

## International Journal of Innovative Research in Science, Engineering and Technology

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# To Investigate the Effect on Concrete by the Partial Replacement of Fine Aggregate with Granite Powder

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**ABSTRACT:** Granite is an igneous rock which is widely used as construction material in different forms. Granite industries produce lot of dust and waste materials. The wastes from the granite polishing units are being disposed to environment which cause health hazard. This granite powder waste can be utilized for the preparation of concrete as partial replacement of sand. In order to explore the possibility of utilizing the granite powder as partial replacement to sand, an experimental investigation has been carried out. The percentages of granite powder added by weight to replace sand by weight were (0%, 5%, 10%, 15%, 20% and 25%) and various tests such as compressive strength, Split tensile strength and Flexural strength are investigated and these values are compared with the conventional concrete without granite fines. Standard cube of 150X150X150mm will be cast and tested for obtaining 28-day compressive strength. Standard cylinder of 150mm diameter and 300mm height will be cast and tested for split tensile strength. Standard beam of 500X100X100 will be cast and tested for flexural strength. Then analyze all the result mathematically and graphically.

**KEYWORDS:** Granite Powder, Compressive strength, Split tensile strength, Flexural strength.

### I.INTRODUCTION

Fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand. The global consumption of natural river sand is very high due to the extensive use of concrete. In particular, the demand of natural river sand is quite high in developed countries owing to infrastructural growth. The non-availability of sufficient quantity of ordinary river sand for making cement concrete is affecting the growth of construction industry in many parts of the country. Recently, Tamil Nadu government (India) has imposed restrictions on sand removal from the river beds due to its undesirable impact on the environment. On the other hand, the granite waste generated by the industry has accumulated over years. Only in significant quantity has been utilized and the rest has been dumped unscrupulously resulting in pollution problems. With the enormous increase in the quantity of waste needing disposal, acute shortage of dumping sites, sharp increase in the transportation and dumping costs necessitate the need for effective utilisation of this waste. There sent work is aimed at developing a concrete using the granite scrap, an industrial waste as a replacement material for the fine aggregate. By doing so, the objective of reduction of cost of construction can be met and it will also help to overcome the problem associated with its disposal including the environmental problems of the region. Accordingly this project work will examine M25 grades of concrete were cast by varying the percentage replacement of sand with granite powder.

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## II. EXPERIMENTAL WORK

### MATERIAL TO BE USED

There are many types of concrete available, created by varying the proportion of the main ingredients below. By varying the proportions of the materials, or by sub situation for the cement and aggregate phases, the finished products can be tailored to its application with varying strength, density or chemical and thermal resistance properties.

The mix design depends on the type of structure being built, how the concrete will be mixed and delivered and how it will be placed to form this structure.

### CEMENT

The name cement goes back to Roman times when a concrete –like masonry made of crushed stone pieces with burned lime and water as binding material was called opus Cementation. Later the combination of brick powder and volcanic tuff with burned lime used as hydraulic binder was called cementation and cement. The importance of clay content concerning the hydraulic properties of a naturally occurring mixture of limestone and clay was discovered by J. Smeaton of England as he was looking for a water resistant mortar.

### ORDINARY PORTLAND CEMENT (OPC)

Ordinary Portland cement (OPC) is by far the most important type of cement. All the discussion that we have done in the previous chapter and most of the discussions that are going to be done in the previous chapter and most of the discussions that are going to be done in the coming chapters to OPC. The OPC was classified into three grades, namely 33 grade 43 grade 53 grade depending upon the strength of the cement at 28 days. If the 28 days strength is not less than 43 N/mm<sup>2</sup>, it is called 43grade cement, and if the strength is not less than 53 N/mm<sup>2</sup>, it is called 53grade cement. But the actual strength obtained by these cements at the factory are much higher than the BIS specifications.

The manufacturer of OPC is decreasing all over the world in view of the popularity of blended cement on account of lower energy consumption, environmental pollution, economic and other technical reasons. In advanced western countries the use of OPC has come down to about 40 percent of the total cement production. In India for the year 1998-99 out of the total cement production i.e. 79 million tons, the production of OPC was 57.00 million tons i.e. 70%. The production of PPC was 16 million tonnes i.e. 19% and slag cement was 8 million tons i.e. 10%. In the year to come the use of OPC may still come down, but all the same the OPC will remain as an important type of cement for faster construction . It is estimated that during 2009 about 75% of concrete is made by using blended cements or blending material.

