

ASTM E 1592 TEST REPORT

Rendered to:

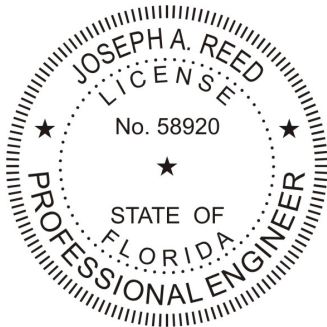
FREY-MOSS STRUCTURES, INC.

SERIES/MODEL: *ArmorPanel*

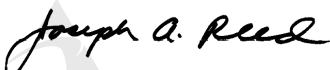
PRODUCT: Steel Roof Deck Panels

This report contains in its entirety:

Cover Page: 1 Page
Report Body: 5 Pages
Tables and Charts: 3 Pages
Photographs: 4 Pages
Drawing: 1 Page
Sketch: 1 Page



Date: 2006.08.03 08:58:22 -04'00'



Digitally Signed by: Joseph A. Reed

Report No: 63810.01-122-18
Test Dates: 05/18/06
Through: 07/20/06
Report Date: 08/02/06
Expiration Date: 07/20/10



ASTM E 1592 TEST REPORT

Rendered to:

FREY-MOSS STRUCTURES, INC.
1801 Rockdale Industrial Blvd.
Conyers, Georgia 30012

Report No: 63810.01-122-44
Test Dates: 05/18/06
Through: 07/20/06
Report Date: 08/02/06
Expiration Date: 07/20/10

Project Summary: Architectural Testing, Inc. (ATI) was contracted by Frey-Moss Structures, Inc. to perform testing on *ArmorPanel* steel roof deck panels. The test specimen area, measuring 20' 0" x 6' 8", was tested in accordance with ASTM E 1592-01, *Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference*. The purpose of this test is to evaluate the comparative resistance of roof assemblies to negative pressures. This test simulates the effects of wind gusts by use of constant interior pressures. Reference Charts #1 to #3 for negative pressures and deflections, Photo No.1 for test equipment and Photo No. 2 for transducer locations.

Test Specimen Description:

Series/Model: *ArmorPanel* Roofing Panels

Roof Panel: The roof deck system consisted of five (5) full width panels. The corrugated galvanized steel panels measured 0.036" (20 gauge) thick, 16" wide, and 120" long. The sides of the panel at the clips utilized a 3" high, 90° upright bend and continued with a 90° lateral bend that measured 1" wide. The side of the panel that overlaps the adjacent panel utilized a 1-1/2" high, 90° upright bend, then a 1/2" wide, 90° lateral bend, and continued with a 3/8" long, 90° downward bend (see attached drawing). The first row of deck clips were fastened at each purlin and the first deck panel was seated on top (reference Photo No.3). The deck panels were secured with 22 gauge steel deck clips that measured 1-1/2" on the bottom at the screw locations, and then went upright 90°, 3" high. The clips were then bent another 90° horizontally forming the top of the clip and measured 1". The final bend was a 90° downward bend that measured 3/4" (see attached drawing). The second row of deck clips was installed and the next panel was put in place and overlapped the previous panel. The last panel used the same installation as the first panel along the perimeter of the test frame. On Specimen #1 and Specimen #2, the deck clips were spaced 48" on center. Specimen #3 represented a corner installation and the deck clips were spaced 24" on center. The roof deck system utilized an end cap which extended the entire width of the roof system and measured 2" on the bottom and then went upright 90°, 3" high. The end cap was then bent another 90° horizontally forming the top of the end cap and measured 1". The end cap was fastened to the test frame with #12 x 1-1/2" self-tapping, 5/16" hex head screws spaced at 8" on center. The other end of the roof deck system had an open end condition.

Test Specimen Description: (Continued)

Fasteners: The 0.036" thick corrugated galvanized steel deck was fastened using the steel clips with #12 x 1-1/2" self-tapping, 5/16" hexhead screws and self-sealing washers, 48" on center at the perimeter and at each purlin, and used #10 x 3/4" self-tapping, 5/16" hex-head screws, 24" on center at the steel decking overlap for the field condition (see attached drawing). To simulate a corner condition the steel deck was fastened using the steel clips with #12 x 1-1/2" self-tapping, 5/16" hex head screws and self-sealing washers, 24" on center at the perimeter and at each purlin, and used #10 x 3/4" self-tapping, 5/16" hex-head screws, 24" on center at the steel decking overlap for the corner condition. The ends of the panels which were overlapped by the end cap were fastened with #10 x 3/4" self-tapping, 5/16" hex-head screws.

Test Frame Construction: The test frame utilized six C5x6.7 steel purlins that were welded to the peripheral support to represent a field installation. The purlins were spaced at 48" on center. For Specimen #3, the test frame utilized eleven steel purlins that were welded to the peripheral support to represent a corner installation (reference Photo No. 4).

