Experimental Investigation of Partially Replacement of River Sand By Quarry Sand

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Abstract- *This paper addresses the experimental studies on strength characteristics of cement concrete in which quarry sand is used as partial replacement of Natural River sand . The study has shown that Crushed sand satisfies the pre-requisites and requirements of fine aggregate from the physical and mechanical characteristics such as strength, specific gravity Natural river sand, if substituted by 100% Quarry Sand from quarries, may give identical or superior results than the reference concrete made with Natural Sand, in accordance of compressive strength. In accordance with this experimental investigation, it is evaluated that quarry sand can be used as a substitute/alternative material to the natural river sand. It is found that quarry sand enhances its mechanical property of concrete. Utilization of quarry dust it will also result in the minimization of the cost of concrete because it is a waste material from quarries. Use of quarry sand in concrete will significantly reduce the disposal issue*

Keywords- Quarry Dust, River Sand , Cement, Concrete, Compressive Strength.

I. INTRODUCTION

In our Country (India) significant dynamism is taken in flourishing the infrastructures such as Express Highways, Power projects, Industrial projects etc, to meet the requirements of globalization. In the construction of buildings and other structures concrete plays a very crucial role.

Aggregate is classified as one of the critical components which has consequences in strength development in the theory that the gap of coarse aggregate is suffused by the fine aggregate and the gap of fine aggregate is suffused by the binding materials.

Amidst these ingredients river sand is frequently used as fine aggregate in concrete which is becoming deficient and hence costly due to unrestrained cost of transportation from natural sources. The exhaustive depletion of these resources creates genuine environmental issues. Thus, Governments are compacting the collection of river sand from riverbed. In such a circumstance, the crusher dust can be an economical substitute to river sand. Crusher sand is a derivative produced from quarrying tasks tangled in the construction of crushed coarse aggregate.

The consumption of manufactured sand in concrete structure has become dominant. It can make construction industry develop with environmentally sociable and sustainable goods.

The Coarse aggregates which are frequently crushed rock are mainly produced by crushers, but it is also manually in concrete which will lessen not only the urge for natural river sand but also the environmental burden. It will help to find feasible clarification to the reducing accessibility of natural sand to make eco-balance.

Natural sand or river sand constitutes as major fine aggregate in cementitious construction. Especially, masonry block production requires 70–90% sand as raw material. While the demand for river sand increases rapidly, the supply of good quality river sand is limited due to the restrictions in sand mining in river beds. Because excessive extraction of river sand to cater the increasing demand has brought undesirable environment-related consequences. The persisting issues encouraged the researchers to find a sustainable alternative for river sand. Quarry dust is one of the alternatives as it has some advantages over river sand such as better contribution to the strength of the cementitious material, better workability, lesser cement consumption and eco-friendly.

II. MATERIALS

2.1 Cement

The cement used was Ordinary Portland Cement of Grade 53. Cement is procured from local market. The physical properties of the cement obtained on conducting appropriate tests and the requirements as per IS: 12269-2013 is given below.

Physical properties of procured Ordinary Portland Cement:

Particulars	Test Results	Requirements of IS: 1489-1991
Specific Gravity	3.20	3.0 – 3.25
Fineness (m^2/kg)	335	300
Normal Consistency	30.5%	24 – 32 %
Initial Setting Time (min)	145min	300min
Final Setting Time (min)	200min	600max

Fig.2.1 CEMENT

2.2 Quarry sand

Quarry sand was utilized as a complete substitute of fine aggregate. The basic examinations performed on quarry sand were organized as per IS-383-1987 and its specific gravity was around 2.81. Wet sieving of quarry sand through a 90 micron sieve **was found to be 87%. Bulk density of Quarry sand was 1.72 kg/m3, and fineness** modulus was found to be 2.90 respectively

Sr. No.	Particulars	Test Results
1	Specific Gravity	3.20
2	Fineness (m^2/kg)	2.90
3	Water Absorption	0.5
4	Partical Shape	Angular
5	Bulk Density kg/m3	1.72

Fig.2.2 QUARRY SAND

2.3. Fine Aggregate

In addition to cement, water and aggregates are the other primary constituents of concrete or mortar mixture. Sand is the largest compound of the mortar and the material that gives mortar it distinctive colour, texture and cohesiveness. Sand is procured from local market. Sand is generally from Wainganga River near Nagpur

Properties	Result
Specific Gravity	2.62
Fineness Modulus	2.58
Particle Shape	Rounded
Water Absorption	1.6%

Fig.2.3 NATURAL RIVER SAND

2.4. Coarse Aggregate

Aggregate is a rock like material of various sizes and shapes, used in the manufacture of Portland cement concrete or mortar bituminous (asphalt), concrete, plaster grout, filter beds and so on. Aggregate is procured from local market. The aggregate which we used are brought from local market.

