PFS Test Report

PFS Test Report # 07-18

GEODECK GUARDRAIL SYSTEM
FOR
LDI COMPOSITES
GREEN BAY, WISCONSIN

By:
PFS Corporation
1507 Matt Pass
Cottage Grove, WI 53527

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TL-109

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GEODECK GUARDRAIL SYSTEM
FOR
LDI COMPOSITES
GREEN BAY, WISCONSIN

GENERAL

The PFS Corporation, Madison, Wisconsin, performed client requested testing services for LDI Composites, Green Bay, Wisconsin. The testing was performed in accordance with procedures and methods referenced in ICC-ES, AC 174, "*Acceptance Criteria for Deck Board Span Ratings and Guardrail Systems" (*March 1, 2006), Section 5.1, and ASTM D7032, Sections 6.2.2, 6.2.3, and 6.2.4. The guardrail system test samples were received in good order at PFS Laboratory on May 9th 2006. The testing was performed from May 25, 2007 through July 9, 2007.

TEST SPECIMEN

The test material was identified by the client as the "GeoDeck" composite guardrail system, which consists of Top Rail, Hollow Balusters, and Bottom Rail. PFS staff assembled three 8-ftx42 inch assembles. The guardrail system was assembled by inserting an aluminum stiffener into Top Rail, securing with galvanized end plates, placing Balusters into Top Rail and Bottom Rail, and mounting rail onto treated 4x4 posts surrounded by a Post Sleeve.
(*See attached installation instructions for details of each installation type*).

CONDITIONING

All specimen components were conditioned prior to testing in an environment of 68° ± 4°F and 50 % ± 5% relative humidity for 40 hours. Testing was conducted in the laboratory atmosphere of approximately 71°F and 52% relative humidity.

GUARDRAIL PERFORMANCE TESTS

The test specimen was defined as two simulated end walls at 8-ft. center of post to center of post, all components and all connections as described in the manufacturer's installation instructions. The test specimen was subjected to the in-fill load test (Section 6.2.2), the uniform load test (Section 6.2.3), and the concentrated-load test (Section 6.2.4), in that order. The specimen was loaded at a rate to achieve the specified loads between 10 seconds and 5 minutes.

Flexural Strength - End Use Adjustments

Third-point load flexure testing was conducted to verify the flexural strength of each guardrail component at ambient and high temperature (+125°F) service conditions. The flexural strength and stiffness were determined in accordance with Section 4.1.1 and the average change in properties between the ambient tests and the high temperature tests were calculated as a percentage and reported. The model code prescribed guardrail test loads were increased proportionately to the flexural strength loss test results data.

In-fill Load

The test specimen must be capable of satisfactorily resisting a load of 139 lbf applied over a one square foot area normal to the in-fill. The in-fill was considered to be the load resisting elements between posts (vertical supports), such as balusters or panel fillers. The load was applied at a position on the in-fill that represented the "worst case" loading and deflection scenarios.
(See Photo 1)

The guardrail system (guard and handrail) is considered to satisfactorily pass if there is no failure, nor evidence of disengagement of any component, nor visible cracks in any component.

Uniform Load Test

The top rail of the guardrail system (guard and handrail) test specimen was subjected to two separate tests where a maximum uniform load of 1050 lbf was applied vertically and horizontally. For the purposes of this test, quarter-point loading was deemed to be equivalent to uniform loading. The guardrail system (guard and handrail) is considered to satisfactorily pass if there is no failure, nor evidence of disengagement of any component, nor visible cracks in any component.
(See Photo 2-3)

Concentrated Load Test

Three separate tests were conducted, where a test load of 555 pounds was applied at the top rail mid span between the posts and top rail adjacent to a post, and a load of 500 pounds was applied to the post. In all cases, the load was continuously applied normal to the top rail (top of guard) at the maximum guardrail system height. When the applied load reaches 200 pounds the deflection at the point of loading was recorded.
(*See Photos 4 - 6)*

The test specimens were inspected prior to testing to verify size and general condition of the materials.
(See Appendix for Detail Test Results)

RESULTS

Guardrail Performance Tests

The guardrail assembly as described herein meets the requirements of ICC-ES, AC174 (Rev., 7/2006).

REPORT REPRODUCTION

Testing Performed by:

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Lead Lab Technician

Report Reviewed by:

James Van Schoyck
Lab Administrator

Report Reviewed by:

Tests Witnessed and

Jon P. Madderom, P.E.
Lab General Manager

Dwight E. McDonald
Lab Testing Manager

PHOTO 1: In fill Test

PHOTO 2: Vertical Uniform Load Test

PHOTO 3: Horizontal Uniform Load Test

PHOTO 4: Concentrated Load Test (Mid Span)

PHOTO 5: Concentrated Load Test (Adjacent to a Post)

PHOTO 6: Concentrated Load Test (At the Post)

