Experimental Investigation on Concrete using Crusher Dust and Floor Slab Chips Are Alternative Materials

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Abstract— The present report investigate the use of crusher dust and floor slab chips in concrete as an alternative fine aggregate and coarse aggregate respectively, the investigations include tests on standard concrete cubes (150 mm x 150 mm x 150 mm), cylinders (150 mm x 300 mm), beams (10 0mm x 100 mm x 500 mm) and short columns (150 mm x 150 mm x700 mm). Tests on the physical properties of crusher dust, floor slab chips and its influence on the strength of fresh concrete and hardened concrete, additionally a comparative study has been done. The properties investigated were fineness modulus, specific gravity, and surface moisture on materials, bulk density, and water absorption. Tests were conducted on 6 cubes, 6 cylinders, 6 beams and 8 short columns for M20 grade design mix with sand and crusher dust as fine aggregates, granite metal and floor slab chips as coarse aggregates. The strength parameters cube compressive strength, Split tensile strength; flexural strength on prisms and compressive strength for short column were compared at 7 days and also at 28 days. Concrete mix design procedure in according to the IS 10262-2009, IS 456-2000 and using 20mm metal was adopted for investigation. The investigation indicates that crushed stone dust is available abundantly as fine aggregate in concrete. The crusher dust not only reduces the cost of concrete and also reduces the effect on environment by taking them in to concrete as an alternative material.

Key words: Concrete, Crusher Dust, Floor Slab Chips

I. INTRODUCTION

Generally while making concrete and motor, river sand is utilized as a fine aggregate, this is accessible from long distances. Besides, this causes diminishing assets and heightening expenses of development materials in making concrete. Subsequently it is important to discover elective material for river sand to satisfy the absence of fine aggregate in making cement concrete.

The alternative material of crusher stone dust was observed to be best appropriate material to create concrete mixes. While crushing of granite or basalt stones, to create coarse aggregate, the crushed stone waste will be accessible plentifully as a by-product. From this present, it's a creative method for subsiding waste materials as opposed to dumping into disposed of zones.

The fundamental point of this anticipates is to investigate the properties and the right decision to utilize stone dust in the formation of concrete. What's more, to this present it's additionally found, that the characteristic strength of a concrete at 28 days, the spilt tensile strength and flexural strength also compressive strength for columns will be more with crusher stone dust instead of with river sand, When it is utilized as a fine aggregate as a part of making concrete. In the event of reinforced concrete scientists has been watched that the crusher stone dust will have great prospects and sparing instead of using river sand in preparing concrete.

II. LITERATURE REVIEW

Introduction: In preparation of concrete, crusher stone dust will be valuable in smaller amounts as fine aggregate. A few attempts were made by many scientists to supplant river sand with crusher dust in mortars and concrete. Mishra is one of the scientists who played out the examinations and clarified the varieties in quality accomplished by utilizing crusher stone dust as a part of making of mortar and concrete as a fine total furthermore impacts relying on their sizes and state of crusher stone dust. The amount of water is fundamental with a specific end goal to accomplish same consistency of all through the mortar will be founded on

1) If fineness modulus decreases then fineness of aggregate will increases.
2) It was based on mix proportions and it was observed more in leaner mixes.

Another specialist called Babu et al., had observed that utilizing of crusher stone dust without appropriate size of fine division of crusher stone dust it won't enhanced the permeability property. Subsequently the crusher stone dust materials must be enhancing with a specific end goal to get best results like Cherthala sand (pit sand). Sahu et al., has found in their explores and reached the accompanying inferences in view of their examinations. They are:

1) When the concrete and mortar has been made with the stone dust in a trial replacement of river sand, there will be some improvement in strength characteristics such as compressive strength, modulus of rupture, split tensile strength and tensile strength were observed.
2) By the increase in partial replacement of sand with crusher stone dust there may be decrease in workability.

Nagaraj concluded that the crusher stone dust was more suitable to replace the sand in making of mortar and concrete compared to rock dust and pebble.

Shukla and Sachan had observed that, 40 percent replacement of river sand with crusher stone dust will not show any significant change in strength of concrete compared in both cases such as partial or full replacement. Finally Kulkarni ET observed in their experimental investigations, and has concluded that, the crusher stone dust is the best suitable alternative material for the replacement of river sand with the stone dust for achieving good results in case of both plastic and cohesive mixes of concrete.

