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Short Communication

Development of building blocks using local sand

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Abstract

This study attempts to develop building blocks using local Brahmaputra river sand. Three types of sand namely: fine, moderately coarse and coarse having fineness modulus (F.M.) of 1.4, 1.8 and 2.5 respectively and ordinary Portland cement (Type-I) were used. For each type of sand three different proportions of cement : sand (1:4, 1:6 and 1:8) were selected. The dimension of the specimens was selected as 250mm×125mm×75mm. After 28 days of water curing the specimens were tested for density, water absorption, and compressive strength. The test results showed that the density of blocks was highest for fine sand, medium for moderately coarse sand and lowest for coarse sand. The water absorption of the blocks for coarse sand was higher than others while the compressive strength of the blocks was highest for coarse sand, medium for moderately coarse sand and lowest for fine sand. It was also revealed that the sand-cement blocks made with moderately coarse sand at 1:6 mix proportions showed the best combination in terms of density, water absorption, compressive strength and cost.

Keywords: Building block, Sand, Cement, Density, Strength

Introduction

Man needs five basic components for a better life; these are food, cloth, housing, education and medicine. Housing is one of the most important needs for the civilized people. As a developing country, the economic condition of the people of Bangladesh is not so good. Also the nation is facing a great problem with its rising population. For the increasing population and because of poor economic condition, people need cheaper and easily available construction material to build house. Now a day search of a low cost construction material is becoming a crying need. In engineering applications, researches are going on to find out appropriate technology which is favourable and friendly to environment. When bricks are manufactured, it is burnt mostly by using wood and it produces poisonous smoke. This harmful smoke pollutes air. Wood which is collected from the tree is an important element of environment that keeps the balance of oxygen and carbon-di-oxide in atmosphere. Due to heavy demand of tree, deforestation takes place. As a result, the atmospheric balance of oxygen and carbon-di-oxide is hampered and creates a hazard on environment.

From the above point of view, sand-cement blocks are considered as an eco-friendly construction material. The term "sand-cement building block" is used as a generic name to cover a wide range of building materials. A sand-cement building block is defined as a formed from a loose mixture of sand, cement and water which is compacted to form a dense block. The blocks demonstrate high compressive strength, dimensional stability on wetting and improved durability (Gooding and Thomas, 1995). Most importantly, sand is readily available every where in the country at a relatively cheaper price. The manufacturing process is very simple and does not require highly skilled labour. In this study an attempt has been made to develop building blocks from local sand using ordinary Portland cement. Properties like density, water absorption and compressive strength have been investigated. The cost of production of the blocks has also been studied considering the present cost of materials.

Materials and Methods

The brief description of the materials used for construction sand-cement block is given bellow:

Cement: There are several types of cement available in the market of which ordinary Portland cement was used for construction of sand-cement blocks.

Sand: Good quality river sand is readily available in Mymensingh. Three types of river sand namely; fine, moderately coarse and coarse sand having fineness modulus of 1.4, 1.8 and 2.5 respectively were used in this study. The particle size distributions of the sands used are shown in Fig 1.

Water: The quality of water plays an important role in sand-cement block construction. The supplied tape water for public use was used for both mortar preparation and curing of blocks.

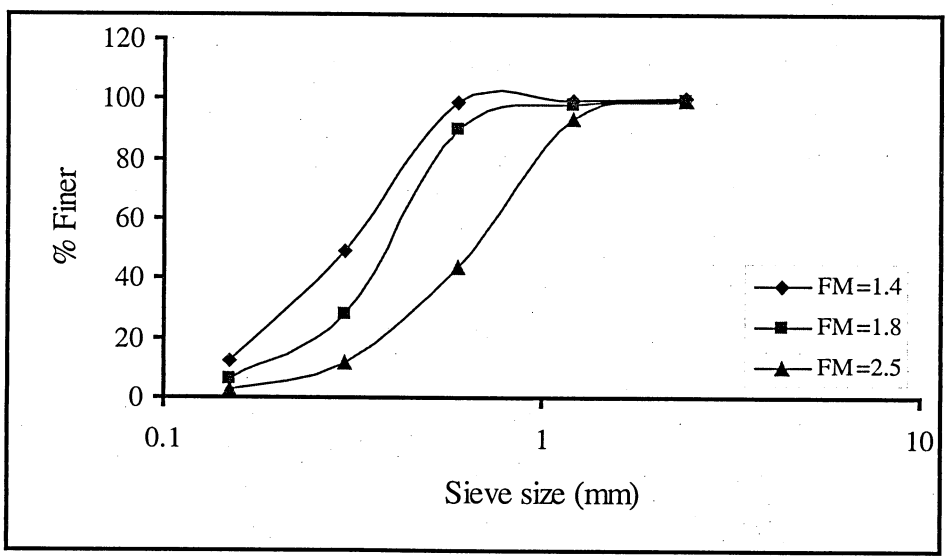

Fig. 1 Particle size distributions of different varieties sands

Method of block construction

In case of sand-cement block preparation the steps are: Mortar preparation, Casting of block, and Curing.

