

**GUARDRAIL SYSTEM PERFORMANCE
TEST REPORT**

Rendered to:

CUSTOM DECORATIVE MOULDING

PRODUCT: *Classic* 8-ft PVC Guardrail System

Report No: 01-42007.01
Report Date: 07/14/03
Expiration Date: 06/24/06



Architectural Testing

GUARDRAIL SYSTEM PERFORMANCE TEST REPORT

Rendered to:

CUSTOM DECORATIVE MOULDING
12136 Sussex Highway
Greenwood, Delaware 19950

Report No.: 01-42007.01
Test Dates: 06/21/02
Through: 06/24/02
Report Date: 07/14/03
Expiration Date: 06/24/06

Product: *Classic* 8-ft. PVC Guardrail System

Project Summary: Architectural Testing, Inc. (ATI) was contracted by Custom Decorative Moulding to conduct structural performance tests on their *Classic* PVC guardrail system. The system was evaluated for the design load requirements of the following building codes and standards:

IBC-2000 / ICC - *International Code Council*

IRC-2000 - *International Residential Code for One- and Two-Family Dwellings*

BOCA-1999 - *Building Officials and Code Administrators (Reference ASCE 7-95)*

ASCE 7-95 - *American Society of Civil Engineers - Minimum Design Loads for Buildings and Other Structures.*

IOTDC-1998 - *International One- and Two-Family Dwelling Code*

SBC-1999 / SBCCI - *Southern Building Code Conference International*

All tests performed are to evaluate structural performance of the railing assembly to carry and transfer imposed loads to the supports (posts). The test specimen evaluated includes the pickets, rails, rail brackets and attachment to the post. The support posts are not a tested component and are included in the test specimen only to facilitate anchorage of the rail brackets.

Test Specimen (Railing Assembly) Description: The railing measured 40 inches high overall bottom rail to top rail and consisted of a reinforced top rail, a bottom rail and spaced pickets which insert into cutouts in the top and bottom rails providing 3-3/4" clear between pickets. The rails were attached to common 4 x 4 pressure treated Southern Pine posts with molded PVC plastic brackets. The brackets attached to a PVC plastic retainer clip that was secured to the post with two (2) #12 x 1-1/2" round head wood screws. A modification was made for Test #5 in which a #8 x 3/4" self-tapping sheet metal screw was used for attachment of the bottom rail to the bottom rail bracket (refer to Photo No. 5 in Appendix B). A modification was made for Test #6 in which a #8 x 3/4" self-tapping sheet metal screw was used for attachment of the top rail to the top rail bracket (similar to Photo No. 5 in Appendix B). The pickets were a square PVC tube that measured 1-1/4" x 1-1/4". Reference drawings and photographs in Appendices A and B for additional detail.

130 Derry Court
York, PA 17402-9405
phone: 717.764.7700
fax: 717.764.4129
www.archtest.com

Equipment: Railing assemblies are tested in a self-contained structural frame designed to accommodate anchorage of the rail assembly and application of the required test loads. The specimen is loaded using an electric winch mounted to a rigid steel test frame. High strength cables, nylon lifting straps and load distribution beams are used to impose test loads on the specimen. Applied load is measured using an electronic load cell located in-line within the loading system. Deflections are measured to the nearest 0.01" using electronic linear transducers.

Set-Up: All railing assemblies were installed and tested as a single railing section by directly securing the posts into a rigid steel test frame. The test fixture rigidly restrains the posts from deflecting. Transducers mounted to an independent reference frame are located to record movement of reference points on the railing system components (ends and mid-point) to determine net component deflections. Uniform distributed loading conditions with interior support (i.e. SBC top rail loading) are simulated with 1/4-point loading. See photos for individual test setups.

