A Comparative Study on Partial Replacement of Sea Sand to the River Sand with Different Types of Cements

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***Abstract* - Concrete is used as a very strong and versatile mouldable construction material. It consists of cement, fine aggregate, coarse aggregate and water. Usually, the use of river sand (fine aggregate) in our country is very huge in the construction industry. Therefore the use of river sand can be replaced with other materials to protect the environment of the river as well as prevent erosion and flooding. Abundant sea sand is one of the alternatives for the reduction of usage of river sand. River sand will be replaced with abundant sea sand in accordance with a specified percentage. Two types of cements are used for testing one is ordinary Portland cement; second one is Portland slag cement with different percentage of sand replacements. The present study was carried out by replacing the river sand with sea sand. The soil was tested as per codal provisions to obtain fineness modulus, specific gravity, bulk density and p^{H}. River sand is replaced with sea sand with percentages 0, 10, 20, 30, and 40% for obtaining the compressive, split tensile and flexural strengths of M_{30} grade of concrete at the age of 7 and 28 days of standard curing.**

Keywords: Ordinary Portland cement, Portland slag cement, sea sand, River sand, water and coarse aggregate etc…

1. INTRODUCTION

Sand plays a major role in any construction industry. It is a major material used for preparation of mortar and concrete and which plays a vital role in mix design. In present days due to erosion and relevant environmental issues, there is a shortage of river sand is formed. The shortage of river sand will affect the construction industry; hence there is a need to find the new alternative material to replace the river sand. Many researchers are finding different materials to replace sand and one of the major materials used to replace the sand is sea sand. M_{30} grade concrete was taken for the present study. Natural sand was replaced partially by sea sand with the percentages 0-40%. Compressive, split tensile, flexural strengths of M_{30} grade concrete was studied for a period of 7 and 28 days of standard curing.

2. MATERIALS AND THEIR PROPERTIES:

2.1. Cement: Here Two types of cements are used for testing. Ordinary Portland cement, Portland slag cement are used. The properties of cements are shown below:

Table 1: Properties of cement used

S.NO	PROPERTY	TEST RESULTS	
		OPC	PSC
1	Normal consistency	33%	33%
2	a) Initial setting time	80 Minutes	80 Minutes
	b) Final setting time	180 Minutes	180 Minutes
3	Specific gravity	2.929	2.63
4	Soundness (Le-chatelierExp.)	1.30 mm	1.30 mm
5	Compressive strength of cement (28 days)	53 Mpa	53 Mpa
6	Specific surface area	320 m2/kg	320 m2/kg

2.2 Fine Aggregate: The fine aggregate forms the filler matrix between the coarse aggregate and cement. The aggregate smaller then IS 4.75 mm sieve is called as fine aggregate. Angular grained sand produces good and strong concrete because of good interlocking property. In this investigation Natural River sand and sea sand was adopted as fine aggregate.

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Table 2: Properties of Fine Aggregate

S.NO	Property	Test results
1	Specific gravity	2.6
2	Bulk density(kg/m)	1543(loose state) 1750(dry rodded)
3	Fineness modulus	2.74
4	Zone	2

2.3 Sea Sand: Sea Sand is used as partial replacement for fine aggregate in this study. It was procured from Machilipatnam beach, which comes under zone – IV. The specific gravity, fineness modulus and sieve analysis for sea sand were as shown:

Table 3: Properties of Sea Sand

S.NO	Property	Test results
1	Specific gravity	2.157
2	Fineness modulus	0.9205
3	Zone	4
4	P^H Value	8.2

2.4 Coarse Aggregate: The coarse aggregate forms the main matrix of the concrete. The retained material on IS 4.75 mm sieve is termed as coarse aggregate. The most commonly used coarse aggregate in concrete is crushed stone and gravel conforming to IS 383-1970. Aggregates should be hard, angular, and should have good crushing strength. Angular aggregates have good interlocking effect and high bond strength. In this investigation 70% passing through 20 mm sieve and retained on 10 mm sieve and 30% passing through on 10 mm sieve was used a coarse aggregate throughout the work. The main properties of coarse aggregate are:

Table 4: Properties of Coarse Aggregate

S.NO	Property	Test results
1	Specific gravity	2.73
2	Bulk density(kg/m)	1468(loose state) 1611(dry rodded)
3	Fineness modulus	7.65
4	Crushing value	21.22%
5	Impact value of aggregate	15.69%

2.5 Water: Water is the most important but the least expensive ingredient of concrete. Clean portable water is used for mixing concrete. Water used for mixing and curing should be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete and steel:

Table 5: Properties of Water

S.NO	Impurity	Max. Limit	Results
1	P^H Value	6 to 8.5	7
2	Suspended matter mg/lit	2000	220
3	Organic matter mg/lit	200	20
4	Inorganic matter mg/lit	3000	150
5	Sulphate(so_4) mg/lit	500	30
6	Chloride(cl)mg/lit	2000 for P.C.C, 1000 for R.C.C	60

3. PREPARATION OF TESTING SPECIMENS:

3.1Mixing: mixing of ingredients is done by the method of hand mixing. Hand mixing is done on a water-tight, non-absorbent platform.

