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NATIONAL RESEARCH COUNCIL OF CANADA

DIVISION OF BUILDING RESEARCH

No.
156

TECHNICAL NOTE

NOT FOR PUBLICATION

FOR INTERNAL USE

PREPARED BY T. Ritchie

CHECKED BY E.V.G.

APPROVED BY R.F.L.

PREPARED FOR Central Mortgage and Housing Corp.

DATE Sept. 8, 1953.

SUBJECT: Properties of Bricks Received from Elmsdale, N.S.

Six bricks were sent to D.B.R. by C.N.R. express from Elmsdale, Nova Scotia, July 1, 1953, presumably from the brick plant there of L.E. Shaw, Limited.

It is understood that these bricks are similar to those to be used in the construction of brick-veneer, plankwall buildings in Halifax, and, also, it is understood that the bricks were sent to D.B.R. by C.M.H.C. in order to obtain information on a suitable mortar for use with these bricks.

The bricks supplied are solid (uncored), of the extruded, wire-cut type, and red in colour, some being quite darker in shade of colour than others, which possibly indicates a higher temperature of firing. They were labelled, for our use, ELM1, ELM2, ELM3, ELM4, ELM5 and ELM6, the first two of these being the bricks which are much darker in colour than the others.

Some properties of the bricks were determined, in accordance with A.S.T.M. Standard Methods of Sampling and Testing Brick (Designation C67-50). These properties are shown in Table 1.

TABLE 1

Some Properties of the Bricks

Brick	Initial Rate of Absorption (grams) (1)	Absorption 24 H.C. (%) (2)	Absorption 5 H.B. (%) (3)	Saturation Coefficient (4)
ELM1	2.1	0.3	1.3	.20
ELM2	2.5	0.5	2.2	.22
ELM3	8.5	3.9	5.3	.74
ELM4	7.9	3.7	5.1	.73
ELM5	10.2	5.3	6.8	.79
ELM6	7.3	4.9	6.1	.81

TECHNICAL WORK

10-10-50

RESEARCH REPORT T. H. H. H.

Central Research and Design Group

SUBJECT: Properties of various materials

Six bottles were sent to D. H. H. by D. H. H. from Birmingham, Nova Scotia, July 1, 1950, presumably from the plant there of D. H. H. Limited.

It is understood that these bottles are similar to those to be used in the construction of brick-veneer, although buildings in Halifax, also, it is understood, but the bottles were sent to D. H. H. in order to obtain information on a suitable mortar for use with these bricks.

The bricks supplied are solid (uncoated), of the standard, wire-cut type, and red in colour, some being white in shade of colour from above, which possibly indicates a higher temperature of firing. They were labelled, two on each side, "H. H. H. and Ltd.", and the first two are being the bricks which are shown in colour from the other.

Some properties of the bricks were determined, in accordance with D. H. H. standard methods, and the following table (see also Table I) shows these properties are shown in Table I.

TABLE I

Some properties of the bricks

Brick	Initial rate of absorption (grams) (1)	Absorption (2) (3)	Absorption (4) (5)	Density (6)
HM1	2.1	10.3	1.3	1.3
HM2	2.2	10.4	1.3	1.3
HM3	2.2	10.4	1.3	1.3
HM4	2.2	10.4	1.3	1.3
HM5	2.2	10.4	1.3	1.3
HM6	2.2	10.4	1.3	1.3

- (1) Initial Rate of Absorption is the amount of water in grams which the dry brick absorbs when placed flat-side down in $1/8$ inch of water for one minute, based on an area of 30 square inches. The initial rate of absorption or suction of a brick determines, to a considerable degree, the strength and extent of bond which the brick establishes with a mortar.
- (2) Absorption 24 H.C. is the amount of water, expressed as a percentage of the dry weight of the brick, which the brick absorbs when it is immersed for 24 hours in water at room temperature.
- (3) Absorption 5 H.B. is the amount of water, expressed as a percentage of the dry weight of the brick, which the brick absorbs when it is immersed in boiling water for 5 hours (following immersion in water at room temperature for 24 hours).
- (4) Saturation Coefficient is the ratio of the amounts of water absorbed by the brick in immersion for 24 hours in water at room temperature and absorbed by the brick in further immersion for 5 hours in boiling water. It is, to some extent, a measure of the ratio of "easily filled" to total pore volume of the brick.

Saturation coefficient, along with compressive strength, or other properties, has been used in the A.S.T.M. Specification C62-50 for clay and shale bricks, to classify bricks with respect to frost resistance. In this respect, these bricks from Elmsdale would be classified as grade SW ("Brick intended for use where a high degree of resistance to frost action is desired and the exposure is such that the brick may be frozen when permeated with water.")

The initial rate of absorption, or suction, of bricks has been found to be a factor of importance in the resistance of brick walls to rain penetration, since this property of bricks considerably affects the extent of bond established between brick and mortar.

