RICE ENGINEERING

ASTM E985 TEST REPORT

GR2457 HCB-10 Base Shoe and PG2475 Pad and Isolator

Rendered to:
R&B Wagner, Inc.
10600 W Brown Deer Rd
Milwaukee, WI 53224

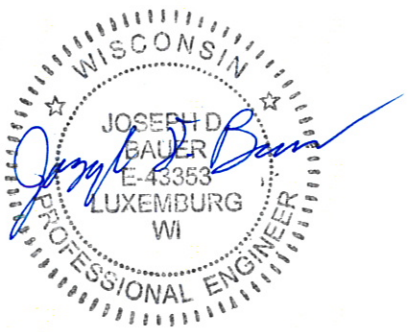
Report Number:	R15-06-210
Set-up Date:	09/25/2015
Test Date:	09/25/2015
Report Date:	10/06/2015

Project Identification: GR2457HCB-10 base shoe with PG2475 pad and isolator ASTM E985 Testing

Project Scope: Rice Engineering was contacted by R&B Wagner, Inc. to witness testing of their GR2457 base shoe guardrail system, specifically the amount of deflection that would occur in 1/2" thick (9/16") tempered SGP laminated glass (1/4" / 0.060" SGP / 1/4") when pulled to design loads as described in ASTM E985 "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings". On September 25, 2015, Joseph Bauer of Rice Engineering witnessed testing for the three different configurations. The testing was performed on-site at the R&B Wagner facility and was conducted by Kelly Bauserman.

Conclusions: The SGP laminated glass lite was tested to a maximum deflection of 2.347" on the end and 1.785" at the center (ultimate test load of 365 lbf). The allowable deflection was 3.5" at the left and 2.25" at the center. The residual deflection (measured at 90 lbf) was 0.073". The allowable residual deflection was 0.45". There were no signs of deformation on the base shoe or any problems with the pad and isolators, therefore 1/2" thick (9/16") tempered SGP laminated glass passed the ASTM E985 test.

Prepared & Witnessed By:



Joseph D. Bauer, Wisconsin P.E.

WAGNER COMPANIES

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MASTER TABLE

ZERO POINT FOR CALCULATIONS	
Height of Rail (h) (in.)	42
Length of Rail (l) (in.)	48
Max Left Deflection [h/12] (in.)	3.5
Max Mid Deflection [(h/24)+(l/96)] (in.)	2.25
Max Residual Deflection (20% of Max Mid) (in.)	0.45

Front

All inputs should be unadjusted read outs from test	Actual lbsf	Mid	Actual lbsf	Left *(If Applicable)*	Actual lbsf	Left 2 *(If Applicable)*
Deflection Reading @ 0 lbsf	0	4.219	0	4.484	0	4.467
Deflection Reading @ Pre-Load (180 lbsf)	179	3.037	180	2.942	180	2.921
Deflection Reading @ Released Test Load (1/2 Pre-load)	90	3.585	90	3.619	90	3.585
Deflection Reading @ 150 lbsf	151	3.223	153	3.147	152	3.314
Deflection Reading @ 200 lbsf	200	2.916	203	2.752	202	2.741
Deflection Reading @ 250 lbsf	249	2.601	255	2.331	255	2.328
Deflection Reading @ 300 lbsf	301	2.266	300	1.977	302	1.954
Deflection Reading @ Ultimate Test Load (365 lbsf)	365	1.876	364	1.474	365	1.465
Deflection Reading @ Released Test Load (1/2 Pre-load)	91	3.478	90	3.549	92	3.512

Back

All inputs should be unadjusted read outs from test	Actual lbsf	Mid	Actual lbsf	Left *(If Applicable)*	Actual lbsf	Left 2 *(If Applicable)*
Deflection Reading @ 0 lbsf	0	4.282	0	4.389	0	4.342
Deflection Reading @ Pre-Load (180 lbsf)	181	3.029	185	2.780	180	2.753
Deflection Reading @ Released Test Load (1/2 Pre-load)	92	3.578	89	3.514	90	3.509
Deflection Reading @ 150 lbsf	151	3.202	155	3.022	151	3.010
Deflection Reading @ 200 lbsf	200	2.891	200	2.642	202	2.567
Deflection Reading @ 250 lbsf	252	2.551	250	2.202	252	2.134
Deflection Reading @ 300 lbsf	300	2.232	301	1.76	300	1.714
Deflection Reading @ Ultimate Test Load (365 lbsf)	365	1.793	364	1.215	365	1.162
Deflection Reading @ Released Test Load (1/2 Pre-load)	91	3.533	90	3.509	90	3.480

