EXPERIMENTAL INVESTIGATION ON ROBOSAND AS REPLACEMENT MATERIAL OF FINE AGGREGATE IN NORMAL CONCRETE

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ABSTRACT

The main cause of concern is the nonrenewable nature of natural sand and the corresponding increasing demand of construction industry. River sand which is one of the basic ingredients in the manufacture of concrete has become highly scarce and expensive. Therefore looking for an alternative to river sand has become a necessity. Hence, the crusher dust which is also known as Robosand can be used as an alternative material for the river sand. Robosand possess similar properties as that of river sand and hence accepted as a building material. The present paper focuses on investigating maximum percentage replacement of river sand by Robosand in varying percentages 0%, 25%, 50%, 75% and 100% for M30 and M40 mix designations. The cubes, cylinders and prisms are casted for each proportion and tests conducted for obtaining the compressive strength, split tensile strength and flexural strength of concrete.

Keywords *–* ***Robosand/Manufactured, Natural Sand, Workability, Compressive Strength, Flexural Strength, Split Tensile Strength.***

I. INTRODUCTION

Concrete plays a vital role in the development of infrastructure globally and its applications are very significant in this advancing world. Traditionally, the basic ingredients of concrete include Cement, Fine aggregate and Coarse aggregate. Generally cement and coarse aggregates is factory made products and their quality and standards can be easily controlled and maintained. Water used for mixing of concrete is usually tap water. The fine aggregates or sand used is usually obtained from natural sources specially river beds or river banks. Now-a-days due to constant sand mining the natural sand is depleting at an alarming rate. Sand dragging from river beds have led to several environmental issues. Due to various environmental issues Government has banned the dragging of sand from rivers. This has led to a scarcity and significant increase in the cost of natural sand. There is an urgent need to find an alternative to river sand. The only long term replacement for sand is manufactured sand. Robosand or M sand is a product of crushed stone, here the stones are crushed into smaller granular sizes that are to the size of river sand granules and washed to remove the fine rock dust to enhance the quality. Robosand is also called as manufactured sand. This paper presents the results of experimental investigation of partial and full replacement of natural sand by manufactured sand. The main aim of the paper is to compare the

compressive strength, split tensile strength, flexural strength and workability of concrete with manufactured and natural sand in varying proportions.

II. MATERIAL PROPERTIES

The materials used in the manufacture of concrete are Cement, Fine aggregate, Coarse aggregate, Robosand and Water.

2.1. Cement:

Ordinary Portland cement of 53 grade cement is used confirming to various specifications as per IS: 12269-1987. Results showed that specific gravity 3.10, Initial setting time 37min and Normal consistency 32%.

2.2. Fine aggregate:

The aggregate which is passing through 4.75 mm sieve is known as fine aggregate. River sand confirming to IS: 2386-1975 is used. Results showed that the specific gravity 2.70, Fineness modulus 2.72, and a bulk density of 1710 Kg/m^3 which is confirms to Zone II.

2.3. Coarse aggregate:

Crushed coarse aggregate of 20mm down size is used which is confirming to IS: 2386-1975.Results showed that the specific gravity 2.75, Fineness modulus 5.9 and a bulk density of 1530 Kg/m^3.

2.4. Robosand:

Robosand or M-Sand was used as replacement of fine aggregate. Robosand is a product of crushed stone, here the stones are crushed into smaller granular size of river sand granules and washed to remove the fine rock dust to enhance the quality as per IS: 2386-1975. Below table shows the properties of Robosand.

Table 2.4.Properties of fine Aggregate(Robosand)

Properties	Observations
Fineness Modulus	2.52
Specific Gravity	2.68
Bulk Density	1688

2.5. Water:

As per IS 456:2000, water used for both mixing and curing should be free from injurious amount of deleterious materials. Portable water (tap water) is generally considered satisfactory for mixing and curing concrete.

