

TEST REPORT

Rendered to:

FORTRESS RAILING AND FENCE SYSTEMS

For:

PRODUCT: *PureView Glass Railing*

TYPE: Hot-Dipped Galvanized Steel and Glass Level Guardrail System

Report No: 89865.01-119-19
Report Date: 02/08/11
Revision 2: 08/23/13



TEST REPORT

89865.01-119-19

Revision 2: August 23, 2013

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TEST REPORT

Rendered to:

FORTRESS RAILING AND FENCE SYSTEMS
P.O. Box 831268
Richardson, Texas 75083

Report No.: 89865.01-119-19
Test Date: 10/28/10
Report Date: 02/08/11
Revision 2: 08/23/13

1.0 General Information

1.1 Product

Pure View Glass Railing

1.2 Type

Hot-Dipped Galvanized Steel and Glass Level Guardrail System

1.3 Project Description

Architectural Testing was contracted by Fortress Railing and Fence Systems to conduct structural performance tests on the 69 in wide by 36 in high *Pure View Glass Railing*. The *Pure View Glass Railing* is a hot-dipped galvanized steel and glass level guardrail system. The system was evaluated for the design load requirements of the following building codes:

2009 *International Building Code*[®], International Code Council

2009 *International Residential Code*[®], International Code Council

Structural tests were performed according to Chapter 17 (Structural Tests and Special Inspections) of IBC 2009.

Exceptions:

- *The test load of two times the design load was not held for 24-hours. The rationale is that railing systems are not subject to long term sustained loads such as snow loads and floor live loads.*
- *A safety factor of 4.0 was applied to in-fill load tests and concentrated load tests at the midspan of top rail to account for Section 2407 of IBC 2009, Glass in Handrails and Guards.*

1.4 Limitations

All tests performed were to evaluate structural performance of the level guardrail assembly to carry and transfer imposed loads to the supporting structure. The test specimens evaluated included the infill, rails, rail brackets, and support posts. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

1.5 Qualifications

Architectural Testing has demonstrated compliance with ANS/ISO/IEC Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc.

1.6 Product Sampling

A representative of Architectural Testing visited Fortress Iron Railing & Fence Systems facility in Richardson, Texas, on 03/18/09, 08/14/09 and 10/15/10, to select the components (with the exception of the glass balustrades which were directly shipped from the supplier) used for testing. All samples selected for testing were marked for identification and were the samples used for all tests reported herein. See photograph in Appendix B for typical sampling mark.

1.7 Product Description

The test specimen components were supplied by Fortress Iron Railing & Fence Systems and were assembled by a representative of Architectural Testing.

Top and Bottom Rail: 1-1/4 in square by 0.07 in wall by 69 in long pre-galvanized Q195 steel tube with nine routings with plastic shoes for glass balustrades

Collar Brackets: 1.55 in square (OD) by 1.3 in deep cast ZG270-500 (ZG35) steel socket bracket with tapered wall thickness ranging from 0.200 in to 0.230 in

In-Fill: Nine 3-5/8 in wide by 34 in long by 0.310 in thick tempered glass balustrades

Post: 2 in square by 0.10 in wall, pre-galvanized and powder-coated outside surface Q195 steel tube post welded to nominal 4 in square, nominal 1/4 in thick base plate with four nominal 1/2 in diameter holes located approximately 5/8 in on-center in from each edge and approximately 2-3/4 in apart on-center and one 0.40 in diameter hole located in the center of the base plate - the continuous fillet weld connecting the tube to the base plate ranged from 1/8 in to 3/16 in - the base plate was attached to the surface of a rigid steel test surface (simulated concrete) as described in Section 1.7 Fastening Schedule.

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

1.8 Fastening Schedule

Connection	Fastener
Rail Bracket to Post*	Two 1/4 in by 1-1/4 in flat-head, self-drilling sheet metal screws
Rail Bracket to Rail*	One 1/4 in by 1-1/4 in flat-head, self-drilling sheet metal screws
Post Mount to Substructure	Four 1/2 in diameter by 1-1/2 in long Grade 8 hex-head bolts with washers and nuts

* 7/32 in diameter pre-drill used

2.0 Structural Performance Testing of Assembled Railing Systems

2.1 Test Equipment

The level guardrail was tested in a self-contained structural frame designed to accommodate anchorage of the guardrail assembly and application of the required test loads. The specimens were 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 specimens. Applied load was measured using an electronic load cell located in-line with the loading system. Electronic linear motion transducers were used to measure deflections.

2.2 Test Setup

The 69 in wide by 36 in high level guardrail assembly was installed and tested as a single railing section by directly securing the posts to steel channels to simulate concrete attachment. The posts were attached to the steel channels with four 1/2 in diameter by 1-1/2 in long Grade 8 bolts, washers, and nuts. Transducers mounted to an independent reference frame were located to record movement of reference points on the guardrail system components (ends and mid-point) to determine net component deflections. See photographs in Appendix B for individual test setups.

2.3 Test Procedure

Each 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 prior to testing. An initial load, not exceeding 50% of design load, was applied and transducers were zeroed. Load was then applied at a steady uniform rate until reaching 2.0 times design load (3.2 times design load in the cases of Test No. 1, 2, 3 and 4) in no less than 10 seconds. After reaching 2.0 times design load (3.2 times design load in the cases of Test No. 1, 2, 3 and 4), the load was released. After allowing a minimum period of one minute for stabilization, load was reapplied to the initial load level used at the start of the loading procedure, and deflections were recorded and used to analyze recovery. Load was then increased at a steady uniform rate until reaching 2.5 times design load (4.0 times design load for glass balustrades and its supporting components) or until failure occurred. The testing time was continually recorded from the application of initial test load until the ultimate test load was reached.

2.4 Test Results

The following tests were performed on the guardrail assemblies for the design load requirements of the codes referenced. Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

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.

