
**PERFORMANCE EVALUATION OF CARTER ARCHITECTURAL PANELS INC.
“EVO™ RIVETLESS™ PANEL SYSTEM”
IN ACCORDANCE WITH AAMA 508-21:**

***REFERENCING ASTM E283, ASTM E1233 (MODIFIED PER AAMA 508),
ASTM 331, AAMA 501.1 & ASTM E330***

Report to:	Carter Architectural Panels Inc. 7925 E Ray Road, Ste. 133 Mesa, AZ. 85212
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Report No.:	22-06-B0106, Revision 1 11 Pages, 2 Appendices
Proposal No.:	22-006-381994
Report Date:	December 14, 2022

1.0 INTRODUCTION

At the request for Carter Architectural Panels Inc., Element was retained to evaluate the “EVO™ RIVETLESS™ PANEL SYSTEM” in accordance with AAMA 508-21 for pressure equalization behaviour and water penetration resistance as outlined in Proposal Number 22-006-347080RV1.

Upon construction, the specimen was assigned the following Element Specimen Number:

Client Specimen Description

EVO™ RIVETLESS™ PANEL SYSTEM

(Equal panel scheme / 4 panels, not individually pressure isolated)

Element Specimen No.

22-06-B0106

Note: The ACM used in the “EVO™ RIVETLESS™ Panel System” by Carter Architectural Panels Inc., was “etalbond®, 4 mm, FR by Elval Colour.” A complete bill-of-materials and details for the specimen identified above is located in Appendix A.

2.0 PROCEDURE

Test Method	Test Description
AAMA 508-21, Section 5.2c <i>Referencing ASTM E1233 (Modified)</i>	Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Pressure Equalization Behaviour
AAMA 508-21, Section 5.2b (static) <i>Referencing ASTM E331</i>	Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Water Penetration Resistance
AAMA 508-21, Section 5.2b (dynamic) <i>Referencing AAMA 501.1</i>	Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Dynamic Water Test

Note: SI units are the primary units of measure. IP units shall be used as reference.

Test Wall Section Description & Details:

The back-up test wall section (air / water barrier) was constructed in an Element test frame as per the detail drawing below in accordance with AAMA 508-21, Section 6.0:

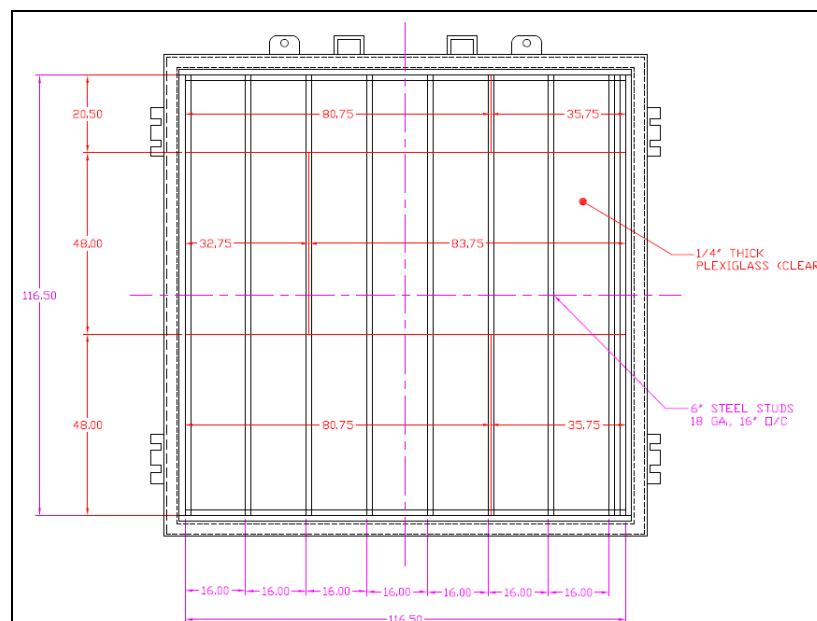


Figure 1 – Back-up Test Wall Framing Construction (dimensions in inches)

Upon construction of the back-up wall, the Plexiglas joints and screw-heads were sealed to ensure the assembly was air-tight.

The application of the cladding system on the test back-up wall was performed by Carter Architectural Panels Inc., authorized personnel on October 24, 2022.

The wall assembly air leakage in accordance with ASTM E283-19 was measured prior to the introduction of the 3 mm (1/8 in) diameter holes through the Plexiglas substate. The intent of this test was to quantify air leakage performance of the assembly installed over a simulated air-tight air barrier system represented by the Plexiglas sheathing.

The values stated in the table below are reflective of air leakage through simulated sheathing (Plexiglas) including rainscreen support structure mechanically fastened into the steel studs to the interior side of the assembly. These values should be concerned to be a system tare.

Table 1 - Assembly Air Leakage Results ASTM E283-19 Element Specimen No.: 22-06-B0106 (Test Date: October 25, 2022)	
Test Pressure Differential	Infiltration
75 Pa (1.57 lbs./ft ²)	0.100 L/s m ² (0.02 CFM/ft ²)

As permitted by AAMA 508-21, Note 5, the perimeter of the specimen was sealed to the fixture that the wall section was constructed into. No drainage/vent holes or critical areas of the specimen that would be affected by water infiltration / drainage or differential pressure were obstructed.

After the air leakage validation for tightness was completed in accordance with ASTM E283-19, as prescribed by AAMA 508-21, Section 6.2, 3 mm (1/8 in) diameter holes were introduced equally spaced 150 mm above horizontal seam including above the base of the mock-up in order for the air/water barrier to have an air leakage rate of 0.6 L/s·m² (0.12 cfm/ft²).

Using the procedure outlined in AAMA 508-21, Section 6.5, the pressure cycling tests were conducted as specified in ASTM E1233. However, ASTM E1233 was modified (*per AAMA 508-21*) to incorporate a positive pressure from 240 Pa (5.0 psf) to 1200 Pa (25.0 psf) to 240 Pa (5.0 psf) based on a maximum average of three (3) seconds for 100 cycles.

Upon completion of the pressure equalization behaviour test, the AAMA 508-21, Section 6.6, water penetration test at 300 Pa (6.27 psf) for fifteen (15) minutes was conducted.

Upon completion of the static water penetration test as outlined in AAMA 508-21, Section 6.6, testing was conducted in accordance with AAMA 508-21, Section 6.7 referencing AAMA 501.1.

3.0 RESULTS

Table 2 – Pressure Equalization Behaviour Analysis ASTM E1233/1233M-14 (2021) Element Specimen Number: 22-06-B0016 (Test Date: October 26,2022)					
Compartment Tested	Maximum External Gust Pressure of Pulse	Maximum Cavity Pressure of Pulse	Requirements		Comments
			Pressure Differential	Maximum Time Shift of Pulse	
Primary Compartment	1200 Pa (25.1 psf)	732 Pa (15.3 psf)	Pressure differential on rain screen cladding shall not exceed 50% of maximum wind gust pressure	< 0.08 seconds	Meets Requirement

Pressure equalization graph is located in Figure 2 (Page 4)

- Air Leakage of Back-Up Wall (air / water barrier): **0.57 L/s•m² (0.113 cfm/ft²)**
- Ratio of cavity volume to vent area (each panel): **912.6 m³ / m² (2993.9 ft³/ft²)**

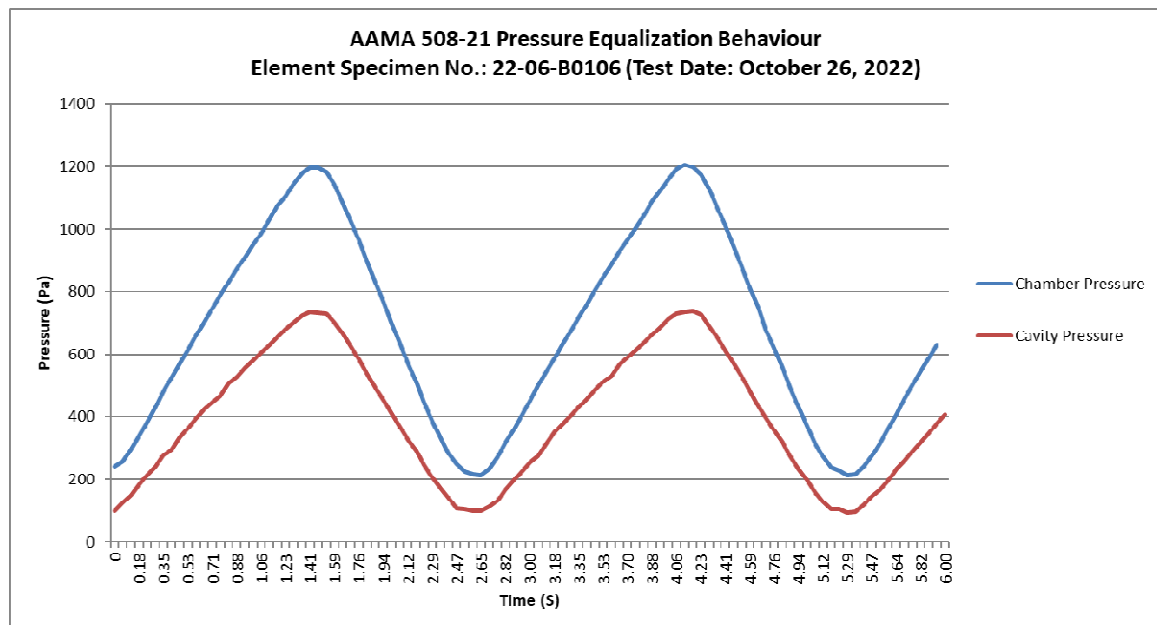


Figure 2 – Pressure Equalization Behaviour

Table 3 – Static Water Penetration Resistance AAMA 508-21, Section 6.6, Referencing ASTM E331-00 (2016) Element Specimen Number: 22-06-B0106 (Test Date: October 26, 2022)			
Test Pressure	Requirements	Results	Comments
300 Pa (6.24 PSF) (15-Minutes)	<p>All water that penetrates the exterior rain screen cladding shall be controlled and drained to the exterior. All water that contacts the air / water barrier shall be visually observed and recorded:</p> <p>a) Water mist or droplets on the air/water barrier surface; and/or</p> <p>b) Water in continuous stream on the air/water barrier surface.</p> <p>Failure shall be defined as water mist or water droplets appearing in excess of 5% of the air/water barrier surface, or continuous streaming at any location on the air/water barrier.</p>	<p>Water mist and/or droplets were observed. No continuous streaming was observed.</p> <p>0.85 % of air/water barrier surface area had water misting and / or water droplets.</p>	<p>Meets Requirement</p>