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Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM E985 per section 7.1.5	Submitted By:	KGB	Submitted On:	10/06/15
Test Focus (Part #s):	48" Long GR2457HCB-10, 1/2" Laminated with SGP Interlayer, PGISO50, PG2475				
Railing Type:	Shoe molding, 4 panel grips, with glass and unsupported sides				
Railing Specifications:	42" (TOR) No caprail. 12" C-C hole locations				
Test Method:	365 lbf load per ASTM standards				

Test Specifications per ASTM E985		Results				
	System Calculations	Load (lbsf)	Displacement (in.)			Test Avg.
			Midrail	Left	Left 2	
Pre Load	**180 (lbsf)**	Preload	0.548	0.677	0.664	0.6297
Released Test Load	**90 (lbsf)**	RTL	0	0	0	0.0000
		150	0.362	0.472	0.271	0.3683
Ultimate Test Load	**365 (lbsf)**	200	0.669	1	0.844	0.7933
		250	0.984	1.288	1.257	1.1763
Deflection Specifications Per ASTM E985		300	1.319	1.642	1.631	1.5307
Max Mid Deflection	**(h/24)+(l/96) = 2.25 in**	UTL	1.709	2.145	2.12	1.9913
Max Left Deflection	**(h/12) = 3.5 in**	RD	0.107	0.07	0.073	0.0833
Residual Deflection (At RTL)	**20% of MD = 0.45 in**					

Notes

Midrail at 0 lbf =4.1

Potentiometer cannot be zeroed, so calculations are done manually

Shoe mounted to steel

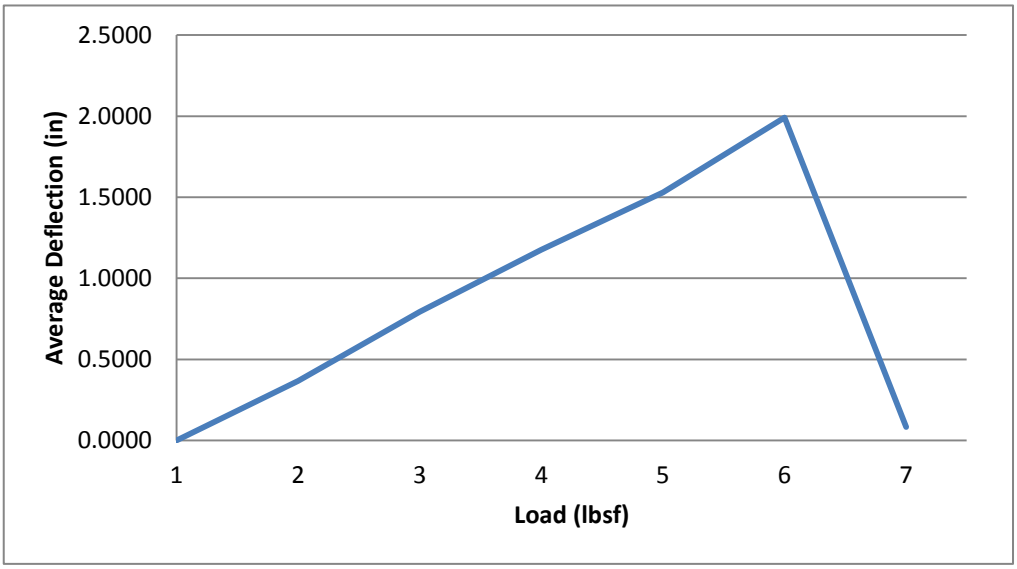
Conclusions

Rail meets ASTM Standard for Max. Allowed Deflection for Mid

Rail meets ASTM Standard for Residual Deflection

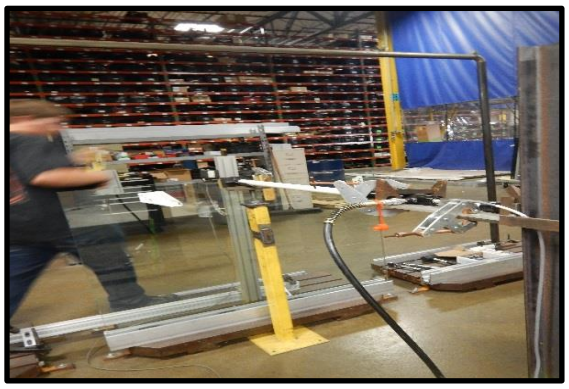
Rail meets ASTM Standard for Max. Allowed Deflection for Left 1

