Intertek | Architectural Testing

TEST REPORT

Rendered to:

FORTRESS RAILING PRODUCTS

For:

***Pure View* Full Glass Panel Aluminum Guardrail**

Report No.: F5648.01-119-19
Report Date: 07/19/16
Test Record Retention Date: 04/27/20

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TEST REPORT

F5648.01-119-19
July 19, 2016

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TEST REPORT

Rendered to:

FORTRESS RAILING PRODUCTS
1720 North 1st Street
Garland, Texas 75040

Report No.:	F5648.01-119-19
Test Dates:	04/06/16
Through:	04/27/16
Report Date:	07/19/16
Test Record Retention Date:	04/27/20

1.0 General Information

1.1 Product

6 ft by 42 in *Pure View* Full Glass Panel Aluminum Guardrail

1.2 Project Description

Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by Fortress Railing Products to perform structural testing on their 6 ft by 42 in *Pure View* full glass panel aluminum guardrail This report is in conjunction with Intertek-ATI report No. B7787.01-119-19 which includes structural performance test results for the *AI*^{13} structural post mounts. The purpose of the testing is performance evaluation in accordance with Sections 4.2.1 and 4.2.7 of the following criteria:

ICC-ES™ AC273 (March 1, 2008 - Editorial Revised January 2012), *Acceptance Criteria for Handrails and Guards*

ICC-ES™ AC273-08 was developed by the ICC Evaluation Service, Inc. (ICC-ES™) as acceptance criteria to evaluate compliance with the following building codes:

2012 *International Building Code*®, International Code Council

2012 International Residential Code®, International Code Council

1.3 Limitations

All tests performed were to evaluate structural performance of the railing assembly to carry and transfer imposed loads to the supports (posts). The test specimen evaluated included the glass panel, rails, rail brackets, posts, and attachment to the supporting structure. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

Testing is limited to satisfying the IRC - One- and Two-Family Dwellings requirements of ICC-ES™ AC273.

Materials used for testing were not sampled in accordance with Section 2.4 of ICC-ES™ AC273.

The glass infill panels were not labeled as referenced by Section 2406.3 of the 2012 IBC.

1.4 Qualifications

Intertek-ATI in York, Pennsylvania has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc. (IAS).

1.5 Product Description

The *Pure View* full glass panel aluminum guardrail system is comprised of aluminum rails and posts as well as glass panel infill. Test specimens consisted of two product colors: Black and White. Drawings are included in Appendix A to verify the overall dimensions and other pertinent information of the tested product, its components, and any constructed assemblies.

1.6 Product Sampling

All components utilized for testing reported herein were directly supplied to Intertek-ATI by Fortress Railing Products and were not independently sampled and selected by an independent inspection agency.

1.7 Witnessing

Jeremy Jordan, Kevin Burt, and Kevin Flatt of Fortress Railing Products were present on 4/06/16 to witness the structural performance testing of assembled railing systems.

1.8 Conditions of Testing

Unless otherwise indicated, all testing reported herein was conducted in a laboratory set to maintain temperature in the range of 68 ± 4ºF and humidity in the range of 50 ± 5% RH.

2.0 Assembly Fastener Testing

Re: ICC-ES™ AC273 - Section 4.2.7

2.1 General

The purpose of this testing was to simulate a 90 degree bracket loading condition, which addresses a situation when the guardrail system is to be installed with the top rails in a corner condition.

2.2 Test Specimens

Short sections of the top rail were attached in accordance with Fortress Railing Products' installation instructions to short sections of both aluminum and wood posts. Specimens were assembled by an Intertek-ATI technician. Rail brackets were secured to the post and to the rail as described in Section 3.4 Fastening Schedule.

2.3 Test Setup

The testing machine was fitted with a post section at the bottom to accommodate anchorage of the rail and bracket. The top rail had a hole drilled in it to attach to the clevis which was then attached to the test machine's crosshead. The bottom post section was attached rigidly to the base of the test machine. See photograph in Appendix B for test setup.

