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Experimental study on Partial Replacement of Cement by Granite Powder

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ABSTRACT
The usage of cement has expanded significantly as a result of daily advancements and development in the construction industry, and the amount of solid debris generated during construction demolition has also increased significantly. These factors led to the reuse of destroyed construction waste like granite powder, which helped to minimize both the amount of solid waste produced and the shortage of cement needed to make concrete. Waste generated from the manufacturing facility of granite powder also results from the destruction of buildings. According to studies, 20–30% of the material prepared in powder production plants ends up as waste. Due to the limited supply of cement, it should be necessary to make use of this waste material in order to manage building wastes. In place of cement, crushed waste granite powders are used. 0%, 30%, 35%, 40%, and 45% of the cement was substituted with crushed granite waste powder. Concrete of the M25 grade has been developed and tested. By substituting different percentages of crushed powder for cement, several mix designs for various sorts of mixes were created. Following completion of the 7, 14, and 28-day curing periods, experimental studies were conducted to determine the workability, compressive strength, split tensile strength, and flexural strength of various concrete mixes containing various percentages of crushed trash. It has been found that as the percentage of crushed powder replacement increases, so does the workability. Additionally, the fine granite powder boosts concrete strength by up to 35% percentage.
KEYWORDS – Granite Powder, Cement, Concrete, Compressive Strength, Split Tensile Strength

1. Introduction

A material with higher compressive strength than tensile strength is concrete. It is typically reinforced with some materials that are strong in tension, like steel, due to its reduced tensile stress. Concrete's elastic behavior is essentially stable at low stress levels but begins to change as matrix cracking takes hold at higher stress levels. Concrete shrinks as it ages because of its low thermal expansion coefficient. All concrete constructions have some degree of cracking because of shrinkage and strain. When concrete is subjected to long-term stresses, it is prone to creep. To make sure the qualities of concrete meet the criteria, several tests are carried out for the applications. Concrete's significant self-weight is one of its drawbacks. Normal concrete will typically have a density of 2200 to 2600 kg/m3. Concrete will become less cost-effective as a structural material to some extent because of its substantial self-weight. In the past, efforts have been made to make concrete lighter in an effort to improve the material's effectiveness as a structural material. Utilizing different elements, lightweight concrete has a density that ranges from 300 to 1850 kg/m3. In essence, adding air to concrete is the only way to create lightweight concrete. In reality, there are three alternative ways to do this.

Instead of cement, crushed granite particles are used alternatively. These pieces of crushed granite powder were used to replace the cement one at a time in a single mix as well as individually.

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Workability tests were undertaken for several combinations with various percentages of these materials in order to evaluate the appropriateness of this crushed waste powder. Workability testing on newly laid concrete are carried out using the slump cone test. Additionally, a compressive strength test is carried out using cast cubes for curing periods of 7, 14, and 28 days to examine the strength variance caused by various percentages of this waste material. The goal of the current investigation is to comprehend how granite waste performs in concrete. Construction debris left over after demolition is also producing granite. The granite industry in India produces 100 million tons of tiles each year, with 15% to 30% of the total production being trash. The granite is strong, hard, and highly resistant to biological, chemical, and physical degradation forces, so we chose these waste tiles as a replacement material to the basic cement to reuse them and to reduce the solid waste produced from construction demolitions. Currently, this waste is not recycled in any way. From the neighborhood, waste tiles and granite powder were gathered.

