



**Architectural
Testing**

DATE: August 28, 2015

BY: JAR/DCC

PROJECT NO. F0895.02-122-34 SHEET 1 OF 11

PROJECT NAME: Door Installation

Door Installation Analysis

4070 Deadbolt 150 MPH Wind Rated Door

Report F0895.02-122-34

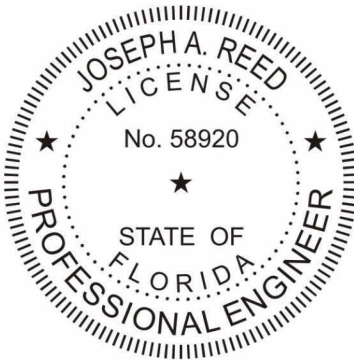
Rendered to:

DIAMOND DOOR PRODUCTS

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August 28, 2015

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 Architectural Testing	DATE: August 28, 2015	PROJECT NO. F0895.02-122-34 SHEET 2 OF 11
	BY: JAR/DCC	PROJECT NAME: Door Installation

Scope

Architectural Testing, Inc., an Intertek company, was contracted by Diamond Door Products to perform engineering analyses of door installations. Specifically, the analyses are to prove the adequacy of the as-tested installations for the tested door configurations listed in Table 1. Installations assume the use of 33 ksi steel for door framing members and support structure. The bottom of the jamb shall be evaluated as if it is installed to a concrete slab.

Table 1 Tested Door Configurations

Door Model	Door Rating	Tested Size	Test Report Number
4070 Deadbolt 150 MPH Wind Rated Door	+50.7/-64.0 psf	60" x 111-3/8" Overall 48" x 84" Panel	E5450.01-801-44

Note: Tests were performed by Architectural Testing, Inc., Plano Texas.

Analyses

Anchor Capacity

Anchor capacities are based on as tested configurations except the bottom of the jamb is assumed installed to a concrete slab. Calculations are presented on page 3 through page 9 and summarized in Table 2.

Table 2 Calculated Anchor Capacities

Location	Anchor	Capacity (lbs)	Comments
Jamb at Head	12 gauge L-Bracket Two (2) 5/16" x 2-1/2" bolts to Purlin Four (4) 1/4" x 1" screws to C-Channel	1,602	1. Limited by shear capacity of 5/16" Grade 2 bolt
Jamb at Middle	12 gauge L-Bracket Four (4) 1/4" x 1" screws to Purlin Five (5) 1/4" x 1" screws to C-Channel	2,315	1. Limited by shear capacity of 1/4" screw
Jamb at Bottom	16 gauge Frame Clip Two 3/8" x 3" Hilt Kwik Bolt 3	1,044	1. Limited by shear capacity of concrete anchor 2. f _c 3,000 psi 3. 2" minimum embedment 4. 3" minimum edge distance

As shown on page 10, the maximum anchor load for the established design pressure is 498 lb. The calculated capacities of the anchors exceed the maximum anchor load thereby validating the anchorage for door size and design pressure presented in Table 1.



Anchor Capacity – Top of Jamb

12 gauge L-Bracket

12 gauge Purlin

16 gauge C-Channel

All steel is Grade 33 Cold-Formed Steel ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

Four (4) 1/4" x 1" screws securing L-Bracket to C-Channel

Shear Capacity of 1/4" TEKS Screw

$$V_a = 463 \text{ lb (ESR 1976, Table 4)}$$

Capacity of Connection

$$V_{\text{tot}} = 4(463 \text{ lb}) = 1,852 \text{ lb}$$

Two (2) 5/16" x 2-1/2" bolts securing L-Bracket to Purlin

Shear strength of 5/16" Grade 2 bolt

$$V_a = 801 \text{ lb (AAMA TIR A9-14, Table 20.2)}$$

Bearing on L-Bracket and Purlin

$$V_a = 2.7tDF_u/\Omega = 2.7(0.105")(0.313")(45,000 \text{ psi})/3.0 = 1,331 \text{ lb}$$

Capacity of Connection

$$V_{\text{tot}} = 2(801 \text{ lb}) = 1,602 \text{ lb.}$$

Governing Capacity of Connection is 1,602 lb



Anchor Capacity – Middle of Jamb

12 gauge L-Bracket

12 gauge Purlin

16 gauge C-Channel

All steel is Grade 33 Cold-Formed Steel ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