2.4 Test Procedure

Testing was performed in accordance with ASTM D 1761 and by using a computer-monitored and -controlled SATEC Unidrive, Model MII 50 UD Universal Testing Machine. Tests were run at a crosshead speed of 0.05 in/min, and each specimen was tested in tension to its ultimate load capacity. Testing was conducted on 04/27/16.

2.5 Test Results

Series No. 1
Attached to *Al*[13] Aluminum Post Mount

Sample No.	Ultimate Load (lb)	Deviation From Average	Mode of Failure
1	872	-2.6%	Bracket broke at rail fastener
2	1064	+18.9%	
3	1080	+20.7%	
4	690	-22.9%	
5	768	-14.2%	
Average	**895**		
Allowable Capacity [1]	**298**	**≥ 200 lb ∴ OK**	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

Series No. 2
Attached to 4x4

Sample No.	Ultimate Load (lb)	Deviation From Average	Mode of Failure
1	996	+3.2%	Bracket broke at rail fastener
2	1063	+10.2%	
3	825	-14.5%	
4	948	-1.8%	
5	994	+3.0%	
Average	**965**		
Allowable Capacity [1]	**322**	**≥ 200 lb ∴ OK**	

[1] *Average ultimate load divided by a factor of safety of three (3.0)*

2.6 Summary and Conclusions

The maximum design load rating required for guardrail systems for use in IRC – One- and Two-Family Dwellings and for rail lengths up to and including 8 ft for use in IBC – All Use Groups is 200 lb. Therefore, fasteners / connectors reported herein meet the performance requirements of ICC-ES™ AC273 for use in corner conditions.

3.0 Structural Performance Testing of Assembled Railing Systems

Re: ICC-ES™ AC273 – Section 4.2.1

3.1 General

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

3.2 Railing Assembly Description

The *Pure View* systems consisted of aluminum top and bottom rails with a glass panel between the rail members. The railing systems had an overall top rail length (inside of post to inside of post) of 69-1/8 in with an overall rail height (top of top rail to bottom of bottom rail) of 40 in. Top and bottom rails attached to aluminum post mounts via *Al^{13} Evolve External* brackets. See Section 3.4 Fastening Schedule for connection details. No support block was used on the bottom rail for testing. See drawings in Appendix A and photographs in Appendix B for additional details.

3.3 Series / Model

The test specimen components were supplied by Fortress Railing Company and were assembled by a representative of Intertek-ATI.

Top / Bottom Rail: 1-5/8 in wide by 1-1/8 high by 0.13 in wall extruded 6063-T5 aluminum profile with 7/16 in wide by 1/2 in high by 0.06 in wall vinyl U-shaped glass panel retainer

Evolve External Brackets: 2.08 in wide by 1.29 in high by 1.25 in deep cast aluminum bracket

Infill: 61-5/16 in wide by 39 in high by 1/4 in thick tempered glass panel

Post: - *Al^{13} Post*: 3 in square by 0.16 in wall, 6063-T5 aluminum tube post welded to a nominal 5-1/2 in square by 0.40 in thick 6063-T5 aluminum base plate with four 0.47 in diameter holes with the center of the holes located approximately 5/8 in in from each edge. The center to center spacing of the holes was approximately 4-1/4 in. One 0.98 in diameter hole was located in the center of the base plate. A 3/8" continuous fillet weld connected the tube to the base plate. The post base was surface-mounted to a rigid steel test surface (simulated concrete) as described in Section 3.4 Fastening Schedule.

- Wood Post: Conventional preservative-treated wood (Southern Yellow Pine) 4x4

See drawings in Appendix A and photographs in Appendix B for additional details.

