*International Journal of Multidisciplinary and Current Research* ISSN: 2321-3124
*Research Article* Available at: http://ijmcr.com

# Experimental Study of Property of Cement Concrete replacing Fine Aggregate with Crushed Stone Dust

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Received 14 Dec 2018, Accepted 16 Feb 2019, Available online 18 Feb 2019, **Vol.7 (Jan/Feb 2019 issue)**

***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, of 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. The compressive strength of M25 and M30 grade concrete at 28 days with 100 % sand , with 25 % of sand by stone dust ,with 50% replacement of sand by stone dust ,with 100 % replacement of sand by stone dust, The flexural strength of M25 and M30 grade concrete at 28 days with 100 sand , with 25 % replacement of sand by stone dust, with 50% of replacement by stone dust, and 100% replacement of sand. The split tensile strength of M25and M30 grade concrete at 28 days with 100 % sand is, with 25 % replacement of sand by stone dust by stone dust, with 50 % replacement of sand by stone dust, with 100 % replacement of sand by stone dust.*

***Keywords:*** *Concrete, Portland Cement, stone dust*

## 1. 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. Experiments 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. To increase the density of resulting mix, the aggregate is frequently used in two or more sizes. The most important function of the fine aggregate is to assist in producing workability and uniformity in mixture. The fine aggregate also assist the cement paste to hold the coarse aggregate particle in suspension. The action promotes plasticity in mixture and prevents the possible segregation of paste and coarse aggregate, particularly when it is necessary to transport the concrete some distance from the mixing plant to the point of placement. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, on the proportions of mix, the method of compaction and other controls during placing compaction and curing the popularity of the concrete due to the fact that from the common ingredient, it is possible to tailors the properties of concrete to meet the demands of any particular situation.

## 2. Materials

The material used is cement, fine aggregate, course aggregate, stone dust and water.

### *2.1 Cement*

Cement is a material having property both adhesive and cohesive which is capable of bending mineral fragment in

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DOI: https://doi.org/10.14741/ijmcr/v.7.1.9

to a compact whole. Various type of cement can be used in concrete with stone dust. The cement should be fresh, free from foreign matters and of uniform consistency. Usually ordinary Portland cement used in normal condition.

**Table-2.1** Physical Properties of Cement

| Sr No | Characteristics | Experiment value | Values as per IS 8112:1989 |
|---|---|---|---|
| 1 | Consistency | 28% | - |
| 2 | Fineness by sieving through is 90 micron standard sieve | 44% | <10% |
| 3 | Setting Time (mintues) | | |
| | Initial | 41 | >30 |
| | final | 278 | <600 |
| 4 | Compressive Strength(3 Days, 7 Days, 28 Days ) | 23.5, 35,45.6 | >22,> 33, 43 |

*2.2 Fine Aggregates*

Commonly used fine aggregate in concrete is sand. The sand should be clean, hard, strong and free from organic impurities. The physical properties of fine aggregates are given in the table 2.2

**Table 2.2** Sieve analysis of fine aggregate

| S. No | Is Sieve Designation | %age Passing | Cumulative Percentage Retained | Grading limit as per IS:383-1970 |
|---|---|---|---|---|
| 1 | 10 mm | 100 | 0 | ZONEIII |
| 2. | 4.75 mm | 95.3 | 4.7 | |
| 3. | 2.36 mm | 82.5 | 17.5 | |
| 4. | 1.18 mm | 71.3 | 28.7 | |
| 5. | 600 micron | 67.5 | 32.5 | |
| 6. | 300 micron | 32.4 | 67.6 | |
| 7. | 150 micron | 8.3 | 91.7 | |

Fineness Modulus = 2.31

*2.3 Natural Coarse Aggregate*

The aggregate was cleaned from all impurities and dust. The coarse aggregate passing through 10mm sieve and retained on 600 micron sieve are mixed in proportion of 60:40 percent. Particle size and other properties of the coarse aggregate are listed in Table 3.

**Table 2.3** Sieve analysis of coarse aggregate

| S. No | IS Sieve Designat ion | Percentage passing | Cumulative Percentage Retained | Grading limit as per IS:383-1970 |
|---|---|---|---|---|
| 1. | 40mm | 100 | 0 | 100 |
| 2. | 20mm | 100 | 0 | 95 to 100 |
| 3. | 10mm | 44.32 | 55.68 | 25 to 55 |
| 4. | 4.75mm | 8.3 | 91.7 | 0 to 10 |

*2.4 Stone dust*

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 4.75 mm sieve and retained 75 micron sieve has been used. That the particle sized and other properties of stone dust are listed in Table 4.

