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Partial Replacement of Fine Aggregate with Granite Fines

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***Abstract*: Granite fines are the byproduct of granite industries while cutting huge granite rocks to the desired shapes. The granite powder from factory is carried by the water and stored in tanks. After evaporation of water the granite dust remained in the tank. Then it is transported and disposed on the land. Hence an effect is made to utilize this fine granite powder in as a filler material in concrete. The major problem of disposing the fines in land leads to various environmental hazards like pollution in air and land. The granite fines exhibit the properties of fine aggregate such as size, fineness and filler capabilities. For investigation purpose cubes are casted with 4 different proportions of granite fines and fine aggregate. The replacement percentage of granite fines to fine aggregate are 0%, 30%, 35%, 40%, for M20 mix proportions, specimens are tested after 28 days of curing, for compression strength, flexural and split tensile strength. The specimen casted with 40 % replacement of granite fines to fine aggregate gives higher strength when compared to control specimen**

***Keywords*: Ordinary Portland cement, Fine aggregate, Coarse aggregate, Granite fines and Concrete properties.**

1. Introduction

Concrete is the most popular building material in the world. 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. The worldwide consumption of sand as fine aggregate in concrete production is very high, and several developing countries have encountered some strain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years. A situation that is responsible for increase in the price of sand, and the cost of concrete. Expensive and scarcity of river sand which is one of the constituent material used in the production of conventional concrete. The use of Crushed Granite Fine (CGF) as an alternative to natural sand. The Granite fines use up to 20% as a partial replacement for natural sand in the production of concrete.

2. Material Properties

1) Material used

- Cement
- Coarse Aggregate
- Fine Aggregate
- Replacement of Granite fines (partial Replacement of fine aggregate 30%, 35% & 40%)
- Admixture
- Water

2) Cement

The materials of cement were used in an ordinary Portland cement super grade (53grade) is used. This cement is most commonly used in concrete construction.

Table 1
Physical Properties of Cement

S. No.	Properties Cement	Result
1	Specific Gravity	3.15
2	Standard consistency	30%
3	Initial Setting Time	32 mins
4	Final Setting Time	9.30 hrs

3) Coarse Aggregate

Aggregates are the important and large used constituents in concrete. They give bond to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. Analysis of combined aggregates confirms the specifications for graded aggregates.

Table 2
Properties of Coarse Aggregate

S. no.	Properties of Coarse Aggregate	Result
1	Specific Gravity	2.90
2	Impact value	39.7
3	Water absorption	2.3
4	Bulk Density	0.75
5	Crushing Test	12.5
6	Flakiness Test	20.1
7	Elongation Test	26.00
8	Abrasion Test	14.2

4) Fine aggregate

Sand collected from nearby river is used for this project. The various properties of sand are tabulated in Table

Table 3
Properties of fine Aggregate

S. No.	Description	Value
1	Specific Gravity	2.89
2	Bulk Density	0.79
3	Sieve Analysis	Zone-III

5) Granite Powder

Granite belongs to igneous rock family. The density of the

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granite is between 2.65 to 2.75 g/cm3 and compressive strength will be greater than 200MPa. Granite powder obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the powder to determine the particle size distribution. From hydrometer analysis it was found that coefficient of curvature was 1.95 and coefficient of uniformity was 7.82. The specific gravity of granite powder was found to be 2.5.

Table 4
Physical Properties of Granite Fines

S. No.	Description	Value
1	Specific Gravity	2.63
2	Bulk Density	0.72
3	Sieve Analysis	Zone-IV

6) Water

Water is an important ingredient of the concrete as it actually participates in the chemical reaction with cement. In general, water fit for drinking purpose is suitable for mixing concrete. Impurities in the water may affect setting time, strength, shrinkage of concrete or promote corrosion of reinforcement. Locally available drinking water was used in the present work.

3. Experimental investigation Test on Hardened Concrete

1. The Compressive Strength
2. The Split Tensile Strength
3. The Flexural Strength

1) Compressive Strength Test

The concrete cubes were crushed at 7, 14, and 28 days in order to determine the compressive strength of the cubes. The compressive strength is determined by dividing the maximu m of failure load of the specimen during the test by the cross sectional area of the specimen.

Compressive strength = $\frac{P}{A}$ (N/mm^2)

where

P - Load (N)

A - Area (mm^2)

2) Split Tensile Strength

Split tensile strength of concrete is usually found by testing plain concrete cylinders. Cylinders of size150mm x 300 mm were used to determine the split tensile strength. After curing, the specimens were tested for split tensile strength using a calibrated compression testing machine of 4000kN capacity. It can be observed that at a 30,35,40% replacement of granite powder, an optimum for 7,14 & 28 days.

