EFFECT ON COMPRESSIVE STRENGTH OF CONCRETE USING SEA SAND AS A PARTIAL REPLACEMENT FOR FINE AGGREGATE

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Abstract

Concrete is a major construction material used in the construction now a days. It is a composite material containing cement, fine aggregate, coarse aggregate and water. Fine aggregate is required in large quantities for manufacturing of concrete. Generally river sand is used as a fine aggregate. Due to increase in the utilization of concrete in construction sector, the need for river sand has been increased enormously. Limitations have been laid on the large scale mining of river sand from river beds. In this context there are cases of illegal mixing of sea sand with river sand. This paper mainly presents the practical study of the compressive strength of the concrete in which sea sand was used as fine aggregate is partially or completely replaced. For this study first control specimens were laid for M20 grade concrete. The fine aggregate proportion from the design mix was replaced partially in percentages of 20%, 40%, 60%, 80% and 100% by sea sand. Compressive strength test was conducted on the various concrete specimens with various fine aggregate proportions and the results were tabulated. The compressive strengths of concrete specimens for respective mix proportions were tested at 7, 14 and 28 days of water curing. The behavior of concrete by partial replacement of fine aggregate with sea sand has been studied. With the increase in the percentage of sea sand replacement in concrete, the compressive strength of the concrete significantly reduced.

Keywords: *Concrete, Fine Aggregate, sea sand, Compressive strength*

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1. INTRODUCTION

The boom in the construction sector is a direct result of economic growth. This rapid growth leads to fierce competition for resource rights of fine aggregate and coarse aggregate from riverbeds. This results in illegal mining of river beds for river sand which in turn causes environmental problems. Due to this scarcity of river sand, the contractors are mixing sea sand with river sand.

This study is a basic practical study on the compressive strength of concrete made by using sea sand as a partial replacement to fine aggregate. In this the fine aggregate was replaced by sea sand in various percentages.

When sea sand is mixed with cement in place of normal river sand to make concrete for buildings, structural issues in buildings arise.

2. NEED FOR PRESENT STUDY

River sand is an essential raw material in construction industry. Especially during monsoons the sources of river sand are unpredictable due to the rise in river water table. Also governments have imposed norms on the mining and utilization of river sand for construction purposes. Due to these reasons different construction companies have started mixing sea sand illegally with river sand. In this scenario there is a need to study the mechanical properties of concrete with sea sand as a partial replacement to fine aggregate.

3. AIM AND OBJECTIVE

The objectives of this study are:

- To study the practical utilization of sea sand as fine aggregate partially or completely.
- To determine the compressive strength of concrete with different percentages of sea sand as fine aggregate as partial replacement.

4. SCOPE OF THE STUDY

This work involved the practical study of compressive strength of concrete made using sea sand as fine aggregate as a partial replacement. In this study the sea sand sample was taken from east peninsular of India which was Visakhapatnam. The sample was taken on the sea shore and not involving the sea sand that is close to the water.

5. MIX DESIGN

The mix design for the control specimens was done based on IS: 10262-1982. The water to cement ratio taken was 0.5. The compressive strength of concrete depends on the properties of the materials used in the concrete. In general the various requirements of concrete are strength, workability and economy. Based on the physical properties of the materials used in the concrete mix design was done. For the present study two trial mixes with different proportioning were laid and the one with better economy and workability was selected for the study.

Table -1: Mix design for M20 grade

Cement	Fine Aggregate	Coarse Aggregate	Water to Cement ratio
1	1.55	3.51	0.5

6. MATERIALS USED IN CONCRETE

6.1 Cement

An OPC 53 grade Maha gold cement was used in this study. The physical properties of the cement used were found based on the respective IS codes

Table -2: Properties of cement

S.NO	Particulars of test	Test results	Requirement as per IS Code
1	Fineness of cement	96%	IS: 4031 PART 1 1996
2	Standard Consistency	30%	IS 4031 – 1996 (Part 4)
3	Setting time		
a	Initial setting time	45 min	As per IS :12269-2013 30min, Minimum
b	Final setting time	195 min	As per IS: 12269-2013 600min, Maximum

6.2 Fine Aggregate

The fine aggregate used in this study was clean river sand purchased near Visakhapatnam. The following tests on fine aggregate were done based on IS 2386-1968 (Part 3)

Table -3: Properties of Fine aggregate

S.NO	Particulars of test	Test results
1	Specific gravity	2.56
2	Fineness modulus	3.4%
3	Bulking of sand	4%
4	Sieve analysis	Zone II

6.3 Coarse Aggregate

In the present investigation crushed stone aggregate of 20mm size was used. The following are the physical properties of coarse aggregate used

Table -4: Properties of Coarse aggregate

S.NO	Particulars of test	Test results
1	Specific gravity	2.86
2	Crushing value	19.5%
3	Impact value	23.1%
4	Fineness modulus	7.24%

7. RESULTS AND DISCUSSIONS

The water cured concrete specimens were tested at the age of 7, 14 and 28 days. The specimens were tested in compression testing machine of capacity 200T. The following are the results obtained after testing.

