Journal of Advances and Scholarly Researches in Allied Education
Vol. 18, Issue No. 4, July-2021, ISSN 2230-7540

Use of M-Sand, Slag Sand and C&D Waste as an Alternative Material for River Sand to Apply In Mortar for Brick Masonry

Hari Aiwale[1]* V. S. Kshirsagar[2] Manik Deshmukh[3] Nitin D. More[4] Nitin A. Shinde[5]

[1] PG Student, Shri Vithhal Education and Research Institute's College of Engineering, Pandharpur, Maharashtra, India

[2,3] Associate Professor, Shri Vithhal Education and Research Institute's College of Engineering, Pandharpur, Maharashtra, India

[4,5] Assistant Professor, Shri Vithhal Education and Research Institute's College of Engineering, Pandharpur, Maharashtra, India

Abstract – Construction industry is one of the major sector, which fulfill the basic need of human being i.e. shelter or building infrastructure. In public sector construction industry builds structures like road, dam, bridges, health care centres etc. The building materials are being the backbone of construction activities, are in much demand according to the need in various activities. River sand is one the major building material in construction practice. For various activities of construction, river sand is employed in different forms .Some of the important activities of construction work are masonry mortar, concrete production, plastering works, road construction and many more. The demand for river sand has increased by many folds from last decade due to rapid growth of construction activities. Conventional sources of natural sand are rivers, in which fine aggregates are formed over a period of time by modification of rock particles physically and chemically. The mining of river sand in both legal and illegal forms has led to its scarcity and which produced ill effects on natural sources of fine aggregate. River sand is a non-renewable material hence need to be conserved for the future, there a need for alternatives which will replace the use fine aggregates partially or by full amount. Many alternative materials were analysed to know their properties so as to replace them in various construction works as natural sand. M-sand (manufactured sand) from aggregate manufacturing plant, slag sand (waste produced from steel industry), Construction & Demolition waste (waste generated after demolition of buildings) are bi-products of their respective industries. All these alternatives were considered to be waste product and were dumped in landfills. The properties of these wastes are similar to that of fine aggregate, which is confirmed from literature studies. Many of research programmes on alternatives have recommended to use the alternatives as fine aggregate in a fixed percentage of replacement. Since these alternative materials can be obtained in less cost or can be processed, will replace the fine aggregate economically. Use of such alternatives is an eco- friendly practice because of reduction in transport for landfills, hence reducing the CO2 emission. Alternatives will help to reduce the landfill problems in an effective manner. Use of such alternatives as replacement to fine aggregates is a sustainable approach. Hence use of alternatives should be encouraged and recommended by government. Replacing these alternatives in construction activities, is a best way to conserve the natural sources of river sand. In the present study an attempt is made to understand the properties of above mentioned alternatives to river sand as masonry mortar. Strength behaviour of brick masonry specimens made with alternatives is examined i.e. compression, tensile and flexural behaviour of brick masonry. Based on the experimental results, best suitable alternative is recommended as an approach towards sustainability.

----------X----------

I. INTRODUCTION

Rapid growth of population in urban areas demands for proper infrastructure in terms of residential and public structures. Construction industry is the main source to fulfill the need for infrastructure. Hence there is a requirement for construction materials in various applications of construction. River sand is one of the important construction material used as fine aggregate in mortar, concrete, plastering and other various means of construction. River sand is becoming scares due to its enormous requirement and use. Main source of natural sand are rivers, which are being emptied or erosion of river is taking

place. Aquatic life is also affected by the rivers which are being eroded. In present scenario there is a requisition of alternatives which can replace the natural sand, partially or by full replacement. There is a need for alternatives which can solve the land fill problems, can be used as a recycle material and which are socially acceptable. There are several investigations on such alternatives being carried out all round the world by different research programmes. Hence there are number of alternatives which can replace river sand, as suggested from experimental investigations. In the present investigation three alternatives i.e. manufactured sand, slag sand, construction & demolition waste are identified. All the three alternatives are from different sources, detailed analysis of each alternative is carried out in further chapters. The present investigation on alternatives to river sand aims towards sustainable approach.

