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Study of Concrete Properties by Replacing Natural Sand with Artificial Sand

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***Abstract*:- Concrete is versatile material of construction everywhere the globe. The development in the construction depends upon the intelligent use of locally available materials. One of the important ingredients of the concrete is fine aggregate. The natural sand is widely use as a fine aggregate. Due to the large demand the resources of natural sand are almost exhaust hence to meet demand of fine aggregate it has been impose to use artificial sand.to keep the quality of concrete intact with artificial sand there is need to study properties of concrete by replacing natural sand with artificial sand.**

In this project workability and compressive strength of concrete have been studied by replacing natural sand with artificial sand with 25%,50%,75%,100%. Out of these better mix proportion is identified on the basis of compressive strength and workability.

It has been found that with use of artificial sand the workability of concrete reduces drastically with intern reduces the compressive strength of concrete due to poor compaction hence plasticizer is added into the concrete and its optimum dose is identified.

It has been found that concrete with replacement 75% of natural sand with artificial sand with 1% dose of superplasticizer gives better result as compare to concrete with natural sand.

1. INTRODUCTION

In India, the conventional concrete is produced by using natural sand obtained from the riverbeds as fine aggregate.
However, thanks to the redoubled use of concrete in most kinds of construction works, the demand of natural or watercourse sand has been redoubled. To meet this demand of industry, excessive quarrying of sand from river beds is taking place causing the depletion of sand resources. The inadequacy of natural sand thanks to such significant demands in growing construction activities have forced to seek out the appropriate substitute. One of the cheapest and the easiest ways of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade. In the present paper an attempt has been made to experimentally study the strength of concrete cubes and workability of concrete. Most important properties of concrete are compressive strength and workability.

2. EXPERIMENT OF WORK

(a) MATERIAL USED:

The properties of various materials used in making the concrete (M20) are discussed in the following sections:

Cement:
Ordinary Portland cement of 53 grade satisfying all the requirements of IS12269-1987 [1] was used in making the concrete slab panels and cubes in the experimental work.
Natural (River) Sand:

Fine Aggregate
The natural sand having fineness modulus of 2.67 and conforming to zone II as per IS: 383- 1970 [2] was used for the experimentation after washing it with clean water. The specific gravity of this natural sand was found to be 2.7.

Artificial sand (Crushed sand):
The crushed sand having fineness modulus of 2.84 and conforming to zone II as per IS: 383-1970 [2] was used for the experimentation after washing it with clean water. The specific gravity of this artificial sand was found to be 2.97.

Coarse Aggregate:
Crushed stone aggregates of 20mm size obtained from local quarry site were used for the experimentation. The fineness modulus of coarse aggregates was found to be 6.3 with a specific gravity of 2.75.

Concrete Mix Proportions :
The concrete of M20 grade was designed using the IS Code method (IS: 10262-1982) [3] of mix design and proportions were obtained after applying necessary corrections to suit field conditions. The final mix ratio expressed as parts of water: cement: fine aggregate: coarse aggregate was 1:1.5:3.

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Water cement Ratio
The water content is taken as 0.5

(b) Casting of Concrete specimens:

The mix proportion as obtained by following the guidelines of IS: 10262-1982[3] was used in making the concrete mixes in the form of cubes and slab panels for study of compressive strength. The concrete cubes of 150mm side and slab panels of 500x300x50mm size were cast by replacing the natural sand at replacement levels of 25%, 50%, 75% and 100% using artificial sand. The workability of the concrete so prepared was studied by conducting slump test as per the standard procedure given in IS: 1199–1959[4]. The results of the slump test are presented in the Table 1.

Workability values of Concrete for diff.% replacement of natural sand.

I D Mark	% replacement of natural sand by artificial sand	Workability Tests (without admixture)	
		Slump (cm)	Compaction factor
A	0% (full natural)	12	0.84
B	25%	2	0.71
C	50%	1	0.75
D	75%	2	0.71
E	100%(full artificial)	3	0.67

TABLE: 1

Standard cube specimens were cast using the procedure described in IS: 516–1959 and were immediately covered with wet cloths and kept there for 24 hours and then released in water tank for 28 days curing

(c) Testing of Specimens:

After 28 days curing period, the concrete cube specimens cast by replacing natural sand with artificial sand at different replacement levels were tested under a compression testing machine (Figure 4) following the procedure given in IS:516–1959 [5].