### WATER

Combining water with a cementitious material forms a cement paste by the process of hydration. The cement paste glues the aggregate together, fills voids within it and allows it to flow more freely. Less water in the cement paste will yield a stronger, more durable concrete; more water will give a free- flowing concrete with a higher slump. Impure water used to make concrete can cause problems when sitting or in causing premature failure of the structure. Hydration involves many different reactions, often occurring at the same time. As the reactions proceed, the products of the cement hydration process gradually bond together the individual sand and gravel particles, and other components of the concrete, to form a solid mass.

### AGGREGATES

Aggregates are the important constituent in concrete. They give body to the concrete, reduce shrinkage and effect economy. Sand, natural gravel and crushed stone are mainly used for this purpose .Recycled aggregates (from construction ,demolition and excavation waste) and over brunt brick chips are increasingly used as partial replacements

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of natural coarse aggregates, while a number of alternatives including stone dust and quarry dust are also available a replacement of natural fine aggregates.

Decorative stones such as quartzite, small river stones or crushed glass are sometimes added to the surface of concrete for a decorative “exposed aggregate” finish popular among landscape designers.

## FINE AGGREGATES

Aggregates are inert granular materials such as sand gravel or crushed stone that along with water and Portland cement are an essential ingredient in concrete. Aggregates strongly influence concrete’s freshly mixed and hardened properties, mixture proportions and economy. Consequently, selection of aggregates is an important process. Although some variation in aggregate properties is expected, characteristics that are considered include:

- Durability
- Particle shape and surface texture
- Abrasion and skid resistance
- Unit weights and voids
- Absorption and surface moisture

## GRANITE POWDER-

Granite belongs to igneous rock family. 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. General properties of commonly available granite are given in Table 1.

S.N o.	Properties	Values
1	Porosity	Very low
2	Absorption	0.5 to 1.5%
3	Specific Gravity	2.6 to 2.8
4	Density	2500-2650 kg/m <sup>3</sup>
5	Crushing strength	1000-2500 kg/m <sup>2</sup>
6	Frost resistance	Good
7	Fire resistance	Low
8	Color	Mostly light coloured

## Chemical Composition of granite powder

S.No	Chemical properties of glass powder	% by mass
1	SiO <sub>2</sub>	72.04(silica)
2	Al <sub>2</sub> O <sub>3</sub>	14.42(alumina)
3	Fe <sub>2</sub> O <sub>3</sub>	1.22
4	TiO <sub>2</sub>	0.30
5	CaO	1.82
6	MgO	0.71
7	Na <sub>2</sub> O	3.69
8	K <sub>2</sub> O	4.12
9	P <sub>2</sub> O <sub>5</sub>	0.12
10	FeO	1.68

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## METHODOLOGY OF WORK

1. Several, literature were reviewed before starting the work to understand the subject better.
2. Specific test on the material which was used in the desertation work was made to know the specification and quality of material.
3. Mix designing for M25 grade of self-compacting concrete was done by using EFNARC guideline and IS 10262-2009.
4. The percentages of granite powder added to replace sand by weight were (0%, 5%, 10%, 15%, 20% and 25%).
5. Gives curing to all sample for 28 days.
6. Testing all samples for compressive strength, flexural strength and split tensile strength.
7. Plotting the results.
8. casting, mixing and curing of concrete:
9. Once the mix design and all the required tests on ingredients of concrete are done and their suitability is found satisfactory, the task of casting cubes, beams and cylinders was taken up. The available laboratory equipment's were utilized in accomplishing the experimental program. The guidelines in IS-10262: 1982 were strictly followed in mixing. Coarse aggregate was washed a day before casting to make it silt free and the laid to dry. On the day of casting, coarse aggregate remained satisfactorily moist so that it does not absorb any further water from the mix i.e. the design of water cement ratio is carefully regulated. The moulds used for cubes, beams and cylinders were of steel having an internal dimension of 150 mm x 150 mm x 150 mm for cube, 100 mm x 100 mm x 500 mm for beam and 150 mm x 300 mm for cylinder. The cement, coarse and fine aggregate were mixed thoroughly with the help of mechanical mixer. Then granite powder is dispersed to the above mixture while mixer is working. For all test specimens, moulds were kept on table vibrator and the concrete was poured into the moulds in three layers by tamping with a tamping rod and the vibration was effected by table vibrator after filling up the moulds. The moulds are kept in vibration for one minute and it was maintained constant for all the specimens. The granite powder is varied in a fraction of 0%, 5%, 10%, 15%, 20%, 25 %.
10. 3 cubes, 3 beams and 3 cylinder specimen are made for each set.
11. The moulds were removed after 24 hours and the specimens were kept immersed in a clear water tank. After curing the specimens in water for a period of 28 days .