III. PHYSICAL PROPERTIES OF CONCRETE

The materials which were used in this research work are ordinary Portland cement 53 grade, River, crusher dust and coarse aggregate of 20 mm nominal size and floor slab chips of 20 mm of nominal size.

CEMENT: For casting the specimens such as cube, cylinder, beams and RCC columns, the ordinary Portland cement of 53 grades was used and Table 1 presents the physical properties of cement is shown below.

Test	53 Grade
Fineness	10.62
Specific gravity	3.15
Normal consistency	31 percent
Setting time	
(a) Initial setting time	33 minutes
(b) Final setting time	131 minutes
Soundness test	2.12 mm
Compressive strength at 28 Days	53.75Mpa

Table 1: Physical properties of cement

A. *Fine Aggregte*

River sand and crushed dust was provided from river Penna and crushed dust from Nandyal. Table 2 shows the physical properties of fine aggregates.

B. *Coarse Aggregate*

The Coarse aggregate of 20 mm size was used in making concrete. The results of physical properties of coarse aggregate were presented in Table NO3.

C. *Preparation of Specimens and Mixes*

The four concrete mixes were designated as A (1:1.587:2.773, w/c = 0.5), B (1:1.752:2.716, w/c = 0.5), C (1:1.587:3.284, w/c = 0.5) and D (1:1.752:3.284, w/c = 0.5) are used in the investigations which are presented in this report. Mix proportions for A, B, C and D has been designed based on the mix design code of IS 10262 – 2009 and SP 23 –1982 for M 20 grade concrete respectively for plain concrete and reinforced concrete. The exact proportions of cement, sand, crusher dust coarse aggregate and floor slab chips are weighed accordingly as given in Table 4.

Property	River sand			Crusher dust		
	Sample 1	Sample 2	Average	Sample 1	Sample 2	Average
Bulk density (kg/m^3)	1597.34	1608.78	1603.06	1714	1735	1724.5
Specific gravity	2.612	2.713	2.66	2.71	2.75	2.46
Fineness modulus	2.56	2.87	2.71	2.65	2.74	2.69
Free surface moisture	0.32 %	0.335 %	0.33 %	0.81 %	0.721 %	0.767 %
Water absorption	1.75 %	2.16 %	1.959 %	1.56 %	2.02 %	1.79 %

Table 2: Physical properties of fine aggregates

Property	Granite metal	Floor slab chips
Max nominal size	20 mm	20 mm
Bulk density (kg/m^3)		
Loose state	1562	1560
Compacted state	1691.97	1750.165
Specific gravity		
Fineness modulus	2.729	2.903
Free surface moisture	8.66	7.81
Water absorption	0.281 %	0.202%
	0.827 %	1.065%

Table 3: Physical properties of granite metal and floor slab chips

Material	Mix designation			
	Mix A	Mix B	Mix C	Mix D
Cement (Kg/m3)	394	399.91	394	399.91
River sand (Kg/m3)	625.58	-	620.88	-
Crusher dust	-	700.768	-	700.76
Coarse aggregate (Kg/m^3)	1093.73	1086.386	-	-
Floor slab chips (kg/m^3)	-	-	1293.8	1293.8
Water cement ratio	0.5	0.5	0.5	0.5

Table 4: Mix proportions for plain and reinforced concrete

IV. TESTING ON CONCRETE

Concrete cubes, cylinders, beams and reinforced concrete columns of standard sizes have been casted and tested for compressive strength, tensile strength and flexural tensile strength and compressive strength of columns and compared properties. The specimens were tested at 7days and at 28days of curing and the mean strength values have been presented.