LDI compositres
Guardrail Performance
GeoDeck
8-ft Rail @ 42-in. height

Guardrail Performance Test	Service Temperature Adjusted Test Loads (lbf)*	Load Applied Net Deflection (in.)	AC 174 Requirement	AC 174 Compliance
Baluster (In-Fill) Load Test	139	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Uniform Load Horizontal - Top Rail Test	1050	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Vertical - Top Rail Test	1050	N/A		
Concentrated Load - Top Rail at Midspan	200	0.656	**Ref. 1. below**	**YES**
	555	1.555		
Concentrated Load - Adjacent to Post	200	0.044	**Ref. 2. below**	**YES**
	555	0.150		
Concentrated Load - Top of Post	200	0.009	**Ref. 2. below**	**YES**
	500	0.025		

1. Rail Height is 42 in. / 24 = 1.75 plus Rail Length is 96.0 in. / 96 = 1.0. Therefore 1.75 plus 1.0 = maximum rail net deflection with load applied is 2.75 inches.

2. Effective Post Height is 42 inches / 12. Therefore maximum post net deflection with load applied is 3.5 inches.

TABLE 1

LDI compositres
Guardrail Performance
GeoDeck
8-ft Rail @ 42-in. height

Guardrail Performance Test	Service Temperature Adjusted Test Loads (lbf)*	Load Applied Net Deflection (in.)	AC 174 Requirement	AC 174 Compliance
Baluster (In-Fill) Load Test	139	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Uniform Load Horizontal - Top Rail Test	1050	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Vertical - Top Rail Test	1050	N/A		
Concentrated Load - Top Rail at Midspan	200	0.641	**Ref. 1. below**	**YES**
	555	1.400		
Concentrated Load - Adjacent to Post	200	0.037	**Ref. 2. below**	**YES**
	555	0.115		
Concentrated Load - Top of Post	200	0.004	**Ref. 2. below**	**YES**
	500	0.018		

1. Rail Height is 42 in. / 24 = 1.75 plus Rail Length is 96.0 in. / 96 = 1.0. Therefore 1.75 plus 1.0 = maximum rail net deflection with load applied is 2.75 inches.

2. Effective Post Height is 42 inches / 12. Therefore maximum post net deflection with load applied is 3.5 inches.

TABLE 2

LDI compositres
Guardrail Performance
GeoDeck
8-ft Rail @ 42-in. height

Guardrail Performance Test	Service Temperature Adjusted Test Loads (lbf)*	Load Applied Net Deflection (in.)	AC 174 Requirement	AC 174 Compliance
Baluster (In-Fill) Load Test	139	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Uniform Load Horizontal - Top Rail Test	1050	N/A	No failure, nor evidence of disengagement of any component, nor visible cracks in any component.	**YES**
Vertical - Top Rail Test	1050	N/A		
Concentrated Load - Top Rail at Midspan	200	0.635	**Ref. 1. below**	**YES**
	555	1.771		
Concentrated Load - Adjacent to Post	200	0.039	**Ref. 2. below**	**YES**
	555	0.128		
Concentrated Load - Top of Post	200	0.001	**Ref. 2. below**	**YES**
	500	0.022		

1. Rail Height is 42 in. / 24 = 1.75 plus Rail Length is 96.0 in. / 96 = 1.0. Therefore 1.75 plus 1.0 = maximum rail net deflection with load applied is 2.75 inches.

2. Effective Post Height is 42 inches / 12. Therefore maximum post net deflection with load applied is 3.5 inches.

TABLE 3

LDI COMPOSITES GUARDRAIL SYSTEM TESTING
(AC 174 & ASTM D7032)
INCREASE LOAD ON ONE 8' RAIL SYSTEM

1 IN-FILL LOAD TEST* ***SECTION 6.2.2***

125 LB LOAD ON 1 SQ. FT. OF IN-FILL AREA

125 lbf x 1.11 (Temp.) (*ADJUSTMENT FACTOR*) = **139 lbf**

2 UNIFORM LOAD TEST* ***SECTION 6.2.3***

125 PLF x 7.6 FT. = 950 LBS
(*APPLIED VERTICALLY & HORIZONTALLY*)
950 lbf x 1.11 (Temp.) (*ADJUSTMENT FACTOR*) = **1,050 lbf**

3 CONCENTRATED LOAD TEST* ***SECTION 6.2.4***

500 LB APPLIED AT TOP OF RAIL MIDSPAN
500 lbf x 1.11 (Temp.) (*ADJUSTMENT FACTOR*) = **555 lbf**

4 CONCENTRATED LOAD TEST ***SECTION 6.2.4***

500 LB APPLIED AT TOP RAIL ADJACENT TO POST
500 lbf x 1.11 (Temp.) (*ADJUSTMENT FACTOR*) = **555 lbf**

5 CONCENTRATED LOAD TEST ***SECTION 6.2.4***

500 LB APPLIED AT TOP OF POST
500 LB (*NO ADJUSTMENT FACTOR APPLIED DUE TO USE OF WOOD POST*) = **500 LBS**

TABLE 4