Table 4 – Water Penetration Resistance Using Dynamic Pressure AAMA 508-21, Section 6.7, Referencing AAMA 501.1-05 Element Specimen Number: 22-06-B0106 (Test Date: October 26, 2022)			
Test Pressure	Requirements	Test Results	Comment
300 Pa ⁽²⁾ (6.24 PSF) (15-Minutes)	<p>All water that penetrates the exterior rain screen cladding shall be controlled and drained to the exterior. All water that contacts the air / water barrier shall be visually observed and recorded:</p> <p>a) Water mist or droplets on the air/water barrier surface; and/or</p> <p>b) Water in continuous stream on the air/water barrier surface.</p> <p>Failure shall be defined as water mist or water droplets appearing in excess of 5% of the air/water barrier surface, or continuous streaming at any location on the air/water barrier.</p>	<p>Water mist and/or droplets were observed.</p> <p>0.51 % of air/water barrier surface area had water misting and / or water droplets.</p> <p>All water that penetrated the exterior rain screen cladding was controlled and drained to the exterior with no continuous streaming observed.</p>	Meets Requirements

⁽²⁾ 300 Pa = 22.1 m/s or 80 km/h (49 mph). Calculation based on the Enswiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

Outdoor conditions during test (October 26, 2022):

Temperature: 11.1 °C
Relative Humidity: 92 % R.H.
Barometric Pressure: 98.57 kPa

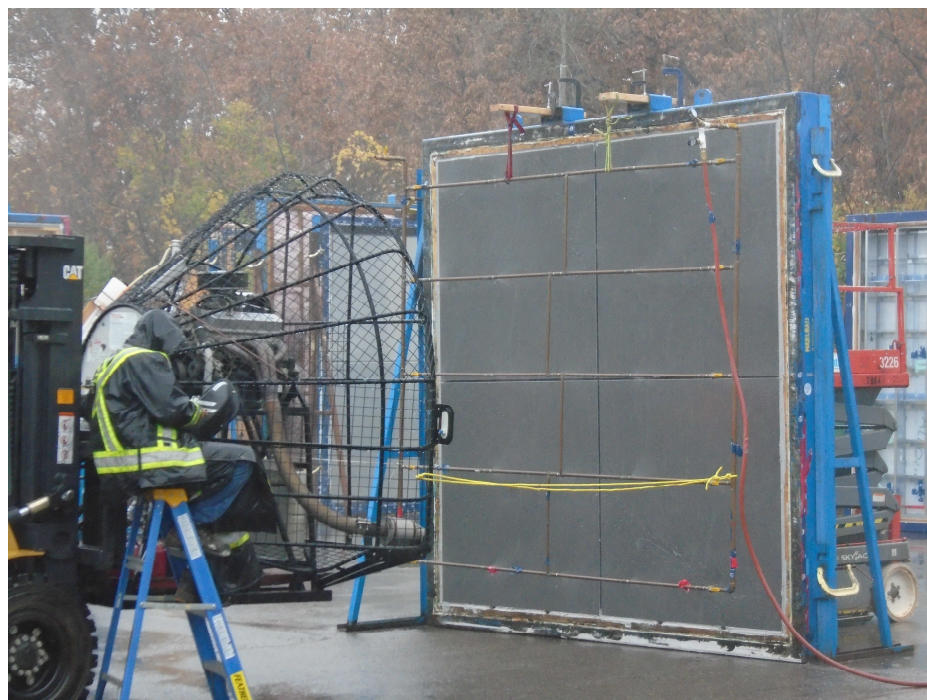


Figure 3 – AAMA 501.1, Dynamic Water Penetration Test

Table 5 – Structural Results, Positive Wind Load Direction ASTM E330/E330M-14(2021) – SI & IP Units Element Specimen No.: 22-06-B0106 (Test Date: October 26, 2022)				
Test Pressure	Gauge No. and Deflection, mm (inches)			
	1	2	3	Net Deflection
3,591 Pa ⁽¹⁾ (75.0 lbs. /ft ²)	-3.89 (-0.153)	-11.37 (-0.447)	-2.47 (-0.097)	-8.15 (-0.321)
Residual Deflection	-0.52 (-0.020)	-0.95 (-0.037)	-0.61 (-0.024)	-0.39 (-0.015)

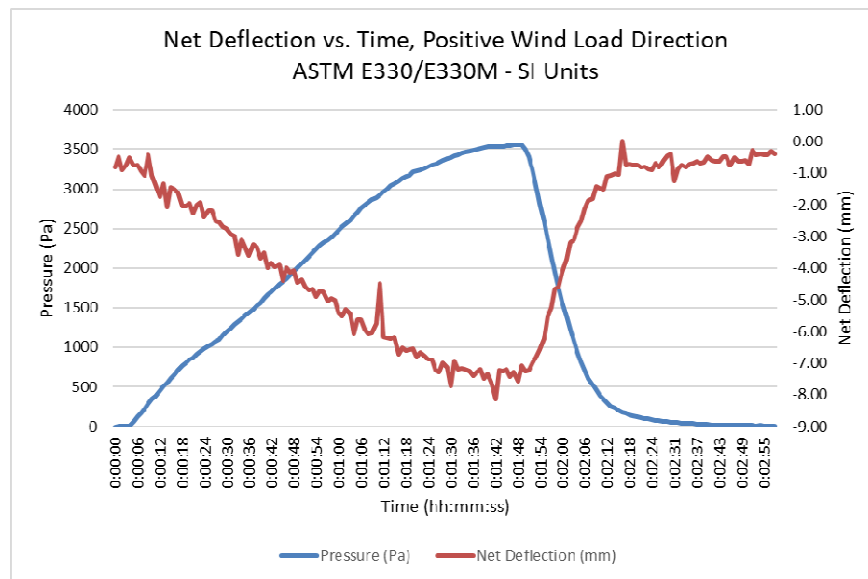


Figure 4 – Net Deflection vs Time, Positive Wind Direction, SI Units

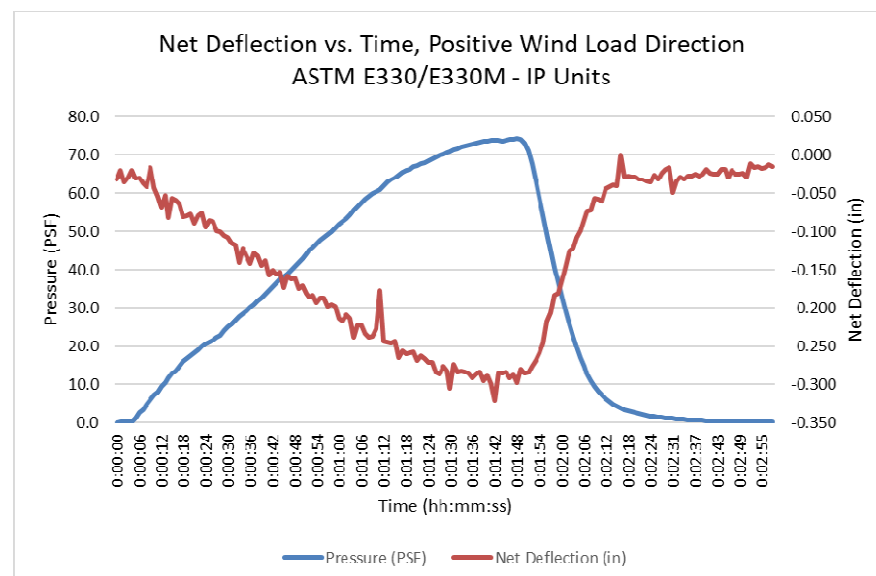


Figure 5 – Net Deflection vs Time, Positive Wind Direction, IP Units

Table 6 – Structural Results, Negative Wind Load Direction ASTM E330/E330M-14(2021) – SI & IP Units Element Specimen No.: 22-06-B0106 (Test Date: October 26, 2022)				
Test Pressure	Gauge No. and Deflection			
	1	2	3	Net Deflection
3,591 Pa ⁽¹⁾ (75.0 lbs. /ft ²)	3.31 (0.130)	11.31 (0.445)	4.13 (0.163)	7.59 (0.299)
Residual Deflection	0.43 (0.017)	1.00 (0.040)	0.91 (0.035)	0.33 (0.013)