A. *Cube Tests*

In every Mix of concrete, six 150 mm x 150 mm x 150 mm cubes have been casted and tested to know the compressive strength, three cubes at the age of 7 days and the remaining three cubes at the age of 28days. The final results of the tests on cubes for compressive strength have been presented in Table 5

Nominal size of C.A	Mix type	Fine aggregate	Coarse aggregate	W/c Ratio	Compressive Strength, N/mm^2	
					7 days	28 days
20 mm	A	River Sand	Granite metal	0.5	21.183	26.22
	B	Crusher Dust	Granite metal	0.5	21.773	26.279
	C	River sand	Floor slab chips (reduced to	0.5	24.44	25.70
	D	Crusher dust		0.5	19.1	24.9

			20mm size) Floor slab chips (reduced to 20mm size)		2	43

Table 5: compressive strength of Cube of M 20 Gradeof design mix (Average of 3 cubes)

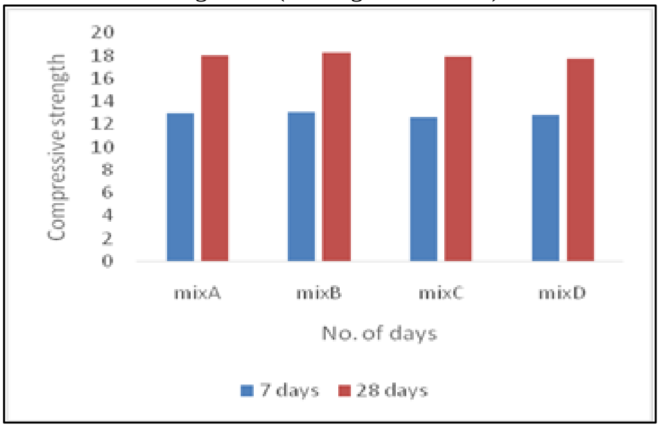

Fig. 1:

B. Split Tensile Tests

Six 150 mm x 300 mm cylinder have been casted and tested to know the split tensile strength in each Mix; three cylinders are tested at the age of 7days and the remaining three cylinders were tested at 28days. Test results for split tensile strength have been presented in Table 6.

Nominal size of C.A.	Mix type	Fine aggregate	Coarse aggregate	W/c Ratio	Tensile Strength, N/mm²	
					7 days	28 days
20 mm	A	River Sand	Granite metal	0.5	1.96	2.52
	B	Crusher Dust	Granite metal	0.5	2.11	2.75
	C	River sand	Floor slab chips	0.5	1.72	2.49
	D	Crusher dust	Floor slab chips	0.5	1.72	2.12

Table 6: Split Tensile strength of M20 Grade of design mix (Average of 3 Cylinders)

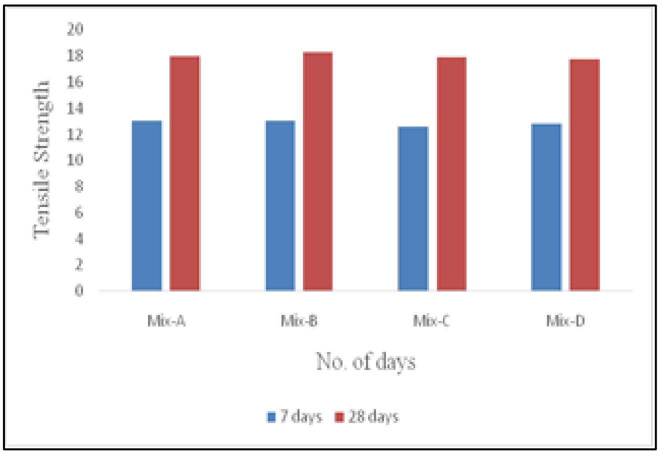

Fig. 2:

C. Flexural Tensile Strength Test

Six 100 mm x 100 mm x 500 mm size prisms are casted and tested in flexural for the two – loading to know the modulus of rupture, three beams at the age of 7 days and the remaining three beams at the age of 28 days. The test result for flexural tensile strength has been presented in Table7.

D. Casting of Columns

Eight numbers of Reinforced concrete columns were casted and tested. The length of the column is 700 mm and of 150 mm x 150 mm size. and the details of the specimens are tested and are given in Table 8. Columns were made with M_{20} grade concrete and Fe-415 grade steel was used for longitudinal reinforcement and stirrups. Out of the eight specimens, there were two controlled specimens cast with 0% of replacement and the other six are casted with full replacement of crusher dust and floor slab chips.