3.4 Fastening Schedule

Connection	Fastener
Rail Bracket to *Al*[13] Post *	Two #12-24 by 3/4" star-drive, trim-head, thread cutting, carbon steel screws
Rail Bracket to Wood Post	Two #12-10 by 2-1/2" (0.154 in minor diameter) star-drive, trim-head screws
Rail Bracket to Rail *	One #12-24 by 3/4" star-drive, trim-head, thread cutting, carbon steel screws (protected side of deck)
Infill to Rail Assembly	No mechanical connection – panel was channel fit to the rails. A co-extruded vinyl glazing adaptor was channel fit to the rails
Post Mount to Substructure	Four 3/8 in Grade 8 hex-head bolts with washer

* *3/16 in diameter pre-drill used*

3.5 Test Setup

The railing assembly was installed and tested as a single railing section by directly securing (surface-mounting) the base of the post mounts to a rigid steel test frame. The railing was assembled by an Intertek-ATI technician. Transducers mounted to an independent reference frame were located to record movement of reference points on the railing system components (ends and mid-point) to determine net component deflections. See photographs in Appendix B for test setups.

3.6 Test Procedure

Testing and evaluation was performed in accordance with Section 4.2.1 of ICC-ES™ AC273. The test specimen was inspected prior to testing to verify size and general condition of the materials, assembly, and installation. No potentially compromising defects were observed. One specimen was used for all load tests which were performed in the order reported. Each design load test was performed using the following procedure:

1. Zeroed transducers and load cell at zero load;
2. Increased load to specified test load in no less than ten seconds; and
3. Held test load for no less than one minute.

3.7 Test Results

Unless otherwise noted, all loads and displacement measurements were normal to the rail (horizontal). The test results apply only to the railing assembly between supports and anchorage to the support.

Key to Test Results Tables:

Load Level: Target test load

Test Load: Actual applied load at the designated load level (target). Where more than one value is reported, the test load was the range (min. - max.) that was held during the time indicated in the test.

Elapsed Time (E.T.): The amount of time into the test with zero established at the beginning of the loading procedure. Where more than one value is reported, the time was the range (start-end) that the designated load level was reached and sustained.

3.7 Test Results (Continued)

69-1/8 in by 42 in *Pure View* Full Glass Panel Aluminum Guardrail
Limited to Use in IRC - One- and Two-Family Dwellings / ICC-ES™ AC273

Specimen No. 1 of 3

Test No. 1 - Test Date: 04/06/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Center**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	202 - 211	00:40 - 01:43	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 2 - Test Date: 04/06/16 **Design Load: 50 lb / 1 Square ft of In-Fill at Bottom**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	200 - 212	00:50 - 01:54	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 3 - Test Date: 04/06/16 **Design Load: 200 lb Horizontal Concentrated Load at Mid-Span of Top Rail**						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	202	00:33	0.21	0.71	0.26	0.48
800 lb (4.0 x D.L.)	803 - 814	01:23 - 02:27	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure			

Deflection Evaluation:
Maximum rail deflection at 202 lb = 0.48 in on a 6 ft rail (69.125 in)

Limits per AC273 [2]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22"> 0.48" \therefore$ ok and $\frac{h}{12}=\frac{36}{12}=3.0"> 0.48" \therefore$ ok

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

[2] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

3.7 Test Results (Continued)

Specimen No. 1 of 3 (Continued)

Test No. 4 - Test Date: 04/06/16 **Design Load: 200 lb Vertical Concentrated Load at Mid-Span of Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)** [1]
200 lb (D.L.)	206	00:22	0.02
800 lb (4.0 x D.L.)	801 - 816	00:59 - 02:03	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure [2]
Deflection Evaluation: Maximum post deflection at 206 lb = 0.02 in on a 6 ft rail (69.125 in) Limits per AC273 [3]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22">0.02"\therefore$ ok and $\frac{h}{12}=\frac{36}{12}=3.0">0.02"\therefore$ ok			

[1] *Displacement was measured at the midspan of the rail.*

[2] *The test load fell below the target load level for a total of 0.5 seconds throughout the duration of the test.*

[3] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

Test No. 5 - Test Date: 04/06/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1001 - 1022	00:55 - 02:00	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