Mortar preparation: Cement and sand in definite proportion were measured by weight. The cement and sand were mixed thoroughly to get a dry mix. The requisite quantity of water was then added and the whole mixture was turned over until a uniform mix was obtained. For all mix proportion a water-cement ratio of 0.45 was maintained.

Casting of block: A mortar mix of specific sand type and specific proportion was poured in the wooden mould which was placed on a polythene sheet and the mortar was compacted thoroughly and the top surface was leveled by a wooden float. Then the mould was lifted up carefully in such a way that the corners/sides of blocks remained unbroken. A typical sand-cement block is shown in Fig 2.

Curing: After 24 hours, the blocks were de-molded for curing in water. Jute bags were used to cover the blocks for curing operation. The blocks were kept for 28 days in such moist condition by applying water.

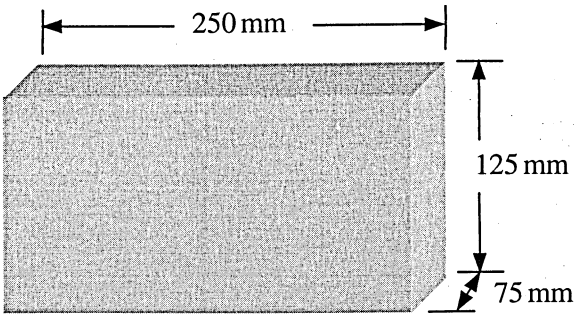

Fig. 2 A sand-cement block with dimensions

Test of sand-cement block

All the tests were conducted in Concrete and Materials Testing Laboratory of the Department of Farm structure, Bangladesh Agricultural University.

Density: The density of sand-cement blocks was obtained by determining the weight of block per unit volume for each sample, i.e. Density = Weight/ Volume

Water absorption: The water absorption of the blocks was determined by measuring the water absorbed by the blocks after 24 hours immerged in water divided by the oven-dry weight of blocks, expressed as percentage.

Compressive strength: The compressive strength of sand-cement blocks was tested by the Universal Testing Machine using the standard formula i.e. Compressive strength = P/A, where P is the ultimate compressive load and A is the loading surface area of the blocks.

Results and Discussion

The average test results for density, water absorption and compressive strength of blocks for each type of sand and proportion are presented in Fig 3. It shows that the density of blocks for fine sand at 1:4 mix proportions was maximum (974 kg/cu.m) among all. The lowest figure was, however, obtained for coarse sand at 1:8 (883 kg/cu.m). It was also found that the density of blocks made from moderately coarse sand was very much closer to each other.

It has been shown that the water absorption of blocks for coarse sand at 1:8 was the highest (18.84%) among all varieties. The lowest value was, however, obtained for fine sand at 1:4 (10.10%). It also revealed that the value of water absorption of blocks for moderately coarse sand was medium and that of moderately coarse and fine sand was within the acceptable range as recommended for first class bricks (Aziz, 1990)

In terms of compressive strength, it is seen that the compressive strength of blocks for coarse sand at 1:4 was the highest (17.6 N/sq.mm) among all. The lowest figure was obtained for fine sand at 1:8 (13.1 N/sq.mm). The compressive strength value of blocks with moderately coarse sand was very close to that of blocks with coarse sand. Similar observations have been made by Moriarty *et. al.* (1985) and Jahan and Kundu (2005).

