



October 8, 2015

Mr. Lyle Krumveide
Northfield Block Co.
3400 Bungalow Road
Morris, IL 60450

Subject: Test Results Concrete Paving Units
Product Group: 60-mm Paving Units
(Holland Stone, Moduline Series, Dublin Cobble, Buckingham Cobble, Domino,
Cambridge Cobble, Bergerac Series, Laffit Series, Mega-Libre)
Reference: ACM # 072815-2873

Dear Lyle,

Attached are the independent laboratory test results for the set of 60-mm Holland Stone paving units manufactured on April 2, 2015. These pavers are manufactured with the same mix design and are representative of the 60-mm Paving Units Product Group which includes all of the units listed in the header, above.

These pavers were tested for compliance with the compressive strength, absorption, resistance to freezing and thawing, and abrasion resistance requirements of ASTM C936-15, *Standard Specification for Solid Concrete Interlocking Paving Units*.

The compressive strength and absorption tests were conducted in accordance with ASTM C140-15, *Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units*. The resistance to freezing and thawing tests were conducted in 3% Saline solution in accordance with ASTM C1645-11, *Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units*. The abrasion resistance tests were conducted in accordance with ASTM C418-12, *Standard Test Method for Abrasion Resistance of Concrete by Sandblasting*.

The table on the next page summarizes the results and the detailed test reports follow.

This set of 60-mm Holland Stone paving units meets the compressive strength, absorption, resistance to freezing and thawing, and abrasion resistance requirements of ASTM C936.

For compressive strength and absorption, ASTM C936 requires that, when tested in accordance with Test Method C140, the average compressive strength of three units be not less than 8,000 psi, with no individual unit less than 7,200 psi. The standard also requires that the average water absorption of three units not be greater than 5%, with no individual unit greater than 7%.

For resistance to freezing and thawing, ASTM C936 requires that units that will be exposed to deicing materials in service are to be tested in 3% saline solution in accordance with Test Method C1645 and the average mass loss of all of the specimens must comply with either of the following: (a) no greater mass loss than 225 g/m² when subjected to 28 freeze-thaw cycles, or (b) no greater mass loss than 500 g/m² when subjected to 49 freeze-thaw cycles.

For abrasion resistance, ASTM C936 requires that, when tested in accordance with Test Method C418, the average volume loss not be greater than 15 cm³/50 cm² and the average thickness loss not exceed 3 mm.

If you have any questions about this report, please contact Dennis Hayes or me.

Respectively Submitted,

A handwritten signature in black ink, appearing to read 'Craig Walloch', is written over a faint yellow hexagonal background.

Craig Walloch
Vice President Technical Development



Summary of ASTM C936 Test Results
 Solid Concrete Interlocking Paving Units
 60-mm Paving Units
 Northfield Block - Morris, IL
 ACM # 072815-2873

Product Group*	60-mm Paving Units		
Paving Unit Type	60-mm Holland Stone		
Manufacturing Date	April 2, 2015		
	<u>ASTM C936 Requirement</u>	<u>Average</u>	<u>Pass/Fail</u>
<u>ASTM C140 Physical Properties</u>			
Compressive Strength (psi)	8,000 min	13,150	Pass
Absorption (%)	5% max	3.1%	Pass
Density (pcf)		140.9	
<u>ASTM C1645 Freeze-Thaw in Saline</u>			
28-Cycle Results (g/m ²)	225 max	7.5	Pass
49-Cycle Results (g/m ²)	500 max (if 28-Cycle criteria is not met)		
<u>ASTM C418 Abrasion Resistance</u>			
Volume Loss (cm ³ /50 cm ²)	15 max	1.50	Pass
Thickness Loss (mm)	3 max	0.30	Pass

* 60-mm Paving Units Product Group includes the following unit types:
 Holland Stone, Moduline Series, Dublin Cobble, Buckingham Cobble, Domino,
 Cambridge Cobble, Bergerac Series, Lafitt Series, Mega-Libre