Test Procedure: The test specimen is inspected prior to testing to verify size and general condition of the materials, assembly and installation. Any potentially compromising defects observed are noted prior to the load test. The assembly is preloaded up to a level not exceeding design load. After pre-loading, all load is released and any necessary fixture adjustments are made. An initial load, not exceeding 20% of design load, is applied and initial deflections recorded or transducers zeroed. Loads are then applied at a steady uniform rate stopping at 20% design load increments to record deflections. The load/deflection procedure continues until reaching 2.0 times design load within a time period of 5-10 minutes. At 2.0 times design load, the load is released. After allowing a minimum period of one minute for stabilization, load is reapplied to the initial load used at the start of the load/deflection procedure and deflections are recorded and used to analyze recovery. For tests that require ultimate loads greater than 2.0 times design load, loading is reapplied and increased at a steady uniform rate until failure occurs or the required ultimate load is reached. The testing time is continually recorded from the application of initial test load until the maximum test load is reached.

Test Results: The following tests were performed on the rail assemblies for the design load requirements of each code as referenced. Rail and picket test results are mid-point deflections for the given test load. Deflection and permanent set are component deflections relative to their end-points. They are not overall system displacement. All loads are horizontal except the SBC top rail design load (see results). All displacement measurements are horizontal. Deflection analysis uses linear regression through the linear range of the load/deflection data. The test results apply only to the components tested, which include the top rail, bottom rail, rail brackets and pickets. Posts are not a tested component and are included in the test setup only to facilitate the rail bracket anchorage.

Test #1 - Specimen #1 Test Date: 06/21/02

IBC and BOCA - 50# / 1 sq. ft. In-Fill @ Center (Three Pickets)

Load Level ¹	Test Load (lbs)	Test Data - Deflection (inches)				Deflection Analysis	
		Top-1	Mid-2	Bot-3	Net	y = mx	Deflection
0.0	0	-	-	-	-	0.00	0.00
0.6	30	0.00	0.00	0.00	0.00	0.22	0.25
0.8	40	0.03	0.17	0.17	0.07	0.30	0.32
1.0	50	0.10	0.45	0.49	0.16	0.37	0.41
1.2	60	0.15	0.65	0.71	0.22	0.44	0.47
1.4	70	0.20	0.82	0.91	0.27	0.52	0.52
1.6	80	0.28	1.08	1.20	0.34	0.59	0.59
1.8	90	0.33	1.27	1.40	0.40	0.66	0.66
2.0	100	0.41	1.52	1.65	0.49	0.74	0.74
0.1	30	-0.04	-0.09	-0.15	0.01	98% Recovery	
2.5	130	Maximum Test Load - <i>Sustained without failure.</i>					

¹ Load level represents % of design load.

Test Results: (Continued)

Test #2 - Specimen #1 Test Date: 06/24/02
IBC, BOCA and SBC - 200# Concentrated Load @ Midspan / Top Rail

Load Level ¹	Test Load (lbs)	Test Data - Deflection (inches)				Deflection Analysis	
		End-1	Mid-2	End-3	Net	y = mx	Deflection
0.0	0	-	-	-	-	0.00	0.00
0.2	50	0.00	0.00	0.00	0.00	0.32	0.17
0.4	80	0.02	0.35	0.01	0.33	0.52	0.50
0.6	120	0.06	0.67	0.06	0.61	0.78	0.78
0.8	160	0.09	0.95	0.10	0.86	1.04	1.03
1.0	200	0.13	1.27	0.15	1.13	1.29	1.30
1.2	240	0.17	1.56	0.19	1.38	1.55	1.55
1.4	280	0.21	1.87	0.24	1.64	1.81	1.81
1.6	325	0.27	2.29	0.31	2.00	2.10	2.17
1.8	360	0.31	2.54	0.34	2.22	2.33	2.39
2.0	400	0.38	3.03	0.40	2.64	2.59	2.81
0.1	50	0.06	0.29	0.02	0.24	91% Recovery	
2.5	502	Maximum Test Load - Sustained without failure.					

¹ Load level represents % of design load.

Test #3 - Specimen #1 Test Date: 06/24/02
IBC, BOCA and SBC - 200 lb Concentrated Load @ Ends / Top Rail

Load Level ¹	Test Load (lbs)	Displacement (inches)			
		Test Data		Adjusted	
		End-1	End-2	End-1	End-2
0.0	0	-	-	0.00	0.00
0.1	50	0.00	0.00	0.04	0.02
0.2	80	0.00	0.00	0.04	0.02
0.4	170	0.06	0.08	0.11	0.10
0.6	260	0.10	0.12	0.14	0.15
0.8	320	0.14	0.18	0.18	0.20
1.0	420	0.18	0.24	0.23	0.26
1.2	500	0.25	0.29	0.29	0.31
1.4	560	0.27	0.32	0.32	0.34
1.6	640	0.32	0.37	0.36	0.39
1.8	720	0.37	0.41	0.41	0.43
2.0	800	0.42	0.47	0.46	0.50
0.1	50	0.04 91%	0.03 94%	Permanent Set Recovery	
2.5	1017	Maximum Test Load - Sustained without failure.			

