A STUDY ON THE QUALITY OF BRICK AND SAND FROM DIFFERENT LOCATIONS OF CHITTAGONG

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ABSTRACT

The quality control of all engineering materials is of prime importance to improve the quality of engineering construction as a whole. Brick & Sand are very important engineering materials in case of construction. Brick are manufactured from natuarally occuring element and sand are collected from nature. So there quality mainly depends on environment & its location. In this study, a survey is conducted to know the common locations of Brick and Sand collection at Chittagong. Opinions are taken from the Engineer of each construction site. From the survey- Satkania, Mogachori, Rangunia and Hathazari are selected as the common Brick collection sites and Dolu, Kalurghat, Rangunia and Nazirhat are selected as the common sand collection sites. Finally various tests on collected sample from the selected sites are conducted and the results are compared with standard value. A comparative study on the quality of handmade brick and sand of Chittagong is conducted in this research which helps further to choose suitable locations of brick and sand collection i.e the study can be used as a decision making tool for brick and sand collection.

Keywords: *Brick and Sand, Tests, Survey, Quality,Standard value.*

1. INTRODUCTION

Any material which has got application in Engineering construction is termed as engineering material. A civil Engineer engaged in the task of planning, design and construction of building, bridge, dams, roads, water purification plants, airfields, or any other structure, should be thoroughly familiar with the desired engineering materials and their properties. Every Engineering structure must be sufficiently strong and durable to resist the action of external forces and internal stresses due to various types of loads (Aziz, 1981). For any type of Civil Engineering work, brick and sand are very important material. Brick is an artificial kind of stone made of clay whose chief characteristics are a plasticity when wet and stone like hardness after being heated to high temperature. Some important uses of bricks are- construction of walls of any size, construction of floors, construction of arches and cornices, making khoa, manufacture of surki etc. Bricks are often broken manually or by using a brick crusher into coarse aggregate for concrete works (Pembshaw & Smith, 2005). Various tests such as compressive strength test, absorption capacity test, salinity test, unit weight test etc. are conducted to determine the quality of bricks.

Sand plays an important part in engineering construction. In concrete work, it is usually termed as fine aggregate. The sand grains may be of sharp, angular or rounded. Sand should be of pure silica. It should be free from clay, silt, organic matter, shells and salts. Sand is mainly used in making mortar, plaster and concrete. Sand is also used to fill up gaps in between bricks in road construction (Hajabbasi, Jalalian & Karimzadeh, 1997). Various tests such as Fineness Modulus, absorption capacity test, salinity test, specific gravity test etc. are conducted to determine the quality of sand.

In terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm (or 1⁄16 mm) to 2 mm. An individual particle in this range size is termed a sand grain. Sand grains are between gravel (with particles ranging from 2 mm up to 64 mm) and silt (particles smaller than 0.0625 mm down to 0.004 mm) (Kaiser & Guggenberger, 2003).

Sand is abundantly available all over Bangladesh. Both Sea sand and river sand of good quality are found in coastal districts like Chittagong, Khulna, and Noakhali. Very good variety of river sand is available in the districts of Sylhet, Dhaka, and Mymensingh. A very good variety of coarse sand is available in Cox's Bazar. Sand is also available in northern districts of Bangladesh but not good quality.

In this paper, a comparative study on the quality of brick and sand of Chittagong was conducted which helps further to choose suitable locations of brick and sand collection. It also helps to know about the condition of clay, which is used in brick production. This study can also be used as a decision making tool for choosing suitable locations of brick and sand collection.

2. SURVEY WORK AND METHODOLOGY

2.1 Survey

In this study a survey was conducted to find out the locations which are most popular in case of brick and sand collection in Chittagong. Survey result is as below –

Brick collecting locations:	Sand collecting locations:
Satkania	1. Kalurghat
Mogachori	2. Dolu
Rangunia	3.Rangunia
Hathazari	4. Nazirhat

Sampler is collected from several brick fields & sand collection points of the above locations.

2.2 Methodology to Determine Quality of Bricks

2.2.1 Compressive Strength Test of Brick:

(This test method conforms to the ASTM standard requirements of specification C 67) At first take a brick sample and remove unevenness observed the bed faces to provide two smooth parallel faces by grinding. Then immerse in water at room temperature for 24 hours. After that, remove the specimen and drain out any surplus moisture at room temperature. Then fill the frog and all voids in the bed faces flush with cement mortar (1 cement, 1 clean coarse sand of grade 3mm and down) and store it under the damp jute bags for 24 hours filled by immersion in clean water for 3 days. After that, remove and wipe out any traces of moisture and place the specimen with flat face s horizontal and mortar filled face facing upwards between plates of the compression testing machine. Then apply load axially at a uniform rate till failure occurs and note maximum load at failure. The load at failure is maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

2.2.2 Salinity Test of Brick:

(This test method conforms to the ASTM standard requirements of specification C 67) At first take a brick sample. Then remove all dust from it. After that, break it into some pieces. Using, a spiral mold of weight 2 kg make the pieces into powder. Then, take 25 gm brick powder in a bowl and immerse it into water for 24 hours. After 24 hours, drop some water into HAND REPRACTOMETER from the bowl. There is a scale in HAND REPRACTOMETER. If the reading is zero in the scale of HAND REPRACTOMETER, it means there is no presence of salt in this brick.