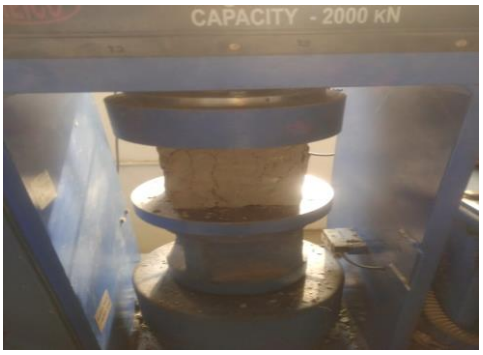

FIG:1 Compression Testing of Concrete Cubes

3. RESULT and CONCLUSION

COMPRESSIVE STRENGTH

SR. NO.	PERCENTAGE OF ARTIFICIAL SAND	PERCENTAGE OF NATURAL SAND	COMPRESSIVE STRENGH N/mm^2	
			7 Days	28 days
1.	00	100	23.86	31.91
2.	25	75	22.75	33.66
3.	50	50	20.66	32.45
4.	75	25	**22.75**	**35.68**
5.	100	0	18.00	33.84

TABLE: 2

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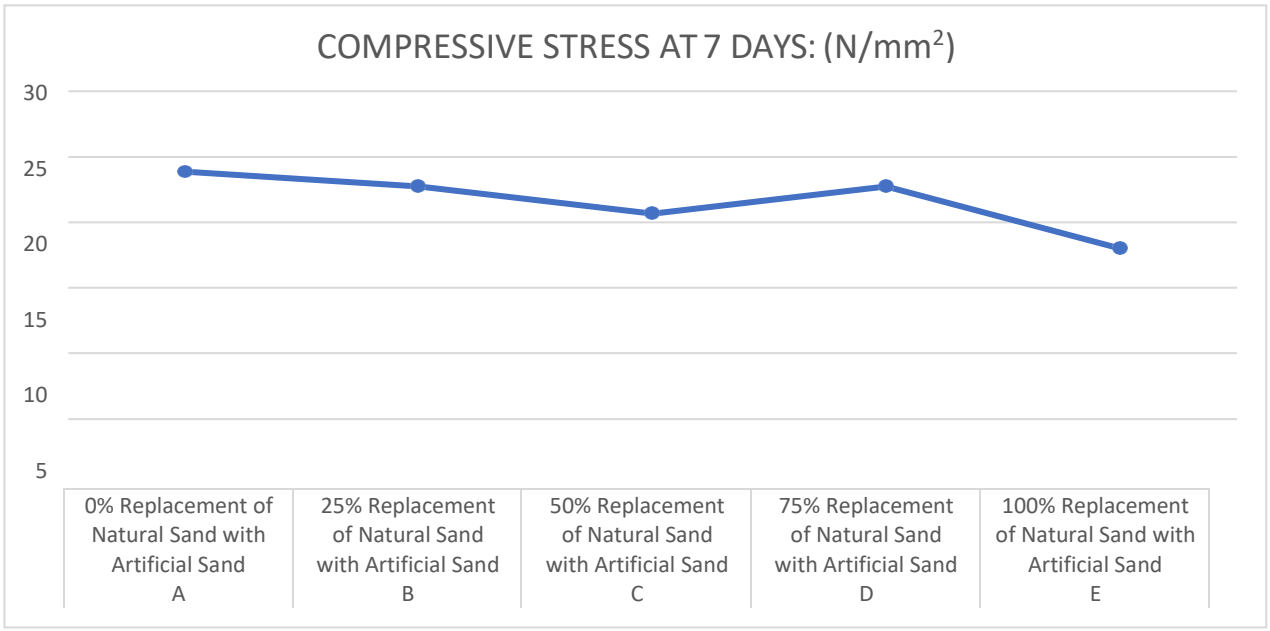

