

**Bangladesh Standard**

**SPECIFICATION FOR HOLLOW CLAY BRICKS AND BLOCKS**



**ICS 91.100.25**

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BANGLADESH STANDARDS AND TESTING INSTITUTION  
MAAN BHABAN  
116-A, TEJGAON I/A, DHAKA-1208, BANGLADESH

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**SPECIFICATION FOR HOLLOW CLAY BRICKS AND BLOCKS**

**0. FOREWORD**

**0.1** This Bangladesh standard was adopted by the Bangladesh Standards and Testing Institution on 21.07.08 after the draft had been thoroughly discussed, reviewed and finalized by the Sectional Committee for Clay Bricks, Hollow Clay Bricks, Clay Ceramic Tiles and Cement Blocks and had been endorsed by the Engineering (Civil) Divisional Committee.

**0.2** This standard is subjected to periodical reviews and amendments, if necessary, in order to cope with the latest industrial and technological innovations and market demands. Any suggestion for improvement will be recorded and placed before the Committee in due time.

**0.3** In the formulation of this standard, consideration was given to the views and suggestions put forwarded by the representative sections of designers, manufacturers and user agencies.

**0.4** In the revision of this standard assistance has been drawn from ASTM C 652, C 67-80a, BS 3921:1974 and assistance so derived is acknowledged herein with thanks.

**1. SCOPE AND APPLICATION**

**1.1** This standard covers hollow building and facing bricks, hollow blocks made from clay, shale, fire clay or mixtures thereof, and fired to incipient fusion.

**2. DEFINITIONS**

**2.1** For the purpose of this standard, the following definitions shall apply:

**2.2 Hollow Brick** – Hollow clay masonry units commercially used in building and civil engineering construction, whose net cross-sectional area in every plane parallel to the bearing surface is not less than 60% of its gross cross-sectional area measured in the same plane and which not exceeding 300 mm in length, 150 mm in width or 115 mm in height.

**2.3 Hollow Block** – Hollow clay masonry walling units exceeding in length or in width or in height the sizes specified for bricks, commercially used in building and civil engineering construction, whose net cross-sectional area in every plane parallel to the bearing surface is less than 60% of its gross cross-sectional area measured in the same plane.

### 3. CLASSIFICATION

#### 3.1 Grades – Three grades of hollow bricks and blocks are covered

**3.1.1 Grade S:** Hollow Bricks / Blocks are intended for use where a high and uniform degree of resistance to weathering in highly differential weather in respect of temperature and humidity prevalent in Bangladesh is desired. The Hollow Bricks / Blocks shall have a regular geometrical form and shall be free from cracks and harmful and unacceptable flaws.

**3.1.2 Grade A:** Hollow Bricks / Blocks are intended for use where a moderate degree of resistance to the weather in Bangladesh is desired. The Hollow Bricks / Blocks in this grade may have some flaws included slight deformation, chippage and surface injuries.

**3.1.3 Grade B:** Hollow Bricks in this grade are intended for use in structures where appearance is not of importance. The Hollow Bricks in this grade may have geometrical irregularities, crack, chippage and other flaws.

#### 3.2 Types of Hollow Bricks and Blocks

**3.2.1 Type F:** Fair Hollow Bricks/Blocks for general use in exposed exterior for facing where no plastering is required and interior masonry walls and partition walls where variation in color range is preferred.

**3.2.2 Type I:** Hollow Bricks/Blocks intended for providing air insulation and lightness of weight which may be used in exterior exposed wall and interior masonry walls having a color range.

**3.2.3 Type T:** Hollow Bricks/Blocks with textured surface, intended to have a textured facing of exterior or interior walls.

**3.2.4 Type R:** Hollow Bricks/Blocks with one or two-ends rounded in one side and intended for use in any ends or joints of a wall to have a rounded smooth edge instead of sharp edge.

**3.2.5 Type C:** Hollow Bricks/Blocks suitable for development of a composite member with provision of hole or holes for placing steel re-bars surrounding concrete.

**Note 1** Any type of Hollow Brick / Block, which does not belong to any of the types as, mentioned above through 3.2.1 to 3.2.5 for designating.

### 4. MATERIALS AND MANUFACTURE

**4.1** The body of all hollow bricks/blocks shall be of clay, shale, fire clay. Mixtures of these materials, with or without admixtures, should be burnt to meet the requirements of this specification. Any coloring or other materials added to the clay shall be of suitable ceramic materials and shall be well distributed throughout the body.

