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**PERFORMANCE EVALUATION OF THE “RIVETLESS PANEL SYSTEM”
IN ACCORDANCE WITH AAMA 508-07 FOR PRESSURE EQUALIZATION
BEHAVIOR & WATER PENETRATION RESISTANCE**

Report to:	Carter Fabricating Inc. 326 Deerhurst Drive Brampton, Ontario L6T 5H9
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Report No.:	14-06-M0363 7 Pages, 3 Appendices
Proposal No.:	14-006-317398
Date:	February 7, 2015

1.0 INTRODUCTION

At the request of Carter Fabricating Inc., Exova was retained to evaluate the "Rivetless Panel System" exterior wall panel system in accordance with AAMA 508-07 for pressure equalization behavior and water penetration resistance as outlined in Proposal number 14-006-317398

Upon receipt, the specimen was assigned the following Exova Specimen Number:

Client Specimen Description

Rivetless Panel System
("T" Panel Scheme / 3 panels, not individually pressure isolated)

Exova Specimen No.

14-06-M0187 / 14-06-M0363

Note: The ACM used in the "Rivetless Wall Panel System" by Carter Fabricating, is "Iarson by ALUCOIL."
A complete bill-of-materials and details for the specimen identified above is located in Appendix A.

2.0 PROCEDURE

Test Description	Test Method
Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Pressure Equalization Behaviour	AAMA 508-07, Section 5.5 – Referencing ASTM E1233 (Modified)
Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Water Penetration Resistance	AAMA 508-07, Section 5.6 – Referencing ASTM E331
Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems – Dynamic Water Test	AAMA 508-07, Section 5.7 – Referencing AAMA 501.1-05

Note: SI units are the primary units of measure. The original testing performed in accordance with AAMA 508-07, Sections 5.5, 5.6 were conducted as outlined in Exova Project No.: 14-06-M0187 on the same specimen referenced in this report.

Test Wall Section Description & Details:

The back-up test wall section (air / water barrier) was constructed in an Exova test frame as per the detail drawing below in accordance with AAMA 508-07, Section 5.0:

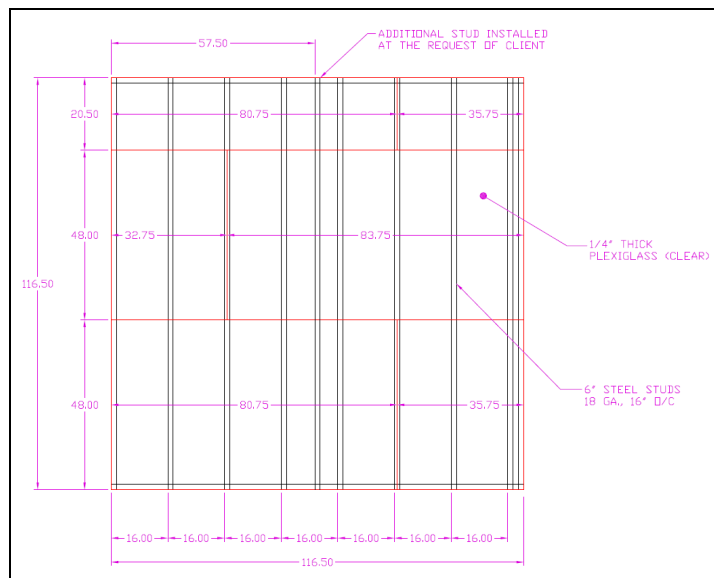


Figure 1 – Back-up Test Wall Framing Construction

Upon completion of the back-up wall, the Plexiglas joints and screw-heads were sealed to ensure the assembly was air-tight. After the air leakage validation for tightness was completed, as prescribed by AAMA 508-07, Section 5.2.2 & Figure 1A, three (3) mm diameter holes were introduced equally spaced 150 mm above horizontal seams and 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.