¹ Load level represents % of design load.

Test Results: (Continued)

Test #4 - Specimen #1 Test Date: 06/24/02
SBC - (50 Horizontal + 100 Vertical) plf Uniform Load ¹ on Top Rail

Load Level ²	Test Load (lbs)	Test Data - Deflection (inches)				Deflection Analysis	
		End-1	Mid-2	End-3	Net	y = mx	Deflection
0.0	0	-	-	-	-	0.00	0.00
0.1	50	0.00	0.00	0.00	0.00	0.07	0.09
0.2	180	0.02	0.20	0.00	0.19	0.25	0.27
0.4	380	0.12	0.53	0.08	0.43	0.52	0.52
0.6	560	0.20	0.81	0.14	0.65	0.77	0.73
0.8	730	0.26	1.12	0.20	0.89	1.00	0.97
1.0	896	0.34	1.48	0.26	1.18	1.23	1.26
1.2	1090	0.44	1.95	0.35	1.56	1.49	1.64
1.4	1260	0.54	2.46	0.45	1.97	1.72	2.05
1.6	1440	0.67	3.13	0.58	2.51	1.97	2.60
1.8	1618	0.80	3.84	0.73	3.08	2.21	3.16
2.0	1798	1.03	4.76	0.96	3.76	2.46	3.85
0.1	50	0.30	1.21	0.31	0.90	76% Recovery	
2.0	1798	Maximum Test Load - Sustained without failure.					

¹ Tested with resultant load = 112 plf. @ -63.4° from horizontal. Uniform load simulated with equivalent 1/4-point loads.

² Load level represents % of design load.

Test Results: (Continued)

Test #5 - Specimen #2 Test Date: 06/24/02
SBC - 200# / 1 sq. ft. In-Fill @ Center (Three Pickets)

Load Level ¹	Test Load (lbs)	Test Data - Deflection (inches)				Deflection Analysis	
		Top-1	Mid-2	Bot-3	Net	y = mx	Deflection
0.0	0	-	-	-	-	0.00	0.00
0.1	25	0.00	0.00	0.00	0.00	0.18	0.16
0.2	40	0.09	0.31	0.32	0.10	0.28	0.26
0.4	80	0.36	1.21	1.28	0.39	0.57	0.55
0.6	120	0.65	2.14	2.17	0.73	0.85	0.89
0.8	160	0.84	2.71	2.65	0.96	1.13	1.12
1.0	200	1.14	3.52	3.35	1.27	1.42	1.43
1.2	240	1.39	4.18	3.89	1.55	1.70	1.71
1.4	280	1.66	4.83	4.40	1.80	1.98	1.97
1.6	320	1.96	5.57	4.97	2.12	2.27	2.28
1.8	360	2.19	6.20	5.44	2.38	2.55	2.55
2.0	405	2.45	6.93	5.97	2.71	2.87	2.87
0.1	25	0.08	0.25	0.23	0.10	96% Recovery	

¹ Load level represents % of design load.**Test #6 - Specimen #2 (w/New Top Brackets and New Rail Insert)****Test Date: 06/24/02****IBC and BOCA - 50 plf Horizontal Uniform Load ¹ on Top Rail**

