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EVALUATION OF RAILING BASE SHOE

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DESCRIPTION AND PURPOSE

R&B Wagner requested that Stork Technimet evaluate a base shoe used in commercial railings. The base shoe was a 4 inch tall, 2.5 inch wide aluminum channel. Each base shoe was four feet long, and had four countersunk holes through the bottom, spaced 12 inches apart. This base shoe is designed to be used with a 1/2 inch thick, tempered glass panel as an infill. The infill is secured to the base shoe with plastic isolators and Panel Grips™.

The base shoes were tested according to ASTM E 935, “Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.” Generally, this specification is used to evaluate an entire railing, but was used to evaluate the base shoe only for this work. A steel railing was substituted for the glass panel, per the request of R&B Wagner, so that larger loads could be safely applied to the base shoe. The deflection was to be measured at the top of the rail, and evaluated against the criteria in ASTM E 985, Standard Specifications for Permanent Railing Systems and Rails for Buildings.

CONCLUSIONS

Three base shoes were tested with the substitute steel railing, two samples with a corner load, and one sample with a center load. One additional base shoe was tested with a glass panel and a center load. Deflections ranged from 1.18 inches to 1.54 inches at 365 pounds. These were less than the maximum allowable.

The residual deflections after the four tests ranged from 0.06 to 0.18 and were less than the maximum allowable residual deflection for each test.

The three steel samples were over loaded to 550 pounds. The deflections ranged from 2.66 to 2.92 inches. The glass sample was over loaded to 485 pounds and the deflection was 2.37 inches.

The deflection in the base shoe was measured and deflections ranged from 0.007 to 0.064 inches. The deflection of the base shoe using a steel panel was greater than the deflection using a glass panel.

PROCEDURE AND RESULTS

Four aluminum base shoes were tested in general accordance with ASTM E935. All of the tests were performed at R&B Wagner’s facility in Butler, Wisconsin. In normal service, the infill is a half-inch thick glass panel measuring 42 inches by 48 inches. For three of these tests, a steel railing was substituted. For one test, a half inch thick glass panel measuring 40 inches by 62 inches was used. The railing was installed by R&B Wagner personnel using standard procedures for each test. On one side of the railing, four large plastic isolators were placed in the base shoe. Four sets of small isolators and aluminum Panel Grips™ were placed opposite of the large isolators and tightened.

For each test, load was applied to the railing using a winch and a turnbuckle, and the load was measured with a load cell. The displacement was measured as near as practical to the load application point with a “String Pot” or Linear Displacement Transducer (LDT). The load was applied and the deflection was measured at a height of approximately 42 inches, corresponding to the top of a typical railing. In addition, the deflection at the top of the base shoe was measured. For the sample tested with a glass panel, blocks of wood were used with c-clamps to distribute the clamping pressure. Load was applied to the c-clamp above the top of the glass at approximately 42 inches. Photographs of the test setups are provided as Figures 1 through 12.

For each test, a preload of 180 pounds was applied and held for two minutes. The preload was then released to half, or 90 pounds. This was considered to be the zero point per ASTM E935. The load was then applied in increments of approximately 50 pounds using the winch or tightening the turnbuckle until the desired load was achieved. Load and displacement were recorded continuously with an eDAQ portable data acquisition system. The load-displacement plots for each sample are provided as Figures 13 through 16. The displacements at 365 pounds varied from 1.18 to 1.54 inches for the samples. Two tests were run with the load applied at the top corner, and two at the top center. ASTM E 985 defines different deflection criteria for center loading and end loading. The results of the tests are listed in Table 1.

If you have any questions concerning the contents of this report, please contact me. It should be noted that it is our policy to retain components and sample remnants for 30 days from October 16, 2007, after which time they will be discarded. If you would like to make alternate arrangements for disposition of the material, please let me know. This project shall be governed exclusively by the General Terms and Conditions of Sale and Performance of Testing Services by Stork Technimet, Inc. a Wisconsin business corporation d.d. March 22, 2004. In no event shall Stork Technimet, Inc. be liable for any consequential, special or indirect loss or any damages above the cost of the work.

