



NSF ENGINEERING REPORT PA# 207762

Testing of the Properties of Composite Floor Material

Test Performed by:

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EXECUTIVE SUMMARY

Report Requested by

Adam M. Genei
I-Rock Industries, Inc.
702 Advance Street
Brighton, MI 48116

Testing of the Properties of Composite Floor Material

Dates of Testing: April 2004

Summary of Test Results

A composite floor material in the form of brick was received from I-Rock Industries for testing. Its physical properties such as density and water absorption were determined. Its mechanical properties including compression load, compression stress and modulus of elasticity, and flexural maximum load, modulus of rupture (referred to elasticity modulus) and shear stress (referred to flexural stress), friction coefficient as well as linear thermal expansion coefficient (LTEC) were also tested.

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Summary of Test Results

Sample	Test	Result
Composite material	Density, g/cm ³	0.972
	Water absorption, %	1.82
	Compression load, lbs	2436
	Compression stress, psi	2107
	Compression elasticity modulus, psi	25958
	Flex load(max), lbs	19.51
	Flex elasticity modulus, psi	45600
	Flex stress, psi	537
	Smooth surface static (dry)	0.22
	Smooth surface dynamic (dry)	0.05
	Smooth surface static (wet)	0.08
	Smooth surface dynamic (wet)	0.045
	Rough surface static (dry)	0.24
	Rough surface dynamic (dry)	0.17
	Rough surface static (wet)	0.24
	Rough surface dynamic (wet)	0.45
	LTEC, mm/mm, °C	2.332x10 ⁻⁵

Description of the Sample(s)

The composite material as received for test from I-Rock Industries was in brick form with a size of 6 in x 4 in x 2 in. The brick is a composite consisting of different color plastic / rubber particles. One side is smooth (as cut surface) and the other side is rough (as formed surface), see pictures below.



Smooth surface is up



Rough surface is up

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Details of the Testing

All tests performed for this job are described below. Prior to testing, the brick samples were conditioned at 73°F and 50% RH for 40hrs. The moisture content of the conditioned samples was found to be 6 ppm.

(1) Density Test

Method: 3 cubes were cut from a brick with a size of 1 in x 1 in x 1 in approximately. The dimensions to the nearest 0.001 in and weight to nearest 0.001 gram were measured. The mass divided by the volume of the cube is the density. The results of density are listed in table 1.

Table 1 Density

	Cube# 1	Cube# 2	Cube# 3
Mass, gram	19.364	18.666	18.620
Length, in	1.075	1.044	1.038
Width, in	1.072	1.052	1.072
Height, in	1.064	1.060	1.050
Density, g/cm ³	0.964	0.978	0.973
Ave. Density	0.972		

(2) Water Absorption

Method: ASTM D1037 (method B) was used. A specimen was cut from a brick with a size of 2 in x 2 in x 1 in approximately. The specimen was weighed and submerged horizontally under 1 in of distilled water for 24 hrs. After the submersion, the specimen was suspended to drain for 10min. and then removed the excess surface water, and immediately weighed the specimen. Then water absorption was calculated as following:

$$\text{Water absorption} = (W_w - W_d) / W_d \times 100\%$$

Where : W_w = Mass of the wet specimen , gram

W_d = Mass of the dry specimen, gram

In this testing, W_w = 96.56 grams

W_d = 94.83 grams

Water Absorption = 1.82%



(3) Compression Test

Compression load, compression stress and modulus of elasticity were tested by using a United Load Frame. 3 specimens with a size about 1 in x 1 in x 1 in were tested and the speed of testing was 0.01 in/min. Their results are listed in table 2 below.

Table 2 Compression Properties

Properties/Specimens	Specimen# 1	Specimen# 2	Specimen# 3	Average
Compression load, lbs	2199	2670	2440	2436
Compression stress, psi	1920	2300	2100	2107
Modulus of elasticity, psi	22857	27710	27308	25958

(4) Flexural Test

Flexural load, modulus of elasticity and flexural stress were tested by using a 5865 INSTRON Load Frame. 3 specimens with a size about 4.8in (length) x 0.48 in (width) x 0.50 in. (height) were tested. Speed of the testing was 0.05 in/min and the span was 2.50 in. The results are listed in table 3 below.

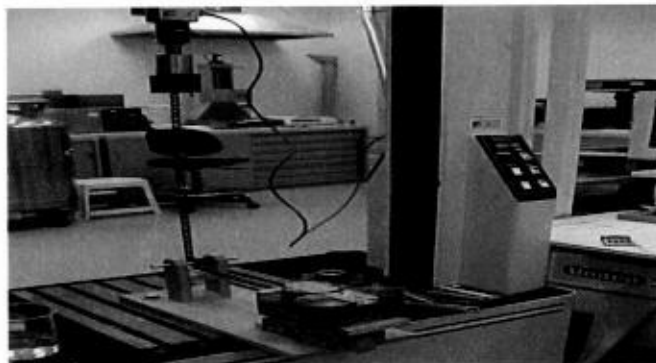
Table 3 Flexural properties

Properties/Specimens	Specimen# 1	Specimen# 2	Specimen# 3	Average
Flexural load, lbs	20.42	14.71	23.39	19.51
Modulus of elasticity, psi	46700	41100	49000	45600
Flexural stress, psi	561	425	626	537

(5) Friction Test

ASTM D 2394 was used as reference to test both static and dynamic friction coefficients. The United Load Frame was used for the friction testing for both smooth and rough sides. Sliding unit is a piece of metal, weighing approximately 23.4 lbs. This rested against a piece of leather, 4 in by 4.5 in, attached to a wood base. Testing speed was 0.05 in/min for static friction testing and 2 in/min for dynamic friction testing. The apparatus used is shown in the picture below. When testing the wet friction coefficient, distilled water was used.

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Results of the friction test are listed in table 4 below.

Table 4 Friction Coefficients

Smooth Surface	Friction Coefficient
Static (dry)	0.22
Dynamic (dry)	0.05
Static (wet)	0.08
Dynamic (wet)	0.045
Rough Surface	
Static (dry)	0.24
Dynamic (dry)	0.17
Static (wet)	0.24*
Dynamic (wet)	0.45

* Mean of 5 tests.

(6) Linear Thermal Expansion Coefficient Test

Linear thermal expansion coefficient (LTEC) was determined by Detroit Testing Lab. Standard ASTM D696 was followed and testing temperatures were from -30°C to 30°C. The equipment used was 5V Vitreous Silica Dilatometer. Results are listed in table 5 below.

Table 5 Linear Thermal Expansion Coefficients

Samples#	LTEC, mm/mm °C	LTEC, in/in °F
1	2.329x10 ⁻⁵	
2	2.407x10 ⁻⁵	
3	2.261x10 ⁻⁵	
Average	2.332x10 ⁻⁵	0.0762x10 ⁻⁵

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