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EXPERIMENTAL IVESTIGATION OF CONVENTIONAL CEMENT CONCRETE REPLACING RIVER SAND BY M- SAND AND ECO- SAND

K.KARTHIKEYAN[1], R.ANITHA[2], S.KOWSALYA[3], S. MANOJKUMAR[4], R.VELLAICHAMY[5]

Assistant professor[1], *Dept of Civil Engineering, Sri Ranganathar Institute of Engineering and Technology, Coimbatore*

UG Students[2, 3, 4, 5], *Dept of Civil Engineering, Sri Ranganathar Institute of Engineering and Technology, Coimbatore*

Abstract: *Concrete is the most undisputable material being used in infrastructure development throughout the world. In this experimental investigation focuses on the effect of complete replacement of river sand by M- sand and Eco- sand as a fine aggregate with addition of fine aggregate. In this paper ECO SAND and M- SAND has been chemically and physically characterized and used as fully replacement in the ratio of 40%, 50%, 60%by weight of cement and sand in concrete. The superplasticizer is preferred to reduce the water content and it is added 2% by weight of concrete. The experimental work mainly concentrates with compressive strength and flexural strength. M30 grade of concrete was used and the specimen were tested at 28 days. Therefore from the results obtained the optimum mix proportion is finalized.*

Key words : Concrete , River sand replaced by Manufactured sand , Eco-sand , superplasticizer , Compressive strength ,flexural strength and tensile strength test.

1. INTRODUCTION

The concrete is well known composite construction material composed primarily of aggregate, cement and water. There are many formulations, which provide varied properties. The aggregate is generally coarse gravel or crushed rocks such as lime stone or granite along with a fine aggregate such as M-sand and Eco-sand. The cement commonly Portland cement and other cementations materials such as fly ash and slag cement serve as binder for the aggregate. Various chemical admixture are also added to achieve varied properties. Water is then mixed with this dry composite , which enable it to be shaped(typically poured) and then solidified and hardened in to rock-hard strength through a chemical process call hydration. The water reacts with the cement , which bonds the other components together eventually creating a robust stone like material. Concrete has relatively high compressive strength, but much lower tensile strength.

2.LITERATURE REVIEW

- P. Mugudeswaran, has published a paper on Green high performance concrete using Eco-Sand Industrial waste on International journal of chemical science 13(2),2015,661-671.ISSN-0972-768.Its made use of eco sand up to 30% as a partial Replacement of sand with to improve the workability of concrete he has compared compressive strength , tensile strength , and flexural strength for various % of Eco- Sand and proved better result.
- D.Dharshanadevi, has published a paper on experimental investigation of influence of Eco-sand in conventional concrete in International conference on latest innovation in applied science Engineering and Technology (ICLIASET 2017) , March 2017.Its made use of Eco-sand up to 35% as a replacement of Eco-sand Grade of concrete used in M30 and replacing about 25%of Eco-sand for fine Aggregate. He has compound compressive strength and flexural strength for various % of Eco-sand and proved better result.
- **M.Prabhu,** has published a paper on influence of GGBS and Sand in green concrete in international journal of innovative research in science Engineering and technology An ISO 3297 : 2007 volume(4) , issue 6 , June 2015 ,Its made use of Eco-sand upto 40% as a partial replacement of fine Aggregate Grade of concrete used in M20.He has compared compressive strength , flexural strength and modulus of Elasticity for various% of Eco-sand and proved Better result.

3. EXPREMENTAL PROGRAM

3.1 Cement:

The Cement is a substance, which acts as a binding agent for materials. The raw material used for manufacture of cement consists of lime, silica, alumina and iron oxide. The oxide, when subjected to high clinkering temperature combine with each other to form a complex compounds called Begue's compounds (C_3 A, C_3 S, C_2 S).Lot of factors impact on the strength of concrete, but strength of cement is the most important and direct factor. In this study ordinary Portland cement of grade 53conforming to IS 12269 – 2997 was used. The property of cement are listed in table 1

Table 1 Properties of cement

Property of cement	Values
Fineness of cement	370 m^2 /kg
Grade of cement	43
Specific gravity	3.15
Initial setting time	30 min
Final setting time	600min

3.2 Manufactured sand:

Manufactured sand (M-Sand) is a substitute of river sand for concrete construction. It is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The properties of manufactured sand are listed in table 2

