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EXPERIMENTAL INVESTIGATION BY USE OF GRANITE FINE WASTE IN CONCRETE

[1]Sahil Sanjeev Salvi, [2]Srinath Avinash Chavan, [3]Akash Rajesh Dangat, [4]Siddhart Shital Kore, [5]Swapnil Maruti Londhe

[1]Assistant Professor, [2]Student, [3]Student, [4]Student, [5]Student

[1]Department of Civil Engineering,

[1]Pimpri Chinchwad College of Engineering and Research, Pune, India

Abstract: In the world of the construction industrial era, the waste generated from the stone industries cause environmental problems. At the same time, Construction industries face many problems not only at the end of the life cycle of the products but also at the beginning of it. It is also significant to develop low-cost building material by the waste produced by stone industry. Therefore, the reuse of Granite fine waste material in the construction industry can be emphasized to produce low-cost concrete. This Project aims at innovative use of Granite Fine waste in concrete by replacing the fine aggregate which is the other alternative that can be used in conventional concrete. The proposed work is investigated for a concrete mix of M20 grade with 0%,10%,20%, and 30% of Granite Fine waste used as the replacement of fine aggregate. A series of 12 cubes are cast and tested after 28 days for the compressive strength. The result appears that the compressive strength of concrete increases up to 10% after the replacement of fine aggregate with Granite fine waste and further, it decreases as the percentage of granite increases.

Index Terms **- Granite Fine Waste, Compressive Strength, Grade of Concrete.**

I. INTRODUCTION

Granite is an important structural and ornamental stone and it also has high compressive strength and durability, it is used extensively for massive structural work. Fine-grained granite that takes and preserves good polish is employed for ornamental and monumental works and also for inscription purposes. The word granite is derived from the Latin word 'granum', which is a grain. Solid waste is produced mainly from industrial processing, mining, and agriculture, and is disposed of inefficiently. The waste produced at the time of mining, processing, and finishing of rocks such as granite, marble, sandstones, consists of a large quantum of the total solid waste. Since there is an increase in population day by day is resulting in demand for building of infrastructure has increased constantly. Concrete is the most widely used manmade construction material in the world whereas the most ingredient in concrete is cement, fine aggregate, and coarse aggregate. For construction purposes river sand is used as fine aggregate in concrete. Recently in India many states like Rajasthan, Tamil Nadu have imposed restrictions on sand removal from the river beds due to unsafe impacts threatening and has forced the search of feasible alternative materials. The complete and proper disposal of this waste is not possible, and the only way to minimize the damages caused by it is its complete utilization. This waste, although with no proper method of disposal, has a potential for usage as a partial or complete replacement of aggregates in cement mortar, or can be used as a Fine aggregate substitute in concrete.

II. AIM

To Investigate experimentally compressive strength by use of Granite Fine waste in Concrete with varying proportion of Granite Fines for M 20 Grade of concrete.

III. OBJECTIVES

The main objective is to study the influence of Granite fine waste in concrete.

- To evaluate the potential use of granite powder in concrete as a replacement for natural sand.
- To examine the degree of strength improvement in concrete obtained with the addition of granite powder.
- To analyse the result of compressive strength with different proportion of granite fines with that of conventional concrete.

IV. LITERATURE REVIEW

Anandhu Ramesh, Sravanan.S, Kanesh Pandian.M, and Charles Raja P investigated the grade of concrete and the percentage of substitution of granite powder with various percentage. The cubes are prepared by 0%,10%,15%,20% of fine/natural aggregate substitution Granite Powder by-product on the behavior of concrete, compressive strength on cubes is performed. Experimental results revealed that compressive strength and axial stress strain behavior of the substitution rate up to 20% is fairly greater than values obtained with natural aggregates and it is suggested that substation of natural aggregates by GP by-product up to 20% is favorable for the concrete resistance.

