Influence of silicone treatment of bricks on moisture penetration and bond strength of brickwork

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INFLUENCE OF SILICONE TREATMENT OF BRICKS ON MOISTURE PENETRATION AND BOND STRENGTH OF BRICKWORK

by

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PREFACE

Work done as part of a continuing program of masonry studies has shown the importance of the suction characteristics of the brick upon the excellence of the bond obtained. It is more difficult to obtain good bond when the brick has a high initial rate of absorption. This led to a study of the silicone treatment of bricks upon the moisture penetration and bond strength of brickwork subsequently made with them. One paper on this work has been published (1). Evidence from a further series of tests is now presented.

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Ottawa
October 1960

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A previous paper (1) described tests which had shown that improved resistance of brick masonry to moisture penetration was obtained when high-suction bricks were treated with a water-soluble silicone before being laid in mortar. The tests had been made on laboratory-constructed panels of brickwork consisting of five bricks laid one above the other with mortar joints between them. An opportunity to secure additional information on the subject was provided in October 1959, when outdoor test piers were being constructed of untreated and silicone-treated bricks to study efflorescence. The piers were constructed by a bricklayer and in the course of the work he was asked to construct, in addition to the piers, small panels of brick masonry that could be tested in the laboratory for moisture penetration and bond strength properties.

MATERIALS

Two types of bricks and two mortars were used. The bricks were used in their normal dry condition, and also after they had been treated by being dipped in a solution of water-soluble silicone, which reduced greatly the property of initial rate of absorption. One of the bricks was of the extruded wire-cut type, while the other was of the dry-press type. Properties of the bricks are given in Table I.

One of the mortars was composed of a masonry cement and sand in proportions by volume of one part to three parts respectively, while the other mortar was made of portland cement, lime and sand in proportions by volume of one part cement, one part lime and 6 parts of dry sand. The lime was a dry hydrate soaked overnight before use. The mortars were mixed on the job site by the bricklayer's helper, by hoeing the materials together in a mortar trough.

PANEL CONSTRUCTION AND TESTING

The panels were constructed by placing a bed of mortar on a brick, setting a brick directly over the brick

below and tapping it into place. The method therefore followed closely that normally used by the bricklayer in his work. The only controlled factor in the construction was the time interval between placing the mortar bed on a brick and setting a brick in it. This period of time was controlled at either ½-minute or 1 minute. In other respects, the manner of construction duplicated as closely as possible the normal technique of the bricklayer.

The panels were stored in the laboratory for several weeks at 73°F and 50 per cent relative humidity before they were tested. The moisture penetration properties were determined by the method described in DBR Internal Report 160 (2). After this test they were dried for about 2 weeks (at 73°F and 50 per cent relative humidity) when the strength of bond between brick and mortar in direct tension was determined, using the method described in DBR Internal Report 175 (3).

RESULTS

The results of the tests are presented in Table II. The third column indicates the average bond strength of all the joints of the panel; in brackets is shown the average bond strength of all the joints of the 3 panels of each set.

The last four columns of the table show the results of the leakage tests. The amounts of water (in ml) that passed through the panels in the first hour of test and in 24 hours of test are shown, along with the maximum rate of leakage recorded during the test (expressed as ml per minute). The final column shows how long it took for dampness to appear on the back of the panel.

It can be seen that for the pressed brick used with both mortars the strength of bond was considerably higher when the brick was treated with the silicone solution. The treatment applied to this brick also resulted in brickwork which was much superior in resistance to moisture penetration, when compared with panels of the untreated brick.

Bond strength of the extruded brick, however, was clearly reduced as a result of the silicone treatment when the brick was used with the masonry cement mortar and was slightly reduced when the brick was used with the 1:1:6 mortar. Moisture penetration tests of panels of the extruded brick did not reveal significant differences between those of untreated and silicone-treated bricks.

CONCLUSIONS

The effect of treating bricks with a water-soluble silicone solution on the bond strength and moisture penetration properties of brickwork panels was studied.

For one brick, of the dry-press type, both bond strength and resistance to moisture penetration increased greatly as a result of the silicone treatment. For another brick of lower suction, however, reduced bond strength and insignificant change in resistance to moisture penetration resulted from the silicone treatment.

