Partial Replacement of River Sand with Robosand

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***Abstract*- The most frequently used fine aggregate across world is river sand. River sand is costly due to undue cost of transportation from natural sources. Also large scale reduction of the source creates environmental problems. As ecological, transportation and other constraint formulate the availability and use of river sand less good-looking. A alternative or replacement product for concrete industry needs to be found. The main parameter investigated in this study is M30 grade concrete with replacement of sand by robosand by 0, 10, 20, 50, 70 and 100%. This paper presents a detailed experimental study on compressive strength, split tensile strength 3, 7 and 28 days on hardened concrete and slump cone test and compaction factor test on fresh concrete.**

1. INTRODUCTION

The 1.1 General:

Concrete is an artificial conglomerate stone made essentially of Portland cement, water, sand and coarse aggregates. The mixture of the materials results in a chemical reaction called hydration and a change in the mixture from plastic to a solid state. It has found use in different fields of civil engineering, in highway engineering concrete is used in the production of slabs used as rigid pavement. The high cost of concrete used in rigid pavement construction stems from the cost of the constituent materials. Such cost can be reduced through the use of locally available alternative material, to the conventional ones normally used in concrete work, of interest to this research is an alternative to sand.

1.2 River Sand:

A thorough study by experts has shown that the riverbed sand supplied for construction purpose is virtually worthless and is not fit for use unless it is tested. It contains 25-30 per cent of silt against the permissible 5 %. Mud content in it is between 20 per cent and 25 per cent against the permissible limit of 2 % to 5 % showing rock sand as a viable substitute for river sand, he said it could be used in reinforced concrete, brick work. Explaining the efficacy of rock sand, Mr. Raja ling, unlike river sand, which was less effective in concrete mixing because sand particles travel long distance in the river water thus losing most of its strength, rock material was obtained by crushing it in the VS (vertical soft impacted) crusher, which added to its strength and made it highly dependable. The river sand collected from different locations and quarries widened the scope for a varied quality, but the same could not be said about ROBO sand, he pointed out.

The worldwide consumption of sand as fine aggregate in concrete production is very high, and several developing countries have encountered some strain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years. A situation that is responsible for increase in the price of sand, and the cost of concrete. Expensive and scarcity of river sand which is one of the constituent material used in the production of conventional concrete was reported in India. The successful utilization of ROBO sand as fine aggregate would turn this waste material that causes an environmental load due to disposal problem into valuable resources, reduction in the strain on the supply of natural sand, and economy in concrete production. Most of the researchers listed above considered alternative material to sand in the production of concrete. This research is aimed at determining the suitability of ROBO sand to replace river sand in the production of concrete, using compressive strength and flexural strength tests as basis for assessment.

1.3 ROBO Sand:

ROBO sand is an ideal substitute to river sand. It is manufactured just the way nature has done for over a million years. ROBO sand is created by a rock-hit-rocking crush technique using state of the art plant & machinery with world class technology. Created from specific natural rock, it is crushed by a three stage configuration of a Jaw Crusher followed by a Cone Crusher and finally a Vertical Shaft Impactor (VSI) to obtain sand that is consistence in its cubical particle shapes and gradation. ROBO sand is the environmental friendly solution that serves as a

perfect substitute for the fast depleting and excessively mined river sand, which is so essential for percolating and storing rain water in deep underground pockets and protects the ground water tables. ROBO sand 0-4.75mm is suitable for all concrete preparations and is used across all segments such as Independent Houses, Builders, RMC Plants, Concrete Batching Plants and Infrastructure Concrete Works.

The cubical particle shape helps make concrete more cohesive A perfect gradation ensures fewer voids and increases the compressive strength. Well balanced physical and chemical properties of ROBO sand make for more durable buildings. ROBO sand is produced under controlled conditions with raw material from a single source resulting in very consistent quality with no seasonal fluctuations. The complete absence of deleterious materials eliminates wastage and works out economical for use in concrete. An optimum level of fineness content helps overcome deficiencies of concrete such as segregation, bleeding, voids and honey combing. Easy availability of ROBO sand in huge quantities around the year leads to execution of construction projects on time. ROBO sand is an eco-friendly product and its helps to conserve nature by preventing depletion of ground water levels.