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Partial Replacement of Fine aggregate by Granite powder (0%, 5%, 10%,15%,20%,25%)

Number of cube sample per replacement (150mmx150mmx150mm) = 3

Number of cylinder sample per replacement (150mmx300mm) = 3

Number of beam sample per replacement (100mmx100mmx500mm) = 3

S.No.	% replacement	Cement(kg)	Fine Aggregate(kg)	Coarse Aggregate(kg)	Water (W/C=0.41) (kg)	Granite Powder (kg)
1	0	22.92	30.49	54.57	9.39	0
2	5	22.92	28.96	54.57	9.39	1.52
3	10	22.92	27.44	54.57	9.39	3.049
4	15	22.92	25.91	54.57	9.39	4.57
5	20	22.92	24.39	54.57	9.39	6.098
6	25	22.92	22.86	54.57	9.39	7.62

## III. RESULT AND DISCUSSION

### 3.0 GENERAL

The study is conducted to analyze the compressive, split tensile and flexural strength of M25 grade concrete with partial replacement of fine aggregate by granite powder in various percentages (5%, 10%, 15% , 20%,25%). There were total 18 specimens of cubes (150 mm x 150 mm x150 mm), 18 Cylinder Specimens (150 mm x 300 mm), and 18 Beam specimens (100 mm x 100 mm x 500 mm). All the specimen was tested for compressive strength, split tensile strength and flexural strength after curing for 28 days. The results of all the tested specimen is given below.

#### Compressive Strength of concrete at 28 days

% Replacement	Compressive Strength in N/mm <sup>2</sup>	% Increase in Strength
0	31.64	0
5	32.12	1.51
10	33.16	4.80
15	35.63	12.61
20	33.61	6.22
25	31.26	1.20

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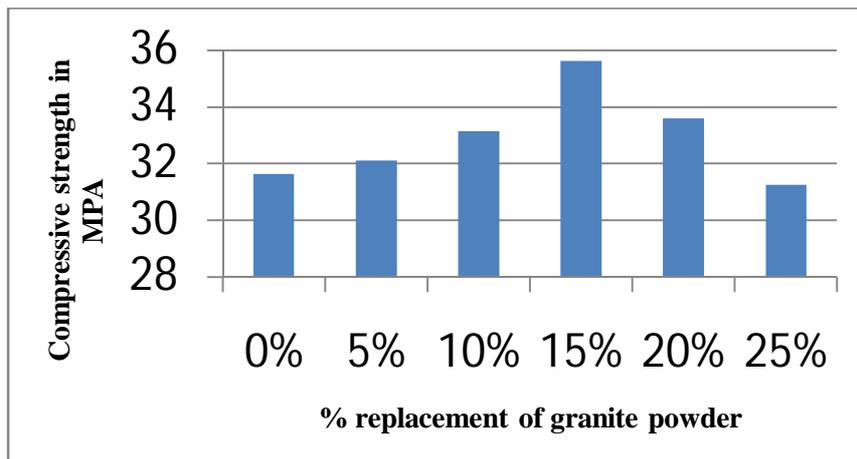


Chart-1 Variation in compressive strength



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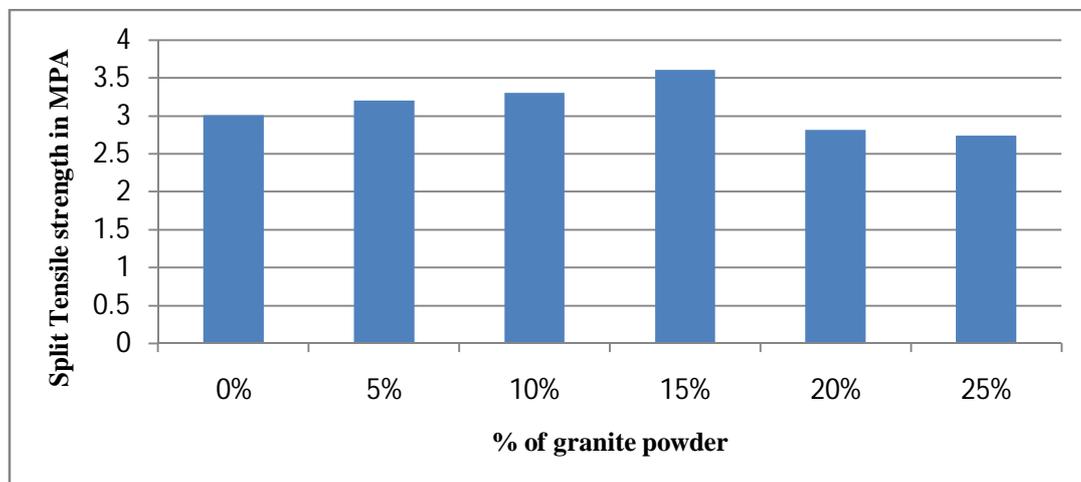
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### Split Tensile Strength of concrete at 28 days

