

# COMPRESSIVE STRENGTH OF HIGH PERFORMANCE CONCRETE USING GRANITE POWDER AS FINE AGGREGATE

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## Abstract

The concrete is being used as 2<sup>nd</sup> 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(brought from muddenahally, Chickaballapur) as a partial fine aggregates at a rate of 0%, 5%, 10%, 15%, 20% and 25% and cement is replaced using 10% fly ash, 10% GGBS, 7.5% silica fumes and 0.9% super plasticizer used too. The beams of size 700mmX150mmX150mm are casted of M40 with w/c ratio 0.42 and cured for a curing period of 7, 14, 28 and 56 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%.

**Keywords:** GP- Granite Powder, cementitious material, flexure strength, HPC- high performance concrete, GGBS, FlyAsh

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## 1. INTRODUCTION

The Normal Concrete is one of the old forms been used to build this world but now a new word came to existence saying High Performance Concrete. This HPC has all properties enhanced due to usage of cementitious material

and now granite powder. This granite is the strongest of all material which is used for construction and now this is used for concrete in the form of powder as a partial replacement for natural sand.

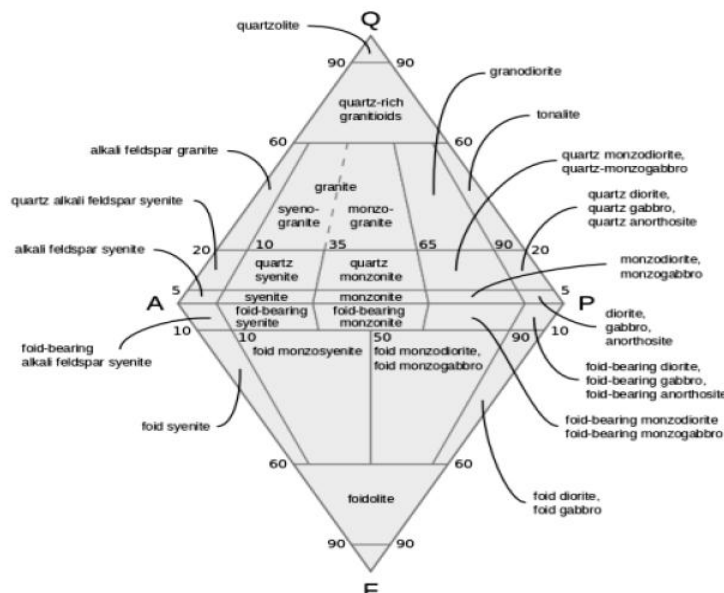


Fig 1: Plutonic rock showing quantity of granite

The conventional concrete is converted to High-Performance Concrete by the use of chemical and mineral admixtures which plays a vital role in improving the characteristics like workability, strength parameters and many more. The admixtures added to cement concrete as a

partial replacement along with super plasticizer as a water reducer to get the high performance. The usual mineral admixtures used are Fly-Ash, Silica Fumes, GGBS, and a small part of Rheo-build1125 as a Super Plasticizer for high performance.

Based on the former experimental analysis, in this current work 10% Fly Ash, 10% GGBS, 7.5% Silica Fumes and 0.9% Super Plasticizer has been used to generate high performance concrete using Granite Powder as partial replacement of Natural Sand with a following percentages that is 0%, 5%, 10%, 15%, 20% and 25%. which are named as follows GP0, GP5, GP10, GP15, GP20 and GP25 respectively.

## 2. LITERATURE REVIEW

### Kanmalai Williams C, Partheeban P, Felix Kala

This paper reports the results of an experimental study on the high performance concrete made with granite powder as fine aggregate. The percentage of granite powder added by weight a range viz. 0, 25, 50, 75 and 100% as a replacement of sand used in concrete and cement was replaced with 7.5% Silica fume, 10% fly ash, 10% slag and 1% super plasticizer. The effects of curing temperature at 32 C and 0.40 water-to-binder (w/b) ratio for 1, 7, 14, 28, 56 and 90 days on compressive strength, split tensile strength, modulus of elasticity, drying shrinkage and water penetration of concrete were studied. Experimental results indicate that the increase in the proportions of granite powder resulted in a decrease in the compressive strength of concrete. The overall test performance revealed that granite powder can be utilized as a partial replacement of natural sand in high performance concrete.

## 3. MATERIAL USED

**A. Cement:** Ordinary Portland Cement Birla Super of grade 43 was used for work. It was dry, clean and free from lumps and stored in a dry place and stacked very close to each other to avoid air circulation.

**B. Silica Fumes:** The Silica Fumes used for this work was bought from Rajaji Nagar Industrial Colony and it was white coloured and in powder form and 7.5% of cement was used. This helps in w/c ratio reduction and increase strength of concrete in hardened state.

**C. Fly Ash:** The Fly Ash which is a bi-product obtained from the gases of burning coal during the production of electricity. It was brought from Shakti Nagar Thermal Power Station, Raichur. It was light grey in colour and finest powder forms same as cement and considered as a best replacement. In this current work 10% to the weight of cement was used.

**D. GGBS:** Ground Granulated Blast furnace Slag. The slag collected on the grounds which are granulated well is called as GGBS and in the current work 10% slag was considered along with other admixtures as a replacement of cement.

**E. Super Plasticizers:** Rheo-build 1125 was used in current work which is Reddish Brown Liquid used at rate of 0.9% of cementitious material and reduces water upto 25%.

**F. Fine Aggregate:** Natural Sand which is locally available was used which was having a fineness modulus 3.26 and conforming zone II with Specific Gravity 2.52 and water absorption 1.03%.