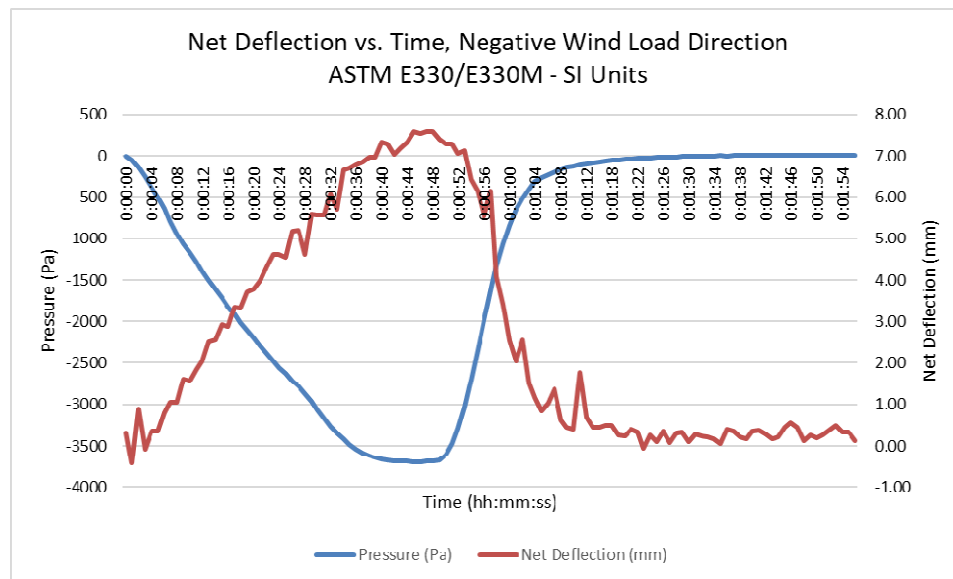


Figure 6 – Net Deflection vs Time, Negative Wind Direction, SI Units

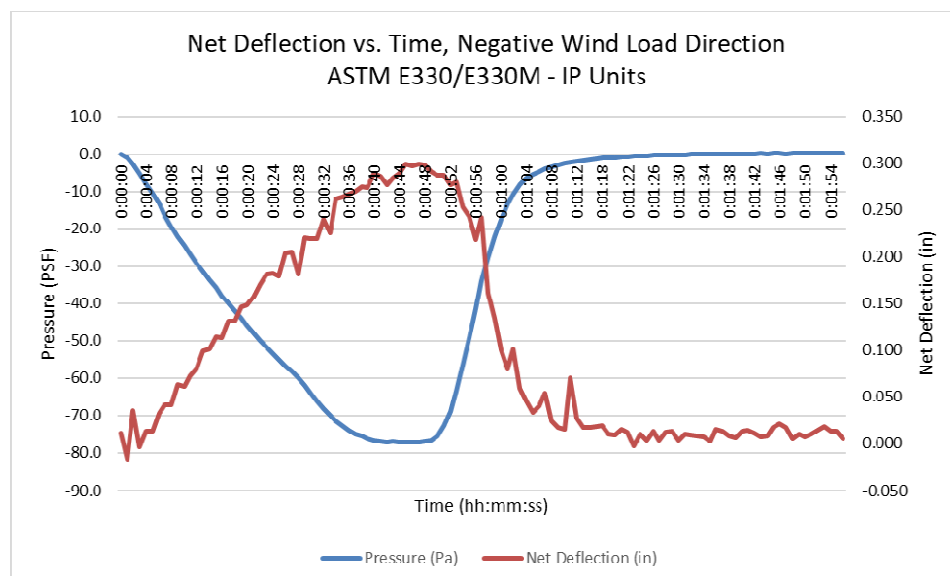


Figure 7 – Net Deflection vs Time, Negative Wind Direction, IP Units

Positive Loading Net Deflection Design Load: (+3591 Pa) = $\frac{8.15 \text{ mm}}{16.4 \text{ mm Requirement}}$
Negative Loading Net Deflection Design Load (-3591 Pa) = $\frac{7.59 \text{ mm}}{16.4 \text{ mm Requirement}}$

Positive Loading Net Deflection Design Load: (+75.0 lbs. /ft²) = $\frac{0.39 \text{ inches}}{0.647 \text{ inch Requirement}}$
Negative Loading Net Deflection Design Load (-75.0 lbs. /ft²) = $\frac{0.33 \text{ inches}}{0.647 \text{ inch Requirement}}$

Note: The support framing exceeded both the deflection (L/180) and load performance requirements (75 psf (3591 Pa) > 25 psf) as referenced in AAMA 508, Section 6.1.1.

(1) 3,591 Pa = 76.5 m/s or 272 km/h (169 mph).

Calculation based on the Enswiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

(2) AAMA 508-21, Section 6.1.1, Note 3 & 6.1.2, states: "Although structural testing is not a requirement to verify performance of the cladding this test requires testing to ASTM E330 for the purpose of measuring and verifying deflection of the backup wall is within the established criteria."

"The test is applicable to back-up walls that are as stiff, or stiffer than what is tested."

Note: Deflection measurement (gauge) locations employed during structural loading are shown below.

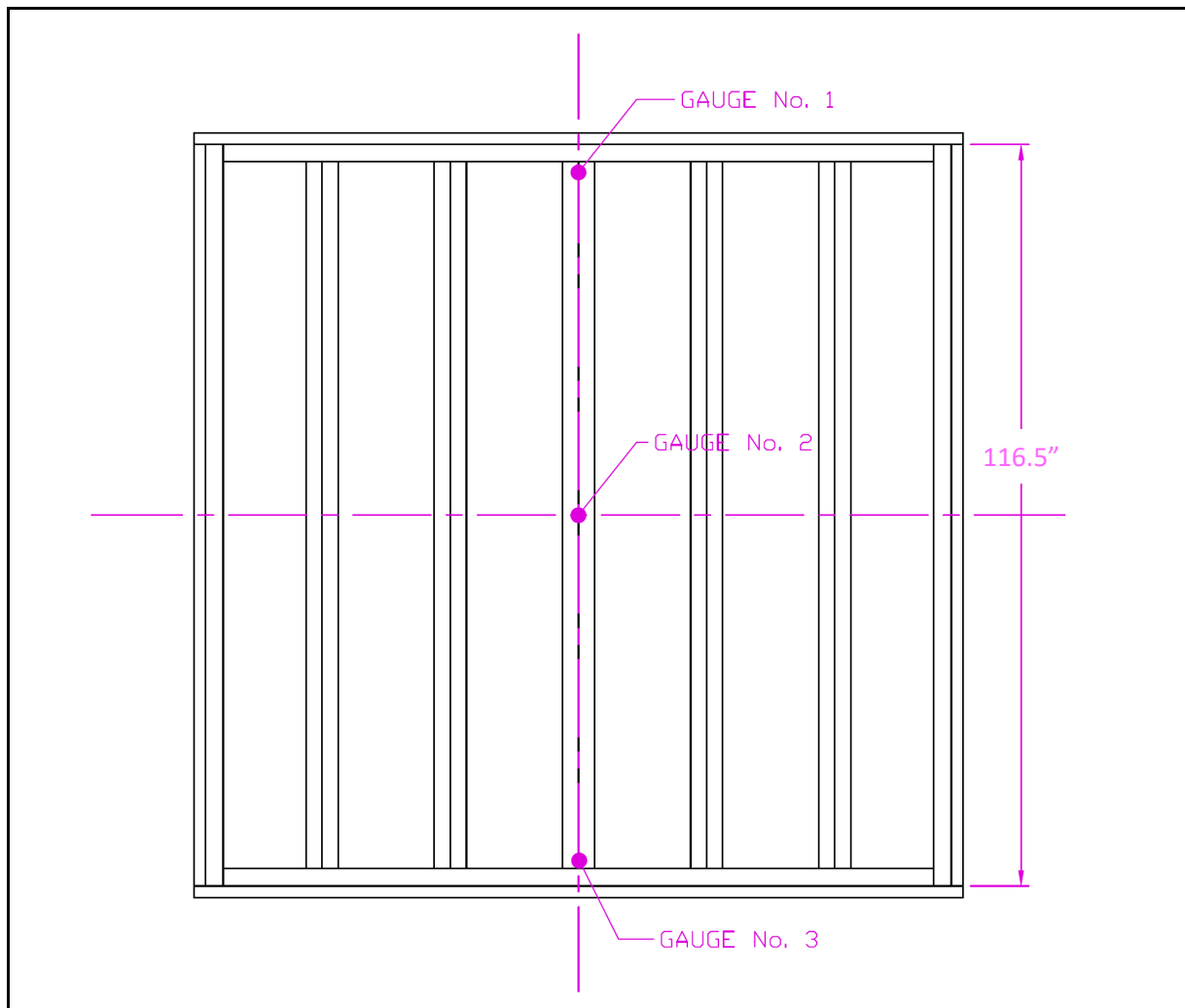


Figure 8 – Deflection Gauge Locations

Table No. 7 - Summarized Structural Results ASTM E330/E330M-14(2021) – SI & IP Units Element Specimen No.: 22-06-B0106 (Test Date: October 26, 2022)	
Test Pressure Sustained/Achieved	Comments
+ 5,387 Pa ⁽³⁾ (112.5 lbs. /ft ²)	Cladding System did not disengage from wall assembly. Structural framing members remained intact.
- 5,387 Pa ⁽³⁾ (112.5 lbs. /ft ²)	Cladding System did not disengage from wall assembly. Structural framing members remained intact.

⁽³⁾ 5,387 Pa = 93.7 m/s or 337 km/h (210 mph).

Load Calculation based on the Ensewiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

*Note: Design loads are building and location specific. Please refer to architect or design engineer for specific building load requirements.

Structural Testing to Failure (beyond AAMA 508-21 test method scope):

At the request of Carter Architectural Panels Inc., structural testing to failure in the negative wind load direction was requested. The testing outlined in this section was not for a project specific condition, and a target design pressure was not specified. Structural testing of the rainscreen system was conducted in general accordance with ASTM E330-14(2021) and negative differential pressure was gradually applied to the exterior face of the wall assembly until failure.

Table 8 – Client Specific (Requested) Testing Test to Failure in the Negative Wind Load Direction ASTM E330-14(21) Element Specimen Number: 22-06-B0106 (October 26, 2022)	
Maximum Pressure Achieved	Comments
6,064 Pa ⁽⁴⁾	Cladding System did not disengage from wall assembly. However, vertical supporting steel studs buckled in the center
126.6 lbs. /ft ²	

⁽⁴⁾ 6,064 Pa = 99.944 m/s (or 224 mph / 360 km/h). Load

Calculation based on the Ensewiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

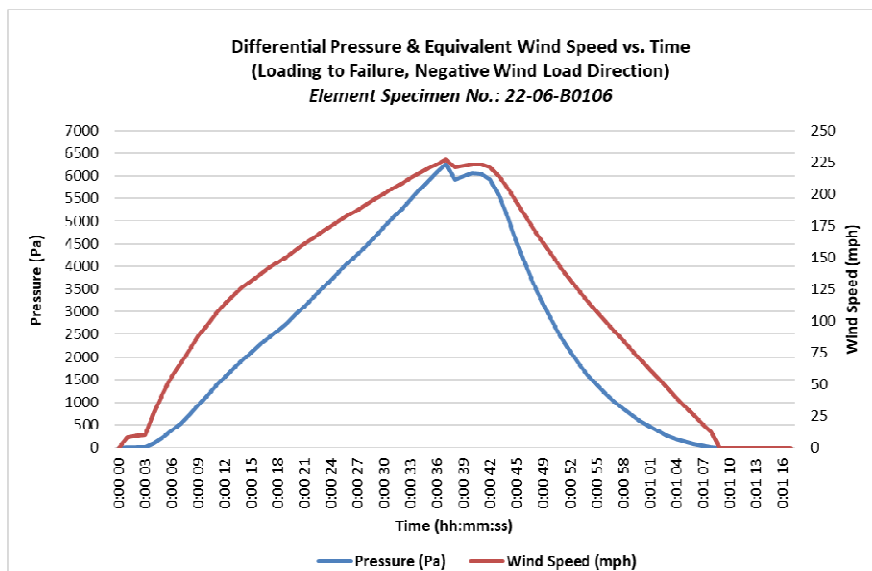


Figure 9 – Differential Pressure & Equivalent Wind Speed vs. Time (during testing to failure)

4.0 SYSTEM MODIFICATIONS

No modifications were made to the system as shown respectively in Appendix A.