1.3 Need for ROBO Sand Utilization:

The sand available in the riverbed is very coarse and contains very much percentage of silt and clay. The silt and the clay presents in the sand reduce the strength of the concrete and holds dampness. Fine particles below 600 microns must be up to at least 30% to 50% for good results. At present these particles are not present in river sand up to the required quantity. The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities

are present in the river sand. The increase of these impurities above certain percentage makes the sand useless for concrete work. There is discrepancy in the sand in two trucks lifted from same source. Hence for important work and to achieve the quality each truck of sand should be tested. For getting required fineness module the sand should be sieved. In routine average wastage of sieving are about 35% and extra labour cost involved. For this reason to fulfil the requirement of fine aggregate (Sand) some alternative material must be found. In foreign countries alternative to river sand is already in use. Fine cubical particles of stone below 4.75 mm are used, to replace the river sand. Such a particle is the crushed quarry dust which is called as ROBO sand that can be used for replacement of river sand in concrete.

1.4 Advantages of ROBO Sand:

- *Greater Durability*:

ROBO Sand has balanced physical and chemical properties that can withstand any aggressive environmental and climatic conditions as it has enhanced durability, greater strength and overall economy. Usage of ROBO Sand can overcome the defects occurring in concrete such as honey combing, segregation, voids, capillary etc.

- High Strength:

The superior shape, proper gradation of fines, smooth surface texture and consistency in production parameter of chemically stable sands provides greater durability and higher strength to concrete by overcoming deficiencies like segregation, bleeding, honey combing, voids and capillary.

- Greater Workability:

The crusher dust is flaky and angular in shape which is troublesome in working. There is no plasticity in the mortar which makes it even difficult for the mason to work, whereas the cubical shape with grounded edge and superior gradation gives good plasticity to mortar providing excellent workability.

- Offsets Construction Defects:

ROBO Sand has optimum initial and final setting time as well as excellent fineness which will help to overcome the deficiencies of concrete such as segregation, bleeding, honeycombing, voids and capillary.

- Economy:

Usage of ROBO Sand can drastically reduce the cost since like river sand, it does not contain impurities and wastage is NIL. In International Construction Scenario, no river sand is used at all, only sand is manufactured and used, which gives superior strength and its cubical shape ensures significant reduction in the cement.

- Eco-Friendly:

ROBO Sand is the only alternative to river sand. Dredging of river beds to get river sand will lead to environmental disaster like ground water depletion, water scarcity, threat to the safety of bridges, dam's etc. Beside with the Government

contemplating ban on dredging of River beds to quarry river sand, as part of the growing concern for environment protection, ROBO Sand will be the only available option.

2. LITERATURE REVIEW

Naveen Kumar & B. Siva Babu

The study of replacement of river sand in concrete with rock sand that the suitability of Crushed Rock fine (CRF) to replace river sand in concrete production for use in rigid pavement was investigated. Strength tests are studied with River sand and Artificial Sand, for Low grade concrete and high grade concrete. 7 days Peak compressive strength values for Low grade concrete and High grade concrete 174.81 Kg/cm 2 and 441 Kg/cm 2 respectively was obtained with River sand, with the replacement of river sand with CRF, as against values of 186.67 Kg/cm 2 and 468.14 Kg/cm 2, obtained. Based on economic analysis and results of tests, river sand replaced with CRF is recommended for use in the production of concrete for use in rigid pavement. Conservation of river sand in addition to better ways of disposing wastes from the quarry sites are some of the merits of using CRF.

