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Engineering Classification of Shari Ghat River Bed Sand and Prospect of its Utilization

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Abstract— Sand is a natural resource can be used as an engineering material which plays an important role in engineering constructions. Generally sand is used as a fine aggregate in mortar, plaster, concrete and finishing works. It also used for filling under floor, basements. Sand should be pure silica (SiO_2), but all types of sand are not suitable for such work.From this point of view, the present study assesses some engineering properties for understanding their suitability for construction works. The properties such as Fineness Modulus (FM), Specific Gravity, Silt & Clay content and Compressive Strength have been estimated in laboratory and the results revealed that the sand is best for mortar and concrete work and suitable for plastering and finishing work. Results also suggest that this sand can be used for filling up the roads and brick soling gap area.

Index Terms— River Bed Sand, Fineness Modulus (FM), Specific Gravity, Sieve Analysis, Compressive Strength, gradation curve, Utilization prospect.

1 INTRODUCTION

SAND deposits are located mostly in the Sylhet area in Bangladesh. The studied area belonging to the Jaintapur Thana in Sylhet district that about 45 km NNE direction of Sylhet town and is also about 189 km NNE of Dhaka. Shari river is located about 7 km from Jaintapur Thana parisad in the east direction.

In the Shari river bed, vast amount of Sands will be deposited. This type of sands will be used in different construction sectors without any assessment.

This studies aim that, proper utilization of sands in different construction sectors.

Natural sand is available from local river beds or pits. An examination should be made on the fineness of the available sands. Based on this fineness, it should be considered to be used for the different sectors of construction. Sand is a loose, fragmented, naturally occurring material consisting of very small particles (fine to medium sized particles between 2 mm & 0.06 mm) of decomposed rocks, corals, or shells. In concreting work it is usually termed as fine aggregate.

Sand is form of silica (SiO_2) and may be of argillaceous, siliceous or calcareous according to its composition. Sand is usually obtained from pits, shores, river beds, & seas. It mainly three kinds of sands in use: Pit Sand, River bed Sand & Sea Sand. Sand should be of pure Silica (SiO_2). It should free from clay, silt, organic matter, shells & salts. Very good variety of sand is available in the districts of Dhaka, Mymensingh, Syhet. Sand is available here and there, but all sand is not suitable for every sand related work. In this study, it is aimed that which sand are suitable for which purpose. It is preferable that sand should be washed before use in all engineering construction.

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2 METHODS

In order to conduct this study steps like field observation, sample collection, analysis and laboratory test etc measures are considered. Methods for this investigation are composed of the following activities:

2.1 Sample Collection

Sample was collected from Shari Ghat river of Jaintapur. Disturebed samples are taken from river bed. After collecting the sample we perform various tests. For performing test, samples should have normal condition. As samples are collected the source, so it was not ready for test. At first it dried in room temperature for one week.

2.2 Laboratory Test

a) Sieve Analysis of Sand

Sieve analysis is one of the oldest methods of size analysis and is accomplished by passing a known weight of sample material successively through fine sieve to determine the percentage weight in each size fraction (*shown in figure 2.1*)

This test was performed to determine the percentage of different grain sizes within sands. Fineness Modulus (FM) is factor which is computed using the sieve analysis results. Lower FM indicates fine particle and Higher FM indicates coarse size particle.

Fineness Modulus (FM) gets from a equation:

$$FM = \frac{\text{Cumulative \% retained on standred ASTM sieves No. 4, 8, 16, 30, 50, 100}}{100}$$

Figure 3.1 (a): Sieve

Figure 3.1 (b): Electric sieve shakers

Fig.1. Sieve analysis test

b) Specific Gravity of Sand

Specific gravity of the sand is defined as the ratio of the mass of a given volume of sands to the mass of an equal volume of water at 4^0C. The specific gravity of sand is 2.65 – 2.68. The specific gravity is generally two types. Determine the specific gravity by Pycnometer method, shown in figure 2.2 Specific gravity depends on temperature so it has to be measured.

Figure (a) pycnometer

Figure (b) digital weight machine

Fig.2.2. Specific gravity test

Calculate the specific gravity of the sands using the following formula:

Specific Gravity of Sand $Gs = (G_T * W_O)/\{ W_O – (W_B – W_A)\}$ (2)

Where,

W_O = Mass of dry sample (sand) (gm

W_A =Mass of empty clean pycnometer+ water (gm),

W_B = Mass of empty clean pycnometer+dry sand+ water (gm),

G_T = Specific gravity of water at temperature T^0C,

Temperature, T^0 C =28

c) Compressive Strength Test

Two types of test specimens are used in our country. This test methods covers determination of the compressive strength of Portland cement mortars , using 50 mm cube specimens. For making mortar sample same ratios are maintain for all type of sand particles and the ratios are water: cement: sand = 0.485: 1: 2.75 as a standard value but sometimes additional amount of water was applied to make the paste workable, shown in figure 2.3.