REFERENCES

(1) Ritchie, T. Influence of silicone pretreatment and wetting of brick on moisture penetration of brick masonry. Brick and Clay Record, Vol. 136, April 1960, p.84-88 (Reprinted as NRC 5686).

(2) Ritchie, T. A small-panel method for investigating moisture penetration of brick masonry. DBR Internal Report 160, September 1958, 13 p.

(3) Hodgins, P.T. Small brick panel tests at Ottawa. Apparatus and techniques for study of bond strength. DBR Internal Report 175, March 1959, 9 p.

TABLE I

PROPERTIES OF THE BRICKS

Brick Properties		Untreated Brick		Silicone-treated Brick	
		Extruded Brick	Pressed Brick	Extruded Brick	Pressed Brick
Suction (gm per min per 30 sq in.)	max.	55.4	87.1	9.5	0.3
	min.	31.1	46.2	0.1	0.1
Water absorption (24 hr, % dry wt)	max.	6.9	8.3	-	-
	min.	6.1	6.1	-	-
Water absoprtion (5 hr boil, % dry wt)	max.	10.0	10.5	-	-
	min.	7.6	7.3	-	-
Saturation Coefficient	max.	0.86	0.84	-	-
	min.	0.75	0.76	-	-
Compressive Strength	max.	10830	6150	-	-
	min.	6460	3310	-	-

(-) not determined

TABLE II - RESULTS OF TESTS

PANEL NO.	CONSTRUCTION DETAILS	BOND STRENGTH DIRECT TENSION (AVERAGE) (psi)	TOTAL LEAKAGE (ml) FIRST HOUR	TOTAL LEAKAGE (ml) 24 HOURS	MAXIMUM LEAKAGE RATE (ml/min)	TIME FOR DAMPNESS TO APPEAR
PRESSED BRICK AND MASONRY CEMENT MORTAR						
37	Brick untreated	8.0	1230	23480	29.0	½ min
38	(½-min interval)*	15.4 (10.4)**	215	10720	9.3	5 min
39		7.8	163	7480	6.5	Immediate
40	Brick silicone treated	31.5	0	42	Very slight	2¼ hr
41	(½-min interval)	23.2 (25.9)	0	18	Very slight	2 hr
42		23.2	0	16	Very slight	35 min
PRESSED BRICK AND 1:1:6 MORTAR						
43	Brick untreated	26.1	31	1630	1.3	4 min
44	(½-min interval)	20.1 (19.2)	28	1247	1.5	12 min
45		13.7	38	2285	1.5	6 min
49	Brick silicone treated	35.8	0	5	Very slight	17 min
50	(½-min interval)	26.6 (29.0)	0	60	Very slight	65 min
51		24.5	0	39	Very slight	45 min
EXTRUDED BRICK AND MASONRY CEMENT MORTAR						
19	Brick untreated	52.1	405	10820	8.0	Immediate
20	(½-min interval)	47.2 (46.5)	0	68	Very slight	1 hr
21		40.3	0	51	Very slight	1¼ hr
34	Brick silicone treated	36.5	0	7	Very slight	2½ hr
35	(½-min interval)	24.4 (30.6)	20	122	Very slight	1 min
36		31.0	0	320	Very slight	3½ hr
13	Brick untreated	51.0	0	16	Very slight	3 hr
14	(1-min interval)	47.3 (50.5)	100	4820	4.0	Immediate
15		53.1	0	18	Very slight	15 min
31	Brick silicone treated	24.8	0	0	0	3 hr
32	(1-min interval)	41.7 (30.1)	0	38	Very slight	20 min
33		23.7	0	3	Very slight	4 hr
EXTRUDED BRICK AND 1:1:6 MORTAR						
1	Brick untreated	29.2	0	7	Very slight	55 min
2	(1-min interval)	44.0 (36.9)	0	7	Very slight	1½ hr
3		37.5	0	510	1.2	5 min
4	Brick silicone treated	36.1	190	820	4	Immediate
5	(1-min interval)	32.1 (35.5)	0	393	0.3	7 min
6		36.9	0	13	Very slight	50 min

* ½-min interval = ½ min. between placing mortar on brick then brick on mortar.
** average strength of all mortar joints in three panels