Test No. 1 – 10/28/10						
Design Load: 50 lb / 1 Square Ft at Center of In-Fill (on Two Balustrades)						
Load Level	Test Load (lb)	E.T. (min:sec)	Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	50	00:00	0.00	0.00	0.00	0.00
3.2x Design Load	161	00:45	0.28	0.58	0.21	0.34
Initial Load	50	02:25	0.01	0.02	0.01	0.01
97% Recovery from 3.2 x Design Load						
4.0x Design Load	200	02:59	Achieved Load without Failure			

¹ Net displacement was the infill displacement relative to its top and bottom.

Test No. 2 – 10/28/10						
Design Load: 50 lb / 1 Square Ft at Bottom of In-Fill (on Two Balustrades)						
Load Level	Test Load (lb)	E.T. (min:sec)	Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	50	00:00	0.00	0.00	0.00	0.00
3.2x Design Load	161	00:26	0.02	0.22	0.02	0.20
Initial Load	50	01:50	0.00	0.01	0.00	0.01
95% Recovery from 3.2 x Design Load						
4.0x Design Load	200	02:26	Achieved Load without Failure			

¹ Net displacement was the bottom rail displacement relative to its ends.

2.4 Test Results (Continued)

Test No. 3 – 10/28/10						
Design Load: 200 lb Concentrated Horizontal Load at Midspan of Top Rail						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	50	00:00	0.00	0.00	0.00	0.00
3.2x Design Load	640	02:00	0.79	2.92	0.87	2.09
Initial Load	50	03:39	0.03	0.52	0.04	0.49
77% Recovery from 3.2 x Design Load						
4.0x Design Load	801	05:50	Achieved Load without Failure			

¹ Net displacement was mid-rail displacement relative to the rail at the support posts.

Test No. 4 – 10/28/10						
Design Load: 200 lb Concentrated Vertical Load at Midspan of Top Rail						
Load Level	Test Load (lb)	E.T. (min:sec)	Rail Displacement (in)			
			End	Mid	End	Net ¹
Initial Load	50	00:00	N/A	0.00	N/A	0.00
3.2x Design Load	641	01:13	N/A	0.83	N/A	0.83
Initial Load	50	02:46	N/A	0.12	N/A	0.12
86% Recovery from 3.2 x Design Load						
4.0x Design Load	802	03:58	Achieved Load without Failure			

¹ One transducer used measuring deflection at mid-span of top rail.

Test No. 5 – 10/28/10				
Design Load: 200 lb Concentrated Load at Ends of Top Rail (Brackets)				
Load Level ¹	Test Load (lb)	E.T. (min:sec)	Rail Displacement (in)	
			Rail End #1	Rail End #2
Initial Load	50	00:00	0.00	0.00
2.0x Design Load	801	01:24	1.12	1.17
Initial Load	50	03:04	0.03	0.04
97% Recovery from 2.0 x Design Load				
2.5x Design Load	1002	05:06	Achieved Load without Failure	

¹ A spreader beam was used to impose loads on both ends of the railing system; therefore, loads were doubled.

2.4 Test Results (Continued)

Test No. 6 – 10/28/10			
Design Load: 200 lb Concentrated Load at Top of Stand-Alone Post ^{1,2}			
Load Level	Test Load (lb)	E.T. (min:sec)	Post Displacement (in)
Initial Load	50	00:00	0.00
2.0x Design Load	401	01:10	1.26
Initial Load	50	02:54	0.03
98% Recovery from 2.0 x Design Load			
2.5x Design Load	501	04:26	Achieved Load without Failure

¹ Post was conservatively tested without a railing attached.

² Load applied at 42 in high from the deck surface to simulate the rail height.

2.5 Summary and Conclusions

Using performance criteria of 75% deflection recovery from 2.0 times design load (3.2 times design load in the cases of Test No. 1, 2, 3 and 4) and withstanding an ultimate load of 2.5 times design load (4.0 times design load for glass balustrades and its supporting components), the test results substantiate compliance with the design load requirements of the referenced building codes for the 69 in wide by 36 in high level *Pure View Glass Railing* assembly and 44-1/2 in high support post reported herein. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

The glass balustrades were not correctly labeled as referenced by Section 2406.3 of the 2009 IBC and the permanent marking that was on the balustrades was not legible when installed, as per the ANSI Z97.1-2004 test standard.

3.0 Closing Statement

Detailed drawings, data sheets, representative samples of test specimens, a copy of this test report, and all other supporting evidence will be retained by Architectural Testing for a period of four years from the original test date. At the end of this retention period, said materials shall be discarded without notice, and the service life of this report by Architectural Testing shall expire. Results obtained are tested values and were secured using the designated test methods. This report neither constitutes certification of this product nor expresses an opinion or endorsement by this laboratory; it is the exclusive property of the client so named herein and relates only to the tested specimens. This report may not be reproduced, except in full, without the written approval of Architectural Testing.

For ARCHITECTURAL TESTING:

Adam J. Schrum
Technician II
Structural Systems Testing

Travis A. Hoover
Program Manager
Structural Systems Testing

AJS:ajs/tah/drm

Attachments (pages): *This report is complete only when all attachments listed are included.*

Appendix A - Drawings (7)

