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"AN EXPERIMENTAL INVESTIGATION ON STRENGTH OF GRANITE-FINES CONCRETE"

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Abstract:

Construction Industry contributes huge amounts to Indian economy and concrete is one of the best materials used in construction. The ingredients used in it include Cement, Sand, Gravel and water. Now-a-days sand is not easily available and recently Government of Andhra Pradesh has imposed certain restrictions on its usage. So sand has become very costly and time has come to search for identifying suitable material for its replacement. In this study an attempt is made to find the suitability of Granite Fines as a replacement option to Natural Sand.

The study evaluates the impact of curing age and mix proportions on the compressive strength of M 20 Grade concrete cubes subjected to partial replacement of sand with granite fines. A total of 75 cubes of 150 mm X 150 mm X 150mm dimensions were cast and cured in water for 3, 7, 28, 60 and 90 days with sand replacement by granite fines ranging from 0 to 40% respectively.

The control mix of 28 day target strength of 27.6 N/mm2 (using Indian standard) was adopted. The study reveals that at 28 days with increase in % of granite fines, initially compressive strength increased till 30% and afterwards it decreased. With increase in days of curing, compressive strength of concrete cubes is increasing. So the optimum replacement level was taken as 30% replacement of sand by granite fines. At this level the compressive strength increased with curing age at a decreasing rate beyond 28 days. The target compressive strength of 27.6 N/mm2 was achieved for this mixture at 7 days of curing. Granite fines content and curing age is having a significant impact on the compressive strength of concrete with granite fines.

Key words: Granite fines, Compressive strength, Sand replacement, Curing Age, Mix Proportions.

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1. INTRODUCTION

Construction Industry a growing industry at a phase of 15% per annum is challenging policy makers to frame out policies which aid and promise a better standard of living to the common man. This industry is promising a contribution of around 8 percent of the country's GDP in past ten years. Initial construction industry did not focus on pollution it is causing by using of certain components in its ingredients. Now construction industry is developing policies which promote use of environmental friendly products and practices which make a better living for people in present and in the future. The construction industry needs more and more sand for its generation of sophisticated and superior buildings. With the present restrictions on its usage by Government of Andhra Pradesh, there is a need for us to identify and select a suitable product for it.

1.1 Present Work

In the present study we casted cement concrete cubes & cylinders with 0%, 10%, 20%, 30% and 40% replacement of sand with granite fines. The method adopted in the investigation used as per the code specifications of IS 456: 2000, and IS 2386. The water Cement Ratio adopted is 0.5 with a mix design ratio of water: Cement: Sand: Gravel is 0.5:1:1.73:3.3 respectively.

1.2 Research Objectives:

Consequently the main objective of this research is to

(1) To investigate the potential use of granite powder in concrete as replacement for Fine aggregate.

(2) Determining the degree of strength improvement in concrete obtained after addition of granite powder

2. REVIEW OF LITERATURE

Sudhir.S.Kalpate et.al (2013) studied about effect of quarry dust as a partial replacement of sand in concrete and has revealed that with increase of percentage of granite fines resulted in decrease in workability and compressive strength reached maximum at replacement percentage of 25% and later decreased. [5]

Behoria.B.V, et.al (2013) Opined that Natural sand can be replaced partially with waste products like rock flour (40%) and also recommend usage of 20 % replacement of natural sand by crushed granite fines when laying rigid concrete pavements.[2]

Babafemi Adewumi John and Olawuyi Babatunde James (2012) investigated on effect of replacement of sand with Granite fines on the compressive and tensile strength of Palm Kernel Shell concrete and felt that 100 % replacement of Natural sand by Crushed Granite fines is possible and Compressive and Tensile strength increases with increase in crushed Granite fines and with the curing Age. [1]

B.S.Waziri, et.al. (2011) revealed that quarry sand can be used as a fine aggregate in the production of medium grade concrete and to obtain the desired compressive strength of 25 N/mm^2 partial replacement of Natural sand by Quarry sand has to varied at an interval of 10% up to the maximum value of 100%.[6]

Manasseh Joel (2010) also recommended that 20 % replacement of

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natural sand by crushed granite fines when laying rigid concrete pavements gives increased compressive strength and can be adopted. [4]

kanmalai Williams.C et.al (2008) studied about mechanical properties of high performance concrete incorporating granite powder as fine aggregates and has opined that with increase in replacement proportion of sand with granite fines Compressive strength of concrete decreases.[3]

3. MATERIALS & RESEARCH METHODOLOGY

3.1 Materials Used:

(a) Cement: The most common available Portland cement of 53 grades was selected for the investigations. It was dry, powdery and free of lumps, because every care was taken to avoid contact with moisture. Initial setting time of 55 minutes, Final setting time of 350 minutes and Specific Gravity of cement is 3.1.