Respectfully submitted,

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Table 1

Load-Deflection Test Results

Test	Infill	Load Point	Deflections (inches)				
			At 365 lbs.	Allowable	Residual at 90 lbs.	Allowable Residual	At 550 lbs.
1	Steel	Corner	1.18	3.50	0.16	0.50	2.92
2	Steel	Corner	1.27	3.50	0.15	0.50	2.70
3	Steel	Middle	1.40	2.25	0.18	0.45	2.66
4	Glass	Middle	1.54	2.25	0.06	0.45	NA

Fig. 1 - **An overall view of the first test setup is shown. The load was applied near the corner of the rail.**

Fig. 2 - **An alternate view of the first test setup is shown.**

Fig. 3 - A close-up view of the load and deflection measurement point is shown. The deflection was measured from the back in the first test.

Fig. 4 - A close-up view of the deflection measurement point on the shoe is shown. The deflection was measured from the back in the first test.

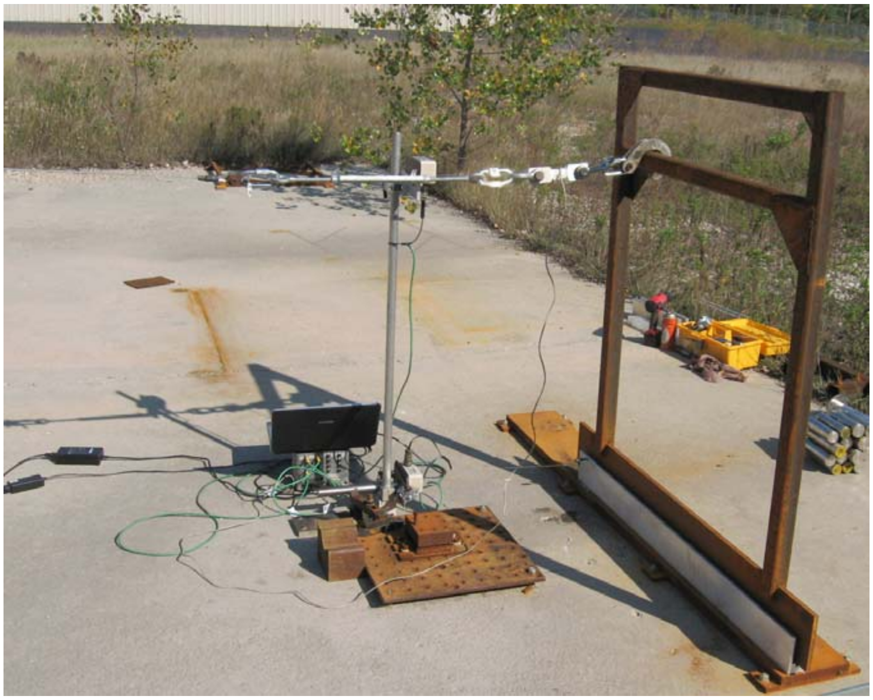

Fig. 5 - An overall view of the first test setup is shown. The load was applied near the corner of the rail.

Fig. 6 - A close up view of the load and deflection measurement point is shown. The deflection was measured from the front in the second test.

Fig. 7 - A close-up view of the deflection measurement point on the shoe is shown. The deflection was measured from the front in the second test.

Fig. 8 - An overall view of the third test setup is shown. The load was applied near the middle of the rail.

