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# Effect of Different Types of Coarse Aggregates on Physical Properties of Mostly Used Grades M20, M25, M30 of Concrete

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***Abstract:*** *Aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and binder (cement/blended cement), are an essential ingredient in concrete. For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete with required shape and sizeAggregates, which account for 60 to 75 percent of the total volume of concrete, are divided into two distinct categories--fine and coarse. The most important property of concrete is its compressive strength. For the purpose of comparison of such compressive strength, three types of coarse aggregates, quartzite, granite, and river gravel, were used. The fine aggregate is normal sand obtained from a borrow pit. This experimental investigation describes the influence of aggregate type and size on the density, compressive, split tensile strength of concrete. To investigate the effect of type and size of aggregate on the compressive strength, density, split tensile strength of concrete an experimental program shall be carried out in GRIET Laboratory. Three different types with three different sizes of course aggregates shall used for developing mix design. The sizes of coarse aggregate shall be 40mm, 20mm, and 12 mm. Ordinary Portland cement is intended to be used as binding material. Different samples shall be tested for compressive strength, split tensile strength and density of concrete. Cylinders of size 150mmx150mm shall be cast in laboratory and tested in testing machines. For each type of coarse aggregate cubes of 150x150mm size to be cast to allow the compressive strength 7 and 28 days.*
*Based on test results, conclusion shall follow.*

***Keywords:*** *Aggregate, Concrete, Compressive strength, Models*

## I. Introduction

The compressive strength of concrete depends on the water to cement ratio, degree of compaction, ratio of cement to aggregate, bond between mortar and aggregate, and grading, shape, strength and size of the aggregate. Concrete can be visualized as a multi-phase composite material made up of three phases; namely the mortar, mortar/aggregate interface, and the coarse aggregate phase. The coarse aggregate in normal concrete are mainly from rock fragments characterised by high strength. Therefore, the aggregate interface is not a limiting factor governing the strength requirement. The onset of failure is manifested by crack growth in the concrete. For normal concrete the crack growth is mainly around the cement paste or at the aggregate/cement paste interfacial zone. The strength of concrete at the interfacial zone essentially depends on the integrity of the cement paste and the nature of the coarse aggregate.

This paper reports the result of a research undertaken to investigate the effect of three different types and sizes of coarse aggregate on the compressive strength of normal concrete. The effect of using quartzite, granite, and river gravel as coarse aggregate on the physical properties of concrete was investigated .The outcome of the study revealed that the strength of concrete for a given water/cement ratio depend on the type and size of aggregate.

## II. Literature Review

- **Abdullahi. M Civil Engineering Department,** In "International Journal Of Civil And Structural Engineering Volume 2, No 3, 2012". Carried out an experimental investigation on 12mm crushed Quartzite, Granite and River Gravel Aggregates Nominal mix (1:2:4) was adopted for this work and mix compositions were calculated by absolute volume method. For each type of coarse aggregate 75 cubes (150x150mm) were cast to allow the compressive strength to be monitored at 3, 7, 14, 21, and 28 days. Test result show that concrete made from river gravel has the highest workability followed by crushed quartzite and crushed granite aggregates. Highest compressive strength at all ages was noted with concrete made from quartzite aggregate followed by river gravel and then granite aggregate.
- **Ozuturan T and Cecen C (1997)** effect of coarse aggregate type on mechanical properties of concretes with different strength cement and concrete research Vol 27 issue 2 papers 165-170
- **Mahmoud Nili, Mohsen Tadayon, Mojtaba Nili** "The Relationships between Setting Time and Early Age Strength of Concrete containing Silica fume, Fly ash and Slag", Third International Conference on Sustainable Construction Materials and technologies.

On the basis of above studies, an attempt has been made in the present investigation was to study on Effect of three aggregate types with different sizes and grades on concrete and 35% replacement of cement by flyash.

## III. Experimental Programme

An extensive experimental Programme involving the various processes of material testing, mix proportioning, mixing, casting and curing of specimens and testing of specimens were done. The forthcoming sections elaborate the various physical and chemical properties of each material separately.

### *3.1 Materials Used*

The materials used in the preparation of concrete mixes includes cement, fine aggregate, coarse aggregates, fly ash, and admixtures. Each material was tested & its physical properties are described below.

#### *3.1.1. Cement*

OPC of 53 grade has been used in the study conforming to recommendations stated in IS: 12269-1987. It was procured from a single source and stored.OPC - penna cement was used throughout the experimental work. The physical properties of OPC are tabulated in Table 1.

#### *3.1.2 Fine Aggregate*

The fine aggregate used was locally available river sand without any organic impurities and conforming to IS: 383 –1970 the physical properties of fine aggregate as shown in Table 2.