2.2.3 Unit Weight of Brick:

(This test method conforms to the ASTM standard requirements of specification C 67) At first measure the length, width and height of sample brick and calculate the volume (V).Then take the weight of brick (W).The unit weight (ɣ) was found by weight of brick divided by volume of brick.

2.2.4 Absorption Capacity test of Brick:

(This test method conforms to the ASTM standard requirements of specification C 62) At first, dry the brick in a ventilated oven at a temperature of 105 °C to 115°C till it attains substantially constant mass. Then, Cool the specimen to room temperature and obtain its weight (W1) specimen too warm to touch shall not be used for this purpose. After that, Immerse completely dried specimen in clean water at a temperature of 27+2°C for 24 hours. Then remove the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (W2).

2.3 Methodology to Determine Quality of Sand

2.3.1 Fineness Modulus Test of Sand

(This test method conforms to the ASTM standard requirements of specification C 136) In this study, for sieve analysis about 500 gm sample was taken. Then air-dry this sample and weight it the nearest 0.5gm. After that, arrange the found sieve in order by inserting the bottom of one to the top of another with the largest on top and pan at the bottom. Then, Place 500 gm sample on the top sieve, cover the sieve, and shake it for 15 minutes. After shaking weight the residue on each sieve and the pan to 0.1 percent of the weight. Then F.M is calculated by taking the sum of cumulative percentage of sand retain on the sieves and dividing the sum by 100.

2.3.2 Unit Weight of Sand

(This test method conforms to the ASTM standard requirements of specification C 29) First of all, take the weight of the standard vessel. Then measure the diameter and height of vessel. Now separate the fine aggregate and fill the measure one-third full of air Dry fine aggregate and level the aggregate with the fingers. After that temp the mass with the round end of the standard 5/8 inch diameter tamping rod by using 25 stroke distributed evenly over the surface. Again fill the measure two-third full and apply 25 stroke as before. In tamping the first layer do not permit the rod forcibly to strike the bottom of the measure in tamping the second and final layer, use only enough force to cause the rod to penetrate into the layer below. Now weight the cylinder or vessel filled with sand. The unit weight in pounds per cubic foot will be computed from the net weight of the sand and the volume of the vessel.

2.3.3 Specific Gravity of Sand

(ASTM C 128 test method for specific gravity and absorption capacity of fine aggregate) At first, clean and dry pycnometer. Then tightly screw its cap and take its mass (M1) to the nearest 0.1g. After that unscrew the cap and place about 200g of sample in the pycnometer. Then screw the cap and determine the mass (M2). After determining the mass, unscrew the cap and add sufficient water to cover the sample. Then shake well the contents. Connect the pycnometer to a vacuum pump. After that, disconnect the vacuum pump and fill the pycnometer with water, about three fourths full. Then reapply the vacuum for about 5 minutes and fill the pycnometer with water completely and take its mass (M3). Finally, empty the pycnometer and fill the pycnometer with water only and take its mass (M4).

3. RESULT AND DISCUSSION

3.1 Result and Discussion for Bricks

3.1.1 Size of Brick:

Size of brick of four locations is shown in Table 1. According to PWD the standard brick size of Bangladesh is 24.2cm X 11.4cm X 7cm (9.5”X4.5”X2.75”). Result shows that Satkanias brick sizes are almost nearest to the standard size. Then Mogachori and Rangunias bricks are second nearest and Hathazari brick are third nearest to standard size.

Table 1: Size of brick

Location	Size of brick (cm)
Mogachori	23.5X10.5X6
Satkania	23.5X10.6X6
Rangunia	23.5X10.5X6
Hathazari	23.2X10.5X6

3.1.2 Unit Weight of Brick:

Result of Unit weight of brick is shown in Table 2. The standard unit weight of brick is 125 lb/ft^3.

Table 2: Unit weight of brick

Location	Unit weight of brick (lb/ft^3)
Mogachori	115
Satkania	107
Rangunia	119
Hathazari	111

3.1.3 Absorption Capacity of Brick:

Result of Absorption capacity of brick is shown in Table 3. The standard absorption capacity of brick is not more than 20% of its self weight.

Table 3: Absorption capacity of brick

Location	Absorption capacity of brick (%)
Mogachori	15
Satkania	17
Rangunia	20
Hathazari	20

3.1.4 Salinity of Brick:

The percentage of soluble salts should not exceed 2.5%. Result of Salinity of brick is shown in Table 4.

Table 4: Salinity of brick

Location	Salt content (%)
Mogachori	Nil
Satkania	Nil
Rangunia	Nil
Hathazari	Nil

From the result, it is observed that there is no presence of salinity in any brick sample.