5.0 DISCUSSION

The "EVO™ RIVETLESS™ PANEL SYSTEM" identified in this report met the requirements of AAMA 508-21 for cavity pressure differential, time shift of pulse, water penetration, and structural deflection criteria exceeding L/180 at 25 psf.

The system contained a cavity volume to vent area ratio of $912.6 \text{ m}^3 / \text{m}^2$ ($2993.9 \text{ ft}^3 / \text{ft}^2$) for each panel. Each panel had two (2) Ø11 mm (0.43 in) drain/vent holes with a measured cavity depth of 82 mm (3.228 in).

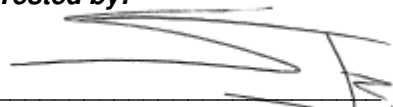
This report is not intended as a comprehensive evaluation of the system regarding performance and application to specific buildings.

6.0 REPORT REVISION HISTORY

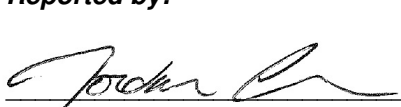
Date:	Revision:
November 29, 2022	Original Document
December 14, 2022	1

Comments:
N/A
Referencing standards included in title page and system tare air leakage in results in Section 2.

Tested by:


Emmanuel Siapno, Ext. 10292
Building Systems Test Technician
Building Systems

Reported by:


Jordan M. Church, B.Tech., Ext. 11546
Operations / Technical Manager
Building Science & Fire Testing Group

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APPENDIX A

Specimen Bill of Materials and Detailed Drawing

(13 Pages)



EVO ARCHITECTURAL PANEL SYSTEM
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PERFORMANCE EVALUATION WALL PROPOSAL NO. 21-006-285609

NOTES

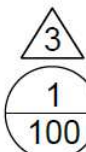
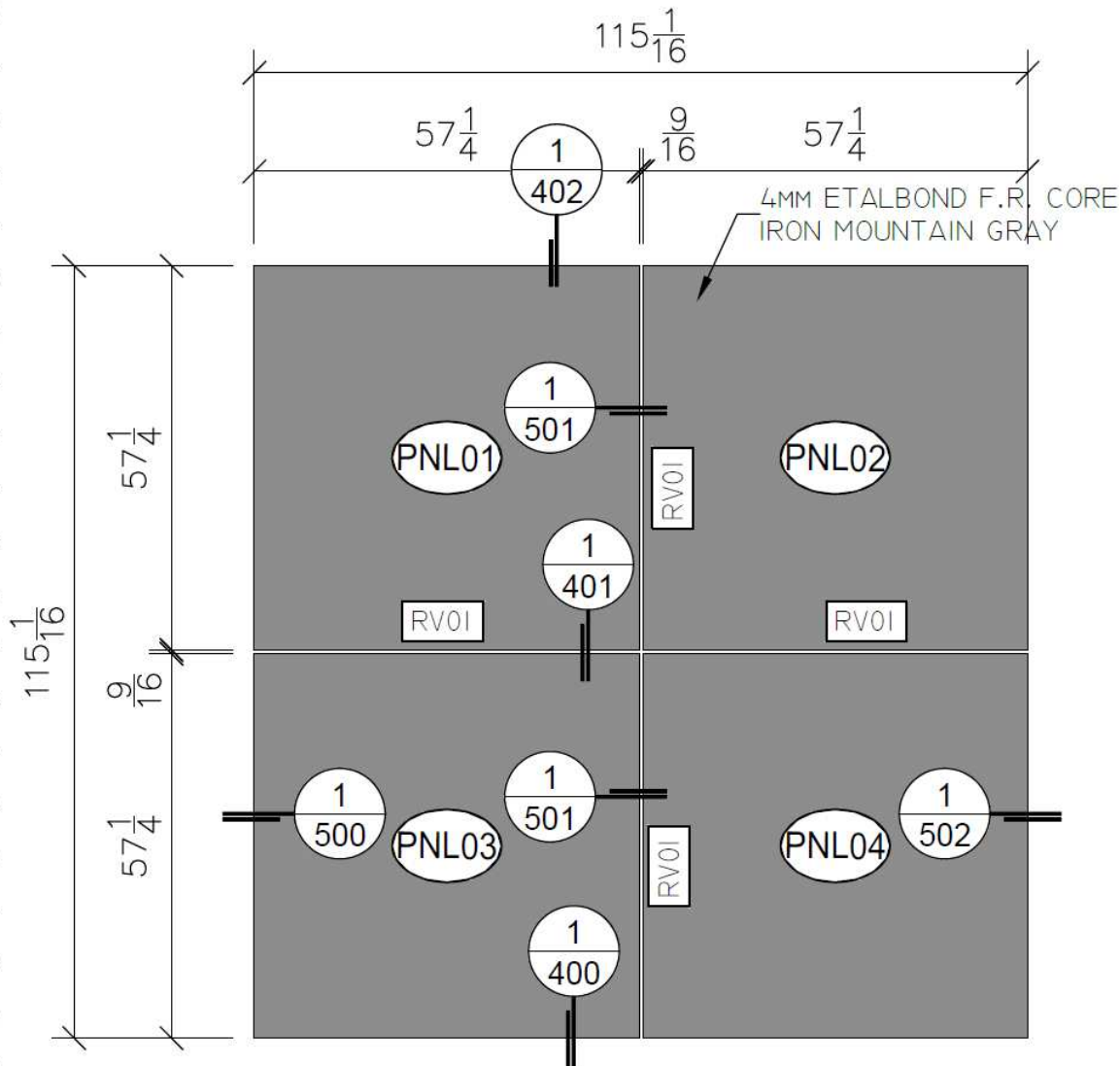
1. CARTER, EVO RIVETLESS PANEL SYSTEM
SUPPLY AND INSTALL.
2. MATERIAL: 4MM ETALBOND F.R. CORE A.C.M
3. FINISH: IRON MOUNTAIN GRAY
4. EXTRUSIONS: EVO SYSTEM BY CARTER ARCHITECTURAL PANELS INC. 1 3/4" OVERALL DEPTH.
5. SUBGIRTS - 16 GA. GALVANIZED SUB-GIRTS.
6. FASTENERS: - AT PANEL TO EXTRUSION - #8 x 3/4" EVO TORXLIG SCREW
- AT EXTRUSION TO GIRT - 1/4"-#14 x 7/8" LONG #2 DRILL POINT @ MAX. 16" O/C
- AT GIRT TO STUDS - 1/4" x 1/4" x 1 1/2" LG. SELF-DRILL TEK 2 @ MAX. 16" O/C

PAGE NO.	TITLE	2021-12-03	2022-03-23	2022-08-31	2022-10-31
001	COVER PAGE	X	X	X	X
100	FRONT ELEVATION	X	X	X	X
100S	FRAMING ELEVATION STIFFENERS				X
101	FRAMING ELEVATION	X	X	X	X
200	WALL PLANS	X	X	X	X
300	WALL SECTION	X	X	X	X
400	SECTION DETAILS - PANEL START	X	X	X	X
401	SECTION DETAILS - HORIZONTAL JOINT	X	X	X	X
402	SECTION DETAILS - PANEL TERMINATION	X	X	X	X
403	SECTION DETAILS - EVO 508 BLOCK	X	X	X	X
500	PLAN DETAILS - PANEL START	X	X	X	X
501	PLAN DETAILS - VERTICAL JOINT	X	X	X	X
502	PLAN DETAILS - PANEL TERMINATION	X	X	X	X
	TOTAL PAGES	12	12	12	13



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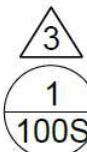
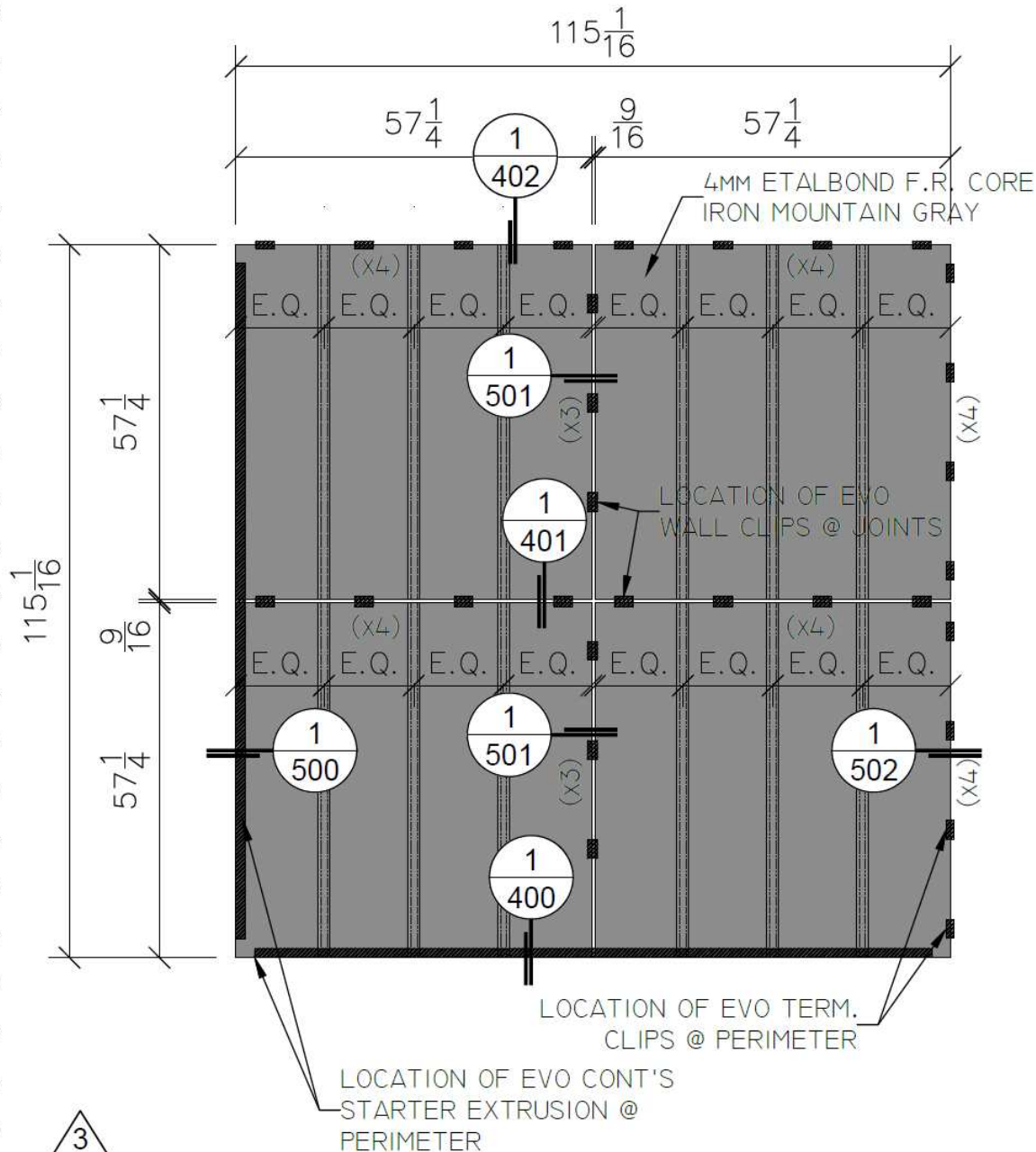
FRONT ELEVATION