The application of the cladding system on the test back-up wall was performed by Carter Fabricating Inc. authorized personnel on June 22, 2014. As permitted by AAMA 508-07, 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.

Using the procedure outlined in AAMA 508-07, Section 5.5, the pressure cycling tests were conducted as specified in ASTM E1233. However, ASTM E1233 was modified to incorporate a positive pressure from 240 Pa to 1200 Pa to 240 Pa based on a maximum average of three seconds for 100 cycles as per AAMA 508-07.

Upon completion of the pressure equalization behavior test, the AAMA 508-07, Section 5.6, water penetration test at 300 Pa for fifteen minutes was conducted.

Test Date: July 10, 2014 (for above)

Upon completion of the static water penetration test as outlined in AAMA 508-07, Section 5.6, testing was conducted in accordance with AAMA 508-07, Section 5.7 referencing AAMA 501.1-05 at 300 Pa.

Test Date: January 23, 2015 (AAMA 508-07, Section 5.7 / AAMA 501.1-05)

3.0 RESULTS

Table 1 – Pressure Equalization Behavior Analysis Exova Specimen Number: 14-06-M0187 / 14-06-M0363					
Compartment Tested	Maximum External Gust Pressure of Pulse (Pa)	Maximum Cavity Pressure of Pulse (Pa)	Requirements		Comments
			Pressure Differential	Maximum Time Shift of Pulse	
Primary Compartment	1178	1132	Pressure differential on rain screen cladding shall not exceed 50% of maximum wind gust pressure	< 0.08 seconds	Meets Requirement

Pressure equalization graphs are located in Figures 2 (Page 4)

- Air Leakage of Back-Up Wall (air / water barrier): **0.57 L/sm²**
- Ratio of cavity volume to vent area (Upper Panels): **664 m³ / m²**
- Ratio of cavity volume to vent area (Lower Panel): **680 m³ / m²**

