

	PROJECT: 3/0 x 6/8 Hollow Metal Doors – FBC 2023	BY: JAR DATE: 08/16/2023
	PROJECT NO.: Q4363.01-122-34	CKD: TAD SHEET: 1 OF 14

Product Approval Supporting Calculations

3/0 x 6/8 Hollow Metal Door Frame Anchorage

Report Q4363.01-122-34

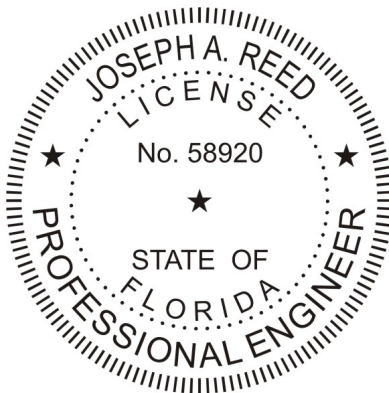
Rendered to:

MASONITE CORPORATION
ONE PREMDOOR DRIVE
DICKSON, TENNESSEE

Prepared by:

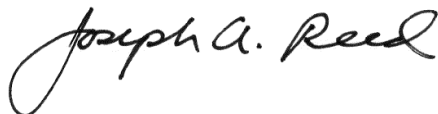
Joseph A. Reed, P.E.
Tanya A. Dolby, P.E.

Architectural Testing, Inc.
130 Derry Court
York, Pennsylvania 17406
(717) 764-7700
Florida COA: 29274



August 16, 2023

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Joseph A. Reed, P.E.
Senior Project Engineer
FL PE 58920



Digitally Signed by: Tanya Dolby

Tanya A. Dolby, P.E.
Manager – Engineering Service

This item has been digitally signed and sealed by Joseph A. Reed, 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 any electronic copies.

	PROJECT: 3/0 x 6/8 Hollow Metal Doors – FBC 2023	BY: JAR DATE: 08/16/2023
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Scope

Architectural Testing, Inc., an Intertek company, was contracted by Masonite Corporation to evaluate installation methods for their 3/0 x 6/8 hollow metal door frame. A design pressure of +/-80 psf has been specified. Reference standards utilized in this project include:

Florida Building Code, Building, 8th Edition (2023). International Code Council, 2023.

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

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.

ACI 318-19 Building Code Requirements for Structural Concrete. American Concrete Institute, 2019.

Submittal Information – Large Diameter Tapcon (LDT) Self-Threading. Red Head Anchoring Systems. Illinois Tool Works, Inc., 2012.

TT-001B Allowable Bearing Stress for APA Wood Structural Panels. APA - The Engineered Wood Association, 2013.

GA-235-17 Gypsum Board Typical Mechanical and Physical Properties. Gypsum Association, 2017.

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.

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Certification of Independence

In accordance with Rule 61G20-3 Florida Administrative Code, Architectural Testing hereby certifies the following:

- Architectural Testing 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.
- Architectural Testing is not owned, operated or controlled by any company manufacturing or distributing products it tests or labels.
- Joseph A. Reed, 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.
- Joseph A. Reed, P.E. does not have, nor will acquire, a financial interest in any other entity involved in the approval process of the product.

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Analyses

Summary of Test Results

The following table summarizes the various door products and their corresponding performance levels which have been established by testing or product certification.

Table 1 Summary of Test Results

Test Report	Test Report Number	Size (W x H)	Performance
Inswing Metal-Edge Impact Rated Steel Door with Hollow Metal Steel Frame (Structural, Impact/Cycle, FER)	210-1915-1,2,3	36" x 80"	+/-80 psf Large Missile
Outswing Metal-Edge Impact Rated Steel Door with Hollow Metal Steel Frame (Structural, Impact/Cycle, FER)	210-1869-1,2,3,7,8,9	36" x 80"	+/-80 psf Large Missile

Testing documented in Table 1 was conducted by National Certified Testing Laboratories in Orlando, Florida (Florida Department of Business & Professional Regulation Test Lab No. TST1589, A2LA Certificate 3054.02).

Design Loads

A design load of +/- 80 psf has been specified. Outswing doors shall have a uniform load to the jamb door stops for positive design loads and concentrated loads at the hinge and locking hardware locations for negative design loads. Inswing doors shall have a uniform load to the jamb door stops for negative design loads and concentrated loads at the hinge and locking hardware locations for positive design loads. Because the positive and negative pressures are the same, outswing and inswing doors shall have the same anchor design loads. Because the sill may be flush, all load is assumed distributed to the jambs.

Calculation of anchorage loads is presented on page 7 to page 8. Loads transferred to the head and threshold are conservatively applied to the jambs for the anchor analyses. Hinge loads are assumed distributed to one anchor and hardware loads are assume distributed to three nearby anchors. A maximum distributed design load of 10 lb/inch and a maximum concentrated design load of 266 lb have been established.