1/2" = 1'-0"



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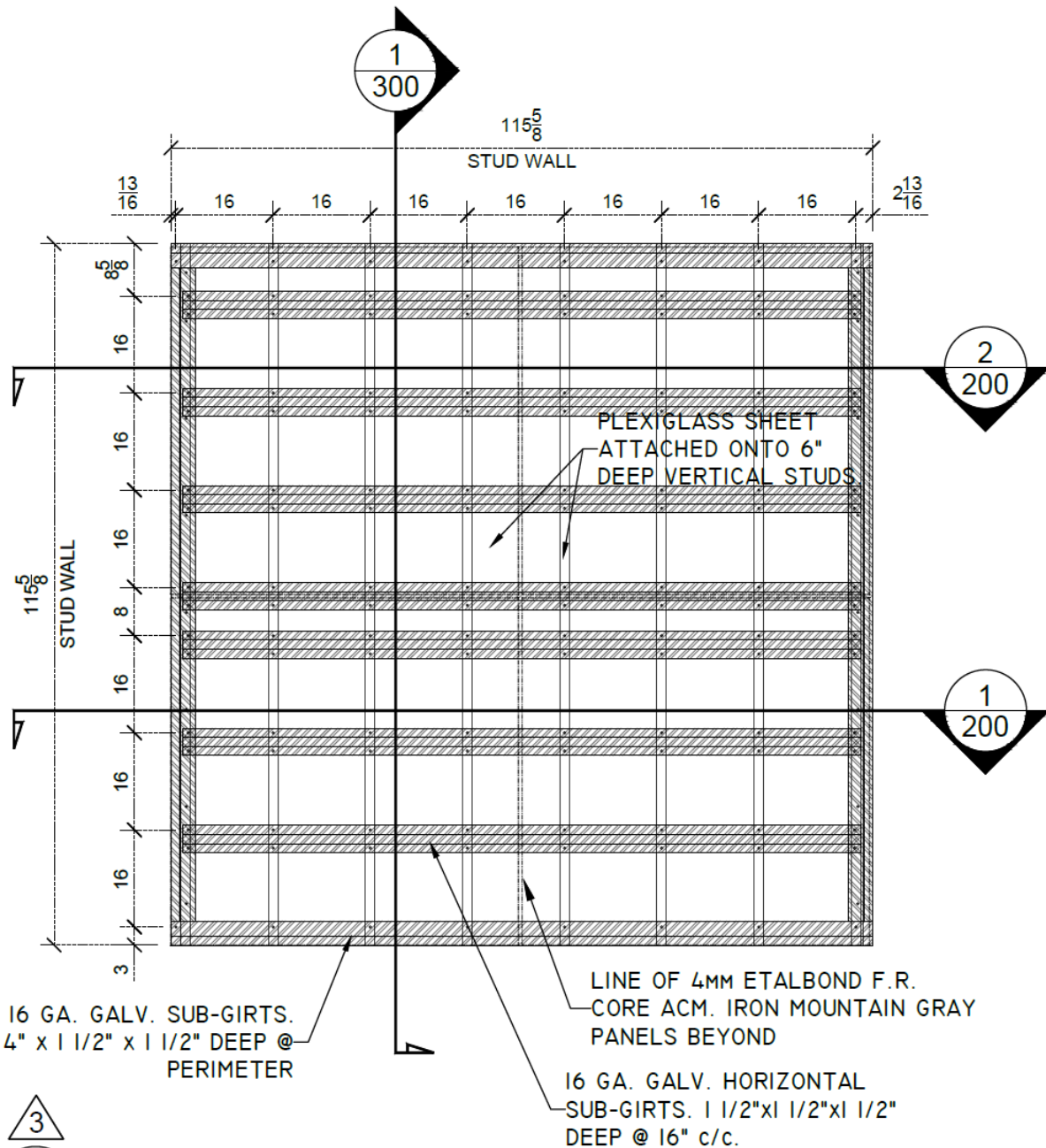
FRONT ELEVATION - EXTRUSION AND STIFFENERS

1/2" = 1'-0"



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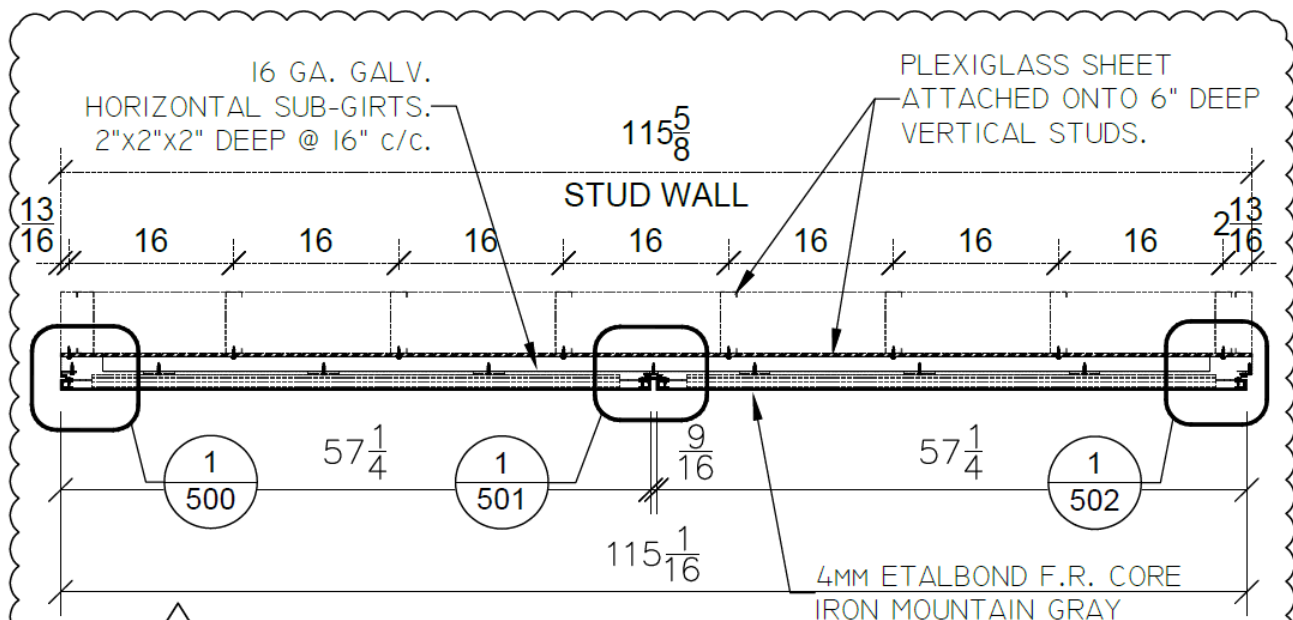
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1
101

FRAMING ELEVATION

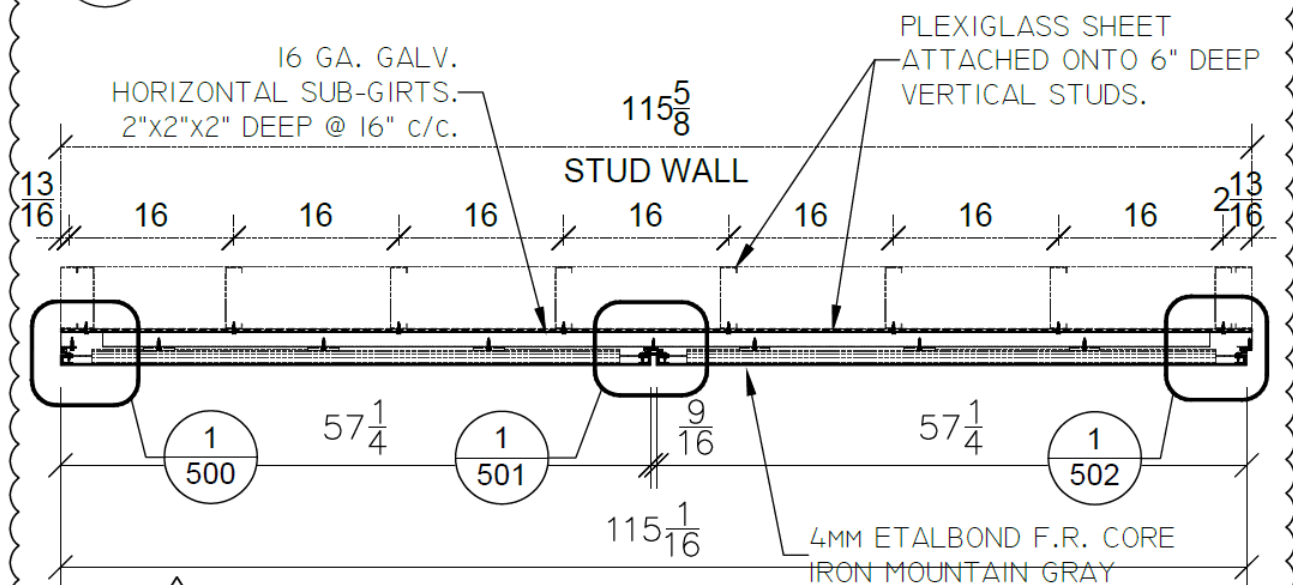
$1/2" = 1'-0"$



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3
2
200
PLAN VIEW AT TOP PANEL
3/4" = 1'-0"

