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STRENGTH AND CHARACTERISTICS OF MODIFIED CONCRETE BY MEANS OF INDUSTRIAL BY-PRODUCTS

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Abstract - *The paper examines the possibility of using granite powder as replacement of sand and partial replacement of cement with fly ash, silica fume, slag and super plasticizer in concrete. The percentage of granite powder extra by weight was 0,10,20,30,40 as a substitution of sand worn in concrete and cement was restored with 7.5%silicafume,10%flyash,10%slag,1%superplasticiser.The belongings of curing temperature at 32 c at 0.40 water–to-binder(w/b)ratio for 7 and 28 days on compressive strength, flexural strength, tensile strength test concrete were studied .The chemical composition of the granite powder and the compressive strength, flexural strength and split tensile strength of concrete containing granite waste was determined. The concrete used was of grade M20, ratio of 1:1.5:3 and granite was replaced partially by 10%, 20%, 30%, and 40% to the weight of cement. The compressive strength, flexural strength and split tensile strength was determined at curing ages 7 and 28 days. The decrease in compressive strength beyond 30% substitution for 7 days and beyond 20% for 28 days. A sharp decrease was observed in split tensile strength beyond 30% granite powder substitution for 7 days and beyond 20% for 28 days. A sharp decrease was observed in flexural strength beyond 20% granite powder substitution for 7 days and 28 days. Experimentally results that the increases in the ratio of granite powder resulted in a diminish in the compressive strength of concrete finally, the overall performance exposed that granite powder can be utilized as a partial replacement of fine aggregate and cement.*

Key Words: Granite waste, fly ash, silica fume, super plasticizer, slag, strength.

1. INTRODUCTION

Fine aggregate is an important constituent of concrete. The most usually worn fine aggregate is natural river sand. The global use of natural river sand is very sky-scraping due to the general use of concrete. In exacting, the insist of natural river sand is quite high in urban countries due to infrastructure growth. The non-availability of enough amount of regular river sand for manufacture cement concrete is affecting the expansion of construction industry in various parts of the country. Recently, Tamil Nadu government (India) has required limits on sand exclusion from the river beds due to its useless impact on the environment. Alternatively, the granite waste generated by the industry has concentrated over years.

With the gigantic increases in the quantity of waste needing disposal, acute shortage of dumping costs impose the need for valuable utilization of this waste. The paper is aimed at increasing a concrete with the granite an industrial waste as alternate material for the fine aggregate and cement. By responsibility so, the objective of decreasing the cost of construction can be met and it will also help to conquer the problem related with its disposal as well as the environmental problems of the region. Hence this paper will observe M20 grade of concrete were spread by varying the percentage substitute of sand and cement with granite waste. The cost distinction between the conventional concrete and the granite powder concrete required were also originated.

2. EXPERIMENTALWORK

The investigational program integrated first the establishment investigation on the materials used in the study i.e. ingredients of concrete. The results are mentioned below.

2.1 Materials used

a) Cement

The most presented Portland cement of grade 53 in agreement to IS: 12269-1987 has been used. The physical properties of the cement secured on conducting appropriate tests as per IS: 269/4831 and the necessities as per IS 12269-1987are given in Table 2.1.

b) Coarse Aggregate

Hard busted granite stones were used as a coarse aggregate in concrete. Size of the coarse aggregate worn in the exploration was 10 to 20mm. The specific gravity of the coarse aggregate is 2.89.

Table 2.1 Properties of Cement

S.No	Properties	Tested values
1	Standard consistency test	33%
2	Initial setting time	35 min
3	Final setting time	290 min
4	Specific gravity	3.15
5	Fineness test	3.2%

c) Fine Aggregate

In the recent work, the concrete mixes were arranged using nearby available river sand. The sand used was detaining to Zone 3. Sheerness modulus and specific gravity of the sand were initiate to be 2.33 and 2.76 respectively.

d) Water

Water is an essential constituent of concrete as it in reality participates in the chemical reaction with cement .In common, water fit for intake is appropriate for mixing concrete. Contamination in the water may affect setting time, strength, decline of concrete or support corrosion of reinforcement. Locally accessible drinking water was used in the present work.

e) Granite waste

Granite applies to igneous rock family. The density of granite is among 2.65 to 2.75 g/cm^3 and compressive strength will be greater than 200Mpa. Granite powder accessed from the polishing units and the properties were established. Considering the granite powder to incline the particle size distribution. From hydrometer analysis it was originate that the Coefficient of curvature was 1.95 and coefficient of consistency was 7.82. The specific gravity of the granite waste was creating to be 2.61. Table 2.2 gives the chemical composition of granite powder.