Five (5) 1/4" x 1" screws securing L-Bracket to C-Channel

Shear Capacity of 1/4" TEKS Screw

$$V_a = 463 \text{ lb (ESR 1976, Table 4)}$$

Capacity of Connection

$$V_{\text{tot}} = 5(463 \text{ lb}) = 2,315 \text{ lb}$$

Four (4) 1/4" x 1" screws securing L-Bracket to Purlin

Shear Capacity of 1/4" TEKS Screw

$$V_a = 1,063 \text{ lb (ESR 1976, Table 4)}$$

Capacity of Connection

$$V_{\text{tot}} = 4(1,063 \text{ lb}) = 4,252 \text{ lb}$$

Governing Capacity of Connection is 2,315 lb



Anchor Capacity – Bottom of Jamb

16 gauge Frame Clip

All steel is Grade 33 Cold-Formed Steel ($F_y = 33,000$ psi, $F_u = 45,000$ psi)

Two 3/8" Hilti Kwik Bolt 3 Anchors

$f'_c = 3,000$ psi

3" edge distance

2" embedment

Anchor Strength $\phi V_n = 1,671$ lb (see following four pages)

ASD Capacity $V_a = (1,671 \text{ lb})/1.6 = 1,044$ lb.

Governing Capacity of Connection is 1,044 lb



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Profis Anchor 2.4.7

1
4080 150 MPH Door
Jamb Anchor to Slab
8/27/2015

Specifier's comments:

1 Input data

Anchor type and diameter:

Effective embedment depth:

Material:

Evaluation Service Report:

Issued | Valid:

Proof:

Stand-off installation:

Anchor plate:

Profile:

Base material:

Reinforcement:

Seismic loads (cat. C, D, E, or F)

Kwik Bolt 3 - CS 3/8 (2)

$h_{ef} = 2.000$ in., $h_{nom} = 2.313$ in.

Carbon Steel

ESR-2302

12/1/2013 | 12/1/2015

design method ACI 318 / AC193

$e_o = 0.000$ in. (no stand-off); $t = 0.060$ in.

$l_x \times l_y \times t = 10.000$ in. $\times$ 3.000 in. $\times$ 0.060 in.; (Recommended plate thickness: not calculated)

no profile

uncracked concrete, 3000, $f'_c = 3000$ psi; $h = 8.000$ in.

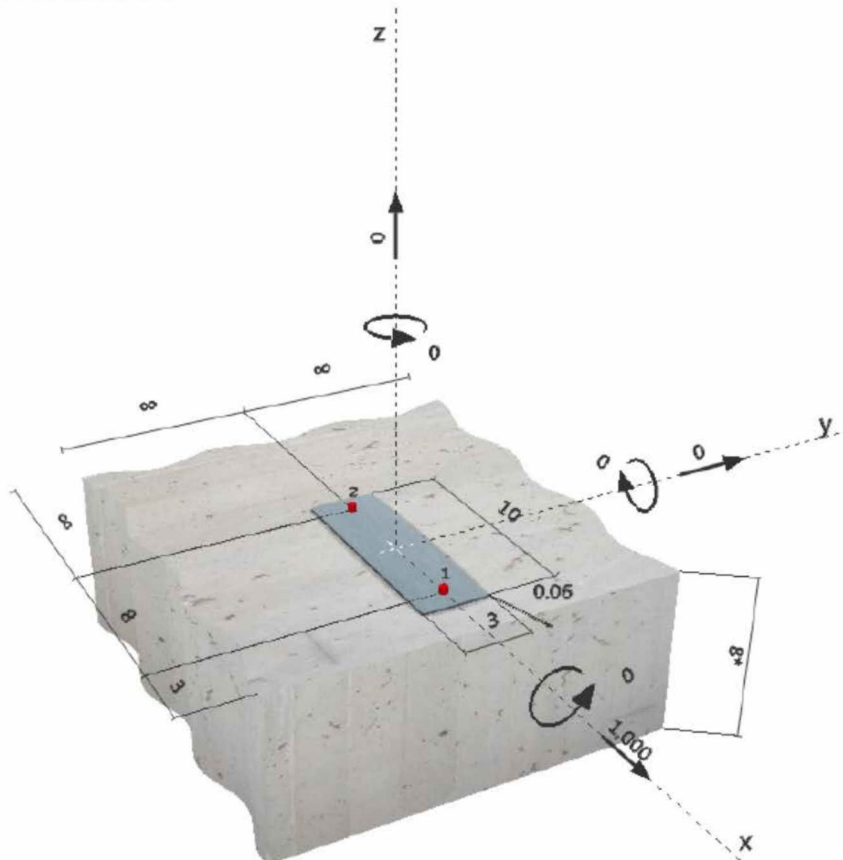
tension: condition B, shear: condition B; no supplemental splitting reinforcement present