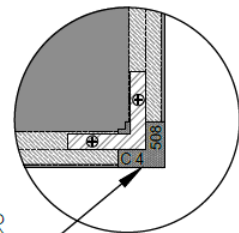
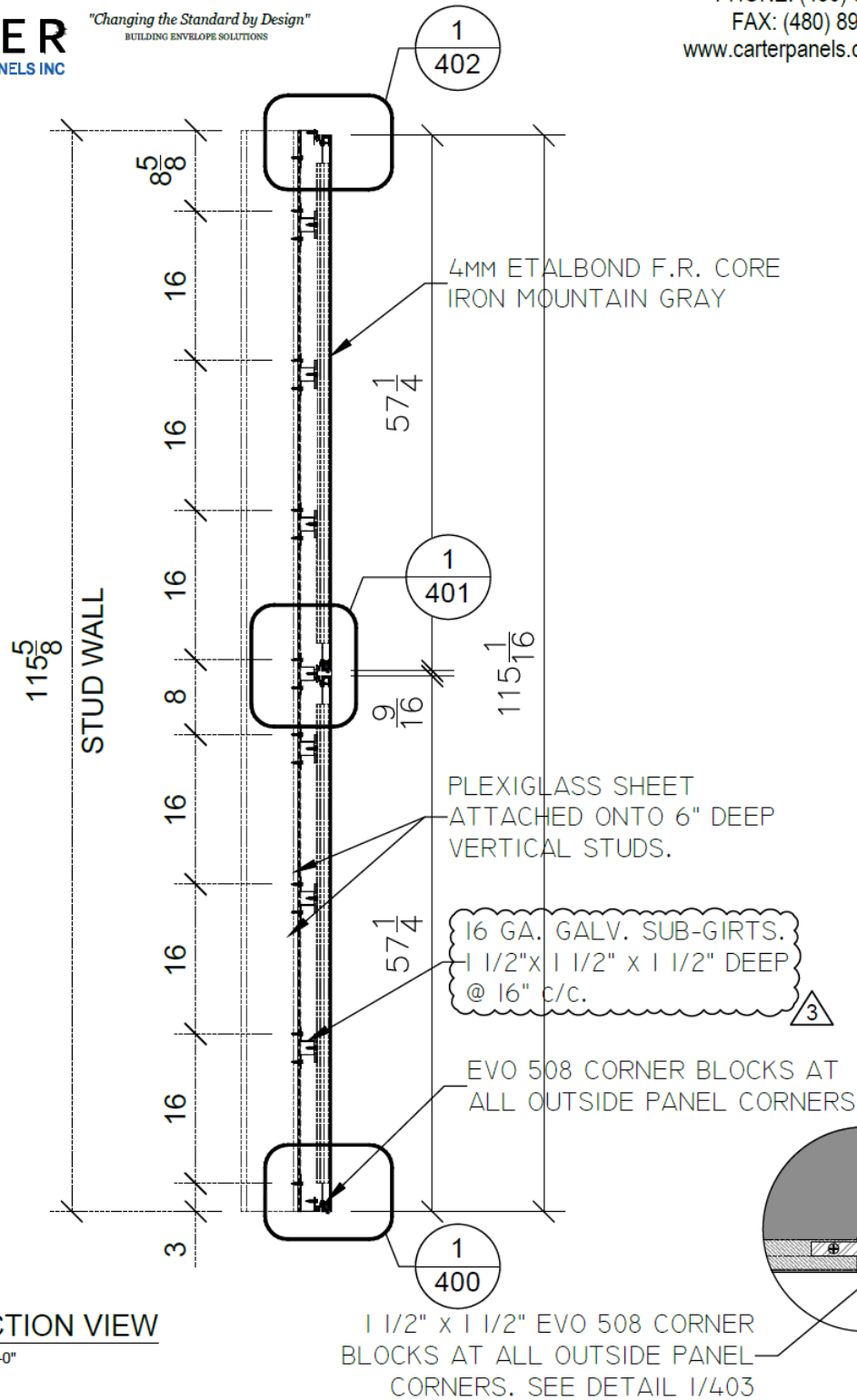


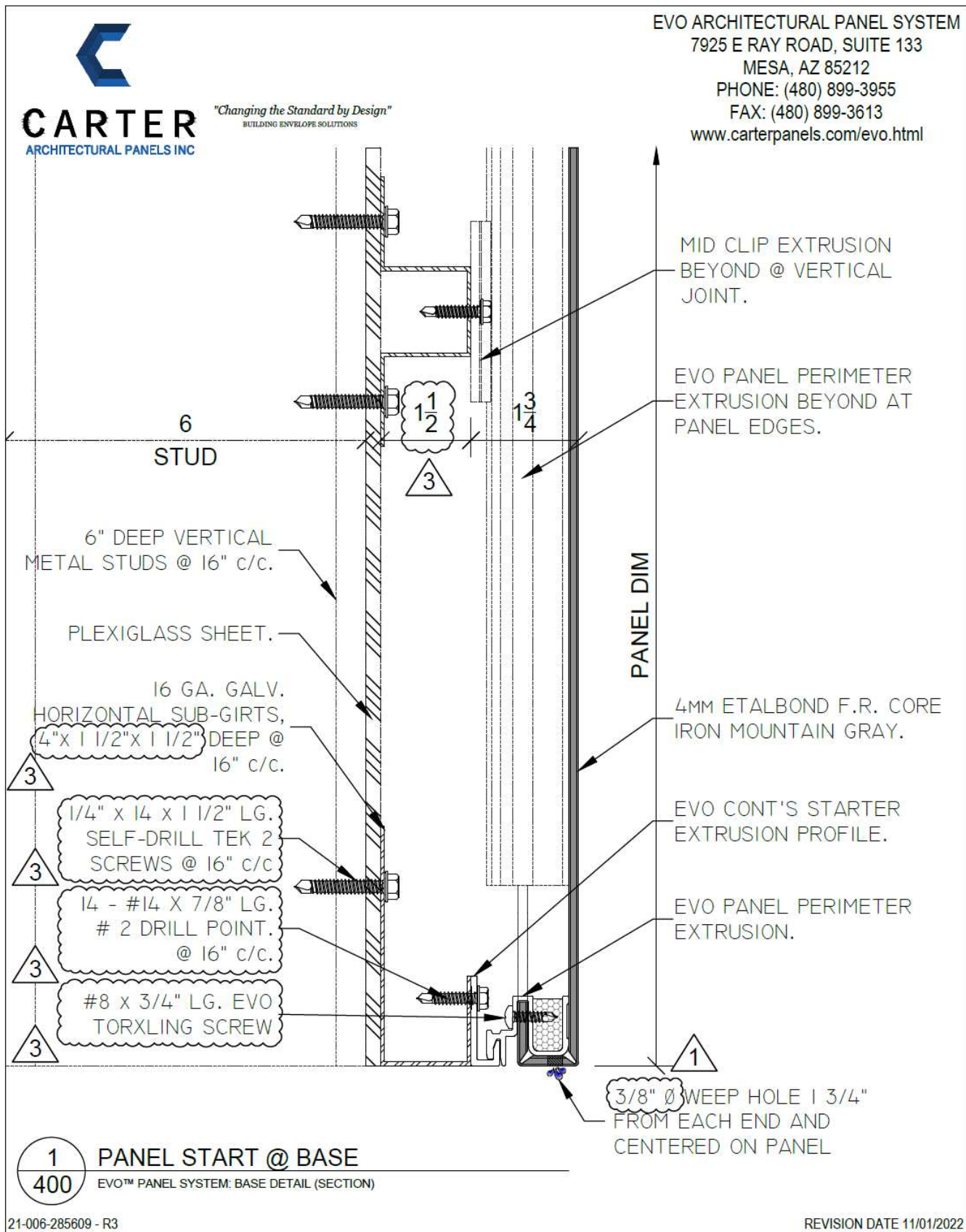
3
1
200
PLAN VIEW AT BOTTOM PANELS
3/4" = 1'-0"



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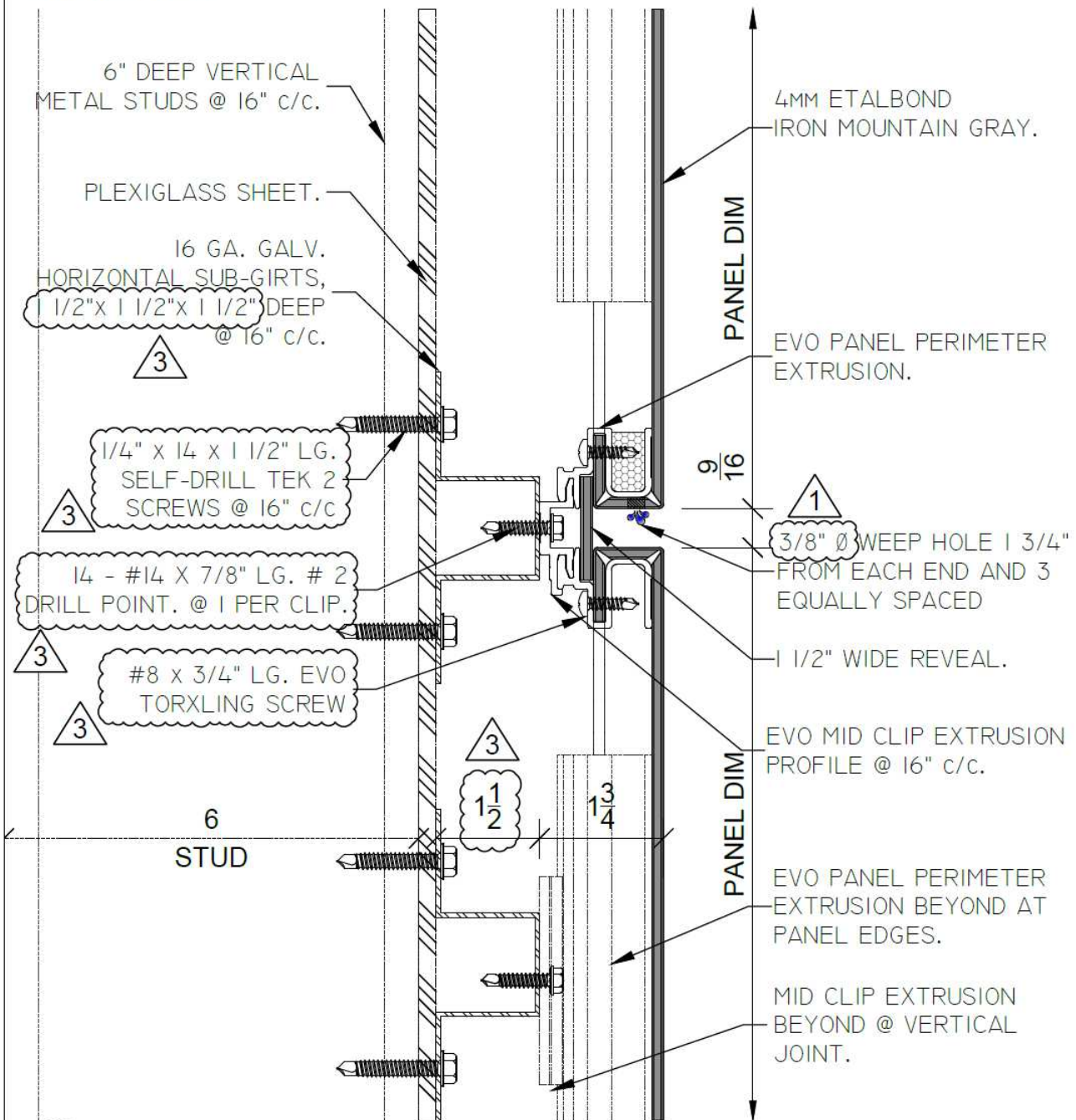