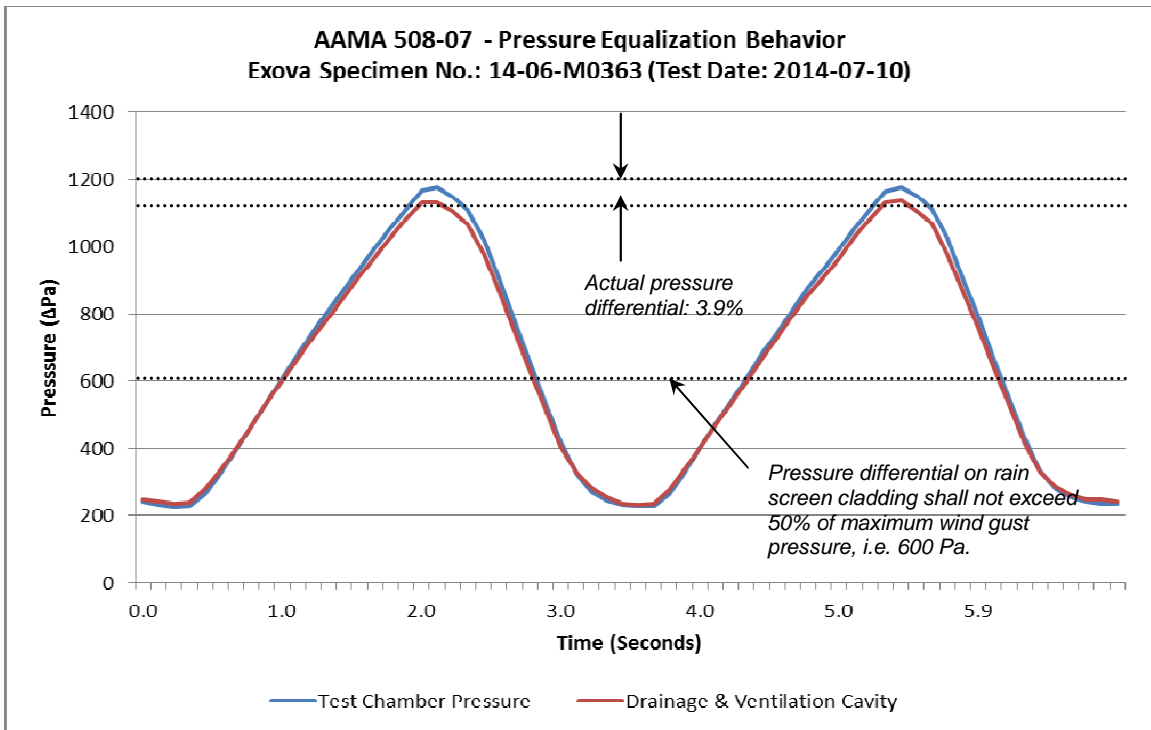


Figure 2 – Pressure Equalization Behavior

Table 2 – Static Water Penetration Resistance AAMA 508-07, Section 5.6, Referencing ASTM E331-00 (2009) Exova Specimen Number: 14-06-M0187 / 14-06-M0363			
Test Pressure (Pa)	Requirements	Results	Comments
300 Pa (15-Minutes)	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: a) Water mist or droplets on the air/water barrier surface; and/or b) Water in continuous stream on the air/water barrier surface. 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.	Water mist and/or droplets were observed. No continuous streaming was observed. 1.31 % of air/water barrier surface area had water misting and / or water droplets.	Meets Requirement

Table 3 – Support Wall Deflection Measurements AAMA 508-07, Section 5.8, Referencing ASTM E330⁽²⁾ Exova Specimen Number: 14-06-M0187 / 14-06-M0363			
Test	Requirements	Test Results	Comment
Uniform Load Deflection (Clause 5.1.2)	ASTM E330 Modified: +/- 1,200 Pa Requirements: - No permanent damage - Report Support Wall Deflection	Stud Length (L) = 2,950 mm Allowable (L/180) = 16.4 mm Net Deflection at Design Pressure: + 1,200 Pa = -2.4 mm - 1,200 Pa = 3.0 mm - No Permanent Damage Observed	Meets Requirements L/180 @ 1,200 Pa

(1) 1,200 Pa = 44.4 m/s (or 100 mph / 160 km/h). Calculation based on the Enswiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

(2) AAMA 508-07, Section 5.8 states: "When testing the actual air/water barrier for a project specific system, perform static structural performance test ASTM E330 at 0.5, 1.0 and 1.5 times the specified positive and negative design pressures." As the testing outlined in this report was not for a project specific system, a design pressure was not outlined. However, Exova performed structural testing of the AAMA 508-07 system in accordance with ASTM E330-00 to a pressure of ±1,200 Pa (160 km/h) for informational purposes.