Peripheral Support: The test apparatus frame was fabricated from C5x6.7 steel channels and measured 7' 0" wide by 20' 0" long by 6.7" deep.

A loose fitting pleated 4-mil plastic film was utilized to assist in obtaining uniform pressure on the metal roof system.

Test Results: Three assemblies were tested per ASTM E 1592-01. The following summarizes the ultimate test loads and the observations made during each test. Deflection measurements are included within tables attached to this report. Reference attached Photo No. 2 for location of deflection measurement devices.

Test Specimen #1:

Simulated Field Condition – Achieved 104 psf

Failure occurred on approach to 120 psf when panels #4 and #5 released from clip (reference Photo No. 5). Reference Table #1 for deflection measurements.

Test Specimen #2:

Simulated Field Condition – Achieved 95 psf

Failure occurred on approach to 104 psf when panels #4 and #5 released from clip (reference Photo No. 6). Reference Table #2 for deflection measurements.

Test Specimen #3:

Simulated Corner Condition – Achieved 119 psf

Failure occurred on approach to 134 psf when panels #1 and #2 released from clip (reference Photo No. 7). Reference Table #3 for deflection measurements.

Discussion of Results

The average ultimate load for the field condition is 112.0 psf. A factor of safety of 2.0 is required making the potential design load 56.0 psf. Review of the load v. deflection charts in Appendix A confirms that the roof panel is behaving in a linear elastic fashion at 56.0 psf and the average purlin deflection is less than $\ell/240$ inches. Thus, 56.0 psf would be the allowable design pressure for the field condition.

The ultimate load for the corner condition is 130.0 psf. A factor of safety of 2.0 is required making the potential design load 65.0 psf. Review of the load v. deflection chart in Appendix A confirms that the roof panel is behaving in a linear elastic fashion at 65.0 psf and the purlin deflection is less than $\ell/240$ inches. Thus, 65.0 psf would be the allowable design pressure for the corner condition.

Witnesses: The following representatives witnessed all or part of the testing.

<u>Name</u>	<u>Company</u>
Jeramie D. Grabosch	Architectural Testing, Inc.
Scott Gill	Architectural Testing, Inc.
Ben Eveler	Architectural Testing, Inc.
Dwayne Spangler	Architectural Testing, Inc.
Steve Eveler	Architectural Testing, Inc.
Joseph A. Reed, P.E.	Architectural Testing, Inc.
Travis A. Hoover	Architectural Testing, Inc.

Detailed drawings, representative samples of the test specimen, and a copy of this report will be retained by Architectural Testing, Inc. for a period of four years from the original test date. The above results were secured by using the designated test methods and they indicate compliance with the performance requirements of the above referenced specification. This report does not constitute certification of this product which may only be granted by the certification program administrator. This report may not be reproduced, except in full, without the approval of Architectural Testing, Inc.

For ARCHITECTURAL TESTING, INC.



Digitally Signed by: Travis Hoover

Travis A. Hoover
Project Engineer



Digitally Signed by: Joseph A. Reed

Joseph A. Reed, P.E.
Director - Engineering and Product Testing

TAH:tah/cmd

Attachments (pages):

- Appendix-A: Tables and Charts (3)
- Appendix-B: Photographs (4)
- Appendix-C: Drawing (1)
- Appendix-D: Sketch (1)

Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	08/02/06	N/A	Original report issue



APPENDIX A

Tables and Charts

Table 1 Specimen #1 – Field Condition

Load (psf)	Displacement (inches)					
	#1	#2	#3	#4	#5	#6
35	0.11	0.08	0.05	0.49	0.76	0.36
7.64	0.04	0.02	0.01	0.03	0.02	0.04
50	0.21	0.15	0.09	0.72	1.46	0.68
7.64	0.11	0.11	0.12	0.11	0.09	0.15
65	0.21	0.10	0.04	1.22	2.53	0.66
7.64	0.18	0.18	0.17	0.18	0.33	0.21
80	0.33	0.28	0.24	3.36	2.83	2.80
7.64	0.25	0.26	0.24	0.90	0.46	0.53
95	0.44	0.45	0.50	4.80	1.61	4.13
7.64	0.34	0.34	0.35	1.55	0.11	1.20
104	0.52	0.51	0.53	5.37	2.83	4.73
7.64	0.42	0.41	0.45	1.84	0.17	1.65
120	Ultimate Test Load – Failure occurred when panels #4 and #5 released from clip.					