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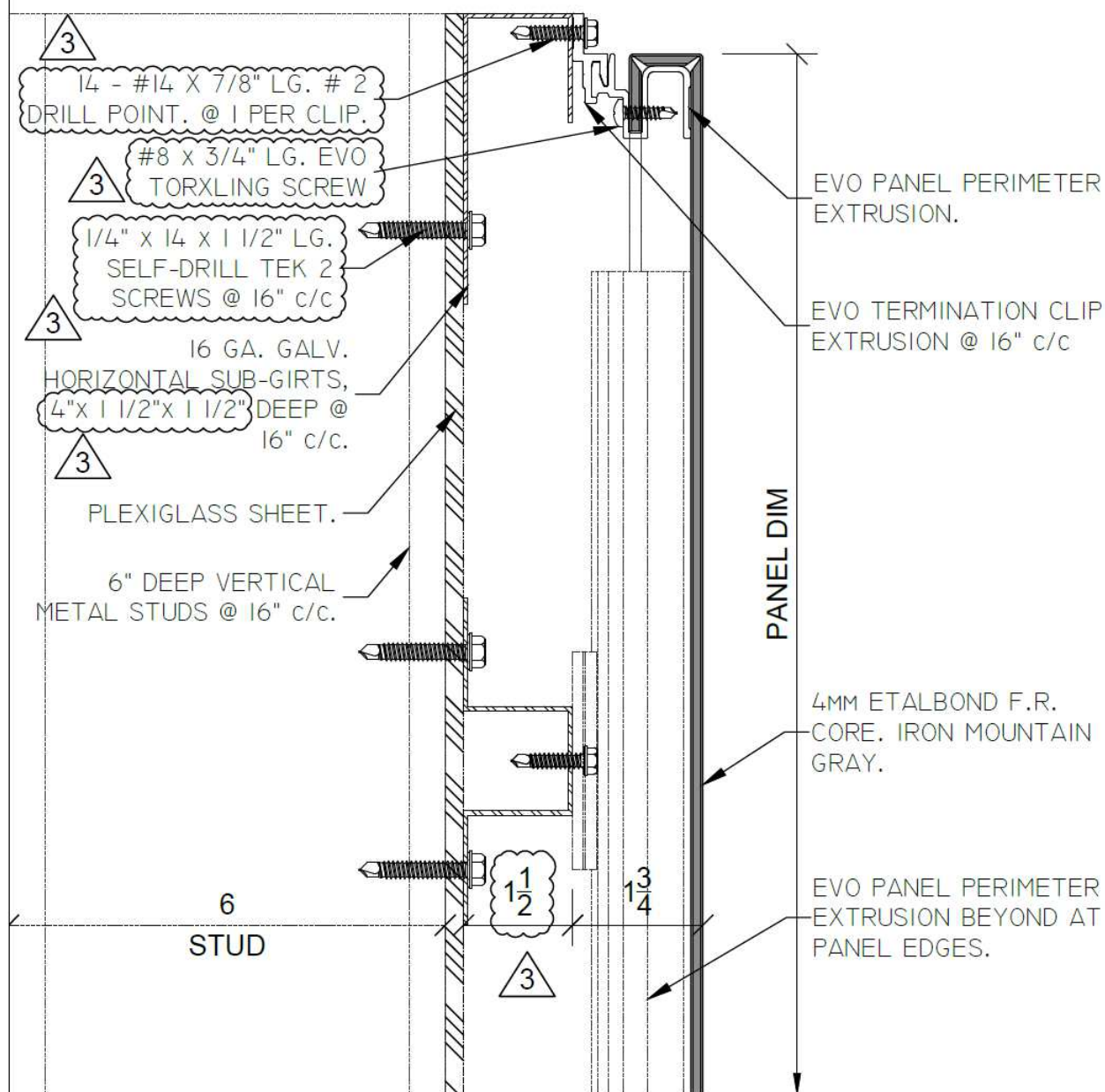


1
401 HORIZONTAL JOINT
EVO™ PANEL SYSTEM: HORIZONTAL JOINT DETAIL (SECTION)



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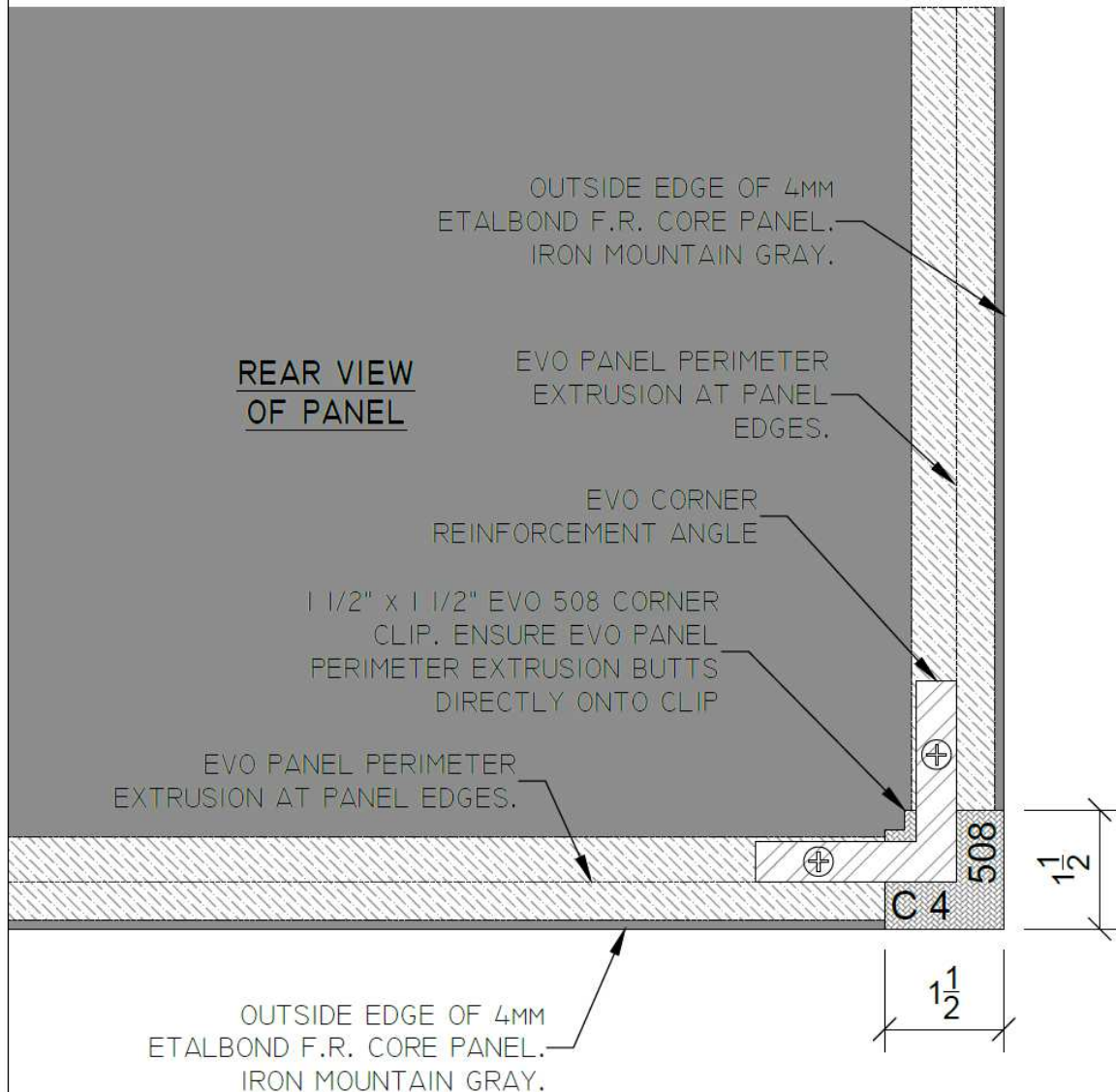


1 PANEL TERMINATION @ TOP



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1
403 REAR PANEL CORNER - 508 CLIP
EVO™ PANEL SYSTEM: TOP DETAIL (SECTION)