Rail meets ASTM Standard for Max. Allowed Deflection for Left 2



TEST PHOTOS

Initial Setup: Mid



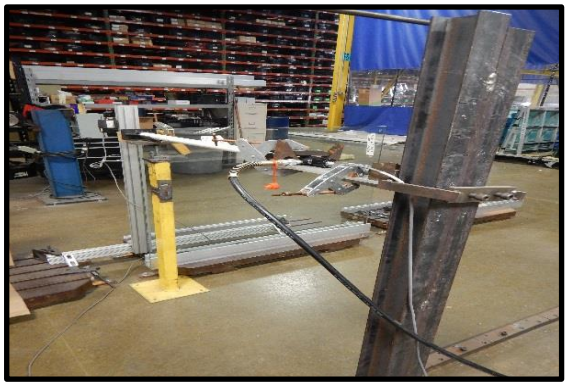
Preload of 180 lbsf
Actual Deflection of 0.548 in

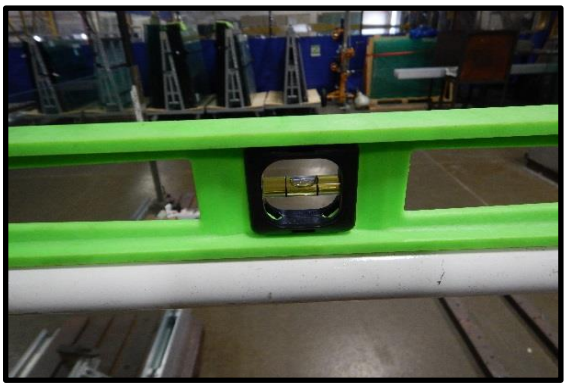
Release Test Load of 90 lbsf

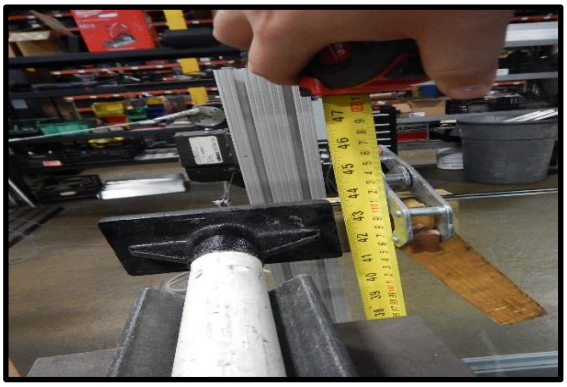
Ultimate Test Load of 365 lbsf
Actual Deflection of 1.709 in

