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Utilization of Crush Sand as an alternative for natural sand in Concrete

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Abstract: Natural Sand is mainly excavated from river beds and contains high percentages of inorganic materials, chlorides, sulphates, silt and clay that adversely affect the strength and durability of concrete thereby reducing the life of the structure. Crushed sand is different in shape, grading and content as compared to river sand. Hence, the usage of crushed sand as a replacement for diminishing natural sand has become essential keeping in view technical, commercial and environmental requirements. This paper deals with usage of Crushed sand as an alternative to River sand as fine aggregate.

Keywords: Compressive Strength, Crushed sand, Fine aggregate, Flexural Strength, Mix proportion, River Sand

I. INTRODUCTION

The use of River sand in Concrete can be replaced by the use of crush sand keeping in mind the scarcity of river sand with depletion of natural resources in terms of river sand, Crush sand can be more efficient and effective. Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. Usage of Crushed Sand in Construction is more a norm in Western Countries than exception there.

The main components of concrete are; cement coarse aggregate, fine aggregate, water and admixtures. Sand is the one of main constituents of concrete making about 35 % of volume of concrete used in construction industry. Natural sand is mainly excavated from river beds and always contains high percentages of inorganic materials, chlorides, sulphates, silt and clay that adversely affecting the strength & durability of concrete & reinforcing steel there by reducing the life of structure. Digging sand, from river bed, in access quantity is hazardous to environment. The deep pits dug in the river bed, affects the ground water level.

II. HEADINGS

1. Introduction
2. Materials
2.1 Cement
2.2 Fine aggregate
2.3 Manufactured sand
2.4 Coarse sand
3. Methodology

III. INDENTATIONS AND EQUATIONS

1. Introduction

Crushed stone or angular rock is a form of Construction aggregate typically produced by mining a suitable rock deposit and breaking the removed rock down to the desired size using Crushers. It is distinct from gravel which is produced by natural processes of weathering and erosion, and typically has a more rounded shape.

Crushed stone is a high-volume, low-value commodity. Production costs are determined mainly by the cost of labor, equipment, energy, and water, in addition to the costs of compliance. These costs vary depending on geographic location, the nature of the deposit, and the number and type of products produced. Crushed stone has one of the lowest average by weight values of all mineral commodities.

2. Materials

2.1 Cement

Portland pozzolanic cement 53 grade conforming to IS 8112 – 1989, and specific gravity of cement is found to be 3.15.

2.2 Fine aggregate

Locally available river sand having bulk density 1762 kg /m3 is used and the specific gravity 2.73 and fineness modulus of river sand is 3.01.

2.3 Manufactured sand

M-Sand is replaced is fully replacement of river sand .It is collected from local manufacturers. The bulk density of manufactured Sand 1460 kg/m2 and the specific gravity 2.43 and fineness modulus of rive Sand is 2.8.

2.4 Coarse aggregate

Considering all the above aspects, blue granite crushed stone aggregate of 12.5mm as maximum size and of typical particle shape "average and cubic" are used as the course aggregate for the present investigation. The aggregates are tested as per the procedure given in BIS: 2386- The bulk density of coarse aggregate 1660 kg/m2 and the specific gravity 2.83 and fineness modulus of coarse aggregate 6.73.

3. Methodology

A total of eight mixes were prepared and studied to investigate the properties of concrete with crushed basalt fine aggregates and natural sand. Four mixes with crushed stone fine aggregates and four mixes with natural sand called control mixes were prepared. The concrete mixes were made with water to-cement ratios of 0.38, 0.41, 0.55 and 0.60. Increase in strength characteristics of concrete has been observed as compared to concrete made with natural river sand is mainly due to denser particle packing and silt free nature as compared to river sand. International Centre for aggregate research (ICAR) has conducted extensive research on the use of manufactured micro fines, up to 17%, in concrete with promising results.

IV. FIGURES AND TABLES

Table 1 Adopted mixture proportions for different grades of concrete

Mixture No	Cement	Crush Stone	CA(10mm)	CA(20mm)	W/C ratio	Plasticizer by % weight of cement
M15	1	3.5	1.75	2.49	0.60	1.5
M20	1	2.92	1.55	2.22	0.55	1.5
M35	1	1.58	0.94	2.14	0.41	2.7
M40	1	1.45	0.89	2.09	0.38	2.7

Table 2 Compressive strength and Flexural strength
(Here, N refers to Normal river sand as aggregate and C refers to Crushed sand as aggregate.)

Mixture no.	Comp(7 days)	Comp(28 days)	Flexural(7 days)	Flexural(28 days)
M15-N	13.84	20.91	2.83	4.22
M15-C	16.53	22.63	2.87	4.26
M20-N	21.94	32.76	2.98	4.96
M20-C	27.00	37.04	3.06	5.12
M35-N	23.30	34.74	2.89	4.22
M35-C	30.84	41.85	2.98	4.26
M40-N	25.53	38	3.76	5.41
M40-C	35.84	47.84	3.86	5.71

Table 3 Percentage increase in Compressive strength and Flexural strength

Mixture No	% increase in compressive strength(7)	% increase in compressive strength(28)	% increase in flexural strength(7)	% increase in flexural strength(28)
M15-C	19.44	8.23	1.41	0.95
M20-C	23.06	13.07	2.68	3.23
M35-C	30.82	20.47	3.11	3.32
M40-C	40.38	25.90	3.48	5.55

V. CONCLUSION

From the experimental results, it can be concluded that usage of Crush sand as a replacement of natural sand as a fine aggregate for concrete gives higher compressive and flexural strength. Moreover, economically it is quite cheaper and easily available. Due to limited availability of natural sand for certain regions and higher transportation cost, this alternative has higher suitability.

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