Table 2.2. Properties of Granite Waste

S. No	Properties	Values
1	Porosity	Very low
2	Absorption	0.5 to 1.5%
3	Specific gravity	2.6 to2.8
4	Density	2500-2650kg/m^3
5	Crushing strength	1000-2500kg/m^3
6	Frost resistance	Good
7	Fire resistance	Low
8	Color	Mostly light colored

f) Admixture

i) Super plasticizer was old for the duration of investigation to progress the workability of concrete per Indian Standards; the amount of super plasticizer should not surpass 2% by weight of cement. A higher amount of super plasticizer may hindrance the hardening process. After trails the optimal amount of super plasticizer was originate to be 0.5% to make slump of 100mm.Table 2.3 gives the chemical properties of cement and industrial waste.

Table 2.3 Chemical Properties of Cement and Industrial Waste

Composition	Cement	Granite waste	Fly ash	Silica fume	Slag
CaO	63.8%	2.61%	5.0%	0.5%	0.8%
SiO2	21.4%	82.25%	52%	96%	56%
Al_2O3	5.1%	5.11%	23%	1.0%	1.5%
Fe2O3	2.6%	2.63%	11%	1.5%	2.0%
MgO	0.36%	0.65%	nil	2.0%	2.2%
Na2O	0.14%	0.98%	0.8%	0.4%	0.6%
K2O	1.88%	0.98%	1.0%	3.0%	5.0%
SO3	3.38%	4.36%	1.0%	0.5%	0.5%
Specific gravity	3.15%	2.72%	2.17%	2.2%	2.4%

ii) Concise silica fume is measured as the most efficient micro filler for high recital concrete. Its two fold things are decline of w/c ratio and increases of hardened concrete. The silica fume worn in this study was in the powder form and enclosed 95% SiO, 0.39% 2CAO, 0.21% MgO, 0.11% KO,

0.15% NaO, 0.13% AlO,) 40%FeO. The properties of silica fume result in more capable gel.

iii) Fly ash was well thought-out in the present study as a substitution of cement in 10%. It is a fine, glass the invention of electricity. Fly ash improves significantly the recital of binder phase and raises the bonding action with aggregate and reinforcement. The properties of fly ash may vary. Considerably according to several factors such as the geographical foundation of the source coal. Conditions throughout combustion and sampling position inside the power plant. The foremost elemental constituents of fly ash are Si,Al,Fe,Ca,C,Mg,K,Na,S,Ti,P and Mn.

iv) Slag is the ground granulated blast furnace slag was used 10% beside with other admixtures as a replacement of cement.

3. DETAILS AND MIX PROPORTIONS

Concrete combine with w/c ratio of 0.40 was arranged. The information of mix proportions for $1m^3$ of concrete are shown in Table 3.1.

Table 3.1 Material Required for 1 M^3 of Concrete (Kg/M^3)

Grade	Cement	Fine aggregate	Coarse aggregate	Water
M20	478.95	626.778	1215.18	191.58

Mortar cubes of 1:3 proportions are finished with metal moulds of size 70.6mm x70.6mm x70.6mm.(1 part of OPC 53 grade and 3 parts of sand by weight. proportion of granite waste replaced with cement and fine aggregate by weight was 0%, 10%, 20%, 30%, 40%. Three cube specimens were casted for each specified proportions and are cured for 7 and 28 days. After curing, mortar cubes are belongs to compression testing. The character of said combinations was assessed. With these new combinations of fly ash, silica fume slag and super plasticizer admixtures are prepared with respect to concrete in varying proportions of 10% 20%, 30%, 40% as shown in Table 3.2, 3.3. Admixtures adopted as a fly ash, silica fume, and slag and are expediently designated.

3.1. Preparation of Test Specimens

The granite waste composed from polishing units was desiccated. As per the mix proportions, the quantities of different ingredients were weighted. Initially sand and granite powder were mixed carefully additional cement and coarse aggregate to the mix. Once all the resources were mixed well, 1%of super plasticizer was added to water and water containing superplasticiser was extra to the dry mix to form concrete. Cubes of size 150mmx150mmx150mm and cylinder 150mm x300mm, prism 500mm x100mm were cast. The specimens were cured in curing tank for a time of 28 days.