3.1.5 Compressive Strength of Brick:

Compressive strength data of brick is shown in Table 5. The standard value of brick compressive strength is 3000-5000 psi.

Table 5: Compressive strength of brick

Location	Compressive strength (psi)
Mogachori	3298
Satkania	3302
Rangunia	2689
Hathazari	2167

The feature of the brick study is given in Table 6.

Table 6: Overall study of Brick

Location	Compressive Strength	Salinity	Absorption Capacity	Unit Weight	Size and Shape
Satkania	+Good Moderate Poor	+Good Moderate Poor	Good +Moderate Poor	Good Moderate +Poor	Good +Moderate Poor
Mogachori	+Good Moderate Poor	+Good Moderate Poor	Good +Moderate Poor	Good +Moderate Poor	Good +Moderate Poor
Rangunia	Good +Moderate Poor	+Good Moderate Poor	Good +Moderate Poor	+Good Moderate Poor	Good +Moderate Poor
Hathazari	Good Moderate +Poor	+Good Moderate Poor	Good +Moderate Poor	Good Moderate +Poor	Good +Moderate Poor

3.2 Result and Discussion for Sands

3.2.1 Fineness Modulus of Sand:

Result of fineness modulus of different sample of sand is given in Table 7. The Standard value of F.M for local sand is 1.2 to 1.8. Result shows that F.M value of all sample are within the standard range.

Table 7: Fineness Modulus of Sand

Location	F.M of sand
Dolu	1.2
Kalurghat	1.5
Rangunia	1.6
Nazirhat	1.4

3.2.2 Unit Weight of Sand:

Result of the unit weight of different sample of sand is given in Table 8. The standard value of unit weight of sand is 1600 kg/m^3.

Table 8: Unit weight of sand

Location	Unit weight of sand(kg/m^3)
Dolu	1360.71
Kalurghat	1475.40
Rangunia	1360.71
Nazirhat	1420.0

3.2.3 Specific Gravity of Sand:

Result of The Specific gravity of different sample of sand is given in Table 9. The allowable specific gravity is 2.5.

Table 9: Specific gravity of sand

Location	Specific gravity of sand
Dolu	2.50
Kalurghat	2.44
Rangunia	2.30
Nazirhat	2.38

3.2.4 Absorption Capacity of Sand

Result of absorption capacity of different sample of sand is shown in Table 10. The standard absorption capacity of sand is not more than 2.60% of its self weight.

Table 10: Absorption capacity of sand

Location	Absorption capacity of sand (%)
Dolu	1.01
Kalurghat	0.80
Rangunia	1.31
Nazirhat	1.01

3.2.5 Salinity of Sand:

Result of Salinity of different sample of sand is shown in Table 11.

Table 11: Salinity of Sand

Location	Salt content (%)
Dolu	Nil
Kalurghat	Nil
Rangunia	Nil
Nazirhat	Nil

From the result, it is observed that there is no presence of salinity in any sand sample.

The overall feature of the sand study is shown in Table 12.

Table 12: Overall study of Sand

Location	FM	Unit Weight	Specific Gravity	Absorption Capacity
Dolu	+Good Moderate Poor	Good Moderate +Poor	+Good Moderate Poor	Good +Moderate Poor
Kalurghat	+Good Moderate Poor	+Good Moderate Poor	+Good Moderate Poor	Good +Moderate Poor
Rangunia	+Good Moderate Poor	Good Moderate +Poor	Good +Moderate Poor	Good +Moderate Poor
Nazirhat	+Good Moderate Poor	Good +Moderate Poor	Good +Moderate Poor	Good +Moderate Poor

4. CONCLUSIONS

The following conclusions can be drawn from the above experimental results.
In case of brick from the above result it is concluded that there is no sample which satisfied all the standard value of all quality. But considering individual parameter it can be concluded that

- In case of size Satkania brick almost satisfies the standard value. So it is suitable to construction whose prime consideration is brick size.
- Unit weight of brick of Rangunia almost near to the standard value. Unit weight of remaining sample far less than standardvalue.

- Absorption capacity of all samples satisfies the standard value. So all sample of brick are suitable to construction considering absorption capacity. There is no presence of salinity in any brick sample. So all are suitable for construction works. Compressive Strength of Satkania & Mogachori brick are within the limit of Standard value. So it is suitable to construction whose prime consideration is brick Compressive Strength.

In case of Sand from the above result it is concluded that there is no sample which satisfies all the standard value of all quality. But considering individual parameter it can be concluded that:

- Fineness Modulus of all sample of sand is within the limit of Standard value. So all sample of sand are suitable to construction considering Fineness Modulus.
- Unit weight of Kalurghat sand almost near to the standard value. So it is suitable to construction whose prime consideration is sand unit weight. Unit weight of remaining sample lesser than standard value.
- Specific gravity & Absorption Capacity of all sample of sand are allowable. So all sample of sand are suitable to construction considering Specific gravity & Absorption Capacity .
- There is no presence of salinity in any sand sample. So all are Suitable for construction works.

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