EXPERIMENTAL INVESTIGATION ON UTILIZATION OF STONE DUST AT KODAD REGION AS A FINE AGGREGATE IN MORTAR

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Abstract

Test examination was completed to think about the plausibility of stone residue (an item got from pounding of rock) as fine total instead of waterway sand in making concrete mortar 1:3, 1:4, 1:5, and 1:6, which are the blends typically embraced in different development exercises. The outcomes acquired are tantamount to the customary mortar. It is reasoned that the compressive quality at 28 days of stone residue utilized as fine total in mortar gives 5.5% higher quality for the proportion of 1:4, 1:5, and 1:6, whereas 5.5% not exactly the regular mortar for the proportion 1:3. Along these lines the stone residue in crude shape can be unhesitatingly utilized as a decent development material in making mortar and that a most extreme of 12% of fine materials i.e. not exactly 150 microns in the Stone residue may not influence the quality of the mortar.
Keywords: Mortar, Stone Dust, Workability, Compressive Strength of Mortar.

Introduction

Fast industrialization because of the execution of progressive conjugative year designs has added to the gathering of modern squanders and results which present transfer and natural issues and cause wellbeing risks. Then again, the social duty of giving "protect for all" is turning into an inaccessible notwithstanding for those with a guaranteed better than the average wage, leaving along different fragments of individuals at the lower monetary level. To beat the above issues thinks about have been started in the utilization of non-traditional materials for halfway substitution of the bond by fly slag in solid; Conversion of agrarian squanders like saw-dust, stopper granules, rice-husk, coconut essence into some helpful building materials, and so forth. Modern side-effects which were once arranged off as a waste material are finding consistently expanding use in the development business. At present, CA is for the most part acquired from hard broken rock stones and the result of squashing the stones is "Smasher residue" or "Stone residue". It is the item gotten by pounding stone, rock, or air-cooled press impact heater slag, uncommonly handled to guarantee reasonable molecule shape and degree. Even though the determinations for sand (fine totals) to be utilized in mortar and cement do allow the utilization of smashed stone residue, there seems, by all accounts, to be general dithering among the field Engineers, for its utilization, even in those territories where the pounded stone residue is accessible free of expense in plenitude. The general propensity is to utilize waterway sand just, regardless of whether it must be transported from long separations. Anyway, the impact of the materials (under 150 microns) on the quality of cement and mortar should be determined. On the off chance that there is a probability of utilizing stone residue in the abovementioned, there will be further sparing in the exertion engaged with handling and there will be a total answer for the transfer issues.

Review of Literature

Sand mining is prohibited by different states in India, and with the expanding interest for waterway sand for development works, Civil Engineers, have communicated the need to advance the utilization of made sand in the development business. According to a report, produced sand is broadly utilized all around the globe on account of its predictable degree and zero polluting influence

Misra R.N, et al. [3] considered the water necessities and compressive quality of concrete mortar utilizing made sand as FA, with FM running from 0.50 to 2.0 and 75% and 100% stream of mortar. Because of the above broad test examinations, he had inferred that the quality of mortar with produced sand is higher than that of the relating blend with bond (sand) mortar. He has prescribed the utilization of produced sand for mortar and has advised the evacuation of unnecessary extents of fine particles.

The examination is done by Nagabhushana and Sharada Bai, et al. [6] contemplated the properties of mortar and cement in which Crushed Rock Powder (CRP) was utilized as a half and full substitution for normal sand. For mortar, CRP is supplanted at rates of 20,40,60,80, and 100. The quality properties of cement were researched by supplanting regular sand with CRP at substitution levels of 20, 30, and 40 percent.

