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An Experimental Study on Sea Sand by Partial Replacement of Sea Sand in Concrete

B. Naga Niranjan Kumar*, P. Kiran Kumar, E. Ramesh Babu, M. Gopal, D. Sreekanth Reddy, K. Sreekanth, U. Yellppa

Department of Civil Engineering, Dr. K. V. Subba Reddy Institute of Technology, Kurnool, Andhra Pradesh, India

ABSTRACT

The rapid growth in development of construction industry is leading to an increase in utilization of natural resources like river sand due to which there has been a much scarcity in availability for construction. This overuse should be balanced by introducing certain abundantly available other natural materials which can be replaced to the river sand. The sea sand seems to have certain similar properties and can be used as a constituent of concrete. This can reduce the river sand replenishment and decrease various ecological imbalances. The fast growth in industrialization has resulted in tonnes and tonnes of by product or waste materials, which can be fly ash, crushed stone dust, silica fume, and granulated blast furnace slag, steel slag etc. The use of these byproducts not only helps to utilize these waste materials but also enhances the properties of concrete in fresh and hydrated states. In the present work a series of tests were carried out to make comparative studies of various mechanical properties of concrete mixes prepared by using Sea Sand. If some of the materials are found suitable in concrete making, cost of construction can be cut down. So in the present study, an attempt has been made to assess the suitability of Sea sand in concrete making. Cubes and beams were cast and tested for compressive strength and flexural strength after 7 days and 28 days. The Sea sand is replaced in percentages of 0%, 20%, 40%, 60%, 80%, and 100%.

Keywords : Aggregate, Sea Sand, Compressive Strength, Split Tensile Strength

I. INTRODUCTION

The river sand still remains the main source of sand for construction industry. The demand for sand has been ever increasing with the development of building industry. As a result, it has been noticed the overexploitation of river sand causing serious environmental problems. One of the main objectives of the study is the identification of potential sources of river sand alternatives. The sea sand is now being recognized as the major alternatives of river sand in this study. Sea sand is some of the alternative that can be used to replace with river sand in the preparation of concrete. As major natural resource Sea sand can be obtained from the sea shores abundantly at free of cost.

II. METHODS AND MATERIAL

A. Problem Statement

Now–a-days, the use of river sand for concrete production has increased rapidly due to increase in number of construction industries. The increase in rate of production of concrete leads to increase in demand for raw materials which in turn leads to price hike of raw materials. Also this demand may be due to scarcity in availability of raw materials mostly the river sand. This problem of importing river sand from other places at a higher price has brought the idea of using the locally available natural material in the place of this river sand. So, by using the sea sand which is abundantly available at the sea shores for the low volume road construction, much of the economy of construction could be saved.

So, by using sea sand from the sea shores as a fine aggregate replacement in preparation of concrete will save our earth for a sustainable environment. It also helps to save much of our river sand from being deployed for construction.

B. Aim And Objective

The objectives of this study are:

1. To determine the performance of using sea sand as a fine aggregate in concrete.
2. To determine the most economic material that can be suitably replaced for construction.
3. To fulfil safe environment by using waste materials.
4. To investigate the basic properties such as Flexural Strength, Compressive strength of sea sand replaced concrete in comparison with Normal River sand used concrete.

C. Scope of The Study

The scope of the study will be focused on the performance of concrete using sea sand as a partial replacement with 20mm nominal maximum aggregate size. In this study the sea sand sample is collected from Mypadu, Indukurupeta Mandal, Nellore District, Andhra Pradesh, India. The sample was taken on the sea shore.

D. Mix Design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative propositions with the object of producing concrete of certain minimum strength and durability as economically as possible. The mix design is based on as IS: 10262-2009.

Table - 1: Shows Mix Design for M30 grade

Water	Cement	Fine aggregate	Coarse aggregate
140	333	740	1258
0.42	1	2.2	3.78

E. Test On Materials

✓ Cement

OPC 53 Grade of Cement Maha cement was used in this study. The following physical test should be conduct in the laboratory as per IS codes

Table – 2: Physical Test results of cement

Sl. no.	Physical Tests	Obtained results	Requirements as per IS codes
1	Fineness	3%	Not >10% as per IS 4031 part 1
2	Standard Consistency	32%	IS 4031 part 4
3	Initial Setting time	42min	Not less than 30 minutes as per IS 4031 part 5
4	Final setting time	265 min	Not more than 600 minutes as per IS 4031 part 5
5	Soundness	2 mm	Not>10mm as per IS 4031 part 3
6	Specific gravity	3.10	IS 2720 part 3

✓ Aggregates

The aggregate used in this study was clean river sand and crushed stone aggregate collected from near Kurnool.