Sr. No.	Size	20mm
1	Specific Gravity	2.65
2	Fineness Modulus	6.82

Fig.2.4 COURSE AGGREGATE

2.5. Water

Water is a vital ingredient of Concrete as it launches the chemical reaction with cement. accustomed portable water will be used throughout the experiment as well as for healing the Concrete Specimens

III. MIX DESIGN

A trial mix has been designed for an assumed compaction factor of 0.80 as per IS 10262 - 1982 for M20 grade. The trial mix is obtained as 1:1.5:2.16 for water cement ratio of 0.40. The proportions ingredients of the mix with quarry will increase with 5% ,10 %,15%.

IV. METHODOLOGY

4.1 Determination of particle size distribution of sand and coarse aggregate This was done in accordance to BS 812 part 1: 1975: The results of the sieve analysis is presented and indicate that the sand is in zone 2. The nominal size of coarse aggregate is 20mm.

4.2 Test for determination of bulk density and voids Bulk density is normally defined as 'The weight of material in a given volume'. It is generally expressed in kg per litre. A cylindrical measure willingly machined to definite internal dimensions is utilized for measuring bulk density. The size of the container for calibrating bulk density.

The cylindrical measure is filled about 1/3 each time with rigorously mixed aggregate and hammered with 25 strokes by a bullet ended tamping rod, 16 mm diameter and 60 cm long. The measure is cautiously struck off level using tamping rod as a straight edge. The net weight of the aggregate in the measure is verified and the bulk density is calibrated in kg/liter

4.3 SPECIFIC GRAVITY AND BULKING OF SAND

In concrete technology, specific gravity of aggregates is utilized in design calculations of concrete mixes. With the specific gravity of each component known, its weight can be transformed into solid volume and hence a theoretical turnout of concrete per unit volume can be calculated. Specific gravity of aggregate is also enforced in calculating the compacting factor in acquaintance with the utility measurements. Likewise, specific gravity of aggregate is needed to be contemplated when we use the light weight and heavy weight concrete. Average specific gravity of the rocks varies from 2.6 to 2.8.

Collapse	Shear	True
In a collapse slump the concrete collapses completely	In a shear slump the top portion of the concrete shears off and slips sideways.	In a true slump the concrete simply subsides, keeping more or less to shape

Percentage Bulking = [100 (Vw - Vd)] / Vd

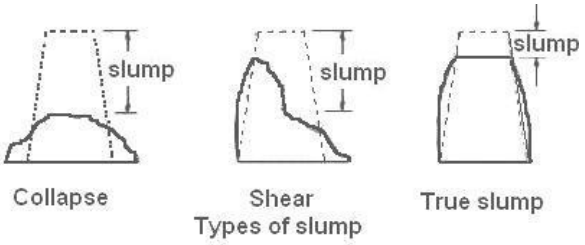
4.4 Workability Test

This was done in accordance to BS 1881: part 102: 1983 for Quarry sand dust concrete of M20 grades

WORKABILITY
(SLUMP CONE TEST)

he **concrete slump test** measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. It can also be used as an indicator of an improperly mixed batch. The test is popular due to the simplicity of apparatus used and simple procedure. The slump test is used to ensure uniformity for different loads of concrete under field conditions

A separate test, known as the flow table, or slump-flow test, is used for concrete that is too fluid (non-workable) to be measured using the standard slump test, because the concrete will not retain its shape when the cone is removed.



4.5 Determination of compressive strength of concrete

In order to perform the cube compression testing of concrete and mortar, 150mm cubes were utilized respectively. All the required cubes were tested in saturated condition, after wiping out the surface moisture. Two cubes for each mix of quarry sand and river sand were tested at the age of 3 days, 7 days and 28 days of curing for concrete and 28th days of curing for mortar using compression testing machine.

After age of 3 days, 7 days and 28 days of curing, the cubes were taken out of the curing tank, dried and tested using a compression machine. These cubes were loaded on their sides during compression testing such that the load was applied perpendicularly to the direction of casting. The cubes were placed in the compression testing machine and the loads are exerted gradually

The average value of the compression strength of two cubes was considered as the compression strength

Fig.4.5 COMPRESSION TEST MACHINE

V. CONCLUSION

- Crushed sand will be satisfied the pre-requisites and requirements of fine aggregate from the physical and mechanical characteristics such as strength, specific gravity
- The sand has been remarkably improved the attributes of concrete made with crushed rock sand.
- In accordance with this experimental investigation, it should evaluate that quarry sand can be used as a substitute/alternative material to the natural river sand.
- We will found that quarry sand enhances its mechanical property of concrete.
- Utilization of quarry dust it will also result in the minimization of the cost of concrete because it is a waste material from quarries.

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