3.2 Test results

a) Compressive strength

Fig. 3.1 Compressive strength test

The compressive strength on concrete was passed out on a compressive testing machine of capacity 2000KN. For the compressive strength test as shown in Fig.3.1, a loading rate of 1KN/min. was enforced as per IS: 516-1959.The specimen used was 150mm cube. The test was executed at 7, 28 days. The specimens were tested instantly after charming the cubes from curing tank in exterior dry condition.

Table 3.2 Replacement of Granite with Cement

Mix designation	Compressive strength		Split tensile strength		Flexural strength	
	7 days	28 days	7 days	28 days	7 days	28 days
GP0	12.6	21.6	1.02	2.07	3.12	4.18
GP10	25.4	28.2	1.52	2.56	3.96	4.34
GP20	23.2	27.4	1.38	2.36	3.58	4.46
GP30	20.6	24.3	1.18	2.27	3.23	4.16

b) Split tensile strength

The split tensile strength of concrete is generally established by testing plain concrete cylinders. Cylinders of size 150mm x 300mm were used to find out the split tensile strength. After curing, the specimens were tested for split

tensile strength by means of a calibrated compression testing machine of 2000KN capacity.

c) Flexural strength

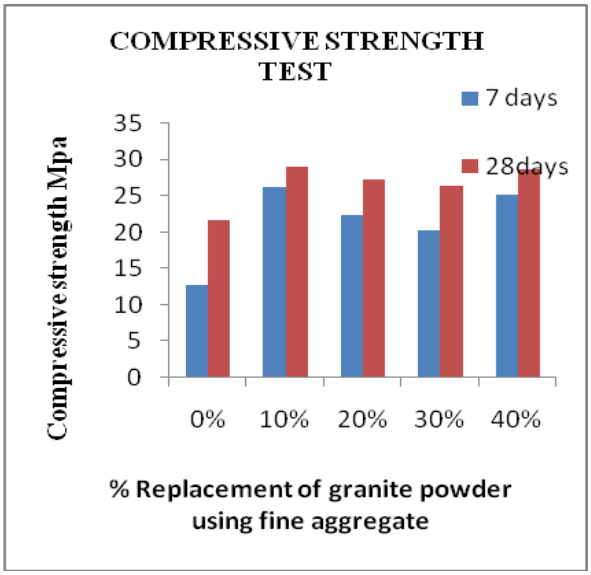
The flexural strength of concrete is typically passed out on a flexural testing prism of size 500mm x100mm x 100mm were used to observe the flexural strength. After curing, Fig.3.2 shown the specimens were tested for flexural test by universal testing machine of 2000KN capacity.

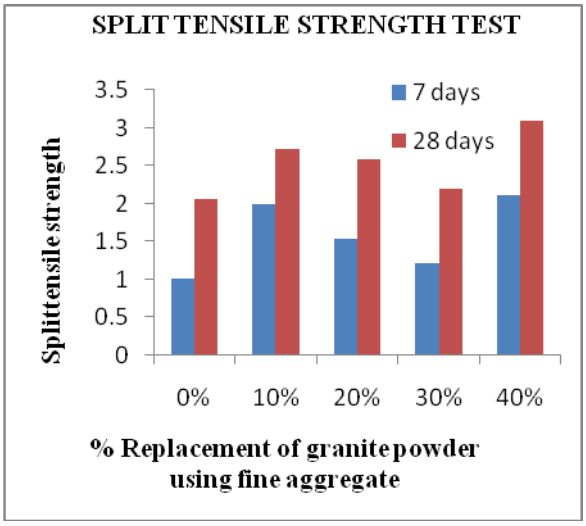
Table 3.3 Replacement of Granite waste with Fine aggregate