Anchor Capacity

The following anchorage methods are evaluated:

1. Compression anchorage to wood or cold-formed steel.
2. Strap anchor to wood or cold-formed steel.
3. Wire anchor in concrete or concrete masonry.
4. Concrete screw anchors in concrete or concrete masonry.

Assumed minimum properties for the substrates and anchorage components are specified in Table 2.

Table 2 Minimum Substrate and Component Properties

Substrate/Component	Properties	Comments
Wood Framing	Spruce-Pine-Fir G = 0.42	Qualifies more dense woods (i.e. greater G) including Southern Yellow Pine (G = 0.55)
Cold-Formed Steel	18 gauge (0.043" thick) $F_y = 33,000$ psi $F_u = 45,000$ psi	Qualifies thicker and stronger steel.
Concrete	Normal Weight $f'_c = 3,000$ psi	Qualifies normal weight concrete with higher compressive strength.
Concrete Masonry	ASTM C90 Type 2 $f'_m = 1,500$ psi	Grout-filled for wire anchors. Hollow for screw anchors.
Masonry Wire Anchor	ASTM A82 $F_u = 80,000$ psi 3/16" diameter	
Strap Anchor	18 gauge (0.043" thick) $F_y = 33,000$ psi $F_u = 45,000$ psi	

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Calculation of anchor capacities are presented on page 9 through page 12 and summarized in Table 3.

Table 3 Summary of Calculated Anchor Capacities

Anchorage Method	Substrate	Anchor Capacity (lb)	Comments
Compression	Wood	See Comments	Approved for +/- 80 psf. Frame leg in contact with wall over full height. Proven by testing for wind-borne debris impact.
	Steel	See Comments	
Strap	Wood	363	Approved for +/-80 psf. (6) #8 Wood screws each strap.
	Steel	363	Approved for +/-80 psf. (6) #10-16 TEKS screws each strap.
Wire	Concrete	442	Approved for +/- 80 psf.
	CMU	442	Approved for +/- 80 psf. CMU shall be fully grouted.
Screw	Concrete	323	Approved for +/-80 psf 3/8" Large Diameter Tapcon (LDT) 3" min edge distance. 1-1/4" min embedment.
	CMU	323	Approved for +/-80 psf 3/8" Large Diameter Tapcon (LDT) 3" min edge distance. 1-1/4" min embedment.

Anchorage Requirements

The overall door dimensions, +/-80 psf design pressure and the calculated anchor capacities presented in this report are used to establish the anchorage requirements for the door. Recommended anchor locations are presented on page 13. The requirements presented on page 13 are reflected on the client drawing (attached).

Attachments

Anchoring Locations and Details. Masonite Exterior Door Products. Revision C, 5/28/15. (2 pages)