2. Methodology

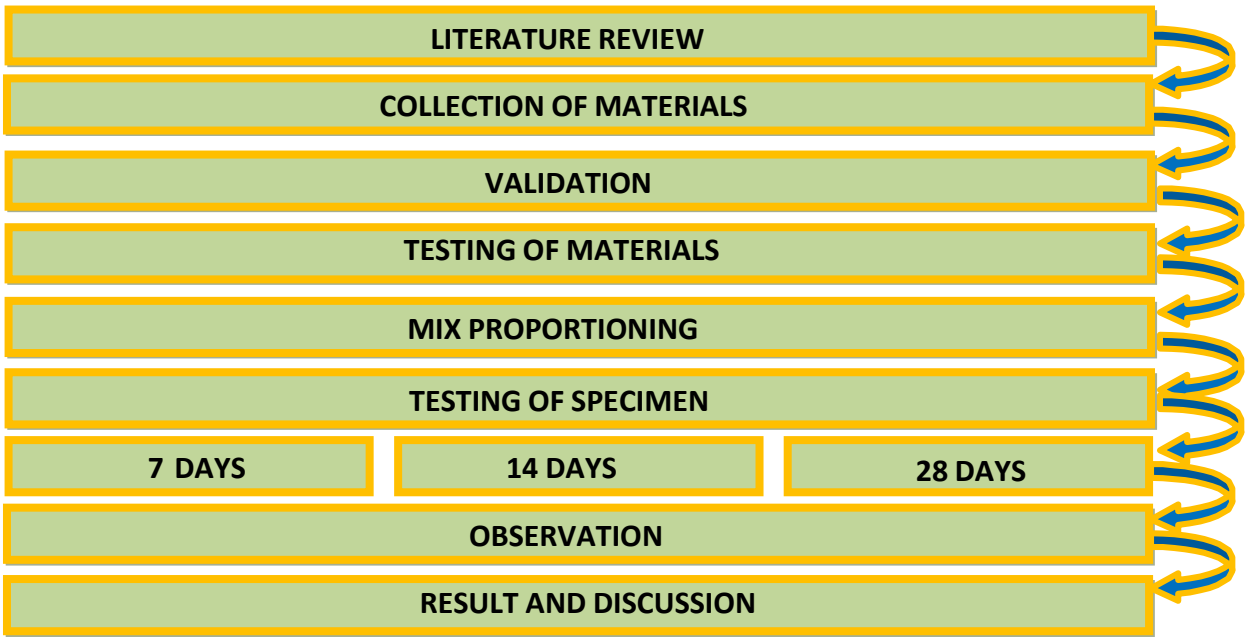

FIG 1. Flowchart

3. Results and Discussion

3.1 Granite

TABLE.1. Composition of Granite

GRANITE	
SYMBOL	%
SiO_2	72.04
Al_2O_3	14.42
K_2O	4.12
Na_2O	3.69
CaO	1.82
MgO	0.71
FeO	1.68
MnO	0.05
Fe_2O_3	1.22

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3.2 Specific Gravity Test (IS 2386:1963)

TABLE.2. Specific Gravity Values

S.No	Material	Specific Gravity
1.	Cement	2.715
2.	Fine aggregate	2.632
3.	Coarse aggregate	2.701

3.4 Different percentage and proportions

TABLE.4. Mix Proportions

GPA(%)	C (Kg/mt)	GPA (Kg/mt)	FA (Kg/mt)	CA (Kg/mt)	WATER (Kg/mt)
0%	394	0	615	1135.3	197
30%	275.8	118.2	615	1135.3	197
35%	256.1	137.9	615	1135.3	197
40%	236.4	157.6	615	1135.3	197
45%	216.7	177.3	615	1135.3	197

3.5 Slump Cone Test

TABLE.5. Slump Value

Specimen	Slump Result
0%	62 mm
30%	73 mm
35%	75 mm
40%	78 mm
45%	79 mm

3.6 Compressive strength Test

TABLE.6. Compressive strength

GPA (%)	GPA(Kg/m³)	C(Kg/m³)	SIZE(mm)	7 days	14 days	28 days
0	0	394	150x150x150	15.97	22.44	25.04
30	118.2	275.8	150x150x150	16.70	23.56	27.56
35	137.9	256.1	150x150x150	17.06	24.58	31.57 ~ **31.6**
40	157.6	236.4	150x150x150	16.47	23.85	29.94
45	177.3	216.7	150x150x150	16.34	23.46	30.07

***UNIT - (N/mm²)**

3.7 Split Tensile Test

TABLE.7. Tensile strength

GPA (%)	GPA(Kg/m³)	C(Kg/m³)	SIZE(mm)	7 days	14 days	28 days
0	0	394	150x300	3.17	3.36	4.21
30	118.2	275.8	150x300	3.42	3.46	4.34
35	137.9	256.1	150x300	3.81	3.95	4.65
40	157.6	236.4	150x300	4.22	4.51	5.11
45	177.3	216.7	150x300	4.40	4.93	5.39

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***UNIT - (N/mm²)**

3.8 Flexural Strength test

TABLE.8. Tensile strength

GPA (%)	GPA(Kg/m³)	C(Kg/m³)	SIZE(mm)	7 days
0	0	394	100x100x500	5.80
30	118.2	275.8	100x100x500	6.08
35	137.9	256.1	100x100x500	6.56
40	157.6	236.4	100x100x500	6.76
45	177.3	216.7	100x100x500	7.8

***UNIT - (N/mm²)**

3.9 Final Results

TABLE.9. Results

Properties	**Gain Over Normal Concrete**
Compressive Strength	+24.20%
Split Tensile Strength	+28.13%
FlexuralStrength	+33.41%

3.10 Test

FIG 2. Tests

4. Conclusions

The usage of Granite powder can be studied as it is similar to that of Granite tile powder waste generation and also it is quite hard compared to the cement using in conventional concrete. A combination of different Granite tiles in different proportions in concrete and their effects on concrete properties like strength, workability can be determined. By the use of Granite Powder Cement in concrete, the physical properties like Strength & durability can be analyzed to prepare a concrete with more advantageous than conventional concrete. The addition of Granite Powder Cement effect on the compressive strength has increasing by 24.20% with (35%) of Granite Powder Cement than start increasing and then decreases by with increase the Granite Powder Cement quantities. The results of the splitting tensile strength tests show that, there is a increase in strength by increasing Granite Powder Cement. It was found that highest splitting tensile strength was achieved by 45%of Granite Powder Cement, which was found about 5.39 N/mm2 compared with other mix. The load carrying capacity is increased to 28.13% compared with the conventional

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specimen. Based on the experimental test result there is an improvement in Flexural strength of the 2.5% mix is higher at age of 7, 14&28 days respectively compared to all other mixes. Granite Powder Cement concrete cylinders continue to sustain load and large deformations without shattering into pieces.

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