Table 2 Properties of M-Sand

Properties	Values
Specific gravity	2.6
Fineness Modulus	2.35

3.3 Eco-Sand:

The eco sand (finely graded silica) is a locally available. Eco sand is bi-product from cement manufacture, which can be used to increases efficiency in concrete. Its micro –filling effect reduces pores in concretes and provides better moisture resistivity and thus durability. It has more consistent grading than many extracted aggregates. Effective use of waste materials and thus cost effective and performs as well as naturally occurring sand. The use of eco sand rather than extracted or dredged naturally sand occurring sand. The use of eco sand rather than extracted or dredged natural sand will help designers and contractors address issues of sustainability .The present study is checking the compressive strength ,tensile strength and flexural of concrete cube using eco sand ,cement and superplasticizer. While the durability characteristics were investigated in terms of alkalinity and water absorption . The properties of Eco-sand are listed in table 3 and 4

Table 3 Physical Properties of Eco-Sand

Properties	Values
Specific gravity	2.4
Fineness Modulus	0.028

Table 4 Chemical properties of eco-sand

CHEMICAL	PERCENTAGE
SiO_2	58-60%
Al_2O_3	2-3%
Iron	1-3%
MgO	0.4-1%
CaO	20-25%

3.4 Coarse aggregates:

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. They can either be from primary, secondary or recycled sources. Primary, or 'virgin', aggregates are either Land- or Marine-Won. Gravel is a coarse marine-won aggregate; land-won coarse aggregates include gravel and crushed rock. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder. Secondary aggregates are materials which are the by-products of extractive operations and are derived from a very wide range of materials. The fractions from 10 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from 10 mm are used conforming to IS: 383 is being used.

Table 5 properties of coarse aggregate

Properties	Values
Specific gravity	2.8
Size of aggregate	20mm
Fineness modulus	5.96

3.5 Water:

Potable water is used for mixing and curing as per IS 456:2000. From durability consideration water cement ratio should be restricted as in case of normal concrete and it should preferably be less than 0.45. The water used for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone or steel. Potable water is generally considered satisfactory for mixing. The pH value of water should be not less than 6.

3.6 Superplasticizer:

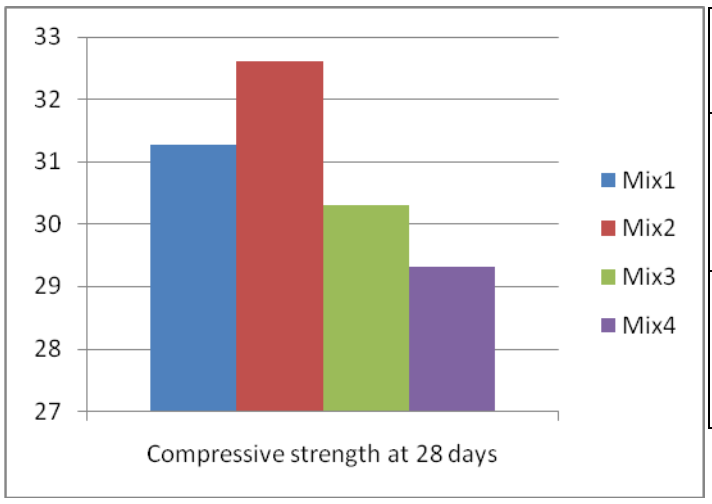
Super plasticizer is used to improve workability and to reduce water consumption by 30%. Super plasticizer also known as high range water reduces, are chemicals used as admixtures where well-dispersed particle suspension are required. These polymers are used as dispersants to avoid particle aggregation and to improve the flow characteristics of suspension such as in concrete application. Their addition to concrete or mortar allows the reduction of the water to cement ratio, not affecting the workability of the mixture, and enables the production of self-consolidating concrete and high performance concrete. This effect drastically improves the performance of the hardening fresh paste. Indeed the strength of the concrete increases whenever the amount of water used for the mix decreases.

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test on cube

The compressive strength as one of the most important properties of hardened concrete in general is the characteristics material value for classification of concrete . 28 days cube compressive strength is tested on cubes of size 150mm x150mm x150mm and 28 days compressive strength is tested.

Mix	Compressive strength N/mm²	Average Compressive Strength
Mix 1	32.0	31.26
	30.7	
	31.1	
Mix 2	32.8	32.6
	33.7	
	31.5	
Mix 3	31.5	30.3
	28.8	
	30.7	
Mix 4	31.1	29.3
	27.1	
	29.7	

