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EXPERIMENTAL STUDY ON FLEXURAL AND SHEAR BEHAVIOUR OF CONCRETE BEAM WITH PARTIAL REPLACEMENT OF FINE AGGREGATE BY ECO SAND

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ABSTRACT

The non-availability of adequate quantity of standard river sand (natural resource) for creating cement concrete affects the expansion of construction industry in several parts of the country. Therefore, the construction industries of developing countries are in stress to spot various materials to eliminate the demand of river sand. The recent development within the field of concrete technology represents an enormous step towards making concrete various materials need to be used as a part of natural river sand. As an example, fly ash, Eco-sand, scum of lime stone, siliceous stone powder, rock mud and granite powder might be utilized in concrete mixes as a partial replacement of natural river sand. Equally Eco-sand can be an alternate replacement of natural river sand.

The objective of the present investigation is to evaluate the possibilities of improving the performance of concrete by using Eco-sand as a partial replacement of natural river sand. Accordingly, the aim of this work is to determine the partial replacement of natural river sand with Eco-sand at various percentage (0, 25, 50, 75& 100 %) levels for making M20 grade mixes. Nature common river sand is expensive due to excessive cost of transportation from natural sources. Also large scale depletion of these sources creates environment problems and other constrains which make the availability and use of river sand less attractive. Eco-sand an abundantly available waste product from cement plant profusely exists as a byproduct in ACC cements at Madukkarai, Coimbatore. As a part of resolving its disposal problems and a solution to the difficulty of acquirement and high rate of sand, Eco-sand can be effectively used for its extremely low cost.

Keywords: Ordinary River sand, alternative material, Eco-sand, M20, byproduct, low cost, strength

I. INTRODUCTION

The construction industry is the base for all development activities. In any developing country the share by construction industry in the plan outlet is between 40% - 50%. In India, this has accounted for nearly 40% of the total investment during the past 40 decades. In any construction, the cost of the materials is about 65% and the cost of labor is about 35%. Building construction costs are increasing over 15% every year. This is primarily due to the increase in the cost of basic building materials and also labour.

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In the last 15 years, it has become clear that the availability of good quality natural sand is decreasing. With a few local exceptions, it seems to be a global trend. Existing natural sand deposits are being empty at a similar rate as urbanization and new deposits are situated either underground, to close to already built-up areas or too secluded from the areas wherever it's required. Hence the shortage of the resources of natural sand and demand for reduction within the price of concrete production has opened the likelihood to spot a substitute material for fine combination (sand) within the production of concrete.

Crushed aggregate and other materials like Eco-sand, silica fumes, sewage sludge ash, and quarry dust are replacing natural sand and gravel in most countries across the world. Eco-sand, which is dumped as excess silica during the manufacture of cement in ACC is one such materials studied. The experimental studies were undertaken to investigate some properties of Eco-sand such as specific gravity, and workability to discuss its suitability to be used as the substitute for fine aggregate. Besides, these reports on the result of an experimental work on different mixes in which fine aggregate is replaced by Eco-sand.

The experimental investigations includes compressive strength and durability tests (water absorption test), which shows that the strength of concrete can be improved by partial replacement of fine aggregate by Eco-sand, provided certain properties of the sand remains unaffected. An experimental approach has also been taken to study the partial replacement of fine aggregate by Eco-sand, in concrete mix. The results of the tests have shown that a reasonable workability and a medium strength can be achieved with an optimum water/cement ratio in a concrete mix.

The overall goal of this project is to reduce the dependence of material market by using the “excess dumped silica waste as “Eco-sand”. Construction industry solely on the natural sand, in order to reduce initial cost of the concrete and to contribute to the development of the environment sound construction.

II. CONCRETE TRIAL MIX DESIGN

This Method is recommended for designing Mixed for general Types of Construction, Using the ingredients of Concrete normally available .The Design is carried out for specified Compressive Strength and Workability of Concrete Using Continuously graded aggregate. The method can be for both, reinforced and Pre stressed concrete. Compressive strength of Concrete IS based on the water cement ratio of the concrete mix. Further, for a given type, Shape, Size, and grading of aggregate, the amount of water determines the workability for normal concretes. The mix proportion for M20 concrete is shown in table 1.

