
Utility of Crushed Stone Sand for Making Masonry Mortar

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Abstract

This paper deals with assessing suitability of crushed stone sand in replacement of natural sand for making of masonry mortar. For an internal study at Maharashtra Engineering Research Institute Nashik, five types of masonry mortar specimens (1:2, 1:3, 1:4, 1:5 & 1:6) were cast in the laboratory using natural sand & OPC 43 conforming to IS 8112 – 1989. Likewise, exactly five similar types of masonry mortar specimens were cast using crushed stone sand & OPC 43. Applying the same concept, similar five types of masonry mortar specimens with same mix proportions as used above were cast using natural sand & PPC conforming to IS 1489 (Part 1) - 1991. Likewise, exactly five similar types of masonry mortar specimens were cast using crushed stone sand & PPC. Compressive strengths at various ages were observed for each masonry mortar specimen.

Comparative study reveals that crushed stone sand can be used in replacement of natural sand for making of masonry mortar if it satisfies the specifications laid down in IS 2116 – 1980 [7] and also it is available at lower price as compared to natural sand.

Keywords

Crushed Stone Sand, Masonry Mortar, PPC, Natural Sand, OPC

Necessity of the Research

It is observed that availability of natural sand is being reduced day by day due to construction of various dams having un-gated or inadequately gated spillways. Also the demand is continuously increasing due to rapid infrastructure development. So, acute shortage of natural sand is to be overcome by provision of alternative fine aggregate i.e. crushed stone sand. [8]

Methodology for Experimental Study

For effective comparison, it would have been logical to provide same quantities of water and cement for each category of mortar mix made with natural sand & crushed stone sand. But in case of mortar, flow plays major role in deciding its suitability for intended use. Hence, flow was kept same (110 – 115 %) for each category of mix made with natural sand and crushed stone sand as per guidelines given in appendix A - 4 on p. no. 22 of IS 2250-1981. [1] Flow table used was as per IS 5512-1983. [4] Thus, taking all other ingredients in same quantity (except water), one mix was cast using natural sand (with OPC & PPC each) and other mix was cast using crushed stone sand (with OPC & PPC each) as per guidelines given in IS 2250-1981. [5][6] Total 10 mixes were cast using natural sand & 10 using crushed stone sand. The proportions of cement & sand adopted were 1:2, 1:3, 1:4, 1:5 & 1:6 by mass. Mix proportions and properties of all mixes referred above are mentioned in table no. 1. Also, graphs (no. 1 to 5) are plotted for comparing the compressive strengths at various ages. [2][3]

Tables and Graphs

Sr No	Notation of mortar mix.	Proportions of various ingredients of mortar in kg.					Flow (%)	Compressive Strength of mortar in N/mm ²				
		Cement		Water	Fine Aggregate			3 days	7 days	14 days	28 days	90 days
		OPC 43	PPC	Litre	Natural sand	Crushed stone sand.						
1	NO - 1:2	1	-	0.345	2	-	115	23.43	28.47	36.17	40.25	56.32
2	CO - 1:2	1	-	0.425	-	2	115	27.94	34.69	41.83	47.61	66.93
3	NP - 1:2	-	1	0.340	2	-	115	15.71	17.13	28.26	35.29	43.87
4	CP - 1:2	-	1	0.420	-	2	115	13.91	17.94	30.07	36.63	49.53
5	NO - 1:3	1	-	0.455	3	-	110	18.95	21.60	32.54	35.91	44.40
6	CO - 1:3	1	-	0.550	-	3	110	19.73	22.62	33.12	39.54	46.60
7	NP - 1:3	-	1	0.450	3	-	115	12.72	13.90	19.76	33.90	38.36
8	CP - 1:3	-	1	0.550	-	3	115	11.50	12.12	18.34	31.70	36.11
9	NO - 1:4	1	-	0.585	4	-	115	9.14	11.33	17.33	23.57	29.81
10	CO - 1:4	1	-	0.680	-	4	115	8.13	12.32	17.13	23.39	28.91
11	NP - 1:4	-	1	0.585	4	-	115	5.39	8.13	12.52	20.37	25.71
12	CP - 1:4	-	1	0.675	-	4	115	6.73	9.01	14.30	21.93	27.20
13	NO - 1:5	1	-	0.705	5	-	115	5.72	9.34	12.91	19.36	26.19
14	CO - 1:5	1	-	0.800	-	5	115	4.98	8.94	12.12	18.32	25.24
15	NP - 1:5	-	1	0.695	5	-	115	3.97	7.33	11.61	16.32	23.04
16	CP - 1:5	-	1	0.785	-	5	115	4.33	7.93	11.92	16.91	23.62
17	NO - 1:6	1	-	0.810	6	-	115	4.92	7.93	9.94	15.92	20.17
18	Co - 1:6	1	-	0.910	-	6	115	4.69	7.13	9.74	15.71	19.93
19	NP - 1:6	-	1	0.800	6	-	115	1.81	4.15	7.13	10.93	17.13
20	CP - 1:6	-	1	0.900	-	6	115	2.71	4.72	8.94	11.92	18.95