**Table 2.4** Sieve analysis of stone dust

| S. No. | IS Sieve Designation | %age passing | Cumulative Percentage Retained | Grading limit as per IS:383-1970 |
|---|---|---|---|---|
| 1. | 10 mm | 100 | 0 | Zone III |
| 2. | 4.75 mm | 100 | 0 | |
| 3. | 2.36 mm | 91.2 | 8.8 | |
| 4. | 1.18 mm | 73.3 | 26.7 | |
| 5. | 600 micron | 65.2 | 34.8 | |
| 6. | 300 micron | 40.2 | 59.8 | |
| 7. | 150 micron | 9.6 | 90.4 | |

Fineness Modulus = 2.32

*2.5 Water*

The water used for concreting should be good quality and free from the injurious salts. In the current work, tap water of lab was used for the mixing and curing purposes.

### 3. Experimental Work

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. For example A10 represents cubes of M25 grade of concrete that were tested for 7 days compressive strength having 0 percent of stone dust replacing river sand in concrete mix. B10 – 20 represents beams of M30 grade of concrete that were tested for 28 days flexural strength having 20 percent of stone dust replacing river sand in concrete mix. Designation of test specimens has been shown in table 5.

### 4. Results and Discussion

*4.1 Preparation of specimens for testing*

After curing of 7 days and 28 days these specimens were taken out of tank and kept until they dried. After drying the cubes, beams, and cylinders were tested in compression, flexure and split tensile respectively.

*4.2 Testing of specimen*

4.2.1 Compressive strength Test

To calculate the compressive strength of concrete cubes the compression testing machine (CTM) having capacity of 200 tonne was used. By dividing the maximum load applied to the specimen during the test by the cross sectional area calculated from mean dimensions of the section, the measured compressive strength of the specimen can be calculated and shall be expressed to the nearest $N/mm^2$. To have an idea about all the characteristics of concrete, out of many test applied to the concrete, this test had been of the utmost important. By this single test one judge that whether concreting has been done properly or not. For this test, cube specimens of 15 cm X 15 cm X 15 cm are commonly used for most of the works. These 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.

**Table 4.2.1:** 7 Days compressive strength of concrete

| S.No. | Sample No. | Load (Tones) | Area (Sq. mm) | Compressive Strength (Mpa) | Average Stergth (Mpa) |
|---|---|---|---|---|---|
| 1. | A1-0 | 56.2 | 22500 | 24.45 | |
| 2. | A2-0 | 56.5 | 22500 | 24.25 | 24.26 |
| 3. | A3-0 | 56.7 | 22500 | 24.12 | |
| 4. | A1-25 | 60.50 | 22500 | 25.33 | |
| 5. | A2-25 | 61.00 | 22500 | 25.55 | 25.23 |
| 6. | A3-25 | 61.10 | 22500 | 25.12 | |
| 7. | A1-50 | 63.50 | 22500 | 26.30 | |
| 8. | A2-50 | 63.20 | 22500 | 26.20 | 26.17 |
| 9. | A3-50 | 63.40 | 22500 | 26.48 | |
| 10. | A1-100 | 54.00 | 22500 | 23.10 | |
| 11. | A2-100 | 55.10 | 22500 | 23.25 | 23.25 |
| 12. | A3-100 | 55.00 | 22500 | 23.12 | |

**Table 4.2.1.1:** 7 Days compressive strength of concrete

| S.No. | Sample No. | Load (Tones) | Area (Sq. mm) | Compressive Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | B1-0 | 56.2 | 22500 | 24.45 | |
| 2. | B2-0 | 56.5 | 22500 | 24.25 | 27.55 |
| 3. | B3-0 | 56.7 | 22500 | 24.15 | |
| 4. | B1-25 | 60.50 | 22500 | 25.25 | |
| 5. | B2-25 | 61.00 | 22500 | 25.55 | 30.66 |
| 6. | B3-25 | 61.10 | 22500 | 25.15 | |
| 7. | B1-50 | 63.50 | 22500 | 26.15 | |
| 8. | B2-50 | 63.20 | 22500 | 26.15 | 31.29 |
| 9. | B3-50 | 63.40 | 22500 | 26.52 | |
| 10. | B1-100 | 54.00 | 22500 | 23.10 | |
| 11. | B2-100 | 55.10 | 22500 | 23.25 | 26.55 |
| 12. | B3-100 | 55.00 | 22500 | 23.15 | |