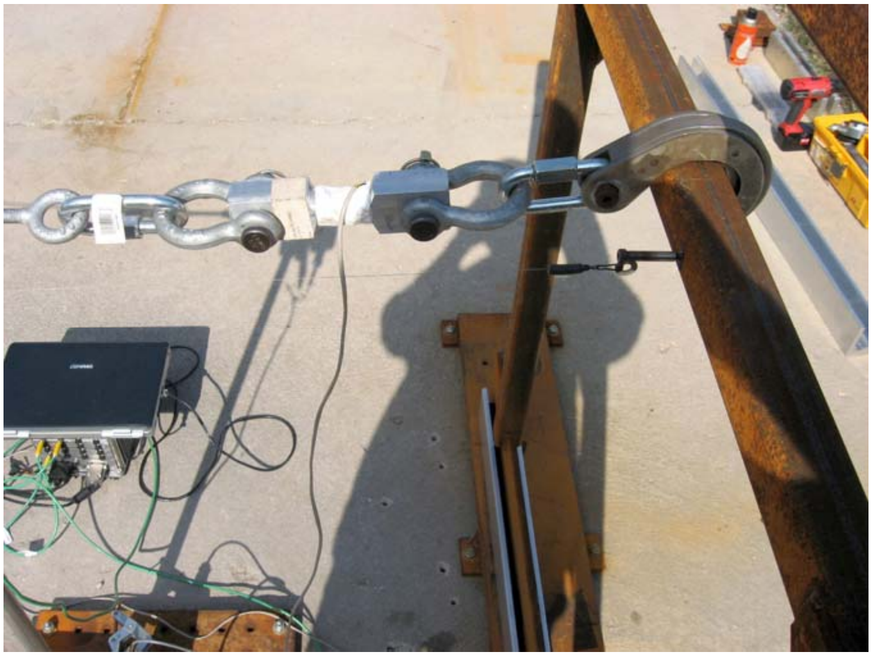

Fig. 9 - A close up view of the load and deflection measurement point is shown. The deflection was measured from the front in the third test.

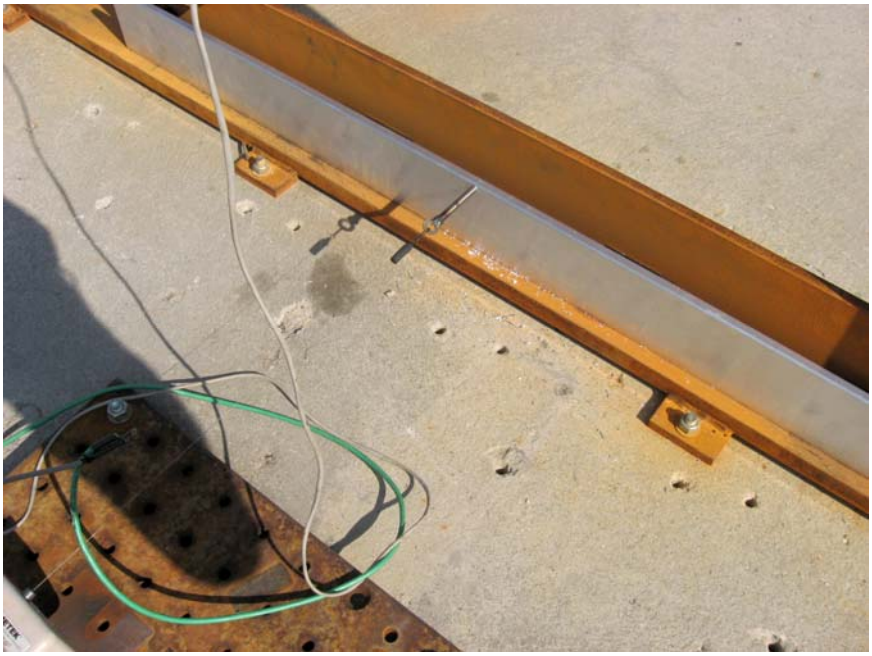

Fig. 10 - A close-up view of the deflection measurement point on the shoe is shown. The deflection was measured from the front in the third test.

Fig. 11 - An overall view of the fourth test setup is shown. The load was applied near the middle of the glass panel.