- Notes:**
1. All applied loads were maintained for 60 seconds
 2. 7.64 psf counteracts the roof weight and represents the zero load condition
 3. See ATI Sketch #1 for indicator locations

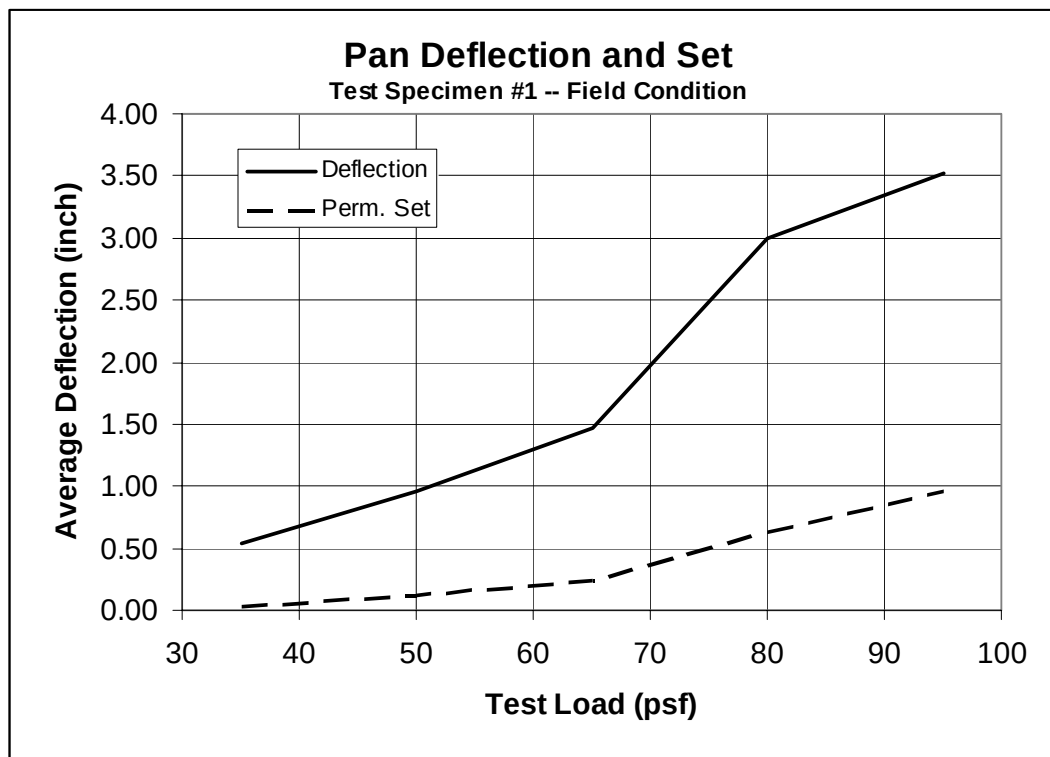


Chart 1 Load Deflection Summary for Specimen #1

Table 2 Specimen #2 – Field Condition

Load (psf)	Displacement (inches)					
	#1	#2	#3	#4	#5	#6
35	0.39	0.30	0.13	0.63	1.26	0.69
7.64	0.32	0.20	0.13	0.25	0.34	0.28
50	0.46	0.35	0.19	1.02	1.75	0.95
7.64	0.38	0.34	0.21	0.41	0.39	0.43
65	0.51	0.38	0.27	1.56	2.43	1.71
7.64	0.43	0.43	0.29	0.48	0.47	0.54
80	0.54	0.41	0.28	1.33	3.26	2.46
7.64	0.52	0.42	0.35	0.50	0.73	0.61
95	0.63	0.14	0.15	3.19	3.59	0.39
7.64	0.13	0.18	0.08	0.68	0.72	0.18
104	Ultimate Test Load – Failure occurred when panels #4 and #5 released from clip.					

- Notes:**
1. All applied loads were maintained for 60 seconds
 2. 7.64 psf counteracts the roof weight and represents the zero load condition
 3. See ATI Sketch #1 for indicator locations