The mortar sample is prepared following the standard procedure and released from the mould. It is placed at a bucket for curing then after the specific duration the mortar is taken out from the bucket and waited for half an hour for removing water and tested by the compression testing machine, shown in figure 3.4. The obtained result is analyzed and then discussion is prepared depending on the result obtained and field observant.

Figure (a) Mixing sand, cement & water

Figure (b) cube specimen

Figure (c) compression testing machine

Fig.2.3. Compressive strength test

3 Result and Discussion

3.1 Fineness Modulus of Shari Ghat River Bed Sand

Fineness Modulus of **fine** aggregate is given tabulated form

TABLE 3.1
FINENESS MODULUS OF FINE AGGREGATE

Sieve size	Standard Opening (mm)	Material retained (gm)	Percent of material retained (%)	Cumulative Percent Retained (%)	Percent finer	Fineness Modulus (FM)
No.4	4.75	0	0.0	0.0	100.0	
No.8	2.36	1	0.1	0.1	99.9	
No.16	1.18	10	1.0	1.1	98.9	
No.30	0.60	38	3.8	4.9	95.1	
No.50	0.30	191	19.1	24.0	76.0	**1.28**
No.100	0.15	743	74.3	98.3	1.7	
No.200	0.075	12	1.2	99.5	0.5	
Pan		5	0.5	100.0	0.0	
Total		1000				

Fineness Modulus (FM),

$$FM = \frac{0 + .1 + 1.1 + 4.9 + 24 + 98.3}{100}$$

$$=1.28$$

From percent finer (%) and sieve size can draw particle size distribution curve or gradation curve of fine sand, shown in figure 3.1

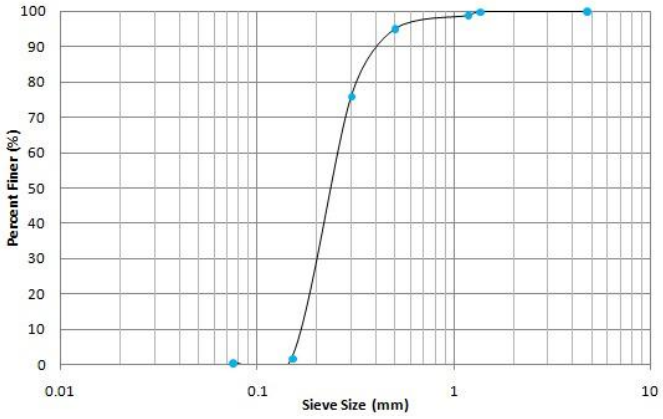

Fig.3.**1:** Gradation Curve of Shari Ghat River Sand (Fine)

Fineness Modulus of medium aggregate is given tabulated form

TABLE 3.2
FINENESS MODULUS OF MEDIUM AGGREGATE

Sieve size	Standard Opening (mm)	Material retained (gm)	Percent of material retained (%)	Cumulative Percent Retained (%)	Percent finer	Fineness Modulus (FM)
No.4	4.75	11	1.1	1.1	98.9	
No.8	2.36	31	3.1	4.2	95.8	
No.16	1.18	284	28.4	32.6	67.4	
No.30	0.60	354	35.4	68.0	32.0	
No.50	0.30	205	20.5	88.5	11.5	**2.94**
No.100	0.15	111	11.1	99.6	0.4	
No.200	0.075	3	0.3	99.9	0.1	
Pan		1	0.1	100.0	0.0	
Total		1000				

$$FM = \frac{1.1 + 4.2 + 32.6 + 68 + 88.5 + 99.6}{100}$$

$$=2.94$$

From percent finer (%) and sieve size can draw particle size distribution curve or gradation curve of medium sand, shown in figure 3.2

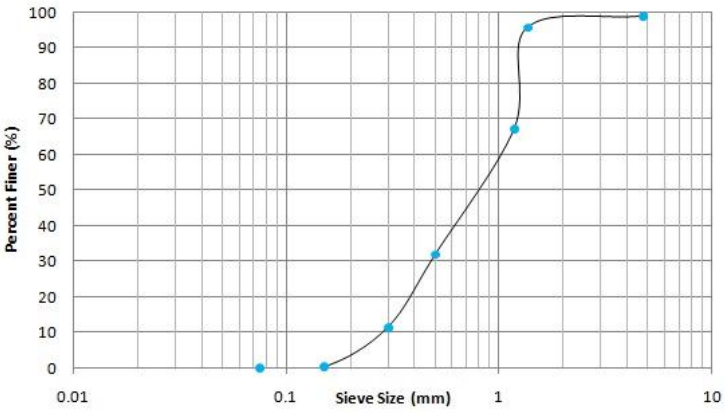

Fig.3.**2:** Gradation Curve of Shari Ghat River Sand (*Medium*)

From the experiment, Fineness Modulus of fine aggregate is **1.28** and Fineness Modulus of medium aggregate is **2.94**. The Fineness Modulus (FM) range (1.24 – 2.94) of shari Ghat river bed sand is nearly similar to the FM range (2.0 – 2.6) of other area's sand of Sylhet. The Fineness Modulus (FM) range of shari Ghat river bed sand compared with the different area in Bangladesh as tabulated form:

TABLE 3.3
COMPARE OF FINENESS MODULUS

Location of Availability	F.M. (Range)
Sylhet area	2.0 – 2.6
Dhaka area	1.2 – 1.6
Comilla area	1.3 – 1.5
Mymensingh area	1.5 – 1.8
Khulna area	1.2 – 1.5
Bogra area	1.3 – 1.4
Shari Ghat River	*1.24 – 2.94*

From the Gradation Curve, it is observed that this sand is not well graded and there is a gap grade between #4 to #100 sieve. In this sand all particle are similar size.