III. METHODOLOGY

Mix design:

The concrete mix is designed for M30 and M40 grade and the degree of workability is medium. The mix design is carried out according to the IS 10262:2009 for the conventional concrete. The obtained mix

proportion for M30 1:1.50:2.62 with water-cement ratio of 0.45 and for M40 1:1.26:2.28 with water-cement ratio of 0.40. In the obtained mix proportion, Fine Aggregate is replaced by Robosand in percentages of 0%, 25%, 50%, 75% & 100%.

Table 3.1.Mix Proportion for M30 Grade

Sl No	Mix Designation	W/C	Cement Kg	Fine Aggregate Kg	Robosand Kg	Coarse Aggregate Kg	Water in lit
1	M30 00%	0.45	437.7	659.37	0	1143.45	197
2	M30 25%	0.45	437.7	494.52	164.84	1143.45	197
3	M30 50%	0.45	437.7	329.68	329.68	1143.45	197
4	M30 75%	0.45	437.7	164.84	494.52	1143.45	197
5	M30 100%	0.45	437.7	0	659.37	1143.45	197

Table 3.2.Mix Proportion for M40 Grade

Sl No	Mix Designation	W/C	Cement Kg	Fine Aggregate Kg	Robosand Kg	Coarse Aggregate Kg	Water in lit
1	M40 00%	0.4	492.5	622.08	0	1126.4	197
2	M40 25%	0.4	492.5	466.56	155.52	1126.4	197
3	M40 50%	0.4	492.5	311.04	311.04	1126.4	197
4	M40 75%	0.4	492.5	155.52	466.56	1126.4	197
5	M40 100%	0.4	492.5	0	622.08	1126.4	197

IV. EXPERIMENTAL RESULTS

Test procedure

Test specimens consists of cube of 150mm×150mm×150mm, cylinders of diameter 150mm and height 3000mm, prism of 100mm×100mm×500mm were casted using different concrete mixes as given in table 3.1 and table 3.2. The specimens were tested and the table4 below shows the hardened state properties for the various mixes of concrete. The moulds were first cleaned and greased properly, and then moulds were filled with concrete without any tamping since it is self compacting concrete. All the specimens kept for curing for required period of time. In this study fresh state properties and hardened state properties for 7 and 28 days show below table.

4.1. Fresh state properties

Table 4.1 Workability Tests

Sl No	Mixture	W/C	Fine Aggregate %	Robosand in %	Slump mm	Compaction factor %	V-BEE Test in Sec
1	M30 00%	0.45	100	0	190	0.77	5
2	M30 25%	0.45	75	25	165	0.74	6
3	M30 50%	0.45	50	50	172	0.76	9
4	M30 75%	0.45	25	75	170	0.75	8
5	M30100%	0.45	0	100	185	0.79	9
6	M40 00%	0.4	100	0	170	0.76	6
7	M40 25%	0.4	0.4	25	175	0.78	7
8	M40 50%	0.4	0.4	50	168	0.76	7
9	M40 75%	0.4	0.4	75	173	0.77	9
10	M40100%	0.4	0.4	100	175	0.79	8

4.2. Hardened state properties

Table 4.2: Test Results

SI. No	Mix Designation	Compressive Strength (N/mm2)		Split Tensile Strength (N/mm2)	Flexural Strength (N/mm2)
		7days	28days		
1	M30 00%	23.78	34.00	3.75	4.50
2	M30 25%	24.22	36.00	3.97	4.83
3	M30 50 %	25.11	38.44	4.40	5.50
4	M30 75 %	23.11	33.11	3.46	4.17
5	M30 100%	18.44	29.78	3.03	3.83
6	M40 00 %	25.11	39.78	4.04	5.17
7	M40 25 %	27.11	41.33	4.33	6.17
8	M40 50 %	28.67	47.78	5.26	7.33
9	M40 75 %	24.44	38.44	3.68	6.00
10	M40 100%	19.78	33.33	3.89	6.00