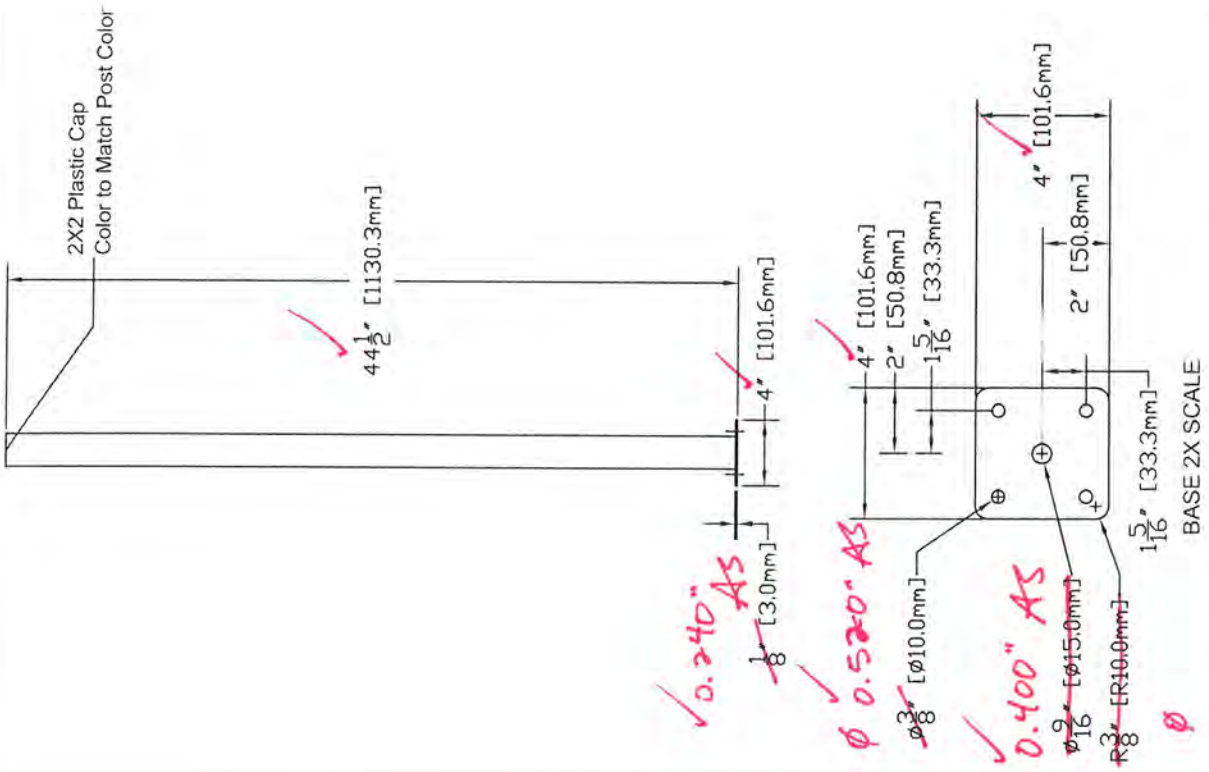
Appendix B - Photographs (7)

Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	02/08/11	N/A	Original report issue
1	04/26/11	6	Corrected height of assembly in Section 2.5
2	08/23/13	4	Corrected 4.0x Test Load

APPENDIX A

Drawings



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Notes:

1. All materials to be Galvanized, G60 Sheet, formed, and welded full length
2. All tube welds to be in a corner and ground smooth with no sharp edges or points
3. After welding and grinding panels to be cleaned, welds regalvanized, receive a zinc phosphate coating, and immediately powder coated.
4. Color matching plastic cap to be installed on open end.



Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# 89865-01-119-19

Date 1/27/11 Tech AJS

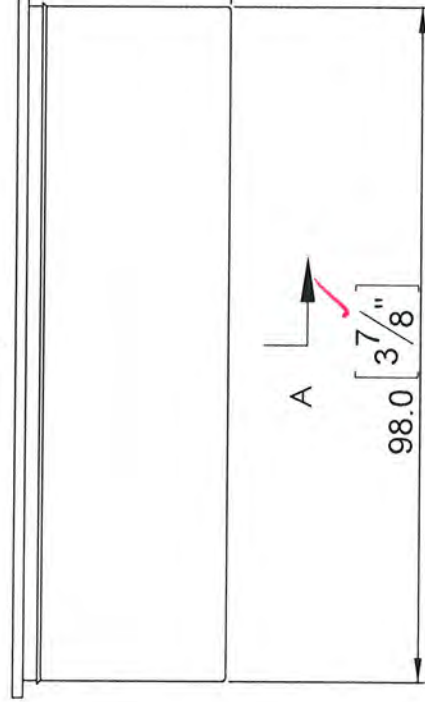
REV	DATE	BY	DESCRIPTION
0	12/16/08	DI	Initial Drawing Generation
TITLE Iron Post			
2" Square X 44 1/2" with 4" Base			
DRAWN BY David Inick			
DATE	12/16/08		
DWG. NAME	DRAWING NO.	SCALE	As Shown
xxxxxx	IP 2" X 44 1/2" WI 4" Base	REV.	0

Fortress Iron, LP
 1800 Jay Ell, Suite 200
 Richardson, TX 75081

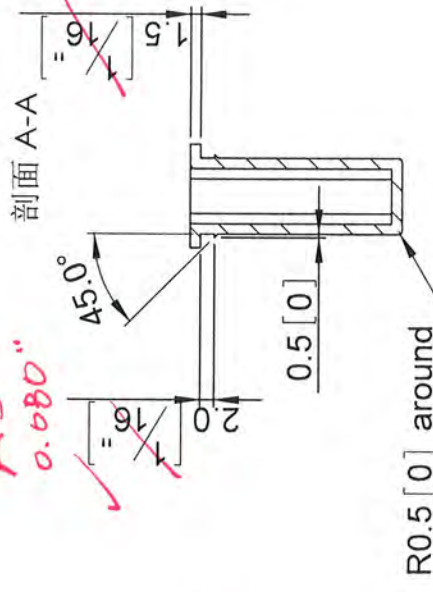


Test sample complies with these details.
Deviations are noted.