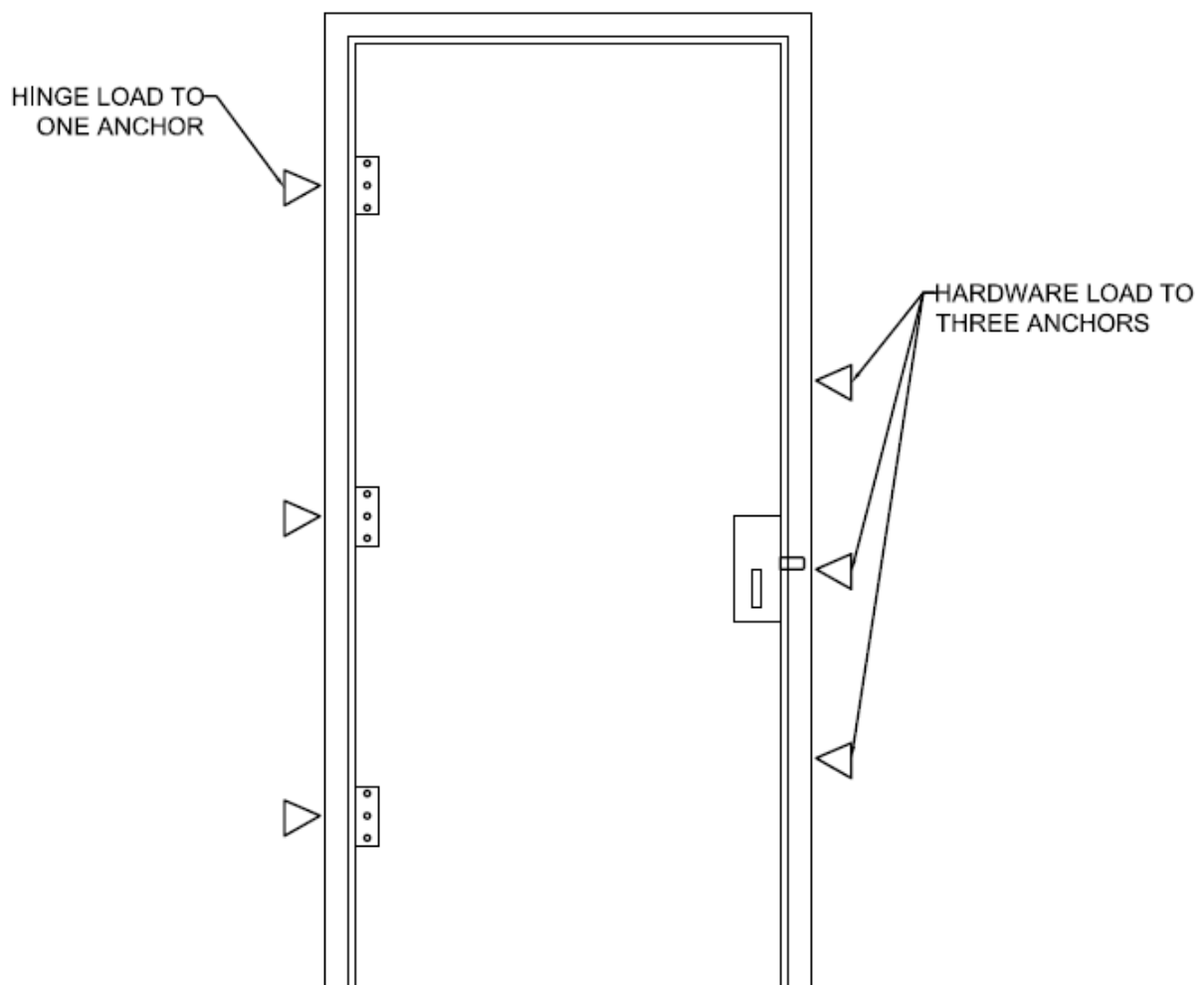
Calculations

Loads to Anchorage

Inswing Door – Positive Load

Outswing Door – Negative Load

The door is pulled off the rebate and all load goes through hinges or hardware.



$$1/2 \text{ Panel Load: } F = (80 \text{ psf}/144)(36\text{'})(80\text{'})/2 = 800 \text{ lb}$$

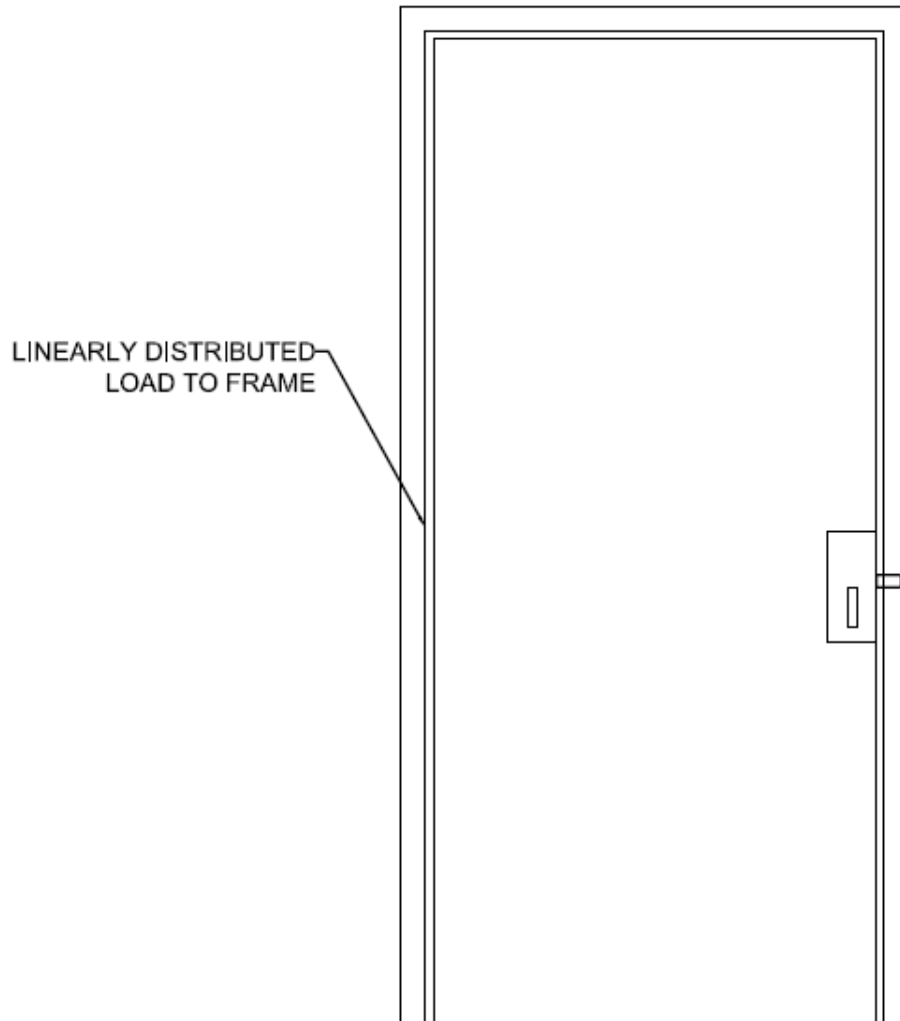
$$\text{Anchor Load : } R = (800 \text{ lb})/3 = 266 \text{ lb}$$