**G. Granite Powder:** Granite Powder brought from Muddenahally, Chickaballapur used in this current work as partial replacement for fine aggregate having specific gravity 2.55, water absorption 1.15%, and fineness modulus 4.23 conforming Zone I.

**H. Coarse Aggregate:** The coarse aggregates were brought from Bharathi Crushers, Muddenahally, Chickaballapur. 20mm downsize were used in this current work having specific gravity 2.65 and water absorption 0.45%.

**I. Water:** The locally available portable water was used for mixing as well as curing which was clean

## 4. MIX DESIGN

The following table showing the mix design for the current project work. C-cement, F-fly ash, G-GGBS, SF-silica fumes, FA- fine aggregates, GP- granite powder, CA- coarse aggregate, W-water, SP- super plasticizer (ALL in kg/m<sup>3</sup>)

**Table 1:** Mix Design Values.

Name	C	F	G	SF	SP	FA	GP	CA	W
GP0	410	-	-	-	-	735.3	-	1043.7	172
GP5	297.2	41	41	31	3.7	698.6	36.7	1043.7	172
GP10	297.2	41	41	31	3.7	661.2	73.5	1043.7	172
GP15	297.2	41	41	31	3.7	625.1	110.3	1043.7	172
GP20	297.2	41	41	31	3.7	588.3	147.1	1043.7	172
GP25	297.2	41	41	31	3.7	551.5	183.8	1043.7	172

## 5. MIXING PROCEDURE

The general procedure of mixing concrete is same followed here in this project too. First the weigh all ingredients of concrete that is cement, fine aggregates, coarse aggregates, water and fly ash, GGBS, silica fumes, granite powder and super plasticizer for HPC. The coarse aggregate goes first in to the mixer and following that the fine aggregates, granite powder, mineral admixtures and water. The super plasticizer can be added while mixing or diluted in water as well. This goes the simple mixing procedure for the required CC and HPC.

## 6. TESTS ON FRESH CONCRETE

**Table 2:** Slump Values of concrete with varying GP%

Name of the test	GP0	GP 5	GP 10	GP 15	GP 20	GP25
Slump value (mm)	85	76	74	74	72	70

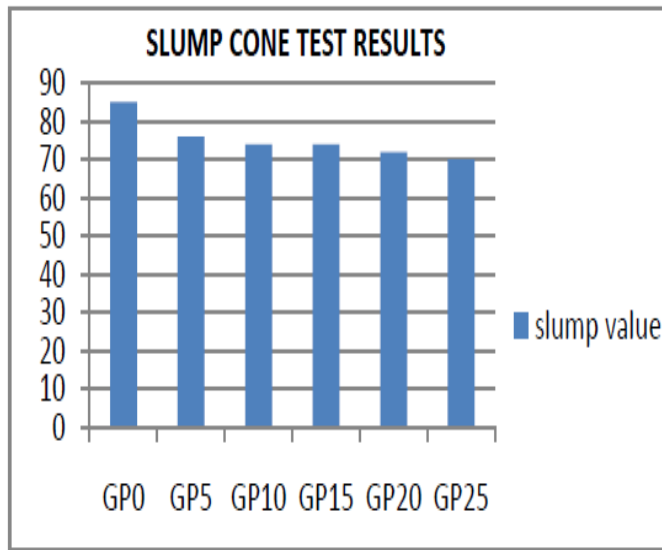


Fig 2: Graphical Representation of Slump Values

## 7. TESTS ON HARDENED CONCRETE

The compressive strength gives the capability of the concrete to sustain the loads by preparing blocks which will be tested using compression testing machine. The data presented show that the compressive strength of all the granite powder concrete was higher closer to that of reference mix (GP0).

Table 3: Compression Strength of concrete with varying GP%

Mix Designation	Compressive strength in $N/mm^2$ wrt curing period in days		
	7 Days	14 days	28 Days
GP0	21	26	40
GP5	25	30.2	45.57
GP10	29.3	33.5	47
GP15	29	39	50.12
GP20	26	37	48
GP25	22	28	38

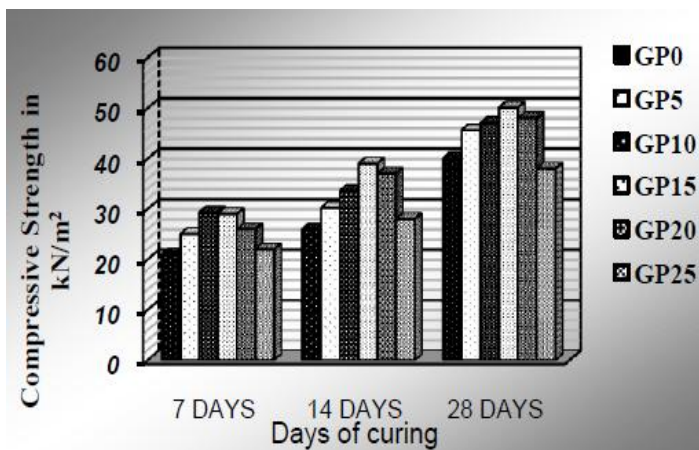


Fig 3: Graphical Representation of compressive strength with varying GP%

## 8. 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 workability of concrete is good even after addition of the granite powder as replacement into concrete.
- The current experimental work shows that the strength properties of the concrete could be enhanced by utilization of granite powder in the place of river sand, granite powder in concrete are the best choice, where they are available.

Hence the granite aggregates can be considered as an alternative for fine aggregates (river sand).

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