Report# 89865.01-119-19
Date 1/27/11 Tech AJS



AS
0.080"



All Dimensions are Metric - mm
without individual tolerance
indications ±0.5

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1800 Jay Ell, Suite 200
Richardson, TX 75081

TITLE: **pure view glass shoes**

DRAWN BY: Benjamin Bi

Date: 2010/12/2

PART #

DWG NAME
pure view glass shoes

SCALE:
1:1

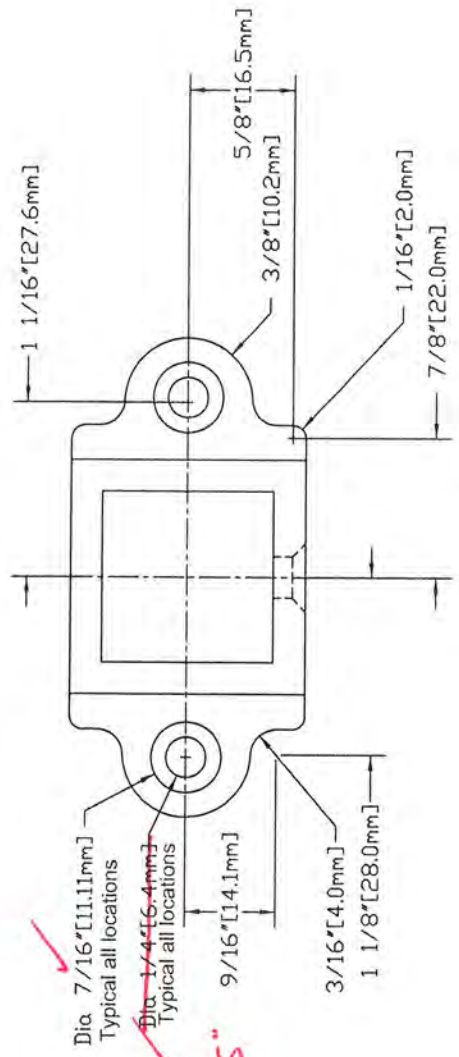
REV:
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REV	DATE	BY	DESCRIPTION

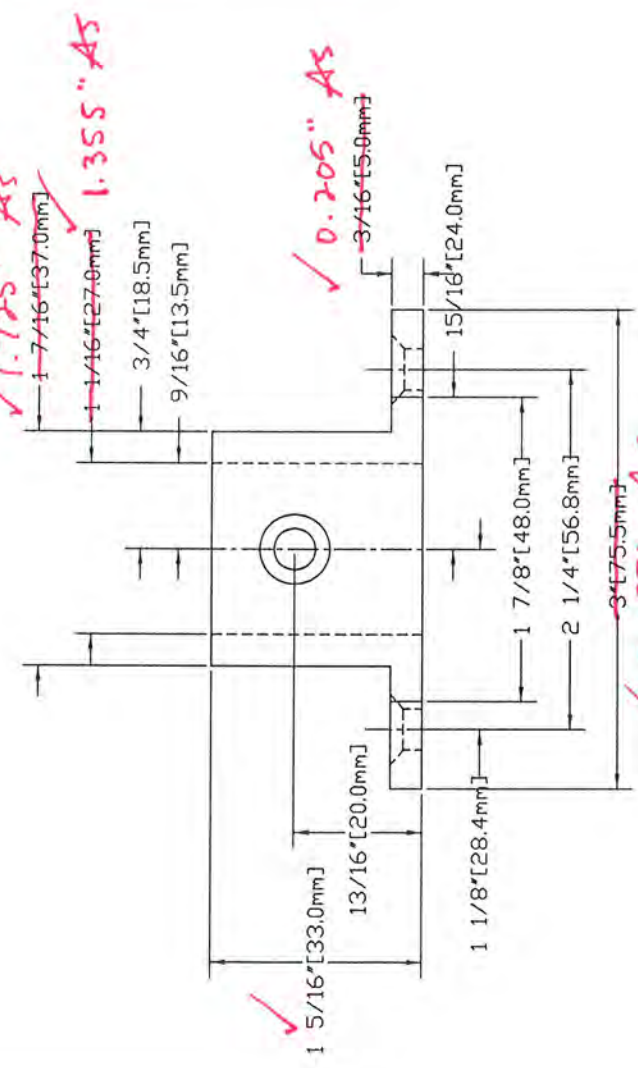


Test sample complies with those details.
Deviations are noted.

Report# 89865.01-119-19
Date 1/27/11 Tech AJS



Dia. 0.275" AS



1.725" AS

1.725" AS

0.205" AS

3.235" AS

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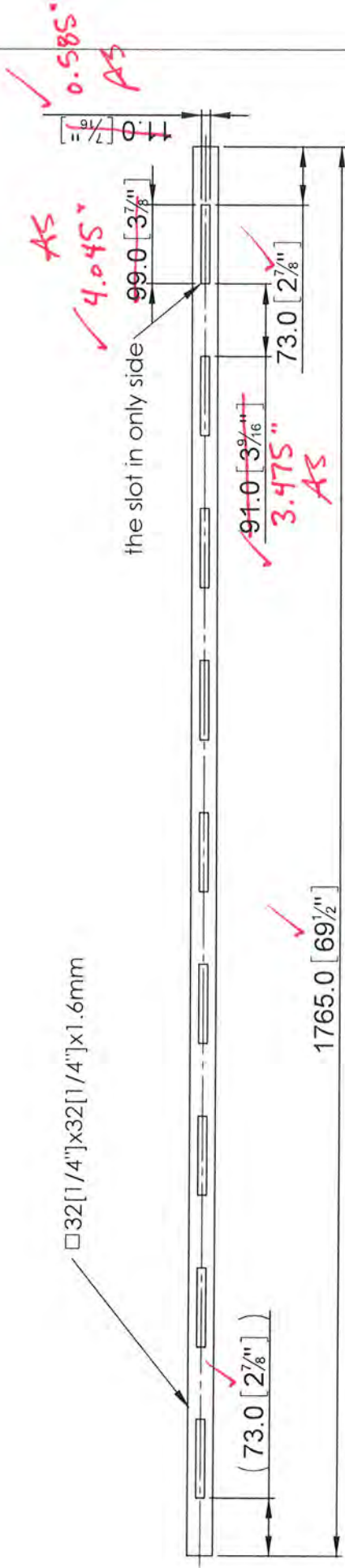


Fortress Iron, LP
216 N. Interurban
Richardson, TX 75081

REV	DATE	BY	DESCRIPTION
0	02/13/06	DI	Initial Drawing Generation
TITLE CB-04 Bracket			
Fixed Bracket for 1" X 1" Railing			
DRAWN BY David Inck			SCALE
DATE 02/13/06			As Shown
DWG. NAME BRACKET			REV. 0
650037			CB-04-1" (BAG 4)

Notes:

1. All materials to be Galvanized, G60 sheet, formed, and welded full length
2. All tube welds to be in corner and ground smoothly with no sharp edges or points



Architectural Testing

Test sample complies with these details. Deviations are noted.

