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Replacement of River Sand Using Manufactured Sand and Quarry Dust in Cement Concrete

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ABSTRACT

River sand is widely used for concrete as fine aggregate. The increased cost of river sand and depletion in ground water table due to illegal sand mining leads to find an alternative for fine aggregate without compromising the strength. In this study, concrete mix M_{30} has been designed using quarry dust and manufactured sand by replacing the river sand. Four mix proportions were made to test the effect of inclusion of quarry dust and manufactured sand in concrete and the results were compared with the control specimens. It was found that the strength of the concrete is enhanced in both the types of replacements.

INTRODUCTION

In general, the river sand is used as fine aggregate in concrete. Large scale construction activities have led to increased cost of river sand which leads to illegal sand mining. Hence, several State Governments have imposed restrictions on sand quarry. Another problem noted is environmental degradation. For the past 4-5 years, crushed sand has not been used much in India as the ordinary crushed sand is flaky, badly graded with rough texture (Prithvi et al. 1991). It produces harsh concrete; but now many improved types of equipments are set up in India to produce crushed sand of acceptable quality at project site. With manufactured sand as fine aggregate, the Pune-Mumbai express highway, one of biggest projects undertaken in India, has been completed. The total quantity involved was 20,000,00 m^3 of concrete.

The other alternative taken in the study is quarry dust obtained from stone quarries. Crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Earlier investigations indicate that stone crusher dust has a good potential as fine aggregate in concrete construction.

MATERIALS AND METHODS

Materials used: Ordinary Portland cement (43 grade) was used for the study. Natural river sand has been used for the study in making the control specimens. Quarry dust for the study has been collected from the nearby stone quarry at Milekkal near Kovaipudur. Earlier investigation (Sahu et al. 2003) indicates that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as a waste product. Crusher dust from quarries, being a waste product will also reduce environmental impact if consumed by construction industry in large qualities. Quarry dust confirming to grading zone II was used for the study.

The term manufactured sand (M sand) is used as aggregate material which is less than 4 mm that is processed from crushed rock or gravel and intended for construction use. IS: 383-1970

(reaffirmed 2007) recognizes manufactured sand as 'crushed stone sand' under Clause 2. The particle shape of manufactured sand is cubic, angular and with rough surface texture (Borge et al. 2004). The old method of manufacturing ordinary crushed sand has been replaced by modern crushers specially designed for producing cubical, comparatively smooth texture, well graded, good enough to replace natural sand. In this study manufactured sand was collected from Thomson Granites, Mannuthy, Kerala. The various properties of sands used for the study are given in Table 1 (Chitra et al. 2005). Manufactured sand conforms with grading zone II. To study the strength parameters, mix proportion used for control mix cement specimen was 1 : 1.23 : 2.58 at a w/c of 0.43 (cement : coarse aggregate: fine aggregate). Sand in the mix was replaced by quarry dust and M sand. Sand in the mix is replaced by quarry dust and M sand. Four different combinations were studied i.e., using sand alone, sand (50%) and Q dust (50%), and using M sand alone, sand (50%) and M sand (50%). Concrete specimens prepared were cured at constant temperature and humidity and their compressive, split tensile strength and flexural strength were determined at 7, 14 and 28 and 56 days.

Tests on concrete: Cubes of standard mould size 150mm × 150mm ×150 mm; cylinder of standard size, 150 mm diameter and 300 mm height; and Beam of standard size, 100 mm × 100 mm × 500 mm were cast. Three cubes each have been cast for every set of replacement. These specimens after curing period (7 days, 14 days, 28 days and 56 days) were tested for their compressive strength, split tensile strength and flexural strength respectively. The average strength of the specimens was obtained for 28 days and 56 days as shown in Table 2 and Fig. 1.

RESULTS AND DISCUSSION

The results obtained for compressive strength for the study period of 28 days and 56 days for sand and replacement of sand partially by either M sand or quarry dust are given in Table 2. It was observed that compressive strength for the partial replacement of M sand (44.78 Mpa) and Quarry dust (45.55 Mpa) are higher compared to river sand mixture (44.44 Mpa) for 28 days study period. The same trend was observed for 56 days also. Similar to compressive strength, the flexural strength and split tensile strength were also higher for the partial replacement of sand either with quarry dust or M sand (Table 2). The increase in compressive strength, split tensile strength and flexural strength

Table 1: Properties of fine aggregate used.