3.7 Test Results (Continued)

Specimen No. 2 of 3

Test No. 1 - Test Date: 04/06/16 Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	201 - 210	00:45 - 01:48	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 2 - Test Date: 04/06/16 Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	202 - 210	00:45 - 01:49	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 3 - Test Date: 04/06/16 Design Load: 200 lb Horizontal Concentrated Load at Mid-Span of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	200	00:53	0.04	0.61	0.24	0.47
800 lb (4.0 x D.L.)	800 - 812	01:37 - 02:39	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 200 lb = 0.47 in on a 6 ft rail (69.125 in) Limits per AC273 [2]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22" > 0.47" \therefore$ ok and $\frac{h}{12}=\frac{36}{12}=3.0" > 0.47" \therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

[2] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

3.7 Test Results (Continued)

Specimen No. 2 of 3 (Continued)

Test No. 4 - Test Date: 04/06/16 **Design Load: 200 lb Vertical Concentrated Load at Mid-Span of Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)** [1]
200 lb (D.L.)	205	00:32	0.04
800 lb (4.0 x D.L.)	798 - 824	01:13 - 02:13	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure [2]
Deflection Evaluation: Maximum post deflection at 205 lb = 0.87 in on a 6 ft rail (69.125 in) Limits per AC273 [3]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22"> 0.04" \therefore$ ok and $\frac{h}{12}=\frac{42}{12}=3.50"> 0.04" \therefore$ ok			

[1] *Displacement was measured at the midspan of the rail.*

[2] *The test load fell below the target load level for a total of 0.5 seconds throughout the duration of the test.*

[3] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

Test No. 5 - Test Date: 04/06/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1001 - 1016	00:56 - 02:00	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

3.7 Test Results (Continued)

Specimen No. 3 of 3

Test No. 1 - Test Date: 04/07/16 Design Load: 50 lb / 1 Square ft of In-Fill at Center of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	200 - 214	00:43 - 01:46	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 2 - Test Date: 04/07/16 Design Load: 50 lb / 1 Square ft of In-Fill at Bottom of Two Pickets			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
200 lb (4.0 x D.L.)	200 - 212	00:32 - 01:35	Sustained load equal to or greater than 200 lb for one full minute without failure

Test No. 3 - Test Date: 04/07/16 Design Load: 200 lb Horizontal Concentrated Load at Mid-Span of Top Rail						
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)**			
			End	**Mid**	**End**	**Net [1]**
200 lb (D.L.)	201	00:32	0.04	0.58	0.23	0.45
800 lb (4.0 x D.L.)	802 - 811	01:15 - 02:18	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure			
Deflection Evaluation: Maximum rail deflection at 201 lb = 0.45 in on a 6 ft rail (69.125 in) Limits per AC273 [2]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22" > 0.45" \therefore$ ok and $\frac{h}{12}=\frac{36}{12}=3.0" > 0.45" \therefore$ ok						

[1] *Each end displacement was measured at the center of the support. Net displacement was the rail displacement relative to the supports.*

[2] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

3.7 Test Results (Continued)

Specimen No. 3 of 3 (Continued)

Test No. 4 - Test Date: 04/07/16 **Design Load: 200 lb Vertical Concentrated Load at Mid-Span of Top Rail**			
Load Level	**Test Load (lb)**	**E.T. (min:sec)**	**Displacement (in)** [1]
200 lb (D.L.)	204	00:28	0.04
800 lb (4.0 x D.L.)	801 - 824	00:46 - 01:48	**Result**: Withstood load equal to or greater than 800 lb for one full minute without failure
Deflection Evaluation: Maximum post deflection at 204 lb = 0.04 in on a 6 ft rail (69.125 in) Limits per AC273 [2]: $\left(\frac{h}{24}+\frac{l}{96}\right)=\left(\frac{36}{24}+\frac{69.125}{96}\right)=2.22"> 0.04" \therefore$ ok and $\frac{h}{12}=\frac{36}{12}=3.0"> 0.04" \therefore$ ok			

[1] *Displacement was measured at the midspan of the rail.*

[2] *Deflection limit calculation based on worse case 36" railing height to satisfy One- and Two-Family Dwelling requirements.*