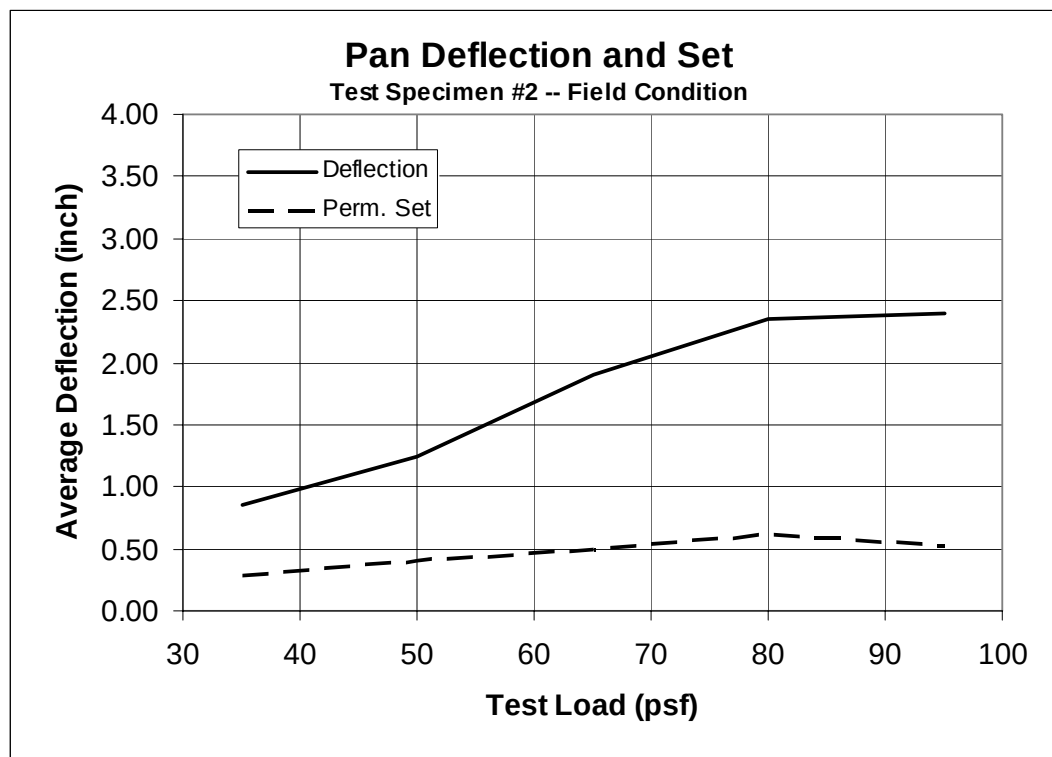


Chart 1 Load Deflection Summary for Specimen #2

Table 3 Specimen #3 – Corner Condition

Load (psf)	Displacement (inches)					
	#1	#2	#3	#4	#5	#6
35	0.18	0.10	0.12	0.36	0.63	0.23
7.64	<0.01	<0.01	<0.01	0.06	0.14	0.23
50	<0.01	0.05	0.03	0.30	0.85	0.50
7.64	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
65	0.03	0.03	0.02	1.22	1.79	0.42
7.64	0.02	0.02	0.01	0.02	0.03	0.02
80	0.01	0.03	0.05	1.89	1.39	0.44
7.64	<0.01	0.01	0.02	0.01	0.01	0.01
95	0.07	0.16	0.15	2.42	0.85	0.62
7.64	<0.01	0.05	0.03	0.04	0.10	0.08
98	0.05	0.13	0.10	2.38	1.97	1.31
7.64	0.01	0.04	0.04	0.05	0.11	0.08
104	0.03	0.10	0.12	2.48	2.03	1.21
119	0.09	0.17	0.14	2.84	2.24	1.96
7.64	0.03	0.09	0.08	0.10	0.15	0.16
130	Ultimate Test Load – Failure occurred when panels #1 and #2 released from clip.					

- Notes:**
1. All applied loads were maintained for 60 seconds
 2. 7.64 psf counteracts the roof weight and represents the zero load condition
 3. See ATI Sketch #1 for indicator locations