One of the most punctual examinations on the appropriateness of making sand for making quality cement was done by Ghosh et al. [2] at Central Road Research Institute [CRRI], New Delhi. They did different tests on the physical properties of made sand acquired from a couple of sources in the U.P. to decide their appropriateness as a FA. Mortar making property, pressure quality, flexural, scraped area misfortune, drying shrinkage, and bond quality of cement was resolved for every one of the examples and inferred that made sand can be unhesitatingly utilized as FA to deliver quality cement. Be that as it may, split elasticity tests and solidness contemplates were not led to decide the general execution of produced sand concrete

Nataraja et al. [7] Explored the likelihood of using Granulated Blast Furnace Slag (GBFS) as a sand substitute in bond mortar, with the end goal to lessen condition issues identified with total mining and waste transfer. In this examination, bond mortar blend 1:3 and GBFS at 0, 25, 50, 75, and 100 percent substitution to normal sand for a steady w/c proportion of 0.5 was considered. The work reached out to 100 percent supplanting of common sand with GBFS for w/c proportions of 0.4 and 0.6. The stream qualities of the different blends and their compressive qualities at different ages were considered. From this examination, it was seen that GBFS could be used somewhat as elective development material for regular sand in mortar applications. A decrease in functionality communicated as stream could be repaid by including an appropriate level of superplasticizer.

Experimental Investigations

The crusher plants located in and around kodad are the sources of crushed stone dust. The stone dust of granite origin collected from akupamula, santhi nagar and nelakondapalli crusher plant, Telangana was taken for this investigation. At present, stone dust is used as a filler material in making a bituminous top for roads and the rate of production of dust is about approximately 22.5 % of the total quantity. Only small amounts of these wastes have been used in road making and in the manufacture of building materials such as lightweight aggregate bricks. Laboratory investigations are carried out on the stone dust obtained from the crusher plant and the results are compared with the existing IS Standards to decide on their suitability as fine aggregate. It was proposed to use stone dust in the making of mortar as a substitute for river sand. First gradation of the stone dust and river were determined by conducting size analysis as per IS. 383-1970. the result of sieve analysis and various physical properties are given in table 1 and 2 for stone dust and river sand

Table 1: Sieve Analysis of Stone Dust and River Sand

S.No	Sieve Size (mm)	Stone Dust				River Sand			
		Weight Retained	Cumulative Weight Retained (gm)	Cumulative % Weight Retained	Cumulative % Weight Passing	Weight Retained	Cumulative Weight Retained	Cumulative % Weight Retained	Cumulative % Weight Passing
1	10	0	0	0	100	0	0	0	100
2	4.75	12	12	1.2	98.8	22	22	2.2	97.8

3	2.36	78	90	9	91	91	113	11.3	88.7
4	1.18	194	284	28.4	71.6	134	247	24.7	75.3
5	0.600	159	443	44.3	55.7	198	445	44.5	55.5
6	0.300	278	721	72.1	27.9	298	743	74.3	25.7
7	0.150	133	854	85.4	14.6	182	925	92.5	7.5
8	Less than 0.150	146	1000	100	0	75	1000	100	0

- ❖ Fineness Modulus of Stone Dust = (sum of Cumulative % Weight Retained/100)=3.404
- ❖ Fineness Modulus of Stone River Sand =(sum of Cumulative % Weight Retained/100)=3.495

Note: - Hence it is ok as per Fineness Modulus value. Generally the Fineness Modulus of Fine Aggregate Varies 2 to 3.5

1. Fineness Modulus Of Fine Sand= 2.2-2.6
2. Fineness Modulus Of Medium Sand =2.6-2.9
3. Fineness Modulus Of Coarse Aggregate= 2.9-3.2

Table-2: Physical Test of Stone Dust and River Sand

S.No	Water absorption on SSD basis (%)	Bulk sp. Gravity on SSD basis (gm/cc)	Unit Wt. (Kg/m)	Maximum Bulk age	Remarks
1	5.56	2.625	1.499	20%	Reference stone dust from crushing quarries
2	3.75	2.599	1.812	24%	