#### *3.1.3 Coarse Aggregate*

The coarse aggregate used was conforming to IS: 383 – 1970. In this study the crushed angular coarse aggregates were used, which was bought from the nearby quarry. Aggregates of 20 mm were chosen for the experiment which is clean and free from deleterious materials. The results obtained are tabulated in Table 3.

#### *3.1.4 Fly Ash*

It was procured from a single source i.e. from APARNA CONSTRUCTIONS pvt Ltd. and stored carefully. The physical properties of fly ash as per IS: 1727 - 1967 as shown in Table 4.

#### *3.1.5 Admixtures*

In order to make the concrete mixes workable Conplast SP 430 (DIS) admixture was used. The addition of fibres and increase in fly ash content reduces the workability, therefore in order to make it use for practical purposes admixtures in appropriate quantity was added to the mix. The specifications are presented in Table 6

#### *3.1.6 Water*

As per recommendation of IS: 456 (2000), the water used for mixing and curing must be clean and free from substances that may be deleterious to concrete or steel. The pH value of water shall be not less than 6. In the present investigation, tap water is used for both mixing and curing purposes

**Table 1:** Physical properties of OPC

| S. No | Property | Test Results |
|---|---|---|
| 1. | Normal consistency | 31% |
| 2. | Specific gravity | 2.9 |
| 3. | Initial setting time | 45 minutes |
| 4 | Final setting time | 182 Minutes |
| 5. | Fineness | 1.3% |
| 6. | Soundness | 2 mm |

**Table 2:** Physical properties of fine aggregate

| S. No | Property | Test Results |
|---|---|---|
| 1. | Fineness | 2.6 |
| 2. | Grading zone | II |
| 3. | Specific gravity | 2.42 |
| 4. | Water absorption (%) | 1.0 % |

**Table 3:** Physical properties of fine aggregate

| S. No | Property | Test Results |
|---|---|---|
| 1. | Fineness | 7.01 |
| 2. | Flakiness index | 4.18 |
| 3. | Specific gravity | 2.6 |
| 4. | Water absorption (%) | NIL |

**Table 4:** Physical properties of fly ash

| S. No | Property | Test Results |
|---|---|---|
| 1. | Specific gravity | 2.3 |
| 2. | Fineness Modulus | 3.14 |

**Table 5:** Physical properties of super plasticizer

| S. No | Property | Test Results |
|---|---|---|
| 1. | Form | Liquid |
| 2. | Color | Brown |
| 3. | Specific gravity | 1.20 to 1.22 at $30^0$C |
| 4. | Dosage | 0.6 - 1.5 litres /100 kg cement |

### *3.2 Mix Proportions*

The mix proportioning was done according to the code IS 10262-2009. Three grades M20, M25, M30 are made with three different aggregated of three different sizes each with Water/cement ratio of 0.40 was maintained for all the concrete mixes. Mix proportions were made. First Superplasticizer was added to obtain a workable mix.Details of these mixes are presented in the Table6.

**Table 6:** Mix Proportions for

***M20 Grade of Concrete***

| $M_{20}$ w/c=0/4 | Size of Aggregate | Cement | Fine Aggregate | Coarse Aggregate |
|---|---|---|---|---|
| Quartzite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.419<br>1.641<br>1.804 | 2.282<br>2.67<br>2.94 |
| Granite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.36<br>1.63<br>1.97 | 2.18<br>2.67<br>3.23 |
| River Gravel | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 2.08<br>1.63<br>1.97 | 3.19<br>2.68<br>3.23 |

***M25 Grade Of Concrete***

| $M_{25}$ w/c=0/4 | Size of Aggregate | Cement | Fine Aggregate | Coarse Aggregate |
|---|---|---|---|---|
| Quartzite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.75<br>1.39<br>1.683 | 2.9<br>2.36<br>2.86 |
| Granite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.75<br>1.39<br>1.685 | 2.92<br>2.36<br>2.878 |
| River Gravel | 12mm<br>20mm<br>40mm | 1<br>1<br>1` | 1.175<br>1.39<br>1.68 | 2.79<br>2.38<br>2.89 |

***M30 Grade Of Concrete***

| $M_{30}$ w/c=0/4 | Size of Aggregate | Cement | Fine Aggregate | Coarse Aggregate |
|---|---|---|---|---|
| Quartzite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.08<br>1.25<br>1.51 | 1.90<br>2.23<br>2.68 |
| Granite | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.08<br>1.25<br>1.51 | 1.89<br>2.23<br>2.69 |
| River Gravel | 12mm<br>20mm<br>40mm | 1<br>1<br>1 | 1.08<br>1.25<br>1.51 | 1.80<br>2.24<br>2.68 |

### *3.3 Mixing Of Concrete, Casting And Curing Of Test Specimens*

Mixing was done using tilting mixers of capacity 40lts. Initially the dry mix constituents of cement, fine aggregate and coarse aggregate was mixed for two minutes and then the water with chemical admixtures were added and mixing continued for another 2 minutes. The total mixing time was kept at 5 minutes approx. for all the trials until a homogeneous mixture was obtained. Compaction was achieved by using needle vibrator and then specimens were casted. All specimens were demolded after 24 hours and placed in curing tanks till the day of testing i.e. for 7 & 28 days.