G. Ganesh Naidu, M Sri Durga Vara Prasad, N. Narendra investigated to discover the combined effect of granite cutting waste and recycled concrete on the workability and mechanical properties of self-compacting concrete. In this experiment the granite cutting waste is replaced with fine aggregate at 0%, 20%,40%,60%,80%, and 100% proportions. Recycled concrete is replaced with coarse aggregate starting from 20 to 100%. Total 36 mixes of cubes were designed to check the fresh and hardened properties. Slump flow and T500, vfunnel, and Lbox tests are conducted to know the flow ability and passing ability of concrete. The result obtained is that the Granite Cutting Waste and Recycled Concrete values are increasing, Slump flow values are gradually decreasing. The reason behind this is, increasing viscosity and nonbonding behavior of recycled concrete and granite cutting waste. As the GC waste and RC values are increasing, Slump flow values are gradually decreasing. The reason behind this is, increasing viscosity and nonbonding behavior of recycled concrete and granite cutting waste.

Dr.G. Prince Arulraj, Mr. Adin and Mr. Suresh Khanna obtained the test result that replacement of fine aggregate with granite powder is found to improve the strength of concrete after the replacement of15% of Fine Aggregate with Granite powder. The utilization of granite powder will avoid disposal problems and related environmental issues. The utilization of granite powder will reduce the usage of river sand and conserve natural resources. The Various percentages of granite powder are added by weight to replace sand by weight which are 0%, 5%, 10%, 15%, 20%, and 25%. To improve the workability of concrete 0.5% Superplasticizer was added. 54 cubes and 36 cylinders were cast. Compressive strength and split tensile strength were found. The test results represent that granite fine as replacement sand has a beneficial effect on the mechanical properties such as compressive strength and split tensile strength of concrete.

Manasseb Joel determined the suitability of Crushed granite fine to replace river sand in concrete production for use in rigid pavement. Various tests like Slump, compressive and indirect tensile strength tests were performed on concrete.40.70N/mm2 and 2.30N/mm2 are the values obtained as high compressive and indirect tensile strength respectively with the partial replacement of river sand with 20% Crushed Granite Fine, as against values of 35.00N/mm2 and 1.75N/mm2, obtained with the use of river sand as fine aggregate after 28 days of curing the. Based on the results of tests obtained, river sand can be replaced with 20% Crushed Granite fine and is recommended for use in the production of concrete for use in the rigid pavement. Conservation of river sand in addition to better ways of disposing wastes from the quarry sites are some of the merits of using Crushed Granite Fines.

Kanamalai Williams C, Partheeban P, Felix Kala T. investigated the high-performance concrete made with replacement of fine aggregate with granite powder. The various percentage of granite powder was added by weight. 0%, 25%, 50%, 75%, and 100% as a replacement of fine aggregate used in concrete and cement was replaced with 7.5%Silica fume, 10% fly ash, 10% slag, and 1% superplasticizer. The effects of curing temperature at 32 0.40 Celsius water binder (w/b) ratio were there for 1, 7, 14, 28, 56, and 90 days which is shown on various test like compressive strength, split tensile strength, modulus of elasticity, drying shrinkage, and water penetration of concrete were studied. Experimental results show that there is an increase in the proportions of granite powder resulted in a decrease in the compressive strength of concrete. After the replacement of 25% granite powder concrete, the highest compressive strength was shown which was 47.35 kPa after 90 days. The overall conclusion revealed that granite powder can be utilized as a partial replacement of fine aggregate in high-performance concrete.

V Methodology and Investigation

5.1 Methodology:

A series of 9 cubes specimens and 3 conventional concrete cubes are cast and tested for compressive strength.

To achieve the aim and objectives, a methodology developed is as follows:

1. Casting of the cube and check for Compressive Strength with conventional concrete for mix M20 is carried out.
2. The Casting of the cube with replacement of Fine Aggregate with Granite fines for mix M20 with varying percentage is done.
3. Testing of the above said cube at 28 days for compressive strength is done respectively.
4. Compressive Strength result tests are compared with that of the conventional concrete strength.