KCP Cement Company ordinary Portland Cement (OPC) 43 grade only used for throughout the investigation. The physical properties of the above cement determined by standard tests are given in Table 3. Tests on fresh mortar (sand and Stone dust as fine aggregate) and on hardened mortars was carried out. The test for determination the mortar making property was performed at 100% flow and 75%. To determine this flow percent, flow table test for mortars of different mix proportions (1:3, 1:4, 1:5 and 1:6 – the mixes chosen for the present study based on the practical ranges normally adopted) were made and percent of water required for 100% and 75% flow are determined. With the above percent of water for 100% flow, mortar cubes of size 70.6 x 70.6 x 70.6 mm, the above mix proportions were prepared using sand and Stone dust as fine aggregate. The cubes are immersion curved for 3 days, 7 days, 14 days and 28 days and end of the above curing period, the specimens are tested and their compressive strength are determined.

Table-3: Physical Properties of Cement

S.NO.	DESCRIPTION	VALUE
1	Initial setting time	112 min
2	Final setting time	168 min
3	Normal consistency	28.5%
4	Fineness (specific surface)	286 m^2/kg
5	Fineness (by dry sieving)	9.1%

6	Specific gravity	3.15
7	Expansion (Le-Chatlier)	2.44 mm
8	Compressive strength ❖ 3 days ❖ 7days ❖ 28 days	 20.90 N/mm^2 25.91 N/mm^2 37.08 N/mm^2

Results and Discussion

Water requirements for various mix proportions (1:3 to 1:6 which will cover the normal practical range used in the field) at 100% and 75% flow values for conventional mortar and Stone dust mortars are given in table 4. The result very clearly indicated that more quantity of water is required for Stone dust mortar when compared to conventional mortar, irrespective of the mix proportion.

Table-4: Water Requirement at Various Flow Values for Different Mortar Proportion

S.No	Mix Proportion	Water Requirement For Various Flow Values (%)			
		Conventional Mortar		Manufactured Sand Mortar	
	By volume	100% flow	75% flow	100% flow	75% flow
1	1:3	16.55	14.55	18.55	16.55
2	1:4	16.55	14.45	18.55	17.10
3	1:5	16.99	15.10	18.99	17.60
4	1:6	17.55	16.20	19.10	17.55

Note: The weight proportion in the table corresponds to that of conventional mortar and Stone dust mortar. Compressive strength of mortars with different mix proportions for 100% flow using Stone dust and conventional fine aggregate are given in Table 5. From the result, it is found that the compressive strength of mortars with Stone dust is higher than the reference mortar using river sand for the mix proportions 1:3, 1:4, 1:5, and 1:6 and at 1:4 mix proportion 28 days compressive strength is approximately equal. Hence the utilization of stone dust as fine aggregate in mortar preparation is ok.

Table-5: Compressive Strength of Various Mortars at 100% Flow

S.No	Mix Proportion	Compressive Strength of Various Mortars at 100% Flow (N/mm^2)							
		3days		7days		14 days		28 days	
		A	B	A	B	A	B	A	B
1	1:3	6.45	6.88	7.66	7.86	11.10	11.43	13.45	13.79
2	1:4	4.88	5.66	6.08	7.28	9.91	10.33	11.09	11.11
3	1:5	4.12	4.84	5.44	5.65	7.71	7.92	9.51	10.06
4	1:6	2.05	2.55	2.86	3.24	4.51	4.83	5.21	5.45

Note: - 1. A-Mortar with Conventional Fine Aggregate
2. B-Mortar with Stone Dust.

Conclusions

- ❖ The following conclusions are arrived at based on the experimental investigations carried out in this study:
- ❖ Stone dust obtained from various sources at akupamula, santhi nagar and nelakondapalli industrial areas in and around kodad satisfy the requirement as specified in IS standards.

- ❖ More quantity of water is required for Stone Dust mortar when compared to conventional mortar, irrespective of the mix proportion.
- ❖ Stone dust mortars have approximately equal strength to reference mortar for different mix proportions, namely for 1:4, 1:5, and 1:6 at 100% flow. Hence, it is concluded that Stone dust mortars are recommended for low-cost construction works.
- ❖ It is also cost-effective than conventional mortar types.

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