edge reinforcement: none or $< \text{No. 4}$ bar

no



Geometry [in.] & Loading [lb, in.lb]





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4080 150 MPH Door

Jamb Anchor to Slab

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2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	500	500	0
2	0	500	500	0

max. concrete compressive strain:

- [‰]

max. concrete compressive stress:

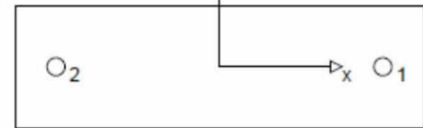
- [psi]

resulting tension force in (x/y)=(0.000/0.000):

0 [lb]

resulting compression force in (x/y)=(0.000/0.000):

0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)



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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_v = V_{ua}/\phi V_n$	Status
Steel Strength*	500	2905	18	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1000	4030	25	OK
Concrete edge failure in direction x**	1000	1671	60	OK

* anchor having the highest loading ** anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-2302

$\phi V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in. ²]	f_{uta} [psi]
1	0.06	106000

Calculations

V_{sa} [lb]
4470

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
4470	0.650	2905	500

4.2 Pryout Strength

$$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nco}} \right)^{1/3} \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \right] \quad \text{ACI 318-08 Eq. (D-31)}$$

$$\phi V_{cp} \geq V_{ua} \quad \text{ACI 318-08 Eq. (D-2)}$$

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$$A_{Nco} = 9 h_{ef}^2 \quad \text{ACI 318-08 Eq. (D-6)}$$

$$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-9)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-11)}$$

$$\psi_{cp,N} = \text{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-13)}$$

$$N_b = k_c \lambda \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-08 Eq. (D-7)}$$

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
1	2.000	0.000	0.000	3.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.000	3.875	24	1	3000

Calculations

A_{Nc} [in. ²]	A_{Nco} [in. ²]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
72.00	36.00	1.000	1.000	1.000	0.774	3718

Results

V_{cp} [lb]	$\phi_{concrete}$	ϕV_{cp} [lb]	V_{ua} [lb]
5757	0.700	4030	1000



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4080 150 MPH Door

Jamb Anchor to Slab

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4.3 Concrete edge failure in direction x+

$$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}} \right) \psi_{ec,V} \psi_{ed,V} \psi_{c,V} \psi_{h,V} \psi_{parallel,V} V_b \quad \text{ACI 318-08 Eq. (D-22)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-08 Eq. (D-2)}$$

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-08 Eq. (D-23)}$$

$$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-26)}$$

$$\psi_{ed,V} = 0.7 + 0.3 \left(\frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-08 Eq. (D-28)}$$

$$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-08 Eq. (D-29)}$$

$$V_b = \left(7 \left(\frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-08 Eq. (D-24)}$$

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cv} [in.]	$\psi_{c,V}$	h_a [in.]
3.000	-	0.000	1.400	8.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
2.000	1.000	0.375	3000	1.000

Calculations

A_{Vc} [in. ²]	A_{Vc0} [in. ²]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
40.50	40.50	1.000	1.000	1.000	1705

