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Strength and Durability of Concrete Using Dredged Sea Sand as Partial Replacement of M-sand

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Abstract- *Concrete is a composite material containing cement, fine aggregate, coarse aggregate and water. Generally river sand is used as a fine aggregate. Increase in demand of concrete leads to scarcity of river sand. For this reason producing a sustainable and durable concrete with dredged sea sand as fine aggregate can be a big solution for the problems facing in the construction industry. Research on sea sand as an aggregate in concrete is an important study in present scenario. The major challenging factor for its usage is the presence of chloride level, inorganic content, shell content, aggregate shape and size of sea sand. This is a basic practical study on strength and durability of concrete using dredged sea sand as partial replacement of M-sand. The strength study proves that about 40% replacement will not affect the overall strength of concrete.*

Key words: Dredged sea sand, Strength, Durability, M-sand,

1. INTRODUCTION

Concrete is the basic construction material used in the construction now a days. It is a composite material containing cement, fine aggregate, coarse aggregate and water. Generally river sand is used as a fine aggregate. Due to increase in the demand of concrete, the need for river sand has been increased enormously. To counter this problem producing a sustainable and durable concrete with the dredged sea sand (DSS) in place of M sand (MS) can be a big solution for the problems facing by the construction industry.

Research on sea sand as an aggregate in concrete is an important study in civil engineering in the present scenario. DSS contains high level chloride ions which will cause corrosion of reinforcements ultimately leads to reducing load carrying capacity. The main applications of dredged sea sand (DSS) , apart from beach replenishment, are coastal defences and land reclamations. The objective of the present study is to analyse the Strength and durability of concrete using dredged sea sand as fine aggregate. In this the fine aggregate will be replaced by DSS in various percentages.

2. MATERIALS AND METHODS

2.1 Materials

The cement used was Ordinary Portland cement of 53 grade, confirming to IS 12269 with a specific gravity of 3.15. M-sand was used as fine aggregate conforming to zone II confirms to IS 383-1970 (Reaffirmed 2002) having specific gravity of 2.63 and water absorption of 3%. The coarse aggregate (CA) with specific gravity of 2.76 and water absorption 1.2% were used. Dredged sea sand which is used as replacement of M-sand was conforming to zone IV. The specific gravity of DSS is 2.31 and water absorption 6.1%.The M sand was partially replaced by Dredged Sea Sand (DSS) at 100%, 10% to 50%. Potable water was used to mixing the concrete having pH value 6.5. The properties of all materials are shown in Tables 1 and Table 2.

Table-1: Properties of cement

Physical property	Material
	Cement
Normal consistency	29.50%
Initial setting time (min)	160
Final setting time(min)	260
Specific gravity	3.03

Table- 2: Properties of fine aggregates

Property	M sand	DSS
Sieve analysis	Zone II	Zone IV
Specific gravity	2.63	2.31
Water absorption	3%	6.1%

2.2 Mix Proportion

The concrete mix used was M_{35} designed according to IS 10262-2009. Water cement ratio was 0.41.The M-sand was replaced by DSS in different percentages.10% 20% 30% 40% 50% and 100 % replacement were done. The

specimen Identification details are given in Table3 and mix proportions are shown in Table 4

Table- 3: Specimen Identification Details

Specimen Id	Specimen Details
100 MS	Normal concrete using M Sand
10DSS	10 % replacement of MS by DSS
20DSS	20 % replacement of MS by DSS
30DSS	30 % replacement of MS by DSS
40DSS	40 % replacement of MS by DSS
50DSS	50 % replacement of MS by DSS
100DSS	100 % replacement of MS by DSS

Table- 4: Details of mix proportions (kg/m^3)

Mix	Cement kg/m^3	M S kg/m^3	DSS kg/m^3	CA kg/m^3		Water kg/m^3
				12.5 mm	20 mm	
100 MS	481	619	0	515	630	188.97
10 DSS	481	557.11	54.36	515	630	194.11
20 SS	481	495.21	108.75	515	630	178.97
30 SS	481	433.31	163.11	515	630	197.28
40 SS	481	371.41	217.48	515	630	198.67
50 SS	481	322.97	283.67	515	630	195.37
100 SS	481	0	543.69	515	630	197.16

2.3 Specimen Preparations

The specimens were prepared for all mixes for determining hardened properties such as cube compressive strength, split tensile strength, durability and bond strength. The specimens were maintained at ambient temperature for 24 hours within the moulds, then demoulded and water cured for 28 days. The specimen details are shown in Table 5

Table 5: Specimen details

TEST	SPECIMEN	SIZE (mm)	NUMBER
Cube compression	Cube	150	6x7=42
Splitting tensile	Cylinder	150diameter, 300 height	3x7=21
Sorptivity	Cylinder	100diameter, 50 height	3x7=21
Water absorption	Cube	100	3x7=21
Bond strength	Cube	150	3x7=21

3. RESULTS AND DISCUSSIONS

3.1 Compressive Strength and split tensile strength

From the results obtained, it was observed that the compressive strength of concrete using DSS as partial replacement is satisfactory up to 50% replacement.

