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Pilot Scale Investigation and Behavior of Blocks by Partial Restoration of Fine Aggregate by Sea Sand

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Abstract: *There has been increase in number of construction industries now a day. It leads to increase in demand for raw material which in turn leads scarcity in availability of raw material especially river sand. Concrete paving blocks has been extensively used in many countries for quite some time as a specialized problem- solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. This technology has been introduced in India for construction of road especially for footpaths, parking areas etc. where the conventional construction of pavement using bituminous mix or cement concrete technology is not feasible or desirable. Manufacturing of this paver block requires huge amount of river sand. This situation calls for an alternative material for river sand. Several research have proposed that sea sand can be a replacement for river sand. More over sea sand is abundantly available in the sea shores. Hence, in this study we have partially replaced river sand with the sea sand in percentages of 0%, 10%, 20%, 30%, 40% in the construction of paver block. The paver blocks were casted and tested for compressive strength at 14th day and 28th days and tested for impact and water absorption test.*

Keywords: *R.C.C. Reinforced Cement Concrete, PVC-Poly Vinyl Chloride, RCC-Reinforced Cement Concrete, SCC-Self Compacting Concrete, EPS-Expanded Polyethylene Sheet.*

I. Introduction

1.1 General

Concrete paving blocks has been extensively used in many countries for quite some time as a specialized problem solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. This technology has been introduced in India for construction of road especially for footpaths, parking areas etc. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking to multiply interlocking shapes. **B. N. Kumar, et al (2001)** conducted an experimental study on Sea Sand by partial Replacement of sea Sand in Concrete**. I**n this study, an attempt has been made to assess the suitability of Sea sand in concrete making. Cubes and beams were casted and tested for compressive strength and flexural strength after 7 days and 28 days. The river sand was replaced by sea sand in varying percentages of 0%, 20%, 40%, 60%, 80%, and 100%. **W.S.Deepak et al (2014)** investigated that the effect on compressive strength of concrete using sea sand as a partial replacement of fine aggregate**.** In this study sea sand was used for fine aggregate partially and completely 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.

1.2 Sand

1.2.1 Properties of River Sand

Granular size of river sand is less than 4.75 mm. 99.5 % of SiO_2 is in pure condition. Al_2O_3 and Fe_2O_3 are the important impurities present (0.5%) in the river sand. River sand is uniform in size and also offered in various particle sizes. It has the property of reducing the shrinkage cracks. **K.Katano, et al (1999)** investigated that theProperties and application Of Concrete Made with Sea water and Un-Washed Sea Sand. They developed high-density and hard concrete using sea water and unwashed sea sand.

1.2.2 Properties of Sea Sand

The bulk density of sandy soils is somewhat higher than 1 g/cm^3. The water content does not exceed 10-20 %. The bulk density of coastal soils generally decreases from sandy to clayey soils, from mineral to organic soils. Simultaneously, increase in the water holding capacity is observed. The Physical and Chemical properties of sea sand are determined using granular size, pH test, chloride test. **P. Sri Lakshmi**, **et al (2006)** conducted a comparative study on partial replacement of sea sand to the river sand with different types of cements. Two types of cements were used for testing ordinary Portland cement and Portland slag cement (PSC) with different percentage of sand replacements. This study was carried out by replacing the river sand with sea sand.

1.2.3 Comparison of Sea Sand and River Sand

Sea sand is more stable (high SBC - Safe Bearing Capacity) than river sand. It is due to the fact that sea sand, which is brought by travelling water either pushed by sea shore or by river during the continuous rolling in between water layers in rivers and seashore (which can be assumed as infinite time process) bigger stone particles continuously decaying during travelling towards sea and dissociates into as small as possible. **B. Subashini et al (1998)** investigated that theusage of sea sand in the construction field with the removal of salt content from the sand. An experimental set up with Sea Sand has been made by reducing the salt content to equalize its properties similar to the River Sand. Remaining dissociateparticles at beach will be of much strength than any other sand on earth surface.