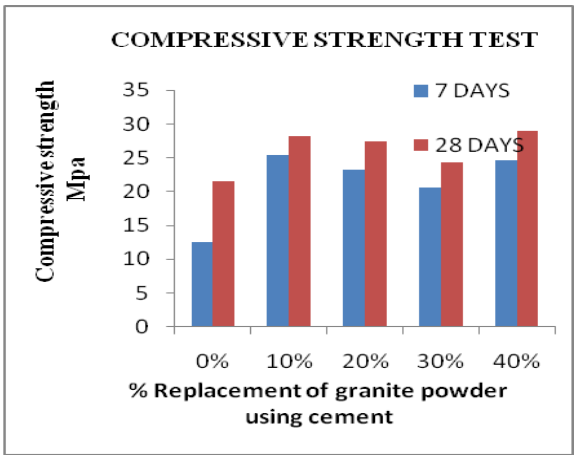
Mix designation	Compressive strength		Split tensile strength		Flexural strength	
	7 days	28 days	7 days	28 days	7 days	28 days
GP0	12.6	21.6	1.02	2.07	3.12	4.18
GP10	26.2	29.0	2.0	2.73	4.08	5.34
GP20	22.4	27.3	1.54	2.58	3.92	5.22
GP30	20.3	26.3	1.22	2.20	3.38	4.45

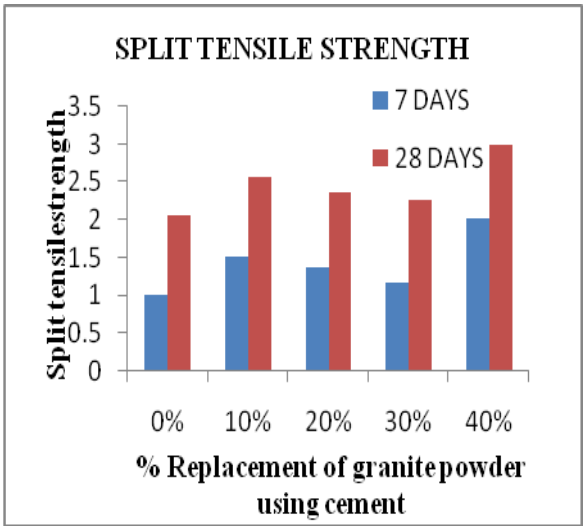
Fig.3.2 Flexural Strength Test

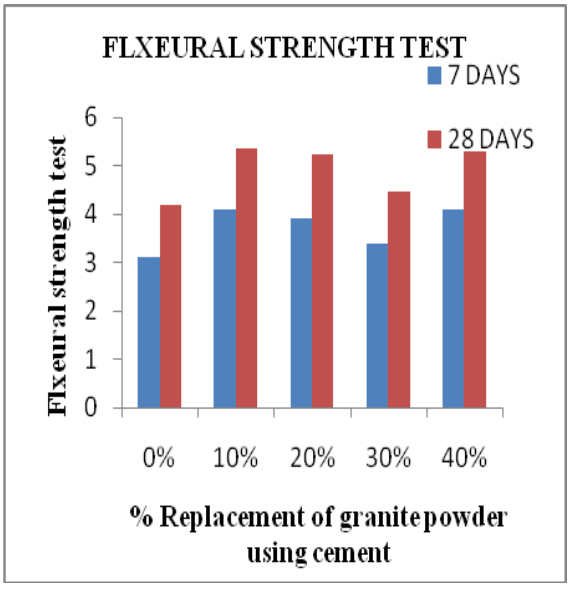
4. RESULTS AND DISCUSSIONS

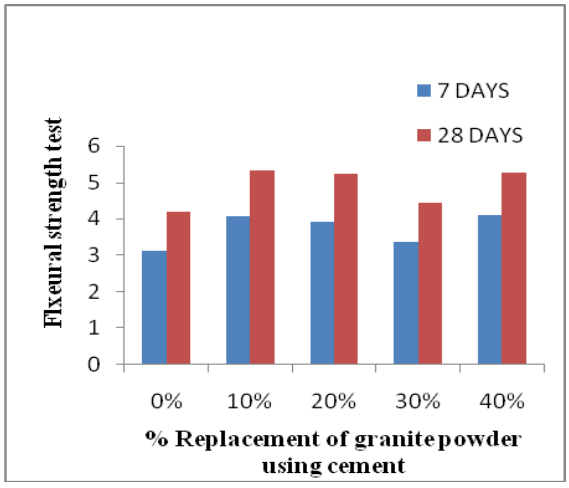












5. CONCLUSION

Replacement of cement and fine aggregate with granite waste is set up to progress the strength of concrete. The most favorable percentage quantity of replacement is found to be 30%. Utilization of granite powder will keep away from the disposal problems and associated environment issues. Utilization of granite waste will diminish the usage of river sand and preserve natural resources.

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