Split tensile strength =(N/mm^2) $\frac{2P}{\pi dl}$

Where,

- P - Load (N)
- D - Diameter of specimen (mm) L: Length of the specimen (mm)

3) Flexural Strength

The determination of flexural strength is essential to estimate the load at which the concrete members may crack. The flexural strength at failure is the modulus of rupture.

The modulus of rupture is determined by testing standard test specimens of size 100 X 100 X 500 mm.

Flexural Strength = $\frac{3Pa}{bd^2}$ (N/mm^2)

where

P - Load (N)

a - Diameter of specimen (mm) b - Breath of the specimen (mm) d- Depth of the specimen (mm).

4. Results and Discussion

Table 5
Compressive Strength of Conventional vs. Granite Fine Concrete

S. No.	Mix	Average compressive strength (N/mm^2)		
	(%)	7 days	14 days	28days
1	0	19.24	24.15	33.6
2	30	21.92	24.15	35.84
3	35	21.16	24.44	34.66
4	40	20.45	23.70	30.95

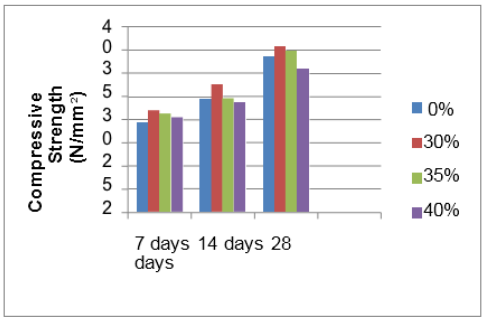

Fig. 1. Compressive strength of conventional vs Granite Fine Concrete

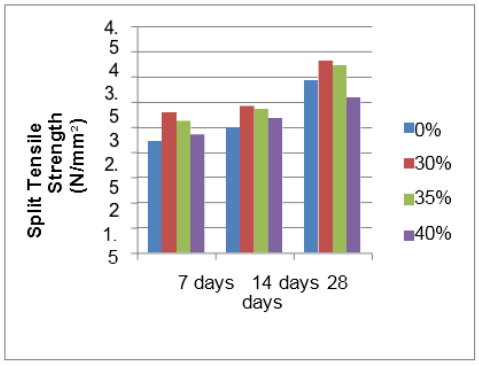

Fig. 2. Split Tensile Strength of Conventional Vs Granite Fine Concrete

Table 6
The Split Tensile Strength of Conventional Vs Granite Fine Concrete

S.No.	Mix	Average split tensile strength (N/mm^2)		
	(%)	7 days	14 days	28days
1	0	2.21	2.49	3.44
2	30	2.78	2.92	3.83
3	35	2.63	2.87	3.72
4	40	2.35	2.68	3.10

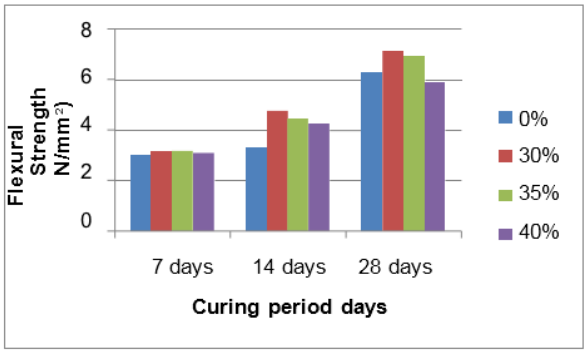

Fig. 3. Flexural Strength of Conventional Vs Granite Fine Concrete

Table 7
Flexural Strength of Conventional vs. Granite Fine Concrete

S. No.	Mix	Average Flexural strength (N/mm^2)		
	(%)	7 days	14days	28days
1	0	3.025	3.326	6.27
2	30	3.17	4.75	7.12
3	35	3.18	4.46	6.95
4	40	3.10	4.27	5.89

5. Recommendation

Based on the results of the test, it is recommended that 40% CGF is optimum for replacement Fine aggregate. it is as well economical for use in concrete works.

6. Conclusion

The specimen casted with 40 % replacement of granite fines to fine aggregate gives higher strength when compared to control specimen with the compressive strength of 1.06% increased, Split tensile strength of 1.11% increased and Flexural strength of 1.14% increased. When to compare to conventional concrete. With addition of admixture. The specimen cast with 35% replacement of fine aggregate by granite fines gives better compressive strength of 1.03% increased, Split tensile strength of 1.08% increased and Flexural strength of 1.01% increased. When to compare to conventional concrete. The Replacement of granite fine at 30% gives less result when compare to conventional concrete. The management of waste granite powder is a main goal of this project. The granite fine concrete has better strength at 10% replacement. The Replacement of granite fine in concrete gives more Economical and provides better performance.

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