

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

## Experimental Study on Compressive Strength of High Performance Concrete using Granite Powder as Fine Aggregate

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**ABSTRACT:** The concrete is being used as 2nd most essential material in the world and most of the companies are in need of economical concrete by replacing cement by cementitious material. This papers show the preparation of concrete using granite powder as a partial fine aggregates at a rate of 0%, 5%, 10%, 15%, 20% and 25% and cement is replaced using 10% fly ash used too. The beams of size 900mmX150mmX150mm are casted of M40 with w/c ratio 0.42 and cured for a curing period of 7, 14, and 28 days. The test results shows increase in flexure strength till 20% of granite powder replacement and rest are equal to normal concrete. Thus, Granite Powder acts as a best replacement to natural sand till 25%.

It was observed that substitution of 7.5% of cement by weight with Granite fines in concrete resulted in an increase in compressive strength for both 7 & 28 days to 33.14 & 43.40 N/mm<sup>2</sup> compared to 23.26 & 39.41 N/mm<sup>2</sup> of conventional concrete. Tensile strength too followed a similar pattern with a 7.5% substitution with granite fines increasing the tensile strength for 7 & 28 days to 2.87 & 4.19 N/mm<sup>2</sup> compared with a 2.4 & 3.4 N/mm<sup>2</sup> of conventional concrete. However flexure strength of 7.5% granite fine replacement exhibited a good improvement of flexural strength for 28 days to 6.34 N/mm<sup>2</sup> compared to a 3.35 N/mm<sup>2</sup> of conventional concrete. Further investigations revealed that to attain the same strength of conventional concrete a 10% substitution with granite fines is effective.

**KEYWORDS:** Granite powder, Fly ash, OPC.

### I. INTRODUCTION

Concrete is a well known composite construction material composed primarily of aggregate, cement and water. there are many formulations, which provide varied properties. The aggregate is generally coarse gravel or crushed rocks such as limestone or granite, along with a fine aggregate such as sand. the cement commonly portland cement and other cementitious materials such as fly ash and slag cement serve as a binder for the aggregate. various chemical admixtures are also added to achieve varied properties.

#### 1.1 Need of usage of granite powder:

Granite is the kind of signature rock of the earth that is found in the abundance through out the world. Most of the continental crust is formed by the volcanic magma that is one major resource of formation of the intrusive igneous rock known as granite. in all seven continental rock wherever you travel you find granite beneath the land and it can be see in all use all around in our daily life. there is a long list of purposes for granite powder and it is in demand since egyptian era.

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## II. LITERATURE REVIEW

**Felixkala T and Partheeban P (2010)** examined the possibility of using granite powder as replacement of sand along with partial replacement of cement with fly ash, silica fume and blast furnace slag.

**Oyekan G.L and Kamiyo O.M (2008)** studied the performance of hollow sandcrete blocks containing cement, sharp sand and granite fines in varying proportions to determine their structural and hydrothermal properties. The percentage of granite fines by volume of the total fine aggregate was varied in steps of 5% to a maximum of 30%.

**BabooRai et al (2011)** investigated the effect of using marble powder and granules as constituents of fines in concrete by partially reducing quantities of cement as well as other conventional fines. Partial replacement of cement and usual fine aggregates with varying percentage of granite powder (0%,5%,10%,15%,20%)

**ShahulHameed M and Sekar A.S.S (2009)** investigated the usage of quarry rock dust and granite sludge powder as possible substitutes for natural sand in concrete. They found that the compressive, split tensile strength and the durability concrete were good when the fine aggregate was replaced with 50% granite sludge powder and 50% Quarry rock dust (Green concrete).

**BaharDemirel (2010)** investigated the effects of using waste marble dust (WMD) as a fine material on the mechanical properties of the concrete. In order to determine the effect of the WMD on the compressive strength with respect to the curing age, compressive strengths of the samples were recorded at the curing ages of 3, 7, 28 and 90 days.

## III. METHODOLOGY

This chapter explains the methods going to be use in this project. Then the granite powder and fly ash are will collected from factory. All the conducted experiments and the flow chart of research work explained in this chapter clearly.