## 5. DIMENSIONS AND PERMISSIBLE VARIATION

**5.1 Size** - The size of hollow bricks/blocks shall be as specified in Clause 2(Definition). From a sample of ten hollow bricks/blocks selected from a lot to be delivered, no hollow bricks/blocks shall depart from the specified size by more than  $\pm 4\%$ .

**5.2 Warpage** - Tolerances for distortion or warpage of face or edges of an individual hollow brick/block from a plane surface and from a straight line shall not exceed the maximum for the grade specified as prescribed in Table-I.

**TABLE I: TOLERANCE ON DISTORTION**

Face Dimension (mm)	Permissible Distortion max <sup>m</sup> (mm)		
	Grade S	Grade A	Grade B
200 and under	3.00	4.00	5.00
Over 200 to 300	3.50	4.50	6.00
Over 300 to 400	3.00	5.00	6.00

## 6. PHYSICAL REQUIREMENTS

**6.1 Durability** - The hollow bricks shall conform to the physical requirements for the grade specified as prescribed in Table II and the hollow blocks shall conform to the physical requirements for the grade specified as prescribed in Table III. When the grade is not specified, the requirements for Grade A shall govern. If the average water absorption is less than 8.0 percent after 24 h submersion in cold water, the requirement for saturation co-efficient shall be waived.

**TABLE II: PHYSICAL REQUIREMENTS FOR HOLLOW BRICKS**

Designation	Compressive Strength (Hollow Brick in Bearing Position) Gross area, min <sup>m</sup> MPa		Water Absorption By 5-h Boiling, max <sup>m</sup> %		Saturation Coefficient max <sup>m</sup>	
	Average of 5 brick	Individual	Average of 5 brick	Individual	Average of 5 brick	Individual
Grade S	21.0	17.5	17.0	20.0	0.78	0.80
Grade A	17.5	15.5	22.0	25.0	0.88	0.90
Grade B	14.0	12.5	25.0	30.0	0.92	0.95

TABLE III: PHYSICAL REQUIREMENTS FOR HOLLOW BLOCKS

Designation	Compressive Strength Mpa		Water Absorption By 5-h Boiling, (max <sup>m</sup> %)		Saturation Coefficient max <sup>m</sup>	
	Flat Construction	Side Construction				
	Min <sup>m</sup> Average of 5 blocks	Min <sup>m</sup> Average of 5 blocks	Average of 5 blocks	Individual	Average of 5 blocks	Individual
Grade S	30	15	17.0	20.0	0.78	0.80
Grade A	25	12	22.0	25.0	0.88	0.90

## 7. EFFLORESCENCE

**7.1** When the hollow bricks/blocks are tested for efflorescence in accordance with Art 16, the rating for efflorescence shall not be more than “slightly effloresced”.

## 8. FINISHES AND APPEARANCE

**8.1** The face or faces that will be exposed in plane shall be free of chips that exceed the limits given in Table III. The limits shall apply to the grades as specified. The aggregate length of chips shall not exceed 10 percent of the perimeter of the face of the hollow brick/block. The face or faces shall be free of other imperfections detracting from the appearance of a sample wall when viewed from a distance of 5m for type F and a distance of 6m for type C and T.

**8.2** Unless otherwise agreed upon by the purchaser and the seller, a delivery of hollow brick/block shall contain not less than 95 percent of the whole delivery of hollow brick/block. In this specification, the term hollow brick/block shall be understood to mean hollow brick/block meeting the requirements of this specification for chippage and tolerances.

TABLE IV: Permissible extent of chippage from the edges and corners of finished face or faces into the subject, max<sup>m</sup> in mm

Designation	Chippage in from	
	Edge	Corner
Grade S	3.50	6.00
Grade A	6.50	9.50
Grade B	8.00	12.50

## 9. HOLLOW SPACES

**9.1 Cores**—The distance of any core (Void space having a gross cross-sectional area equal to or less than 9.68 cm<sup>2</sup>) from exposed edges shall be not less than 16 mm.

**9.2 Cells**—The distance of cells (void space having a gross cross-sectional area greater than 9.68 cm<sup>2</sup>) from any edge of the unit shall not be less than 13mm.

**9.3 Webs**—The thickness of webs between cells shall not be less than 13 mm or 9.5 mm between cells and cores, or 6 mm between cores.

## 10. VISUAL INSPECTION

**10.1** The brick/block, as delivered to the site, shall, by visual inspection, conform to the requirements specified by the purchaser or to the sample or samples approved as the standard of comparison and to the samples passing the tests for physical requirements. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Minor indentations or surface cracks incidental to the usual method of manufacture, or the chipping resulting from the customary methods of handling in shipment and delivery, should not be deemed grounds for rejection.