All these alternatives identified are being the waste from different industries which will minimize the land fill problems and replace the natural aggregates. These alternatives are by-products, which can be used in construction activities economically. Adverse effects on environment are also reduced by these alternative materials hence are socially acceptable. Sustainable advantages of alternatives to river sand are as follows:

1. Reduce the ill-effects on sources of river sand Decreases the landfill problems

2. Reduce the demand of non-renewable materials like gravel, rock and river sand.

3. Reduces the emission of carbon dioxide gas by reducing the transport distance for landfilling 4.Acts as a sustainable material which is good for environment, economical and socially acceptable

II. METHODOLOGY

Methodology with respect to each objective is briefly given below

1. To determine the physical properties of different alternatives for river sand.

For achieving this object, the process applies as like the determination of physical properties and test results will be compared with natural sand. For that purpose, the test will be used like

- Sieve analysis
- Specific gravity
- Water absorption
- Bulk density
- Bulking of fine aggregate

2. To determine the properties of masonry mortar with various alternatives for river sand.

For achieving this object, the process apply as like the determination of fresh and hardened properties of masonry mortar. For that purpose, mortar mix design will be used to carry out the experiments and the results are compare to river sand.

3. To determine the properties of brick masonry constructed with the alternatives selected in the present study.

For achieving this object, the present study mainly concentrates the behavior of brick masonry made with three alternatives in masonry mortar. For that purpose, the tests as like compressive strength, water absorption, flexural strength and shear strength on brick masonry will be carried out.

4. To determine the economic comparison of alternatives with river sand.

For achieving this objective cost comparison of all the alternatives and river sand will have to be done to get the economy comparison.

The construction industry is facing problems due to scarcity of river sand. Several investigation have revealed the need for alternatives to river sand. There are about eleven alternatives identified so far. The present investigation is on three alternative materials. The three alternatives are M-sand, Slag sand and C&D waste obtained from distinct sources.

This chapter deals with the experiments on alternatives and mode of procurement. The present chapter is mainly divided in two parts as follows:

I. Characterization of alternatives to river sand, based on their physical properties.

II. Examining the alternatives by replacing river sand in mortar mix of 1:6 at 25%, 50%, 75% and 100%.

III. ALTERNATIVES TO RIVER SAND

The three alternatives considered in present study were brought and processed to obtain fine aggregates. These include;

M-sand:

Manufactured sand or artificial sand is produced by crushing the rocks to the required size in aggregate manufacturing plant. Special crushers are employed to obtain the desired size of aggregates. The dust particles generated during the crushing process are washed to get fine aggregates of good quality. In the present investigation the required quantity of manufactured sand is procured from RMC India, Aggregate manufacturing plant, Bangalore. The sample is sieved i.e. materials retained on 4.75mm and passing through 150μ sieves are neglected. Further the sample is examined to know its various properties. A typical scene observed in an aggregate

manufacturing plant where heaps of M-sand can be found is shown in Fig

Fig. Heap of M-sand in aggregate manufacturing plant

Fig. Manufacturing plant

Slag sand:

Slag sand or blast furnace slag is a by-product of steel manufacturing plant formed during the smelting process of steel production. It is non-metallic in nature, with glass particles having silicates and alumino silicates of lime. This by-product of steel is commonly stored outside the production unit in heaps and according to its end use is crushed to the required size and send to the consumer In the present study, slag sand is procured from JSW steel limited, Hospet. The sample was packed in bags and brought by truck (Fig 4.4) to the college laboratory, each bagapproximately weighing 50 kg. The slag sand was already in fine size i.e. finer than 4.75mm in size hence the sand is sieved only with 150µ sieve and used in experimental programme.

IV. PHYSICAL PROPERTIES OF FINE AGGREGATES Sieve analysis:

Fineness modulus = sum of percentage cumulative weight retained / 100

Sieve size (mm)	Wt. retained (gm)	Wt. retained in (%)	Per. cumulativewt. retained (%)	Cumulative percentage passing (%)
4.75	10	0	0	100
2.36	18	1.2	1.2	98.8
1.18	237	15.8	17	83
600µ	446	29.73	46.73	53.27
300µ	661	44.06	90.89	9.21
150µ	119	7.93	98.72	1.28

Weight of river sand sample considered for sieve analysis = 1500gm Fineness modulus = 2.54 Compressive strength of masonry mortar with alternatives is done according to IS: 2250-1981 standards. To carry out the test, mould of size 70.6×70.6×70.6 mm are used. Cement mortar is mixed with known quantity of water as determined by flow test for respective % replacements. The mould is filled in two layers by tamping 25 times for each layer. Care must be taken for uniform tamping so as to avoid the segregation of mortar mix, excess of mortar is struck off and mortar is levelled with a trowel. Once the specimen are cast, they are kept for curing in a place which is free from vibration and at temperature of 27+/- 20C.