Nominal size of C.A.	Mix type	Fine aggregate	Coarse aggregate	W/c Ratio	Flexure Tensile Strength, N/mm²	
					7 days	28 days
20 mm	A	River Sand	Granite metal	0.5	3.89	5.67
	B	Crusher Dust	Granite metal	0.5	3.92	5.616
	C	River sand	Floorslab chips	0.5	3.636	5.51
	D	Crusher dust	Floorslab chips	0.5	3.783	5.36

Table 7: Flexural Tensile strength of M20 grade mix (Average of 3 prisms)

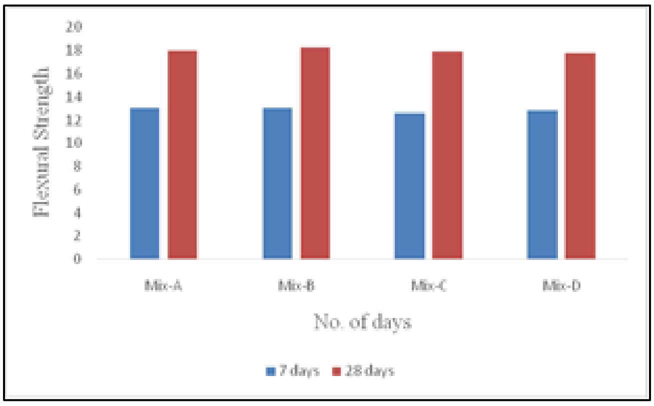

Fig. 3:

Nominal size of C.A.	Mix type	Fine aggregate	Coarse aggregate	W/c Ratio	Flexure Tensile Strength, N/mm² 7 days	Flexure Tensile Strength, N/mm² 28 days
20 mm	A	River Sand	Granite metal	0.5	13.01	18.01
	B	CrusherDust	Granite metal	0.5	13.06	18.30
	C	River sand	Floor slab chips	0.5	12.63	17.89
	D	Crusher dust	Granite chips	0.5	12.81	17.75

Table 8: Compressive strength of column of M 20 Grade design mix (Average of 3 columns)

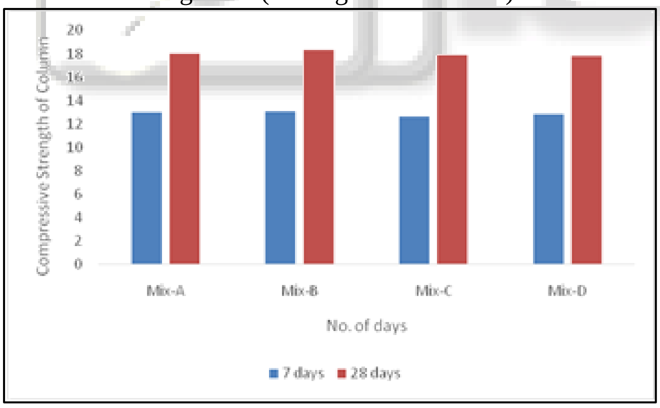

Fig. 4:

V. Results and Discussion

The result values of cube compressive strength has been presented in table 5, spilt tensile strength result values are presented in table 6 and the result values of modulus of rupture has been presented in table 7 and the result values of compressive strength of column has been presented in table 8.

A. *Discussions*

The physical properties of materials, the strength characteristics and workability of concrete in compression test, tensile test, and flexural strength and compressive strength of column for Fe 415 steel and for M 20 Grade concrete with sand and crusher dust as a fine aggregate and metal on 20mm metal and floor slab chips were sustained and discussed.

VI. Conclusions

The crushed dust gives the strength to the concrete mix for plain cement concrete and reinforcing concrete. There has been strong bonding between the crushed dust and ultra-fine particles due to roughness of crushed dust particles. The conventional concrete would be more permeable and durable than the concrete with crushed dust.

When each mix is compared with conventional concrete, the concrete prepared of with crushed dust having the increase in the compressive strength nearly of about 0.225 % for concrete. The tensile strength of concrete increases of about 9.114%, in flexural strength nearly of about 0.35 % when concrete made with crushed stone dust as fine aggregate, the compressive strength of column of about 1.610%.

To achieve strength and economy the crushed dust would be useful in plain concrete and reinforcing concrete beams and also decreases its impact on environment.

VII. Future Enhancement

1) By replacing natural sand with different percentages of crusher dust, so that clear variation of strength will be plotted as well as optimum amount can be found
2) Conducting experimental investigation for M_{30}, M_{40}, M_{50} and also for high strength concrete.
3) Conducting the experiments on chloride penetration test and water absorption tests on concrete to ensure adequate durability.
4) Suitability of crusher dust should be ascertained for plastering.

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