

M Sand as Fine Aggregate Replacement in Concrete: Effect on Compressive Strength

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Abstract: In present days natural sand of good quality are becoming scarcer and costlier due to non-accessibility of river during entire year, illegal dredging, rapid growth of construction activities etc. So it is needed to search an alternative material to use as natural sand in construction activities. M Sand is such an alternative material which can be effectively being used in construction as partial replacement of natural sand. Hence present study taken a view to verify the suitability and potential use of M Sand in concrete mix as fine aggregate. To accomplish this an experimental programme was planned for cast specimen cubes at an interval of 16 percent replacement of fine aggregate with M Sand in concrete. Results shows natural sand can be effectively replace with M Sand and maximum strength obtain at 64 percent replacement of natural sand with M Sand based on compressive strength.

Keywords--- Coarse Aggregate, Compressive Strength, Fine Aggregate, M Sand Replacement

I. INTRODUCTION

Concrete is commonly used construction material due to its ease of availability, mouldability, rigidity and durability. It generally consists of binding material, fine aggregate, coarse aggregate and required quantity of water, where sand is normally used as fine aggregate. Due to rapid growth of construction activity, the available sources of natural sand are getting exhausted. Hence conservation of natural resources is big problem for civil engineers since construction activities cannot be diminished as it is intimate able. The only way is to search an alternatives material which can fully or partially replaced naturally available material in construction. M Sand is such an alternative material which can be effectively being used in construction as partial replacement of natural sand. This is a waste product obtained from aggregate crushing plant. M Sand is suitable in terms of strength and economy over normal sand for medium grade concrete (Mahzuz et al 2011)[1]. 40 percent fine aggregate can be effectively replaced with M Sand (Franklin et al 2014)[2]. The compressive strength of concrete mix had increased by 22% with the use of crusher dust at 40% replacement of natural sand (2013)[3]. The present study aimed to utilizing M Sand as fine aggregate in concrete in place of natural fine aggregate. For that an experimental program was find out to study the suitability and potential use of M Sand as partial replacement of fine aggregate in concrete. To accomplish this concrete cubes were cast for different replacement level at an interval of 16 percent to determine

compressive strength of concrete at different level of fine aggregate with M Sand. The study shows that compressive strength of concrete made using M Sand as fine aggregate replacement having greater value in comparison of conventional concrete.

II. MATERIALS AND METHODS

A. Cement

Portland Pozzolana Cement (fly ash based) brand name Birla Gold confirming to IS 1489 (Part 1) – 1991[4] single batched used in this investigation. The properties are shown in table 1.

Table 1: Properties of Cement

Standard Consistency	31%
Initial Setting Time	240 minutes
Final Setting Time	315 minutes
7 days Compressive Strength	33 N/mm ²
28 days Compressive Strength	44 N/mm ²
Specific Gravity	2.72

B. Fine Aggregate

River sand available in Allahabad confirming to IS 383-1997[5], zone II used in this study. It was completely passed by 4.75 mm sieve. Fineness modulus and specific gravity of this material was 2.76 and 2.3 respectively.

C. Coarse Aggregate

Locally available coarse aggregate having two fraction 20mm and 10mm sizes individually sieved was used in the present study. One fraction was passed through 20 mm sieve and another through 10 mm sieve. The specific gravity of coarse aggregate was 2.66 for both fractions. Fineness modulus was 6.9 for 10 mm aggregate and 7.7 for 20 mm aggregate. For concrete mix a proportion of 40:60 of coarse aggregate was used where 40% 10 mm aggregate and 60% 20 mm aggregate.

D. M Sand

Grey colour M Sand was collected from local stone crushing units of Bharatpur, Rewa road, Uttar Pradesh. It was initially dry in condition and thoroughly retained on IS 150 μ sieve before preparation of mix. The M Sand also confirmed zone II of IS 383-1997[5]. Fineness modulus of M Sand was 2.85 and specific gravity was 2.4.

E. Super Plasticizer

KEM SUPLAST 101 S super plasticizer manufactured by Chembond Chemicals was to be used in the study. It was synthetic super plasticizer based on sulphonated naphthalene and instantly dispersible in water having specific gravity 1.2.

M25 grade of concrete is used as bench mark which was designed as per IS 10262 –2009[6] guidelines. The proportion of materials was 1:1.54:3 with water cement ratio 0.42 and dose of super plasticizer was 0.65% by weight of cement. The coarse aggregate used in a combination of 40:60 individually sieved with IS sieve size 10 mm and 20mm respectively. The particle size distribution of fine aggregate and M Sand was nearly same and confirm same zone according to IS 383-1997[5]. Total 84 specimen of size 150 X 150 X 150 mm were casted for this investigation. Initially 18 specimens cube of size 150 mm were casted for mix design calculation contained 380 cement per cubic meter of concrete with varying water cement ratios. Then 36 specimen of same size casted for replacement of fine aggregate with M Sand at different percentage. For a percent replacement 6 cubes were casted, 3 for 7 days and 3 for 28 days. The cube was filled in two parts with manually mix mixture and vibrated on a table vibrator. Workability of fresh concrete was measured by slump cone. Uniformity and accuracy was maintained during mix preparation and test. After 24 hours of casting specimens were demoulded and put in water bath for curing. The compressive strength of concrete for 7th days and 28th days were tested on analogue compression testing machine confirm to IS 14858 – 2000[7] of capacity 2000kN. Figure 1 shows a tested specimen in compression testing machine.



Figure 1: Compression Testing Machine

III. RESULT AND DISCUSSION

The average compressive strength of concrete for 7th days and 28th days were tested as per IS 516 – 2004[8] guidelines and results are tabulated in table 2. It was observed that the compressive strength of specimen at all replacement level of natural fine aggregate with M Sand was more than designed value of conventional concrete which shows suitability of M Sand in concrete as partial or full replacement of natural fine aggregate from compressive strength point of view. The 7 days compressive strength increase up to 32% replacement of natural sand with M Sand. 28 days compressive strength gradually increased up to 64% replacement of natural sand with M Sand .

Table 2: Compressive Strength of Cubes with Different Percentage of M Sand

Concrete Cube Group	% of M Sand in Concrete	Compressive Strength (N/mm)	
		7 days	28 days
B0	0	27.12	38.58
B1	16	26.88	38.92
B2	32	30.75	41.62
B3	48	27.35	39.37
B4	64	27.18	43.92
B5	80	27.46	41.60
B6	100	23.68	42.20

IV. CONCLUSION

On the basis of above investigation it can be concluded that –

- M Sand is to be used as fine aggregate replacement in concrete as partially or fully.
- Use of M Sand as fine aggregate in concrete is beneficial in different manners such as environmental aspects, non-availability of good quality of fine aggregate, and strength criteria also.
- Compressive strength of cubes with M Sand as

fine aggregate replacement obtain maximum value on 60 percent replacement level of natural sand with MSand.

- It to be used at that place where setting time is not much important because excess dose of super plasticizer increase the setting time.

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Shilpa Thakur "M Sand as Fine Aggregate Replacement in Concrete: Effect on Compressive Strength "International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.5, 2018, pp. 78-80