A Study on Performance of Concrete With Granite Powder as Fine Aggregate Replacement

Gururaj Hadimani[1], Sundip Shenoy[2]
[1, 2] Dept of Civil Engineering
[2]Asst. Professor, Dept of Civil Engineering
[1, 2] NMAM institute of Technology, Nitte,

Abstract- *Granite fine powder is the waste produced from the granite industry at rock proceeding polishing units. These waste fines are disposed in large area which cause effect on environmental and human health because granite fines are airborne and can easily inhaled. The experimental study has been carried out to know possibility of using granite fine powder and fly ash as a partial replacement by weight of natural fine aggregates and cement. The aim of the study to using granite fine powder and fly ash to improve the strength parameter and also study the optimum percentage of replacement in concrete*

The study was preparing a concrete of strength M25 with mix proportion of 1:1.69:3.01 with w/c ratio 0.45. Fine aggregate and cement is replaced by granite powder and fly ash by the weight respectively. Replacing of fine aggregate and cement (OPC 53) as 10%, 20% and 30%

The results are obtained by experimental investigation, it was noted that substituent of 10% fine aggregate and cement by weight with granite powder and fly ash was most effective in obtaining the maximum strength increasing in compressive strength compare to the normal concrete similar results are also noted that for split tensile strength and flexural strength increased at 10% replacement compare to the normal concrete.

Keywords- Granite powder (GP), Fly ash(FA),fine aggregates, combine replacement.

I. INTRODUCTION

Fine aggregate is a fundamental .constituent of concrete. The general utilization of run of the fine aggregate is high an outcome of thebbroad use in concrete. Principally the energy for ordinary stream of sand is high in made countries inferable from infrastructural progress. In this situation some making countries are going up against a need in the supply off fine aggregate. Thennon-openness of satisfactory measure of standard fine aggregate for influencing bbond to concrete is affecting the movement of the change business in various parts of the country. Consequently the movement tries in making countries are under stress to see reasonable materials to limit the demand on sand. in order to limit the dependence on standard aggregates as the noteworthy wellspring of aggregates in concrete deceitfully made aggregates and imposter aggregates produced using mechanical misuse give an isolating choice to the change business. Some appropriate materials have startin late been used as a touch of place of trademark conductor sand. For example fly impacting remains slag and lime stone siliceous stone powder shake clean and quarry waste were used as a touch of concrete mix as a lacking substitution of sand. Accordingly the Granite stone powder aggregate could be another choice to standard sand in arranging of concrete.

II. OBJECTIVES

- To design the concrete for M25 grade of concrete.
- Fine aggregates and cement is to be partially replaced by granite powder and fly ash respectively and arrived at final proportion.
- To optimize use of percent of granite powder and fly ash as replacement to basic ingredients.
- To study the properties of ingredients of concrete and design the concrete mix for various replacements.
- To study the properties and compare the strength and design the concrete mix for various replacement.

III. MATERIALS USED

A. Cement

OPC of 53 Grade was used throughout the Study. The cement was procured from the local market in Karkala, Karnataka. Initial tests for determining the basic requirements of the cement were conducted in accordance with the guidelines provided by IS: 12269-1987. The details of initial tests conducted on the cement have been listed in the following table.

Fig 1- Cement Sample

Table 1 – Properties of cement

Property	Test results
Normal consistency	29.6%
Specific Gravity	3.14
Initial setting time	110 minutes
Final setting time	270 minutes

B. Coarse Aggregates

The coarse aggregates used throughout the study have been procured from local quarry in Halakatte, Karnataka. The size of the aggregates used in the present study is 20 mm passing IS sieves. Tests were conducted on these aggregates as per the guidelines provided by IS: 2386 (Part III) 1963. The details of the tests conducted are tabulated in the following table.

Fig 2- Coarse Aggregate Sample

Table 2 – Properties of the coarse aggregates.