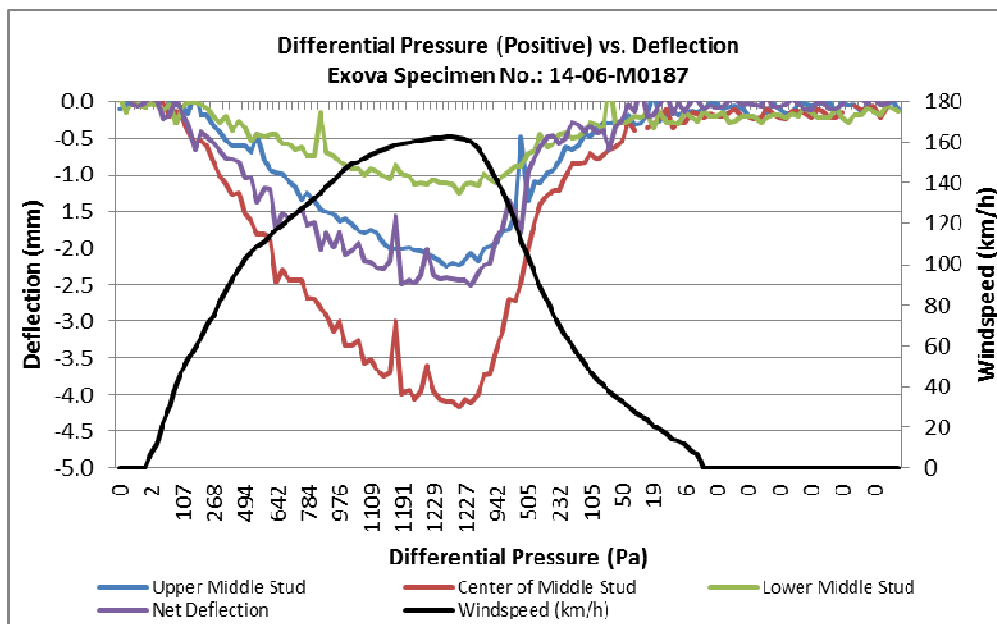


Figure 3 – Differential Pressure (Positive) vs. Deflection, ASTM E330

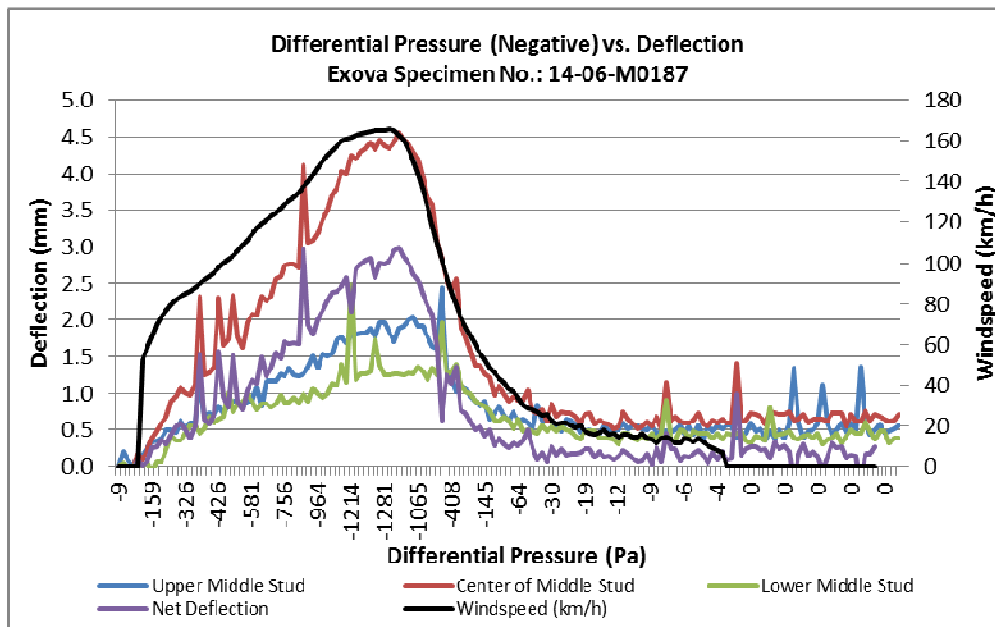


Figure 4 – Differential Pressure (Negative) vs. Deflection, ASTM E330

Table 4 – Water Penetration Resistance Using Dynamic Pressure AAMA 501.1-05, Section 5.7, Referencing AAMA 501.1-05 Exova Specimen Number: 14-06-M0187 / 14-06-M0363			
Test Pressure (Pa)	Requirements	Test Results	Comment
300 Pa ⁽²⁾ (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 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>1.39 % 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>	<p>Meets Requirements</p>

⁽²⁾ 300 Pa = 22.1 m/s (or 50 mph / 80.5 km/h). 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 (January 23, 2015):

Temperature: 1.3 °C
 Relative Humidity: 59 %RH
 Barometric Pressure: 99.56 kPa (Environment Canada, Toronto Pearson International Airport)

4.0 SYSTEM MODIFICATIONS

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

5.0 DISCUSSION

The Carter Fabricating Inc. "**Rivetless Panel System**" (Exova Specimen No.: 14-06-M0363) identified in this report met the requirements of AAMA 508-07 for cavity pressure differential, time shift of pulse and static and dynamic water penetration.