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Outswing Door – Positive Load

Inswing Door – Negative Load

The door is pushed to the rebate and creates a uniform load to the jambs.

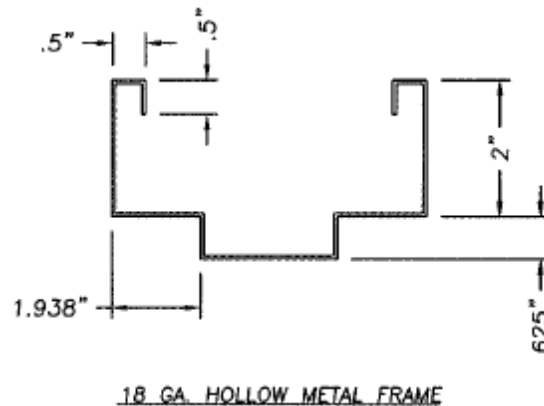
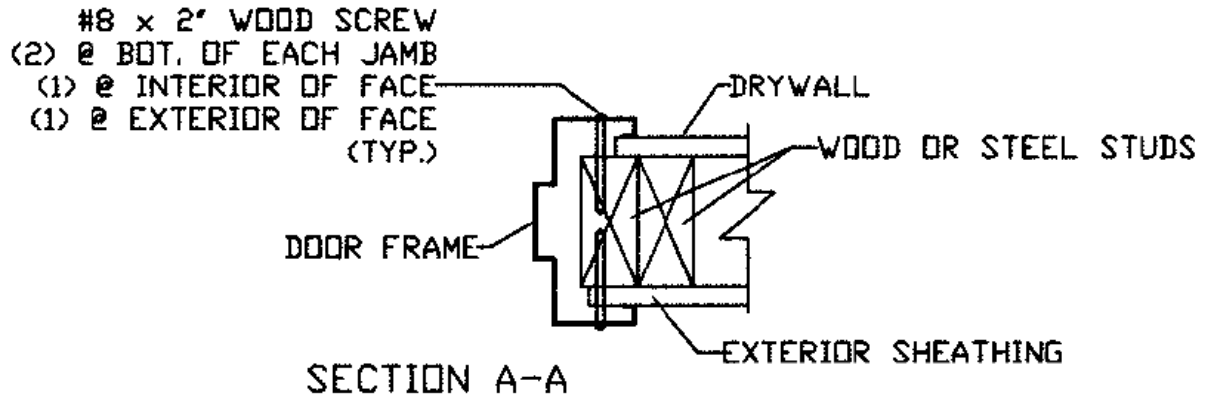


$$1/2 \text{ Panel Load: } F = (80 \text{ psf}/144)(36\text{'})(80\text{'})/2 = 800 \text{ lb}$$

$$\text{Distributed Load: } r = (800 \text{ lb})/(80\text{'}) = 10 \text{ lb/ft}$$

Anchorage Capacity

Compression Anchor



Check Bearing at 1/2" wide Frame Leg to Wall

Applied Bearing Stress: $F_p = (10 \text{ lb/inch}) / (.50") = 20 \text{ psi}$

For wood structural panels (Plywood or OSB)

Allowable Bearing Stress: $F = 0.5F_c$ (0.5 Wet Service Factor, see APA TT-001B)