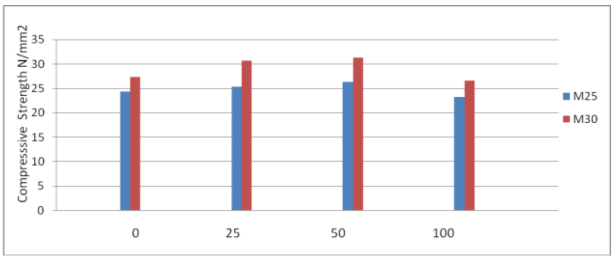


**Fig. 1** 7 Days compressive strength of concrete

**Table 4.2.1.2:** 28 days compressive strength of concrete

| S.No. | Sample No. | Load (Tones) | Area (Sq. mm) | Compressive Strength (Mpa) | Average Stergth (Mpa) |
|---|---|---|---|---|---|
| 1. | A4-0 | 97 | 22500 | 42.39 | |
| 2. | A5-0 | 83 | 22500 | 36.15 | 38.72 |
| 3. | A6-0 | 87 | 22500 | 37.99 | |
| 4. | A4-25 | 107 | 22500 | 45.55 | |
| 5. | A5-25 | 89 | 22500 | 37.85 | 41.18 |
| 6. | A6-2 | 94 | 22500 | 39.90 | |
| 7. | A4-50 | 93 | 22500 | 39.45 | |
| 8. | A5-50 | 98 | 22500 | 41.83 | 40.45 |
| 9. | A6-50 | 94 | 22500 | 39.93 | |
| 10. | A4-100 | 101 | 22500 | 43.14 | |
| 11. | A5-100 | 78 | 22500 | 33.12 | 38.22 |
| 12. | A6-100 | 91 | 22500 | 38.49 | |

**TABLE 4.2.1.3 :**28 Days compressive strength of concrete

| S.No. | Sample No. | Load (Tones) | Area (Sq. mm) | Compressive Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | B4-0 | 100 | 22500 | 44.24 | |
| 2. | B5-0 | 100 | 22500 | 44.54 | 44.58 |
| 3. | B6-0 | 101 | 22500 | 44.97 | |
| 4. | B4-25 | 101 | 22500 | 44.90 | |
| 5. | B5-25 | 109 | 22500 | 48.42 | 47.08 |
| 6. | B6-25 | 108 | 22500 | 48.05 | |
| 7. | B4-50 | 111 | 22500 | 49.32 | |
| 8. | B5-50 | 109 | 22500 | 48.44 | 48.87 |
| 9. | B6-50 | 110 | 22500 | 48.89 | |
| 10. | B4-100 | 112 | 22500 | 49.85 | |
| 11. | B5-100 | 99 | 22500 | 44.09 | 46.19 |
| 12. | B6-100 | 101 | 22500 | 44.77 | |

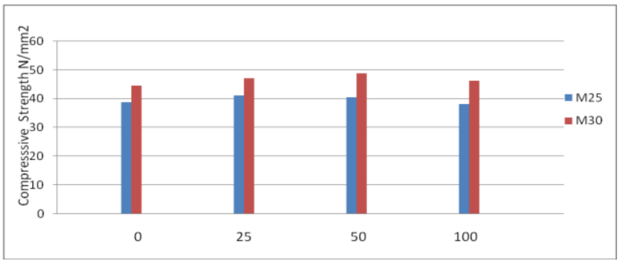


**Fig. 2** 28 Days compressive strength of concrete

4.2.2 Split Tensile Strength

As concrete is weak in tension, it has become one of the basic and important properties of the concrete. Due to its brittle nature and low tensile strength, the concrete is not usually expected to resist the direct tension. While determining the tensile strength of concrete, the load is applied to the member till it cracks & the cracks developed are in the form of tension failure. For assessing the tensile strength of concrete in the laboratory, the usefulness of the splitting cube test is widely accepted and the usefulness of the above test for control purposes in the field is under investigation. With a view to unify the testing procedure for this type of test for tensile strength of concrete the standard has been prepared. The load at which splitting of specimen takes place shall then be recorded. The compression testing machine (CTM) having capacity of 200tonne was used for the splitting tensile strength of the concrete cylinders.

