Miller
Material Co.

2405 East 85th Street
Kansas City, MO 64132-2600
Phone: (816) 444-2244
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Oldcastle®

November 1, 2016

Project: John Knox Village Lee's Summit, MO
Contractor: Builders Stone & Masonry

Certification

The Concrete masonry units (CMU) produced by Miller Material have the following equivalent thickness fire rating.

8x8x16 Normal weight 1.5 hour fire rating

This assessment is based on a calculated analysis of our units conforming to ASTM C-90. Testing in accordance with ASTM C-140 is used to determine the units Equivalent Thickness and Percent Solid. These values along with the aggregate type (ASTM-C33) determine the Fire Resistance Rating.

Should you have any further questions contact me at 816-444-2244.

Respectfully Submitted,

Doug Cohee
Masonry Sales
Miller an Oldcastle co,
Phone: (816) 444-2244
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NATIONAL CONCRETE MASONRY ASSOCIATION
Sustainable Concrete Products for Structures and Hardscapes

13750 Sunrise Valley Drive
Herndon, VA 20171-4662
703.713.1900
Fax: 703.713.1910
www.ncma.org

February 12, 2016

Todd Yuncker
Miller Material Co. - Oldcastle
2405 E 85th Street
Kansas, MO 64132

Please find enclosed a copy of a test report that we performed at your request on the following product that you supplied to the NCMA Research and Development Laboratory:

8 x 8 x 16 inch Concrete Masonry Unit
Mark: '8 x 8 x 16 Regular NW'
Made: 10/12/2015
NCMA Job Number: 15-528-4A

We are pleased to report that the tested properties from this report comply with the applicable requirements of ASTM C90-15, Standard Specification for Loadbearing Concrete Masonry Units.

The attached report includes the tested compressive strength of the concrete masonry unit. The compressive strength of masonry constructed using these units can be calculated using the Unit Strength Method as outlined in Section 1.4.B.2.b of Specification for Masonry Structures (TMS 602-13 / ACI 530.1-13 / ASCE 6-13). It should be noted that as a result of industry research, the Unit Strength Method was recalibratied in the 2013 edition of the Specification for Masonry Structures, reducing the conservatism in the calculated compressive strength of masonry that was present in previous editions. Because jurisdictions adopt model codes at different times, the calculated values using both the 2011 and the 2013 Specification for masonry structures is provided below.

In accordance with the Unit Strength Method, the compressive strength of masonry is a function of unit strength and mortar type. As shown in the attached test report...

Net Area Compressive Strength of
8 x 8 x 16 inch Concrete Masonry Unit — 3660 psi
Mark: '8 x 8 x 16 Regular NW'
Made: 10/12/2015

Therefore, the net area compressive strength of masonry when these units are used, can be considered to be the following:

	TMS 602-13/ ACI 530.1-13/ ASCE 6-13		*TMS 602-11/ ACI 530.1-11/ ASCE 6-11*	
	Net Area Compressive Strength		Net Area Compressive Strength	
When used with:	of Masonry		of Masonry	
Type M or S mortar	2660	psi	2450	psi
Type N mortar	2320	psi	2310	psi

The values provided above can be compared directly to the specified compressive strength of masonry, f'_m. If these values exceed f'_m, compliance has been documented.

As mentioned before, the Unit Strength Method is a conservative method for determining compliance with the specified compressive strength of masonry when compared against the alternative Prism Test Method that may also be used. The results from the Prism Test Method will likely exceed the values calculated values of the Unit Strength Method.

Sincerely,

Nicholas R. Lang
Director of Research & Development

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ASTM C140/C140M-15 Test Report
Sampling and Testing Concrete Masonry Units and Related Units

Job No.: 15-528-4A
Report Date: 2/12/2016

Client: Miller Material Co. - Oldcastle
Address: 2405 E 85th Street
Kansas, MO 64132

Testing Agency: National Concrete Masonry Association
Research and Development Laboratory
Address: 13750 Sunrise Valley Drive
Herndon, VA 20171-4662

Standard Specification: ASTM C90-15

Sampling Party: Miller Material Co. - Oldcastle

Unit Description:
8 x 8 x 16 inch Concrete Masonry Unit
Mark: '8 x 8 x 16 Regular NW'
Made: 10/12/2015

