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WATER PENETRATION STUDY

MORTAR NET USA, LTD.

TOTALFLASH CAVITY-WALL DRAINAGE SYSTEM

Mortar Net USA, Ltd.
541 S. Lake Street
Gary, Indiana 46403

December 5, 2007

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REPORT OF TESTS

SUBJECT:	**Water Penetration Study to Determine the Effectiveness of the Mortar Net TotalFlash Cavity-Wall Drainage System Used in Masonry Cavity Wall Construction**
PROJECT:	**Mortar Net USA, Ltd. Research Program - TotalFlash**
TEST METHODS:	ASTM E 514, "Test Method for Water Penetration and Leakage Through Masonry" ASTM C 67, "Test Methods of Sampling and Testing Brick and Structural Clay Tile" ASTM C 140, "Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units" ASTM C 270, "Specification for Mortar for Unit Masonry"
NTL PROJECT #:	1039-07
PAGE:	1 of 9

TEST OVERVIEW

This study was designed to test the effectiveness of Mortar Net's TotalFlash cavity-wall drainage system in masonry cavity wall construction. Within this study, three masonry cavity walls were constructed and subjected to the test procedures outlined in ASTM E 514, "Test Method for Water Penetration and Leakage Through Masonry". The walls were constructed each with a first course of brick and a second course of concrete masonry units. Two wall systems were constructed with the TotalFlash cavity-wall drainage system installed at the base of the second course of concrete masonry units, while the third wall was constructed with no water management system, except for standard peel and stick flashing. All three walls were constructed with the intent to allow leakage through the brick to test the effectiveness of the TotalFlash cavity-wall drainage system.

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TEST WALL DESCRIPTIONS

Wall #1 – TotalFlash #1

- Brick facing wythe;
- TotalFlash cavity-wall drainage system installed within a 1" cavity;
- Concrete masonry unit wythe.

Wall #2 – TotalFlash #2

- Brick facing wythe;
- TotalFlash cavity-wall drainage system installed within a 1" cavity;
- Concrete masonry unit wythe.

Wall #3 – Control #1

- Brick facing wythe;
- Peel and stick flashing installed within a 1" cavity;
- Concrete masonry unit wythe.

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TEST WALL FABRICATION

Three (3) walls for water penetration testing were constructed according to ASTM E 514 requirements. The three walls were double-wythe wall panels, 48" wide x 56" high. Each wall was assembled using a face of clay brick and a second of concrete masonry units (cmu). A one-inch air cavity was located between the clay brick and the concrete masonry units. Each open end of the walls used a water end dam. In the first two walls, the mason installed the Mortar Net TotalFlash product in the 1" cavity according the manufacturer recommendations. In the third wall, the mason installed peel and stick flashing in the 1" cavity.

The walls were built during a two day period by an experienced lead mason. Workmanship was judged as to be average. Ambient temperature was maintained between 60 degrees F. and 75 degrees F. during the fabrication and subsequent curing period. Each wall was constructed by one mason and required approximately 1.5 hours to complete with the masonry work being done over a period of about 60 minutes. The walls were constructed on an inverted steel channel, and the bottom course was laid on a bed of mortar. Full bedded mortar joints were used, and the walls were constructed one course at a time by applying mortar the full length of the bed joint, then buttering the ends of a brick one at a time before setting on the bed joint. The joints were initially struck and tooled with a concave jointer after the top course was laid, and a final tooling was done approximately 30 to 60 minutes later. The bed and head joints were full.

The walls were constructed in a random order to avoid potential systematic errors which might have occurred if the walls had been built in a particular order. The walls were cured according to ASTM E 514 which requires curing for 7 days enclosed in plastic sheeting and for a minimum of 7 subsequent days curing in laboratory air. The total curing time for the walls ranged from 14 to 21 days. Flashing was built into the wall to collect water that had passed completely through the wall. There was a bottom trough which was built under the wall to collect water that penetrated into the interior cavities on the blocks, collected at the bottom of the cavities and leaked through the weep holes and mortar joints.

TEST PROCEDURES

ASTM E 514 test procedures were followed throughout the test. ASTM E 514 test chambers were constructed of welded aluminum angle stock, and the observation face of the chambers was outfitted with Lexan sheet to allow full view into the chamber. All fixtures and appurtenances were in conformity with ASTM E 514, section 4. Each frame was outfitted with a monometer to measure interior pressure and a flow meter to monitor the amount of flow. During the testing, the frame was pressurized to 10 psf, and the water flow was adjusted to 40.8 gal/hour which is equal to 3.4 gal/sq.ft./hr. The units were held in place with clamps, and closed cell foam gasket materials.

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MATERIAL TEST DATA

A. Concrete Masonry Units

Nominal 8" x 8" x 16", two core, medium weight concrete masonry units (CMU) were manufactured by Northfield Block Company, Mundelein, Illinois. The following are the CMU physical properties. The results represent the average of three units tested in conformity with ASTM C 140.