1.3 Objective

- To determine the optimum percentage of sea sand as a partial replacement of fine aggregate in manufacturing of Concrete Paver blocks.
- To investigate the mechanical properties such as Compressive strength, impact strength of sea sand replaced paver blocks in comparison with Normal River sand used paver blocks.

1.4 Need For This 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 level. Also governments have imposed norms on the mining and utilization of river sand for construction purposes. Due to these reasons different manufacturing 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 of fine aggregate.

II. Methodology

2.1 General

Methodology is the general research strategy that outlines the way in which research is to be undertaken and, among other things, identifies the methods to be used in it.

2.2 Methodology

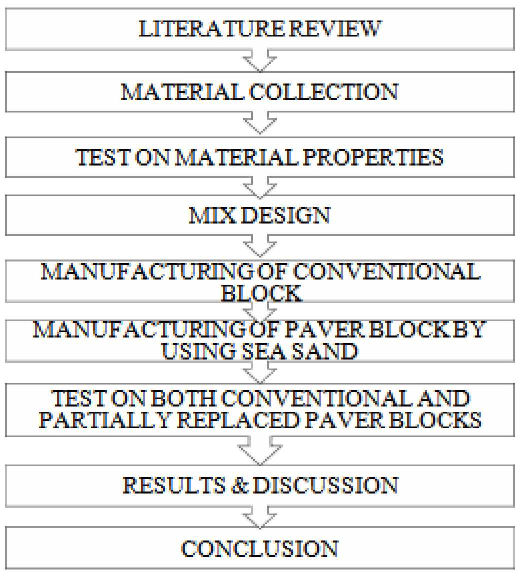


Fig 2.1.Methodology adopted

III. Material Collection And Testing

3.1 General

Cement, sea sand, river sand, water and coarse aggregate were procured and tested in the laboratory physical and chemical properties of the materials were found. The details of the materials, Mix design is explained in this chapter.

3.2 Cement

Ordinary Portland cement of 53 grade confirming IS 12269 was used in the experimental work. Table 3.1 shows the physical properties of cement.

Table.3.1 Physical Properties of Cement

S.NO	PROPERTY	CEMENT
1	Specific gravity	3.134
2	Bulk unit weight	1450 kg/m^3
3	Consistency	34 %
4	Initial setting time	33 mins
5	Final setting time	600 mins

3.3sand

Different tests were carried out on Sea Sand to determine its properties. The procedure and the results obtained are discussed below.

3.3.1 Specific Gravity Test:

Specific gravity of solids, G_s is defined as the ratio of the weight of a given volume of solids to weight of anequivalent volume of water. The specific gravity value for River sand and Sea sand are 2.845 and 2.72 respectively.

3.3.2 RIVER SAND

Weight of soil taken = 500 g

Table 3.2 sieve analysis test value for sea sand

S. No	size of sieve in (mm)	weight of soil retained (w_r)kg	% weight retained $=w_r/w \times 100$	% cumulative weight retained (w_c)	%finer =100 -wc
1	4.75	0.000	0	0	100
2	2.36	0.000	0	0	100
3	1.18	0.000	0	0	100
4	0.600	0.002	0.4	0.4	99.6
5	0.425	0.044	8.8	9.2	90.8
6	0.300	0.060	12	21.2	78.8
7	0.150	0.349	69.8	91	9
8	0.075	0.043	8.6	99.6	0.4
9	PAN	0.002	0.4	100	0