Residual Deflection at 90 lbsf
Actual Deflection of 0.107 in

Initial Setup: Left 1







Preload of 180 lbsf
Actual Deflection of 0.677 in

Release Test Load of 90 lbsf

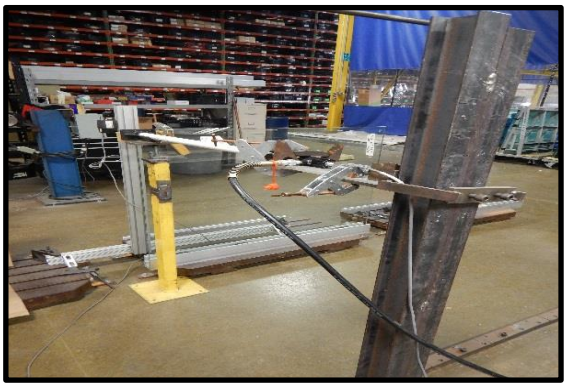
Ultimate Test Load of 365 lbsf

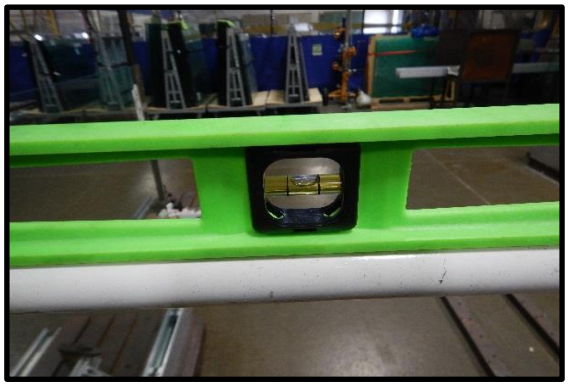
Actual Deflection of 2.145 in

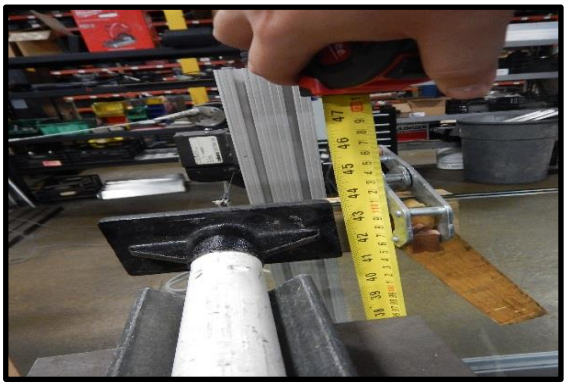
Residual Deflection at 90 lbsf

Actual Deflection of 0.07 in

Initial Setup: Left 2







Preload of 180 lbsf
Actual Deflection of 0.664 in

Release Test Load of 90 lbsf

Ultimate Test Load of 365 lbsf

Actual Deflection of 2.12 in

Residual Deflection at 90 lbsf

Actual Deflection of 0.073 in

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Test Specifications per ASTM E985	
	System Calculations
Pre Load	**180 (lbsf)**
Released Test Load	**90 (lbsf)**
Ultimate Test Load	**365 (lbsf)**
Deflection Specifications Per ASTM E985	
Max Mid Deflection	**(h/24)+(l/96) = 2.25 in**
Max Left Deflection	**(h/12) = 3.5 in**
Residual Deflection (At RTL)	**20% of MD = 0.45 in**

Results

Load (lbsf)	Displacement (in.)			Test AVG
	Midrail	Left	Left 2	
Preload	0.549	0.734	0.756	0.6797
RTL	0	0	0	0.0000
150	0.376	0.492	0.499	0.45566667
200	0.687	1	0.942	0.8337
250	1.027	1.312	1.375	1.2380
300	1.346	1.754	1.795	1.6317
UTL	1.785	2.299	2.347	2.1437
RD	0.045	0.005	0.029	0.0263