4350 River Green Parkway, Suite 200 Duluth, Georgia 30096 phone (770) 476-3555 fax (770) 476-0213

Plant: <u>Northfield Block Co. – Morris, Illinois</u>	Job No: <u>1803-10-111</u>
Client: <u>ACM Chemistries – Mr. Craig Walloch</u>	Report No: <u>000262</u>
Lab No: <u>072815-2873</u>	Report Date: <u>8/14/15</u>
Unit ID: <u>60-mm Holland Stone Pavers, mfg.: 4/2/15</u>	Received Date: <u>8/3/15</u>
<u>Compressive Strength Test Date: 8/11/15</u>	

SUMMARY OF AVERAGE TEST RESULTS

	<u>ASTM C936</u> <u>Required</u>	<u>Result</u>	
Net Area Compressive Strength	8,000 min.	13,150	psi
Absorption	5 max.	3.1	%
Oven Dry Density	-	140.9	pcf

	<u>ASTM C140</u> <u>Required</u>	<u>Result</u>	
Length / Width	2.1 max.	2.02	
Minimum Aspect Ratio	0.60 min.	0.625	
Maximum Aspect Ratio	1.20 max.	0.626	
Average Cap Thickness	0.060 max.	0.023	in.
Thickness Variation Across Cut	0.08	Not Cut	in.

Please see the accompanying page for detailed results.

These results meet the compressive strength and absorption requirements of ASTM C936-15. Tests were performed in accordance with ASTM C140-15.



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Plant: <u>Northfield Block Co. – Morris, Illinois</u>	Job No: <u>1803-10-111</u>
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TESTING OF SOLID CONCRETE PAVING UNITS

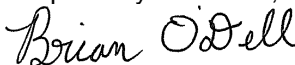
Compressive Strength – test date: 8/11/15

Specimen No.	1	2	3	Average
Received weight, lbs	5.950	5.870	5.896	5.905
Width, inches (mm)	3.859 (98.0)	3.844 (97.6)	3.849 (97.8)	3.851 (97.8)
Thickness, inches (mm)	2.413 (61.3)	2.405 (61.1)	2.410 (61.2)	2.409 (61.2)
Length, inches (mm)	7.786 (197.8)	7.774 (197.5)	7.781 (197.6)	7.780 (197.6)
Aspect Ratio	0.625	0.626	0.626	0.626
Height after capping, inches	2.465	2.446	2.455	2.455
Average cap thickness, inches	0.026	0.021	0.023	0.023
Net Area, in ²	30.05	29.88	29.95	29.96
Maximum load, lbs	337,300	412,420	416,290	388,670
Aspect Ratio Factor	1.013	1.013	1.014	1.013
Compressive Strength, psi	11,370	13,990	14,090	13,150

Absorption and Density

Specimen No.	4	5	6	Average
Received weight, lbs	5.936	5.872	5.898	5.902
Immersed weight, lbs	3.416	3.378	3.402	3.399
Saturated weight (SSD), lbs	5.978	5.940	5.948	5.955
Oven dry weight, lbs	5.806	5.744	5.774	5.775
Absorption, %	3.0	3.4	3.0	3.1
Absorption, pcf	4.2	4.8	4.3	4.4
Density, pcf	141.4	139.9	141.5	140.9

These results meet the compressive strength and absorption requirements of ASTM C936-15. Tests were performed in accordance with ASTM C140-15.

Respectfully submitted,

 Brian O'Dell
 Construction Materials Manager



4350 River Green Parkway, Suite 200 Duluth, Georgia 30096 phone (770) 476-3555 fax (770) 476-0213

Project: <u>Northfield Block Co. – Morris, Illinois</u>	Job No: <u>1803-10-111</u>
Client: <u>ACM Chemistries – Mr. Craig Walloch</u>	Report No: <u>000262</u>
Lab No: <u>072815-2873</u>	Report Date: <u>10/2/15</u>
Unit ID: <u>60-mm Holland Stone Pavers, mfg.: 4/2/15</u>	Received Date: <u>8/3/15</u>