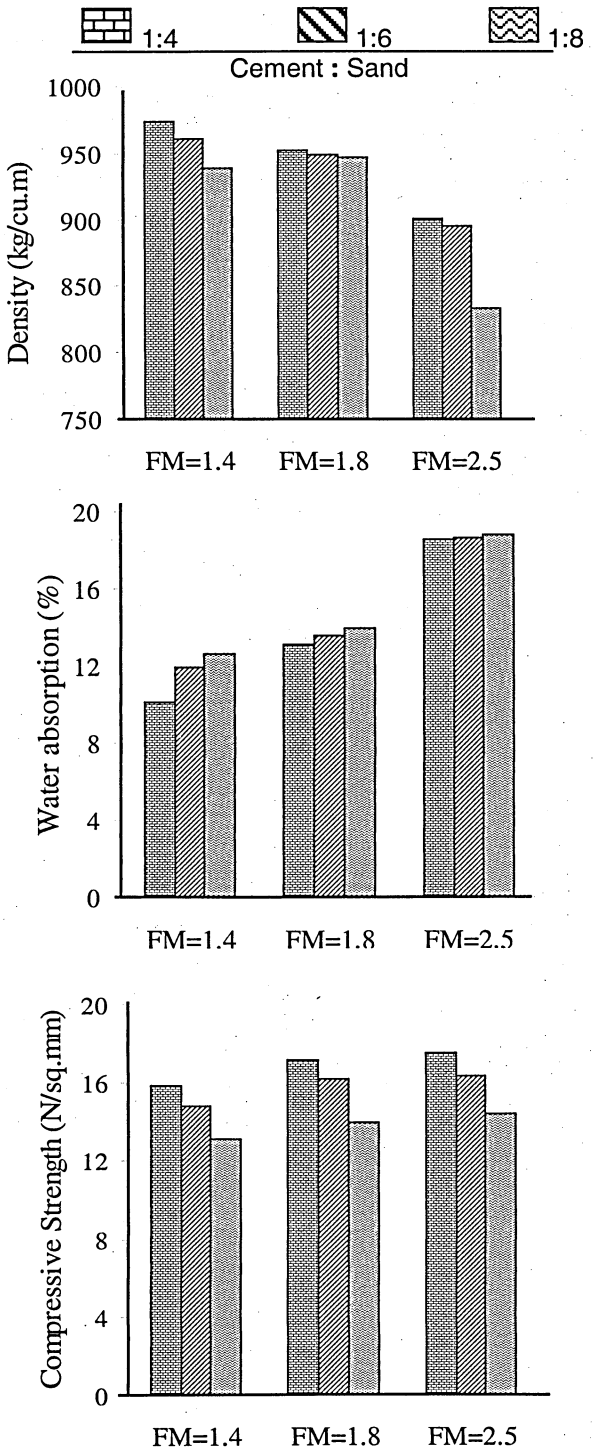

Fig. 3. Density, Water absorption and Compressive strength of sand- cement blocks for different sand with various mix proportion

Along with density, water absorption and strength, the estimated cost of sand-cement blocks has been shown in Table 1. It has been found that, for each variety of sand the cost per 100 blocks at 1:4 mix proportions is higher and that of at 1:8 is lower. Again the cost of blocks for coarse sand at 1:4 is the highest (Tk.685) and that for fine sand at 1:8 is the lowest (Tk.450). It appears to be a good correlation between cement-sand proportions and cost of the blocks; the higher the sand proportion, the lower was the cost. Among the three varieties, the sand-cement blocks of moderately coarse sand with 1:6 mix proportions was found to be the best combination in terms of density, water absorption, strength and cost in this study.

Table 1. Density, Water absorption, Compressive strength and Cost of sand-cement blocks

Type of sand	Cement: Sand	Density (kg/cu.m)	Water absorption (%)	Compressive strength (N/sq.mm)	Cost Tk/100 blocks
Coarse (FM = 2.5)	1:4	901	18.6	17.6	685
	1:6	895	18.7	16.4	550
	1:8	883	18.8	14.5	480
Moderately Coarse (FM = 1.8)	1:4	952	13.1	17.2	660
	1:6	949	13.6	16.2	535
	1:8	946	14.0	14.0	465
Fine (FM = 1.4)	1:4	974	10.1	15.9	650
	1:6	961	11.9	14.8	525
	1:8	939	12.8	13.1	450

Although the cost of sand-cement blocks appears to be slightly higher than the market price of the traditional bricks, the strength of sand-cement block is much greater than that of the traditional bricks. If, however, the blocks are produced commercially the production cost will surely decrease.

Conclusion

The observation made in this study on density, water absorption, compressive strength, and finally cost estimation of sand-cement blocks from different sand varieties with various mix proportions is quite promising. Considering the environmental issues, particularly energy crisis and pollution, emphasis should be given by both government and private sectors in promoting the manufacture and use of sand-cement block instead of traditional clay-burnt bricks.

References

Aziz M.A. 1990. A text book of engineering materials, Kazi Mahfuzur Rahman, 34/2, Zigatola, Dhaka, p 35.

Gooding D.E. and Thomson T.H. 1995. The potential of cement stabilised building blocks as an urban building material in developing countries. DTU Working Paper No. 44.

Moriarty J.P., Svare T.I. and Therkinldsen O.K. 1985. Sand-cement block for low cost housing, Building Research and Practice, London, UK.

Jahan S.M. and Kundu S.C. 2005. Manufacture of hollow building block, Project Work and Report, Department of Farm Structure, Bangladesh Agricultural University, Mymensingh.