Characteristics	Test Results
Specific Gravity	2.84
Water Absorption	0.40%
Bulk density in loose state	1.40 kg/m^3
bulk density in compacted state	1.566 kg/m^3

C. Fine aggregates:

The locally available fine aggregates were used in present the study. The fine aggregates used were passing through 4.75 mm IS sieve. The test for determining the properties of the aggregates were conducted as per the guidelines prescribed the IS 383- 1970 and the results of the above tested have been tabulated in the following table

Fig 3 –Fine aggregates Aggregate Sample

Table 3 – Properties of the fine aggregates

Characteristics	Test Results
Specific Gravity	2.51
Water Absorption	2%
fineness modulus	2.306
Bulk density in loose state	1.42 kg/m^3
bulk density in compacted state	1.62 kg/m^3
Grading zone	III

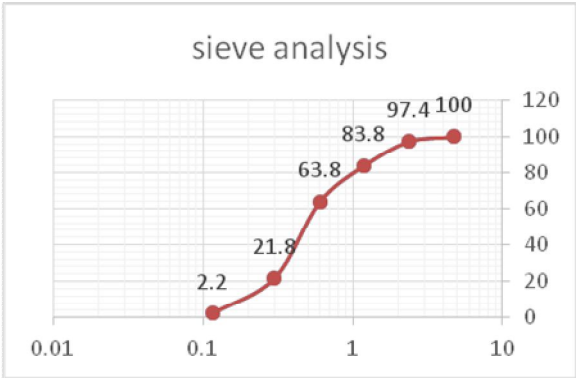

Fig 4- sieve analysis of Fine aggregates

D. Granite powder

The locally available Granite powder was used in present the study. The Granite powder used were passing through 300 microns IS sieve. The test for determining the properties of the Granite powder were conducted as per the guidelines and the results of the above tested have been tabulated in the following table.

Fig 5- Granite powder Sample

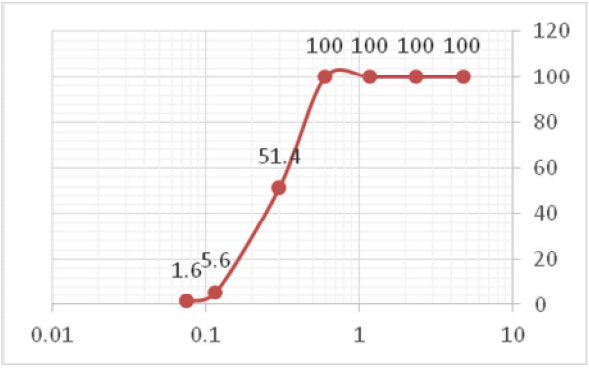

Fig 6- sieve analysis of Granite powder

Table 4 – Properties of the Granite powder

Particulars	Test Results
Specific Gravity	2.58
shape of the particle	Fine powder
Fineness Modulus	2.414
Grading Zone	Zone- III
Bulk density in loose state	0.52 kg/m^3

E. Fly ash

The fly ash used have been procured from udupi power corporation limited (UPCL) padubidri, Udupi. Fly ash conforming to requirement of code IS: 1727(1969) .The properties of the fly ash have been listed in the following table.

Table 5 – Properties of the fly ash

Test parameter	Results
Specific gravity	2.11
fineness of fly ash	384 m^2/kg

IV. EXPERIMENTAL PROCEDURE

Mix proportion 1:1.69:3.01.Four mix's casted were fine aggregate and cement was replaced with 0%, 10%, 20% and 30% granite powder and fly ash by weight respectively. All mixes has constant water cement ratio of 0.45.

A. Mix Proportion for M-25 Grade of concrete

Cement	Fine aggregates	Coarse aggregates
1	1.69	3.01

Table 4(A): Mix proportion of concrete

Ingredients (kg/m^3)	0%	10%	20%	30%
cement	400	360	320	280
sand	678.68	610.81	542.94	4754.07
Coarse agg	1206.54	1206.54	1206.54	1206.54
Granite powder	0	67.86	135.73	203.60
Fly ash	0	40	80	120
water	180	180	180	180

B. Preparation and casting of specimens

The standard size specimens were casted as per IS:516-1959, cubes of 150x150x150mm are casted for compression test, cylinder of size 150mm diameter x300mm height are casted for split tensile test, and 100x100x500mm size beams are casted for flexural test.