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Table 1. MIX PROPORTIONS FOR M20 OF CONCRETE

Different % of eco sand	Mix proportion				
	Cement (Kg)	Sand (Kg)	Eco sand (Kg)	Coarse aggregate (Kg)	Water content
ECO 0%	372	708.8	-	1190.99	186
ECO25%	372	531.6	165.3	1190.99	186
ECO50%	372	354.40	325.85	1190.99	186
ECO75%	372	177.20	495.900	1190.99	186
ECO100%	372	-	661.2	1190.99	186

III. TESTS ON CONCRETE FOR COMPRESSIVE STRENGTH

For cube compression testing of concrete, 150 mm cubes were used. All the cubes were tested in saturated condition, once wiping out the surface moisture. For every trial combine, combination, 3 cubes were tested at the age of , 7 days, 14 days, 28 days of set using AIMIL compression testing machine of 3000 KN capacity as per IS : 516-1959, as shown in table 2. The compressive strength of concrete provides a plan regarding the quality of a concrete. The grade of concrete is fastened solely on the 28 days compressive strength of concrete. The check specimens, cube-shaped in form area unit of size 15cm x 15cm x 15cm. If the most important traditional size of the combination doesn't exceed 20mm, 10cm cubes is also used as an alternate. Compression tests area unit created at recognized ages of the tests specimens, the foremost usual and 28 days a minimum of 3 specimens, ideally from completely different batches shall be created for testing at every selected age.

PREPARATION OF TEST SPECIMEN

Test specimen : Cube
Size of specimen : (150 x150 x150)
Compression testing machine, /UTM Vibrator or Tamping Scale, tray, Carded fine and coarse aggregate and cement.

Table 2. RESULT OBTAINED BY COMPRESSIVE STRENGTH

Percentage of Eco sand on cube	No of cube	7^{th} Day N/mm^2		14^{th} Day N/mm^2		28^{th} Day N/mm^2	
		Test value	Avg value	Test value	Avg value	Test value	Avg value
0%	1	22.12	22.41	24.15	23.17	29.34	29.47
	2	21.78		23.01		29.65	
	3	23.12		22.88		29.43	

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25%	1	23.82	23.47	24.34	24.86	31.14	31.21
	2	23.34		25.53		31.65	
	3	22.93		24.45		30.48	
50%	1	20.06	20.52	22.32	22.53	26.34	25.60
	2	21.12		21.78		25.53	
	3	20.54		23.22		24.75	
75%	1	16.20	15.61	18.12	18.39	22.02	22.06
	2	14.72		18.64		21.98	
	3	15.37		18.15		23.12	
100%	1	13.98	13.59	14.20	14.96	16.92	17.11
	2	13.45		14.92		17.64	
	3	13.32		15.37		17.15	

COMPRESSIVE STRENGTH ANALYSIS

The compressive strength tested on cube for different percentage of Eco sand for M20 concrete for 7day, 14day and 28day better result achieved in 25% value was maximum strength for **23.47**N/mm^2, **24.86**N/$mm^2$and **31.21N**/mm^2. The figure 1 shows the average compressive strength in cubes