The system contained a cavity volume to vent area ratio of $664 \text{ m}^3/\text{m}^2$ (Upper Panels) & $680 \text{ m}^3/\text{m}^2$ (Lower Panel) and used two $\text{Ø}9.5 \text{ mm}$ drain/vent holes per upper panel and four $\text{Ø}9.5 \text{ mm}$ drain/vent holes on the lower panel.

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

6.0 REPORT REVISION HISTORY

<u>Date:</u>	<u>Revision:</u>	<u>Comments:</u>
2015-02-07	Original Document	N/A

Tested by:

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APPENDIX A

Specimen Bill of Materials and Drawings

(4 Pages)

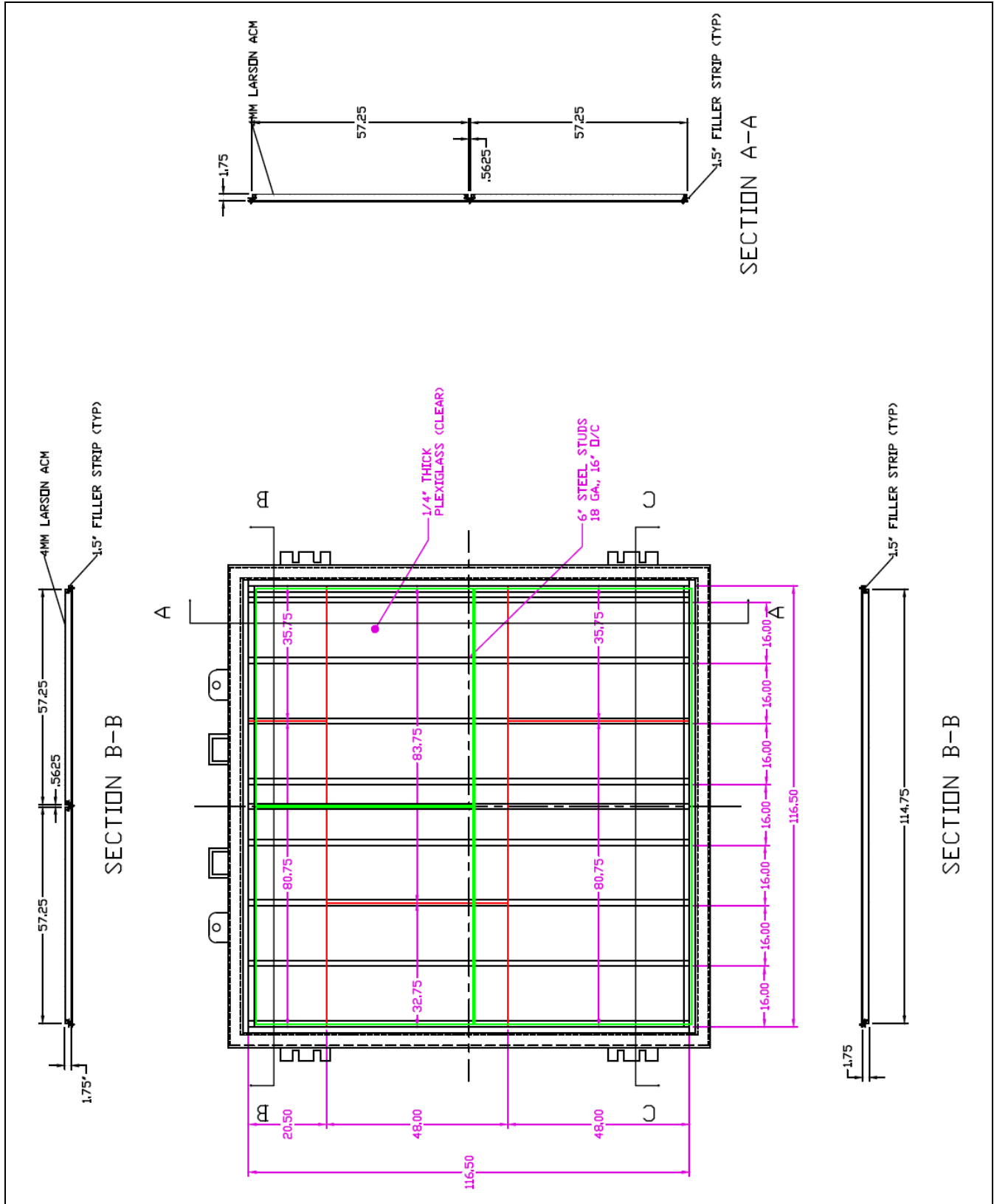
Bill of Materials (Provided by Carter Fabricating):

