FLEXURAL 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(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.*

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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.

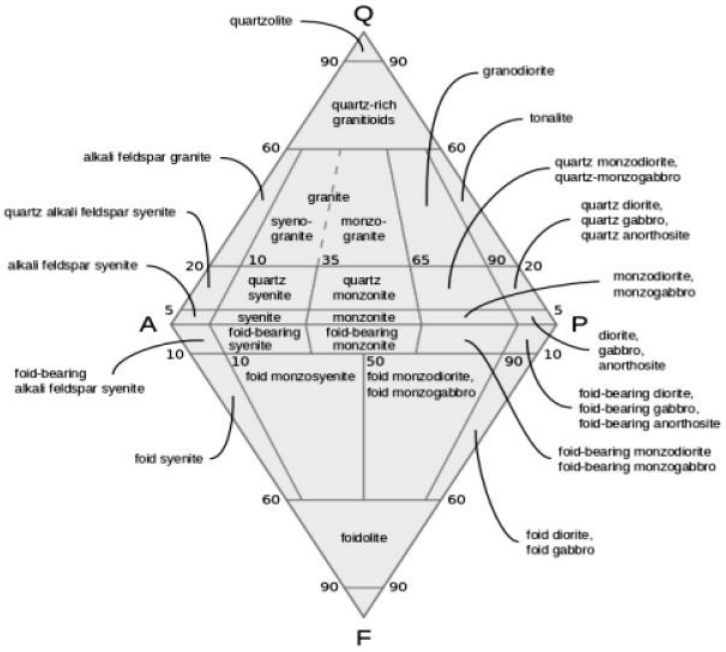

Fig 1: Plutonic rock showing quantity of granite

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 DEIGN

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^3)

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

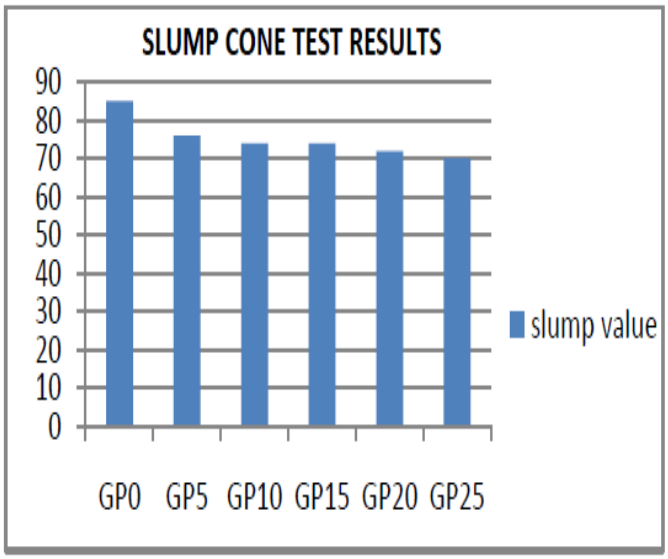

Fig 2: Graphical Representation of Slump Values

7. TESTS ON HARDENED CONCRETE

Flexural strength is a mechanical limitation for brittle material such as concrete which is defined as a material's capacity to defend against bend or twist under load. Flexural strength is the measure of the tensile strength of concrete. It is measured in terms of stress whose symbol is σ.

The flexural strength is expressed as Modulus of Rupture (MR) in psi (MPa). It is also known as *bend strength, or fracture strength*.

A laboratory mix design, based on flexure may be needed, or cement content may be selected from early experience to offer the required design MR, as the designers of pavements make use of a hypothesis based on flexural strength.

The data required to calculate flexural strength are measured by experimentation, with square samples of the material placed under load in a single point testing setup.

The data such as maximum applied load, known as "P", material span length between points in the test setup, known as "L", width of the material specimen, known as "b"; and average depth of the specimen, known as "d" are collected from the load experiments. Change maximum applied load in kN; material span length in m; width of the material specimen in inches; and average depth of the specimen in inches. Replace or substitute the numerical values for this data in the equation $R = \frac{3(PXL)}{2(bXd^2)}$ for manipulating flexural strength.

Table 3: Flexural Strength of concrete with varying GP%

Mix Designation	Flexure strength wrt curing period in days			
	7 Days	14 days	28 Days	56 Days
GP0	5.2	5.7	7.8	8.7
GP5	5.38	5.8	6.5	6.7
GP10	5.63	6.1	6.72	7.1
GP15	5.83	6.2	6.9	7.25
GP20	5.8	6.5	6.94	7.37
GP25	5.8	6.48	6.9	7.37

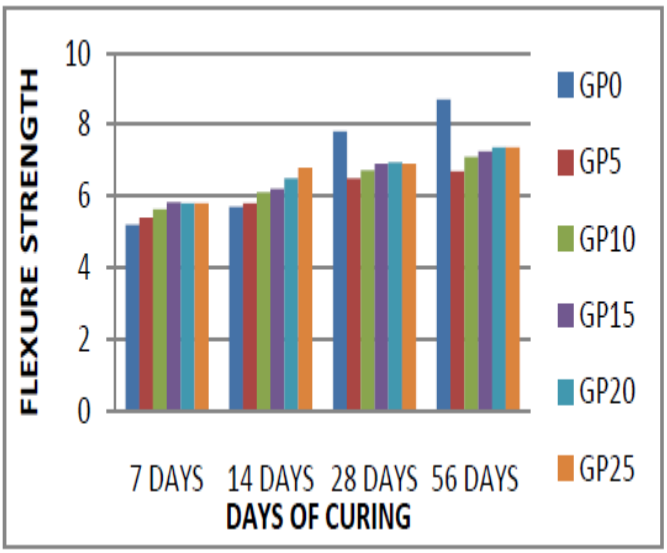

Fig 3: Graphical Representation of flexure strength with varying GP%

8. CONCLUSION

The flexural strength shows increasing trend at early stages of curing even after replacing natural sand by granite powder.

The later stage of curing that is 28 and 56 days let to a new increment in strength with the increase in GP% but not as much as conventional concrete.

The workability is as good as conventional concrete.

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

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