Properties	N sand	Quarry dust	M sand
Fineness modulus	2.25	2.56	2.7
Specific gravity	2.67	1.77	2.44
Water absorption	2%	0.5%	4%

Table 2: Strength parameters of concrete.

Description of Proportion	Curing days	Cube Compressive Strength, Mpa	Split Tensile strength, Mpa	Flexure strength, Mpa
S	28	44.44	3.67	4.40
	56	45.33	3.96	4.70
S+Q	28	45.55	4.24	5.18
	56	46.22	4.38	5.29
S+M	28	44.78	3.89	4.64
	56	45.79	3.96	4.91

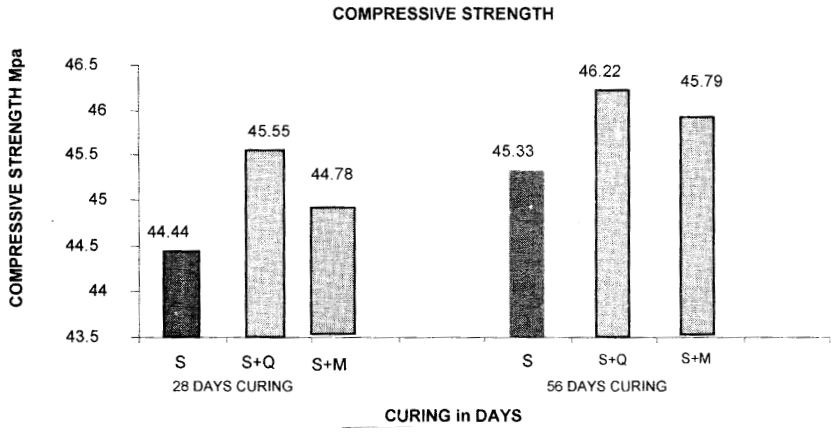

Fig. 1: Compressive stength of various concrete mixtures after 28 and 56 days of curing.

for M sand and quarry dust is possibly due to the sharp edges which provide stronger bond with cement compared to the rounded shape of river sand (Prakash Rao & Giridhar Kumar 2004, Vishwanatha 2007, Nagendra 2007). Since clean sand is now scarce, these materials give a better alternative to river sand.

CONCLUSION

It can be concluded from the study that 50% of natural sand can be replaced by quarry dust and manufactured sand with improvement in strength values without altering water cement ratio when no water modifying admixture is used. As the quarry dust contains more fine particles the need for water is comparatively more than sand mixture to produce the minimum workability for concreting works. Since these alternative materials reduce the utility of river sand, the environmental degradation due to excessive sand mining can be minimized

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REFERENCES

Prithvi, S., Kandal, John, B. Motter, Maqbool and Khatri, A. 1991. Shape and Texture: Manufacture Verses Natural Sands, Paper presented at the 1991 Annual Meeting of the Transportation Research Board in Washington DC, January 19, www.eng.anburn.edu/center/ncat/reports/rep, pp. 1-26.

Sahu, A.K., Kumar Sunil and Sachin, A.K. 2003. Crushed stone waste as fine aggregate for concrete. The Indian Concrete Journal, 77(1): 845-847.

Borge Johannes, Wigum, Porbjorg Holmgeirsdottir, Sevein Willy Danielsen and Ole Viggo Anderson. 2004. Production and Utilization of Manufactured Sand for Concrete Purposes, February 2004, www.honnun.is/sand, pp.1-88.

Chitra, R., Jayanthi, J., Tamilarasi, C. and Vanajakshi, V.S. 2005. Replacement of Fine Aggregate in Cement Concrete by Manufactured Sand and Quarry Dust, Guided by Mrs. Sunilaa George, Project Report Submitted in Partial fulfilment of the requirement of Bachelor of Engineering (Civil Engineering), Anna University, Chennai.

Prakash Rao,D.S. and Giridhar Kumar, V. 2004. Investigations on concrete with stone crusher dust as fine aggregate, The Indian Concrete Journal, July 2004, pp. 45-50.

Vishwanatha, C.S. 2007. Manufactured sand: Need of the hour. Cover story article by Agith G. Anthony in Master Builder Magazine, pp. 54-63.

Nagendra, R. 2007. Proportioning of concrete mixes using manufactured sand. Article in Master Builder Magazine, pp. 64-71.