Load Level ²	Test Load (lbs)	Test Data - Deflection (inches)				Deflection Analysis	
		End-1	Mid	End-2	Net	Y = mx	Deflection
0.0	0	-	-	-	-	0.00	0.00
0.1	50	0.000	0.000	0.000	0.00	0.22	0.26
0.2	80	0.022	0.148	0.030	0.12	0.35	0.38
0.4	175	0.103	0.642	0.121	0.53	0.78	0.79
0.6	255	0.180	1.054	0.193	0.87	1.13	1.12
0.8	320	0.225	1.376	0.246	1.14	1.42	1.40
1.0	420	0.305	1.893	0.330	1.58	1.86	1.83
1.2	480	0.360	2.240	0.396	1.86	2.13	2.12
1.4	560	0.439	2.705	0.480	2.25	2.48	2.50
1.6	640	0.513	3.141	0.555	2.61	2.84	2.86
1.8	720	0.606	3.612	0.636	2.99	3.19	3.25
2.0	800	0.726	4.228	0.742	3.49	3.55	3.75
0.1	50	0.130	0.570	0.106	0.45	87% Recovery	
2.4	982	Ultimate Load - Brackets disengaged. ³					

¹ Tested w/equivalent qtr-point loading.² Load level represents % of design load.³ Ultimate test load would substantiate design load for a maximum railing length of 7.5-ft.

Summary and Conclusions: Using a performance criteria of 75% recovery from 2.0 times design load and an ultimate load not less than 2.5 times design load (2.0 for SBC), the test results, in our opinion, substantiate compliance with the design load requirements of the referenced building codes within the following limitations.

Building Code	Maximum Rail Length
IBC and BOCA	7.5-ft. ² (8 ft. / One- and Two-Family Dwellings only.) ¹
SBC ²	8 ft.

¹ One- and Two-family Dwellings as defined by the referenced codes.

² Includes additional bracket-to-rail fastener referenced in Tests #5 and #6 and indicated on the attached drawings.

A copy of this report will be retained by ATI for a period of four years. This report is the exclusive property of the client so named herein and is applicable only to the sample tested. Results obtained are tested values and do not constitute an opinion or endorsement by this laboratory. This report may not be reproduced, except in full, without the written approval of Architectural Testing.

For ARCHITECTURAL TESTING, INC.



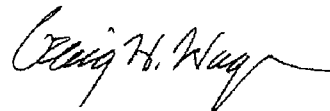
Digitally Signed by: Michael S. Ward

Michael S. Ward
Technician

MSW:msw/nlb
01-42007.01

Attachments

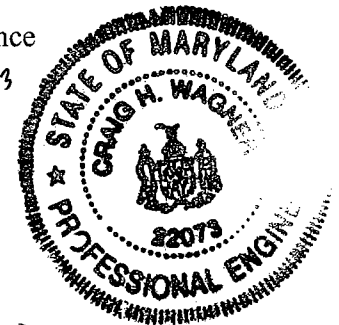
- Appendix A: Drawings (3)
- Appendix B: Photographs (3)



Digitally Signed by: Craig H. Wagner

Craig H. Wagner, P.E.
Director - Code Compliance

7/14/03



DOCUMENT CONTROL ADDENDUM #01-42007.00

Current Issue Date: 07/14/03

Report No.: 01-42007.01

Requested by: Jeff Davis, Custom Decorative Moulding

Purpose: Structural performance testing of a *Classic* 8 ft. PVC guardrail system.