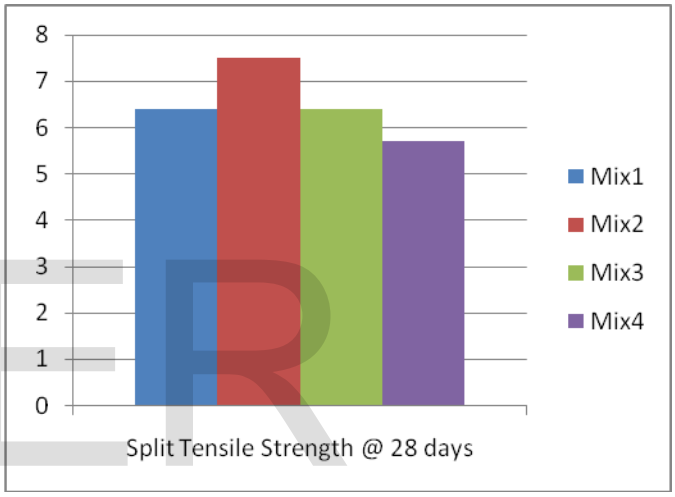


	8.2	
	7.1	
Mix 3	6.1	6.4
	6.3	
	6.9	
Mix 4	5.6	5.7
	6.1	
	5.6	

4.2 Split tensile strength test of cylinder

The test is carried out by placing cylindrical specimen (150mm diameter and 300mm height) horizontally between the loading surface of a compression testing machine and the load applied until failure of the cylinder , along the vertical diameter . It is estimated the compressive stress is acting for about 1/6 depth and remaining 5/6 depth is subjected to tension. The magnitude of tensile stress (acting in a direction perpendicular to the line of action of applied compression) is given by $2P/\pi DL$, Where P is applied load , D and L are Diameter and Length of Cylinder, respectively. The average split tensile strength of the cylinder for various % replacement of M-sand and Eco-sand are shown in Table

Mix	Split tensile strength N/mm²	Average Split Tensile Strength
Mix 1	6.3	6.4
	6.9	
	6.1	
Mix 2	7.2	7.5



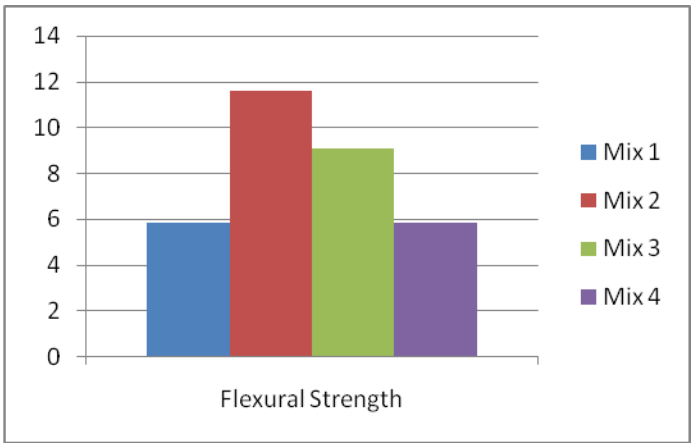
4.3 Flexural strength test on prism

Standard size of the prism (500 mm x100 mm x100 mm) were cast and at the end of the curing period of 28 days tested for its spilt tensile strength. The average spilt tensile strength of the cylinder for various % replacement of Eco sand and M sand are shown in Table

The test to be conducted on the specimen immediately after taken out of the curing condition which decline flexural strength. Place the specimen on the loading point. The hand finished surface of the specimen should not be in contact with loading points. Applying

loads between 2 to 6 percent of the computed ultimate load. Employing0.10mm and 0.38mm leaf type feeler gauges, specify whether any space between the specimen and load applying or support blocks is greater or less than each of the gauges over a length of 25mm or more. Load the specimen continuously without shock till the point of failure at a constant rate (Indian standard specified loading rate of 400kg/min for 150mm specimen and 180kg/min for 100mm specimen, stress increase rate 0.06+/0.04N/mm^2.s according to British standards). The loading rate as per ASTM standards can be computed based o the following equation r = PL/bd^2. finally measure the cross section of the tested specimen at the each and at centre to calculate average depth and height..

Mix	Flexural strength N/mm^2	Average Flexural Strength
Mix 1	7.5	5.8
	5	
	5	
Mix 2	10	11.6
	10	
	15	
Mix 3	7.5	9.1
	10	
	10	
Mix 4	5	5.8
	7.5	
	5	



5. CONCLUSIONS

1. The compressive strength of the concrete cube specimens increases by 4.11% when the M sand content is greater than Eco sand.
2. The split tensile strength of the concrete cylinder specimens increases by 14.6% when the M sand content is greater than Eco sand.
3. The Flexural strength of the concrete prism specimens increases by 50% when the M sand content is greater than Eco sand.
4. lso, it is concluded that when the percentage of Eco sand is further increased, correspondingly it reduces the compressive strength, split tensile strength and flexural strength.

6. REFERENCES

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