5.2 Experiment and Investigation

The experimental program is designed to study the bond strength of Granite Fines wastes with varying percentages replacing Fine Aggregate in concrete. The replacement of Fine Aggregate is done at 0%, 10%, 20%, and 30% in M20 concrete mix which is later used in the casting of the cubes. Cube specimens of 150 mm x 150 mm x 150 mm are cast and are kept in water for curing to 28 days for testing the compressive strength of concrete

5.3 Material to be Used

1. Cement: Ordinary Portland cement of 53 grade is used in this experimentation conforming to I.S- 8112- 1989.
2. Fine Aggregate: Fine aggregates are the second ingredient of the aggregate phase in concrete. Sand is the most commonly used fine aggregate in concrete. Fine aggregates that pass from 4.75 mm (No.4) sieve but are retained on 75um (No.200) sieve.
3. Coarse Aggregate: The coarse aggregates used for the concrete are 20 mm passing and retained on a 4.75mm.
4. Water: Potable water is used for the experimentation.
5. Granite: Granite belongs to the igneous rock family. The density of the granite is between 2.65 to 2.75 g/cm3. The material is ordered from Granite Powder Company named Rajendra R Raibagi situated in Gajendragad, Karnataka, India. The type of Granite used is a Mixture of Himalayan Blue and Mudgal Grey.

Table 1 Material Testing

Materials	Specific Gravity	Water Absorption	Grading
Coarse Aggregate	2.61	0.54	As per table 2 of IS383
Crushed Sand	2.66	2.0	Zone 2 as per Table4 of IS 383
Granite Fines	2.7	0.5 to 1.5%	---

Table 2 Chemical Compound of Granite Powder

Chemical Compound	Chemical Formula	Weight in %
Silica	SiO_2	70.86
Alumina	Al_2O_3	01.89
Ferric Oxide	Fe_2O_3	02.39
Calcium Oxide	CaO	00.80
Magnesium Oxide	MgO	02.02
Sodium Oxide	Na_2O	09.34
Potassium Oxide	K_2O	04.71
Loss on Ignition	LOI	02.06

5.4 Material Testing

Fine aggregate and coarse aggregates are tested before the experiments and checked for conformity with relevant Indian standards. Specific gravity test and water absorption test of course aggregate are conducted as per IS: 2386 (Part III)1963. Specific gravity test of fine aggregate is done as per IS: 2720 (Part II)1973.

5.5 Concrete Mix Proportions

Concrete for M20 grade is prepared. A mixed proportion of 1: 1.5: 3 with 0.5 water-cement ratio to get a characteristic strength of M20 which are considered for this experimental study. The exact quantity of materials for each mix is calculated for one cube.

5.6 Preparation of Mix Design

Four sets of mix design were prepared with the use of different substituents such as follows:

1. Cement + fine aggregate + 20 mm coarse aggregate + water
2. Cement+ (Granite Fines 10% + Fine aggregate 90%) + coarse aggregate + water
3. Cement + (Granite Fines 20%+ Fine aggregate 80%) + coarse aggregate + Water
4. Cement + (Granite Fines 30% + Fine Aggregate70%) + Coarse aggregate +Water

These concretes were prepared and cast in 150mm concrete mould to take the compressive test. After 24 hours these moulds were De-moulded and set for curing in a water tank. The compressive tests were taken in 28 days respectively to check the results.

Table 3 Material Required For 1 Cube

Sr. No	% Of Granite Powder	Coarse Aggregate in Kg	Fine Aggregate in Kg	Cement in Kg	Granite Powder in Kg
1	0%	5	2.5	1.7	0
2	10%	5	2.25	1.7	0.25
3	20%	5	2	1.7	0.5
4	30%	5	1.75	1.7	0.75

5.7 Mixing and Casting

Thorough mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that the mass becomes homogenous, uniform in colour, and consistency. There are two methods adopted for mixing concrete:

(i) Hand mixing (ii) Machine mixing

From two methods, hand mixing is efficient and also economical for small concreting work.

An in-house casting setup is done in the Laboratory of Civil department using Cubes of 150mm x 150mm x 150mm.

5.8 Curing

The process of providing adequate temperature, moisture and time to allow concrete achieve to the desired properties for it is termed as 'Curing'. The cubes are stored in the moist air of at least 90% relative humidity a place free from vibration, and at a

temperature of 27°C for 24 hours. After this period, the cubes are marked and removed from the mold and unless required for the test within 24 hours, immediately submerged in clean fresh water and kept there until taken out just before to the test for 28 days.

5.8 Testing:

Compression test is to be conducted on cubes on proposed experimentation work.