3.2 Casting of Specimens: The well mixed green concrete is filled in to the moulds by vibration.

3.3 Curing: The specimens are then removed from the moulds and immediately transferred to the curing pond containing clean and fresh water and cured for 7 days and 28 days.

3.4 Tests on hardened concrete: The following tabular form presents the compressive strengths of various proportions of M30grade concrete mix with various replacement levels of sea sand at 7 days and 28 days of curing.

Table -6: compressive strength test at the age of 7 &28 days of curing with OPC& PSC

S.NO	% Replacement of sea sand	compressive strength test at the age of 7 &28 days(MPa)			
		7 days		28 days	
		OPC	PSC	OPC	PSC
1	0%	46.9	42.5	64.5	51.7
2	10%	47.5	43.9	65.68	57.8
3	20%	48.31	45.6	66.66	64.3
4	30%	45.9	42.14	61.1	47.1
5	40%	45.5	40.14	60.17	43.4

Graph-1: compressive strength of OPC at the age of 7& 28 days

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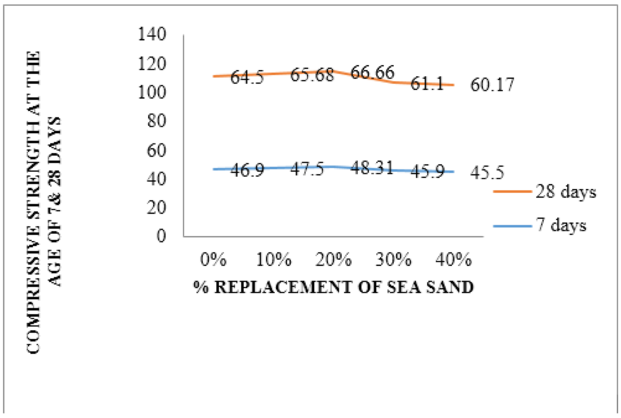


Graph-2: compressive strength of PSC at the age of 7& 28 days

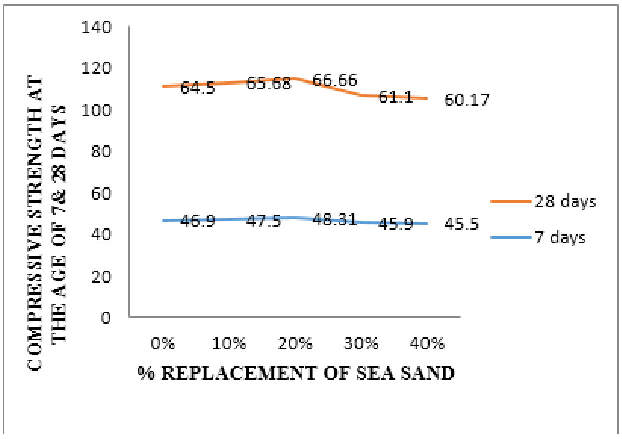
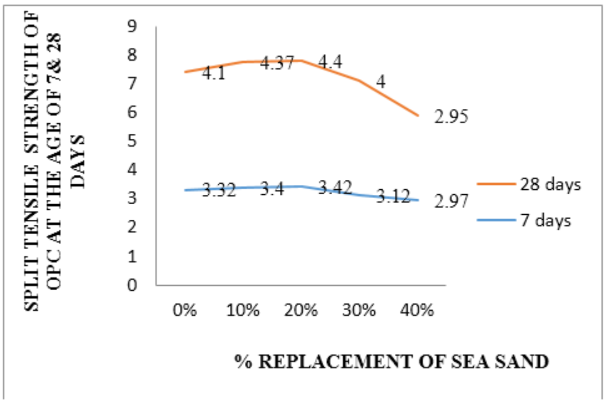


Table -7: Split Tensile strength test at the age of 7 &28 days of curing with OPC& PSC