Freeze-Thaw Testing of Concrete Pavers – ASTM C1645-11

Specimen No.	7	8	9	Average
Received weight, g	2,681	2,673	2,651	2,668
Width, mm	98.0	98.3	97.9	98.1
Height, mm	61.5	61.7	60.7	61.3
Length, mm	197.9	197.6	197.7	197.7
Total surface area, m ²	0.0752	0.0754	0.0746	0.0751
Mass loss at 7 cycles, g	0.2	0.1	0.2	0.2
Loss at 7 cycles, g/m ²	2.7	1.3	2.7	2.2
Mass loss at 28 cycles, g	0.5	0.9	0.3	0.6
Loss at 28 cycles, g/m ²	6.6	11.9	4.0	7.5

Notes:

- These results comply with the freeze-thaw resistance requirements of ASTM C 936-15.
- Tests were performed in accordance with ASTM C1645-11.
- The tests were performed in 3% saline solution.
- The freeze-thaw cycles were started on 9/4/15.

Respectfully submitted,

Brian O'Dell
Materials Laboratory Manager

October 7, 2015

Mr. Craig Walloch
ACM Chemistries, Inc.
3190 Reys Miller Road, Suite 100
Norcross, GA 30071

Phone: (770) 417-3490
Fax: (770) 417-3491
Email: cwalloch@acmchem.com

Subject: **Report for Abrasion Resistance of Paving Units**
Sample Identification: ACM # 072815-2873
TEC Project No: TEC 14-1137
TEC Laboratory ID: 15-1060

Dear Mr. Walloch:

Testing, Engineering and Consulting Services, Inc. (TEC Services) is an AASHTO R18, ANS/ISO/IEC 17025:2005, and Army Corps of Engineers accredited laboratory. TEC Services is pleased to present this report of the abrasion resistance testing performed on the paving units delivered to our Lawrenceville, Ga. laboratory in September of 2015. TEC Services performed this testing in accordance with the term and condition stated in our Service Agreement (TEC-PRO-14-1137) dated August 25, 2014.

A set of two paving units, identified as ACM # 072815-2873, were provided for abrasion resistance testing. The abrasion resistance testing was performed in accordance with ASTM C418-12 *Standard Test Method for Abrasion Resistance of Concrete by Sandblasting*. The samples were immersed in water for 24 hours prior to testing and were tested in the saturated, surface dry condition. The traffic surface of the each sample was abraded with ASTM C778 20-30 standard graded sand at 59.7 psi for one minute. A shield with a 1 in² circular opening was used to isolate the test area. Upon completion of testing any dust or fine particles were removed using compressed air. The abrasion was performed on each brick unit in four locations for a total of eight locations. Volume loss determinations were performed using standard clay as specified in ASTM C418. The test results are reported in Table 1. All test results pertain only to the samples tested.

Table 1 – ASTM C418 - Abrasion Resistance Test Results

Sample ID & Test Area	Clay Supply Initial Weight, (g)	Final Weight of Clay Supply, (g)	Weight of Clay in Cavity, (g)	Volume of Clay per Cavity, (cm³)	Abrasion Coefficient, (cm³/cm²)
15-1060-1A (2873-1)	21.190	20.773	0.417	0.233	0.037
15-1060-1B (2873-1)	20.773	20.313	0.460	0.257	0.040
15-1060-1C (2873-1)	20.313	19.871	0.442	0.247	0.039
15-1060-1D (2873-1)	19.871	19.516	0.355	0.199	0.031
15-1060-2A (2873-2)	19.516	19.244	0.272	0.152	0.024
15-1060-2B (2873-2)	19.244	18.995	0.249	0.139	0.022
15-1060-2C (2873-2)	18.995	18.727	0.268	0.150	0.024
15-1060-2D (2873-2)	18.727	18.458	0.269	0.150	0.024
Average of 8 Areas					0.030

The samples tested had an average abrasion coefficient of 1.5 cm³/50cm², which is less than the allowed 15 cm³/50cm² referenced in Section 5.6 of ASTM C936-12 *Standard Specification for Solid Concrete Interlocking Paving Units*.

Testing, Engineering and Consulting Services, Inc. appreciates the opportunity to provide our professional services for this important project. If you have any questions regarding this report, or if we can be of further assistance please contact us at 770-995-8000.

Sincerely,

Testing, Engineering & Consulting Services, Inc.



Chip P. Sherwood Jr.
 Laboratory Technician



Shawn P. McCormick
 Laboratory Principal