International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 10, Issue 11 (November 2014), PP.70-72

Replacement of Fine Aggregate with Local available Soil

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Abstract:- Cement, sand and aggregate are basic needs for any construction industry. Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. Now a day's erosion of rivers and considering environmental issues, there is a scarcity of river sand. The non-availability or 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, such that excess river erosion and harm to environment is prevented. Many researchers are finding different materials to replace sand and one of the major materials is local available soil. Using different proportion of this available soil along with sand the required concrete mix can be obtained. This paper presents a review on the study of replacement of fine aggregate with local available soil with different percentages (10%,20%,30%,40%,50% & 60%). Of all the trail mixes, the optimum replacement of soil with sand was found to be 30%.

Keywords:- Sand, local available soil, alternative material

I. INTRODUCTION

Cement, sand and aggregate are essential needs for any construction industry. Sand is a major material used for preparation of mortar and concrete and plays a most important role in mix design. In general consumption of natural sand is high, due to the large use of concrete and mortar. Hence the demand of natural sand is very high in developing countries to satisfy the rapid infrastructure growth. The developing country like India facing shortage of good quality natural sand and particularly in India, natural sand deposits are being used up and causing serious threat to environment as well as the society. Rapid extraction of sand from river bed causing so many problems like losing water retaining soil strata, deepening of the river beds and causing bank slides, loss of vegetation on the bank of rivers, disturbs the aquatic life as well as disturbs agriculture due to lowering the water table in the well etc are some of the examples.

II. LITERATURE REVIEW

Dr.T.S.Thandavamoorthy [1] investigated the feasibility of making concrete from soil instead of river sand. He concluded that the properties of local soil is as good s the regular river sand and the investigation has proved that it can as well be used as fine aggregate in the production of concrete in lieu of river sand because its availability now a days has become scarce and also expensive.

Nagabhushana and Sharada Bai [2] studied the properties of mortar and concrete in which Crushed Rock Powder (CRP) was used as a partial and full replacement for natural sand. For mortar, CRP is replaced at percentages 20,40,60,80 and 10. The strength properties of concrete were investigated by replacing natural sand by CRP at replacement levels of 20,30 & 40 percents.

Aggarwal et al.,[3] have carried out experimental investigations to study the effect of use of bottom ash as a replacement of fine aggregates. Different strength properties were studied and it consisted of compressive strength, flexural strength and splitting tensile strength. The strength development for various percentages of 0-50 replacement of fine aggregates with bottom ash can easily be equated to the strength development of normal concrete with ages.

Siddique [4] presented the results of an experimental investigation carried out to evaluate the mechanical properties of concrete mixtures in which fine aggregate i.e., sand was partially replaced with Class F fly ash. Sand ws replaced in five percentages i.e 10,20,30,40 and 50% of class F fly ash by weight. Tests were performed for the evaluation of properties of fresh concrete. Compressive strength, splitting tensile strength, flexural strength and modulus of elasticity were determined at 7,14,28,56,91 & 365 days. Test results indicated significant improvement in the strength properties of plain concrete by the inclusion of fly ash as partial replacement of fine aggregate (sand) and could be effectively used in structural concrete.

III. EXPERIMENTAL INVESTIGATION

Mix design has been conducted for M 30 concrete making use of IS 10262:2009 code with normal constituents of concrete with UltraTech OPC 53 grade cement. river sand and mechanically crushed 20 mm conventional granite. Fine aggregate was replaced with local available soil and the replacement levels are 10%,20%,30%,40%,50% & 60%. The sieve analysis for river sand and local available soil are as follows:

Table 1 Sieve Analysis – River Sand

S.No	IS Sieve Size (mm)	Weight retained (gm)	% weight retained	Cumulative % weight retained	% finer (passing)	Limits for zone-II (IS 383-1970)
1.	10	0	0	0	100	100
2.	4.75	0	0	0	100	90-100
3.	2.36	80.3	8.03	8.03	91.97	75-100
4.	1.18	350.8	35.08	43.11	56.89	55-90
5.	0.6	218	21.8	64.91	35.09	35-59
6.	0.3	270.2	27.02	91.91	8.09	8-30
7.	0.15	80.7	8.07	100	0	0-10
Sum of cumulative percentage retained				309		

Table 2 Sieve Analysis –Local Soil

S.No	IS Sieve Size (mm)	Weight retained (gm)	% weight retained	Cumulative % weight retained	% finer (passing)	Limits for zone-II (IS 383-1970)
1.	10	0	0	0	100	100
2.	4.75	0	0	0	100	90-100
3.	2.36	182	18.2	18.2	81.8	60-95
4.	1.18	365.3	36.53	54.73	45.27	30-70
5.	0.6	177.1	17.71	72.44	27.56	15-34
6.	0.3	193.4	19.34	91.78	8.22	5-20
7.	0.15	82.2	8.22	100	0	0-10
Sum of cumulative percentage retained				337.15		

Cube Specimens of sizes 150x150x150 mm were casted and tested for compressive strength as per IS:516 after 28 days of curing and the results were as follows:

IV. RESULTS AND DISCUSSIONS

4.1 Compressive Strength of M30 grade concrete using local available soil

The following tabular form presents the compressive strengths of various proportions of M30 grade concrete mix with various replacement levels of local available soil at 1day,3 days, 7 days, 28 days of curing.