% Replacement	Split Tensile Strength	% Increase in Strength
0	3.01	0
5	3.21	6.64
10	3.31	9.96
15	3.61	19.93
20	2.82	6.31
25	2.74	4.20

### Variation of split tensile strength for different percentage of granite powder



### Flexural Strength of concrete at 28 days

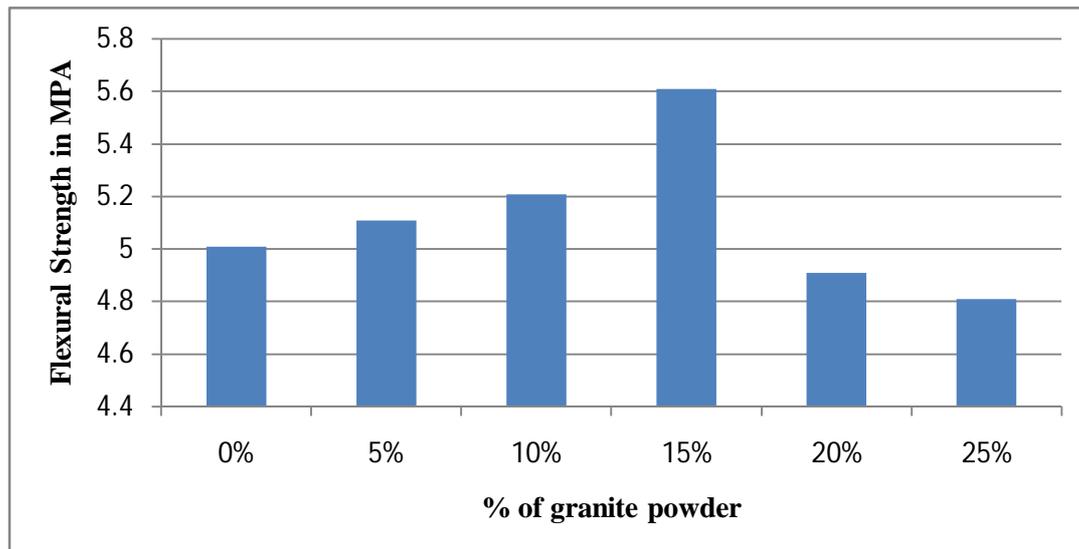
% Replacement	Flexural Strength	% Increase in Strength
0	5.01	0
5	5.11	1.99
10	5.21	3.99
15	5.61	11.97
20	4.91	1.92
25	4.81	1.82

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Variation in flexural strength

### IV. CONCLUSION

1. It has been found that the compressive strength gives maximum value for partial replacement of granite powder 15%. Compressive strength increases around 13% as compared to conventional concrete.
2. Split tensile strength increases around 20%. The quantity of granite powder 15% of the weight of cement.
3. Flexural strength increases at 12% of granite powder by the weight of cement. Flexural strength increases around 15%.