Fig. 12 - A close up view of the load and deflection measurement point is shown. Wood blocks were used to distribute the load. Deflection was measured from the front in the fourth test.

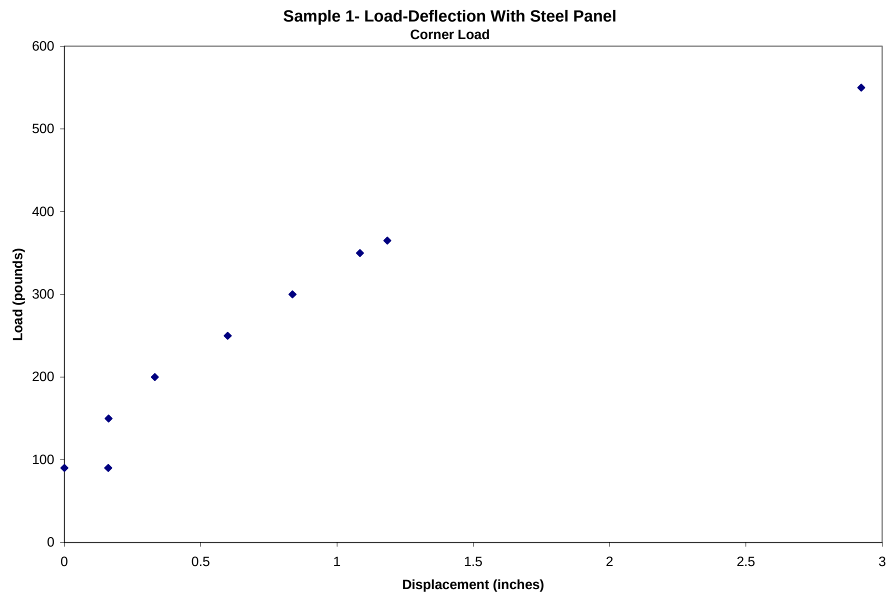

Fig. 13 - A plot of load versus deflection for sample one with a steel railing. The load was applied to the upper corner and the displacement measured from the back.

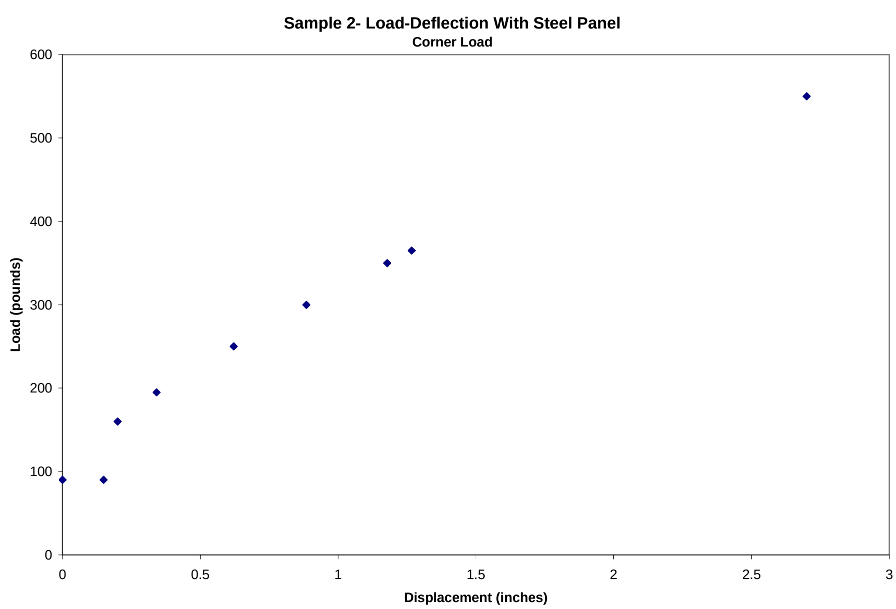

Fig. 14 - A plot of load versus deflection for sample two with a steel railing. The load was applied to the upper corner and the displacement measured from the front.