S.NO	% Replacement of sea sand	Split Tensile strength test at the age of 7 &28 days(MPa)			
		7 days		28 days	
		OPC	PSC	OPC	PSC
1	0%	3.12	2.27	4.1	3.62
2	10%	3.4	2.44	4.37	3.74
3	20%	3.42	2.8	4.4	3.93
4	30%	3.12	2.0	4.0	3.53
5	40%	2.97	1.81	2.95	2.87

Graph-3: Split Tensile strength test of OPC at the age of 7& 28 days



Graph-4: Split Tensile strength test for PSC at the age of 7& 28 days

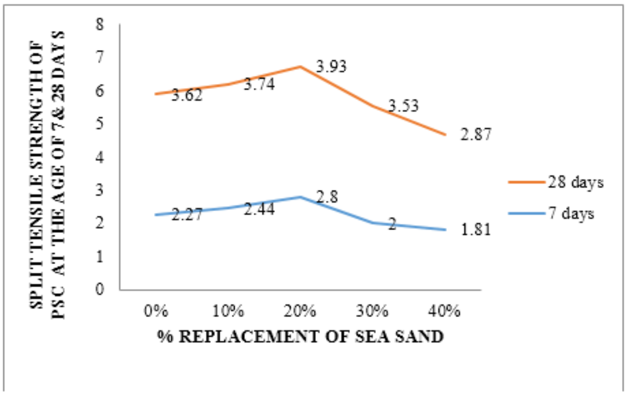


Table -8: Flexural strength test at the age of 7 &28 days of curing with OPC& PSC

S.NO	% Replacement of sea sand	Flexural strength test at the age of 7 &28 days(MPa)			
		7 days		28 days	
		OPC	PSC	OPC	PSC
1	0%	5.15	4.368	6.67	5.36
2	10%	6.24	4.624	6.89	6.04
3	20%	7.0	5.808	7.66	6.9
4	30%	4.15	3.64	6.52	5.31
5	40%	3.43	1.64	4.08	4.91

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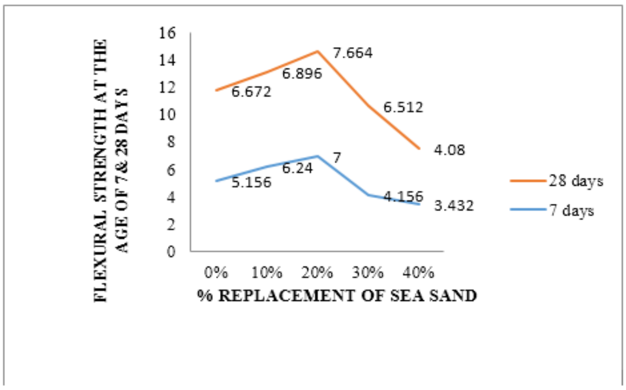
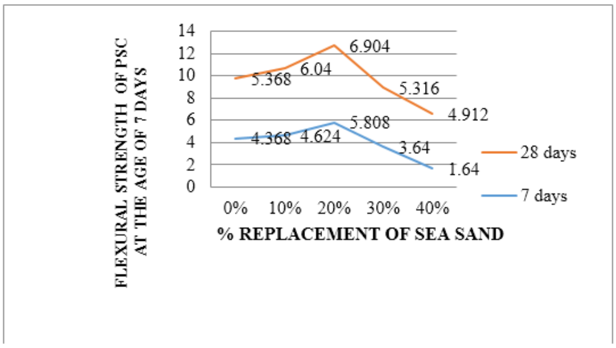
Graph-5: Flexural strength test for OPC at the age of 7& 28 days



Graph-6: Flexural strength test for PSC at the age of 7& 28 days



3. CONCLUSIONS:

The following conclusions have been drawn from the Experimental study done:

1. The compressive strength of **OPC** at 20% replacement of sea sand at age of 28 days of curing is 3.15% more than 0% replacement.
2. The compressive strength of **PSC** at 20% replacement of sea sand at age of 28 days of curing is 19.5% more than 0% replacement.
3. The split tensile strength of **OPC** at 20 % replacement of sea sand at age of 28 days of curing is 6.81% more than 0% replacement.
4. The split tensile strength of **PSC** at 20 % replacement of sea sand at age of 28 days of curing is 7.88% more than 0% replacement.
5. The Flexural strength of OPC at 20 % replacement of sea sand at age of 28 days of curing is 12.9% more than 0% replacement.
6. The Flexural strength of PSC at 20 % replacement of sea sand at age of 28 days of curing is 22.2% more than 0% replacement.

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