**10.2** Unless otherwise agreed upon by purchaser and the seller, a delivery of brick/block shall contain not less than 95% whole brick/block.

## 11. SAMPLING AND TESTING

**11.1 Selection of Test Specimens**-For the purpose of these tests, full-size brick / block shall be selected by the purchaser or by his authorized representative. Specimens shall be representative of the whole lot of units from which they are selected and shall include specimens' representative of the complete range of colors, textures and sizes in the shipment.

**11.2 Number of Specimens** -For the modulus of rupture, compressive strength and absorption determinations, at least ten bricks / blocks shall be selected from each lot of 250,000 brick / block or fraction thereof. For larger lots, five individual brick / block shall be selected from each 500,000 bricks/blocks or fraction thereof, contained in the lot. In no case less than five bricks/blocks shall be taken. Additional specimens may be taken at the discretion of the purchaser.

**11.3 Identification**-Each specimen shall be marked, so that it may be identified at any time. Markings shall cover not more than 5 % of the superficial area of the specimen.

### 11.4 Weight Determination

**11.4.1 Drying**- Dry the test specimens in a ventilated oven at 110 to 115° C for not less than 24 h and until two successive weighing at intervals of 2 hours show an increment of loss not greater than 0.2 % of the last previously determined weight of the specimen.

**11.4.2 Cooling** – After drying, cool the specimens in a drying room at a temperature of  $24 \pm 8^{\circ}\text{C}$ , with a relative humidity between 30 and 70 %. Store the units free from drafts, unshackled, with separate placement for a period of at least 4 h. Do not use specimens noticeably warm to the touch for any test requiring dry units.

**11.4.2.1** An alternative method of cooling the specimens to approximate room temperature may be used as follows: Store units, unstacked, with separate placement, in a ventilated room for a period of 4 h, with a current of air from an electric fan passing over them for a period of at least 2h.

**11.4.3 Calculations and Report**

**11.4.3.1** Calculate the weight per unit area of a specimen by dividing the total weight in kgs by the average area in square centimeter of the two faces of the unit as normally laid in a wall.

**11.4.3.2** Report results separately for each unit with the average for five units or more.

**12. MODULOUS OF RUPTURE (FLEXURE TEST)**

**12.1 Test Specimens** – The specimens shall consist of whole dry full-size units (see 12.4.1). Five such specimens shall be tested.

**12.2 Procedure:**

**12.2.1** Support the test specimen flatwise unless specified and reputed otherwise (that is, apply the load in the direction of the depth of the unit) on a span approximately 25 mm less than the basic unit length and loaded at midspan. If the specimens have recesses (panels or depressions) place them so that such recesses are on the compressions side. Apply the load to the upper surface of the specimen through a steel bearing plate 6.35 mm in thickness and 38.1 mm in width and of a length at least equal to the width of the specimen.

**12.2.2** Make sure the supports for the test specimen are free to rotate in the longitudinal and transverse directions of the test specimen and adjust them so that they will exert no force in these directions.

**12.2.3** Speed of Testing – The rate of loading shall not exceed 28896 N / min. but this requirement may be considered as being met if the speed of the moving head of the testing machine immediately prior to application of the load is not more than 1.27 mm/min.

**12.3 Calculations and Report:**

**12.3.1** Calculate the modulus of rupture of each specimen as follows:

Modulus of rupture,  $S = 3WI/2bd^2$  where:

$S$  = Stress in specimen at midspan, Pa x  $10^4$

$W$  = Maximum load indicated by the testing machine, N,

$I$  = Distance between the supports mm.

$b$  = average overall width, face to face, of the specimen, mm, and

$d$  = average overall depth, bed surface to bed surface, of the specimen, mm.

**12.3.2** Report the average of the modulus of rupture determinations of all the specimens tested as the modulus of rupture of the lot.



### 13. COMPRESSIVE STRENGTH

**13.1 Test Specimens-** The test specimens shall consist of dry half brick/block (See 12.4.1), the full height and width of the unit, with a length equal to one half the full length of the unit  $\pm 25\text{mm}$ , except as described below. If the test specimen, described above, exceeds the testing machine capacity, the test specimens shall consist of dry pieces of brick/block, the full height and width of the unit, with a length not less than one quarter of the full length of the unit, and with a gross cross sectional area perpendicular to bearing not less than  $90\text{ cm}^2$ . Test specimens shall be obtained by any method that will produce, without shattering or cracking a specimen with approximately plane and parallel ends. At least five specimens shall be tested.