**Calculations:** The split tensile strength of the specimen calculated from the following formula

**Tsp = (2P/ (πdL))**

Where P= maximum load in tone
L= length of the specimen
d= diameter of width of the specimen

**Table 4.2.2:** 28 Days split tensile strength of concrete

| S.No. | Sample No. | Load (Tones) | Area (Sq. mm) | Split Tensile Strength (Mpa) | Average Stergth (Mpa) |
|---|---|---|---|---|---|
| 1. | A13-0 | 19 | 14137.17 | 2.44 | |
| 2. | A14-0 | 21 | 14137.17 | 2.85 | 2.58 |
| 3. | A15-0 | 19 | 14137.17 | 2.51 | |
| 4. | A13-25 | 22 | 14137.17 | 3.05 | |
| 5. | A14-25 | 21 | 14137.17 | 2.61 | 3.49 |
| 6. | A15-25 | 22 | 14137.17 | 3.07 | |
| 7. | A13-50 | 21 | 14137.17 | 2.72 | |
| 8. | A14-50 | 21 | 14137.17 | 2.85 | 2.91 |
| 9. | A15-50 | 22 | 14137.17 | 3.10 | |
| 10. | A13-100 | 20 | 14137.17 | 2.68 | |
| 11. | A14-100 | 20 | 14137.17 | 2.61 | 2.64 |
| 12. | A15-100 | 20 | 14137.17 | 2.60 | |

**Table 4.2.2.1**: 28 Days split tensile strength of concrete

| S. No. | Sample No. | Load (Tones) | Area (Sq. mm) | Split Tensile Strength (Mpa) | Average Stergth (Mpa) |
|---|---|---|---|---|---|
| 1. | B13-0 | 23 | 14137.17 | 3.11 | |
| 2. | B14-0 | 24 | 14137.17 | 3.28 | 3.21 |
| 3. | B15-0 | 24 | 14137.17 | 3.19 | |
| 4. | B13-25 | 26 | 14137.17 | 3.45 | |
| 5. | B14-25 | 26 | 14137.17 | 3.51 | 3.52 |
| 6. | B15-25 | 26 | 14137.17 | 3.55 | |
| 7. | B13-50 | 26 | 14137.17 | 3.65 | |
| 8. | B14-50 | 25 | 14137.17 | 3.28 | 3.41 |
| 9. | B15-50 | 26 | 14137.17 | 3.44 | |
| 10. | B13-100 | 24 | 14137.17 | 3.20 | |
| 11. | B14-100 | 24 | 14137.17 | 3.23 | 3.24 |
| 12. | B15-100 | 24 | 14137.17 | 3.28 | |

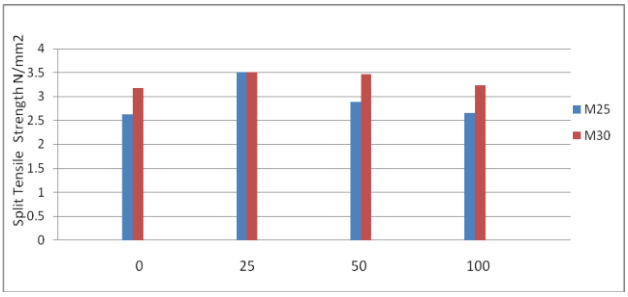


**Fig.3** 28 Days split tensile strength of concrete

4.2.3 Flexural Strength Test

Beam specimens of dimension 100mmX100mmX500mm were casted for this test. A material's ability to resist deformation under load is defined as Flexural strength, also termed as bend strength, or fracture strength, modulus of rupture, a mechanical parameter for brittle material. In case where a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique, the transverse bending test is most frequently employed. The point of highest stress experienced within the material at its moment of rupture is representation of the flexural strength. The beam tests are found to be dependable to measure flexural strength. Dimensions of the beam and manner of loading are the points on which flexure strength depends. By using third point loading, the flexural strength is found out in this study. While in symmetrical two points loading the critical crack may appear at any section not strong enough to resistance the stress with in the middle third, where the bending moment is maximum. Depending on the type, size and volume of coarse aggregate used, flexural modulus of rupture was about 10 to 20 percent of compressive strength.