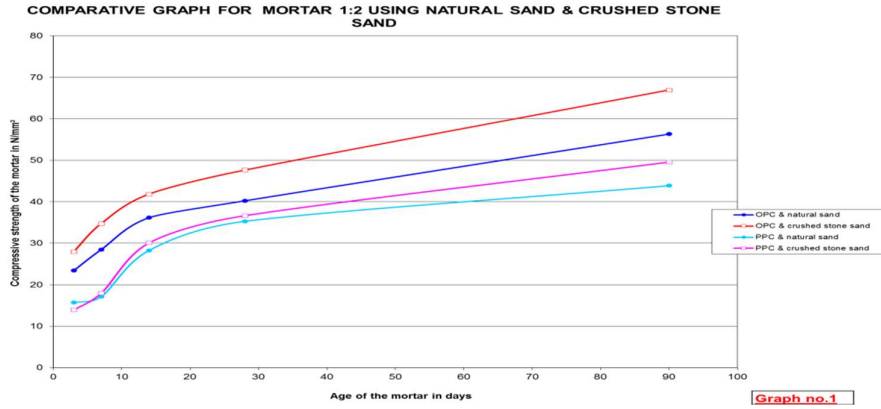
NO - Mortar made with natural sand & OPC

CO - Mortar made with crushed stone sand & OPC

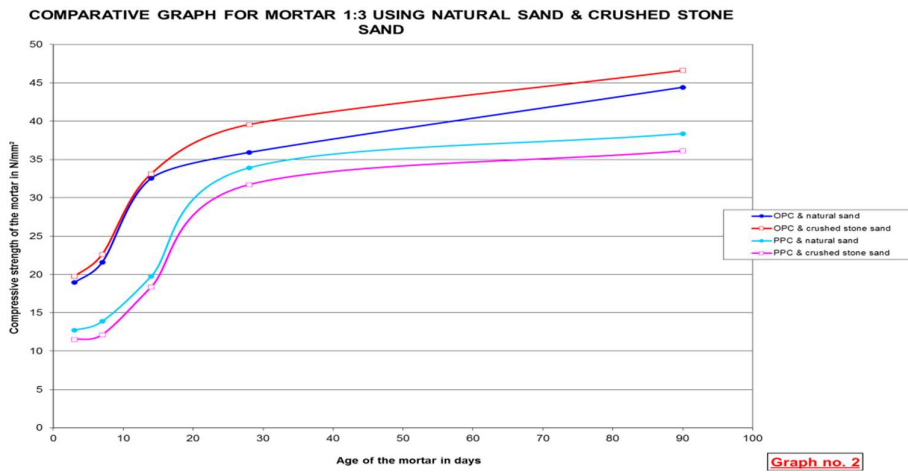
NP - Mortar made with natural sand & PPC