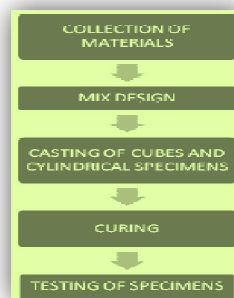


Fig 3.1 : Schematic diagram of Experimental work

## IV. MATERIALS

### 4.1 Materials :

As far as building is concerned, the term concrete means an artificial stone made by mixing sand, stone, cement and water. This mixture, cast into a form of the desired shape and size, hardens into a stone-like mass the concrete.

### 4.2 Cement :

Cement is a fine gray powder. The word "cement" can be traced back to the Roman term opus caementicium, used to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder.

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### 4.3 Aggregate :

Aggregates are inert granular materials such as sand, gravel, or crushed stone. 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.

### 4.4 Fine aggregate :

Sand is a mass of finely crushed rock. It is either crushed naturally as seen on the sea shore, in river beds, or in deserts, or it is artificially produced in crusher plants near rock.

### 4.5 Coarse aggregate :

Aggregates were first considered to simply be filler for concrete to reduce the amount of cement required. They can form 80% of the concrete mix so their properties are crucial to the properties of concrete.

### 4.6 Granite powder :

Granite belongs to igneous rock family. The density of the granite is between 2.65 to 2.75 g/cm<sup>3</sup> and compressive strength will be greater than 200 mpa.

### 4.7 Fly ash :

Fly ash can be a cost-effective substitute for Portland cement in some markets. It's also is available in two colours, and colouring agents can be added at the job site.

**Table 4.1. Granite powder Mix ratios**

Granite powder	Natural sand
5	95
10	90
15	85

**Table 4.2 Percentage quantities of raw materials**

Mix	Natural sand(%)	Granite powder (%) replacing of fine aggregate	Fly ash (%)replacing of cement
M1	Nominal mix	0	0
M2	95	5	10
M3	90	10	10
M4	85	15	10

### 4.8 Test for fresh concrete :

To study the workability of concrete will be conducting by slump cone test on fresh concrete.

#### a) Slump Flow Test

The slump flow test is used appraise the horizontal free flow of in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concreting.

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### 4.9 Test for hardened concrete:

#### a) Compressive Strength

The compression test is used to determine the hardness of cubical specimens of concrete. Cubes of size 100 mm x 100 mm x 100 mm are casted. Compressive strength is calculated by the following formula,

$$\text{Compressive strength} = \text{Load/cross-sectional area of the cube}$$



Fig 4.3. Compression testing machine

#### b) Split tensile strength

This is an indirect test to determine the tensile strength of the cylindrical specimens 150 mm diameter and 300 mm height. The split tensile strength can be calculated using the formula,

$$F_t = 2p/\pi DL$$

Where  $f_t$  = Split tensile strength of the specimen in N/mm<sup>2</sup>

P = Maximum load in N applied to the specimen

D = Diameter of the specimen in mm

L = Length of the specimen in mm



Fig 4.4 Spilt tensile strength

#### c) Flexural strength test

Flexural strength tests are carried out on the rectangular beams and its sizes 500×100×100. The flexural strength of the beam is calculated by using the formula,

$$F_r = 3PL/bd^2$$

Where  $f_r$  = Flexural tensile strength of specimen in N/mm<sup>2</sup>

P = Maximum load in N

L = Length of the specimen in mm

b = Width of the specimen in mm

d = Depth of the specimen in mm

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Fig 4.5. Flexure strength

#### 4.10 Density :

Density is most important factor in high performance concrete and it is used find out the density for hardened concrete.

#### 4.10 Durability :

It is defined as the ability of concrete to resist weathering action, chemical attack, and abrasion while maintain its properties.

## V. RESULTS AND DISCUSSION

#### 5.1 Density:

Normal density of concrete is 24 to 25 kN/m<sup>3</sup>. The density is achieved as compared to 28 days strength and the observed values are tabulated below.

Table 5.3 Density of concrete

28 days Strength (mpa)	Density kN/m <sup>3</sup>
39.76	22.4
35.67	23.6
32.50	24.5

#### 5.2 Durability of concrete :

Durability of concrete is done with acid curing and weight losses is to be measured. The weight losses are measured and tabulated as below. The weight loss due to acid curing and it is achieved after 30 days.

