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ANALYSIS ON STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF RIVERSAND WITH SAWDUST AND ROBOSAND

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ABSTRACT

Sand accumulation from store is costly because of undesirable cost of transportation from common sources and expansive scale abuse of normal sand makes natural effect on society. To overcome from this emergency, incomplete supplanting of sand with saw clean and robosand can be a monetary option. In creating nations like India. Sawdust can be described as free particles or wood chippings got as by-items from sawing of timber into standard useable sizes. Clean Sawdust with sensible amount of bark has ended up being satisfactory, since it doesn't present high substance of common material that may unsettle the responses of hydration. The crusher tidy created from stone crushers and waste by item from quarry is one of the option materials for stream sand. Saw tidy and robosand in extent utilized as fine totals in cement and the compressive and split elasticity were tried. There were absolutely three blends arranged for the examination, steadily expanding the supplanting rates from 0-75% with sawdust and robosand in extent. The compressive and split rigidity step by step diminishes for the expanding substitution rates. The ideal blend found to create M20 review of cement is 10% of saw tidy and 40% of robosand, absolutely half substitution of waterway sand. What's more, the cost decrease is 2.69% for every cubic meter of cement.

Keywords: strength of concrete, partial replacement, river sand, robosand and sawdust.

1. INTRODUCTION

Concrete is the outstanding material of prime choice where strength, durability, impermeability, fire resistance & absorption resistance are required. The extensively used fine aggregate for the making of concrete is the natural river sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming scarce, due to the excessive non scientific approach of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc., are becoming common threats. Because of the exhaustion of stream bed it has additionally turned out to be costly. The high and expanding expense of these materials has enormously frustrated the advancement of safe house and other infrastructural offices in developing nations.

The present plan requests recognition of efficient and locally accessible substitute materials for the river sand for making concrete which is environment friendly for the quick depleting and excessively mined river sand and prompt to a general decrease in development cost for sustainable development. This experimental study aims to investigate the suitability of sawdust and robosand as replacement for fine aggregate in the production of low-cost and lightweight composite as a building material for making concrete.

2. METHODS AND MATERIALS

a) Methodology

The methodology for the work is shown in Figure-1. Finally the test results are compared with the conventional concrete or the strength, weight and cost. The optimum usage of sawdust and robosand in concrete is found from the analysis.

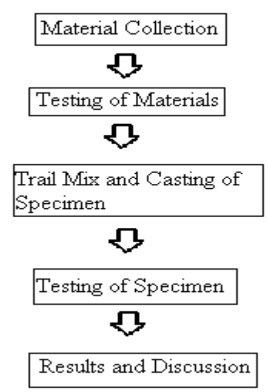

Figure-1. Methodology.

b) Materials used

The varies materials and method of conducting the test was discussed in detail and detailed methodology of the work was presented

Materials used

- Water
- Course aggregate
- Cement
- River sand
- Robosand
- Saw dust

i. Water

The water utilized for the current study was pottable water as recommended by the standard. The water was clean and free from physical impurities, with respect to IS: 10500-1963.

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ii. Coarse aggregate

The natural broken stone (coarse aggregate) adopted for the current study was of 20mm size maximum. It contains sizes ranges from 5-20 mm normal continuous graded stones. It was retrieved from a local quarry near Chengalpattu, Kanchipuram District. The shape and quality of aggregate was uniform throughout the project work. It was free from any impurities. It was tested for the impact and crushing values in the laboratory.

iii. Cement

The cement adopted for the current expolatary analysis was OPC of 53 grade, conforming to Indian Standard 12269–1987.

iv. River sand

Natural river sand confirming to Zone 2 grading as per IS: 383 – 1987 was used. The sand was thoroughly washed with water to lessen the quatum of foreign organic matter and later sun dried. The river sand was tested for density, moisture content and fineness modulus in laboratory.

v. Sawdust

The sawdust was sourced from local wood saw mill, near Chengalpattu. The sawdust consisted of chippings from various hardwoods. It was sun dried and It was sieved through 4.75 mm sieve for the purpose of concreting samples. The saw dust was tested for density, moisture content and fineness modulus in laboratory. The sawdust sample is shown in Figure-2.

Figure-2. Saw dust used in concrete.

vi. Robosand

Robosand can be explained as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to edge fine particles under 4.75mm. Quarry dust is fine rock particles. When earth bed rock are busted into cramped as quarry dust. The robosand was sourced from local quarry, near chengalpattu. The grading of robosand is as per Zone 2 having no pollutants. The robosand was tested for its density, Moisture content and Fineness modulus in laboratory. The sample of robosand is shown in Figure-3.