#### 13.2 Capping Test Specimens:

**13.2.1** All specimens shall be dry and cool within the meaning of 11.4.1 and 11.4.2 before and portion of the capping procedure is carried out.

**13.2.2** If the surface which will become bearing surfaces during the compression test are recessed or paneled, fill the depressions with a mortar composed of 1 part by weight of quick-hardening cement conforming to BDS EN 197-1:2003 and 2 parts by weight of sand. Age the specimens at least 48 h before capping them. Where the recess exceeds 12.7 mm, use a brick or tile slab section or metal plate as a core fill. Cap the test specimens using one of the two procedures described in 13.2.3 and 13.2.4.

**13.2.3 Gypsum Capping** – Coat the two opposite bearing surfaces of each specimen with shellac and allow drying thoroughly. Bed one of the dry shellacked surfaces of the specimen in a thin coat of near paste of calcined gypsum (plaster of paris) that has been spread in an oiled nonabsorbent plate, such as glass or machined metal. The casting surface plate shall be plane within 0.076mm in 406.4 mm and sufficiently rigid; and so supported that it will not be measurably deflected during the capping operation. Lightly coat it with oil or other suitable material. Repeat this procedure with the other shellacked surface. Take care that the opposite bearing surfaces so formed will be approximately parallel and perpendicular to the vertical axis of the specimen and the thickness of the caps will be approximately the same and not exceeding 3.18 mm. Age the caps at least 24 h before testing the specimens.

**Note 2** – A rapid-setting industrial type gypsum, such as Hydrocal or Hydrostone, is frequently used for capping.

**13.2.4 Sulfur-Filler Capping** – Use a mixture containing 40 to 60 weight % sulfur, the remainder being ground fire clay or other suitable inert material passing a No. 100 (150- $\mu\text{m}$ ) sieve with or without plasticizer. The casting surface plate requirements shall be as described in 13.2.3 Place four 25 mm square steel bars on the surface plate to form a rectangular mold approximately 13 mm greater in either inside dimension than the specimen. Heat the sulfur mixture in a thermo-statically controlled heating pot to a temperature sufficient to maintain fluidity for a

reasonable period of time after contact with the surface being capped. Take care to prevent overheating and stir the liquid in the pot just before use. Fill the mold to a depth of 6.35 mm with molten sulfur material; Place the surface of the unit to be capped quickly in the liquid, and hold the specimen so that its vertical axis is at right angles to the capping surface. The thickness of the caps shall be approximately the same. Allow the unit to remain undisturbed until solidification is complete. Allow the caps to cool for a minimum of 2 h before testing the specimens.

### 13.3 Procedure:

**13.3.1** Test brick specimens flat wise (that is the load shall be applied in the direction of the depth of the brick). Test structural clay tile specimens in a position such that the load is applied in the same direction as in service. Center the specimens under the spherical upper bearing within 1.59 mm.

**13.3.2** The testing machine shall conform to the requirements of ASTM Methods E 4.

**13.3.3** The upper bearing shall be a spherically seated, hardened metal block firmly attached at the center of the upper head of the machine. The center of the sphere shall lie at the center of the surface of the block in contract with the specimen. The block shall be closely held in its spherical seat, but shall be free to turn in any direction and its perimeter shall have at least 6.35 mm clearance from the head to allow for specimens whose bearing surfaces are not exactly parallel. The diameter of the bearing surface shall be at least 127 mm. Use a hardened metal bearing block beneath the specimen to minimize wear of the lower platen of the machine. The bearing block surface intended for contract with the specimen should have hardness not less than H R C 60 (HB 620). These surfaces shall not depart from plane surfaces by more than 0.03mm. When the bearing area of the spherical bearing block is not sufficient to cover the area of the specimen, place a steel plate with surfaces machined to true planes within + 0.03 mm, and with a thickness equal to at least one third of the distance from the edge of the spherical bearing to the most distance corner between the spherical bearing block and the capped specimen.

**13.3.4 Speed of Testing** – Apply the load, up to one half of the expected maximum load, at any convenient rate, after which, adjust the controls of the machine so that the remaining load is applied at a uniform rate in not less than 1 nor more than 2 min.

### 13.4 Calculations and Report

13.4.1 Calculate the compressive strength of each specimen as follows:

$$\text{Compressive strength, } C = W / A$$

Where:

C = compressive strength of the specimen, Pa x 10<sup>4</sup>

W = maximum load, N, indicated by the testing machine, and

A = average of the gross areas of the upper and lower bearing surfaces of the specimen mm<sup>2</sup>.