- 2 - "EVO" RIVETLESS PANELS (PANEL SIZE IS 57.25" X 57.25")
- 1 - "EVO" RIVETLESS PANEL (PANEL SIZE IS 57.25" X 115.25")

- EACH PANEL CONSISTED OF 4MM LARSON ACM
- # 8 SELF DRILLING SCREWS ON 16" MIN CENTERS USED TO FASTEN THE PERIMETER PANEL EXTRUSION TO THE 4MM LARSON ACM
- WEEP HOLES @ .375" DIAMETER ON 20" CENTERS WITH FOAM BUG SCREEN BACKING
- CUSTOM DIE PERIMETER EXTRUSION AROUND THE ENTIRE PANEL PERIMETER (6061 T6 ALUMINUM CUSTOM PROFILE)
- 3" MID-CLIPS (MOUNTING CLIPS 6061 T6 ALUMINUM CUSTOM DIE PROFILE) EACH SCREWED TO THE PERIMETER EXTRUSION ON 16 INCH CENTERS WITH 2 #6 X .375" SCREWS. AND THEN AFFIXED TO THE SUBSTRATE OR Z-GIRT (18 GA G-90 GALVANIZED METAL) USING .25" SELF DRILLING PAN HEAD SCREWS
- 1.5" WIDE FILLER STRIP MATERIAL (4MM LARSON ACM) USED TO COVER THE PANEL JOINTS, CUT AS REQUIRED.
- EXTRUDED ALUMINUM STARTER STRIP (6061 T6 ALUMINUM CUSTOM PROFILE) AT THE BASE AND ONE SIDE OF THE PANEL WALL.

Note: The ACM used in the "Rivetless Wall Panel System" by Carter Fabricating, is "larson by ALUCOIL" manufactured in Manning, South Carolina, USA. The larson® Aluminum Composite Material (ACM) utilized is a fully tested and certified, architectural wall cladding material available in both polyethylene (PE) and fire retardant (FR) core panels.

Test Specimen Details (Provided by Carter Fabricating):



Test Specimen Details (Provided by Carter Fabricating):

Specimen detail drawings had been removed from this page to protect proprietary information. Please contact Carter Fabricating Inc. for information pertaining to system details and assembly.

APPENDIX B

Specimen Construction Photographs

(2 Pages)



Figure B1 – Backup Wall Framing and Plexiglas Installation



Figure B2 – Lower Panel Installation



Figure B3 – Upper Panel Installation



Figure B4 – Completed Wall

APPENDIX C

AAMA 501.1-05 Photographs (*Dynamic Pressure Test*)

(2 Pages)



Figure C1 - Specimen Set up in front of viewing chamber



Figure C2 - Spray rack Set up for water penetration



Figure C3 - Wind Machine setup to simulate Dynamic Pressure (AAMA 501.1-05)