3.2 Specific Gravity of Sand

$G_S = (G_T * W_O)/\{ W_O - (W_B - W_A)\}$

$= 2.84$

Specific gravity of **Fine** sand at 28^0C is tabulated bellow:

TABLE 3.4
SPECIFIC GRAVITY OF FINE SAND

Observation No	W_P (gm)	W_O (gm)	W_{PS} (gm)	W_A (gm)	W_B (gm)	G_T (gm)	G_S (gm)	Average Value of G_S
1	274	10	284	1265	1271.5	0.9963	2.84	2.88
2	274	10	284	1265	1272	0.9963	3.32	
3	274	10	284	1265	1271	0.9963	2.49	

Specific Gravity of medium aggregate

$Gs = (G_T * W_O)/\{ W_O - (W_B - W_A)\}$
$= 2.49$

Specific gravity of **Medium** sand at 28^0C is tabulated bellow:

TABLE 3.5
SPECIFIC GRAVITY OF MEDIUM SAND

Observation No	W_P (gm)	W_O (gm)	W_{PS} (gm)	W_A (gm)	W_B (gm)	G_T (gm)	G_S (gm)	Average Value of G_S
1	274	10	284	1265	1271	0.9963	2.49	2.51
2	274	10	284	1265	1270.5	0.9963	2.21	
3	274	10	284	1265	1271.5	0.9963	2.84	

The Specific gravity of Fine sand is 2.88 and Specific gravity of Medium sand is 2.51. The Specific gravity of sand decreasing from fine to medium aggregate. The average specific gravity of Shari Ghat river bed sand is 2.695

3.3 Compressive Strength of Sand–Cement Mortar

The compressive strength of mortar with increasing curing period is tabulated bellow:

TABLE 3.6
COMPRESSIVE STRENGTH OF SAND–CEMENT MORTAR

Age (days)	Specimen No.	Specimen area (mm^2)	Compressive Strength (MPa)	Average Value (MPa)
3	1	50 × 50	10.74	10.65
	2	50 × 50	11.18	
	3	50 × 50	10.03	
7	1	50 × 50	12.70	12.28
	2	50 × 50	11.98	
	3	50 × 50	12.18	
28	1	50 × 50	19.42	19.48
	2	50 × 50	21.10	
	3	50 × 50	17.93	

The Experimental compressive strength compared with the standard requirement of minimum compressive strength. The effect of age on compressive strength of sand is shown in figure 5.1. It is shown that, the experimental compressive strength of sand is substantial deviated from the standard value. This deviation takes place due to impurities of sand, lack of lab facilities, experimental error, Instrumental error and effect of Portland cement and so on.

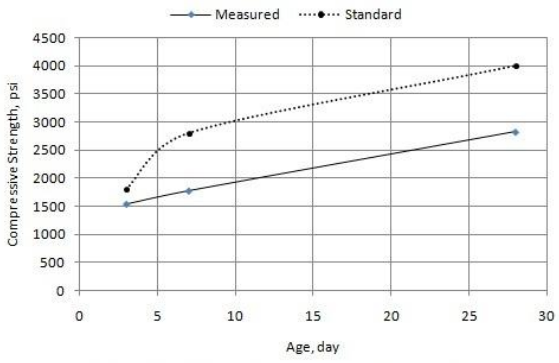

Fig.3.**3:** Effect of age on compressive strength

3.3 Utilization Prospect

This studies aim that, proper utilization of sands in different construction sectors. Sand size between 4.75mm and 0.15mm is called as fine aggregate. It is used for making concrete, mortar and plaster. It is also used for filling under floor, basements. It is also better to use for fill up the roads and brick soling gap area. Natural sand is available from local river beds or pits. An examination should be made on the fineness of the available sands. Based on this fineness, it should be considered to be used for the different sectors of construction such as plastering and finishing works, Mortar, Concrete & Filling sand. River bed Sand generally contains earthly impurities like gravels, pebbles etc. These impurities should be screened and washed before the sand is used.

4 CONCLUSION

It is necessary to use perfect sand for any purpose with due properties. From the study it is evident that fine to medium sand found in Shari Ghat river bed, which is good for plastering and finishing work. It is most suitable for fill up the roads and brick soling gap area. It is also better to use for Mortar and Concrete work. For stabilization purpose cement can be used as stabilizing agent. For economical purposes the percentage of cement should be used as much strength as required for construction. The compressive strength increases with the curing period.

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