### REFERENCES

1. Dr.G.Prince Arulraj, Mr.A.Adin and Mr.T.Suresh Kannan "GRANITE POWDER CONCRETE", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.3, No.1, February 2013.
2. A ARIVUMANGAI1 AND T FELIXKALA2 "Fire Resistance Test on Granite Powder Concrete", International journal of earth sciences and engineering ISSN 0974-5904, Volume 08, No. 02 April 2015, P.P.301-306
3. S.Vishnu Shankar1, K.Saravana Raja Mohan2, "Durability Studies on Cement Mortar with Granite Powder as A Partial Replacement of Cement" International Journal of ChemTech Research CODEN (USA): IJCRGG ISSN: 0974-4290 Vol.8, No.3, pp 1417-1422, 2015
4. Divakar Y., Manjunath S. and Dr. Aswath M.U, (2012), "Experimental investigation on behaviour of Concrete with the use of granite fines", International Journal of Advanced Engineering Research and Studies, Vol. I Issue IV, pp.84-87.
5. J. Thivya 1, M. Arivukkarasi2, "Comparative Analysis on Partial Replacement of Cement by Metakaolin and Fine Aggregate by Granite Powder", International Journal of Advanced Engineering Research and Technology (IJAERT) Volume 4 Issue 4, April 2016, ISSN No.: 2348 – 8190.
6. P. L. Chowdary, Studies on Strength Properties of "Effect of Waste Granite Powder on the Compressive Strength of Concrete " Journal of Environmental Science, Computer Science and Engineering & Technology JECET; June 2015- August 2015; Sec. A; Vol.4.No.3, 716-727. E-ISSN: 2278-179X .
7. M. Manikandan, Dr. T. Felixkala, "EXPERIMENTAL STUDY ON PROPERTIES OF GRANITE WASTE IN SELF COMPACTING HIGH PERFORMANCE REINFORCED CONCRETE BEAM", International Conference on Current Research in Engineering Science and Technology (ICCREST-2016).
8. Raghavendra R1, Sharada. S. A2, G. Narayana3 , "FLEXURAL STRENGTH OF HIGH PERFORMANCE CONCRETE USING GRANITE POWDER AS FINE AGGREGATE " ,IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308 .
9. N . Kiran Kumar, "AN EXPERIMENTAL INVESTIGATION ON STRENGTH OF GRANITE-FINES CONCRETE" , International Journal of Science & Technology ISSN (online): 2250-141X www.ijst.co.in Vol. 4 Issue 2, September 2014 .
10. Allam M. E., Bakhom E. S., Ezz H. and Garas G. L., "INFLUENCE OF USING GRANITE WASTE ON THE MECHANICAL PROPERTIES OF GREEN CONCRETE", ARPN Journal of Engineering and Applied Sciences VOL. 11, NO. 5, MARCH 2016 ISSN 1819-6608.

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(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

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11. Dr.T. Felix Kala, "Properties of Granite Powder Concrete", 1st International Conference on Infrastructure Development, UMS Surakarta, 1 – 3 Nov 2013 ISBN: 978-979-636-154-4.
12. T. Felixkala and P. Partheeban, "Granite powder concrete", Indian Journal of Science and Technology Vol. 3 No. 3 (Mar 2010) ISSN: 0974-6846 .
13. K.Chiranjeevi reddy, Y.Yaswanth Kumar, P.Poornima, "Experimental Study on Concrete with Waste Granite Powder as an Admixture", Int. Journal of Engineering Research and Applications ISSN : 2248-9622, Vol. 5, Issue 6, ( Part -2) June 2015.
14. Tanveer Asif Zerdi, "Strength and Durability Properties of Granite Powder Mixed Concrete", Volume : 5 | Issue : 5 | May 2016 • ISSN No 2277 - 8179 | IF : 3.508 |.
15. Raghavendra , "COMPRESSIVE STRENGTH OF HIGH PERFORMANCE CONCRETE USING GRANITE POWDER AS FINE AGGREGATE", IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 |.
16. Dilip Kumar, "EFFECT OF PARTIAL REPLACEMENT OF CEMENT BY FLY ASH AND ADDITION OF GRANITE POWDER ON THE PROPERTIES OF CONCRETE", International Journal of Computer & Mathematical Sciences IJCMS ISSN 2347 – 8527 Volume 3, Issue 5 July 2014.
17. K.Chiranjeevi reddy, "Experimental Study on Concrete with Waste Granite Powder as an Admixture", K.Chiranjeevi reddy Int. Journal of Engineering Research and Applications [www.ijera.com](http://www.ijera.com) ISSN : 2248-9622, Vol. 5, Issue 6, ( Part -2) June 2015, pp.87-93.
18. Dr. G. Elangovan , "EXPERIMENTAL STUDY OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH GRANITE DUST POWDER", International Journal On Engineering Technology and Sciences – IJETSTM ISSN (P): 2349-3968, ISSN (O): 2349-3976 Volume 2 - Issue 6, June 2015 .
19. Shehdeh Ghannama , "Experimental study of concrete made with granite and iron powders as partial replacement of sand", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2350-3258, Vol.3, No.4, February 2014.
20. Allam M. E., "RE-USE OF GRANITE SLUDGE IN PRODUCING GREEN CONCRETE", ARPN Journal of Engineering and Applied Sciences VOL. 9, NO. 12, DECEMBER 2014 ISSN 1819-6608.
21. IS 8112 (1989): Specification for 43 grade Ordinary Portland cement [CED 2: Cement and Concrete]
22. IS 4031-3 (1988): Methods of Physical test for hydraulic cement, Part 3: Determination of soundness [CED 2: Civil Engineering]
23. IS 650 (1991): Specification for standard sand for testing of cement [CED 2: Cement and Concrete]
24. IS 383 (1970): Specification for Coarse and fine Aggregate from Natural Sources for Concrete [CED 2: Cement and Concrete]
25. IS 456 (2000): Plain and Reinforced Concrete – Code of practice [CED 2: Cement and Concrete]