CP - Mortar made with crushed stone sand & PPC

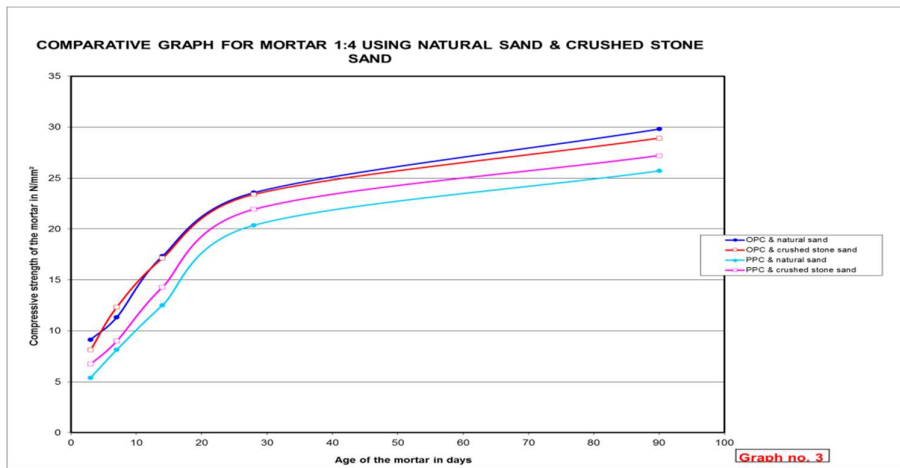
Table 1: Mix Proportions and Compressive Strength of Mortars



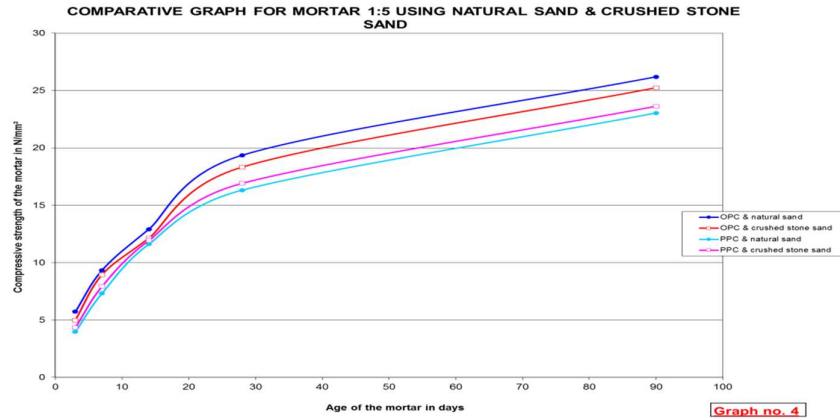
Graph1: Mortar 1:2



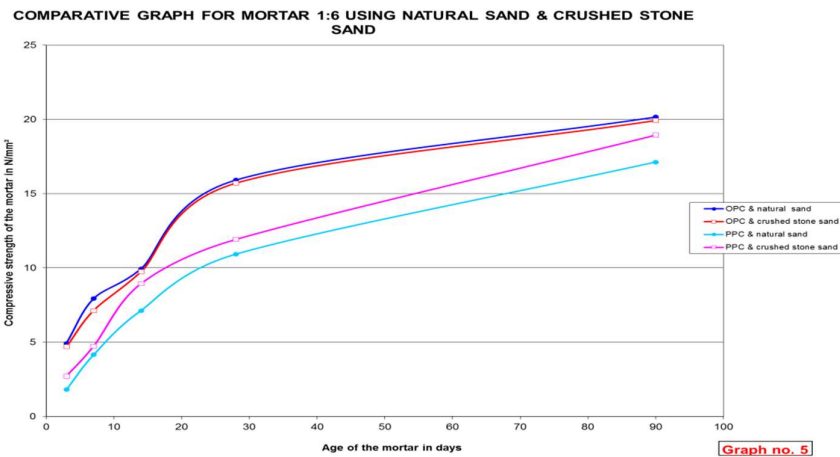
Graph 2: Mortar 1:3



Graph 3: Mortar 1:4



Graph 4: Mortar 1:5



Graph 5: Mortar 1:6

Result and Discussion

- 1) For rich mortar mixes (1:2 & 1:3), water requirement is 23.2 and 20.9 % more if crushed stone sand is used in lieu of natural sand. Yet the compressive strength is more as compared to the mix using natural sand.
- 2) For lean mortar mixes (1:4, 1:5 & 1:6), water requirement is about 16.2, 13.5 and 12.3 % more if crushed stone sand is used in lieu of natural sand. Yet the compressive strength is almost same or slightly less as compared to the mix using natural sand.

Conclusion

Various compressive strength tests carried out in MERI laboratory indicates that Crushed stone sand may be used in lieu of natural sand for making of masonry mortar if it satisfies all the specifications given in IS 2116-1980 and also it is available at lower price as compared to natural sand.

References

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