**Calculations:**

**$F_b$= 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

**Table 4.2.3:** 7 Days flexural strength of concrete

| S.No. | Sample No. | Dial Gauge Reading | Load (Tones) | Flexural Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | A7-0 | 25 | 7.66 | 3.81 | |
| 2. | A8-0 | 25 | 7.97 | 3.85 | 4.06 |
| 3. | A9-0 | 28 | 9.2 | 4.43 | |
| 4. | A7-25 | 28 | 8.89 | 4.34 | |
| 5. | A8-25 | 27 | 9.2 | 4.56 | 4.46 |
| 6. | A9-25 | 29 | 9.2 | 4.50 | |
| 7. | A7-50 | 30 | 9.2 | 4.52 | |
| 8. | A8-50 | 29 | 9.2 | 4.55 | 4.55 |
| 9. | A9-50 | 29 | 9.2 | 4.69 | |
| 10. | A7-100 | 27 | 8.58 | 4.25 | |
| 11. | A8-100 | 28 | 8.89 | 4.32 | 4.21 |
| 12. | A9-100 | 28 | 8.58 | 4.18 | |

**Table 4.2.3 .1 :** 7 Days flexural strength of concrete

| S.No. | Sample No. | Dial Gauge Reading | Load (Tones) | Flexural Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | B7-0 | 29 | 8.28 | 4.24 | |
| 2. | B8-0 | 28 | 8.58 | 4.24 | 4.41 |
| 3. | B9-0 | 31 | 9.81 | 4.65 | |
| 4. | B7-20 | 32 | 9.81 | 4.92 | |
| 5. | B8-20 | 31 | 9.81 | 4.94 | 4.97 |
| 6. | B9-20 | 33 | 1.12 | 5.06 | |
| 7. | B7-30 | 32 | 9.81 | 4.96 | |
| 8. | B8-30 | 30 | 10.12 | 5.14 | 5.11 |
| 9. | B9-30 | 33 | 10.12 | 5.16 | |
| 10. | B7-50 | 32 | 9.5 | 4.70 | |
| 11. | B8-50 | 30 | 9.2 | 4.68 | 4.64 |
| 12. | B9-50 | 31 | 9.2 | 4.63 | |

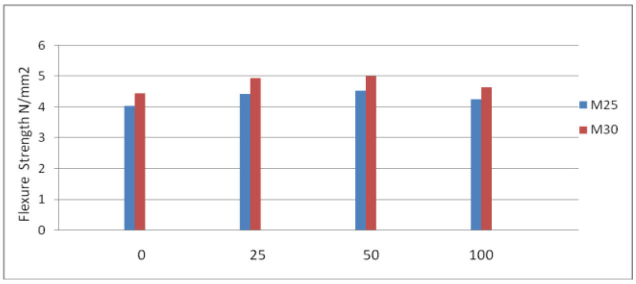


**Fig.4** 7 Days flexural strength of concrete

**Table 4.2.3.2: 28** Days flexural strength of concrete

| S.No. | Sample No. | Dial Gauge Reading | Load (Tones) | Flexural Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | A10-0 | 41 | 12.88 | 6.48 | |
| 2. | A11-0 | 44 | 13.8 | 6.95 | 6.79 |
| 3. | A12-0 | 45 | 14.41 | 7.30 | |
| 4. | A10-25 | 43 | 13.18 | 6.65 | |
| 5. | A11-25 | 45 | 13.5 | 6.65 | 6.71 |
| 6. | A12-25 | 45 | 13.8 | 6.92 | |
| 7. | A10-50 | 41 | 13.8 | 6.76 | |
| 8. | A11-50 | 45 | 13.8 | 6.75 | 6.72 |
| 9. | A12-50 | 44 | 13.8 | 6.65 | |
| 10. | A10-100 | 43 | 13.18 | 6.54 | |
| 11. | A11-100 | 44 | 13.18 | 6.45 | 6.44 |
| 12. | A12-100 | 43 | 12.88 | 6.40 | |