Compressive Strength, net, psi	2970
Dimensions	
Length, in.	15.65
Height, in.	7.65
Width, in.	8.00
Thickness	
Face shell, minimum in.	1.33
Web, minimum in.	1.25
Absorption	
Pcf	6.45
Percent	4.78
Moisture Content, percent	11.2
Unit weight, dry, pcf	114.3

Brick Analysis (ASTM C 67)

Brick size: 7.62 inches long x 3.62 inches wide x 2.25 inches high. The following are the clay brick physical properties. The results represent the average of three units tested in conformity with ASTM C67.

Absorption (%)	
24 hour	8.8
5 hour boil	10.3
Saturation Coefficient	0.83
IRA (g/min/30 sq.in.)	16.2
Compressive Strength (psi)	10,170

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B. Mortar Batches

a. Mortar Batching Information

Similar Mix designs were utilized for each mortar batch. Mortar constituents were weigh-batched to assure accuracy. ASTM C 270, Type "S" mortar proportions were selected for the evaluation. The amount of water was adjusted to provide the required consistency as judged by the mason.
Mortar proportions are as follows:

Cement, Type 1	1 part
Lime	½ part
Mason Sand	4 ½ parts

b. Mortar Cementitious Materials

Cement	Portland Cement Type 1 (ASTM C 150)
Lime	Type "S" Hydrated Lime (ASTM C 207)

c. Mortar Aggregates – Mason Sand

Gradation	% Passing Each Sieve
# 4	100.0
# 8	100.0
# 16	90.4
# 30	78.3
# 50	28.9
# 100	2.0
F.M. 1.94	

The mason sand meets ASTM C 144 specifications

d. Mortar Physical Properties

All mortar properties were obtained in accordance with ASTM C 780. Air contents were determined using the pressure method (ASTM C231). Compressive strengths were determined on 3-inch diameter by 6-inch high cylinders (ASTM C 39).

Plastic Mortar	
Cone penetration, mm	50
Air content, %	5.3
Hardened Mortar	
Compressive strength, PSI	
7 days	2480
28 days	2970

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TEST RESULTS

A. OBSERVATIONS

Wall #1 – TotalFlash #1

No signs of dampness were visible on the back wall after the four-hour test. Also, no water was collected through the back of the wall. Measurable water began flowing through the weep holes 10 minutes after the start of the test. During the course of the four-hour test a total of 15 gallons of water exited through the weep holes. At the completion of the test, no water was found to have collected within the wall cavity.

Wall #2 – TotalFlash #2

No signs of dampness were visible on the back wall after the four-hour test. Also, no water was collected through the back of the wall. Measurable water began flowing through the weep holes 15 minutes after the start of the test. During the course of the four-hour test a total of 14.5 gallons of water exited through the weep holes. At the completion of the test, no water was found to have collected within the wall cavity.

Wall #3 – Control #1

Measurable water began trickling through the weep holes 90 minutes after the start of the test. During the course of the four-hour test a total 0.25 gallons of water exited the weep holes. At the completion of the test, water collected within the cavity to a height of 4.0 inches.

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TEST RESULTS (continued)

B. DATA

ASTM E 514 Testing

Test Date:	11-13-07	11-14-07	11-14-07
	TotalFlash Wall - 1	TotalFlash Wall - 2	Control Wall - 3
First dampness on back of wall	no signs	no signs	180 minutes
First visible water on back of wall	no water	no water	no water
Percent dampness on back of wall @ 4 hours	0%	0%	10%
Total leakage through back of wall (gallons)	none	none	none
Total leakage rate through back of wall (gallons/hour)	0.00	0.00	0.00

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TEST RESULTS (continued)

C. COMPARATIVE DATA

Water Collection Comparative Study

	Water Collected Through Weep Holes	First Sign of Water Exiting Weep Holes	Depth of Water Remaining in Cavity Wall
Wall #1 – TotalFlash #1	15.0 gallons	10 minutes	no water
Wall #2 – TotalFlash #2	14.5 gallons	15 minutes	no water
Wall #3 – Control #1	0.25 gallons	90 minutes	4.00 inches

Average			
TotalFlash	14.75 gallons	12.5 minutes	no water
Control	0.25 gallons	90 minutes	4.00 inches

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TEST RESULTS (continued)

D. SUMMARY

The Mortar Net TotalFlash cavity-wall drainage system test walls showed no signs of dampness or water penetration through the back of the concrete masonry units at the conclusion of the ASTM E 514 tests. In addition, Mortar Net TotalFlash strongly outperformed the standard peel and stick flashing system during the course of this test procedure. While the wall cavities and the corresponding weep holes in the control wall became almost completely blocked with mortar droppings, the TotalFlash water management system provided a system for preventing mortar blockage, allowing water to escape through the weep holes.

Respectfully submitted,

NELSON TESTING LABORATORIES

Mark R. Nelson
Principal