Nagabhushana and H. Sharada bai

Studied that Concrete is a major building material which is used in construction throughout the world. It is extremely versatile and is used for all types of structures. Due to rapid growth in construction activity, the consumption of concrete is increasing every year. This results in excessive extraction of natural aggregates. The use of these materials is being constrained by urbanization, zoning regulations, increased cost and environmental concern. Thus, it is becoming inevitable to use alternative materials for aggregates in concrete which include recycled aggregates, fly ash, manufactured sand, crushed rock powder etc. The use of such materials not only results in conservation of natural resources but also helps in maintaining good environmental conditions. The present investigation aims in the study of properties of mortar and concrete in which Crushed Rock Powder (CRP) is used as a partial and full replacement for natural sand. For mortar, CRP is replaced at 20% 40%, 60%, 80% and 100%. The basic strength properties of concrete were investigated by replacing natural sand by CRP at replacement levels of 20%, 30% and 40%. The use of sand in construction results in excessive sand mining which is objectionable. Due to rapid growth in construction activity, the available sources of natural sand are getting exhausted. (Palaniraj, 2003) Also, good quality sand may have to be transported from long distance, which adds to the cost of construction. In some cases, natural sand may not be of good quality. Therefore, it is necessary to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete.

V. Bhikshma, R. Kishore & C.V. Raghu Pathi experimented that Sand is basic concrete making construction material required in large quantities. Hence, in the present scenario, it is necessary to find the most suitable substitute for sand, easy to produce and has all the required qualities for use in concrete. Manufactured sand is one among such materials to replace river sand, which can be used as an alternative fine aggregate in mortars and concretes. To attain the set out objectives of the present investigation, M50 grade concrete has been considered. Strength properties such as cube compressive strength and flexural strength of beams, and load carrying capacity, moment carrying capacity, behavior of strains in compression as well as tension fibers and cracking patterns have been studied for the grade of concrete. In this paper a total of 15 cube specimens 150 × 150 × 150 mm and 10 beam specimens of size 1500 × 150 × 230 mm were cast for testing. The results have been compared for the specimens made with natural fine aggregate

N. Vivek experimented as environmental, transportation and other constraints make the availability and use of natural sands less attractive for the concrete producer, a substitute or replacement product for the concrete industry needs to be found. Manufactured sands have been around for a considerable time. However, manufactured sand people around the world generally try to synthesize natural sands, rather than taking advantage of the many properties that good manufactured sand can offer, to enhance the performance of concrete. Manufactured sand is becoming widely used around the world. Understanding of the differences between manufactured sand and natural sand is becoming increasingly important. The acceptance of what were once considered high percentages of minus 75 micron (200 meshes) materials in manufactured sands, along with the introduction of specifications on sand

particle shape, will ensure that quality manufactured sands will be the preferred option for concrete in the future.

3. RAW MATERIALS USED

The materials that are used in manufacturing concrete are as follows:

- Cement
- Fine Aggregate
- ROBO Sand
- Coarse Aggregate
- Water

4. EXPERIMENTAL PROGRAM

4.1.Testing For Physical Properties of Cement

S.No.	Type Of Test	Result
1	Fineness	2.8%
2	Standard consistency	26.8%
3	Specific gravity	3.1
4	Initial setting time (min)	50 minutes
5	Final setting time (min)	290 minutes

4.5 MIX DESIGN FOR M30 GRADE:

The concrete mix design has been done as per IS method

- Details of materials
- Grade of concrete – M30
- Type of cement – OPC 53 grade
- Maximum nominal size of Coarse aggregate – 20mm
- Exposure condition – Severe
- Degree of Supervision – good
- Type of aggregate – Angular aggregate

Assuming state of surface to be SSD (Surface Saturated Dry state)

- Test data of materials
- Specific gravity of OPC- 3.11
- Specific gravity of Natural Sand – 2.673
- Specific gravity of ROBO sand – 2.67
- Specific gravity of Coarse aggregate - 2.66
- Sieve analysis
- Sand – Conforming to zone-II of IS 383-1970
- Aggregate 20 mm nominal size

5. TESTS ON CONCRETE

5.1 FRESH CONCRETE:

5.1.1WORKABILITY:

Workability can be determined by two tests as indicated below:

- Slump cone test
- Compaction factor test

5.1.2. Slump Cone Test

Sl. No	Materials	Slump height (mm)
1	Normal concrete	50
2	Concrete with 10% Replacement of ROBO Sand	40
3	Concrete with 20% Replacement of ROBO Sand	41
4	Concrete with 50% Replacement of ROBO Sand	45
5	Concrete with 70% Replacement of ROBO Sand	40
6	Concrete with 100% Replacement of ROBO Sand	41

Reporting Of Results:

The slump measured should be recorded in mm of subsidence of the specimen

during the test. Any slump specimen, which collapses or shears off laterally gives incorrect result and if this occurs, the test should be repeated with another sample. If in the repeat test also, the specimen shears, the slump should be measured and the fact that the specimen sheared, should be recorded.

5.1.3. COMPACTION FACTOR

Sl. No	Concrete	Compaction factor
1	Normal concrete	0.86
2	Concrete with 10% Replacement of ROBO Sand	0.84
3	Concrete with 20% Replacement of ROBO Sand	0.80
4	Concrete with 50% Replacement of ROBO Sand	0.83
5	Concrete with 70% Replacement of ROBO Sand	0.83
6	Concrete with 100% Replacement of ROBO Sand	0.81

5.2 HARDENED CONCRETE

5.2.1 COMPRESSION TEST:

Size of cube = 0.15m x 0.15m x 0.15m

Sl. No	Concrete	Compressive Strength (Mpa)		
		3 Days	7 Days	28 Days
1	Normal concrete	19.25	28.29	38.81
2	10%Replacement of ROBO Sand	16.74	27.25	39.70

3	20% Replacement of ROBO Sand	18.81	23.70	35.70
4	50% Replacement of ROBO Sand	16.59	25.77	36.00
5	70% Replacement of ROBO Sand	18.22	26.96	37.03
6	100% Replacement of ROBO Sand	18.51	27.40	39.85

5.2.2 SPLIT-TENSILE STRENGTH:

Size of Cylinder = 0.15m Dia X 0.30m High

Sl. No	Concrete	Split tensile Strength (Mpa)		
		3 Days	7 Days	28 Days
1	Normal concrete	2.12	3.25	3.77
2	10% Replacement of ROBO Sand	1.98	2.85	3.15
3	20% Replacement of ROBO Sand	1.88	2.21	3.25
4	50% Replacement of ROBO Sand	1.93	2.59	3.11
5	70% Replacement of ROBO Sand	1.86	2.68	3.06
6	100% Replacement of ROBO Sand	1.74	2.49	3.3

6 CONCLUSION

This study presents the effective way of utilizing robo sand aggregate in concrete. Presently, robo sand is available at a low price in market .Also from the results it is proved that the concrete obtained using robos and aggregate satisfy the minimum requirements of M30 grade of concrete. The Weight is also reduced. Hence it is possible to make M30 grade of normal concrete making use of saw dust and robo sand as fine aggregates.The effect of percentage replacement of Robo sand on strength property and workability were evaluated and compared with reference mix of 0% replacement of River sand by Robo sand.

- From the above experimental results it is observed that, Robosand can be used as alternative material for the fine aggregate.
- From the experimental results 50% of fine aggregate can be replaced with Robosand.
- Higher fineness modulus, particles grading shape and texture have contributed to better workability of manufactured sand.
- Manufactured sand found to have good gradation and good finish which is lacking in Natural sand.
- Manufactured sand has potential to provide alternative to natural sand and helps in maintaining the environment as well as economical balance.
- Robo sand qualifies itself as suitable substitute for river sand at reasonable cost.
- For 100% of Robo sand replacement we can get better compressive strength than that of normal concrete.
- The compressive strength of concrete specimens made with 10%replacementof river sand by Robo sand gives higher strength of 12% to 15% and with 100% replacement gives a higher strength of 3% to 4% as compare to reference mix.
- The split tensile strength of concrete specimens made with 50% replacement of river sand by Robo sand gives higher strength of 7%to 9% and with 100% replacement gives a higher strength of 3%to 4% as compare to reference mix.
- By replacement of natural sand with Robo sand, the cost of the construction can be reduced to10% per cum.

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