$F = 0.5(360 \text{ psi}) = 180 \text{ psi}$ **OK**

For drywall panels

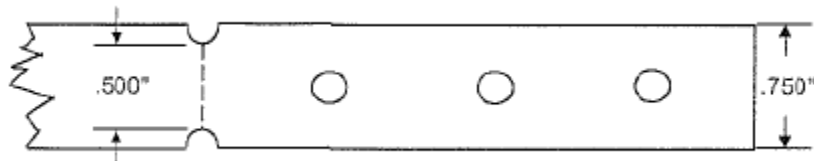
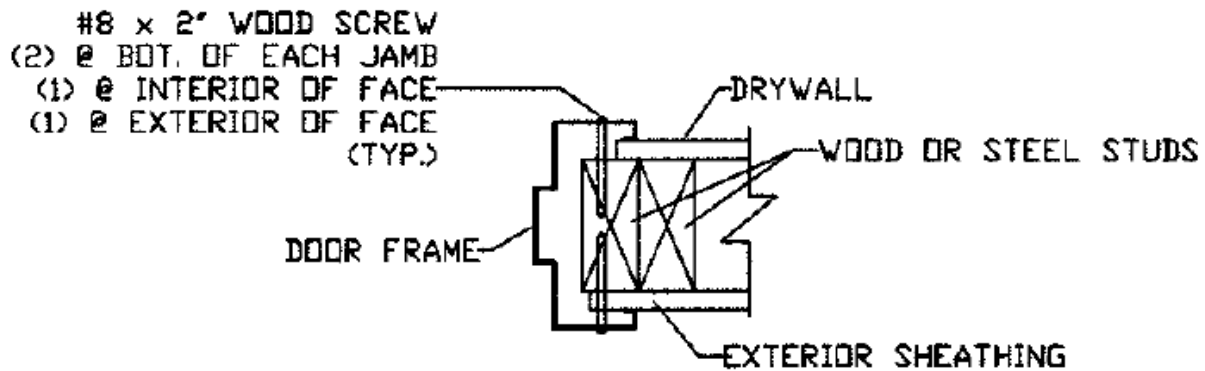
Allowable Bearing Stress: $F = F_u / SF$

$F = (400 \text{ psi}) / 4.0 = 100 \text{ psi}$ **OK** (see GA-235-17)

As-tested method proven for static loads and impact/cycle

As-tested installation to wood proves installations to cold-formed steel

Strap Anchor to Wood or Cold-Formed Steel


Anchor Load: $R = 266 \text{ lb}$

Tension Load Screw: $F = (266 \text{ lb}) / (3 \text{ screws}) = 87 \text{ lb}$

Withdrawal of #8 Wood Screw: $W' = pWC_D = (1\text{-}3/8'')(82 \text{ lb/inch})(1.6) = 180 \text{ lb}$ **OK**

Pull-over of #8 Wood Screw: $P_{nov} = 1.5t_1d_wF_u = (1.5)(0.043'')(0.344'')(45,000 \text{ psi})$
(Governs Pull-over) $= 998 \text{ lb}$
 $P_a = P_{nov} / \Omega = (998 \text{ lb}) / 3.0 = 333 \text{ lb}$ **OK**

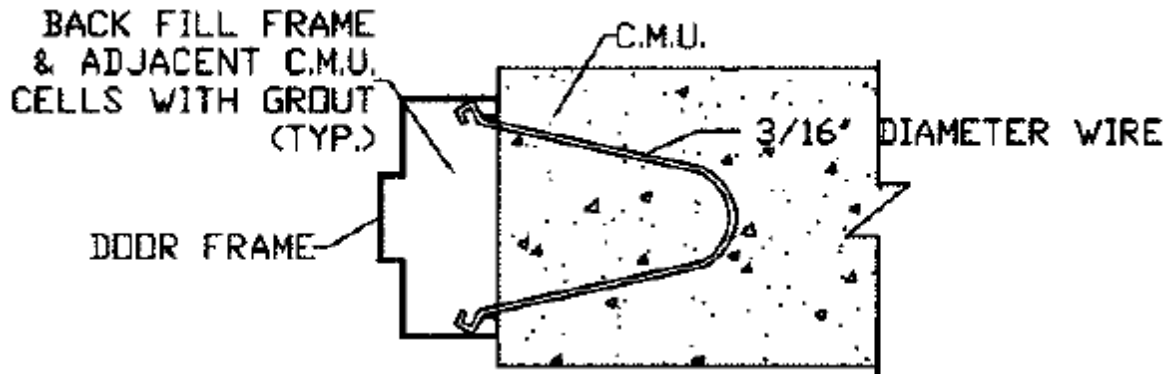
Tensile Capacity of #10-16 TEKS: $P_{t_s} / \Omega = 885 \text{ lb}$ (ESR 1976) **OK**

Shear of Strap at Bend: $V_a = 0.6F_uwt / \Omega = 0.6(45,000 \text{ psi})(0.500'')(0.043'') / 1.6$
 $= 363 \text{ lb}$ **OK** **GOVERNS**

Strap Anchor method proven for static loads

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Wire Anchor



Anchor is limited by shear strength of one diameter of wire.