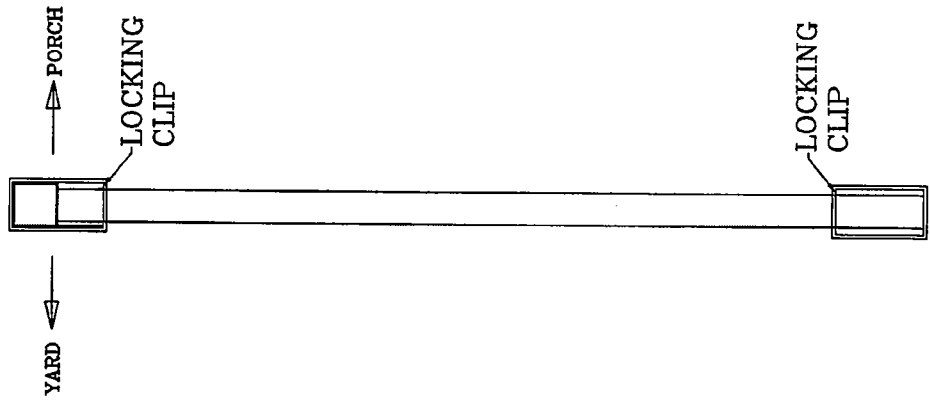
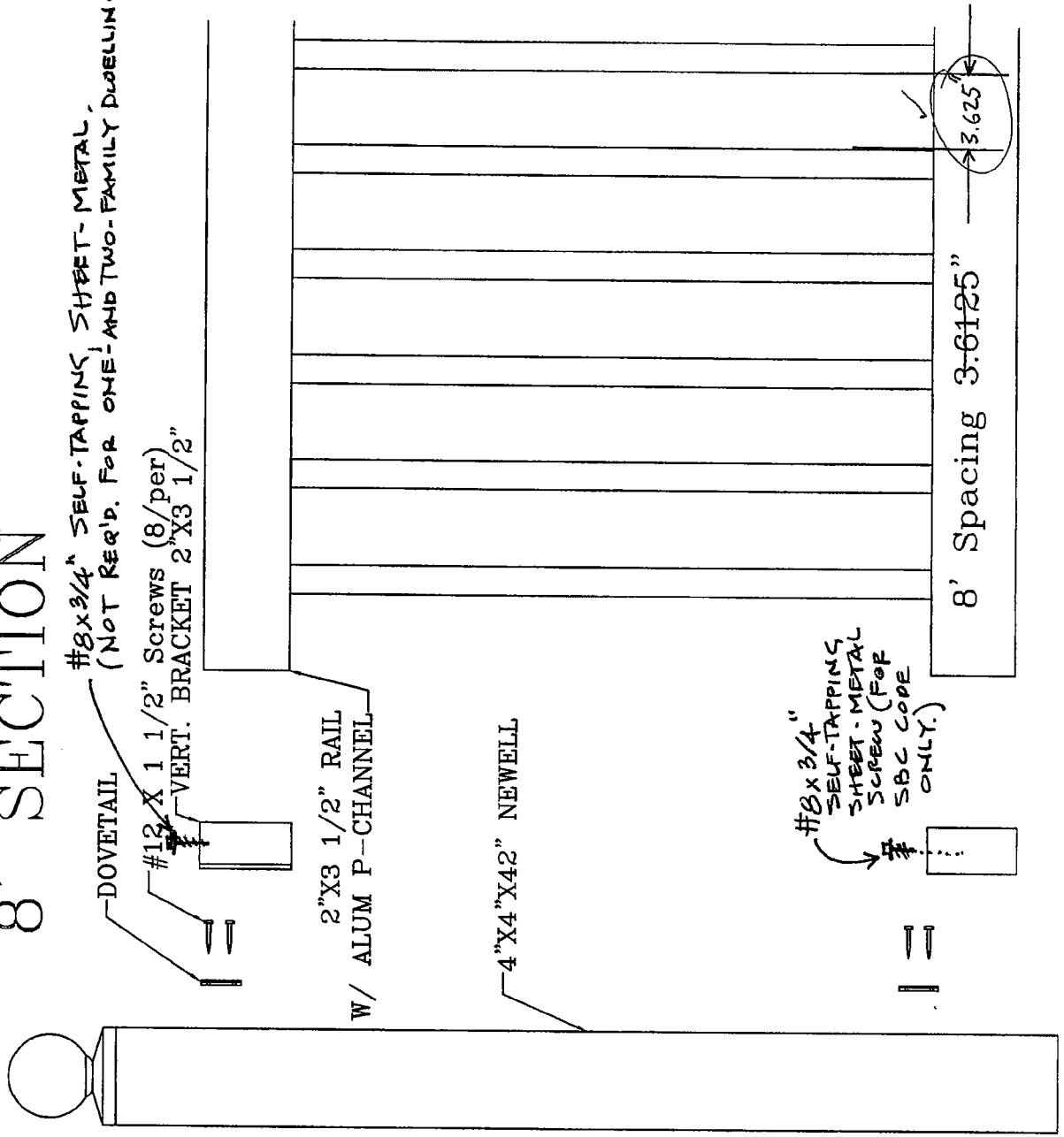
Issued Date: 07/14/03

Comments: P.E. seal required on report.