Fineness modulus of sea sand =2.21

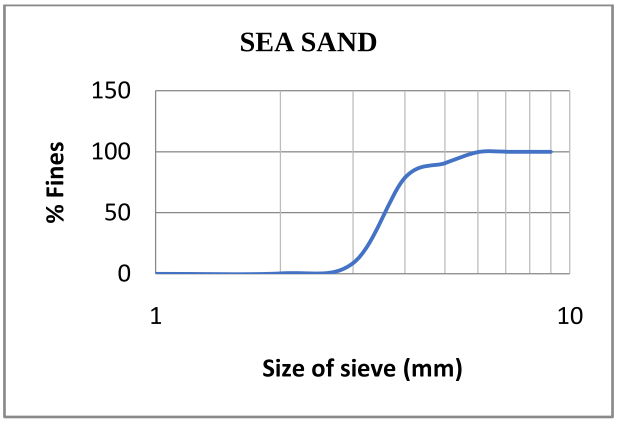


Fig3.1 sieve analysis graph for sea sand

Table 3.3 Sieve analysis test for river sand

S.No	size of sieve in (mm)	weight of soil retained (w_r)kg	% weight retained =wr/w x 100	% cumulative weight retained (w_c)	%finer =100-wc
1	4.75	0.001	0.002	0.2	99.8
2	2.36	0.004	0.008	1	99
3	1.18	0.032	0.064	7.4	92.6
4	0.600	0.084	0.168	24.2	75.8
5	0.425	0.170	0.340	58.2	41.8
6	0.300	0.087	0.174	75.6	24.4
7	0.150	0.027	0.054	8.1	19
8	0.075	0.017	0.034	84.4	15.6
9	PAN	0.078	0.156	100	0

Fineness Modulus of river sand = 3.32

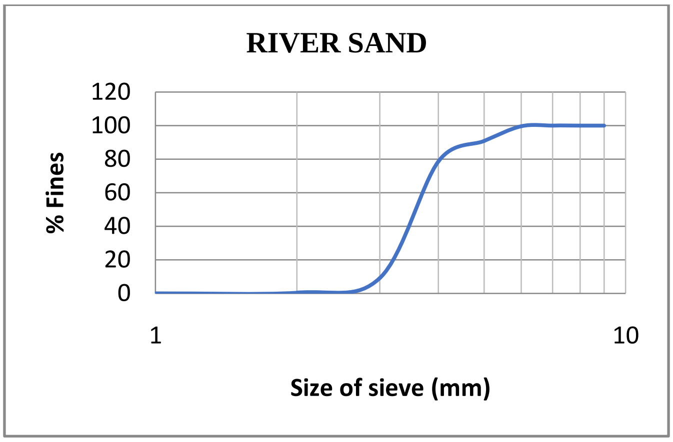


Fig3.2 sieve analysis graph for river sand

3.3.3 Chloride test

Normality of the Silver Nitrate solution (N_2) = 0.0126N Chloride content in soil before washing = 0.014 g/g of soil

Chloride content in soil after washing = 0.0000446 g/g of soil.

3.4coarse Aggregates-

Coarse aggregate are the crushed stone used for making concrete. The commercial stone is quarried, crushed and graded. Much of the crushed stone used is granite, limestone and trap rock.

Crushed angular granite metal of 10 mm size from a local source was used as coarse aggregate. Size of aggregates used Aggregates passing through 12.5 mm size sieve and retained on 10 mm size sieve were used.

3.4.1 Specific Gravity Test For Aggregate:

Specific gravity of solids, G_s is defined as the ratio of the weight of a given volume of solids to weight of an equivalent volume of water.

Table 3.4 Specific gravity test for coarse aggregate

Aggregate	Empty weight of pyconometer w_1 (gm)	weight of aggregate dried in oven and pyconometer w_2 (gm)	weight of aggregate dried in oven, water and pyconometer w_3 (gm)	weight of water and pyconometer w_4 (gm)
Sample	630	960	1669	1445

Specific Gravity = $W_2 - W_1 / (W_4 - W_1) - (W_3 - W_2)$

Specific gravity for aggregate = 2.62

IV. Results And Discussions

4.1 General

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining the relative proportions with the objective of producing concrete of desired strength and durability as economically as possible.

4.2 Mix Design

As per IS 10262:2009 the minimum grade recommended for paver block (non- traffic condition)
is M30. For our study we have chosen M30 grade.

Mix design for M30 grade:-

Mix Proportions

Design mix ratio

Water : Cement : Fine aggregate : Coarse aggregate

0.40 : 1 : 1.96 : 3.074

4.2.1 Mix Proportions

The following mix proportion were arrived from the literature study.