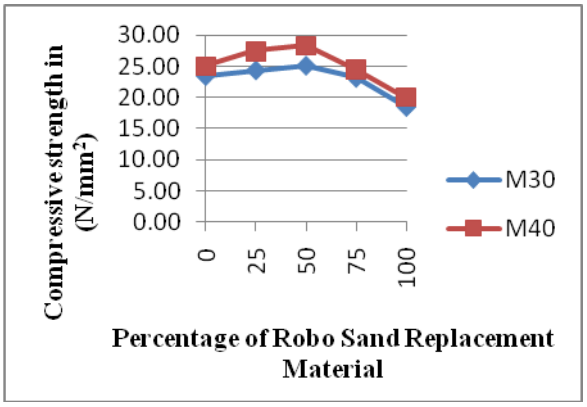

Fig.1: compressive strength of concrete for 7days

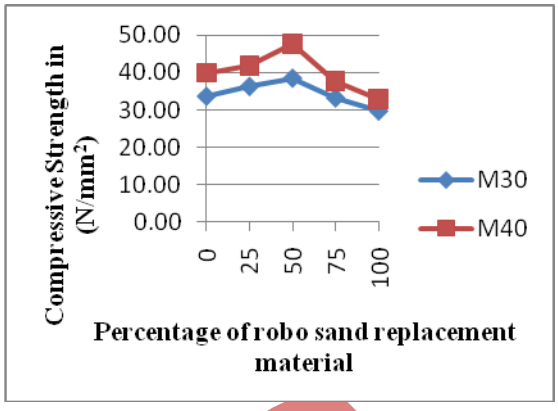

Fig.2: compressive strength of concrete for 28days

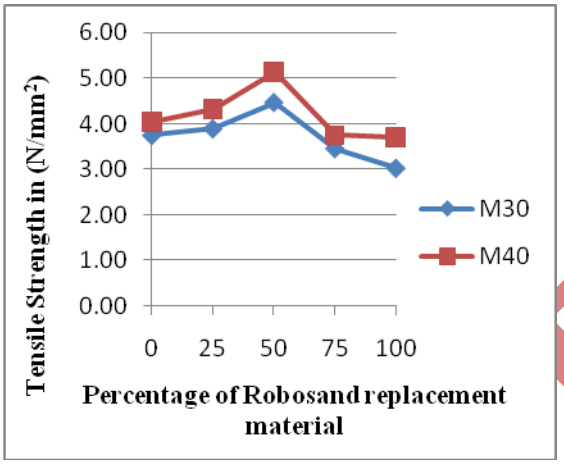

Fig.3: Tensile strength of concrete for 28days

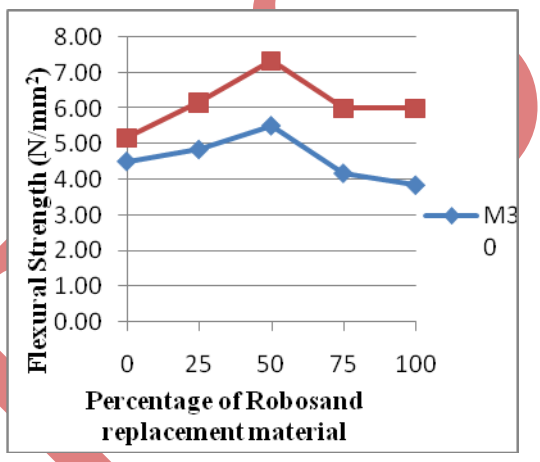

Fig.4: Flexure strength of concrete for 28days

V. CONCLUSIONS

1) From the above experimental results it is observed that, Robosand can be used as alternative material for the fine aggregate.
2) From the experimental results 50% of fine aggregate can be replaced with Robosand.
3) Higher fineness modulus, particles grading shape and texture have contributed to better workability of Manufactured sand.
4) Manufactured sand found to have good gradation and good finish which is lacking in Natural sand.
5) Manufactured sand has potential to provide alternative to natural sand and helps in maintaining the environment as well as economical balance.
6) Robosand qualifies itself as suitable substitute for river sand at reasonable cost.
7) For economical constructions 100% of Robosand can be adopted for flexure strength.
8) For 75% of Robosand replacement we can get better compressive strength than that of normal concrete.

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