Fig -1: Compression testing machine

Table -5: 7 days compressive strength

Mix	Different mixes	Compressive strength (MPa)	%Reduction
1	100% river sand	17.39	---
2	80% river sand and 20% sea sand	15.85	8.85
3	60% river sand and 40% sea sand	13.98	19.6
4	40% river sand and 60% sea sand	12.7	26.96
5	20% river sand and 80% sea sand	10.57	39.21
6	100% sea sand	9.62	44.68

Table -6: 14 days compressive strength

Mix	Different mixes	Compressive strength (MPa)	%Reduction
1	100% river sand	21.92	---
2	80% river sand and 20% sea sand	17.31	21.03
3	60% river sand and 40% sea sand	16.20	26.09
4	40% river sand and 60% sea sand	14.38	34.4

5	20% river sand and 80% sea sand	13.08	40.32
6	100% sea sand	11.7	46.6

Table -7: 28 days compressive strength

Mix	Different mixes	Compressive strength (MPa)	%Reduction
1	100% river sand	27.81	---
2	80% river sand and 20% sea sand	18.29	34.23
3	60% river sand and 40% sea sand	17.15	38.33
4	40% river sand and 60% sea sand	15.32	44.9
5	20% river sand and 80% sea sand	14.08	49.37
6	100% sea sand	12.84	53.82

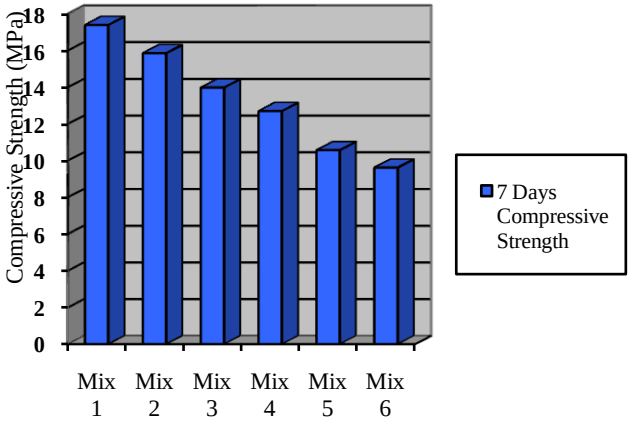

Chart -1: Variation of 7 days compressive strength for different mixes

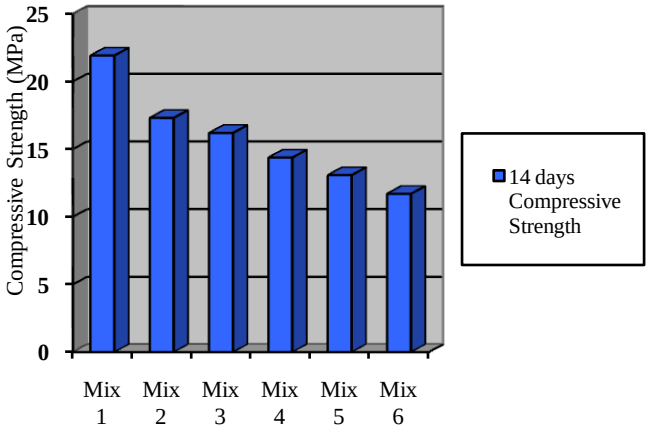

Chart -2: Variation of 14 days compressive strength for different mixes

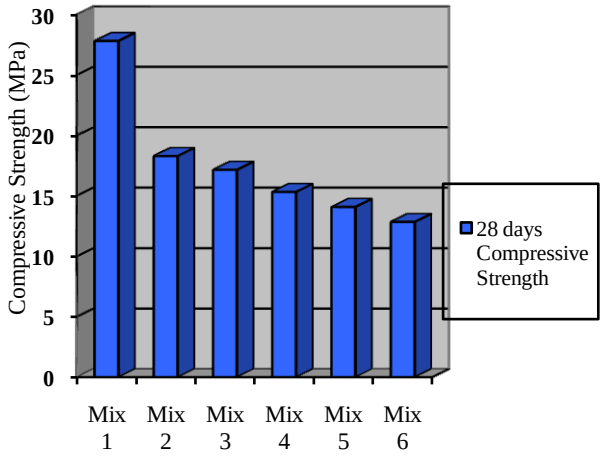

Chart -3: Variation of 28 days compressive strength for different mixes

The results show that there is a constant decrease in the compressive strength with the increase in the quantity of sea sand in the concrete. The decrease in the strength is gradual for the different mixes used. The reduction in strength also increased with the increase in the age of concrete.

8. CONCLUSION

- In case of 20% replacement of sea sand as fine aggregate the Characteristic compressive strength is reduced by 34.23%.
- At 40% replacement of fine aggregate with sea sand the Characteristic compressive strength is reduced by 38.33%.
- 60 % replacement of fine aggregate with sea sand reduces the Characteristic compressive strength by 44.9%.
- In case of 80% replacement of sea sand as fine aggregate the Characteristic compressive strength is reduced by 49.37%.
- It is observed that for 100% replacement of sea sand as fine aggregate in concrete compressive strength is reduced by 53.82%.
- Usage of Sea sand in concrete found there is a significant reduction in strength of the concrete.
- The reduction in compressive strength of concrete for 7 days is 44.68%, for 14 days is 46.6% and for 28 days is 53.82%.
- The reduction in characteristic compressive strength of the concrete is significant for partial replacement of sea sand as fine aggregate.

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BIOGRAPHIES

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