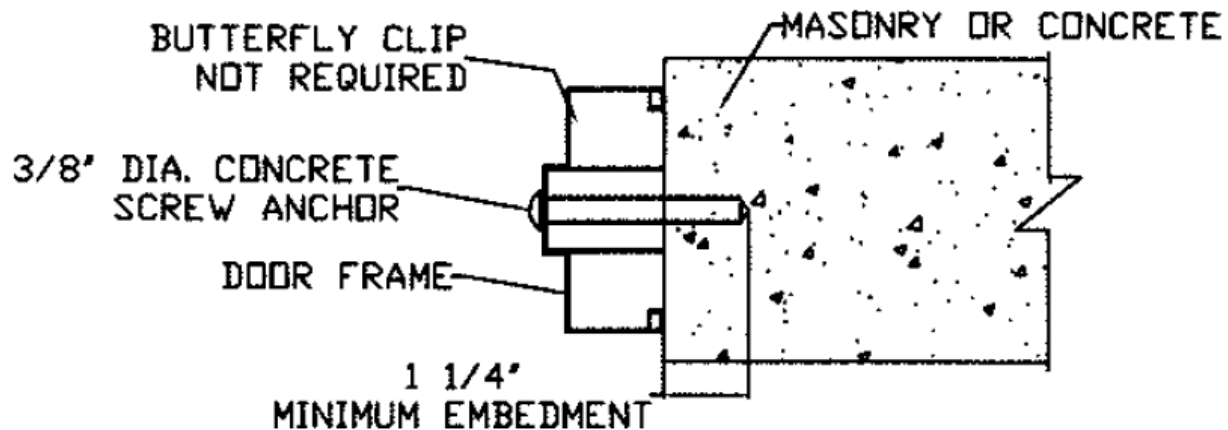
Shear Capacity of Wire: $V_a = A_g F_{nv} / \Omega$

$$= (\pi(3/16")^2/4)((0.48)(80,000 \text{ psi}))/2.4 = 442 \text{ lb } \underline{\text{OK}}$$

Wire Anchor method proven for static loads

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Screw Anchors to Masonry or Concrete



Use 3/8" diameter Large Diameter Tapcon (LDT) with 1-1/4" minimum embedment and 3" edge distance.

Shear Capacity in Concrete: $V_a = (691 \text{ lb})(0.57 \text{ edge reduction}) = 394 \text{ lb}$ **OK**

Shear Capacity in CMU: $V_a = (794 \text{ lb})(0.57 \text{ edge reduction}) = 453 \text{ lb}$ **OK**

Bending of 3/8" LDT Anchor

$L = 2.625''$ (Standoff from frame to wall)

$S = \pi d^3/32 = \pi(0.375)^3/32 = 0.00518 \text{ in}^3$

$F_b = (1.3)(0.6F_y) = (1.3)(0.6)(105,000 \text{ psi}) = 81,900 \text{ psi}$ (1.3 for weak axis)

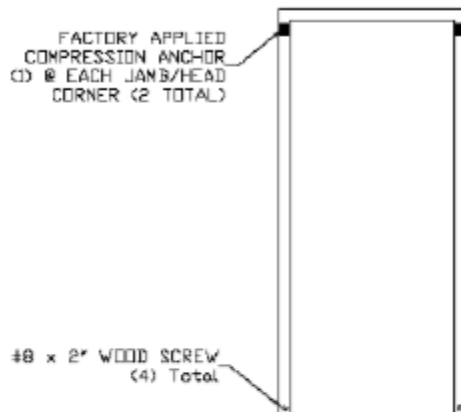
$F_b = M/S = (VL/2)/S$ (L/2 for guided bending)

$V = 2SF_b/L = (2)(0.00518 \text{ in}^3)(81,900 \text{ psi})/2.625'' = 323 \text{ lb}$ **OK** **GOVERNS**

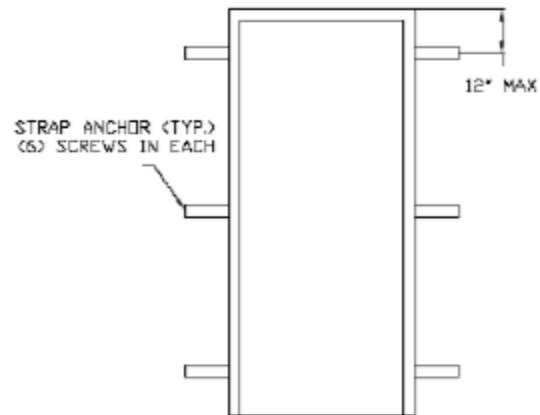
Screw Anchor method proven for static loads

