16 TEKS Screw in Steel Stud

$$\begin{aligned} V_a &= 4.2(t_2^3 D)^{1/2} F_{tu2}/n_s \\ V_a &= 4.2(0.0428''^3 \times 0.190'')^{1/2} (45,000 \text{ psi})/3.0 \\ V_a &= 243 \text{ lb.} \end{aligned}$$

### Bending of #10-16 TEKS Screw

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.140)^3/32 = 0.000269 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(92,000 \text{ psi}) = 71,760 \text{ psi (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000269 \text{ in}^3)(71,760 \text{ psi})/0.25" = 155 \text{ lb.} \end{aligned}$$

**Capacity of Connection is 155 lb.**

### **Alternate Installation – Through-Frame to Concrete**

3/16" Tapcon Anchor

1-1/2" Minimum Embedment; 2" Minimum Edge Distance

1/4" Maximum Shim Space

PVC Frame, 0.100" thickness at fastener location

Minimum  $f'_c = 3,000$  psi Concrete

#### **Allowable Shear of 3/16" Tapcon Anchor**

$$V_a = 186 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

#### **Bearing of 3/16" Tapcon Anchor on Frame**

$$V_a = DtF_p$$

$$V_a = (0.170")(0.100")(10,000 \text{ psi})$$

$$V_a = 170 \text{ lb}$$

#### **Bending of 3/16" Tapcon**

$$L = 1/4" \text{ (Maximum Shim Space)}$$

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

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

$$F_b = M/S = (VL/2)/S \text{ (L/2 for guided bending)}$$

$$V = 2SF_b/L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi})/0.25" = 412 \text{ lb.}$$

**Capacity of Connection is 170 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment.**

**Alternate Installation – Through-Frame to CMU**

3/16" Tapcon Anchor

1-1/2" Minimum Embedment, 2" Minimum Edge Distance

1/4" Maximum Shim Space

PVC Frame, 0.100" thickness at fastener location

Minimum ASTM C90 Concrete Masonry Unit

**Allowable Shear of 3/16" Tapcon Anchor**

$$V_a = 135 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

**Bearing of 3/16" Tapcon Anchor on Frame**

$$V_a = D t F_p$$

$$V_a = (0.170")(0.100")(10,000 \text{ psi})$$

$$V_a = 170 \text{ lb}$$

**Bending of 3/16" Tapcon**

$$L = 1/4" \text{ (Maximum Shim Space)}$$

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

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

$$F_b = M/S = (VL/2)/S \text{ (L/2 for guided bending)}$$

$$V = 2SF_b/L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi})/0.25" = 412 \text{ lb.}$$

**Capacity of Connection is 135 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment.**

### **Alternate Installation – Strap Anchor to Steel Stud**

#10-16 TEKS Screw securing strap anchor to steel stud

18 gauge (0.0428" thick) steel stud ( $F_y = 33,000$  psi,  $F_u = 45,000$  psi)

18 gauge (0.043" thick) steel strap anchor ( $F_y = 33,000$  psi,  $F_u = 45,000$  psi)

1/4" Maximum Shim Space

### **Allowable Shear of #10-16 TEKS Screw**

$$P_{ss}/\Omega = 573 \text{ lb (ESR-1976)}$$

### **Bearing of #10-16 TEKS Screw on Strap Anchor**

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 331 \text{ lb.} \end{aligned}$$

### **Bearing of #10-16 TEKS Screw on Steel Stud**

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.190")(0.0428")(45,000 \text{ psi})/3.0 \\ V_a &= 329 \text{ lb.} \end{aligned}$$

### **Tilting of #10-16 TEKS Screw in Steel Stud**

$$\begin{aligned} V_a &= 4.2(t_2^3 D)^{1/2} F_{tu2}/n_s \\ V_a &= 4.2(0.0428''^3 \times 0.190'')^{1/2} (45,000 \text{ psi})/3.0 \\ V_a &= 243 \text{ lb.} \end{aligned}$$

### **Bending of #10-16 TEKS Screw**

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.140)^3/32 = 0.000269 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(92,000 \text{ psi}) = 71,760 \text{ psi (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000269 \text{ in}^3)(71,760 \text{ psi})/0.25" = 155 \text{ lb.} \end{aligned}$$

**Capacity of Connection is 155 lb.**

**Alternate Installation – Strap Anchor to Concrete**

3/16" Tapcon Anchor; 1-1/2" Minimum Embedment; 2" Minimum Edge Distance

PVC Frame, 0.100" thickness at fastener location

Minimum  $f'_c = 3,000$  psi Concrete

18 gauge (0.043" thick) steel strap anchor ( $F_y = 33,000$  psi,  $F_u = 45,000$  psi)

