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## **Water Permeability Study of Clear Water Repellents**

### Project:

Plant Research

### Specification:

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 270, "Specification for Mortar for Unit Masonry"

### Objective:

The purpose of this study was to determine the effectiveness of Nawkaw Corporations NUBW-66 water repellent when applied to leaky clay masonry walls. Three walls were constructed and tested in accordance with ASTM E 514-90. After this was completed, the walls were allowed to dry out for one month. At this time, the walls were sealed with the water-repellent and then re-tested in accordance with ASTM E 514.

### Materials:

#### **Brick**

Three types of brick were selected for this project. All are stiff mud, extruded brick with a red-firing body. The bed surface of each brick is wire cut, and all are 100 percent solid. The face surfaces of the 35.7 (1.85 kg) IRA brick are die skin. Those of the other two brick are wire cut. Each brick is from a different manufacturer, and all are commercially available. Dimensions and physical properties of the brick are given in Table 1. All values were determined in accordance with ASTM C 67-97, "Standard Specification for Facing Brick", Grade SW. The 35.7g (1.85 kg) brick meet the requirements of ASTM C 216, Grade MW. All of the brick were very close to the dimensional tolerances for FBX brick. Brick with chips or cracks were not used to build test specimens. Although no quantitative measurements were made, the bed surface textures of the three bricks were visually rated. The 46.2g (2.83 kg) brick had the smoothest bed surface and the 14.7 g(0.76 kg) brick the roughest.

**Table 1 Brick Properties**

	<b>C</b>	<b>D</b>	<b>E</b>
<b>Initial Rate of Absorption</b>			
g/min/30 inch <sup>2</sup>	14.7	35.7	46.2
(kg/min/m <sup>2</sup> )	(0.76)	(1.85)	(2.38)
24h Cold Water Absorption, %	5.7	11.9	8.2
5h Boiling Water Absorption, %	7.8	13.9	10.8
<b>Compressive Strength</b>			
psi	18,300	9,630	11,300
(MPa)	(12.6)	(66.4)	(77.8)
<b>Width</b>			
inches	3.62	3.56	3.62
(mm)	(91.9)	(90.4)	(91.9)
<b>Height</b>			
inches	2.25	2.25	2.25
(mm)	(57.1)	(57.1)	(57.1)
<b>Length</b>			
inches	7.75	7.62	7.62
(mm)	(198)	(194)	(194)
<b>Density</b>			
lb/ft <sup>3</sup>	136	126	127
(kg/mm <sup>3</sup> )	(2180)	(2020)	(2030)

**Mortar**

Three types of mortar were used with cementitious materials consisting of masonry cements and mortar cements. Mortar types included are N and S. The mortars were mixed with a 1:3 ratio of cement:sand. Materials were measured by weight using the measurements of materials given in ASTM C 270. Mortar properties were measured in accordance with ASTM C 270 and are given in Table 2.

**Table 2 Mortar Properties**

Mix No	<u>5</u>	<u>6</u>	<u>7</u>
Mortar Type	N	N	S
Flow (%)			
Initial	110	113	111
Final	86	90	90
Water Retention (%)	78.2	79.6	81.1
Cone Penetrometer (mm)	46	51	50
Air Content (%)	11.2	17.9	17.4
Compressive Strength (psi)			
7 days	2850	1559	2485
28 days	2993	1974	2761

**Wall Fabrication:**

Three single wythe clay brick masonry walls for permeance testing were constructed according to ASTM E 514-90 requirements. The walls were built during a 24 hour period by an experienced lead mason. Workmanship was judged to be average. Ambient temperature was maintained between 60°F and 75°F during the fabrication and subsequent curing period.

Each wall was constructed by the mason and required approximately 1.5 hours to complete. The wall was 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 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 514-90 which requires curing for 7 days enclosed in plastic sheeting and for a minimum of 7 days subsequent curing in laboratory air. The total curing time for the walls ranged from 35 to 42 days.

Flashing was built into the wall to collect water that had passed completely through the wall. Water which leaked through the exposed face of the wall and passed through to the back of the wall was collected in the trough which was located between the first and second course.

**Test Procedures:**

ASTM E 514-90 test procedures were followed throughout the test.

ASTM E 514-90 test chambers were constructed of welded aluminum angle stock, and the observation face of the chamber was fitted with Lexan sheet to allow full view into the chamber. All fixtures and appurtenances were in conformity with ASTM E 514-90, 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/hr which is equal to 3.4 gal/ft<sup>2</sup>/hr. The units were held in place with clamps, and a closed cell foam gasket material and silicone caulking provided the proper tight seal. To facilitate a tight seal, the test frame was attached to the brick making this the exposed face.

**Test Results:**

<b>Wall Sample No.</b>	<b><u>1</u></b>	<b><u>2</u></b>	<b><u>3</u></b>
Mortar Type/Brick No	S/C	S/C	S/C
<b>Initial Tests Prior to Sealing</b>			
Time of first dampness (min)	2	2	2
Time of first visible water (min)	2	2	2
Area of dampness (% of test area)	20	30	20
Water collected in 4 hours (liters)	7.0	8.0	12.0
<b>Tests After Sealing</b>			
Time of first dampness (min)	0	0	0
Time of first visible water (min)	0	0	0
Area of dampness (% of test area)	0	0	0
Water collected in 4 hours (liters)	0	0	0

**Authorizing Signature:**



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