Anchorage Requirements

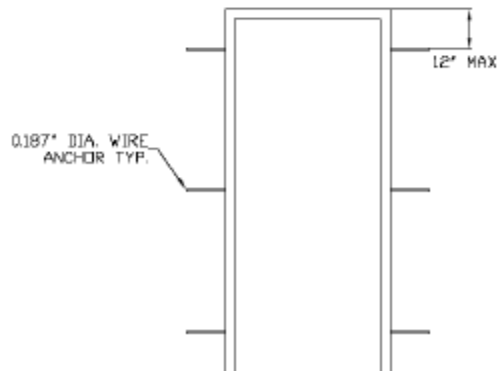
WOOD OR STEEL 2X STUDS
USING COMPRESSION ANCHORS



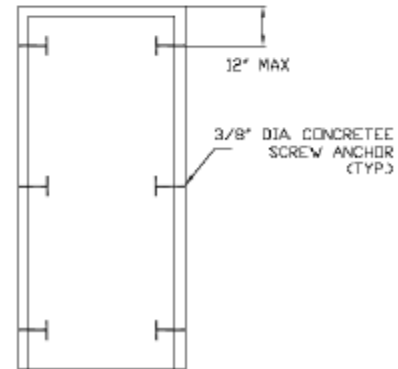
STRAP ANCHORS IN WOOD OR
STEEL 2X STUDS



WIRE ANCHORS IN CONCRETE
OR MASONRY



CONCRETE OR MASONRY USING
CONCRETE SCREW ANCHORS



	PROJECT: 3/0 x 6/8 Hollow Metal Doors – FBC 2023	BY: JAR DATE: 08/16/2023
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Revision Log

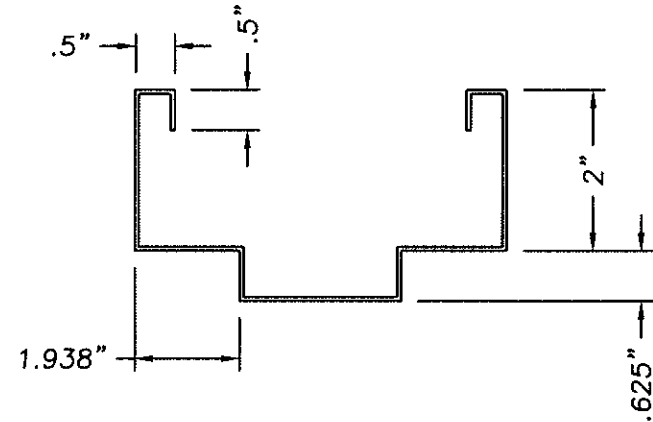
<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	08/16/23	N/A	Original report issue



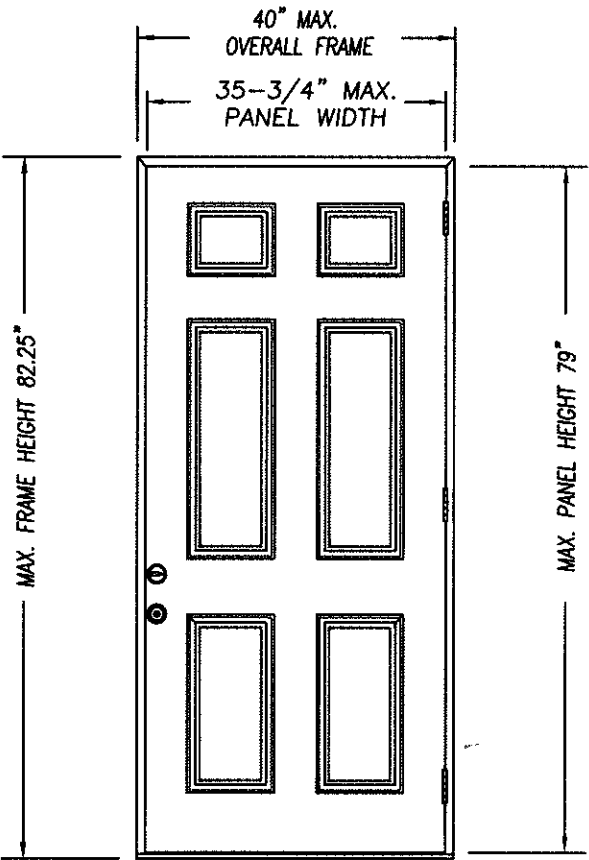
SIDE-HINGED METAL-EDGE STEEL DOOR UNIT
6'-8" SINGLE OPAQUE DOOR IN HOLLOW METAL FRAME