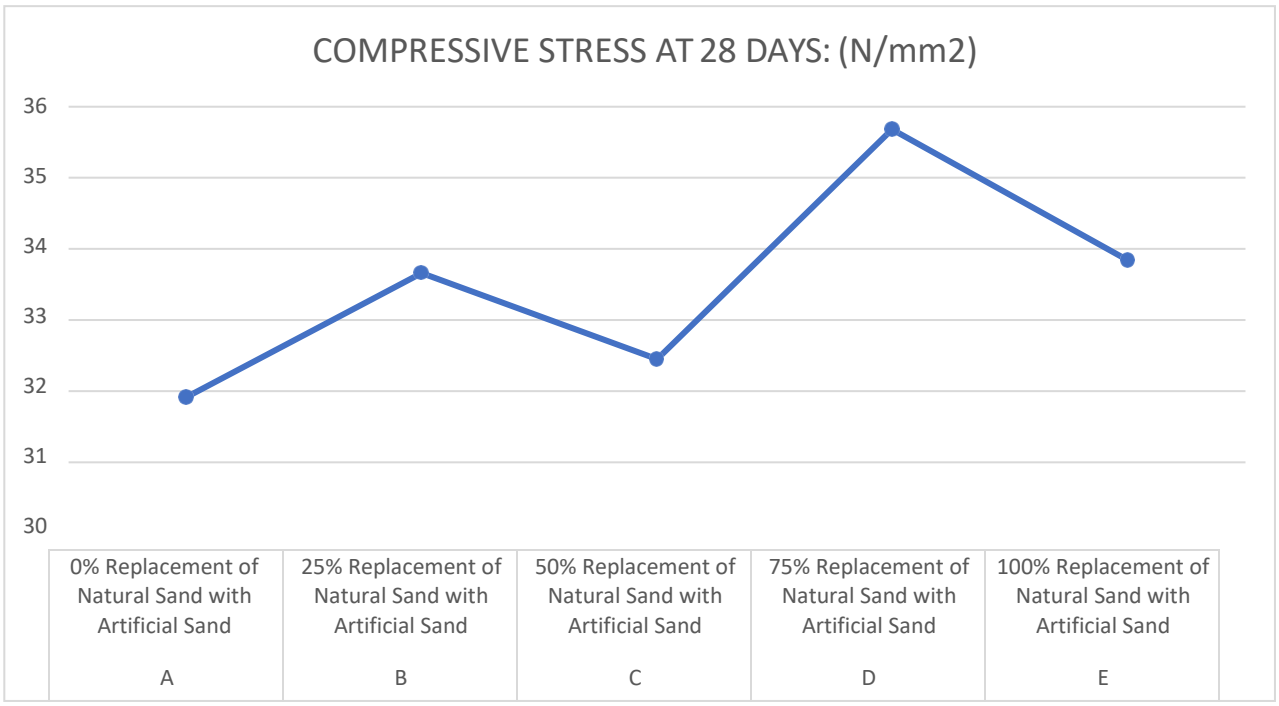

ID MARK	COMBINATION:	COMPACTION FACTOR READINGS:
A	0% Replacement Of Natural Sand With Artificial Sand	0.84
B	25% Replacement Of Natural Sand With Artificial Sand	0.71
C	50% Replacement Of Natural Sand With Artificial Sand	0.75
D	75% Replacement Of Natural Sand With Artificial Sand	0.71
E	100% Replacement Of Natural Sand With Artificial Sand	0.67

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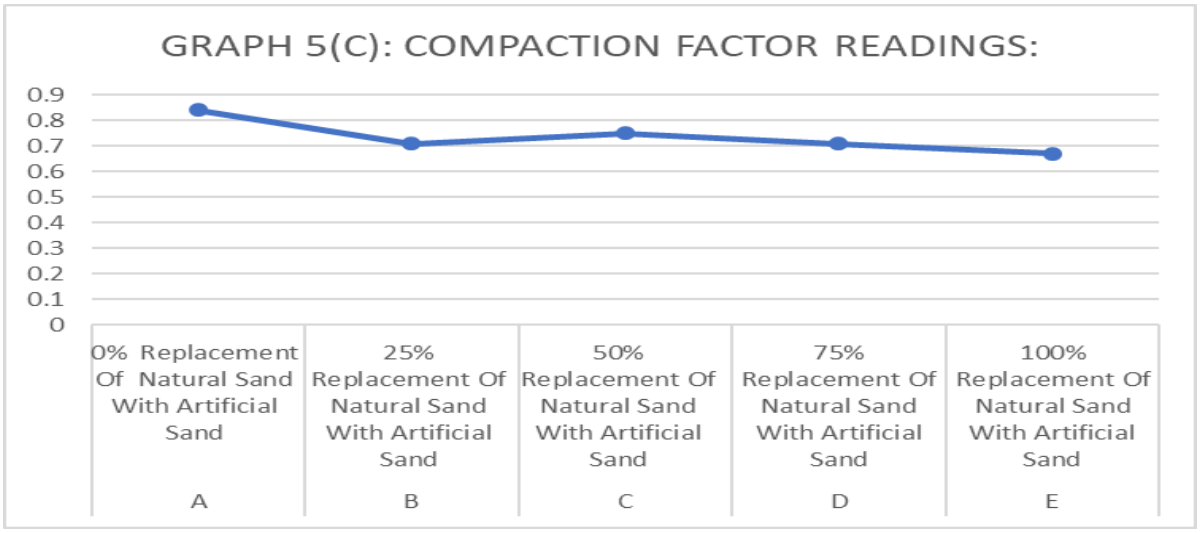