(b) Water: In general, water fit for drinking is suitable for mixing concrete. Impurities in the water may affect concrete, setting time, strength. Hence locally available purified drinking water was used in present work.

(c) Granites: Granites was used as fine aggregate in concrete. Granites are plutonic light colored igneous rocks. The word granite is derived from Latin word granum meaning a grain. Many types of granites are distinguished on the basis of relative abundance of some accessory minerals and special textural features (hornblende-granite, augite granite etc). They generally possess all the essential qualities of a good building stone showing very high crushing strength, low absorption values etc.

Table 3.1 Properties of Granite

S.No	Properties	Values
1	Absorption	1%
2	Specific Gravity	2.8
3	Crushing Strength	2500 kg/m2
4	Color	Mostly Light Colored
5	Fineness Modulus	2.41

(d) Fine aggregate: The percentage of granite powder by weight ranging from 0 to 40% as a replacement of sand was used in concrete. In the present study locally available river-sand was adopted passing 4.75 mm to 150 microns retained. Specific Gravity of Sand is 2.7 and Fineness modulus is 2.33. Sieve analysis was carried out for the sand and granite powder was passed through a No4 (4.75 mm) sieve was 96 and for granite powder was 100.

(e) **Coarse Aggregate:** Locally available gravels of size 20 mm passing 10 mm retained are taken and specific gravity of coarse aggregate is arrived as 2.6. The mix proportions adopted is M20.

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3.2 Best specimens & Procedure

The granite scrap are initially broken into pieces and then fed into abrasion machines with required amount of chargers, and allowed for 10000 revolutions. The granite powder was collected and its properties were tested.

A tilting type rotary drum in which all ingredients are properly introduced is used for obtaining rich mix. First coarse aggregate is placed and 40% of water is added for allowing water absorption. After mixing for 20 seconds the fine aggregate with cement properties added and 40% of water is added and allowed for mixing 15 to 20 seconds. This was followed finally by adding granite waste and cement with 20% of water and allowed for 20 seconds.

Cube and cylinder specimens were cast and tested for studying the variation in strength properties due to replacement of fine aggregate. The entire test specimen was cast in removable cast iron moulds and vibration table is used for vibration. The de-moulded specimens after Completion of 1 day were cured at water temperature of 27 degree centigrade (+/-2 degree centigrade). Different batches were adopted for 3 days, 7 days, 28 days, 60 days and 90 days ages.

The various strength properties studied were compressive strength, split tensile strength, Modulus of elasticity and water penetration test. The dimensions and the number of specimens used for the present study are listed in below table. The various specimens cast were tested after curing for required period. Compressive strength and split tensile strength were determined using compression testing machine (CTM) of 2000 KN capacity

Table 3.2 Details of Specimen

Material Properties	Shape and Dimensions of Specimens	No of Specimens
Compressive Strength (3,7,28,56,90 days)	Cube 150 mm X 150 mm X 150 mm	50

4. RESULTS & DISCUSSION

In order to facilitate the analysis, interpretation of results is carried out at each phase of the experimental work. This interpretation of the results obtained is based on the concrete knowledge available in the literature as well as on the nature of results obtained. The significance of the result is assessed with reference to the standards, specified in relevant IS codes.

Table 4.1 Cement Properties

Characteristic of cement	Value
Fineness of cement	94.73%
Normal consistency cement	33%
Initial setting Time	55 minutes
Final setting time	350 minutes
Specific Gravity	3.1

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Table 4.2 Sand Properties

Properties	Unit	Results
Specific gravity	-	2.7
Bulking of sand	%	4
particle size variation	mm	0.15 to 4.75
Water absorption for sand	%	1
Bulk Density of Sand	kg/m^3	1460
Fineness modulus of sand.	%	3.5

Table4.3 Sieve Analysis Data for the Sand

IS sieves (mm)	Weight retained (gm.)	% of weight retained	Cumulative % of weight retained	% passing
4.75	13	1.3	1.3	98.7
2.36	102	10.2	11.5	88.5
1.18	315	31.5	43.0	57
0.6	206.5	20.65	63.65	36.35
0.3	294	29.4	93.05	6.95
0.15	61.5	6.15	99.2	0.8
Pan	8	0.8	100	0

Table 4.4 Granite Properties

Properties	Values
Water Absorption	1.%
Specific Gravity	2.6
Color	Mostly Light Colored
Fineness Modulus	2.35

Table 4.5:- Coarse aggregate properties

Properties	Unit	Results
Specific gravity	-	2.72
Particle size variation	mm	6.3 to 20mm
Fineness Modulus	-	4.506
Water Absorption	%	0.5
Bulk Density	kg/m^3	1469.8

Table 4.6 Sieve analysis data for coarse aggregate.