GENERAL NOTES

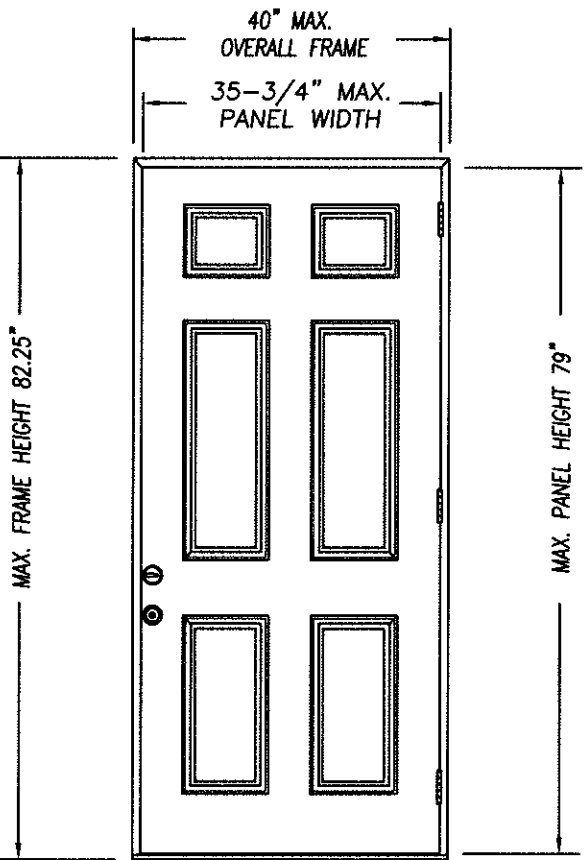
- 1. EVALUATED FOR USE IN LOCATIONS ADHERING TO THE FLORIDA BUILDING CODE AND WHERE PRESSURE REQUIREMENTS AS DETERMINED BY ASCE 7, MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES, DOES NOT EXCEED THE DESIGN PRESSURES LISTED.
- 2. HURRICANE PROTECTIVE SYSTEM (SHUTTERS) IS NOT REQUIRED.
- 3. IN THE HVHZ, FACTORY PRIMED DOORS MUST BE PAINTED IN ACCORDANCE WITH SECTION 2220 OF THE FBC.



18 GA. HOLLOW METAL FRAME



SINGLE OUTSWING SINGLE UNIT



SINGLE INSWING SINGLE UNIT

Addendum to NAMI

Certification No.: NI006591
Reviewed By: [Signature]
Date Reviewed: 5/28/15

CONFIG	MAX WIDTH	DESIGN PRESSURE RATING		WHERE WATER INFILTRATION PERFORMANCE IS REQUIRED TO BE 15% OF DESIGN PRESSURE	
		INSWING	OUTSWING	INSWING	OUTSWING
X	40"	+80.0 / -80.0	+80.0 / -80.0	+19.0 / -19.0	+55.0 / -55.0

TABLE OF CONTENTS

SHEET #	DESCRIPTION
1	TYPICAL ELEVATIONS & GENERAL NOTES
2	ANCHORING LOCATIONS & DETAILS

MASONITE INTERNATIONAL CORP.
1955 POWIS RD.
WEST CHICAGO, IL 60185

PRODUCT:
"EXTERIOR DOOR PRODUCT"
METAL-EDGE STEEL DOOR
IN HOLLOW METAL FRAME
PART OR ASSEMBLY:
TYPICAL ELEVATIONS
& GENERAL NOTES

NO.	DATE	REVISIONS	
		BY	DATE
C	5/28/15	ANCHOR UPDATE	SWS
B	11/2/10	MISC UPDATES	SWS
A	7/26/06	ADDED LOCK DETAIL	SWS

DATE: 6/10/06

SCALE: N.T.S.

DWG. BY: SWS

CHK. BY:

DRAWING NO.:

DWG-MA-FL0150-06

SHEET 1 OF 2

KURT BALTHAZOR
FLORIDA P.E.
#56533

PRODUCT:	"EXTERIOR DOOR PRODUCT" 6'-8" OPAQUE METAL-EDGE STEEL DOOR IN HOLLOW METAL FRAME
PART OR ASSEMBLY:	ANCHORING LOCATIONS & DETAILS

C	5/28/15	ANCHOR UPDATE		SWS
B	11/2/10	MISC UPDATES		SWS
A	7/26/06	ADDED LOCK DETAIL		SWS
NO.	DATE			BY
REVISIONS				

DATE:	6/10/06
SCALE:	N.T.S.
DWG. BY:	SWS
CHK. BY:	
DRAWING NO.:	
DWG-MA-FL0150-06	
SHEET	2 OF 2

1.	KWIKSET SERIES 400 GRADE 3 CYLINDRICAL LATCH AND SERIES 980 GRADE 1 DEADLOCK HARDWARE TO BE INSTALLED AT 5-1/2" CENTERLINE.
2.	4" X 4" FULL MORTISE BUTT HINGES.