Figure-3. Robosand used in concrete.

3. CONCRETE MIX DESIGN

Concrete mix design is characterized as the acceptable choice and adapt of ingredients to outturn a concrete with pre-characterized qualities of both states of concrete. When all is said in done, concrete mixes were designed beneficial to accomplish a well-defined various properties of fresh and hard concrete. The options and good fit of materials rely on the structural concern of the concrete, the situation to which the structure will be exposed, specifically the approaches of concrete generating, conveying, placing, pressing and finishing the surface etc.

a) Design stipulations

The following are design stipulations for which design is made in IS method. The general aggregate size, exposure environment and quality control shall be given as per actual site conditions.

Characteristic compressive strength required - 20MPa
Maximal size of aggregate (angular) - 20mm
Degree of workability - 0.90
Degree of quality control - Good
Type of Exposure - Mild

b) Data required

The required details of material characteristics like specific gravity, water absorption and moisture content for mix design and proportions are presented in the Table-1, and the Table-2. The properties of materials were tested in the laboratory and the results are produced.

Table-1. Mix design in details.

S. No.	Properties	Values
1	Specific gravity of cement	3.15
2	Specific gravity of coarse aggregate	2.80
3	Specific gravity of fine aggregate	2.60
4	Water absorption (Coarse aggregate)	1.2%
5	Water absorption (Fine aggregate)	1.5%
6	Free surface moisture(Coarse aggregate)	Nil
7	Free surface moisture (Fine aggregate)	2.0%
8	Water cement ratio	0.46

Table-2. Mix proportions.

S. No.	Mix	River Sand	Saw Dust	Robo sand	Combined Replacement
1	M1	100%	0%	0%	0%
3	M2	50%	10%	40%	50%
4	M3	25%	15%	60%	75%

4. RESULTS AND DISCUSSION

a) Material properties

i. Sawdust

The properties of saw dust are shown in Table-3. It shows the density of light weight aggregate and will reduce the overall density of concrete. The thermal properties and fire resistance will be very less as sawdust used in the concrete.

ii. Robosand

Robosand or M-Sand was used as replacement of fine aggregate. Robosand is a result of crushed stone, here the stones are pulverized into smaller granular size of river sand granules and washed to expel the fine rock dust to enhance the quality as per IS: 2386-1975The properties of robosand are shown in Table-3. The Fineness property of robosand coincides with river sand.

iii. Riversand

The properties of river sand are listed in Table-3. It satisfies the IS 383 – 1987 requirements in terms of fineness modulus of zone 2 grading requirements.

Table-3. Properties of sawdust, robosand and river sand.

S. No	Parameters	Sawdust	Robosand	River Sand
1	Fineness modulus	2.0	2.4	2.6
2	Bulk Density	635 Kg/m3	1688 Kg/m3	1480 Kg/m3
3	Moisture content	14.0%	2.0%	1.70%
4	Specific gravity	2.15	2.68	2.65

iv. Cement

Ordinary Portland cement (OPC) of 53 Grade conforming to IS 12269 – 1987 was adopted for the current sudy. The test been carried out as per the Indian Standards IS 4031 – 1988. The properties of cement are given in Table-4.

Table-4. Physical properties of cement.

S. No	Property	Result	Permissible limit as per IS: 12269 – 1987
1	Normal consistency	35%	NA
2	Initial setting time	40 min	Not less than 30 min
3	Final setting time	500 min	Not more than 600 min
4	Specific Gravity	3.16	Not less than 3.15
5	Fineness of cement (90 micron sieve)	7% retained	Not more than 10%

v. Coarse aggregate

Crushed coarse aggregate of 20mm down size is used which is confirming to IS: 2386-1975. The properties of coarse aggregate used are given in Table-5.

Table-5. Properties of coarse aggregate.

S. No.	Parameters	Value
1	Specific gravity	2.8
2	Water absorption	1.4
3	Crushing value%	17
4	Impact value%	19.5

vi. Compressive strength

Experimental results for cube compressive strength for mix M1, M2 & M3 for 7days and 28 days are tabulated in Table -6. The graphical representation of compressive strength for various mixes at 7 and 28 days is shown in Figure-4.