**Table 4.2.3.3:** 28 days flexural strength of concrete

| S.No. | Sample No. | Dial Gauge Reading | Load (Tones) | Flexural Strength (Mpa) | Average Strength (Mpa) |
|---|---|---|---|---|---|
| 1. | B10-0 | 41 | 13.18 | 6.49 | |
| 2. | B11-0 | 50 | 15.33 | 7.50 | 7.52 |
| 3. | B12-0 | 52 | 15.63 | 7.80 | |
| 4. | B10-25 | 42 | 12.88 | 6.50 | |
| 5. | B11-25 | 44 | 12.57 | 6.22 | 6.48 |
| 6. | B12-25 | 43 | 13.18 | 6.51 | |
| 7. | B10-50 | 46 | 14.4 | 6.92 | |
| 8. | B11-50 | 47 | 14.4 | 6.95 | 6.93 |
| 9. | B12-50 | 47 | 14.4 | 6.90 | |
| 10. | B10-100 | 44 | 14.1 | 7.10 | |
| 11. | B11-100 | 46 | 14.1 | 6.99 | 6.99 |
| 12. | B12-100 | 47 | 13.8 | 6.85 | |

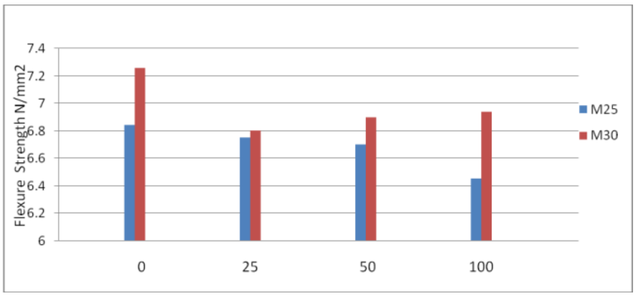


**Fig.5** 28 Days flexural strength of concrete

## Conclusion

The following conclusions were drawn from the present experimental study

1) The compressive strength, flexural strength and split tensile strength of concrete for grade M25 and M30 with stone dust as fine aggregate were found to be comparable with the concrete made with river bed stone.
2) Stone dust can be effetely used in plain cement concrete in place of fine aggregate.
3) To maintain the workability some admixture are used.
4) The compressive strength of concrete at 28 days for M25 grade at 25% stone dust is more as compare to sand.
5) The compressive strength of concrete at 28 days for M30 grade at 25% & 50% of stone dust is high as compare sand.
6) Stone dust gives better result as compare to sand.

## References

[1]. Mohamad Iqbal Malik, Syed Rumysa Jan, "Study of concrete involving use of ovary dust as partial replacement of fine aggregate" International organization of scientific research, vol. 5 Feb.2015.

[2]. Tomas U. Ganiron JR. "Effect of sawdust as fine aggregate in concrete mixture for building construction" international journal of advance science and technology volume 63. 2014.

[3]. Eknath P. Salokhe, D.B Desai" Application of foundry waste in manufacturing of concrete" Second international conference on emerging trends in engineering 2014.

[4]. 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.

[5]. Priyanka A Jadhav "Effect of replacement of natural sand by manufactured sand on the properties of cement mortar" international journal of civil and structure. Vol. 3. 2013.

[6]. H. MerveBasar "Effect of waste foundry sand as partial replacement of sand on mechanical and micro strength characteristics of ready mix concrete.2012.

[7]. MohaiminualHaque,Sourav "Use of stone powder with sand in concrete and mortar" ARPN Journal of science and technology. Vol. 2. 2012.

[8]. M.G.Shaikh "Durability studies of concrete made by using artificial sand with dust and natural sand" international journal of science and engineering. ISSN 0974- 5904. VOL. 04. 2011.

[9]. Saverla Monasi, Daniela Sani and Francesa Tittareli "Used foundry sand in cement mortar and cement production" The open waste management General 2010.

[10]. Rana Burhan "Effect of partial replacement of sand with limestone filler on some properties of normal concrete". 2010.

[11]. Iiangovana R, Mahendrana. N And Nagamanik K. "Strength and durability properties of concrete containing quarry rock dust as fineaggregate" ARPN journal of engineering and applied science vol.3 no. 5. 2008.

[12]. Saeed Ahmad and Shahid Mohmood "Effect of crushed sand and natural sand on properties of fresh and hardened concrete" 2008, 33rd conference on our world in concrete and structures, Singapore.

[13]. Katz. A. and Baum, H. "Effect of high level of fine content on concrete properties" ACI Material journal. (2006).

[14]. Kumar P.S. Mannan,N.A Kurian, VJ And Achuyth H " Investigation on the flexural strength of high performance reinforced concrete beam using standard aggregate" Vol. 42. 2006.