V. RESULTS AND DISSCUSION

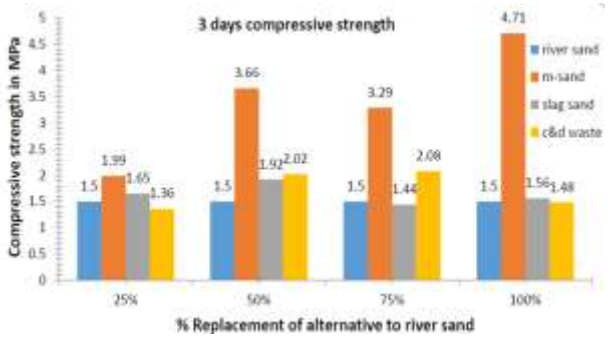

Fig. Compressive strength at 3 days

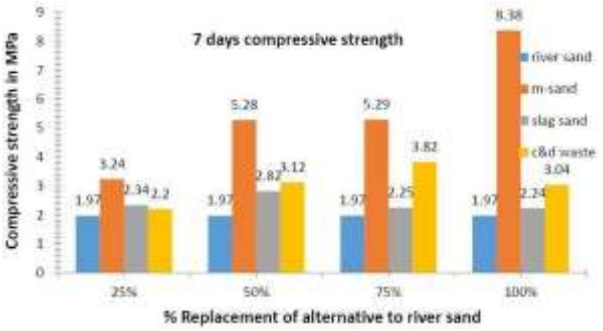

Fig. Compressive strength at 7 days

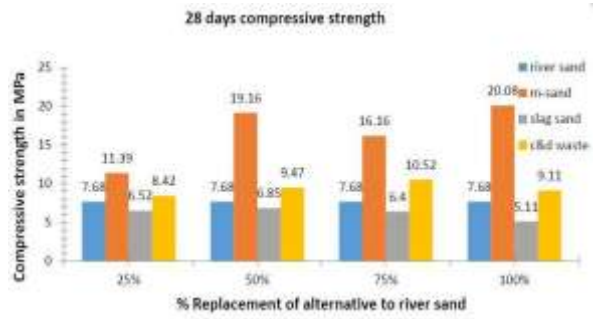

Fig. Compressive strength at 28 days

VI. CONCLUSIONS

Based on the experimental investigations carried on the three alternatives namely m-sand (manufactured in aggregate manufacturing plant), slag sand

(industrial by-product from steel plant) and C&D waste (recycled fine aggregate) the following conclusions can be drawn;

1. Sieve analysis on all the three alternatives has shown that it can be categorized under zone-2 sand as per IS codal provisions.

2. Specific gravity of all the three alternatives are lower than natural sand. The same is reported in literature review.

3. Water absorption exhibited by m-sand and slag sand is around 2%. However C&D waste has shown 6% similar to past research findings. This being due to the presence of adhered mortar around the particles.

4. The loose and rodded densities of slag sand and C&D waste are lower while m-sand has shown high values when compared with density values of natural sand.

5. Bulking property a measure of water absorbing capacity by the sand particles are comparable with that of natural aggregates. However m-sand has shown 63% bulking.

6. Mortar mix of 1:6 with OPC was maintained for all mortars. Varying percentage of replacement was attempted from 25% to 100% or full replacement. 3days, days.

Appendices, if present, must be marked A, B, C, and placed before the Acknowledgment section.

ACKNOWLEDGMENT

The authors would like to thank Dr. P. M. Pawar Head of the Civil Department and prof. V. S. Kshirsagar SVERI's college of Engineering Pandharpur, for their kind support and providing good infrastructure.

The authors are also grateful to Prof. Manik Deshmukh for her encouragement and support.

REFERENCES

[1] B. V. Venkata Ram Reddy (2011), "Suitability of manufactured sand (M-sand) as fine aggregate in mortar and concrete", CSIC Project sponsored by department of mine and geology (Govt. of Karnataka).

[2] H. M. A. Mahzuz, A. A. M. Ahmed and M. A. Yusuf (2011), "Use of stone powder in concrete and mortar as an alternative of sand", African Journal of Environmental Science and Technology, Vol. 5(5), pp. 381-388.