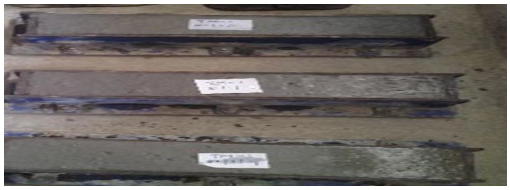

Fig 6 – Beam specimen

Fig 7- Cube specimens

C. Specimen testing

After the curing period of 7 days and 28 days, specimens are taken out from curing tank and surface wiped were off and test will be conducted for compression test for cubes (150x150x150mm), split tensile test for cylinders (150mm diax300mm height) and flexural test for beams (100x100x500mm) as per IS:516-1959.

Fig 8- Compressive testing

Fig 9- Split tensile testing

Fig 10- Flexural testing

V. TEST RESULTS

1. Compressive strength test results

Table 5.1.1: Replacement of granite powder by weight of fine aggregate

Compressive strength (MPa)		
% Replacement GP	7 days	28 days
0%	19.11	33.62
10%	21.77	35.55
20%	20.59	30.96
30%	19.55	29.18

Table 5.1.2: Replacement of fly ash by weight of cement

Compressive strength (MPa)		
% Replacement fly ash	7 days	28 days
0%	19.11	33.62
10%	26.21	43.55
20%	24.88	37.98
30%	20.88	31.55

Table 5.1.3: Combined replacement of granite powder and fly ash by weight of fine aggregate and cement respectively

Compressive strength (MPa)		
% Replacement GP + FA	7 days	28 days
0%	19.11	33.62
10%	26.96	41.48
20%	24.74	39.7
30%	22.36	36.59

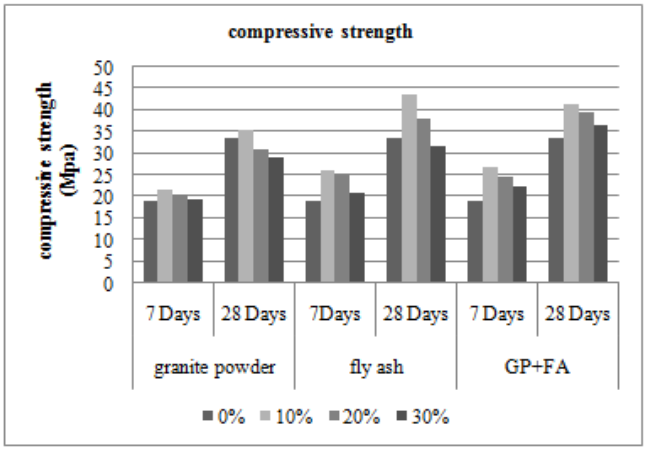

Fig 7 - Variation of Compressive strength in concrete with partial replacement of Granite powder and Fly ash with partial replacement by weight of fine aggregates and cement respectively.

2. Split tensile strength test results

Table 5.2.1: Replacement of granite powder by weight of fine aggregate

Split tensile strength (MPa)		
% Replacement granite powder	7 days	28 days
0%	1.83	3.34
10%	2.63	3.84
20%	2.35	3.1
30%	2.25	2.9

Table 5.2.2: Replacement of fly ash by weight of cement

Split tensile strength (MPa)		
% Replacement fly ash	7 days	28 days
0%	1.83	3.34
10%	2.88	3.6
20%	2.54	3.4
30%	2.09	3.22

Table 5.2.3: Combined replacement of granite powder and fly ash by weight of fine aggregate and cement respectively

Split tensile strength (MPa)		
% Replacement of GP+ FA	7 days	28 days
0%	1.83	3.34
10%	2.12	4.15
20%	1.98	3.78
30%	1.69	3.29

