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Effect of Fine Aggregate Particles on Compressive Strength of Cement Mortar

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ABSTRACT:

The Cement Sand mortar 1:6 is commonly used in the masonry work. The sand is an important ingredient of mortar. Various studies on mortar properties have been done with correlating its Fineness Modulus to various parameters. It is a fact that the same fineness modulus may have different particle size distribution patterns. Sand is composed of different sized particles e.g. ranging from 4.75mm to 150 micron in varying proportions, These gradation of particles affect the performance of mortar by improving the workability ,compressive strength etc. and vice versa. The presence of fine particles in sand is of a paramount importance. An attempt has been made to study the effect of fine particles i.e. passing 600 micron sieve in different percentages as specified by IS code; on cement sand mortar 1:6 .The main objective is to identify a particle size distribution which requires less water for better workability of mortar without sacrificing the strength of mortar.

KEY WORDS: *Compressive strength, workability, cement mortar, water cement ratio, sand, flow test.*

I. INTRODUCTION

Mortar for masonry work is a combination of Cement and river sand and water. The mortar provides a level bed for masonry as well as it joins the assembly and distributes the stresses in structure. Therefore the study of its different variables e.g. water cement ratio, workability, particle size gradation is important. It is an open secret that the quality of sand is hardly addressed in our country. Every batch of sand received is different from its previous supply. The important property of mortar is its workability; which is judged at work place by mason, who adds water to mortar just to make it workable so that it is easily spread over the bed and joints get properly filled. Therefore the study of the sand considering its different sized fractions in varying proportions is must. IS 2250-1981 (reaffirmed 2000) has categorized different grade of masonry mortars in terms of their compressive strength at 28 days. In present study Grade of masonry mortar is MM 3 with cement sand mortar 1:6. As per IS code this mortar should have compressive strength 3 to 5 N/mm2 at 28 days. The mortar should give a flow value of 110 to 115 to maintain its fluidity during application provided no segregation and bleeding occurs. The sand samples were prepared considering the lower, upper and two intermediate limits prescribed for Zone II sand i.e. 35, 43, 51 and 59 % passing 600 micron sieves.

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Table 1: Grading of Sand Zone by IS 383-1970

Sieve Size	Percentage of passing for Grading Zone			
	Zone I	Zone II	Zone III	Zone IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 micron	***15-34***	***35-59***	***60-79***	***80-100***
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

II LITERATURE REVIEW

B.V. Venkataram Reddy, (2012) reported that C.M.1:4 achieved 100 % flow on water cement ratio of 1.2 while C.M. 1:6 attained 100% flow value on 1.75 water cement ratio. Compressive strength for these mortar cubes was assessed as per the guide lines of IS 2250 and was found 15.50 MPa for C.M.1:4 and 8.19 MPa for C.M.1:6 at the flow value of 100 %.

Vladimir G. Haach, (2011) suggests that the mortar mix prepared with fine sand required more amount of water than the mortar mix made with coarse sand. This also resulted in low flow value for fine sand mortar and vice versa.

Reddy and Gupta (2005) observed that fine sands require 25-30 % more water to achieve a certain consistency than coarse sands.

III METHODOLOGY

The sand collected from nearby Sindh river was sieved through designated IS sieves i.e.4.75, 2.36, 1.18 mm & 600, 300 and 150 micron sieves. Different sized particles were collected and blended in required proportions in order to prepare the samples of sand with fine particles 35, 43,51 & 59 % passing 600 micron sieve. Cement and sand mortar was mixed in 1:6 ratio. The water cement ratio was varied from 1.0 to 2.00 in order to achieve a flow value of 110-115 percent. Each sand sample was tested for its workability on Flow Table as per IS 2250-1981 for each water cement ratio. The mortar cubes were casted and cured in water tanks. After 28 days of curing period cubes were tested. The details are given in table 2.

Table 2:Gradation of prepared sand samples

S.No.	IS Sieve	Percentage Passing for			
		S1	**S2**	**S3**	**S4**
1	4.75mm	90	93	96	100

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2	2.36mm	75	83	92	100
3	1.18mm	55	67	78	90
4	600 micron	35	43	51	59
5	300 micron	8	15	23	30
6	150 micron	0	0	0	0
% passing 600 micron sieve		35%	43%	51%	59%

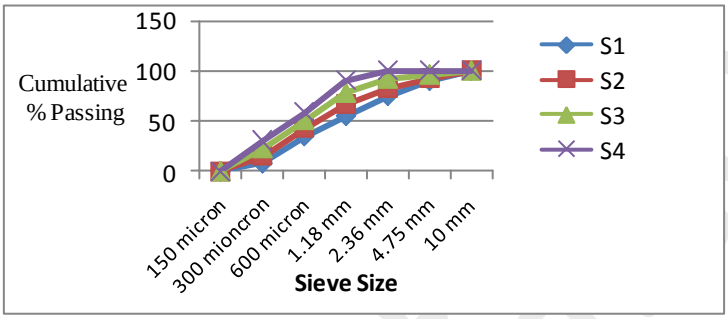

Fig.1

IV RESULTS AND DISCUSSION

The flow values for different mortar cubes with different sand samples for each water cement ratio have been tabulated –