[3] Priyanka A. Jadhav, Dilip K. Kulkarni (2013), "Effect of replacement of natural sand by manufactured sand on the properties of cement mortar", International Journal of Civil and Structural Engineering, Volume 3, No 3.

[4] Leonardo F. R. Miranda, Camila S. Constantino, Carla R. Monich and Antonio A. de M. Neto (2013), "Use of Recycled Sand Produced at Construction Sites in Bedding Mortars", American Society of Civil Engineers Library.

[5] C. Aciu (2014), "Research on recycled ceramic waste in the composition of ecological mortars", Journal of Applied Engineering Sciences, Volume 4(7), pp. 712.

[6] Nagabhushana and H. Sharada Bai (2011), "Use of crushed rock powder as replacement of fine aggregate in mortar and concrete", Indian Journal of Science and Technology, Volume. 4 No. 8.

[7] S. E. Enavenil and B. Vijaya (2013), "Manufactured Sand, A Solution and an Alternativeto River Sand and In Concrete Manufacturing", Journal of Engineering, Computers & Applied Sciences (JEC&AS), Volume 2, No.2.

[8] M. C. Nataraja, P.G. Dileep Kumar, A. S. Manu and M. C. Sanjay (2013), "Use of granulated blast furnace slag as fine aggregate in cement mortar", International Journal of Structural and Civil Engineering Research, Volume.2, No.2.

[9] J. Sridhar and R. Malathy (2011), "Study on Compressive Strength of Cement Mortar with Partial Replacement of Fine Aggregate by Steel Slag for Ferrocement Laminates", International Journal of Earth Sciences and Engineering, Volume. 04, No. 06, pp. 1139-1144.

[10] Ansu John and Elson John (2013), "Study on the partial replacement of fine aggregate using induction furnace slag", American Journal of Engineering Research (AJER), Volume-4, pp. 1-5.

[11] Mohammed Nadeem and Arun D. Pofale (2012), "Utilization of Industrial Waste Slag as Aggregate in Concrete Applications by Adopting Taguchi's Approach for Optimization", Open Journal of Civil Engineering, 2, pp.96-105.

[12] J. Silva, J. de Brito and R. Veiga (2010), "Recycled Red-Clay Ceramic Construction and Demolition Waste for Mortars Production", American Society of Civil Engineers Library.

[13] Leonardo Fagundes Rosemback Miranda, Maylane Pedrosa Lapenda, Sidnei H. C. Teixeira and Vanessa Vogt (2014), "Rational Procedure for Composition of Screed Mortar

with Recycled Sand at a Construction Site", American Society of Civil Engineers Library.

[14] Darshan B. (2012), "A study on use of recycled fine aggregates in masonry mortar", M.Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[15] Preethi K. (2013), "Study on recycled aggregates and its application in masonry mortar and cement concrete", M. Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[16] Vidyasagar (2009), "An experimental study on flexural strength of brick masonry", M. Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[17] Prakash K. (2008), "Study on behaviour of masonry with concrete crushed aggregate in cement mortar", M. Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[18] Hanamant Reddy (2007), "Experimental investigation on the compressive, tensile, flexural and shear strength of bricks & cement mortar", M. Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[19] Atul Kumar (2009), "Study on behaviour of solid concrete block masonry under flexure and shear loading condition", M. Tech Thesis, Department civil engineering, BMSCE, Bengaluru, India.

[20] IS: 383-1970 (Reaffirmed 2002), "Specification for coarse and fine aggregates from natural sources for concrete", Bureau of Indian standards, New Delhi.

[21] IS: 2250-1981, "Indian standard code of practice for preparation and use of masonry mortars", Bureau of Indian standards, New Delhi.

[22] IS 3495(part 2): 1992, "Indian standard code for methods of test of burnt clay building bricks", Part-2 Determination of water absorption, Bureau of Indian standards, New Delhi.

[23] IS 3495(part 1): 1992, "Indian standard code for methods of test of burnt clay building bricks", Part-1 Determination of compressive strength, Bureau of Indian standards, New Delhi.

[24] IS 3495(part 1to 4): 1992 (Reaffirmed 2002), "Indian standard code for methods of test of burnt clay building bricks", Bureau of Indian standards, New Delhi.

[25] ASTM-C307-03(2012), "Standard test method for tensile strength of **chemical resistant** mortar, grout, and monolithic surfacing.

Corresponding Author

Hari Aiwale*

PG Student, Shri Vithhal Education and Research Institute's College of Engineering, Pandharpur, Maharashtra, India