APPENDIX A

Drawings

Traditional 8' SECTION



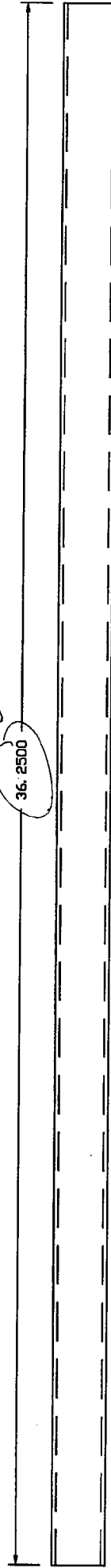
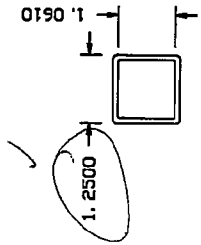


Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 01-42007.01

Date 4.29.3 Tech M. [Signature]

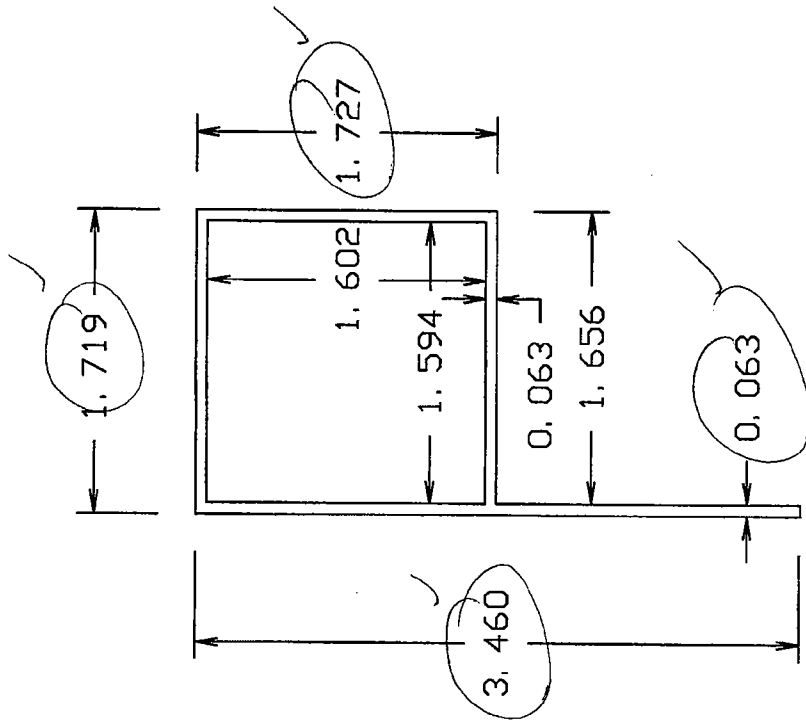




Architectural Testing

Test sample complies with these details.
Deviations are noted.