**Note 3** - When compressive strength is to be based on net area (example: clay floor tile), substitute for A in the above formula the net area, mm<sup>2</sup> of the fired clay in the section of minimum area perpendicular to the direction of the load.

## 14. ABSORPTION

**14.1 Accuracy of weighing** - The scale or balance used shall have a capacity of not less than 2000 g, and shall be sensitive to 0.5 g.

**14.2 Test Specimens** - The test specimens shall consist of half brick/block conforming to the requirements of 11.1. Five specimens shall be tested.

### 14.3 5- h and 24- h Submersion Tests:

#### 14.3.1 Procedure

**14.3.1.1** Dry and cool the test specimens in accordance with 11.4.1 and 11.4.2 and weigh each one.

**14.3.1.2** Saturation – Submerge the dry, cooled specimen, without preliminary partial immersion, in clean water (soft, distilled or rain water) at 15.5 to 30°C, for the specified time. Remove the specimen, wipe off the surface water with a damp cloth and weigh the specimen. Complete weighing of each specimen within 5 min after removing the specimen from the bath.

#### 14.3.2 Calculations and Report:

**14.3.2.1** Calculate the absorption of each specimen as follows:

$$\text{Absorption \%} = 100 (W_s - W_d) / W_d$$

Where:

W<sub>d</sub> = Dry weight of the specimen, and

W<sub>s</sub> = Saturated weight of the specimen after submersion in cold water.

**14.3.2.2** Report the average absorption of all the specimens tested as the absorption of the lot.

### 14.4 1-h, 2-h, and 5-h, Boiling Tests

**14.4.1 Test Specimens** – The test specimens shall be the same five specimens used in the 5-h or 24-h cold –water submersion test where required and shall and shall be used in the state of saturation existing at the completion of that test.

### 14.4.2 Procedure

**14.4.2.1** - Return the Specimen that has been subjected to the cold-water submersion to the bath and subject it to the boiling test as described in 11.4.2.2.

**14.4.2.2** - Submerge the specimen in clean water (Soft distilled or rain water) at 15.5 to 30°C in such a manner that water can circulate freely on all sides of the specimen. Heat the water to boiling, within 1 h. Boil continuously for specified time and then allow cooling to 15.5 to 30°C by natural loss of heat. Remove the specimen, wipe off the surface water with a damp cloth, and weigh the specimen. Complete weighing of each specimen within 5 min after removing the specimen from the bath.

**14.4.2.3** - If the tank is equipped with a drain so that water at 15.5 to 30°C can be passed through the tank continuously and at such a rate that a complete change of water takes place in not more than 2 min. Make weighing at the end of 1 h.

### 14.4.3 Calculations and Report

**14.4.3.1** Calculate the absorption of each specimen as follows:

$$\text{Absorption \%} = 100 (W_b - W_d) / W_d$$

Where:

$W_d$  = dry weight of the specimen, and

$W_b$  = Saturated weight of the specimen after submersion in boiling water.

**14.4.3.2** Report the average absorption of all the specimens tested as the absorption of the lot.

#### 14.4.3.2.1 Saturation Coefficient:

Calculate the saturation coefficient of each specimen as follows:

$$\text{Saturation coefficient} = W_s - W_d / W_{bb} - W_d$$

Where:

$W_d$  = dry weight of the specimen, and

$W_s$  = Saturated weight of the specimen after 24-h submersion in cold water and

$W_{bb}$  = Saturated weight of the specimen after 5-h submersion in boiling water.

## 15. INITIAL RATE OF ABSORPTION (SUCTION)

### 15.1 Apparatus:

**15.1.1 Trays or Containers** - Watertight trays or containers, having an inside depth of not less than 12.7 mm and of such length and width that an area of not less than 1935.5cm<sup>2</sup> of water surface is provided. The bottom of the tray shall provide a plane, horizontal upper surface, when suitably supported, so that an area not less than 203.2 mm in length by 152.4 mm in width will be level when tested by a spirit level.

**15.1.2 Supports for Brick/Block** – Two non corrodible metal supports consisting of bars between 127 mm and 152.5 mm in length, having triangular, half round, or rectangular cross section such that the thickness (height) will be approximately 6.35 mm. The thickness of the two bars are rectangular in cross section, their width shall not exceed 1.94 mm.