Notes

Midrail at 0 lbf = 4.38 in

Potentiometer cannot be zeroed, so calculations are done manually

Shoe mounted to steel

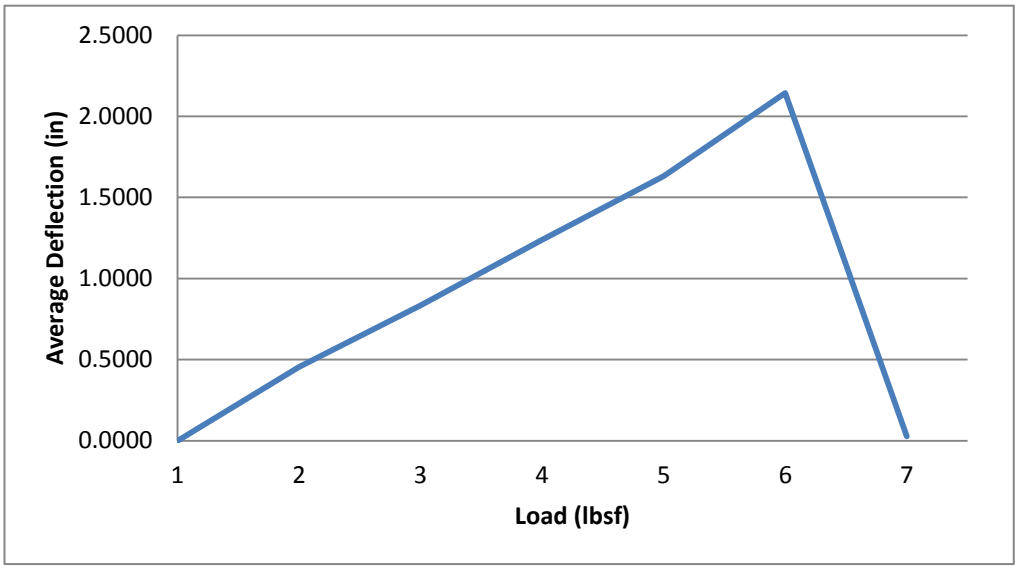
Conclusions

Rail meets ASTM Standard for Max. Allowed Deflection for Mid

Rail meets ASTM Standard for Residual Deflection

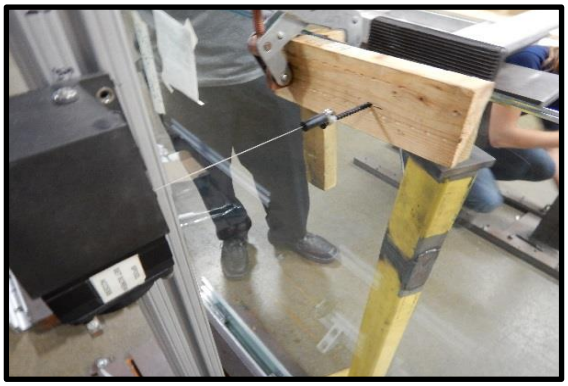
Rail meets ASTM Standard for Max. Allowed Deflection for Left 1

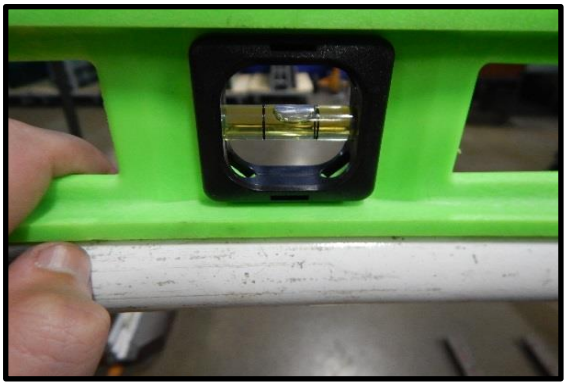
Rail meets ASTM Standard for Max. Allowed Deflection for Left 2