IS sieves (mm)	Weight retained	% weight retained	Cumulative % weight retained	% passing
20	2522	50.44	50.44	49.56
12.5	2366	47.32	97.76	2.24
10	100	2.00	99.76	0.24
4.75	12	0.24	100	0

Table 4.7 Slump Value.

Combination Code	% of sand replaced by Granite	Slump (mm)
GF0	0	40
GF10	10	45
GF20	20	43
GF30	30	42
GF40	40	40

It is observed that the slump value increases with increase in % replacement of sand with granite fines for the same w/c ratio. However the increase is in a controlled manner and is within 25% in its variation when compared with reference mix (GF0).

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Table 4.8 Compaction Factor Test:

Combination Code	% of sand replaced by Granite	Compaction Factor
GF0	0	0.89
GF10	10	0.88
GF20	20	0.87
GF30	30	0.86
GF40	40	0.85

The variation of workability is measured in terms of compaction factor with constant w/c ratio (0.5). The values are obtained for different mixes such as GF0 (0% granite fines), GF10 (10%), GF20 (20%), GF30 (30%), and GF40 (40%) are 0.89, 0.88, 0.87, 0.86, 0.85 respectively.

In this study the compressive strength is magnificent at 30% granite powder addition and mixes with higher % then 30% showed lesser compressive strength than the mix with no addition of granite fines to river sand. The reason may be attributed to increased amount of fine granite powder present in mixes. Compressive strength increases as curing age increased. 90 days cured concrete cubes resulted in higher compressive strength compared to 3 days cured concrete cubes, the reason can be attributed to mixes with cubes cured more than a month results in resisting higher loads by gaining strength.

Table 4.9 Compressive Strength for different percentage of granite fines at different ages of curing of concrete.

% of Granite fines replacing Sand	Compressive Strength (N/ mm^2)				
	3 days	**7 days**	**28 days**	**60 days**	**90 days**
0	20	25	28	31	34
10	20	24	26	30	32
20	22	26	28	31	34
30	23	27	30	33	36
40	20	23	25	29	32

5. CONCLUSION

From the test results it is clearly evident that granite powder as a partial replacement of sand proves to be beneficial when mechanical properties of strength is considered. Concrete mix with 30 % addition of granite fines proves to be better when compared with other proportions.

Compressive Strength, particularly in all the ages higher than reference mix (GF0), there was an increase in strength as the days of curing increases. The compressive strength with 30 % addition of granite fines yielded higher value compared with other values.

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6. REFERENCES

I. Babafemi, A.J.; Olawvyi,B.J.; Olusula, K.O., Influence of curing age and mix composition on compressive strength of volcanic Ash blended cement laterized concrete, Civil Engineering Dimension-Journal of civil Engineering Science and application, Vol 14, pp 84-91

II. Bahoria B.V.; Parbat, D.K.; and Naganaik, P.B., Replacement of Natural Sand in Concrete by waste products: A state of Art, Journal of Environment Research and development, V 17, April-June 2013, PP 1651-1656.

III. Kanmalai Williams.C.; Partheeban,P.; and Felix Kala,T., Mechanical Properties of High Performance concrete incorporating granite Powder as fine aggregate, International Journal on design and Manufacturing technologies, Vol 2, July pp 67-73.

IV. Manasseh Joel., Use of crushed Granite fine as replacement to River Sand in concrete production, Leonardo Electronic Journal of practices and technologies, issue 17, July-December 2010, pp 85-96.

V. Sudhir S. Kapgate.; and Satone, S.R., Effect of Quarry dust as partial replacement of sand in concrete, Indian streams Research Journal, Volume 3, issue 5, June 2013, pp 1-8.

VI. Waziri,B.S.; Bukar,A.G.; and Gaji,Y.Z.A., Applicability of Quarry Sand as a fine Aggregate in the production of medium grade concrete, Continental Journal of Engineering Sciences,2011.