Report# 01-47007.01
Date 4.29.3 Tech MLW



APPENDIX B

Photographs



**Photo No. 1
In-Fill Test**



**Photo No. 2
Top Rail Concentrated Load Test @ Mid**

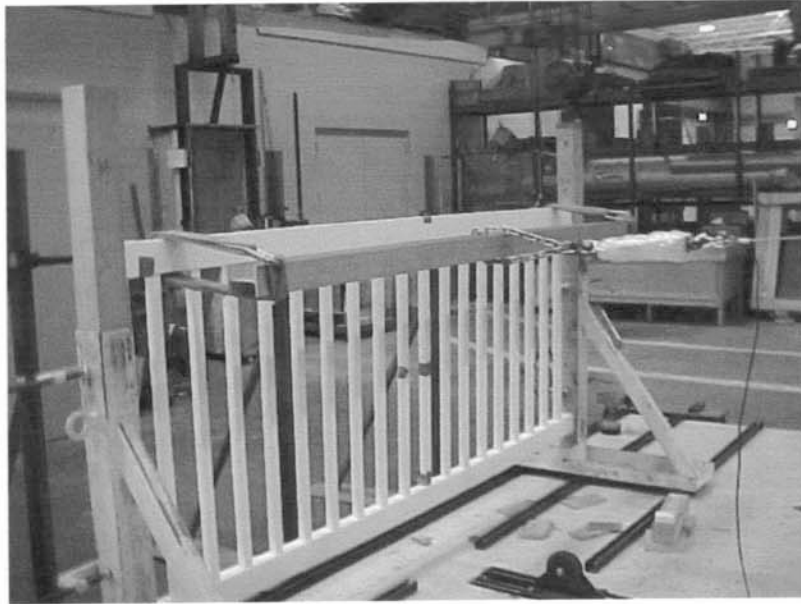


Photo No. 3
Top Rail Concentrated Load Test @ Ends

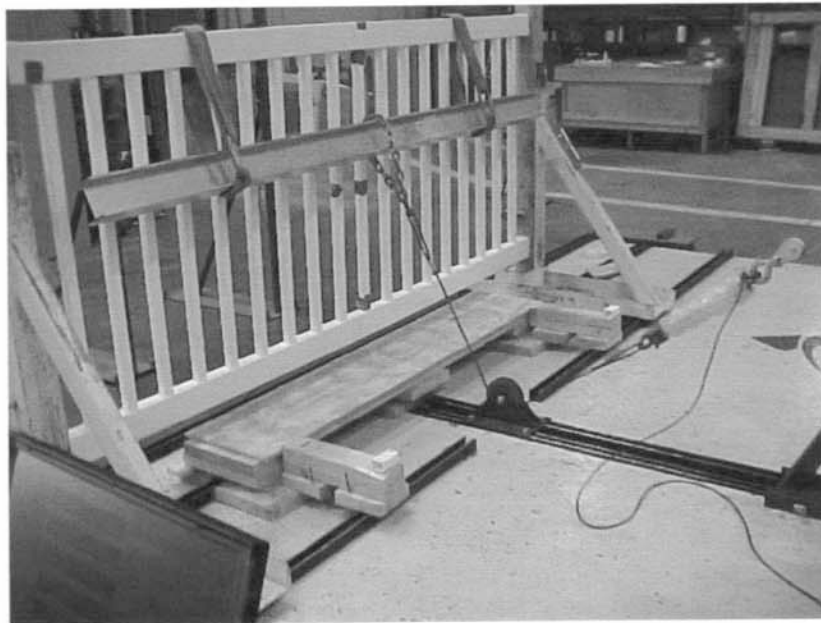


Photo No. 4
SBC Top Rail Load Test

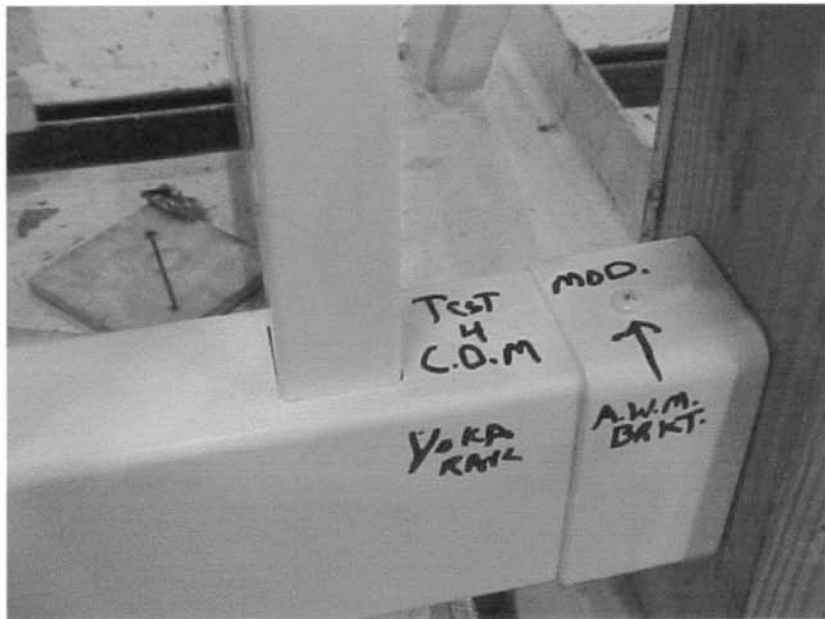


Photo No. 5
Bracket Modification in Test #5