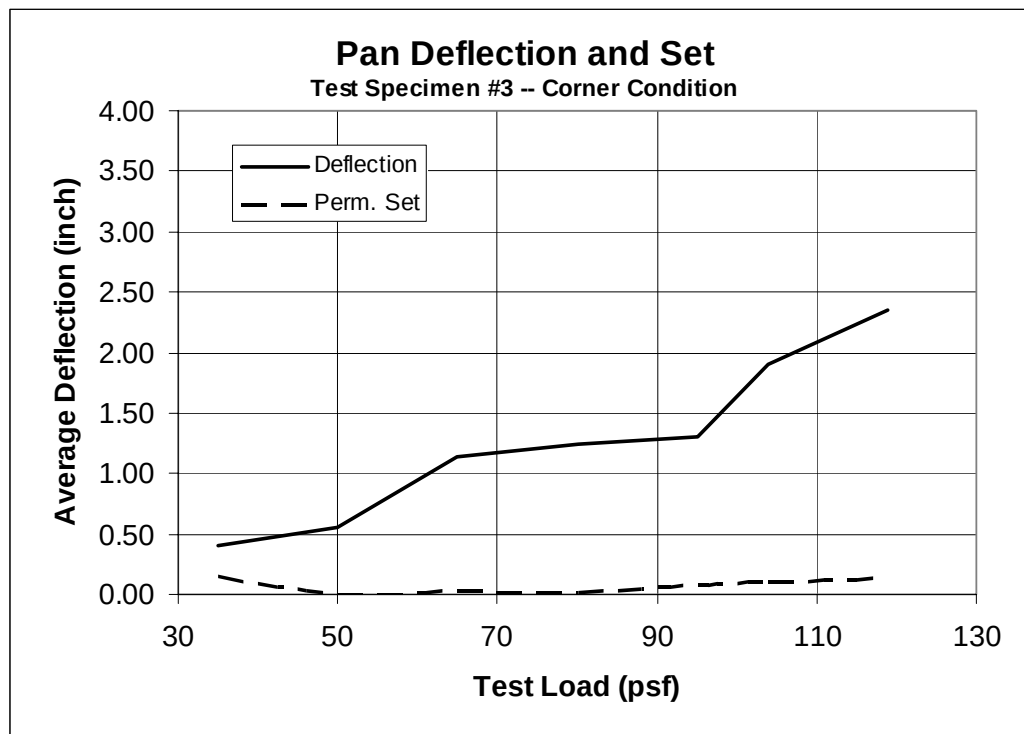


Chart 1 Load Deflection Summary for Specimen #3

APPENDIX B

Photographs



Photo No. 1
ASTM E 1592 Test Chamber

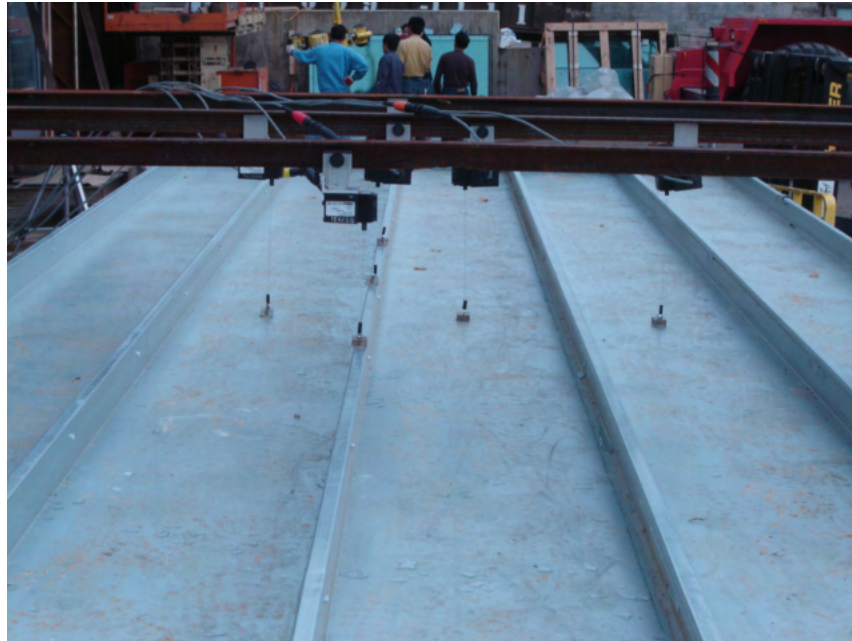


Photo No. 2
Transducer Locations

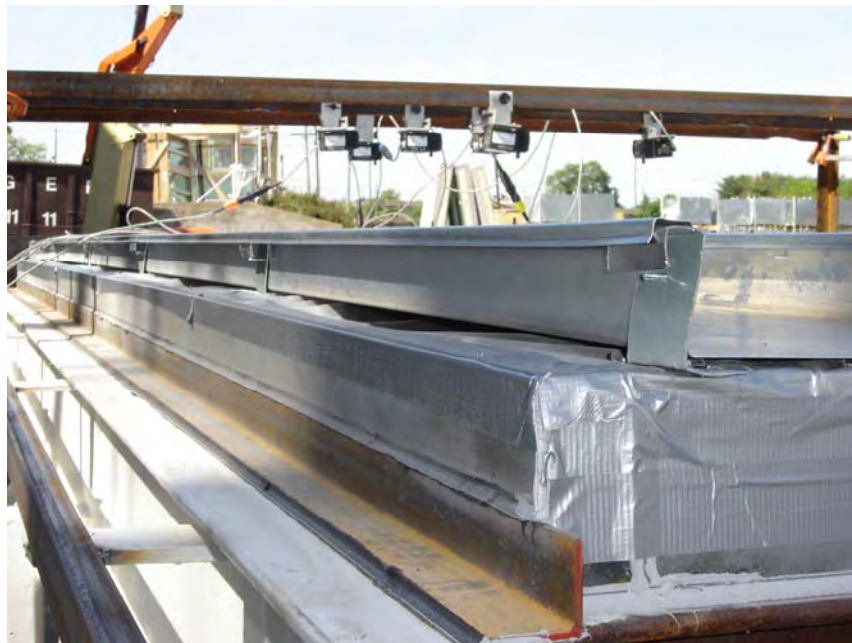


Photo No. 3