Table 3

S.No.	W/C Ratio	Flow value percentage			
		S1	S2	S3	S4
1.	1.0	52.50	45.75	43.75	38.00
2.	1.1	57.50	49.25	46.00	43.00
3	1.2	67.75	55.00	51.00	44.75
4.	1.3	70.75	61.00	55.75	47.25
5.	1.4	77.50	68.75	62.75	53.50
6.	1.5	85.50	74.50	68.00	56.25
7.	1.6	92.25	78.50	78.75	67.50
8.	1.7	***111.50***	86.50	88.25	75.75
9.	1.8	122.00	***110.50***	***112.25***	86.25
10.	1.9	-	-	-	***110.00***

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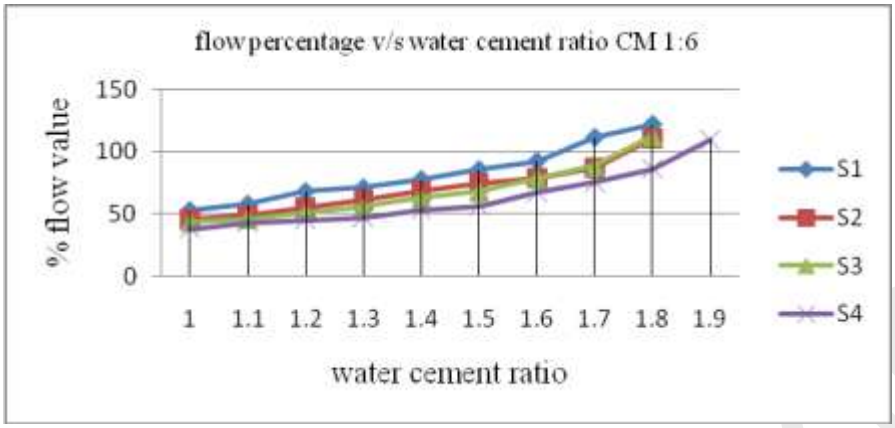

Fig. 2

The Compressive Strengths for mortar cubes have been appended below

Table 4

S.No.	W/C Ratio	Compressive strength N/mm2			
		S1	S2	S3	S4
1.	1.0	11.70	9.38	8.24	7.91
2.	1.1	8.69	7.88	7.82	7.60
3	1.2	7.20	6.56	6.24	6.06
4.	1.3	6.62	5.93	5.22	5.15
5.	1.4	6.48	5.24	4.80	4.60
6.	1.5	6.22	4.93	4.38	3.86
7.	1.6	5.87	4.27	4.02	3.60
8.	1.7	5.64	3.82	3.69	3.44
9.	1.8	5.42	3.44	3.33	3.20
10.	1.9	5.31	3.07	3.03	2.90

The characteristic of mortar is well suited when the flow value is within the range of 110 - 115 percent. Therefore the values of Compressive strength have been evaluated at 110-115% flow value. For S1 (35 % passing 600 micron) showed required flow value at W/C ratio of 1.7 while the S2,S3,S4 attained flow value at 1.8,1.8 and 1.9 W/C ratios respectively. The compressive strength of S1 at desired flow value was 5.64 N/mm2 which is the highest among the other 3 sand samples. Sand sample S4 attained the compressive strength at W/C ratio 1.9; 2.90 N/mm2 which was the lowest among the samples

V CONCLUSION

The results show that the sand sample containing 35% finer particles i.e. passing 600 micron sieve attained the desired flow value of 110-115% at the lowest W/C ratio 1.70 and gained the compressive strength of 5.64 N/mm2 which can be compared with the permissible compressive strength prescribed in IS 2250-1981 i.e.3 to 5 N/mm2 which is even more than its higher limit of 5 N/mm2. As the percentage of fine particles passing 600 micron sieve increased in the sand samples S2, S3, S4; the water needed for same consistency increased. The increase in water /cement ratio resulted a decrease in the compressive strength of mortar for prescribed flow value of 100- 110 %. Although the compressive strength values were found near to the lower limits of 3.0 N/mm2. It can be concluded that the fine particles are more thirsty hence require more water resulting in lower compressive strength. As it supports this concept that due to the presence of fine particles, the surface area increases resulting in the increased amount of water.

VI RECOMMENDATIONS

The sand is an important ingredient of mortar and its properties need to be carefully addressed. The sand before dispatching to the site should be examined for its particle size distribution and it should be blended accordingly so that its maximum strength contribution can be utilized.

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