Table 4.1 Mix proportions for various Mixes

Mix Name	Cement	River sand	Sea sand	Coarse aggregate
Mix0	100%	100%	0%	100%
Mix1	100%	90%	10%	100%
Mix2	100%	80%	20%	100%
Mix3	100%	70%	30%	100%
Mix4	100%	60%	40%	100%

4.3 Tests On Fresh And Hardened Concrete

4.3.1 Compressive Strength Test

The test specimens were casted in rubber zigzag moulds of volume $0.00248m^3$. The concrete was filled into the mould in layers approximately 2.5 cm deep. Each layer was compacted either by heavy vibration or hand compaction. After the top layer has been compacted the surface of the concrete was brought to the finished level with the top of the mould, using a trowel. After proper curing concrete block were tested in compression testing machine. Fig 7.1 shows the compression test on concrete paver block

Fig 4.1 compression testing on paver block

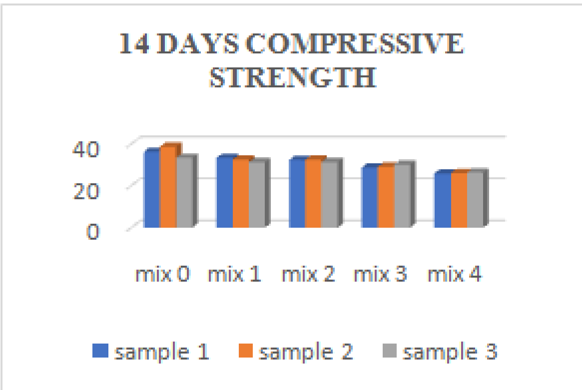
4.3.1.1 14 Days Compressive Strength

Paver blocks were casted and tested after 14 days and the results obtained were tabulated below.

Table 4.1 14 days compressive strength for various mix proportions.

S.No	**Mix Name**	**sample1 N/mm^2**	**sample 2 N/mm^2**	**sample 3 N/mm^2**	**Average compressive strength N/mm^2**
1	Mix0	36.21	38.74	33.32	36.9
2	Mix1	33.32	32.5	31.3	32.37
3	Mix2	32.32	32.5	31.3	32.3
4	Mix3	28.69	29.12	30.12	29.31
5	Mix4	25.81	26.01	26.32	26.05

Fig 4.2 14 days compressive strength result



4.3.1.2 28 Days Compressive Strength

Paver blocks were casted and tested after 28 days and the results obtained were tabulated below.

Table 4.2 28 days compressive strength for various mix proportions.

S. No	Mix Name	sample 1 N/mm²	sample 2 N/mm²	sample 3 N/mm²	Average compressive strength N/mm²
1	Mix0	46.38	40.75	45.48	44.21
2	Mix1	39.45	36.37	38.15	37.33
3	Mix2	37.35	37.48	36.48	37.10
4	Mix3	35.33	34.3	34.75	34.79
5	Mix4	33.48	33.48	32.91	33.29

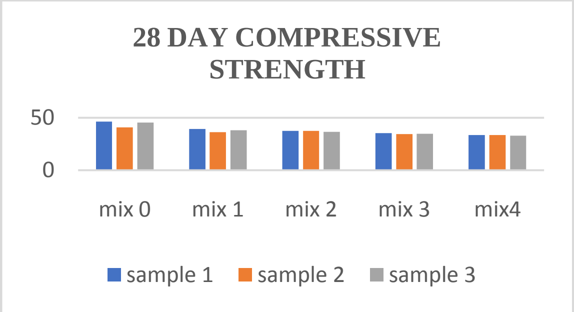


Fig 4.3 28 days compressive strength result

4.3.2 Impact Strength Test

Cement concrete paver blocks are mainly used for road construction. These blocks are subjected to impact load due to the vehicle. So, we are in need to check the impact strength of paver blocks. As per IS 15658-2006 the impact tests were conducted.

Fig4.4 Impact test on paver block

Procedure:
Cement concrete blocks were placed in the level surface.The hammer weight dropped from 458mm above the paver blocks top surface.The no of blows at which the paver block were broken was noted the result obtained as Height of the Hammer = 458mm , Weight of the Hammer= 4.98kg.