Report# 89865.01-119-19

Date 1/27/4 Tech AJS

All Dimensions are Metric - mm without individual tolerance indications ±0.5

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Iron Railing & Fence Systems

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Richardson, TX 75081

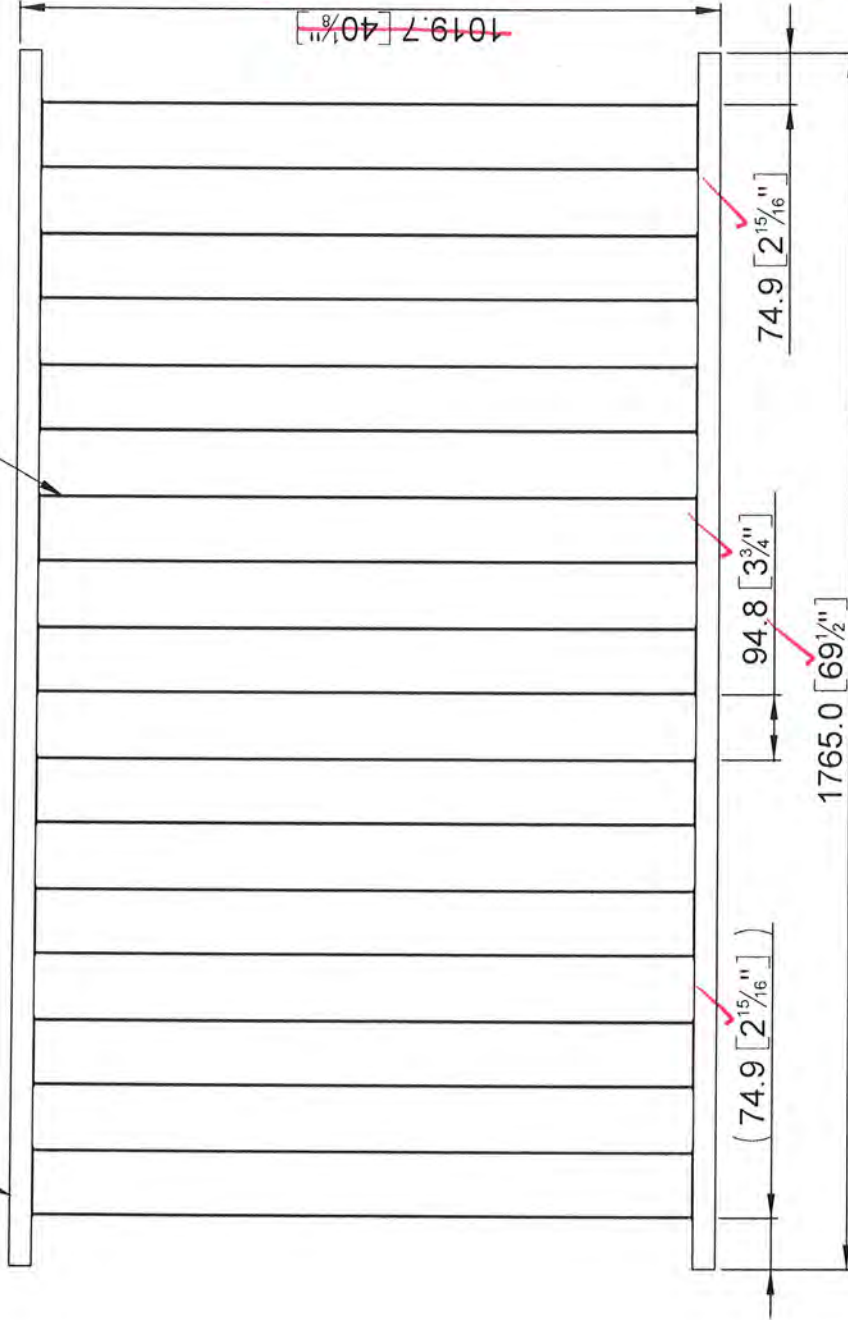
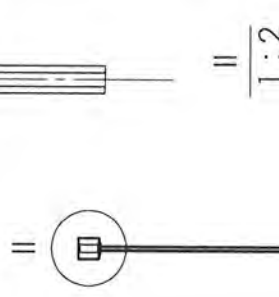
REV	DATE	BY	DESCRIPTION
TITLE: pure view guardrail tubing			
DRAWN BY: Benjamin Bi			
Date: 2010/12/2			
PART #			
DWG NAME: pure view guardrail tubing			
SCALE: 1:1			
REV: 0			

Item No.	Drawing No.	QTY
1	pure view guardrail tubing	2
2	Pure View Glass 39.8inch	9
3	pure view glass shoes	18

1 1/4" X 1 1/4" X 1.6mm square tubing both rails

Pure View glass

Pure View glass shoe



Test sample complies with these details. Deviations are noted.