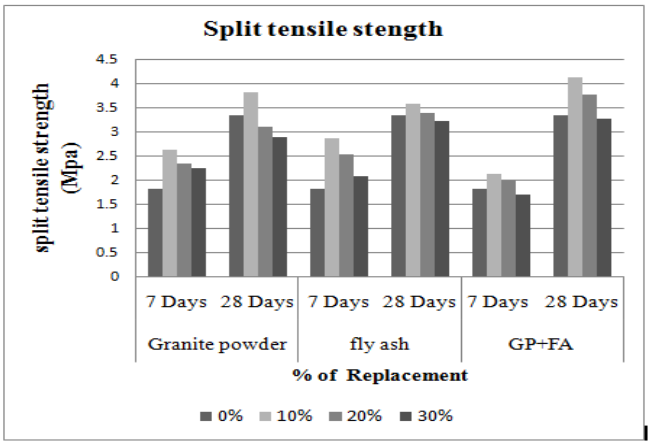

Fig 8 - Variation of Split tensile strength of concrete with partial replacement of Granite powder and Fly ash with partial replacement by weight of fine aggregates and cement respectively.

3. Flexural strength test results

Table 5.3.1: Replacement of granite powder by weight of fine aggregate

Flexural strength (MPa)		
% Replacement granite powder	7 days	28 days
0%	3.1	5.1
10%	3.4	6.6
20%	3.3	5.9
30%	3.2	4.8

Table 5.3.2: Replacement of fly ash by weight of cement

Flexural strength (MPa)		
% Replacement fly ash	7 days	28 days
0%	3.1	5.1
10%	3.6	5.7
20%	3.3	4.8
30%	2.9	4.6

Table 5.3.3: Combined replacement of granite powder and fly ash by weight of fine aggregate and cement respectively.

Flexural strength (MPa)		
% Replacement of GP+ FA	7 days	28 days
0%	3.1	5.1
10%	3.5	6.8
20%	3.4	6.7
30%	3.2	5.9

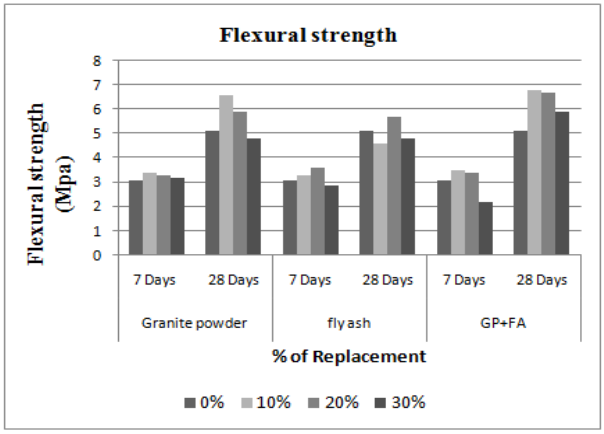

Fig 9 - Variation of Flexural strength of concrete with partial replacement of Granite powder and Fly ash with partial replacement by weight of fine aggregates and cement respectively.

VI. CONCLUSION

- The M25 grade concrete has been designed for normal conventional concrete and the replacement of fine aggregate and cement and designed.
- Granite fines powder and fly ash is to be replaced by weight of fine aggregates and cement respectively, and it shows the good workability and fluidity as normal conventional concrete.
- From test results of compressive strength, spit tensile strength and flexural strength tests shows 10% replacement of Granite powder and 10% Fly ash mix gives the maximum strength of concrete.
- The compressive strength and split tensile strength test results for replacement 10% Granite powder and 10% Fly ash on 28 days curing strength shows the 23% and 24% increase in strength compare to the normal concrete.
- Flexural strength test for replacement of 10% Granite powder and 10% Fly ash on 28 days curing strength shows 34% increase in the strength as compare to the normal concrete.
- It can be concluded that both Granite and Fly ash can be utilised in concrete at 10% replacement with fine aggregates and cement respectively.
- The effective utilisation of Granite powder and Fly ash in concrete can save natural resources and helps to address the issue of industrial waste disposal.

VII. ACKNOWLEDGEMENT

It gives me immense pleasure to extend my heartfelt gratitude towards Mr. Sundip Shenoy, Asst. Professor NMAM Institute of Technology, nitte.

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