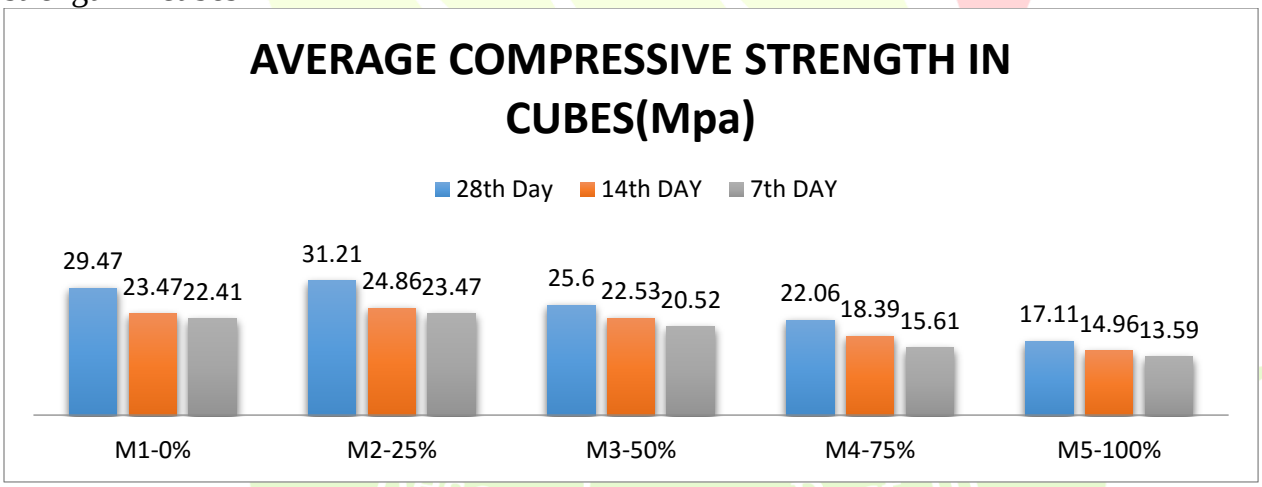

Figure 1 Average Compressive Strength in Cubes (Mpa)

SPLIT TENSILE SRENGTH

Test specimen are stored in water for 7 days and 28days as shown in table. They are taken from the water after 7, 28 days they are tested immediately on removal from the water. The specimen here tested with help of hand compression testing machine. Two point load method could be applied for testing the specimen is shown in table 3.

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Table 3. SPLIT TENSILE STRENGTH FOR CYLINDER

$fct = \frac{2P}{3.14\ DL}$ N/mm^2	C1 - 0%	C2 - 25%	C3 - 50%	C4 - 75%	C5 - 100%
7 Days	1.04	**1.07**	0.96	0.78	0.71
28 Days	1.29	**1.35**	1.13	1.03	0.84

SPLIT TENSILE STRENGTH FOR CYLINDER

The split tensile strength tested on cube for different percentage of Eco sand for M20 concrete for 7day and 28day better result achieved in 25% value was maximum strength for 1.07Mpa and 1.35Mpa. The figure 2 shows the split tensile strength for cylinder.

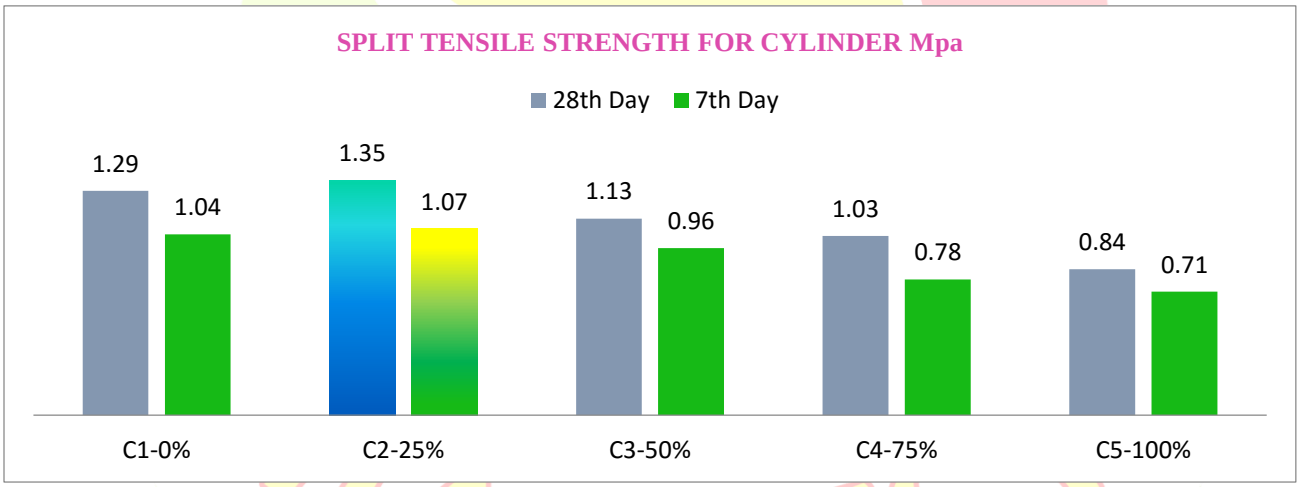

Figure 2. Split tensile Strength for Cylinder Mpa

FLEXURAL STRENGTH

All load and deflection data required for further calculations shall be obtained from the digital data stored from the test. The first peak load (Pmax) is obtained as the load at the point where the slope of the load deflection curve is first zero.