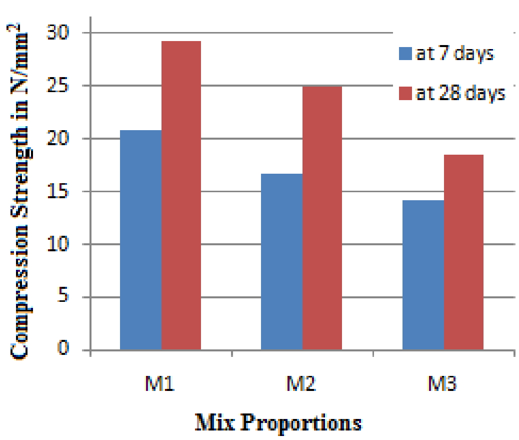

Figure-4. Mix proportions vs compression strength.

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Table-6. Compression strength of concrete at 7 & 28 days.

MIX	Compression strength at 7 days		Compression strength at 28 days	
	Stress (N/mm²)	Average (N/mm²)	Stress (N/mm²)	Average (N/mm²)
M1	21.30	20.90	29.50	29.30
	21.50		29.70	
	20.00		28.80	
M2	16.50	16.67	25.40	24.49
	16.50		24.90	
	17.00		24.50	
M3	14.20	14.16	19.50	18.56
	13.70		18.00	
	14.60		18.20	

vii. Split tensile strength

Experimental results for split tensile strength for mix M1, M2, & M3 for 7 and 28 days are tabulated in Table-7. The graphical representation of split tensile strength for different blends at week and 4th week is shown in the Figure-5.

Table-7. Split tensile strength of various mix proportions at 7days & 28 days.

MIX	Split Tensile strength at 7 days		Split Tensile strength at 28 days	
	Stress (N/mm²)	Average (N/mm²)	Stress (N/mm²)	Average (N/mm²)
M1	2.80	2.80	3.40	3.44
	2.79		3.45	
	2.83		3.47	
M2	2.32	2.31	3.10	3.10
	2.30		3.2	
	2.30		3.0	
M3	1.69	1.68	2.10	2.12
	1.70		2.15	
	1.65		2.11	

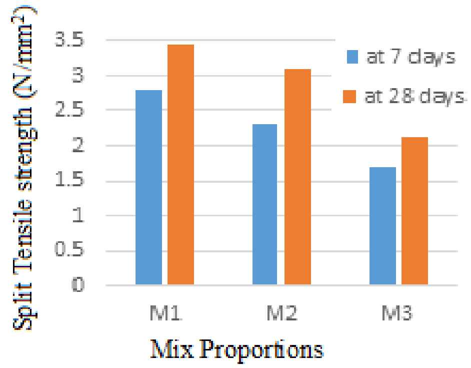

Figure -5. Mix proportion vs split tensile strength.

viii. Discussion on split tensile strength

The tensile strength is one of the fundamental and convincing properties of the concrete. The concrete is not generally wanted to resist the direct tension on account of its low tensile strength and brittle nature. Withal, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack.. The tensile strength of nearly 70% of strength at 28 days is achieved at 7 days. The optimum results are obtained for mix M2.

ix. Slump

The slump was measured using slump cone apparatus and the slump was found from 110 to 125mm for normal mix and 120 to 135 mm for quarry dust and saw dust concrete.

5. COST ANALYSIS

For the optimum mix proportion M2 the cost is compared with the nominal controlled mix concrete. Table-8. shows the Cost analysis for M20 grade of optimum mix concrete which is totally 50% replacement with 10% of saw dust and 40% of robosand.

Table-8. Cost analysis.

S. No.	Materials Required	Cost/kg	Quantity in kg/ m³		Cost of Concrete in Rs./m³	
			Nominal mix	Sawdust and Robosand	Nominal mix concrete	Sawdust and Robosand
1	Cement	7.00	400	400	2800	2800
2	River sand	1.65	584	289	963.6	476.85
3	Robosand	0.75		232		174
4	Saw Dust	3.00		63		189
5	Coarse Aggregate	.65	1275	1275	828.75	828.75
Grand Total					**4592.35**	**4468.6**

6. CONCLUSIONS

Based on the investigation the detailed outcomes were made.

- From the experimental results 50% of fine aggregate can be replaced with 40% Robosand and 10% sawdust for M20 grade concrete
- The cost reduction up to Rs.123.75 per cubic meter of concrete is achieved.
- 70% of the characteristic compressive strength is obtained at 7days
- The stand in of fine aggregate by 50% totally with sawdust 10% and robosand 40% gives the compressive strength of 24.90N/m ^{2} and 75% totally with sawdust 15% and robosand 60% gives compression strength of 18.56N/mm$^{2.}$
- 28-day characteristic strength of the concrete decreases gradually for the increasing replacement percentages.

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