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Strength Studies in Concrete with M-Sand and Silica Fume

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Abstract: The huge quantity of concrete is consumed by construction industry all over the world. In India, the conventional concrete is produced using natural sand from river beds as fine aggregate. Decreasing natural resources poses the environmental problem and hence government restriction on sand quarrying resulted in scarcity and significant increase in its cost. This paper presents the optimization of partial replacement of natural sand by M sand with silica fume. Concrete mixes were evaluated for compressive strength and split tensile strength. The ordinary Portland cement was partially replaced with silica fume by 0, 5, 7.5 and 12.5% and natural sand was replaced with manufactured sand by five proportions with 0, 10, 20, 30 and 40%. The results indicated that there is an increase in the compressive and split tensile strength of concrete at 30% of M-Sand and 7.5% of silica fume.

Keywords: M-Sand, silica fume, compressive strength and split tensile strength.

I. INTRODUCTION

Natural sand is mainly excavated from river beds and always contain high percentage of in organic materials, chlorides, sulphates, silt and clay that adversely affect the strength, durability of concrete and reinforcing steel there by reducing the life of structure, when concrete is used for buildings in aggressive environments, marine structures, nuclear structures, tunnels, precast units, etc. The cheapest and the easiest way of getting substance for natural sand is by crushing natural stone to get artificial sand of desired size and grade is known as Manufactured sand. Concrete with crushed stone dust as replacement of natural sand in concrete can attain the same compressive strength and lower degree of shrinkage as the control concrete.

II. OBJECTIVES

- M-Sand has balanced physical and chemical properties that can withstand any aggressive environmental and climatic conditions as it has enhanced durability, greater strength and overall economy.
- To replace the Natural sand by M sand and Cement with silica fume.
- To determine the compressive strength and Split tensile strength and compare it with Conventional concrete.

III.LITERATURE SURVEY

P Daisy Angelin et al (2015):

Durability studies on concrete with manufacturing sand as a partial replacement of fine aggregate. In HCL Solution had anticipated that manufactured sand was individual among such materials to supplant river sand which can be utilized as an option fine aggregate in mortars and concrete. An endeavour had been completed in the current analysis to talk about the properties of concrete for example, workability and compressive strength of concrete, which was set up by supplanting natural sand with artificial sand at various substitution levels (0, 20, 40, 60, 80 and 100%). The outcomes had anticipated that supplanting of natural sand with manufactured sand in order of 60% deliver cement of acceptable workability and compressive strength. Durability of the concrete was additionally tried through immersing the cubes in 5% hydrochloric acid solution.

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Hayla Miceli et al (2017):

Manufactured fine aggregates had turned into a reasonable contrasting option to natural sands in building and structure everywhere throughout the earth, specifically somewhere a supportable resource of the afterward was not accessible. Though composition normally makes no significant problems in their use as coarse aggregates, the utilization of these stones in construction of MS be able to symbolize a test, for the most part related to the nearness of calculable measures of contaminating minerals, specifically micas, which can negatively affect together rheology and strength of concrete and mortars. The effort exhibits the change in the attributes of three manufactured fine aggregates throughout dry rare-earth attractive division. It exhibits that the mica/biotite substance.

IV. MATERIALS

4.1 Cement: 53 grade cement is used. The properties are presented in the table 1.

Table 1. Properties of cement

S.	Property	Cement (53 grade)
1	Specific gravity	3.12
2	Fineness	9.19
3	Consistency	34%
4	Initial setting time	55 min
5	Final setting time	488min

4.2 M-Sand:

The physical properties of M-Sand are investigated.

4.3 Silica fume: The physical properties of silica fume are presented in table 2.

Table 2: Physical properties of Silica fume

S. No.	Properties	Silica fume
1	Colour	Dark Grey
2	Specific gravity	2.20
3	Fineness	20000m^2/kg

V. CONCRETE MIX DESIGN

The mix proportion is 1:1.52:2.39.

VI. EXPERIMENTAL INVESTIGATIONS

6.1 Compressive strength results

The compressive strength conducted in the cast and cured specimen and results presented in table 3 to 5.

Table 3. Compressive strength of concrete for M-Sand

Mix. No	M-Sand	Compressive strength, N/mm^2	
		7days	28days
1	0%	34.51	49.95
2	10%	37.89	54.45
3	20%	38.36	55.92
4	30%	40.58	56.92
5	40%	36.78	53.78

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Table 4. Compressive strength of concrete for silica fume

Mix. No	Silica fume	Compressive strength, N/mm^2	
		7days	28days
1	0%	34.51	49.95
2	5%	37.04	53.23
3	7.5%	40.23	58.06
4	12.5%	36.96	53.50

Table 5. Combined compressive strength of concrete with M-Sand and silica fume

Mix. No	M-Sand + silica flume	Compressive strength, N/mm^2	
		7days	28days
1	0%	34.51	49.95
2	30%MS+7.5%SF	43.65	61.48

6.2 Split tensile strength results:

The split tensile strength conducted in the cast and cured specimen and results presented in table 6 to 9.

Table 6. Split tensile strength of concrete for M-Sand

Mix. No	M-Sand	Split tensile strength, N/mm^2	
		7days	28days
1	0%	3.34	4.85
2	10%	3.36	5.27
3	20%	3.75	5.34
4	30%	3.93	5.56
5	40%	3.31	4.84

Table 7. Split tensile strength of concrete for silica fume

Mix. No	Silica fume	Split tensile strength, N/mm^2	
		7days	28days
1	0%	3.34	4.85
2	5%	3.57	5.20
3	7.5%	3.88	5.92
4	12.5%	3.60	4.81

Table 8. Combined Split tensile strength of concrete with M-Sand and silica fume

Mix. No	M-Sand + silica flume	Split tensile strength, N/mm^2	
		7days	28days
1	0%	3.34	4.85
2	30%MS+7.5%SF	4.45	6.27

VII. CONCLUSIONS

1. At 30% replacement of natural sand by M-Sand, the compressive strength of concrete is 40.58 and 56.92 N/mm^{2}at 7 and 28 days.
2. At 7.5% replacement of cement with silica fume, the compressive strength of concrete is 40.23 and 58.06 N/mm^2 at 7 and 28 days.
3. At 30% M-Sand + 7.5% SF the compressive strength of concrete is 43.65 and 61.48 N/mm^2 at 7 and 28 days.
4. At 30% M-Sand + 7.5% SF the split tensile strength of concrete is 3.93 and 5.56 N/mm^2 at 7 and 28 days.
5. At 7.5% SF the split tensile strength of concrete is 3.88 and 5.92 N/mm^2 at 7 and 28 days.
6. At 30% M-Sand + 7.5% SF the split tensile strength of concrete is 4.45 and 6.27 N/mm^2 at 7 and 28 days.

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