Table 5.3 Durability of concrete

Mix	Initial weight (kg)	Weight loss due to acid attack test (kg)
M1	8.46	8.24
M2	8.38	8.17
M3	8.04	7.98

#### 5.3 Compressive strength:

The compression test is used to determine the hardness of cubical specimens of concrete. The compressive strength is increased gradually with their mix ratios and conventional concrete strength is achieved.

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**Table 5.4 Compressive strength**

Mix	Compressive strength (N/mm <sup>2</sup> )		
	7 days	14 days	28 days
Conventional mix	31.11	40.67	41.33
M1	32.96	41.67	42.01
M2	34.02	42.89	44.22
M3	36.10	44.78	46.51

### 5.4 Spilt tensile strength:

The spilt tensile strength is used to determine its tensile strength of specimens. The strength is increased at 7,14,28 days as compared with conventional concrete.

**Table 5.5 Spilt tensile strength**

Mix	Spilt tensile strength N/mm <sup>2</sup>		
	7 days	14 days	28 days
Conventional mix	3.0	3.2	3.7
M1	2.9	3.0	3.6
M2	2.8	2.8	3.4
M3	2.7	2.6	3.0

### 5.5 Flexure strength:

The flexure strength is calculated as above given formula and tabulated as below. The strength is increased at 7,14,28 days as compared with conventional concrete.

**Table 5.6 flexure strength**

Mix	Flexural strength N/mm <sup>2</sup>		
	7 days	14 days	28 days
Conventional mix	4.9	5.1	5.4
M1	4.5	4.8	5.0
M2	4.4	4.6	4.8
M3	4.2	4.4	4.7

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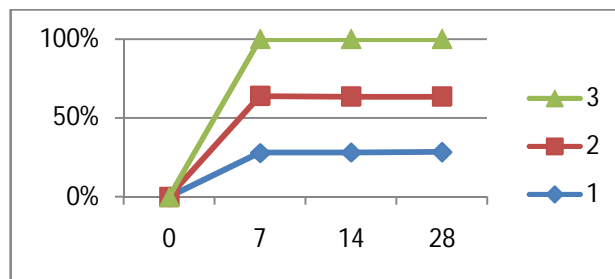
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### 5.6 Compressive strength:

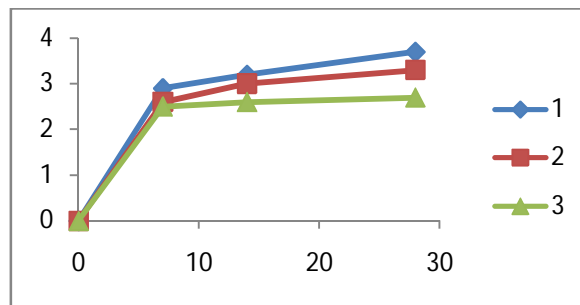
The 7,14,28 days compressive strength is plotted in graph below and it's X axis is mix ratios and Y axis is strength. The strength is increased as compared with conventional concrete.



**Fig 5.6 Compressive strength**

### 5.7 Split tensile strength:

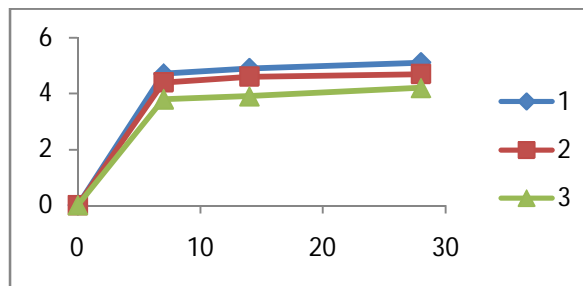
The split tensile strength is plotted as graph shown below. The strength is plotted for 7,14,28 days and it's 28 days strength is increased as compared with conventional concrete.



**Fig 5.7 Split tensile strength**

### 5.8 Flexure strength :

The flexure strength is plotted as graph shown below. The strength is increased at 28 days and it is attained a maximum flexure strength. The flexure is occurred at centre point of the prism. The strength is increased after 14 days as shown in graph.



**Fig 5.8 Flexure strength**

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## VI. CONCLUSION

- Compressive Strength of HPC shows increasing trend till 15% increment of Granite powder and again it was very near to the conventional concrete.
- The Split tensile strength and Flexure strength was achieved their strength compared to conventional concrete.
- The Durability of concrete is good even after addition of the granite powder as replacement into concrete.

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