**15.1.3 Means for Maintaining Constant Water Level** – Suitable means for controlling the water level above the upper surface if the supports for the brick/block within + 0.25 mm (see note 3) , including means for adding water to the tray at a rate corresponding to the rate of removal by the brick/block undergoing test (see note 4). For use in checking the adequacy of the method of controlling the rate of; flow of the added water, a reference brick/block or half brick/block shall be provided whose displacement in 3.18mm of water corresponds to the brick/block or half brick/block to be tested within  $\pm 2.5$  %. Completely submerge the reference brick/block in water for not less than 3 h preceding its use.

**Note 4-** A suitable means for obtaining accuracy in control of the water level may be provided by attaching to the end of one of the bars two stiff metal wires that project upward and return, terminating in points; one of which is 3.18 – 0.25 mm and other 3.18 – 0.25 mm above the upper surface or edge of the bar. Such precise adjustment is obtainable by the use of depth plates of a micrometer microscope. When the water level with respect to the upper surface of edge of the bar is adjusted so that the lower point dimples the water surface when viewed by reflected light and the upper point is not in contact with the water, the water level is within the limits specified. Any other suitable means for fixing and maintaining a constant depth of immersion may be used if equivalent accuracy is obtained. As an example or such other suitable means, there may be mentioned the use of rigid supports movable with respect of the water level.

**Note 5** -A rubber tube leading from a siphon of gravity feed and closed by a spring clip will provide a suitable manual control. The so-called “chicken-feed” devices as a rule lack sensitivity and do not operate with the very small changes in water level permissible in this test.

**15.1.4 Balance**, having a capacity of not less than 3000 g. and sensitive to 0.5 g.

**15.1.5 Drying Oven** that provides a free circulation of air through the oven and is capable of maintaining a temperature between 110 and 115 ° C.

**15.1.6 Constant – Temperature Room**, maintained at a temperature of  $21 \pm 1.4$  ° C.

**15.1.7 Timing device** - A suitable timing device, preferably a stop watch of stop clock, which shall indicate a time of 1 min to the nearest 1 s.

**15.2 Test specimen**, consisting of whole brick/block. Five specimens shall be tested.

### 15.3 Procedure:

**15.3.1** Dry and cool the test specimens in accordance with 11.4.1 and 11.4.2.

**15.3.2** Measure to the nearest 1.27mm the length and width of the flatwise surface of the test specimen of rectangular units or determine the area of other shapes to similar accuracy that will be in contact with the water. Weigh the specimen to the nearest 0.5 g.

**15.3.3** Adjust the position of the tray for the absorption test so that the upper surface of its bottom will be level when tested by a spirit level, and set the saturated reference brick (15.1.3) in place on top of the supports. Add water until the water level is  $3.18 \pm 0.25$  mm above the top of the supports. When testing tile with scored bed surfaces, the depth of water level is  $3.18 \pm 0.25$  mm plus the depth of scores.

**15.3.4** After removal of the reference brick/block, set the test brick/block in place flatwise, counting zero time as the moment of contact of the brick/block with the water. During the period of contact ( $1 \text{ min} \pm 1 \text{ s}$ ) keep the water level within the prescribed limits by adding water as required. At the end of  $1 \text{ min} \pm 1 \text{ s}$ , lift the brick/block from contact with the water, wipe off the surface water with a damp cloth, and reweigh the brick/block to the nearest 0.5 g. Wiping shall be completed within 10 s of removal from contact with the water, and weighing shall be completed within 2 min.

**Note 6**– Place the brick/block in contact with the water quickly, but without splashing. Set the brick/block in position with a rocking motion to avoid the entrapping of air on its under surface. Test brick/block with frog of depression uppermost.

#### **15.4 Calculations and Report:**

**15.4.1** The difference in weight in grams between the initial and final weighings is the weight in grams of water absorbed by the brick/block during 1-min contact with the water. If the area of its flatwise surface (length times width) does not differ more than  $\pm 4.84 \text{ cm}^2$  ( $\pm 2.5\%$ ) from  $193.55 \text{ cm}^2$ , report the gain in weight in grams as the initial rate of absorption in 1 min.

**15.4.2** If the area of its flatwise surface differs more than  $\pm 4.84 \text{ cm}^2$  ( $\pm 2.5\%$ ) from  $193.55 \text{ cm}^2$  as follows:

$$X = 193.55 W/LB$$

Where:

X = Gain in weight corrected to basis of  $193.55 \text{ cm}^2$  flatwise area,

W = actual gain in weight of specimen, g

L = length of specimen, cm and

B = width of specimen, cm.

**15.4.3** Report the corrected gain in weight, X, as the initial rate of absorption 1min.

**15.4.4** If the test specimen is a cored brick calculate the net area and substitute for LB in the equation given in 15.4.2. Report the corrected gain in weight as the initial rate of absorption in 1 min.