Table – 3: Physical Test of aggregates

Sl. No	Physical Tests	Obtained results	Requirements as per IS 383
1	Impact Test	19.74%	Not more than 45%
2	Los Angeles Abrasion Test	9.89%	Not more than 50%
3	Specific gravity		
	a) Coarse Aggregate	2.72	2.6-2.9
	b) Fine Aggregate	2.61	2.6-2.8
4	Water absorption		Not>2%as per IS:2386-Part 3
	a) Coarse Aggregate	0.6%	
	b) Fine Aggregate	0.3%	

F. Tests on Concrete

✓ **Slump Test**

Table – 4: Shows the slump values of sea sand used concrete

SL NO	Percentage addition of Sea Sand to concrete	Slump Values in mm.
1	0%	103
2	20%	98
3	40%	95
4	60%	93
5	80%	90
6	100%	86

✓ **Compaction Factor Test**

Table – 5: Shows the Compaction factor values of sea sand used concrete

SL NO	Percentage addition of Sea Sand to concrete	Slump Values in mm.
1	0%	0.98
2	20%	0.96
3	40%	0.93
4	60%	0.90
5	80%	0.88
6	100%	0.86

III. RESULT AND DISCUSSION

All specimens will be moist cured for one day and after moist curing the specimens will be water cured for required days. Traditional curing the cubes moulded with the cement concrete is subjected to curing in the water Tank and then checks the strengths at the age of 7 days and 28 days.

Table – 6: Shows the Compression and Flexural strengths of sea sand used concrete cubes and beams

Percentage of sea sand added in concrete mix	Compressive strength in Mpa		Flexural Strength in Mpa	
	Age in days		Age in days	
	7	28	7	28
0%	33.04	41.93	3.38	4.64
20%	34.81	44.38	3.48	4.80
40%	37.33	47.55	3.52	4.94
60%	35.70	46.07	3.32	4.54
80%	33.18	42.07	3.22	4.43
100%	32.44	40.60	3.15	4.25

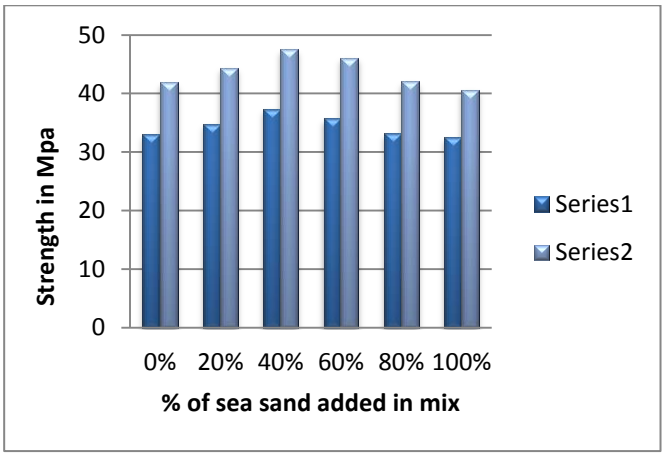

Chart -1: Difference of 7 days and 28 days compressive strength test results

In the present study, the sea sand has been replaced with river sand in concrete mix. The compressive strength and flexural strength for

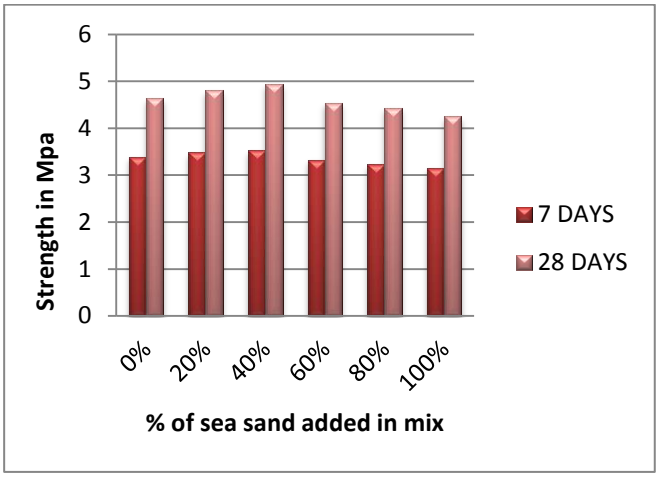

Chart -2: Difference of 7 days and 28 days Flexural strength test results

Different percentages of sea sand are shown in table. The normal M30 grade with no replacement is used as a reference for compressive and flexural strengths and the increase or decrease in Percentage of strength is calculated. For 20% replacement the compressive strength has increased for 5.84% and gradually increased with increased in percentage of sea sand. The optimum strength achieved is 13.4% more than the normal strength at 40% of sea sand replaced and then decreased 3.17% for 100% of replacement. The flexural strength behavior is also similar in this case since the strength has increased for about 3.44% by 20% replacement and increased to 6.46% more than the normal concrete mix strength for 40% replacement. For 100% replacement the strength has been decreased for about 8.4% for 100% replacement than the normal concrete mix strength.

IV. CONCLUSION

1. The replacement of sea sand to concrete slightly increases the compressive and flexural strength.
2. By replacing 40% sea sand the compressive strength has increased by 13.4%
3. By replacing 40% sea sand the Flexural strength has increased by 6.46%.
4. Adoption of waste materials, cost of construction can be reduced to some extent.

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