Date Samples Received: 11/20/2015

Summary of Test Results

Physical Property	ASTM C90-15 Specified Values	Average Test Results		Physical Property	ASTM C90-15 Specified Values	Average Test Results	
Net Compressive Strength	2000 min	3660	psi	Min. Faceshell Thickness (t_{fs})	1.25 min	1.28	in.
Gross Compressive Strength	****	1780	psi	Min. Web Thickness (t_w)	0.75 min	1.02	in.
Density	****	131.5	pcf	Equivalent Web Thickness	****	2.34	in.
Absorption	13 max	8.5	pcf	Normalized Web Area (A_{wn})	6.5 min	26.5	$in.^2/ft^2$
Percent Solid	****	48.6	%	Equivalent Thickness	****	3.72	in.
Net Cross-Sectional Area	****	58.13	$in.^2$	Max. Var. from Spec. Dimensions	.125 max	0.080	in.
Gross Cross-Sectional Area	****	119.61	$in.^2$				

Individual Unit Test Results

Compression		Received	Cross-Sectional Area *		Max.	Compressive Strength	
	Specimen	Weight	Gross	Net	Load	Gross	Net
Units	No.	lb	in^2	in^2	lb	psi	psi
	#1	34.34	119.61	58.13	222290	1860	3820
	#2	34.58	119.61	58.13	220080	1840	3790
Date Tested:	#3	34.38	119.61	58.13	195530	1630	3360
12/1/2015	Average	34.43	119.61	58.13	212630	1780	3660

* Unit areas determined as the average of the three absorption units and are assumed to be the same as those units tested in compression.

Absorption	Specimen	Avg Width	Avg Height	Avg Length	Avg./Min. Face Shell Thickness	Min. Web Thickness	Minimum Web Area	Normalized Web Area
Units	No.	in.	in.	in.	in.	in.	$in.^2$	$in.^2/ft^2$
	#4	7.64	7.69	15.62	1.29	1.02	23.45	26.4
	#5	7.66	7.71	15.65	1.28	1.02	23.57	26.5
Date Tested:	#6	7.65	7.70	15.65	1.29	1.02	23.53	26.5
11/24/2015	Average	7.65	7.70	15.64	1.28	1.02	23.52	26.5

**Where the thinnest points of opposite face shells differ in thickness by less than 0.125 inches, their measurements are averaged.

Date Tested:	Specimen No.	Received Weight lb	Immersed Weight lb	Saturated Weight lb	Oven-Dry Weight lb	Absorption pcf	Density pcf	Net Volume ft^3	Percent Solid %
11/25/2015	#4	34.58	20.17	36.28	34.12	8.4	132.2	0.2582	48.6
to	#5	34.38	20.01	36.18	33.94	8.6	131.0	0.2591	48.5
11/27/2015	#6	34.56	20.13	36.32	34.12	8.5	131.5	0.2595	48.7
	Average	34.51	20.10	36.26	34.06	8.5	131.5	0.2589	48.6

Comments: 1) These units meet or exceed the compression strength, absorption and dimensional requirements of ASTM C90-15.

Nicholas R. Lang
Director of Research & Development

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ASTM C426-10 Test Report
Linear Drying Shrinkage of Concrete Masonry Units

Job No.: 15-528-4B
Report Date: 2/12/2016

Client: Miller Material Co. - Oldcastle
Address: 2405 E 85th Street
Kansas, MO 64132

Testing Agency: National Concrete Masonry Association
Research and Development Laboratory
Address: 13750 Sunrise Valley Drive
Herndon, VA 20171-4662

Unit Specification: ASTM C90-15

Sampling Party: Miller Material Co. - Oldcastle

Unit Size and Description:
8 x 8 x 16 inch Concrete Masonry Unit
Mark: '8 x 8 x 16 Regular NW'
Made: 10/12/2015

Date Samples Received: 11/20/2016
Date Testing Started: 1/7/2016

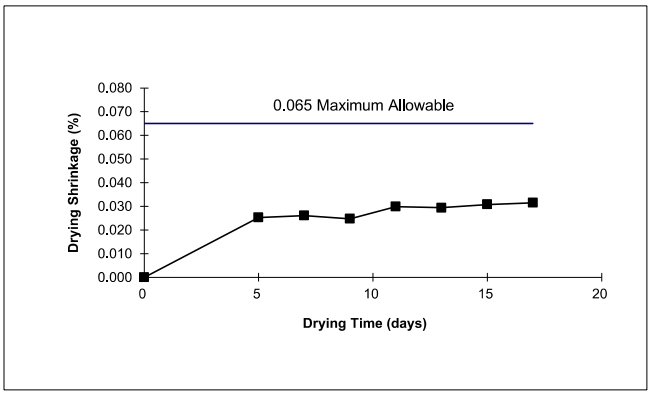
One face shell from each of three units was saw-cut from submitted specimens for the purpose of testing in accordance with ASTM C426-10.