Table 4.3 Impact value

Mix name	Percentage of additional of sea sand	number of blows
Mix0	0%	6
Mix1	10%	3
Mix2	20%	3
Mix3	30%	3
Mix4	40%	2

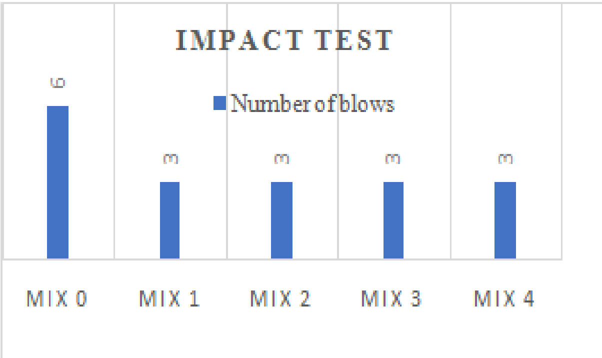


Fig.4.5 Impact load value for various mix proportion

4.3.3 Water Absorbsion Test
Procedure
Drying Subsequent to saturation, the specimens shall be dried in a ventilated oven at 107 + 7°C for not less than 24 h and until two successive weighing at intervals of 2 h show an increment of loss not greater than 0.2 percent of the previously determined mass of the specimen. The dry weight of each specimenshall be recorded in N to the nearest O.OIN.

Mix	Dry specimen	Wet specimen	Percentage of Water absorption
Mix 0	4.770	4.775	0.104%
Mix 1	4.570	4.580	0.21%
Mix 2	4.555	4.570	0.43%
Mix 3	4.630	4.650	0.436%
Mix 4	4.675	4.700	0.53%

V. Results And Discussions

5.1 Results
1. The optimum percentage of replacement level of sea sand for fine aggregate is 30% without compromising mechanical properties of paver block (compressive strength, Impact strength.).
2. Compared to the conventional block, the compression strength value of mix 1, mix 2, mix 3, remains same. But compressive strength resultfor MIX 4 (40%) was low compared to other mixes.
3. Compared to conventional paver block 14 days & 28 days compressive strength value of MIX 4 paver block is nearly 25% low.
4. Compared to the conventional block, the impact value of mix 1, mix 2, mix 3, remains same. But impact value for MIX 4 (40%) was low compared to other mixes.
5. With increase in percentage of sea sand the impact strength of paver block is reduced.
6. With increase in percentage of sea sand the water absorption value of paver block is increased.

This research is focused on comparative study of using sea sand as the partial replacement for fine aggregate. The significant conclusions drawn from the study are given below. with increase in percentage of sea sand as fine aggregate the compressive strength and impact strength is reduced but up to 30% replacement of sea sand as fine aggregate the variation in strength compared to the conventional paver block is 20%.In such place where the river sand is not fully available we can use the fine aggregate up to 30%.

References

[1]. Chandana, and Mynuddin.“Experimental Study on Strength of Concrete by Partial Replacement of Fine Aggregate with Sawdust and Robosand”.International Journal & Magazine of Engineering, Technology, Management and Research A Peer Reviewed Open Access International Journal.

[2]. Keisaburo et al, “Properties and application of concrete made with sea water and un-washed sea sand”.

[3]. Kumar et al “Investigation on Replacement of beach sand to river sand in Cement concrete” International Journal of Computational Engineering Research.

[4]. M.S.Shetty “ concrete technology – theory and practice” edition 2010

[5]. Seeni et al “. Experimental Study of Partial Replacement of Fine Aggregate with Waste Material from China Clay Industries”

[6]. PranshuSaxena and AshishSimalti. International Journal of Computational Engineering Research “Scope of replacing fine aggregate with copper slag in concrete”.

[7]. Sai Deepak and G.Tirupathi Naidu. “Effect on compressive strength of concrete using sea sand as a partial replacement for fine aggregate”.

[8]. Sandeep et al. “An examination of Possible usage of Mumbai Creek Sand for Making Concrete – A Review” International Journal of Scientific and engineering Research

[9]. IS 10262:2009 guidelines for concrete mix proportioning

[10]. IS 15658 : 2006 precast concrete blocks for paving

[11]. IS 383-1970 specification for coarse and fine aggregates from natural sources for concrete.