### *3.4 Tests On Concrete*

Test methods include the tests of fresh concrete mix for workability and hardened concrete specimens for compressive and split tensile strength test.

### *3.5 Workability Test*

Slump test for fresh concrete was done conforming IS : 1199-1959 in order to measure the workability of concrete mixes.

### *3.6 Compressive Strength*

In this investigation, the cube specimens of size 150x150x150mm are tested in accordance with IS: 516 – 1969. After 7 & 28 days of curing, cube specimens were removed from the curing tank and test for compression. The test was repeated for the three specimens and the average value was taken as the mean strength. Values are tabulated in table 7.

### *3.7 Split Tensile Strength*

*i*n this test concrete cylinders of size 150 mm diameter and 300 mm height are tested in accordance with is: 5816 -1999. the split tensile strength reported is the average of three results obtained from 3 identical cylindrical specimens. split tensile strength is calculated by the following formula and values are given in table 8.

$f_s = 2p/\pi dl$

where $(f_s)$ is the splitting strength (mpa),

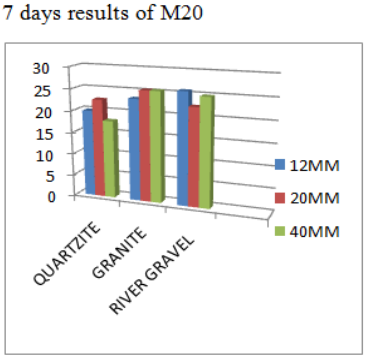
p = failure load (kn), l = length of cylinder(mm)

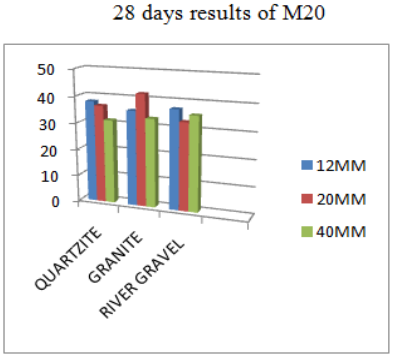
and d = diameter of cylinder (mm).

### *3.8 Test Result*

| **N/mm$^2$** | | **Quartzite** | | | **Granite** | | | **River Gravel** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 12mm | 20mm | 40mm | 12mm | 20mm | 40mm | 12mm | 20mm | 40mm |
| M20 | 7 days | 19.95 | 22.65 | 17.92 | 23.39 | 25.40 | 25.44 | 25.77 | 22.51 | 24.88 |
| | 28 days | 38 | 36.59 | 31.4 | 25.55 | 41.92 | 33.18 | 37.26 | 32.9 | 35.48 |
| M25 | 7 days | 25.92 | 27.55 | 25.18 | 28.59 | 26.37 | 21.62 | 26.22 | 20.44 | 21.63 |
| | 28 days | 46.96 | 39.7 | 46.52 | 46.77 | 43.03 | 28.88 | 27.55 | 30.51 | 26.41 |
| M30 | 7 days | 26.22 | 28.93 | 24.66 | 28.81 | 26.44 | 28.14 | 25.33 | 21.22 | 21.04 |
| | 28 days | 35.55 | 36.66 | 34.07 | 39.14 | 43.14 | 44.44 | 37.77 | 34.22 | 34.77 |

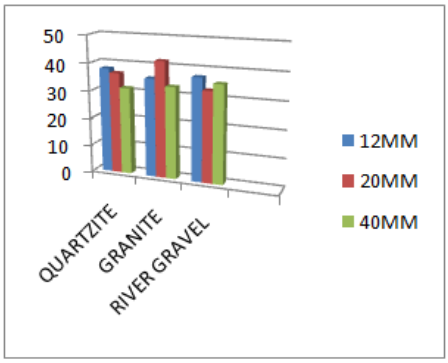
***Compressive Strength Results of M20 for 7 and 28 days***