Test specimen are stored in water for 7 days and 28days. They are taken from the water after 7, 28 days they are tested immediately on removal from the water. The specimen here tested with help of hand compression testing machine. Two point load method could be applied for testing the specimen. The flexural strength for prisum mould is shown in table 4.

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Table 4. FLEXURAL STRENGTH FOR PRISUM MOULD

$fct = \frac{Pmax \times L}{bd^2}$	P1 - 0%	P2 - 25%	P3 - 50%	P4 - 75%	P5 - 100%
7 Days	1.51	**1.72**	1.28	1.07	0.98
28 Days	2.56	**2.82**	1.96	1.46	1.23

FLEXURAL TENSILE STRENGTH FOR PRISUM

The flexural strength tested on cube for different percentage of Eco sand for M20 concrete for 7day and 28day better result achieved in 25% value was maximum strength for 1.72Mpa and 2.82Mpa. The figure 3 shows the flexural tensile strength for prisum Mpa.

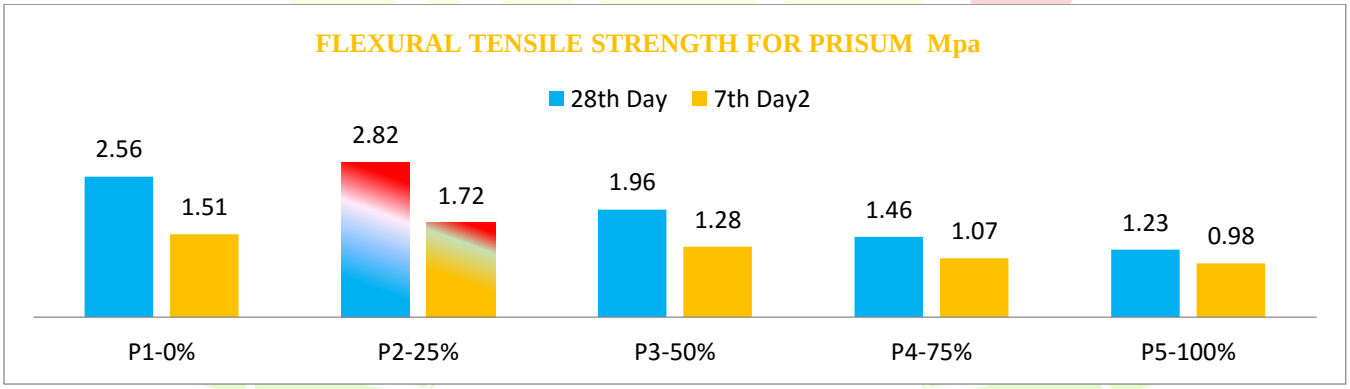

Figure 3. Flexural tensile strength for prisum Mpa

IV. CONCLUSION

The compressive strength tested on cube for different percentage of Eco sand for M20 concrete for 7day, 14day and28day better result achieved in 25% value was maximum strength for 23.47N/mm^2, 24.86N/$mm^2$and 31.21N/mm^2. The split tensile strength tested on cube for different percentage of Eco sand for M20 concrete for 7day and 28day better result achieved in 25% value was maximum strength for 1.07Mpa and 1.35Mpa. The flexural strength tested on cube for different percentage of Eco sand for M20 concrete for 7day and 28day better result achieved in 25% value was maximum strength for 1.72Mpa and 2.82Mpa. Effective use for waste material and thus cost effective and performs as well as naturally occurring

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sand. Thus Ecosand achieves better concrete composites to maintain ecology.

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