5.9 Compression Test:

The Compression test is the most common test conducted on concrete. The test is easy to perform and gets most of the desirable characteristics properties of concrete which is related to its compressive strength. The compression test is carried out in the cube of the size 150 x 150 x 150 mm. The cubes are filled with 0%, 10%, 20%, and 30% with Granite Fines. Each layer is compacted by hand compaction. After the top layer has been compacted the surface of the concrete is brought to the finished level with the top of the mold, using a trowel. After 24 hours the cubes are remoulded and are shifted to a curing tank wherein, they are allowed to cure for 28 days. After 28 days of curing the cubes, are tested on a digital compression testing machine as per I.S. 5161959. The failure load is noted. The compressive strength is calculated as follows:

Compressive strength (MPa) = Failure load divided by cross-sectional area.

VI Result and Discussion

In this study, the different percentages of Granite Fine as 0%, 10%, 20%, and 30% were replaced by Fine Aggregate in concrete. Results obtained in this research have been given in subtitles as 'compressive strength'.

Compressive Strength:

Results of Compressive strength for M20 grade of concrete on cube specimen with 0%, 10%,20%, and 30% with Granite Fine replacement of Fine aggregate in concrete are shown in the table.

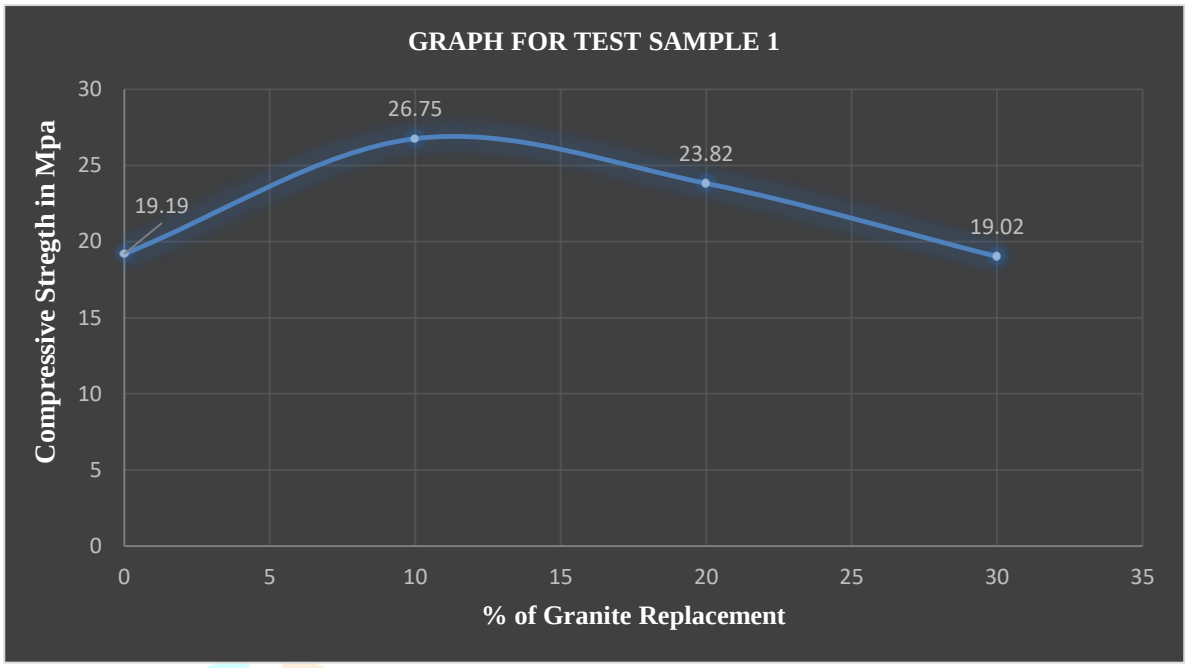
Table 3 Material Required For 1 Cube

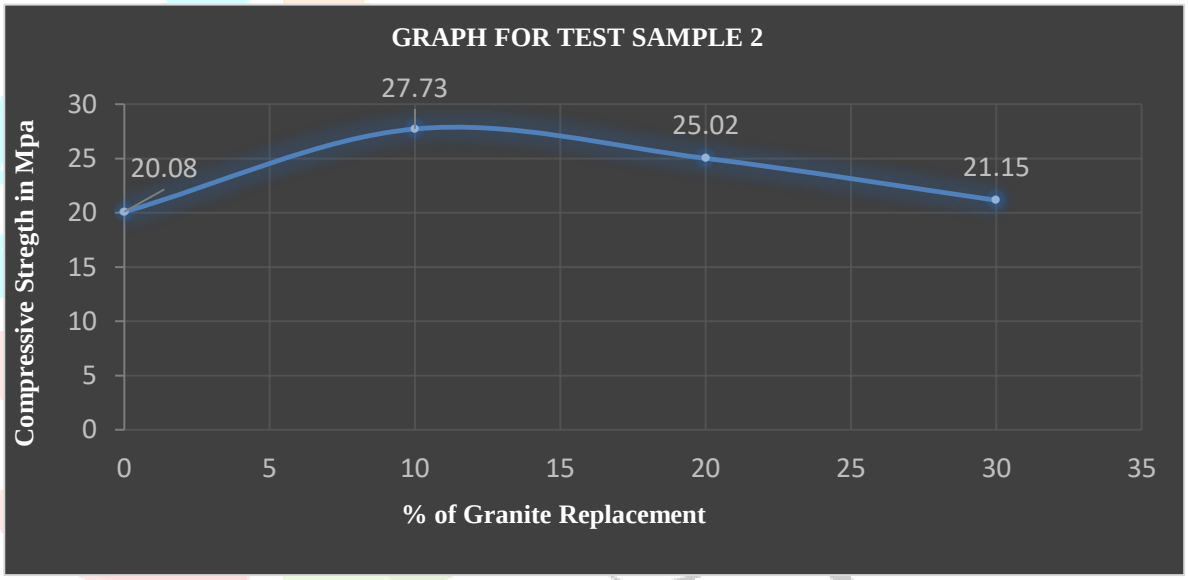
COMPRESSIVE STRENGTH In (KN)					
Sr. No	**%Of Granite Powder**	**Test Sample 1 in KN**	**Test Sample 2 in KN**	**Test Sample 3 in KN**	**Average of all 3 samples In KN**
1	0	448	452	457	452
2	10	602	624	664	630
3	20	536	563	570	556
4	30	428	476	796	465