Report# 89865.01-119-19
Date 1/27/11 Tech *AJS*

All Dimensions are Metric - mm without individual tolerance indications ±0.2

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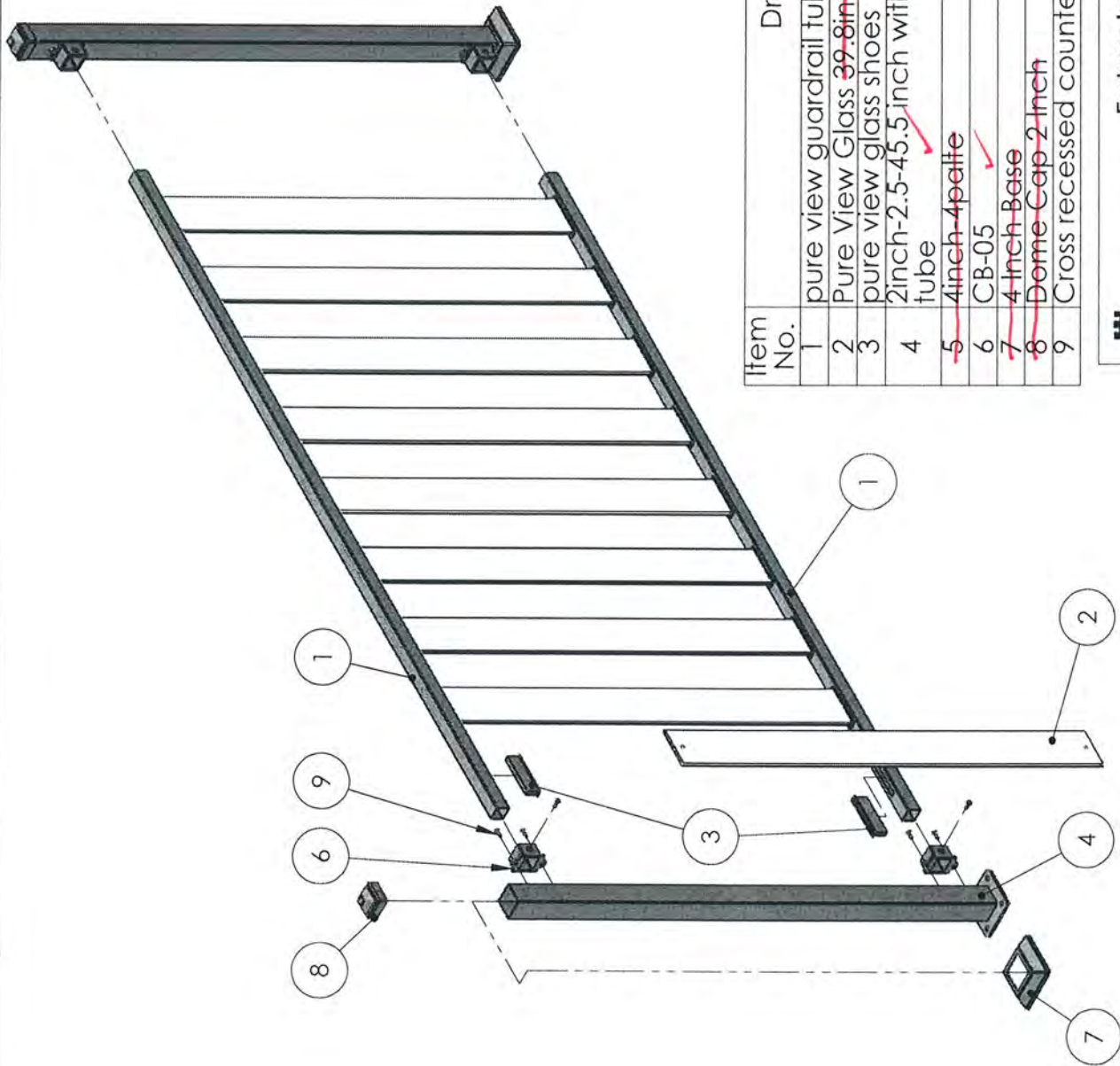
REV	DATE	BY	DESCRIPTION
			Pure View Glass Guard
			System 39.8inch by 6
			DRAWN BY Benjamin Bi
			Date: 2010/12/2
			PART #
			DWG NAME: Pure View Glass Guard System
			39.8inch by 6 feet
			SCALE: 1:10
			REV: 0



Test sample conforms with these details.
Deviations are noted.

Report# **89865.01-119-19**

Date **1/27/11** Tech **AJS**



Item No.	Drawing No.	QTY
1	pure view guardrail tubing ✓	2
2	Pure View Glass 39.8inch 34 in. ✓ AS	9
3	pure view glass shoes ✓	18
4	2inch-2.5-45.5 inch with 4 inch base plate square tube ✓	2
5	4inch-4palte	2
6	CB-05 ✓	4
7	4 Inch Base	2
8	Dome Cap 2 Inch	2
9	Cross recessed countersunk tapping-ST6X18 ✓	12