ID MARK	COMBINATION:	SLUMP READINGS:
A	0% Replacement of Natural Sand with Artificial Sand	12cm
B	25% Replacement of Natural Sand with Artificial Sand	2 cm
C	50% Replacement of Natural Sand with Artificial Sand	1 cm
D	75% Replacement of Natural Sand with Artificial Sand	2 cm
E	100% Replacement of Natural Sand with Artificial Sand	3 cm

Conclusion of Part A:

- From the above table 75% replacement of natural sand with artificial sand give the better compressive strength.
- As the strength is adequate but the workability is not good hence we have to go for part B

PART B:

EXPERIMENTATION:

From the above Result we conclude following percentage of Artificial sand are adequate:

1. 50% Artificial Sand
2. 75% Artificial Sand
3. 25% Artificial Sand

2. But the workability of selected percentage is not adequate so, we cast 27 cubes with different admixtures. 0.5%, 1% and 1.5% admixture. We have casted the cubes and the cubes are in curing phase for 28 days, after 28 days we will do the compaction test again for the final result.

ADMIXTURE:

Admixture is defined as a material other than aggregate, water and cement added to the concrete, to enhance the performance of concrete. We used FAIR FLOW HSP (High performance concrete super plasticiser) Admixture to enhance the workability of the concrete.

SLUMP VALUE WITH AND WITHOUT ADMIXTURE

SR. NO.	COMBINATION	SLUMP VALUE WITHOUT ADMIXTURE	SLUMP VALUE WITH ADMIXTURE
1	25 % Replacement of Natural Sand with Artificial Sand	2 CM	3 CM
2	50 % Replacement of Natural Sand with Artificial Sand	1 CM	19 CM
3	75 % Replacement of Natural Sand with Artificial Sand	2 CM	18 CM

COMPACTION FACTOR VALUE WITH AND WITHOUT ADMIXTURE

SR NO.	COMBINATION	COMPACTION FACTOR WITHOUT ADMIXTURE	COMPACTION FACTOR WITHOUT ADMIXTURE
1	25 % Replacement of Natural Sand with Artificial Sand	0.71	0.85
2	50 % Replacement of Natural Sand with Artificial Sand	0.75	1.00
3	75 % Replacement of Natural Sand with Artificial Sand	0.71	0.98

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COMPRESSIVE STRESS AND WEIGHT WITH ADMIXTURE AT 28 DAYS

SR NO.	COMBINATION	28 DAYS COMPRESSIVE STRESS WITH ADMIXTURE(N/mm2)	WEIGHT AT 28 DAY WITH ADMIXTURE (kg)
1	25 % Replacement of Natural Sand with Artificial Sand	35.68	40.62
2	50 % Replacement of Natural Sand with Artificial Sand	32.45	34.84
3	75 % Replacement of Natural Sand with Artificial Sand	33.06	42.93

COMPRESSIVE STRESS AT 28 DAYS WITH AND WITHOUT ADMIXTURE

SR NO.	COMBINATION	28 DAYS COMPRESSIVE STRESS WITHOUT ADMIXTURE (in N/mm2)	28 DAYS COMPRESSIVE STRESS WITH ADMIXTURE (in N/mm2)
1	25 % Replacement of Natural Sand with Artificial Sand	33.66	40.62
2	50 % Replacement of Natural Sand with Artificial Sand	32.45	34.84
3	75 % Replacement of Natural Sand with Artificial Sand	35.68	42.93

COMPARISON OF 100% NATURAL SAND WITH 75% REPLACMENT OF NATURAL SAND WITH ARTFICIAL SAND WITH ADMIXTURE AT 28 DAYS

SR NO.	COMBINATION	28 DAYS COMPRESSIVE STRENTH	WORKABILITY (by compaction factor)
1	100% Natural sand	31.91	0.84
2	75% replacement of natural sand with artificial sand with admixture 1%	42.93	0.98

CONCLUSIONS: -

1. The value of slump is increased after addition of 1% of admixture for all proportions of sand replacement and maximum slump value is obtained at 50% replacement of natural sand with artificial sand and same pattern is observed with compaction factor.
2. The compressive strength of blocks after adding 1% of admixture is more than the compressive strength without addition
3. The optimum value of compressive strength is obtained at 75% replacement of natural sand with artificial sand and 1% addition of admixture.
4. The percentage increase in the compressive strength of 75% replacement of natural sand along admixture with 100% natural sand with is 31%.
5. There is significant increase in the compressive strength with admixture at 28 day with respect to compressive strength without admixture.
6. The percentage increase in the workability of 75% replacement of natural sand along admixture with natural sand is 15.29%.

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