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Experiment Study on Replacement of Fine Aggregate with Stone Dust

Priyanka Rani[1], Ravinder Kumar[2]

[1]Post Graduate Student, Department of Civil Engineering, RPIIT, Karnal, Haryana, India
[2]Assistant Professor, Department of Civil Engineering, RPIIT, Karnal, Haryana, India

ABSTRACT

The purpose of this study was to investigate the possibility of using crushed stone dust as fine aggregate partially with different grade of concrete composites. The suitability of crushed stone dust waste as fine aggregate for concrete has been assessed by comparing its basic properties with that of conventional concrete. The equivalent mixes were obtained by replacing natural sand by stone dust partially and fully. The test result indicate that crushed stone dust waste can be effectively used to replace natural sand in concrete. In the experimental study, strength characteristics of concrete using crushed stone dust as fine aggregate it is found that there is increase in compressive strength, flexural strength and tensile strength of concrete.

Keywords: Concrete, Fine Aggregates (F), Stone Dust(S).

INTRODUCTION

Concrete is a composite material widely used as construction material. Concrete is formed by the combination of cement, aggregate and water, in particular proportion in such a way that the concrete meets the need as regards its workability, strength, durability and economy. Stone dust is one such material which can be used to replace sand as fine aggregate stone are the natural hard substance formed from minerals and earth material which are present in rock. Concrete made with this replacement attains the same compressive strength tensile strength. Experiment have been made to check some property of stone dust and their suitability of those properties to enable stone dust to be used as partial replacement material for sand in concrete. The use of crushed stone dust in concrete is desirable because of its benefits such as useful disposal of by product.

In Iraq the most common aggregate natural was sand and gravel. Properties of aggregate affect the durability and performance of concrete, so fine aggregate is essential component of concrete and cement mortar. Now a day’s sand is becoming a very costly material, in this situation research begin for cheap and easily available alternative material than river sand. Crushed stone dust as a fine aggregate, is an attractive alternative of river sand for cement mortar. It is purpose made fine aggregate produced by crushing and screening or further processing washing, grading, classifying of quarried rock, cobble, boulder or gravel from which natural fine aggregate has been removed.

LITERATURE REVIEW

Mohammad Iqbal Malik (2015) In this study fine aggregate were replaced by quarry dust as 0%, 10%, 20% 30% 40% by weight for M25 mix. The concrete specimen were tested for compressive strength durability and density at 28 days of age and the result obtained were compare to those of normal concrete the result showed that by increasing the quarry dust content workability increase and compressive strength increased.

Eknath P. salokhe (2014) Investigation were performed to evaluate the comparative study of properties of fresh hardened concrete containing ferrous 7 nonferrous foundry waste sand as fine aggregate replacement fine aggregate were replaced with four percentages of foundry sand. The percentages of replacement were 0, 10, 20, 8, 30% by weight of fine aggregate & tests were performed for all replacement level of foundry sand for M20 grade concrete at different curing periods.

Sayed farhana (2013) investigated the feasibility of using the stone waste chips in concrete production as partial replacement of natural aggregate in Indian context and to reduce disposal and pollution problems. As aggregate are being an important part of concrete by volume and cost. Stone chips have such potential as they possess good physical and chemical properties.

Mohaminul Haque (2012) study is to be establish that the powder sand can be used as an alternative of sand in making medium grade concrete and mortar where high strength is required. This study has been conducted in different proportion of sand and powder sand in different mixing ratio for both mortar and concrete. The laboratory tests are made to find strength for various ratio and then are compared with each other. The result shows that stone powder almost equivalent strength concrete and mortar works.

MATERIALS

Ordinary Portland cement conforming to IS: 8112-1989 of grade 43, was used for preparation of concrete mix. Locally available coarse aggregates and fine aggregates and water was used. The specific gravity of fine aggregates & coarse aggregates was found to be 2.65 & 2.70 respectively.

Stone dust available from crusher plant at Ambala is used so that sieve configuration gets matched with that of river sand used for preparation of concrete mix. Stone dust passing through 4.75mm sieve and retained 75 micron sieve has been used. The fineness modulus of stone dust was found to be 2.32

METHOD OF CAST AND TESTING OF SPECIMEN

The sizes of cubes were 150mm x 150mm x 150mm, the sizes of beam were 500mx 100mm x 100mm and the size of cylinder was 150mm diameter and 300mm in height.