1/4" Maximum Shim Space

**Allowable Shear of 3/16" Tapcon Anchor**

$$V_a = 186 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

**Bearing of 3/16" Tapcon Anchor on Strap Anchor**

$$\begin{aligned} V_a &= 2.7DtF_{tu}/\Omega \\ V_a &= 2.7(0.188")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 327 \text{ lb.} \end{aligned}$$

**Bending of 3/16" Tapcon**

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.170")^3/32 = 0.000482 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \text{ (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi})/0.25" = 412 \text{ lb.} \end{aligned}$$

**Capacity of Connection is 186 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment.**

**Alternate Installation – Strap Anchor to CMU**

3/16" Tapcon Anchor; 1-1/2" Minimum Embedment, 2" Minimum Edge Distance

PVC Frame, 0.100" thickness at fastener location

Minimum ASTM C90 Concrete Masonry Unit

18 gauge (0.043" thick) steel strap anchor ( $F_y = 33,000$  psi,  $F_u = 45,000$  psi)

1/4" Maximum Shim Space

**Allowable Shear of 3/16" Tapcon Anchor**

$$V_a = 135 \text{ lb} \quad (\text{NOA-No. 16-1222.06})$$

**Bearing of 3/16" Tapcon Anchor on Strap Anchor**

$$\begin{aligned} V_a &= 2.7D_tF_{tu}/\Omega \\ V_a &= 2.7(0.188")(0.043")(45,000 \text{ psi})/3.0 \\ V_a &= 327 \text{ lb.} \end{aligned}$$

**Bending of 3/16" Tapcon**

$$\begin{aligned} L &= 1/4" \text{ (Maximum Shim Space)} \\ S &= \pi d^3/32 = \pi(0.170")^3/32 = 0.000482 \text{ in}^3 \\ F_b &= (1.3)(0.6F_y) = (1.3)(0.6)(137,000 \text{ psi}) = 106,860 \text{ psi} \text{ (1.3 for weak axis bending)} \\ F_b &= M/S = (VL/2)/S \text{ (L/2 for guided bending)} \\ V &= 2SF_b/L = (2)(0.000482 \text{ in}^3)(106,860 \text{ psi})/0.25" = 412 \text{ lb.} \end{aligned}$$

**Capacity of Connection is 135 lb**

**Qualifies 1/4" Tapcon if longer length anchor is required to achieve minimum embedment.**

## **Anchorage Requirements**

### 144 x 96 Door

Fin Anchors at Head/Sill:  $20 + 20 = 40$  anchors  
Fin Anchors at Jambs:  $13 + 13 = 26$  anchors  
Total Fin Anchor Capacity:  $(40 + 26)(60 \text{ lb/anchor}) = 3,960 \text{ lb}$

Strap Anchors at Head/Sill:  $12 + 12 = 24$  anchors  
Total Strap Anchor Capacity:  $(24)(124 \text{ lb/anchor}) = 2,976 \text{ lb}$

Frame Anchors at Head: 5 anchors  
Frame Anchors at Jambs:  $6 + 6 = 12$  anchors  
Total Frame Anchor Capacity:  $(5 + 12)(124 \text{ lb/anchor}) = 2,108 \text{ lb}$

Total Anchor Capacity: 9,044 lb

Load to Anchors:  $(144'')(96'')(50 \text{ psf}/144) = 4,800 \text{ lb} < 9,044 \text{ lb}$  **OK**

The capacity of the strap and frame anchors is 5,084 lb which is greater than the maximum applied load. This permits a finless install of the non-Impact doors.

### 144 x 96 Door – Finless at Sill

Fin Anchors at Head: 20 anchors  
Fin Anchors at Jambs:  $13 + 13 = 26$  anchors  
Total Fin Anchor Capacity:  $(20 + 26)(60 \text{ lb/anchor}) = 2,760 \text{ lb}$

Strap Anchors at Head/Sill:  $12 + 12 = 24$  anchors  
Total Strap Anchor Capacity:  $(24)(124 \text{ lb/anchor}) = 2,976 \text{ lb}$

Frame Anchors at Head: 5 anchors  
Frame Anchors at Jambs:  $6 + 6 = 12$  anchors  
Total Frame Anchor Capacity:  $(5 + 12)(124 \text{ lb/anchor}) = 2,108 \text{ lb}$

Total Anchor Capacity: 7,844 lb

Load to Anchors:  $(144'')(96'')(50 \text{ psf}/144) = 4,800 \text{ lb} < 7,844 \text{ lb}$  **OK**

## **Appendix A**

### **Revision Log**

| <u>Identification</u> | <u>Date</u> | <u>Page &amp; Revision</u> |
|-----------------------|-------------|----------------------------|
| Original Issue        | 12/11/23    | Not Applicable             |