Installation of First Panel – Field Condition



Photo No. 4
Corner Condition – Purlin Spacing

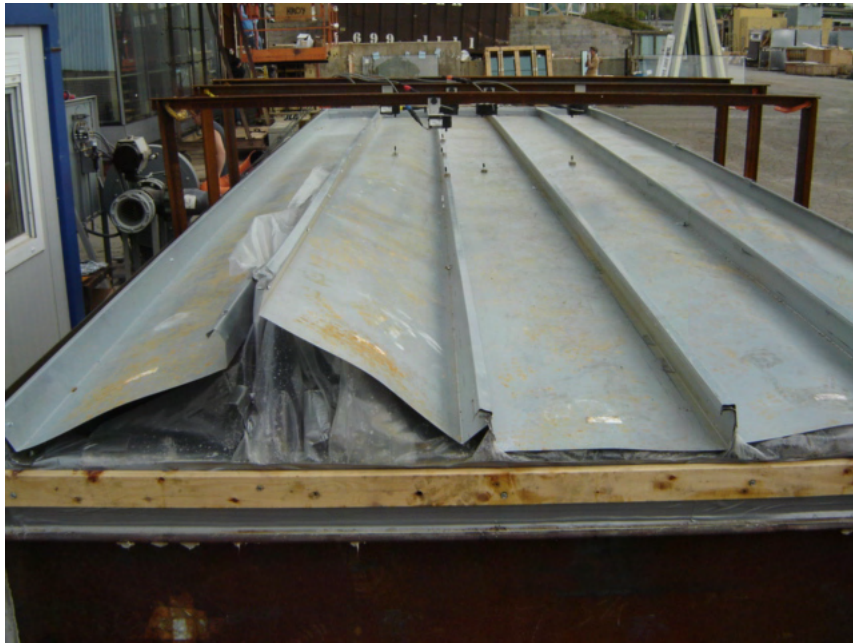


Photo No. 5
Test Specimen #1 – Failure Mode



Photo No. 6
Test Specimen #2 – Failure Mode

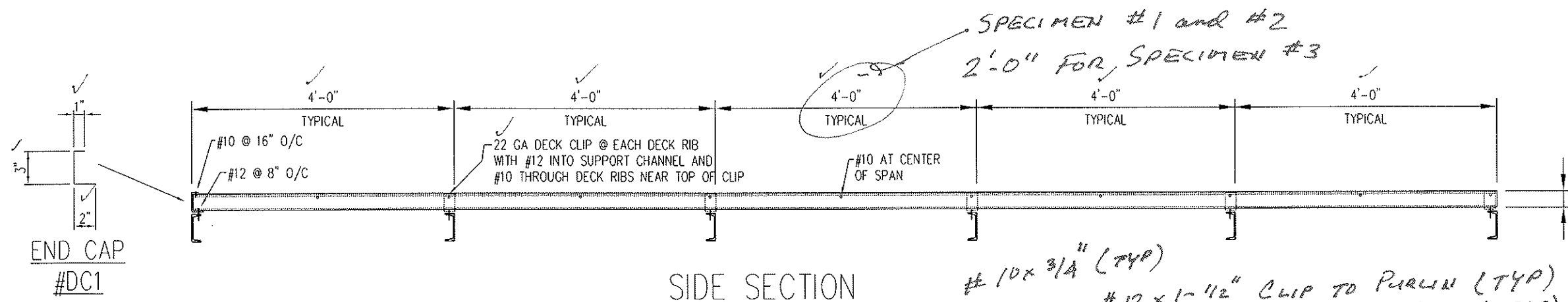


Photo No. 7