Each reported value represents an average of calculated shrinkage values from measurements taken on each of two sides of the three specimens.

	Unit #1		Unit #2		Unit #3		Average	
	Weight (lbs)	Linear Drying Shrinkage (%)	Weight (lbs)	Linear Drying Shrinkage (%)	Weight (lbs)	Linear Drying Shrinkage (%)	Weight (lbs)	Linear Drying Shrinkage (%)
Saturated	6.84	—	7.13	—	6.62	—	6.87	—
5 Days	6.52	0.025	6.78	0.026	6.30	0.024	6.53	0.025
7 Days	6.51	0.027	6.77	0.028	6.30	0.023	6.53	0.026
9 Days	6.51	0.025	6.77	0.027	6.30	0.023	6.53	0.025
11 Days	6.51	0.030	6.77	0.032	6.60	0.027	6.62	0.030
13 Days	6.51	0.031	6.76	0.031	6.29	0.026	6.52	0.029
15 Days	6.51	0.032	6.76	0.033	6.29	0.027	6.52	0.031
17 Days	6.51	0.033	6.76	0.034	6.29	0.028	6.52	0.031

Final Linear Drying Shrinkage, S (%)

Unit #1	Unit #2	Unit #3	Average
0.032	0.033	0.027	**0.031**



Note: Final linear drying shrinkage, S, is calculated by averaging the final length measurement at equilibrium with the previous two measurements for each specimen.

Comments: 1) These units comply with the drying shrinkage requirements of ASTM C90-15.

Nicholas R. Lang
Director of Research and Development

Perlite Loose-Fill Masonry Insulation

Perlite, an inorganic mineral, is as permanent as the walls it insulates.

The physical character of expanded perlite lends itself to a variety of special purposes – including use as loose-fill masonry insulation. For a detailed explanation of perlite expansion, see Infosheet: "Why Perlite Works"

PROPERTIES & BENEFITS

Insulation: Thermal performance tests have shown significant energy savings when perlite is used to fill the cavities in concrete masonry structures.

Standards, Specifications and References:

Perlite is represented in the standards by ASTM product specification C549. The ASTM test methods used to evaluate loose-fill Perlite insulation are listed below.

- ASTM C549 "Specification for Perlite Loose-Fill Insulation"
- ASTM C520 "Test Methods for Density of Granular Loose Fill Insulations"
- ASTM C1363 "Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus"
- ASTM E 84 "Test Method for Surface Burning Characteristics of Building Materials"
- ASTM E 136 "Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C"

Non-Combustible: Perlite attributes—

- The temperature range for perlite fusion is 2,300-2,450°F (1,260-1343°C).
- Perlite is a Class A, Class 1 building material
- Flame spread 0; Smoke density 0

4 Hour Fire Ratings: Underwriters Laboratories Design No. U905 shows that a 2 hour rated 8, 10, or 12 inch (20, 25, or 30 cm) concrete block wall is improved to four hours when cores are filled with perlite. UL Designs U901, U904, and U907 also achieve 4 hour fire ratings.

TABLE 1

R AND U-VALUES FOR CONCRETE BLOCK ASSEMBLIES WITH AND WITHOUT PERLITE

BLOCK SIZE	BLOCK TYPE	Perlite Fill	R-Value	U-Value
6 in. (15cm)	Lightweight	No **Yes**	2.59 **5.24**	0.39 **0.19**
8 in. (20cm)	Lightweight	No **Yes**	2.86 **6.95**	0.35 **0.14**
10 in. (25cm)	Lightweight	No **Yes**	3.06 **8.46**	0.33 **0.12**
12 in. (30cm)	Lightweight	No **Yes**	3.11 **9.90**	0.32 **0.10**
6 in. (15cm)	Heavyweight	No **Yes**	1.80 **2.58**	0.56 **0.39**
8 in. (20cm)	Heavyweight	No **Yes**	1.96 **3.26**	0.51 **0.31**
10 in. (25cm)	Heavyweight	No **Yes**	2.08 **3.82**	0.48 **0.26**
12 in. (30cm)	Heavyweight	No **Yes**	2.14 **4.32**	0.47 **0.23**

1 R-values with units $ft^2 \cdot hr \cdot °F/Btu$ were calculated using the Isothermal Planes Method described in the *ASHRAE Handbook of Fundamentals*. The U-value with units $Btu/ft^2 \cdot hr \cdot °F$ is the reciprocal of the R-value. The R-values and U-values include interior and exterior air-film resistances that total R 0.85.