21-006-285609 - R3

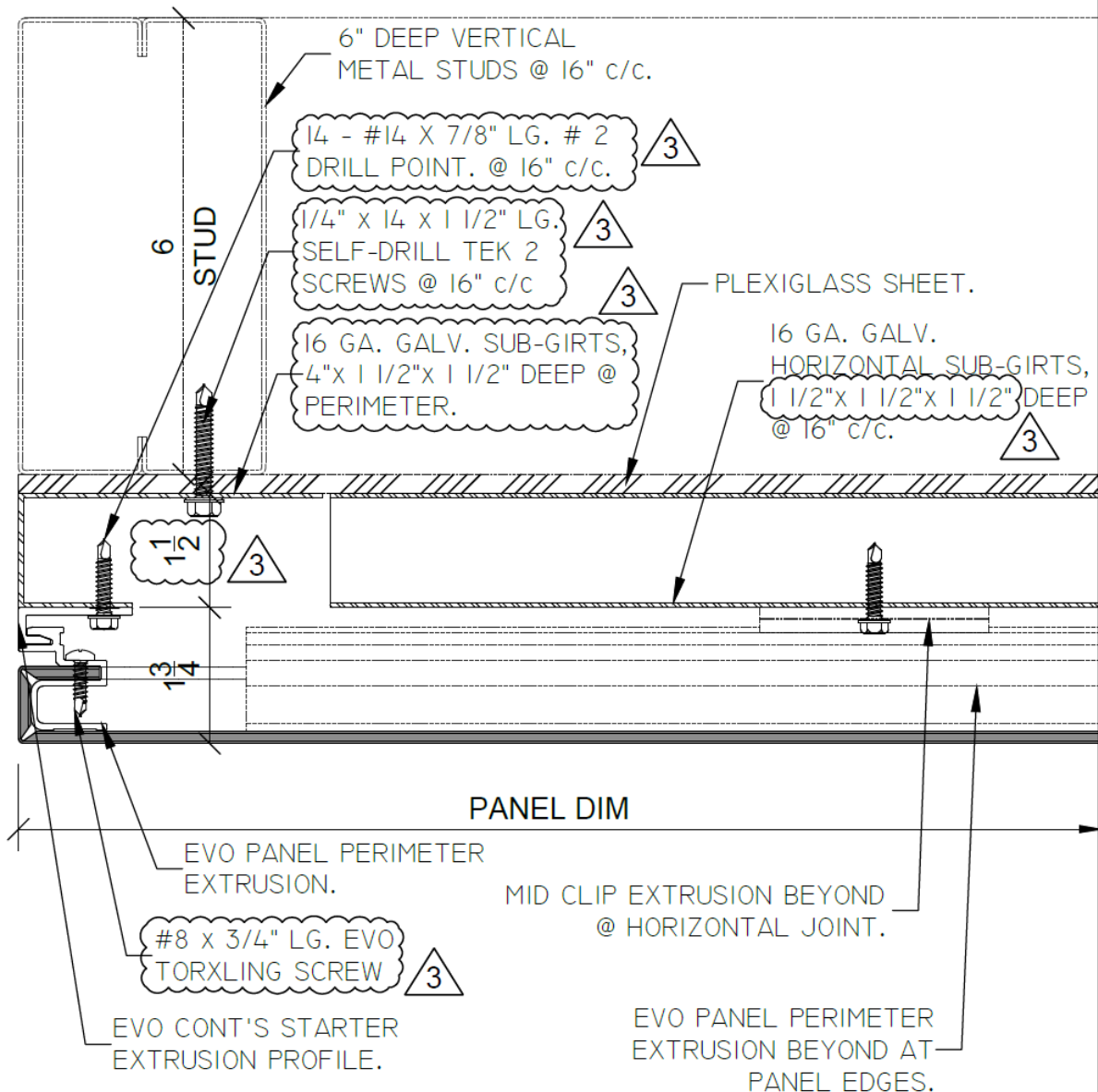
REVISION DATE 11/01/2022

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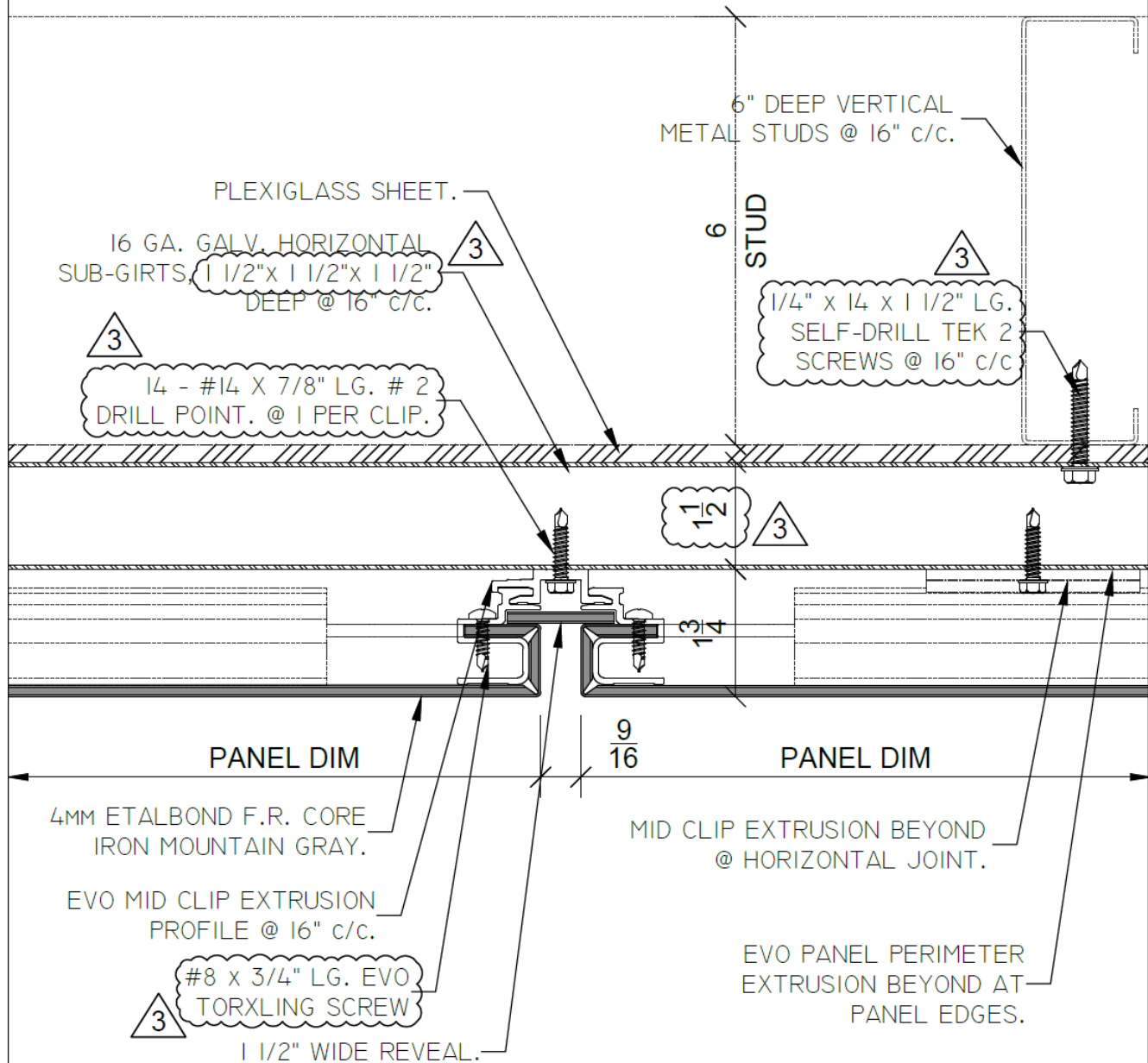


1
500 PANEL START @ LEFT
EVO™ PANEL SYSTEM: START DETAIL (PLAN)



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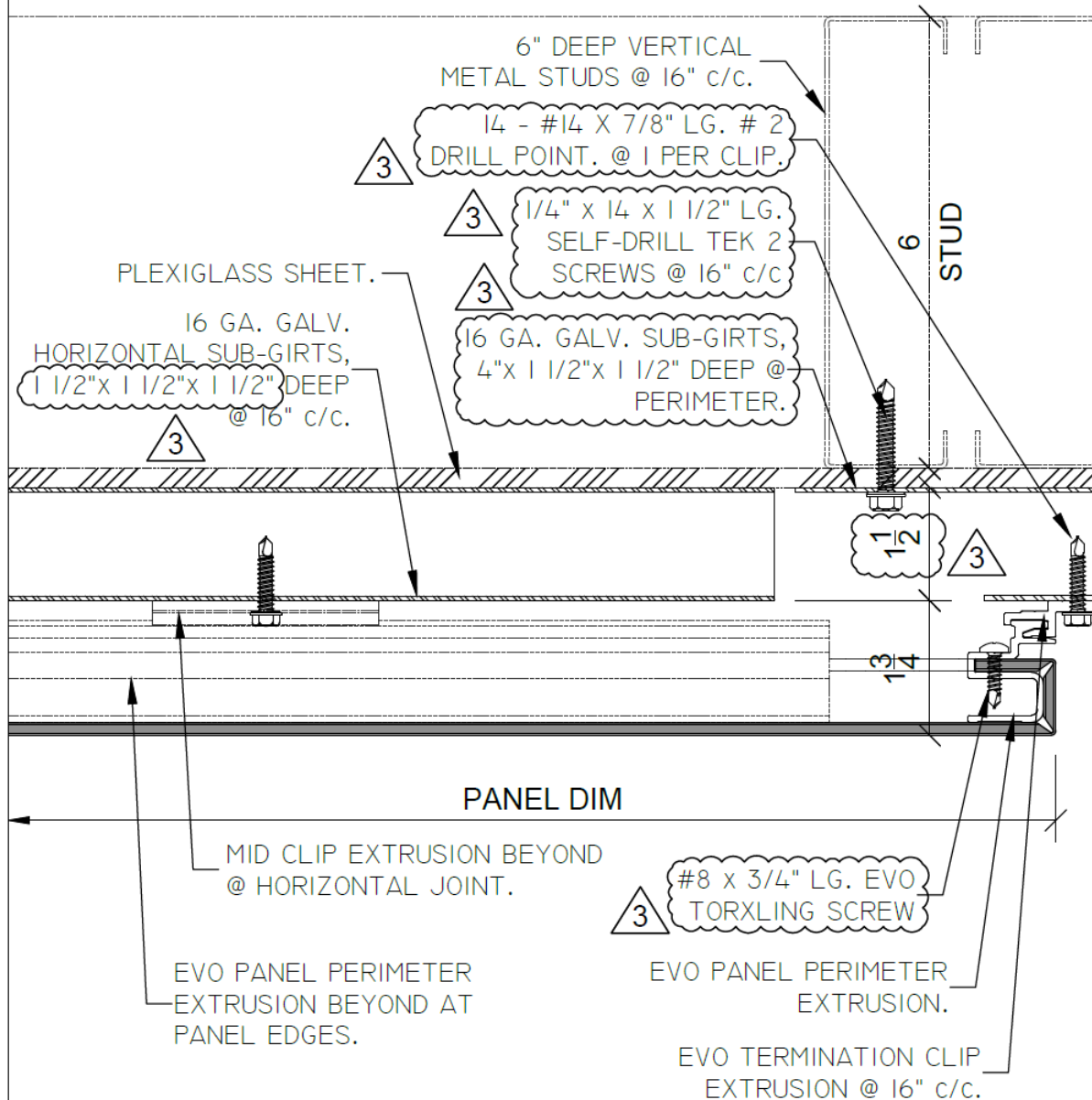


1
501 VERTICAL JOINT
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1
502 PANEL TERMINATION @ RIGHT
EVO™ PANEL SYSTEM: END DETAIL (PLAN)

APPENDIX B

Photographs of Rain Screen System

(1 Page)



Figure B1 – Test Specimen (Exterior View)



Figure B2 – Test Specimen (Interior View)