Table 3: Cube Compressive Strength at 1day,3 days, 7 days, 28 days

S.No	% of soil replacement to sand	1 day (MPa)	3 days(MPa)	7 days(MPa)	28 days(MPa)
1.	**0%**	**12.44**	**18.22**	**22.66**	**36.88**
2.	**10%**	**11.55**	**16.88**	**21.77**	**34.66**
3.	**20%**	**10.66**	**16.00**	**20.00**	**31.55**
4.	**30%**	**8.88**	**14.22**	**18.22**	**30.66**
5.	**40%**	**8.00**	**12.00**	**16.88**	**28.88**
6.	**50%**	**6.66**	**10.66**	**14.66**	**26.22**
7.	**60%**	**4.88**	**8.44**	**12.44**	**18.22**

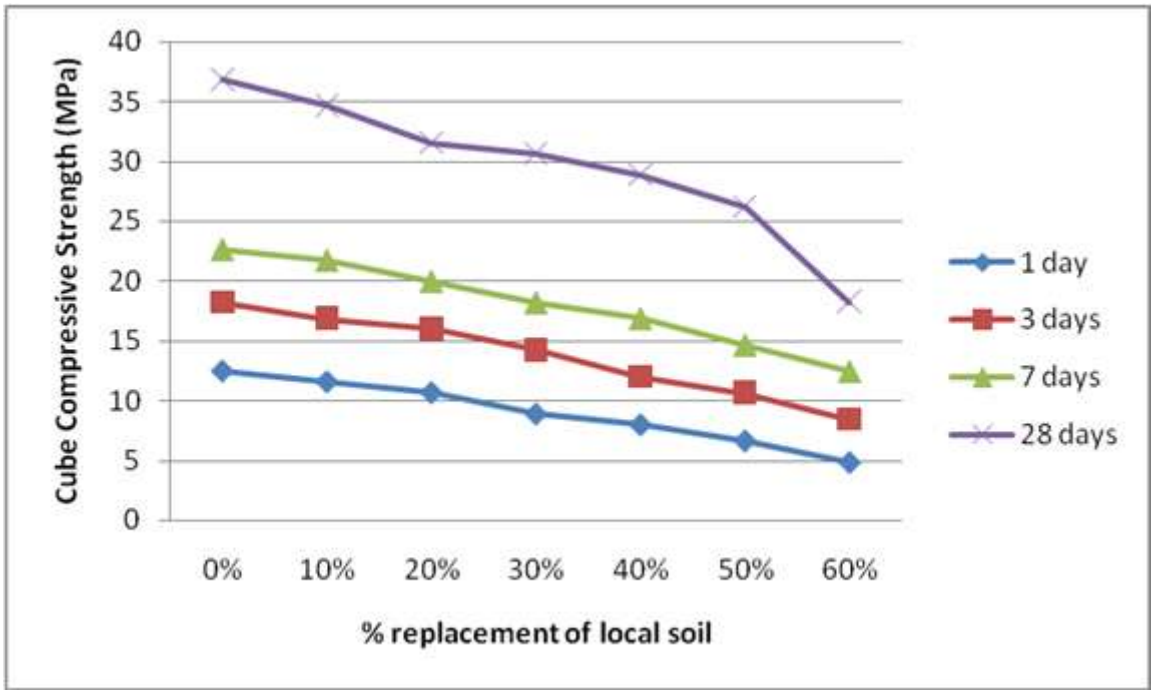

Fig: 1 Cube Compressive Strength (Mpa) at 1day,3 days, 7 days, 28 days

V. CONCLUSIONS

1. The specific gravity for river sand was 2.707 whereas for loal soil it was 2.679. The fineness modulus for river sand was 3.09 whereas for local soil it was 3.37
2. The compressive strengths are decreasing with the increase in the percentage replacement of sand with local available soil.
3. The replacements 10%,20% and 30% compressive strengths values were above 30MPa and beyond the target mean strength. 30% replacement of soil with sand is desirable for normal constructions.
4. From various tests conducted, it can be concluded that the properties of local soil is as good as the regular river sand and the investigation has proved that it can as well be used as fine aggregate in the production of concrete in lieu of river sand because its availability now a days has become scarce and also expensive.

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