2 R-values are based on apparent thermal conductivity for loose-fill perlite of 0.32 $Btu \cdot in./ft^2 \cdot hr \cdot °F$, thermal conductivity of 2.97 $Btu \cdot in./ft^2 \cdot hr \cdot °F$ for light-weight concrete and 8.93 $Btu \cdot in./ft^2 \cdot hr \cdot °F$ for normal-weight concrete.

3 Block Density: Lightweight block nominal - 85 lbs/ft^3 (1.36 kg/l); Heavyweight block nominal -135 lbs/ft^3 (2.16 kg/l)

4 RSI = R/5.678

Perlite Loose-Fill Masonry Insulation

Permanent: Perlite is an inorganic, naturally occurring mineral and is as permanent as the walls which contain it. It supports its own weight and will not settle or bridge.

Economical: Perlite loose-fill masonry insulation offers excellent thermal and fire resistant properties at an economical cost. It is lightweight and pours easily and quickly without requiring special equipment or skills.

TABLE 2

THERMAL RESISTANCE VALUES for VENEER and CAVITY WALL CALCULATIONS

	R Values ($^{\circ}F \cdot ft^2 \cdot h/Btu$)	R Values ($K \cdot m^2/W$)
Outside Air Film	0.17	0.03
Common Brick (w/ holes)	0.20	0.04
Face Brick (no holes)	0.44	0.08
Air Space in Cavity 3/4 to 4 in (19-102 mm)	0.97	0.17
1 inch (2.5 mm) cavity filled w/ perlite	3.12	0.55
2 inch (5.1 mm) cavity filled w/ perlite	6.25	1.10
3 inch (7.7 mm) cavity filled w/ perlite	9.38	1.65
4 inch (10.3 mm) cavity filled w/ perlite	12.5	2.20
Reflective Air Space	3.08	0.54
Furring (nonreflective air space)	1.01	0.18
Gypsum or Plaster Board 1/2 inch (13 mm)	0.45	0.08
Gypsum or Plaster Board 5/8 inch (16 mm)	0.56	0.10
Inside Air Film	0.68	0.12

Perlite Institute, Inc.
www.perlite.org • (717) 238-9723

Perlite Loose-Fill Masonry Insulation

INSTALLATION GUIDE

TABLE 3

APPROXIMATE PERLITE MASONRY BLOCK LOOSE-FILL COVERAGE: BY AREA*
NUMBER OF 4 ft³ BAGS REQUIRED (4 ft³ EQUALS ~ 110 LITERS)

	CORE FILL: BLOCK SIZE			**CAVITY FILL**: CAVITY WIDTH		
WALL AREA ft² (m²)	6 INCH (15cm)	8 INCH (20cm)	12 inch (30cm)	1 INCH (2.5cm)	2 INCH (5.0cm)	3 INCH (7.5cm)
1,000 (93)	46	65	118	21	42	62

APPROXIMATE PERLITE MASONRY BLOCK LOOSE-FILL COVERAGE: BY BLOCK COUNT*
COVERAGE PER 4ft³ BAG (4 ft³ EQUALS ~ 110 LITERS)

	12-INCH (30cm) BLOCK	10-INCH (25cm) BLOCK	8-INCH (20cm) BLOCK	6-INCH (15cm) BLOCK
Number of Blocks Filled	9	13	17	23
	1 INCH (2.5cm) CAVITY	1.5 INCH (3.9cm) CAVITY	2 INCH (5.1cm) CAVITY	2.5 INCH (6.4cm) CAVITY
Square Feet of Wall Filled	48	32	24	19

*Adjust coverage to compensate for filled/reinforced cavities.

GUIDELINES FOR USE:

Materials

It is recommended that the loose-fill perlite shall conform to the requirements of ASTM Designation C549. Ask your supplier to provide documentation that the product conforms to ASTM C549 Standard Specification for Loose Fill Insulation.

Installation

1. The loose-fill perlite should be installed in the following locations:

a. In the cores of all exterior (and interior) hollow masonry walls.

b. In the cavity between all exterior (and interior) masonry walls.

c. Between exterior masonry walls and interior furring.

2. The loose-fill perlite should be poured directly (or via a hopper) in the top of the wall at any convenient interval (not in excess of 20 ft [6 m]). Wall sections under doors and windows should be filled before sills are placed. Rodding or tamping is not recommended.

3. All holes and openings in the wall through which loose-fill perlite can escape should be permanently sealed or caulked prior to installation. Screening should be used in all weep holes. (The inclusion of weep holes is considered good construction design practice to allow passage of any water which might penetrate the cavities or core spaces of wall construction.)

4. The loose-fill perlite must remain dry. Suitable means should be used as the work progresses to insure that the insulation is protected from inclement weather.

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