Lab. No.: J562B

SUBJECT: Testing of "Chocolate" Marble Stone Samples.

Dear Ms. Yamnitz;

At your request, we have completed the testing of the above referenced stone samples submitted to our laboratory. The test description and corresponding ASTM test method were as follows:

Test 1 - Absorption & Density- ASTM C97.

Test 2 - Compressive Strength, Dry, Wet, Loading Direction Perpendicular & Parallel to Rift – ASTM C170.

Test 3 - Flexural Strength, Dry, Wet, Loading Direction Perpendicular & Parallel to Rift – ASTM C880.

Test 4 – Modulus of Rupture, Dry, Wet, Loading Direction Perpendicular & Parallel to Rift - ASTM C99.

Test 5 – Coefficient of Friction – ASTM C1028

Test 6 – Solar Reflectance – ASTM E1980.

Test 7 – Freeze/Thaw – ASTM C67.

Test 8 – Freeze/Thaw & De-icing Salt Durability – ASTM C1645.

PROCEDURES & RESULTS

The specimens for tests 1 through 6 were prepared and tested in accordance with the above ASTM designations.

A 60 kip Instron 4486 S/N 11313J (calibration traceable to NIST) test machine was employed for tests 2 through 4.

For test7, five specimens with 2"x2"x4" were subjected to 50 cycles of freezing and thawing in accordance with modified ASTM C67 . There were no indications of, cracking, or breakage on any of the five specimens tested, and the average weight loss on completion of testing was 0.006%. The results are presented in Table VII. The specimens meet the requirements of AC51/ ASTM C67 for freeze/thaw.

PROCEDURES & RESULTS (Cont'd)

For test 8, three specimens with dimensions 6"x6"x3" were subjected to 28 cycles of freeze/thaw with specimens submerged in salt water. The tests were performed in accordance with ASTM C1645. The results for 7 day and 28 day cycles are presented in Table VIII. Based on the data, the average weight loss of the three specimens was below the maximum of 225 grams/m^2 specified in ASTM C936. The specimens meet the requirements of ASTM C936 for freeze/thaw.

The test results are presented in Tables I through VIII.

If you have any questions regarding this report, please contact the undersigned at 510 835 3142.

Respectfully Submitted,
TESTING ENGINEERS, INC.

Hossein Arbabi, Ph.D., P.E.
Senior Engineer

TABLE I
Absorption – ASTM C97
"Chocolate" Marble

Specimen No.	Absorption, %	Specific Gravity	Density, lbs/ft^3
1	0.08	2.71	169.1
2	0.08	2.71	169.1
3	0.08	2.69	167.9
4	0.08	2.69	167.9
5	0.08	2.71	169.1
Average	**0.08**	**2.70**	**168.6**

TABLE II
Compressive Strength, psi – ASTM C170
"Chocolate" Marble

Specimen No.	Compressive Strength, Dry, Perpendicular to Rift	Compressive Strength, Dry, Parallel to Rift	Compressive Strength, Wet, Perpendicular to Rift	Compressive Strength, Wet, Parallel to Rift
1	16.865	16,895	12,426	13,412
2	11,377	18,867	14,155	13,050
3	24,269	19,925	14,784	14,103
4	13,648	16,697	14,063	11,608
5	16,579	21,136	14,630	11,027
Average	**16,548**	**18,704**	**14,012**	**12,640**

TABLE III
Modulus of Rupture, psi – ASTM C99
"Chocolate" Marble

Specimen No.	Modulus of Rupture, Dry, Perpendicular to Rift	Modulus of Rupture, Dry, Parallel to Rift	Modulus of Rupture, Wet, Perpendicular to Rift	Modulus of Rupture, Wet, Parallel to Rift
1	2,256	1,121	1,613	1,350
2	1,713	1,252	1,617	1,176
3	1,822	1,036	1,701	1,364
4	1,642	1,054	1,479	1,181
5	1,828	1,267	1,930	1,512
Average	**1,852**	**1,146**	**1,668**	**1,317**

TABLE IV
Flexural Strength, psi - ASTM C880
"Chocolate" Marble

Specimen No.	Flexural Strength, Dry, Perpendicular to Rift	Flexural Strength, Dry, Parallel to Rift	Flexural Strength, Wet, Perpendicular to Rift	Flexural Strength, Wet, Parallel to Rift
1	1,306	1,100	1,375	938
2	1,389	1,086	1,324	1,035
3	1,400	1,017	1,383	987
4	1,614	984	1,300	993
5	1,348	941	1,268	868
Average	**1,411**	**1,026**	**1,330**	**964**
Stand. Dev.	**119**	**67**	**49**	**64**

Table V
Coefficient of Friction – ASTM C1028
"Chocolate" Marble

Frctional Force, lbf	
Dry	**Wet**
31.4	36.8
31.0	34.6
30.2	31.4
32.0	35.4
31.4	34.4
30.4	34.8
33.0	37.6
29.6	36.0
30.0	36.4
31.4	35.8
29.4	33.2
29.0	34.0
Average = 30.7	Average = 35.0
Average Coefficient of Friction = 0.75	**Average Coefficient of Friction = 0.67**

Table VI
Solar Reflectance - ASTM E1980
"Chocolate" Marble

Sample ID	Solar Reflectance		Thermal Emittance		Solar Reflectance Index (SRI)		
	ASTM C1549		ASTM C1371		ASTM E1980		
	Average	Std. Dev.	Average	Std. Dev.	Low Wind	Medium Wind	High Wind
Marble 6"x6"	**0.316**	**0.030**	**0.86**	**0.00**	**31**	**32**	**34**

TABLE VII
Freeze/Thaw – ASTM C67
"Chocolate" Marble

Specimen No.	Original weight, g	Weight after 50 freeze/thaw cycles, g	Weight loss, g	Percent weight loss
1	738.1	738.1	0	0
2	734.5	734.3	0.2	0.03
3	736.8	736.8	0	0
4	734.6	734.6	0	0
5	736.0	736.0	0	0
Average	**736**	**735.96**	**0.04**	**0.006**

TABLE VIII
Salt Water Exposure-freeze/thaw – ASTM C1645
"Chocolate" Marble

Specimen No.	7 Day Weight Loss, g	7 Day Weight Loss per Unit Area, g/m^2	28 Day Weight Loss, g	28 day Weight Loss per Unit Area, g/m^2
1	0.010	0.1	5.112	65.1
2	0.008	0.1	2.725	34.9
3	2.625	32.9	29.63	371.8
Average	**0.881**	**11.0**	**12.5**	**157.3**

September 20, 2017

Ms. Jackie Yamnitz
EARTHWORKS
19797 Eisenbeis Bottom Road
STE Genevieve, MO 63670

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