Test Specimen #3 – Failure Mode



APPENDIX C

Drawing

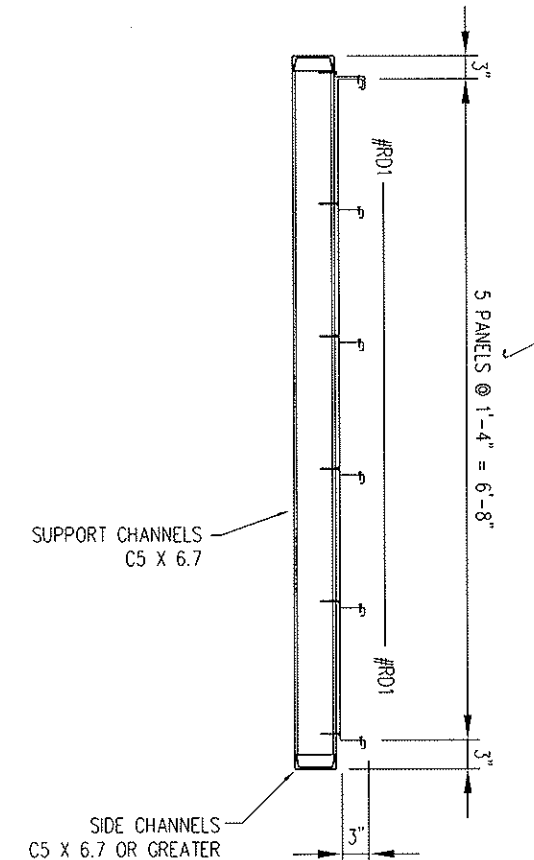
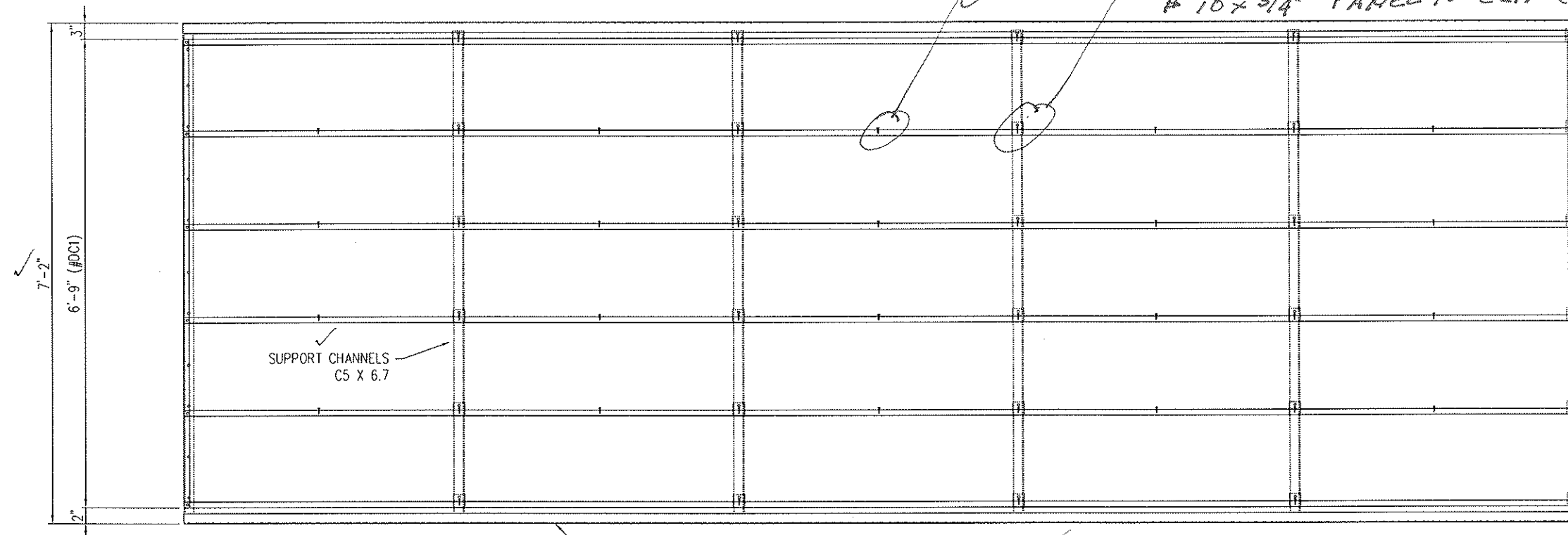


Architectural Testing

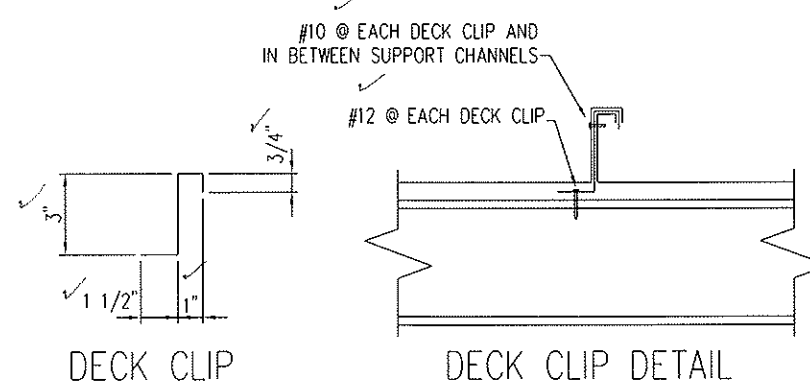
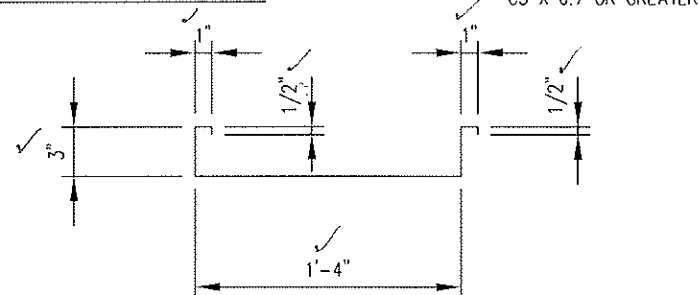
Test sample: these details used:

Report# 63810.01

Date 8/2/06 Test TK



ROOF PANELS



20 GA. - ASTM 1008 - $F_y = 50$ ksi

GALVANIZED FINISH

ASSEMBLY INSTRUCTIONS

- 1) INSTALL #DC1 FIRST 3" FROM ONE SIDE AND 2" FROM OTHER SIDE AS SHOWN.
- 2) ALIGN DECK AS SHOWN FOR FIRST TEST WITH 3" ON EACH SIDE OF DECK AS SHOWN. FOR THE SECOND AND THIRD TEST OFFSET DECK 1/2" EACH WAY TO AVOID USING THE SAME HOLES. (#DC1 SHOULD SHIFT WITH DECK)
- 3) START DECK BY INSTALLING PANEL AT THE BOTTOM OF THE PAGE FIRST AND WORKING UPWARD. ON THE STARTER PANEL PUT FIRST ROW OF CLIPS DOWN FIRST AT 3" FROM EDGE OF STEEL. LAY DOWN STARTER DECK AND THEN INSTALL CLIPS ON TOP SIDE OF STARTER DECK. INSTALL SECOND ROW OF CLIPS AND THEN LAY SECOND DECK SHEET. CONTINUE WITH THE BALANCE OF THE PANELS.
- 4) INSTALL ALL OTHER FASTENERS AS SHOWN.

DRAWING E1 - ROOF PANELS

FREY-MOSS STRUCTURES

ARMORPANEL

ROOF PANELS

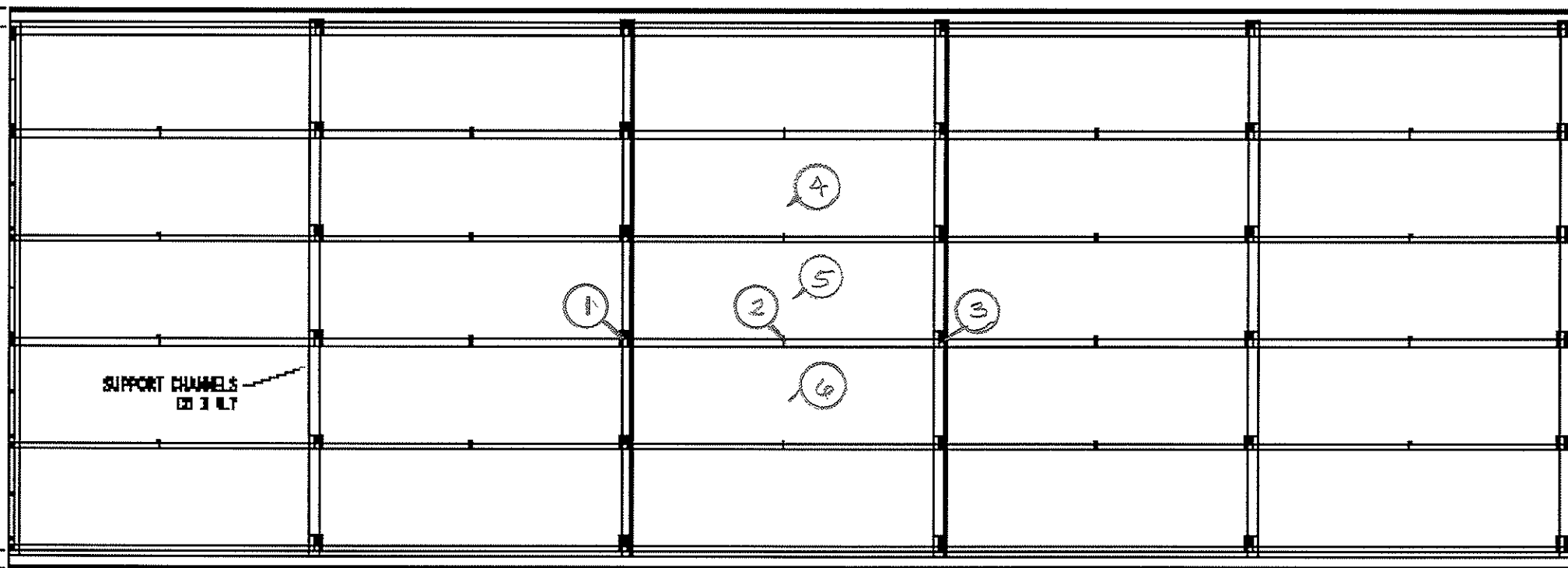
JOB NO: FLORIDA

DATE: 4-19-06

DWG BY: A.R.

APPENDIX D

Sketch



SKETCH #1 INDICATOR LOCATIONS