Test No. 5 - Test Date: 04/07/16 **Design Load: 200 lb Concentrated Load at Both Ends of Top Rail (Brackets)**			
Load Level [1]	**Test Load (lb)**	**E.T. (min:sec)**	**Result**
1000 lb (2.50 x D.L.) x 2	1002 - 1015	00:50 - 01:54	Each end withstood load equal to or greater than 500 lb without failure

[1] *Load was imposed on* both *ends of rail using a spreader beam; therefore, loads were doubled.*

3.8 Summary and Conclusions

When installed between adequate supports, the railing assemblies reported herein meet the structural performance requirements of Section 4.2.1 of ICC-ES™ of AC273 with guardrail details and Occupancy Classification as shown in the following table:

***Pure View* Full Glass Panel Aluminum Guardrail**	**Guardrail Type**	**Bracket Type**	**Support Posts**	**Code Occupancy Classification**
6 ft by 42 in (69-1/8 x 40)	Level / In-Line Application	*Al[13] Evolve External* Bracket	*Al[13] Post* (Simulated Concrete Application) or Preservative Treated (Southern Pine) 4x4 Wood Posts	IRC – One and Two-Family Dwellings

Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

4.0 Closing Statement

Intertek-ATI will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Intertek-ATI for the entire test record retention period.

Results obtained are tested values and were secured using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimens tested. This report may not be reproduced, except in full, without the written approval of Intertek-ATI.

For INTERTEK-ATI:

Digitally Signed by: Emily C. Riley

Emily C. Riley
Project Manager

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Virgal T. Mickley, Jr., P.E.
Senior Project Engineer

ECR:vtm/jas

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix A - Drawings (10)
Appendix B - Photographs (4)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	07/19/16	N/A	Original report issue

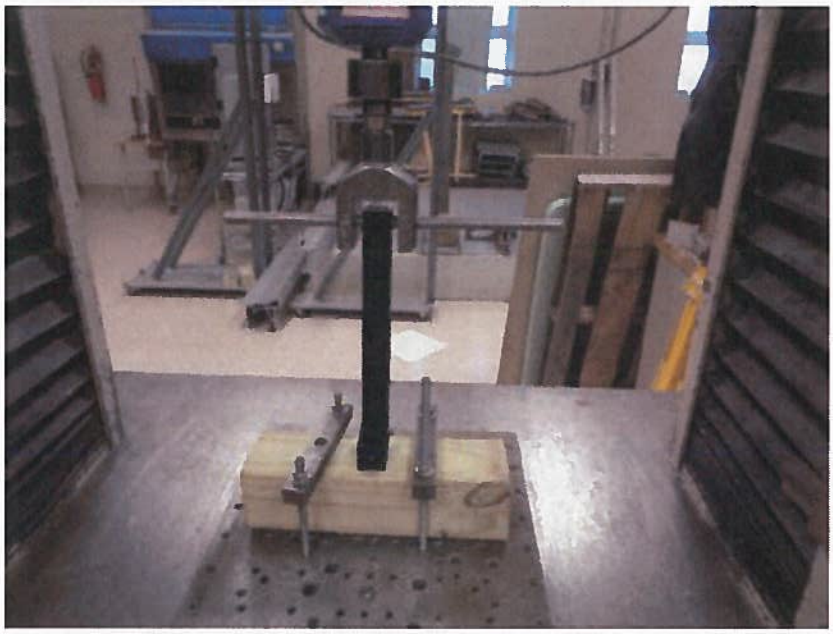

Photo No. 1
Assembly Fastener Test Setup

Photo No. 2
In-Fill Load Test at Center

Photo No. 3
In-Fill Load Test at Bottom

Photo No. 4
Horizontal Concentrated Load Test at Mid-Span of Top Rail

Photo No. 5
Vertical Concentrated Load Test at Top of Post Mount

Photo No. 6
Concentrated Load at Both Ends of Top Rail (Brackets)

Photo No. 7
Rail Collar Bracket and Post Mount Connection