In the present study, 48 cubes, 48 beams and 24 cylinders were cast. 24 cubes, 24 beams, and 12 cylinders were of M25 grade of concrete and 24 cubes, 24 beams, and 12 cylinders were of M30 grade of concrete. out of 24.6 cubes and beams were cast for each 0, 20, 50, and 100 percentage of stone dust replacing river and for each grade of concrete and out of 12, 3 cylinder were cast for each 0, 20, 50 and 100 percentage of stone dust replacing river sand for each grade of concrete.

Table 1: Mix Combination of Casting of Test Specimens

S No	Mix Combination	Fine Aggregates (%)	Stone Dust (%)
1	F100 S0	100	0
2	F75 S25	75	25
3	F50 S50	50	50
4	F0 S100	0	100

Mix M25 is represented by A and Mix M30 by B. suffix 1 to 3 and 4 to 6 were used for beams that were tested in flexure for 7 days and 28 days respectively. Suffix 7 to 9 and 10 to 12 were used for beams that were tested in flexure for 7 days and 28 days respectively and suffix 13 to 15 were used for cylinder that were tested for split tensile strength at 28 days. 0, 25, 50, and 100 percentage of stone dust that replaced the river sand.

Compressive Strength Test

To calculate the compressive strength of concrete cubes the compression testing machine (CTM) having capacity of 200 tonne was used. The specimens are tested by compression testing machine after 7 days curing and 28 days of curing. Loading should be done gradually at the rate of 140 kg/cm^2 per minute till the specimen breakdown or fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

Fig 1 – Compressive Testing Machine

Table 2: 7 Days Compressive Strength of Concrete

S No.	Sample No.	Load (in tonnes)	Area (Sq. mm)	Compressive Strength (MPa)
1	A1, A2, A3 - S0	56.20	22500	24.50
2	A1, A2, A3 - S25	61.00	22500	25.60
3	A1, A2, A3 - S50	63.20	22500	26.10
4	A1, A2, A3 - S100	55.10	22500	23.30
5	B1, B2, B3 – S0	56.50	22500	24.20
6	B1, B2, B3 – S25	61.10	22500	25.10
7	B1, B2, B3 – S50	63.50	22500	26.20
8	B1, B2, B3 – S100	55.00	22500	23.10

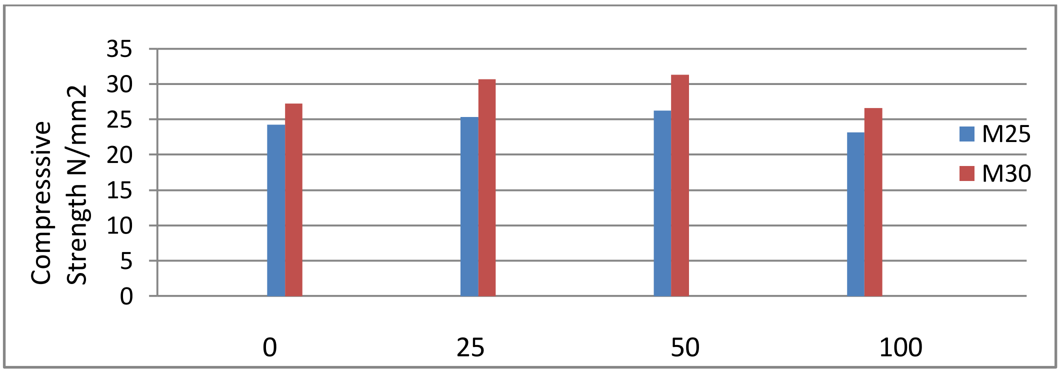

Fig 2 - 7 Days Compressive Strength of Concrete

Table 3: 28 Days Compressive Strength of Concrete

S No.	Sample No.	Load (in tonnes)	Area (Sq. mm)	Compressive Strength (MPa)
1	A4, A5, A6 - S0	97, 83, 87	22500	38.80
2	A4, A5, A6 - S25	107, 89, 94	22500	41.14
3	A4, A5, A6 - S50	93, 98, 94	22500	40.42
4	A4, A5, A6 - S100	101, 78, 91	22500	38.24
5	B4, B5, B6 - S0	100, 100, 101	22500	44.60
6	B4, B5, B6 - S25	101, 109, 108	22500	47.11
7	B4, B5, B6 - S50	111, 109, 110	22500	48.88
8	B4, B5, B6 - S100	112, 99, 101	22500	46.22