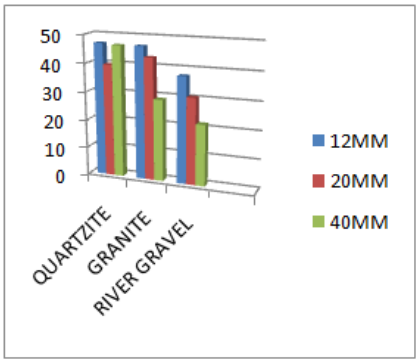



***Compressive Strength Results Of M25 For 7 And 28 Days***

7 days results of M25

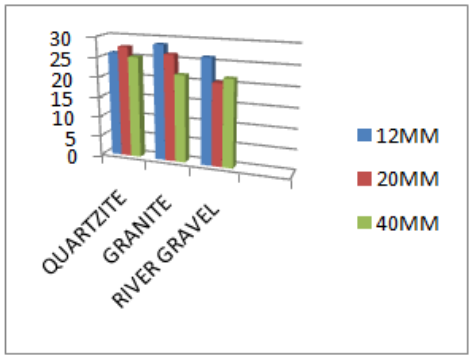



28 days results of M25

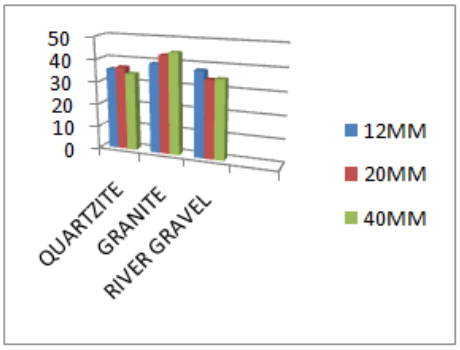



***Compressive Strength Results Of M30 For 7 And 28 Days***

7 days results of M30



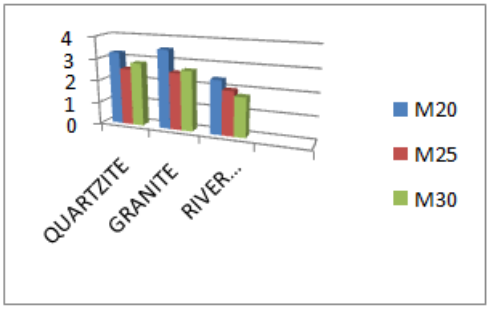

28 days results of M30




***Tensile Test Results Of Concrete (40mm Aggregate)***

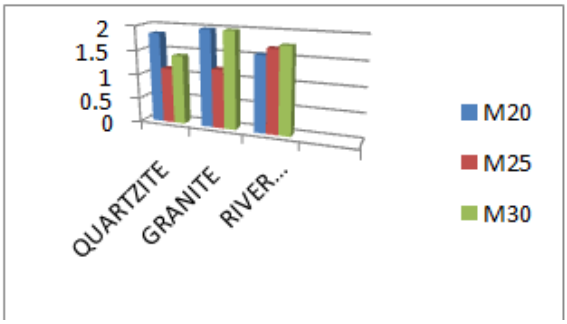
***For 7 Days***

| Type Of Aggregate | $M_{20}$ | $M_{25}$ | $M_{30}$ |
|---|---|---|---|
| Quartzite | 1.839 | 1.13 | 1.41 |
| Granite | 1.98 | 1.20 | 1.98 |
| River Gravel | 1.55 | 1.69 | 1.76 |




***For 28 Days***

| **Type Of Aggregate** | $M_{20}$ | $M_{25}$ | $M_{30}$ |
|---|---|---|---|
| Quartzite | 3.25 | 2.54 | 2.829 |
| Granite | 3.53 | 2.54 | 2.68 |
| River Gravel | 2.40 | 1.98 | 2.40 |



## IV. Conclusion

Aggregate type has effect on the compressive strength of normal concrete. Highest compressive strength was achieved from all grades of concrete containing 12mm Quartzite, followed by concrete containing Granite and river gravel. Concrete containing River Gravel shows the least strength development at all ages. It is suggested that quartzite aggregate may be employed for concrete work in places where concrete practitioners have variety of choices available**.**

## References

[1]. **M.S. Shetty** "**Advanced Concrete Technology**" Third Edition, S.Chand & Co. Ltd., New Delhi, 1992.
[2]. **M.L.Gambhir** "**Concrete Technology**", Third Edition TATA Mc. Graw. Hill Publishing Co. Ltd.
[3]. Effect of aggregate type on Compressive strength of concrete BY **Abdullahi. M** Civil Engineering Department, Federal University of Technology P.M.B 65, Minna Niger State, Nigeria
[4]. **In "International Journal Of Civil And Structural Engineering Volume 2, No 3, 2012".**
[5]. IS: 456 – 2000 Code of practice for plain and reinforced concrete (fourth revision).
[6]. IS: 2386 – 1963 (all parts) Methods of Test for Aggregate for Concrete.
[7]. IS: 10262.2009 Concrete Mix Proportioning – Guidelines (First Revision).
[8]. IS: 7320 – 1974 Specification for concrete slump test apparatus.
[9]. IS: 516 – 1959 Method of test for strength of concrete (sixth print January, 1976).
[10]. IS: 5816 – 1970 Method of test for splitting tensile strength of concrete cylinders.

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