**15.4.5** If specimen is non-prismatic, calculate the net area by suitable geometric means and substitute for LB in the equation given in 15.4.2.

## **16. EFFLOROSCE**

**16.1.1 Trays and Containers** – Watertight shallow pans or trays made of corrosion-resistant metal or other material that will not provide soluble salts when in contact with distilled water containing leaching from brick/block. The pan shall be of such dimensions that it will provide not less than a 25 mm depth of water. Unless the pan provides an area such that the total volume of water is large in comparison with the amount evaporated each day. Suitable apparatus shall be provided for keeping a constant level of water in the pan.

**16.1.2** Drying Room maintained at a temperature of  $24 \pm 8^{\circ}\text{C}$ , with a relative humidity between 30 and 70 %, and free from drafts.

**16.1.3** Drying Oven that provides a free circulation of air through the oven and is capable of maintaining a temperature between 110 and 115°C.

### **16.2 Test Specimens**

**16.2.1** The sample shall consist of ten full-size bricks/blocks.

**16.2.2** The ten specimens shall be sorted into five pairs so that both specimens of each pair will have the same appearance as nearly as possible.

**16.3 Preparation of Specimens** – Remove any adhering dirt that might be mistaken for efflorescence by brushing. Dry the specimens and cool them as prescribed in 11.4.1 and 11.4.2.

### **16.4. Procedure**

**16.4.1** Set one specimen, each of the five pairs, on end, partially immersed in distilled water to a depth of approximately 25 mm for 7 days in the drying room. When several specimens are tested in the same container, separate the individual specimens by a space of at least 51mm.

**Note 7**– Do not test specimens from different sources simultaneously in the same container, because specimens with a considerable content of soluble salts may contaminate salt-free specimens.

**Note 8**– Empty and clean the pans or trays after each test.

**16.4.2** Store the second specimen from each of the five pairs in the drying room without contact with water.

**16.4.3** At the end of 7 days inspect the first set of specimens and then dry both sets in the drying oven for 24 h.

**16.5 Examination and Rating** – After drying, examine closely and compare each pair of specimens, observing the top and all four faces of each specimen. If there is no observable difference due to efflorescence, report the rating as “no efflorescence” If any difference due to efflorescence is noted, view the specimens from a distance of 3m under an illumination of not less than 538.2 lm/m<sup>2</sup> by an observer with normal

vision. If under these conditions no difference is noted, report the rating as “slightly effloresced”. If a perceptible difference due to efflorescence is noted under these conditions, report the rating as “effloresced.” Record the appearance and distribution of the efflorescence.

## 17. MEASUREMENT OF SIZE

**17.1 Apparatus-** A 30cm steel rule, graduated in 1mm divisions or a gage or caliper having a scale ranging from 25 to 300 mm and having parallel jaw, shall be used for measuring the individual units. Steel rules or calipers of corresponding accuracy and size required shall be used for measurement of larger brick/block, solid masonry units and tile.

**17.2 Test Specimens-** Measure ten dry full size units. These units shall be representative of the shipment and shall include the extremes of color range and size as determined by visual inspection of the shipment. (The same samples may be used for determining efflorescence and other properties).

**17.3. Individual Measurements of Length, Width. And Depth** – Measure the length along both beds and along both faces from the midpoints of the edges bounding the units. Record these four measurements to the nearest 1mm and record the average to the nearest 0.5mm as the length. Measure these like manners across both ends from the midpoints of the edges bounding the faces. Record these four measurements to the nearest 1 mm and record the average 10 to the nearest 0.5 mm as the width Measure the depth across both faces and both ends from the midpoints of the edges bounding the beds. Record these four measurements to the nearest 1 mm and record the average to the nearest 0.5 mm as the depth. Use either the steel rule or the gage described in 17.1. Retest by the same method when required.