Two indications of the proper initial rate of absorption of bricks in regard to securing rain-tight walls are available. The A.S.T.M. (In a Note in its Specification C62-50) states, "Data indicate that a low rate of suction (20 grams per minute or less) is desirable both from the standpoint of bond and watertightness". Another authority (C.C. Connor, A.S.T.M. Proc. Vol. 48, 1948) says that the suction should be within the range of 5 to 25 grams (when the brick is placed in $1/8$ inch of water for 1 minute). It can be seen from Table 1 that two of the six bricks are lower in suction than the lower limit placed on this property by Connor for Rain-resistant brickwork.

resistance to penetration.

When the lower limit placed on this property is known for a given specimen from Figure 1 that two of the six plates are known. In section the plate is placed in 1/8 inch of water for 1 minute. It can be that the section should be within the range of 2 to 32 inches from another specimen (C.C. control, V.S.L.M. spec. set, 10, 100) and is desirable both from the standpoint of being in a water bath and in a water bath. The V.S.L.M. (in a note in the specification COS-20) states, "There is no reason to believe that the initial rate of absorption of plates in water is a factor of importance in the resistance of

the initial rate of absorption of section of plates

and water.

considerably affects the extent of being established between plates and water to water penetration, since this property of plates has been found to be a factor of importance in the resistance of the initial rate of absorption of section of plates

water."

exposure is such that the plate may be shown when immersed with high degree of resistance to water section is desired and the should be considered as a stage of (which is intended for use more a to show resistance. In this respect, these plates from Figure COS-20 for each and water plates, to classify plates with respect to other properties, has been used in the V.S.L.M. specification

absorption coefficient, along with compressive strength,

weight of the plate.

A measure of the ratio of weight, "initial" to water hole ation for 2 points in rolling water. It is, to some extent, room temperature and exposed on the plate in further immersion exposed on the plate in immersion for 32 points to water at

(1) absorption coefficient is the amount of the amount of water (points).

(following immersion in water at room temperature for 32 exposure when it is immersed in rolling water for 2 points percentage of the dry weight of the plate, which the plate

(3) absorption 2 H.V. is the amount of water, expressed as a percentage.

exposure when it is immersed for 32 points in water at room percentage of the dry weight of the plate, which the plate

(5) absorption 32 H.V. is the amount of water, expressed as a weight of water.

strength and extent of being which the plate establishes of a plate determines, to a considerable degree, the square inches. The initial rate of absorption of section 1/8 inch of water for one minute, based on an area of 30

(7) initial rate of absorption is the amount of water in 1/8

The composition and properties of mortar can also affect the rain resistance of brick walls. It is generally agreed that mortar for brickwork should have high water retentivity (i.e. give up its water slowly to an absorbent brick), and be of easy workability (i.e. not harsh to work under the trowel). In general mortars of the portland cement-lime type such as 1-1-6 (one cement, one lime, six sand, by volume) are suitable. Usually, the higher the lime content, the more workable is the mortar; the higher the cement content, the stronger it is (but not necessarily the brickwork).

For adequately rain-resistant brickwork the mortar probably should not have more than 2 volumes of portland cement per volume of lime.

With dense, low rate of absorption bricks, such as those received from Elmsdale, used with a plastic mortar, such as are most mortars high in lime, some difficulty may be experienced due to "floating" of the bricks in the mortar (i.e. not "staying put" when laid, or easily displaced thereafter). In this event, a mortar higher in cement would be more suitable; however, the type and grading of the sand would influence the results, also.

In summary, the following remarks are made concerning the bricks received from Elmsdale:

- (1) They can be expected to be, in themselves, highly durable in regard to the action of frost.
- (2) Because of the low initial rate of water absorption of some of them, it may be difficult to secure good bonding with mortar.
- (3) A suitable mortar for use with them is probably of composition 1-1-6, one volume portland cement, one volume lime and six volumes sand.

The composition and properties of mortar can also affect the rain resistance of brick walls. It is generally agreed that mortar for brickwork should have a high water resistance (i.e. give up its water slowly to an evaporant brick), and be of easy workability (i.e. not hard to work under the trowel). In general mortars of the portland cement-lime type (such as 1-1-5) (one cement, one lime, six sand, by volume) are suitable. Usually, the higher the lime content, the more workable is the mortar; the higher the cement content, the stronger it is (but not necessarily the brickwork).

For adequately rain-resistant brickwork the mortar probably should not have more than 2 volumes of portland cement per volume of lime.

With dense, low rate of absorption bricks, such as those received from Limala, used with a plastic mortar, such as are most mortars when in lime, some difficulty may be expected due to "floating" of the bricks in the mortar (i.e. not "sitting put" when laid, or easily displaced thereafter). In this event, a mortar higher in cement would be more suitable; however, the type and grading of the sand would influence the results, also.

In summary, the following remarks are made concerning the bricks received from Limala:

- (1) They can be expected to be, in themselves, highly durable in regard to the action of frost.
- (2) Because of the low initial rate of water absorption of some of them, it may be difficult to secure good bonding with mortar.
- (3) A suitable mortar for use with them is probably of composition 1-1-5, one volume portland cement, one volume lime, and six volumes sand.