REV	DATE	BY	DESCRIPTION

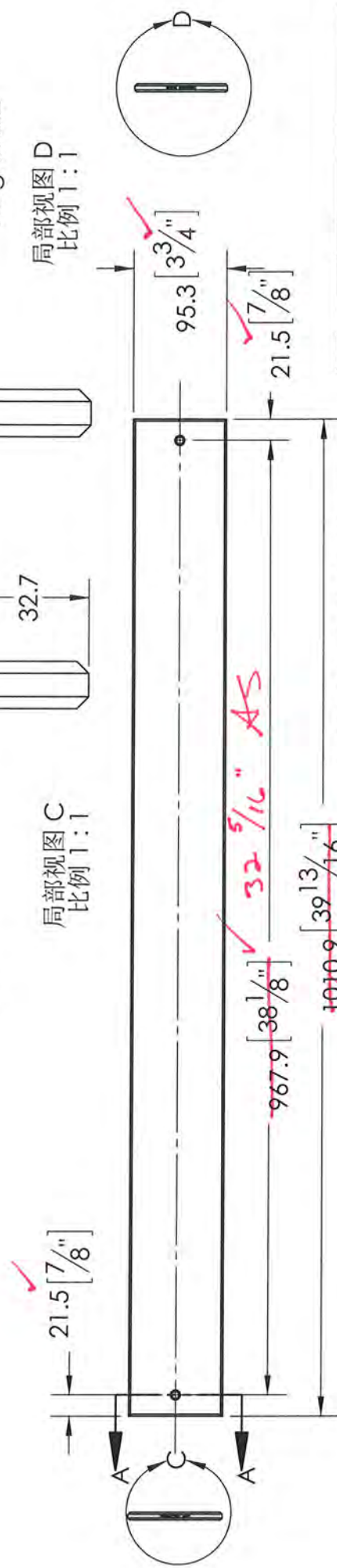
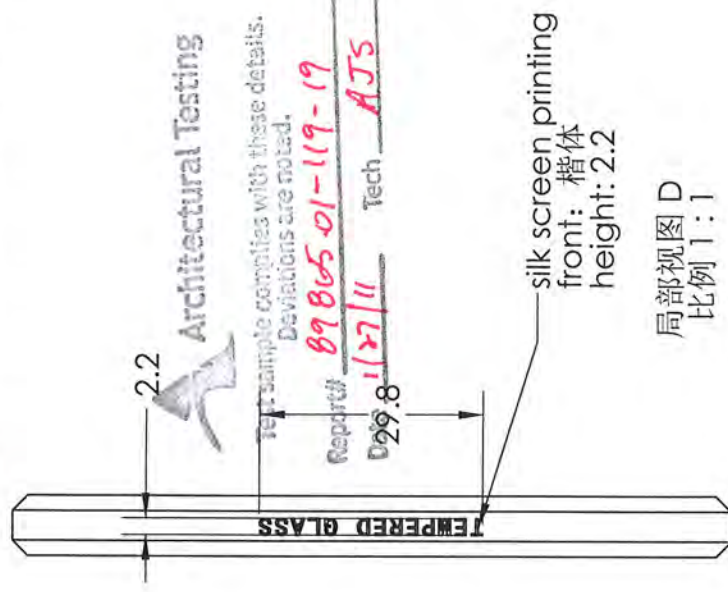
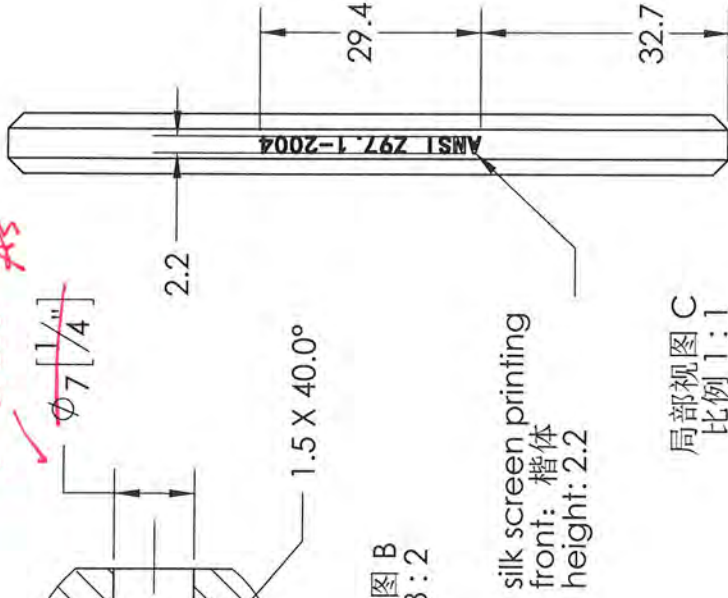
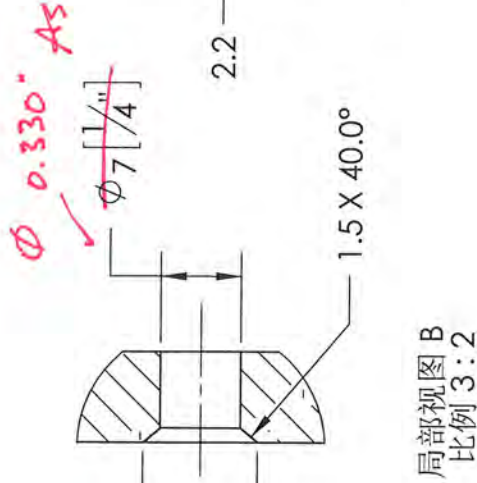
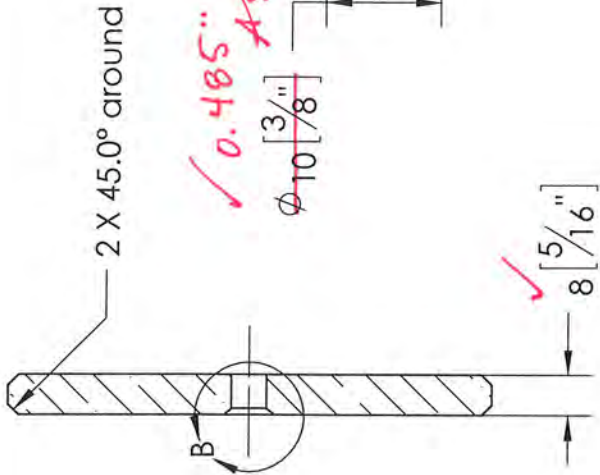
TITLE: **Pure View Glass 39.8inch by 6 feet-System**
 DRAWN BY: Benjamin B
 Date: 2010/12/21
 DWG NAME: Pure View Glass 39 8inch by 6 feet-System
 PART #

FORTRESS
 Iron Railing & Fence Systems

Fortress Iron, LP
 1800 Jay Ell, Suite 200
 Richardson, TX 75081

Notes:

1. Material: **tempered glass**
2. Meet the standards: **ANSI Z97.1-2C**
3. Not sharp corners and air bubble



All Dimensions are Metric - mm
All Dimensions are ± 0.5mm

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Richardson, TX 75081



REV	DATE	BY	DESCRIPTION

TITLE: **Pure View Glass 39.8inch**

DRAWN BY: Benjamin Bi

DATE: 2010/12/21

PART #: DWG NAME: Pure View Glass 39.8inch

APPENDIX B

Photographs

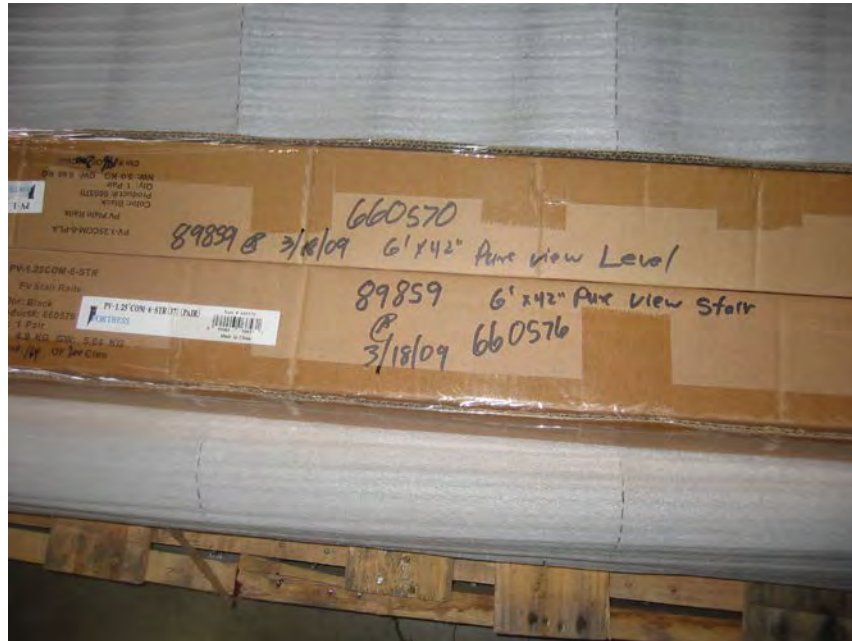


Photo No. 1
Typical Sampling Mark – 03/18/09 Sample Selection



Photo No. 2
Typical Sampling Mark – 08/14/09 Sample Selection



Photo No. 3
In-Fill Load Test at Center of Two Glass Balustrades



Photo No. 4
In-Fill Load Test at Bottom of Two Balustrades



Photo No. 5
Concentrated Horizontal Load Test at Midspan of Top Rail

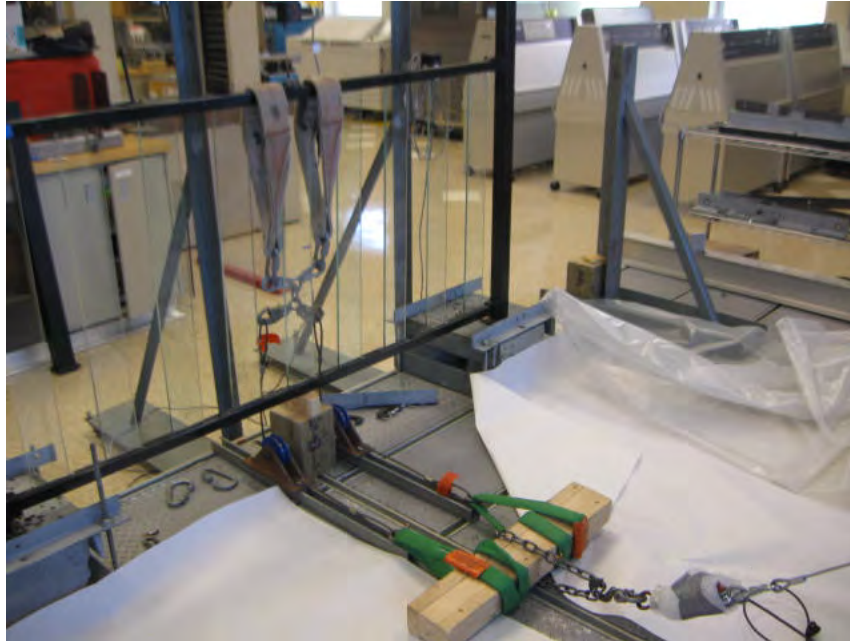


Photo No. 6
Concentrated Vertical Load Test at the Midspan of Top Rail



Photo No. 7
Concentrated Load Test at Ends of Top Rail (Brackets)



Photo No. 8
Stand-Alone Post Test with Load Applied at 42 in High

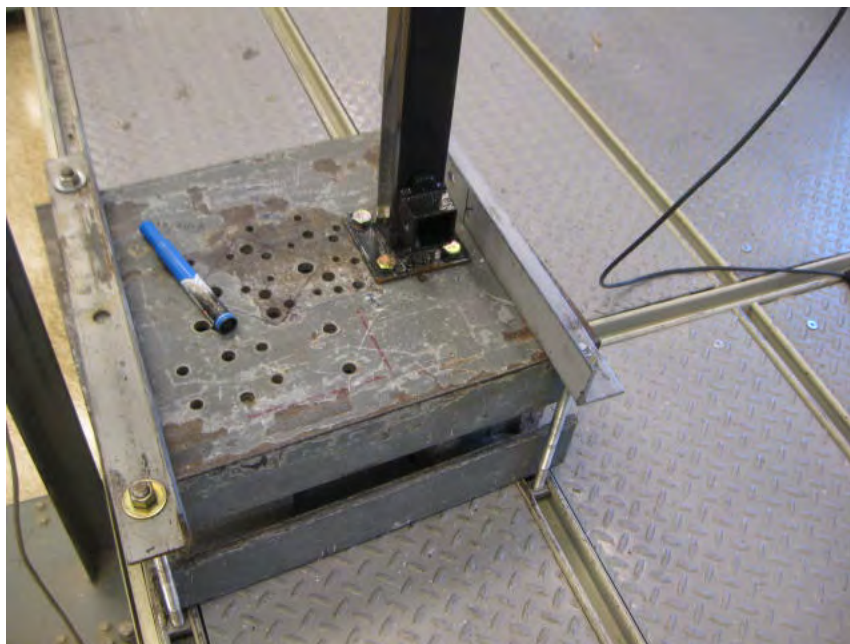


Photo No. 9
Post Connection to Steel Channel (Rigidly Restrained)



Photo No. 10
Typical Rail Bracket Connection



Photo No. 11
Permanent Marking on One End of Glass Balustrade – ANSI Z97.1-2004



Photo No. 12
Permanent Marking on One End of Glass Balustrade – TEMPERED GLASS