Results

V_{cbg} [lb]	$\phi_{concrete}$	ϕV_{cbg} [lb]	V_{ua} [lb]
2387	0.700	1671	1000

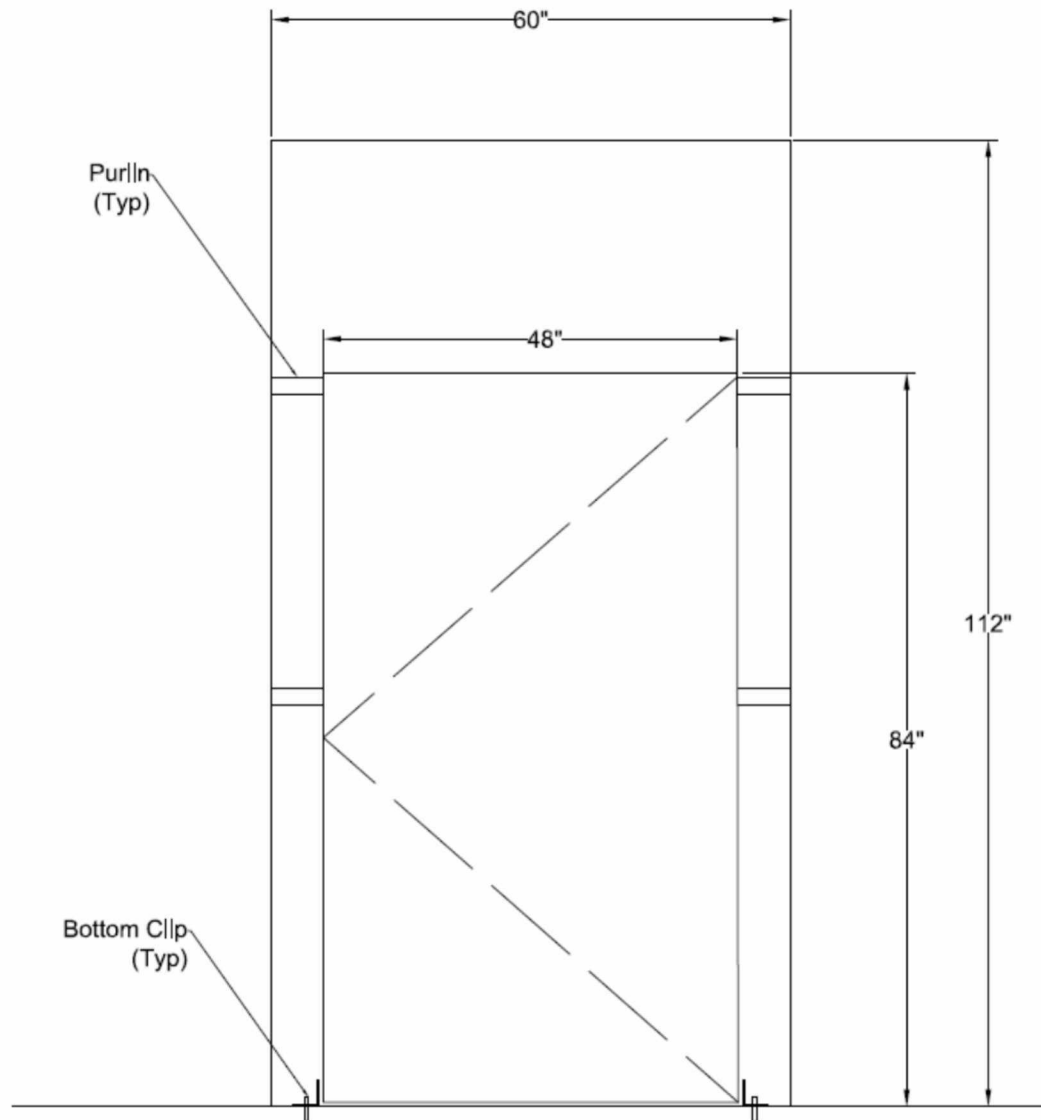
5 Warnings

- Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!



Loads to Anchors



Assume Load is equally divided among 6 total anchors.

$$R = pA = (64.0 \text{ psf})(60''/12)(112''/12)/6 = 498 \text{ lb.}$$

 Architectural Testing	DATE: <u>August 28, 2015</u>	PROJECT NO. <u>F0895.02-122-34</u> SHEET <u>11</u> OF <u>11</u>
	BY: <u>JAR/DCC</u>	PROJECT NAME: <u>Door Installation</u>

Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	08/28/15	N/A	Original report issue