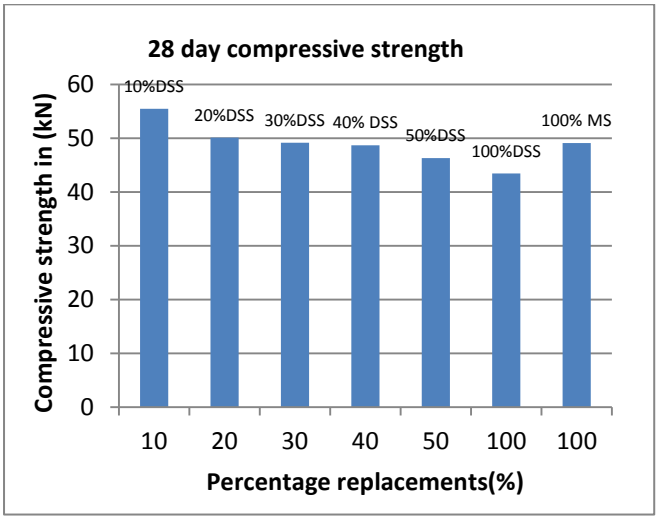
In case of split tensile strength it seems to be decreasing with increasing in percentage of sea sand. The results of compressive strength and split tensile strength are shown in Table 6 and graphical representation of compressive strength is shown in Chart- 1

Table-6: Compressive strength and split tensile strength

Mix	Cube Strength (N/mm^2)	Splitting tensile Strength (N/mm^2)
100% MS	49.08	3.93
10%DSS	55.47	3.62

20%DSS	50.11	3.49
30%DSS	49.15	3.38
40%DSS	48.67	3.35
50%DSS	46.32	3.2
100%DSS	43.43	3

Chart- 1 Compressive strength result



3.2Bond strength

Bond strength of all mixes were tested using bond specimens with 16mm diameter reinforcement bars. Pull-out test has done for bond strength testing. Pull-out failure occurs when a specimen reaches its ultimate bond stress before the yield stress of reinforcing bars. Table 7 shows the pull-out result of specimens with Corrosion (WC) and without corrosion (W/O C)

Table 7 Pull out test results

Specimen ID	Type	Maximum load (kN)	Bond strength N/mm²
100% MS	WC	23.6	3.500
	W/O C	87.2	13.351
10%DSS	WC	21.8	3.368
	W/O C	95	14.55
20%DSS	WC	23.6	3.521
	W/O C	70.6	10.717
30%DSS	WC	87.6	13.565
	W/O C	63	9.646
40%DSS	WC	18	2.756
	W/O C	72	11.024
50%DSS	WC	16	2.645
	W/O C	57	8.72

3.3. DURABILITY TEST RESULTS

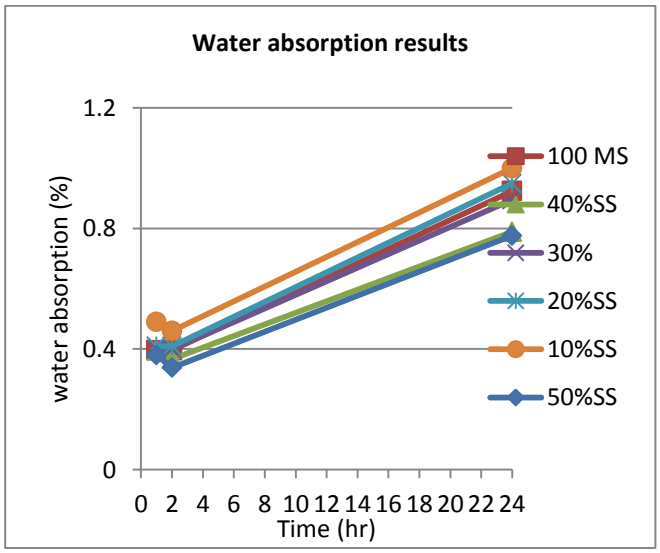
3.3.1 Water Absorption Results

The test shows that at 10% and 20% replacement water absorption is greater than normal mix. The water absorption rate decreases at 30%40%and50%.Water absorption results were shown in Table 8 The graphical representation of the result were shown in chart 2

Table 8 Water Absorption results

Specimen	Water Absorption(%)		
	1 Hour	2 Hour	24 Hour
100% MS	0.396	0.396	0.924
50% SS	0.380	0.338	0.776
40% SS	0.396	0.367	0.789
30%SS	0.399	0.399	0.895
20% SS	0.409	0.409	0.949
10% SS	0.49	0.46	1.1
100% SS	0.3935	0.3935	0.3935

Chart- 2 Water absorption result



3.3.2 Sorptivity Result.

The table 9 shows that the Sorptivity values of different mixes. The result tells that sorptivity decreases with increase in percentage of replacement.

Table 9: Sorptivity results

Time (min)	SORPTIVITY					
	100% MS	10%SS	20%SS	30%SS	40%S	50% SS
0	173.72	173.57	161.98	145.80	134.7	127.6
5	173.82	173.67	162.02	145.91	134.7	126.6
10	173.82	173.67	162.08	145.91	134.7	126.6
20	173.82	173.67	162.08	145.97	134.7	126.6
30	173.87	173.73	162.11	145.97	134.7	126.6
60	173.87	173.63	162.14	146.00	134.7	126.6
120	173.88	173.79	162.17	146.04	134.7	126.6
180	173.88	173.82	162.24	146.07	134.7	126.6
240	173.88	173.86	162.24	146.07	134.7	126.6
300	173.88	173.86	162.24	146.07	134.7	126.6

4. CONCLUSIONS

The compressive strength is satisfactory up to 50% replacement of Dredged sea sand and the strength is more in 10 % replacement than normal M-sand mix. Splitting tensile strength are also satisfied. Pull-out test result says that bond strength of 10 % replacement is higher compared to other replacements. The test shows that at 10% and 20% replacement water absorption is greater than normal mix. The water absorption rate decreases at 30%40%and50%. So we can conclude that up to 50 % replacement will give satisfactory concrete strength and durability

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