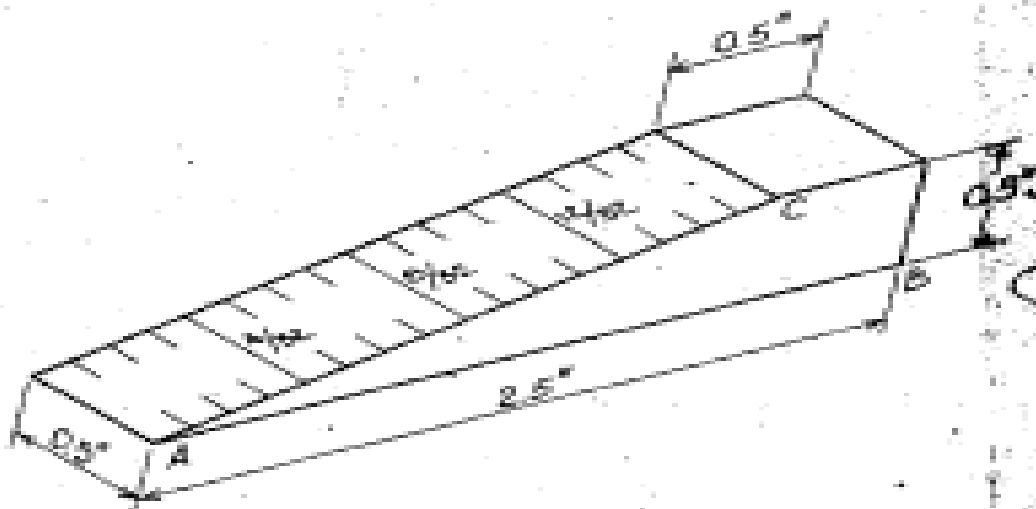
## 18 MEASUREMENT OF WARPAGE

### 18.1 Apparatus:

#### 18.1.1 Steel Straightedge:

**18.1.2 Rule of Measuring Wedge** – A steel rule graduated from one end in 1 mm divisions, or alternatively, a steel measuring wedge 60 mm in length by 12.5 mm in width by 12.5mm in thickness at one wend and tapered, starting at a line 12.5 mm from one end, to zero thickness at the other end. The wedge shall be graduated in 1-mm divisions and numbered to show the thickness of the wedge between the base, AB, and the slope, AC, Fig. 1.





**Fig. 1 Measuring Wedge**

**18.1.3 Flat surface**, of steel or glass, not less than 305 by 305 mm and plane to within 0.025mm.

**18.2 Sampling** – Use the sample of ten units selected for determination of size.

**18.3 Preparation of samples** - Test the specimens as received, except remove any adhering dirt by brushing.

#### **18.4 Procedure:**

**18.4.1** Where the warpage is concave, place the straightedge lengthwise of diagonally along the surface to be measured, selecting the location that gives the greatest departure from straightness. Select and measure the maximum warpage as shown by the greatest distance of the unit surface from the edge of the straightedge either by the steel rule or wedge. Measure this distance to the nearest 1 mm, and record it as the concave warpage.

**18.4.2** When the warpage is convex, lay the unit with the convex surface in contact with a plane surface and with the corners approximately equidistant from the plane. Take measurements from the plane surface to the four corners of the unit. Record the average of the four measurements as the convex warpage of the unit.

### **19. MEASUREMENT OF LENGTH CHANGE**

**19.1 Apparatus**- A dial micrometer or other suitable measuring device graduated to read in 0.001-mm increments, mounted on a stand suitable for holding the specimen in such a manner that producible results can be obtained, shall be used for measuring specimen length. Provisions shall be made to permit changing the position of the dial micrometer on its mounting rod so as to accommodate large variations in specimen size. The base of the stand and the tip of the dial micrometer shall have a conical depression to accept a 6.35mm steel ball. A suitable reference instrument shall be provided for checking the measuring device.

**19.2 Preparation of specimen** – Remove the ends of deeply textured specimens to the depth of the texture by cutting perpendicular to the length and parallel to each other. Drill a hole in each end of the specimen with 6.35mm carbide drill. Drill these holes at the intersection of the two diagonals from the corners. Place 6.35mm steel balls in these depressions by cementing in place with calcium aluminate cement. Any equivalent method for establishing the reference length is permissible.

**19.3 Procedure** – Mark the specimen for identification and measure to the nearest 0.001mm in a controlled environment and make subsequent measurements in the same controlled environment  $\pm 1^{\circ}\text{C}$  and  $\pm 5\%$  relative humidity. Apply a reference mark to the specimen for orientation in the measuring device. Check the measuring device with the reference instrument before each series of measurements.

## 20. REJECTION

**20.1** If the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new specimens shall be selected by the purchaser from the retained lot and tested at the expense of the manufacturer. If the second set of specimen fails to conform to the tests requirements, the entire lot shall be rejected.

## 21. COST OF TESTS

**21.1** Unless otherwise specified in the purchase order, the cost of tests shall be borne as follows:

**21.1.1** If the results of the test show that the brick/block do not conform to the requirements of this specification, the costs shall be borne by the seller.

**21.1.2** If the results of the tests show that the brick/block do conform to the requirements of this specification, the costs shall be borne by the purchaser.

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