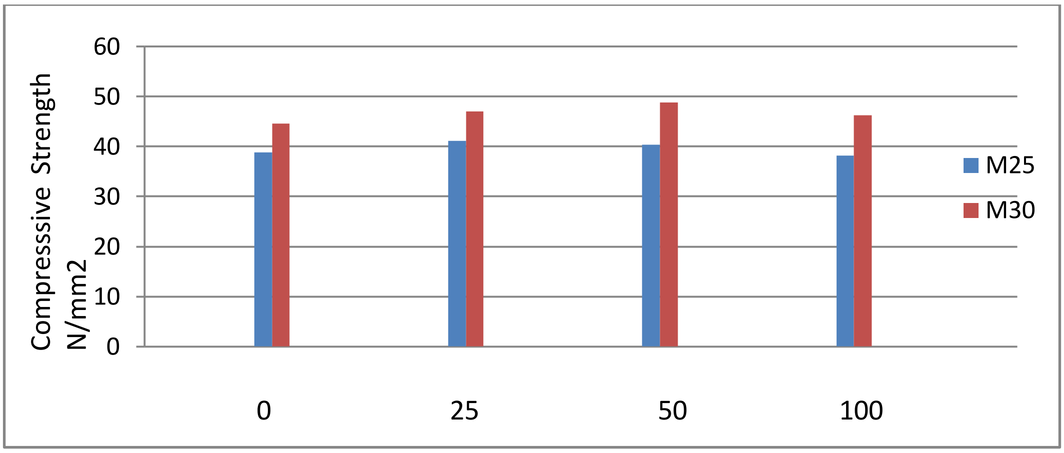

Fig 3 - 28 Days Compresive Strength of Concrete

Split Tensile Strength

The split tensile strength of the specimen calculated from the following formula
Tsp = (2P/ (πdL))
Where
P= maximum load in tonne
L= length of the specimen
d= diameter of width of the specimen

Fig 4– Split Tensile Testing

Table 4: 28 Days Split Tensile Strength of Concrete

S No.	Sample No.	Load (in tonnes)	Area (Sq. mm)	Split Tensile Strength (MPa)
1	A13, A14, A15 - S0	19, 21, 19	14137.17	2.63
2	A13, A14, A15 - S25	22, 21 ,22	14137.17	3.51
3	A13, A14, A15 - S50	21, 21, 22	14137.17	2.89
4	A13, A14, A15 - S100	20, 20, 20	14137.17	2.66
5	B13, B14, B15 - S0	23, 24, 24	14137.17	3.18
6	B13, B14, B15 - S25	26, 26, 26	14137.17	3.51
7	B13, B14, B15 - S50	26, 25, 26	14137.17	3.46
8	B13, B14, B15 - S100	24, 24, 24	14137.17	3.23

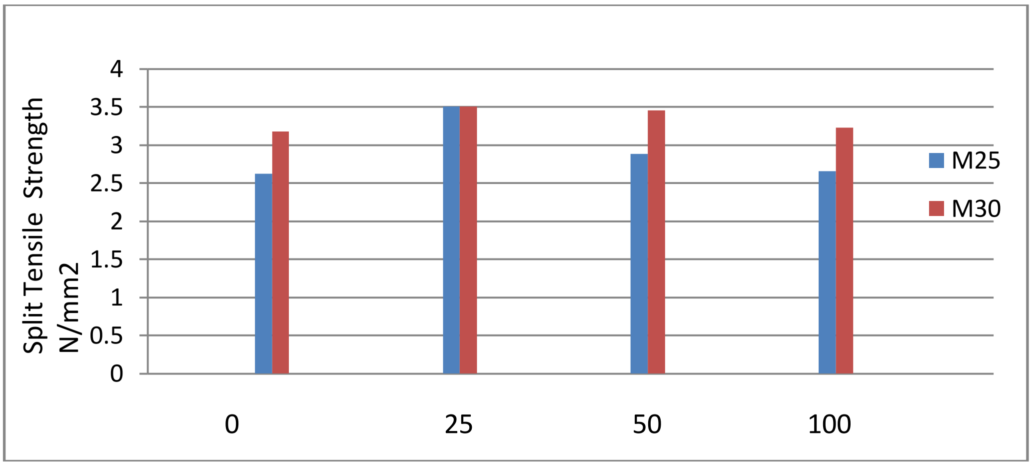

Fig 5 - 28 Days Split Tensile Strength of Concrete

Flexural Strength Test

Beam specimens of dimension 100mmX100mmX500mm were casted for this test.The flexural strength of specimen calculated by following formula:

F_b= PL/ bd^2 when a was greater than 13.3 cm or

F_b=3 Pa/2 bd^2 when a was in between 11.0 cm and 13.3 cm

Where,
a = the distance between the line of fracture and the nearest support.
b= width in cm of specimen
d= depth in cm of specimen at point of failure
L= length in cm of specimen on which specimen was supported
P= maximum load in kg applied to specimen

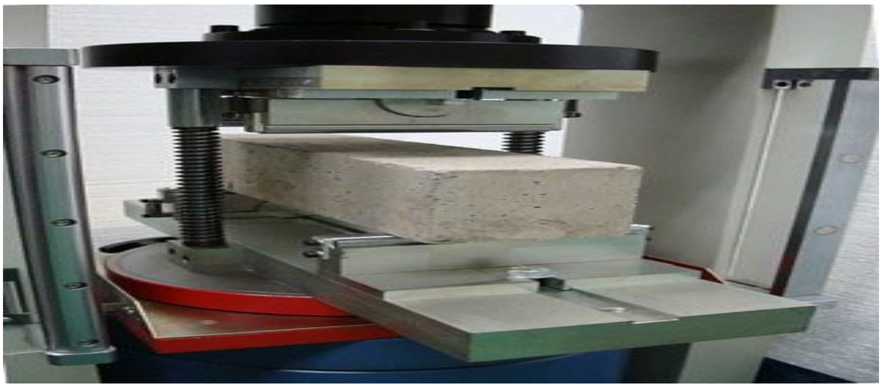

Fig 6 - Flexural Strength Machine

Table 5: 7 Days Flexural Strength Of Concrete

S No.	Sample No.	Dial Gauge Reading	Load (in tonnes)	Flexural Strength (MPa)
1	A7, A8, A9 - S0	24, 25, 29	7.66, 7.97, 9.2	4.03
2	A7, A8, A9 - S25	28, 29, 29	8.89, 9.2, 9.2	4.43
3	A7, A8, A9 - S50	29, 29, 30	9.2, 9.2, 9.2	4.53
4	A7, A8, A9 - S100	27, 28, 28	8.58, 8.89, 8.58	4.25
5	B7, B8, B9 - S0	27, 28, 32	8.28,8.58,9.81	4.44
6	B7, B8, B9 - S25	32, 32, 33	9.81, 9.81,10.12	4.95
7	B7, B8, B9 - S50	32, 33, 33	9.81,10.12,10.12	5.00
8	B7, B8, B9 - S100	31, 30, 30	9.5, 9.2, 9.2	4.65

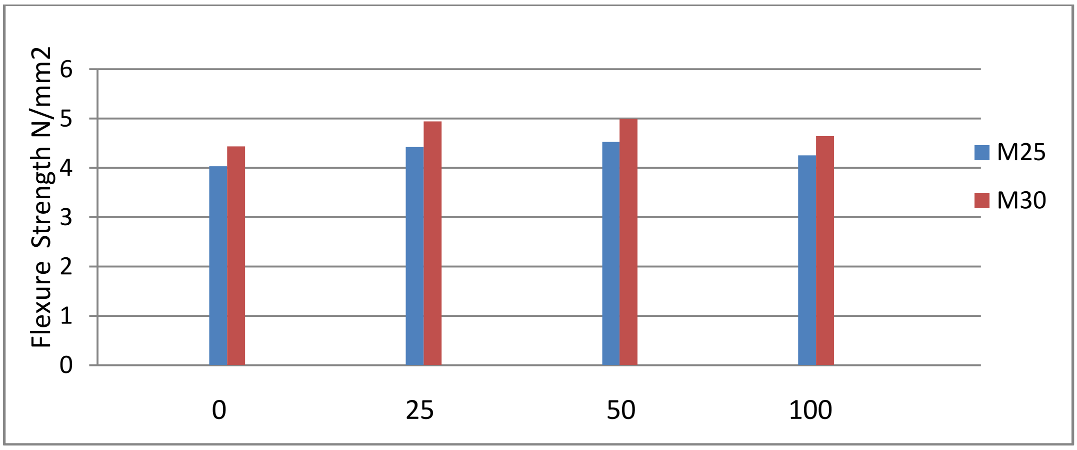

Fig 7 - 7 Days Flexural Strength of Concrete

Table 6: 28 Days Flexural Strength of Concrete

S No.	Sample No.	Dial Gauge Reading	Load (in tonnes)	Flexural Strength (MPa)
1	A10, A11, A12 - S0	42, 45, 47	12.88,13.8,14.41	6.84
2	A10, A11, A12 - S25	43, 44, 45	13.18,13.5,13.8	6.75
3	A10, A11, A12 - S50	40, 45, 45	13.8,13.8,13.8	6.70
4	A10, A11, A12 - S100	43, 43, 42	13.18,13.18,12.88	6.45
5	B10, B11, B12 - S0	43, 50, 51	8.28,8.58,9.81	7.26
6	B10, B11, B12 - S25	42, 41, 43	9.81, 9.81,10.12	6.47
7	B10, B11, B12 - S50	47, 47, 47	9.81,10.12,10.12	6.9
8	B10, B11, B12 - S100	46, 46, 45	9.5, 9.2, 9.2	6.94