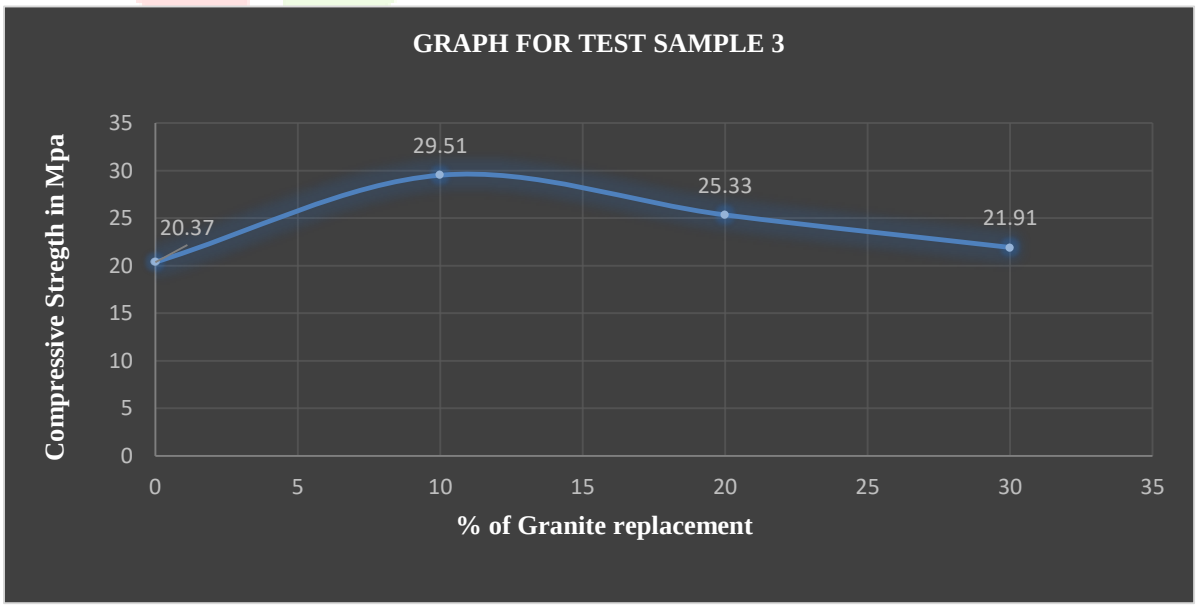
Table 3 Material Required For 1 Cube

COMPRESSIVE STRENGTH In (Mpa)				
Sr. No	**%Of Granite Powder**	**Test Sample 1 in N/mm²**	**Test Sample 2 in N/mm²**	**Test Sample 3 in N/mm²**
1	0	19.19	20.08	20.37
2	10	26.75	27.73	29.51
3	20	23.82	25.02	25.33
4	30	19.02	21.15	21.91

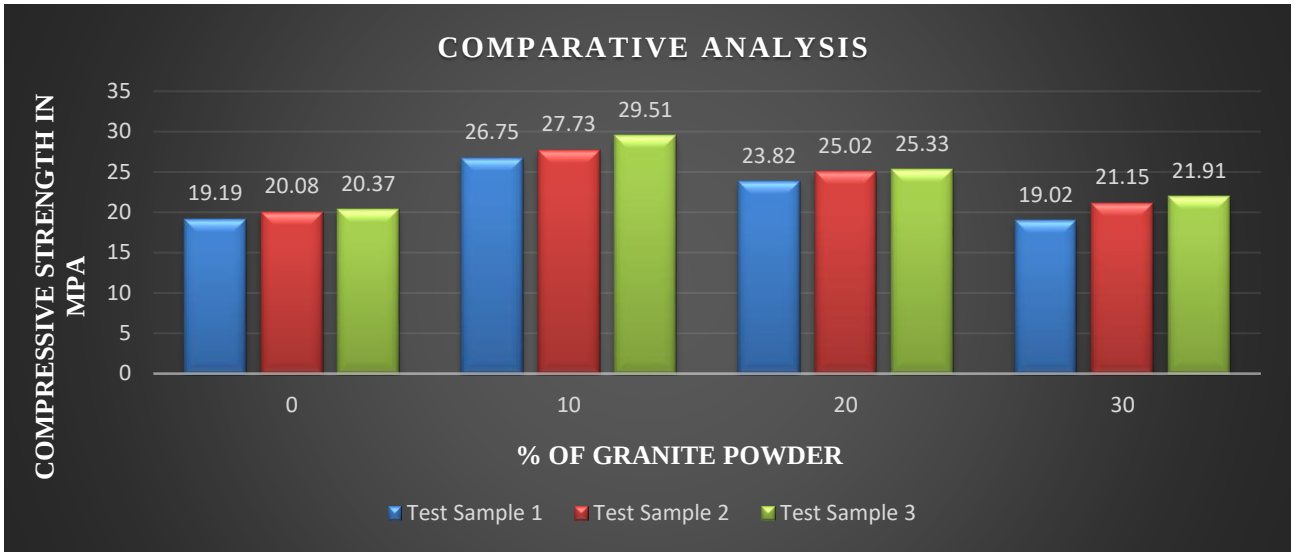
GRAPH 1 COMPRESSIVE STRENGTH V/s PERCENTAGE OF GRANITE REPLACEMENT FOR SAMPLE 1, 2 & 3







GRAPH 2 COMPARATIVE ANALYSIS FOR ALL 3 SAMPLES



VII Conclusion

Following conclusions can be obtained from the present experimental work on the effects of the varying percentage of Granite Fines Compressive strength.

1. The use of Granite Fine waste in partial replacement of Fine Aggregate in concrete showed an increase in Compressive strength.
2. Compressive Strength shows an increasing trend till 10% of replacement of Granite and further, it decreases which is nearly equal to the strength of conventional concrete.
3. The use of Granite Fine waste in the replacement of fine aggregate shows a 40% increase in Compressive Strength when it is replaced by 10% as compared to conventional concrete.
4. The comparative increase in compressive strength as compared with conventional concrete at 20% and 30% of Granite fine waste content are 24% and 4% Respectively for M20 mix of concrete.
5. All the Specimens with Granite Fine Waste failed in Crushing Mode.

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