TEST PHOTOS

Initial Setup: Mid

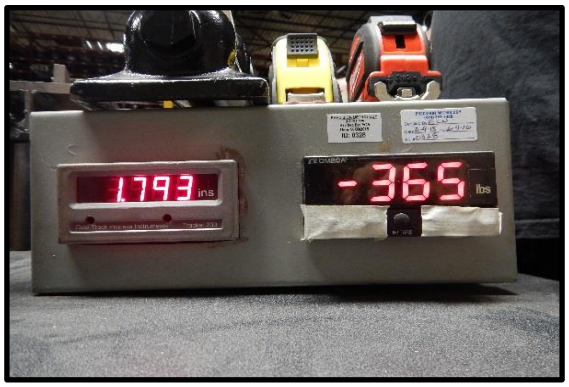




Preload of 180 lbsf
Actual Deflection of 0.549 in

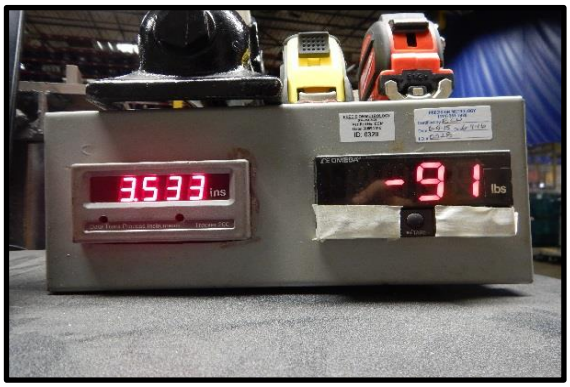
Release Test Load of 90 lbsf

Ultimate Test Load of 365 lbsf
Actual Deflection of 1.785 in

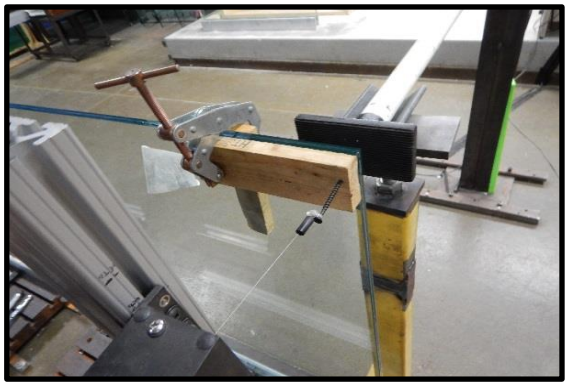


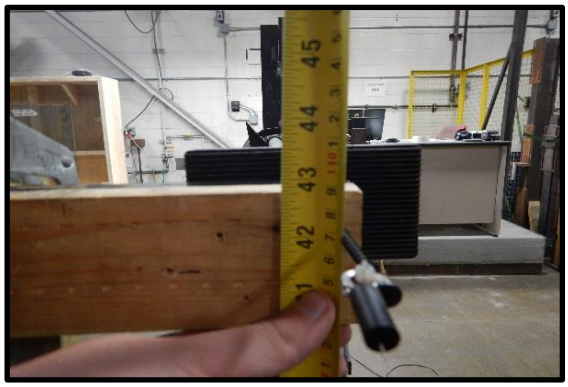
Residual Deflection at 90 lbsf

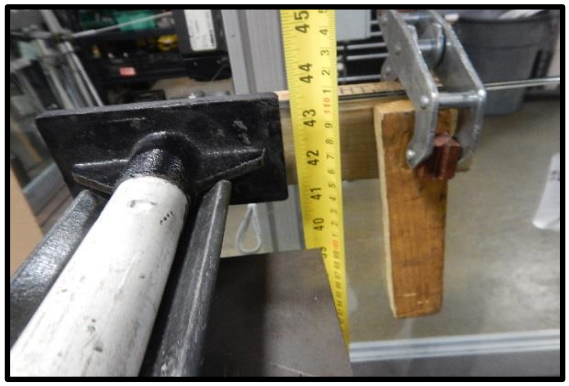
Actual Deflection of 0.045 in



Initial Setup: Left 1







Preload of 180 lbsf

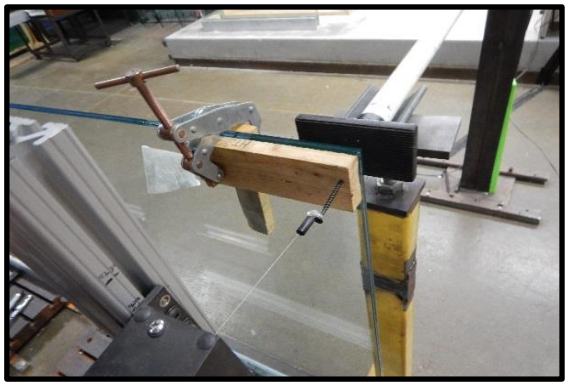
Actual Deflection of 0.734 in

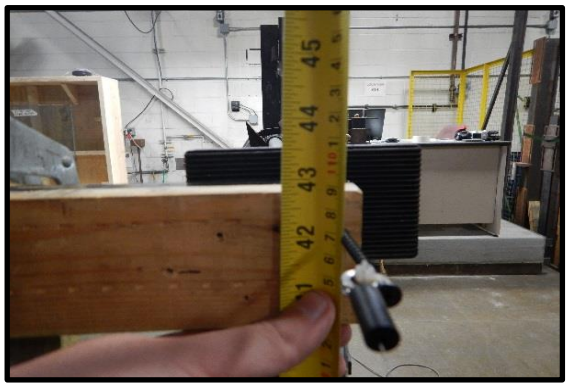
Release Test Load of 90 lbsf

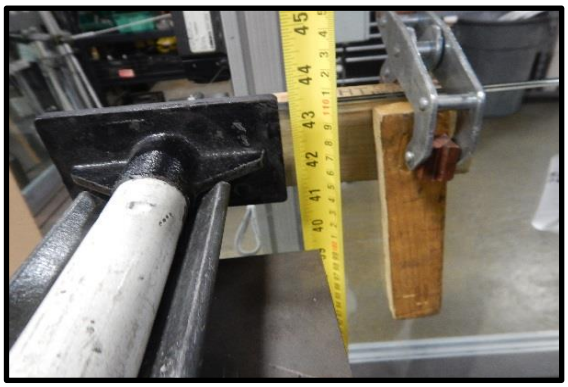
Ultimate Test Load of 365 lbsf

Actual Deflection of 2.299 in

Initial Setup: Left 2







Preload of 180 lbsf
Actual Deflection of 0.756 in

Release Test Load of 90 lbsf

Ultimate Test Load of 365 lbsf

Actual Deflection of 2.347 in

Residual Deflection at 90 lbsf

Actual Deflection of 0.029 in