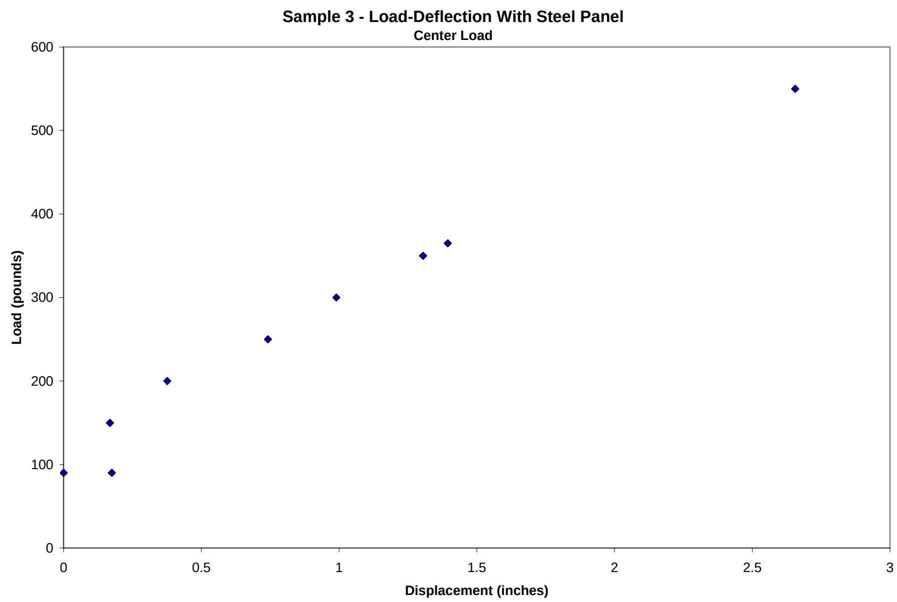

Fig. 15 - A plot of load versus deflection for sample three with a steel railing. The load was applied to the upper center and the displacement measured from the front.

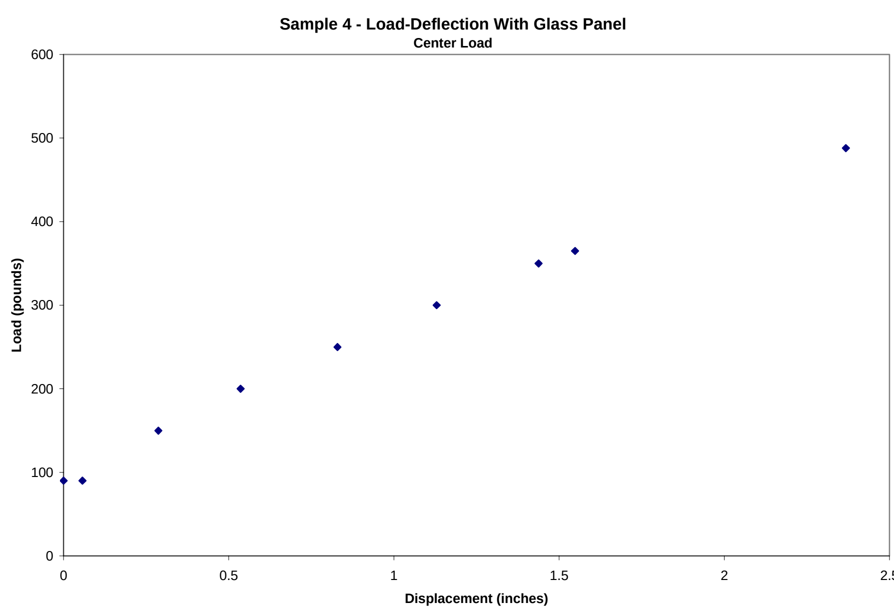

Fig. 16 - A plot of load versus deflection for sample four with a glass panel. The load was applied to the upper center and the displacement measured from the front.