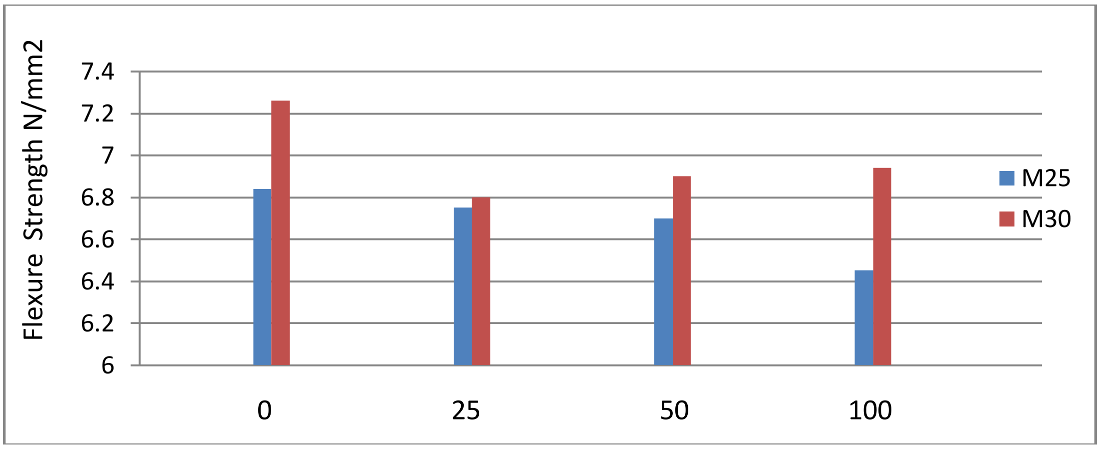

Fig 8- 28 Days Flexural Strength of Concrete

RESULT & DISCUSSION

In the experimental study of stone dust, the cubes were tested for 7 days and 28 days compressive strength with 0%, 25%, 50%,100% replace of fine aggregate by stone dust in M25 and M 30 grade of concrete.

- 7 days compressive strength of M-25 and M-30 concrete mixes follow same pattern, S25 and S50 give more strength as compare to nominal mix, but the ultimate compressive strength is given by S50 concrete mix of both M-25 and M-30, as we move for 28 days strength they also follow same pattern as 7 days compressive strength. For M-25, S50 give max. Strength of 40.42 and for M-30, S50 give max. Strength of 48.88.
- The 28 days flexural strength of M-25 and M-30 shows entirely different pattern from each other. For M-25, mix shows fall in flexural strength as we move from S0 to S100 and for M-30, S0 give max. Flexural strength

and S25 gives minimum strength and after S25 strength start increasing till S100 but S100 mix give less flexural strength then S0.

- The split tensile strength of different mixes of M-25 gives more strength then nominal mix but maximum strength is given by S25, but for M-30 mixes maximum split tensile strength is given by S50 mix.

REFERENCES

[1]. Bureau of Indian Standards, IS 10262 : 2009, Concrete Mix Proportioning-Guidelines.
[2]. Bureau of Indian Standards, IS 8112 : 1987, "OPC-43 Grade Cement.
[3]. Bureau of Indian Standards, IS 4031 : 1968,For Determining the properties of Cement.
[4]. Dr. A. Vijay Kumar, K. Retathi, C. Bharathi, "strength and durability studies on concrete using quarry dust as fine aggregate" International research journal of engineering and technology, vol. 02. Oct 2015.
[5]. Eknath P. Salokhe, D.B Desai " application of foundry waste in manufacturing of concrete" Second international conference on emerging trends in engineering 2014.
[6]. Sheetal A. Sahare "effect of artificial sand with quarry ust on strength of hardened concrete" international journal of engineering and technology vol. 1. 2014.
[7]. Saiyad Farhan " a study on utilization of stone chips as an aggregate replacement in concrete in India context" international journal of engineering Trends and technology vol 4 2013.