

# An Experimental Study on Partial Replacement of Cement and Fine Aggregate by Granite Powder and Glass Powder

T. Venkatachalam<sup>1</sup>, Rohan Davis<sup>2</sup>, Nisari K.M<sup>3</sup>, Aswathy P.M<sup>4</sup>, Sruthi Suresh<sup>5</sup>

<sup>1st</sup> Assistant Professor, Department of Civil Engineering, KEC, Kuppam

<sup>2nd -5th</sup> Students, Department of Civil Engineering, KEC, Kuppam

**Abstract** - Concrete is used as the major material in construction industries. Now a day's production of waste by products increasing day by day. The concept of partial replacement of cement and fine aggregate with waste by products when it is capable for sustainable development is characterized in this investigation of granite powder and glass powder used as partial substitute in proportions varying from 10%, 20%,30% by weight to cement and sand in the concrete tested from compressive strength. Concrete cube measuring 150\*150\*150mm is evaluated at 3,7,14,28 days similarly tensile strength of cylinder is detected measuring 150\*300mm of cylinder evaluated for 3,7,14, 28 days in the CTM machine. Hence this describes the feasibility of using granite powder and glass powder in concrete as partial replacement. Further, it encourages the engineers, contractors and government to accept this kind of alternative materials for the better future.

**Keyword:** Granite powder, Glass powder, Compressive strength.

## I. INTRODUCTION

Concrete is an important structural material in construction. The usual ingredients in concrete are cement, fine aggregate, coarse aggregate and water. Here it describes about partial replacement of cement and fine aggregate with granite powder and glass powder. Granite waste is an industrial waste which is obtained from the granite polishing industry, it can be used as partial replacement for cement. Granite powder is an industrial byproduct generated from granite polishing industries. These products are left largely unused hence an experimental investigation is carried out to find the possibility of using the granite powder as partial replacement of cement in concrete.

Glass powder is made from the highest quality of material with colorless and it is pollution free and not classified as hazardous. glass powder is generally classified as solid waste, in which special methods of removal are not required. Hence this glass powder can be used as partial replacement of sand. When waste glass is reused in making concrete as replacement of fine aggregate, the production cost will go down. So here we are introducing a new idea of concrete production with partial replacement of granite powder and glass powder in place of cement and sand after considering all the properties of these materials. To find the

strength of these replacement concrete it is subjected to compression test and tensile test using CTM (Compression testing machine).

## II LITERATURE REVIEW

Concrete is an important structural material in which we are introducing a new way of concrete by partially replacing of cement with Granite powder and sand using Glass powder. The test conducted on various percentages of granite powder and glass powder like 10 %, 20 %, 30%. After this concrete is taken for determining both compressive strength and tensile strength in CTM machine to find whether it is applicable to use instead of conventional concrete.

## III MATERIALS USED

1. Ordinary Portland Cement (43 Grade)
2. Granite Powder.
3. Sand.
4. Glass Powder.
5. Coarse Aggregate (20mm size)
6. Water.

## IV PROPERTIES OF MATERIALS

Table 1: Properties of Cement & Granite Powder

Sl No	Description	OPC	Granite Powder
1	Specific gravity	3.15	2.58
2	Fineness	5%	9%



Fig 1: Determination of Specific Gravity

Table 2: Properties of Sand & Glass Powder

Sl No	Description	Sand	Glass Powder
1	Specific gravity	2.575	2.51
2	Sieve analysis	Zone II	Zone II

Table 3: Properties of Coarse Aggregate

Sl No	Description	Values
1	Specific gravity	2.71
2	Water absorption	0.25%
3	Flakiness index	14.4%
4	Elongation index	14.7%



Fig2: Determination of properties of Coarse Aggregate

Properties of Water

Water cement ratio used is 0.55. It should be free from organic matter, impurities and salt and the pH value should be between 6 and 7 is used for casting and curing the concrete blocks as per IS456-2000. PH of water = 6.5

V. MIX PROPORTION FOR M20 GRADE

The mix was done by according to IS 10262:2019. In this present work M20 grade concrete was considered. For the present investigation, mix design for M20 grade of concrete was carried out using the above coarse aggregate, fine aggregate, and the binder properties. The properties are considered while doing mix design such as 100 mm slump, mild exposure, crushed angular aggregates 20 mm, fine aggregate as ZONE -2. Water cement ratio = 0.55

For 1m<sup>3</sup> of concrete required materials as follows:

Table 4: Mix proportion values

Descript	Cement	C.A	F. A	Water
For 1m <sup>3</sup>	358.47	674.38	1157.99	197.6
Mix Prop	1	1.88	3.230	0.55

VI. TESTING OF CONCRETE

After making of mix design, we have to prepare the cubes and cylinders for testing of concrete. Tests will be conduct at the age of 3, 7, 28 days. The size of cubes is 150 x 150 x150 mm. Size of cylinder Diameter of 150 mm and height is 300 mm. The following tests are conducted.

- 1) Fresh Concrete
- 2) Hardened Concrete

A. Fresh Concrete

For fresh concrete, we have to do the slump test. It is the main test to find workability of concrete.

Results: Slump value for M20 grade concrete = 10mm.  
Type of slump = True slump



Fig 3: Properties of Fresh Concrete

B. Hardened Concrete

After making of cubes and cylinders, we have to place the cubes and cylinders in distilled in water for proper curing of concrete.

- 1) Compressive Strength
- 2) Tensile Strength

1. Compressive Strength



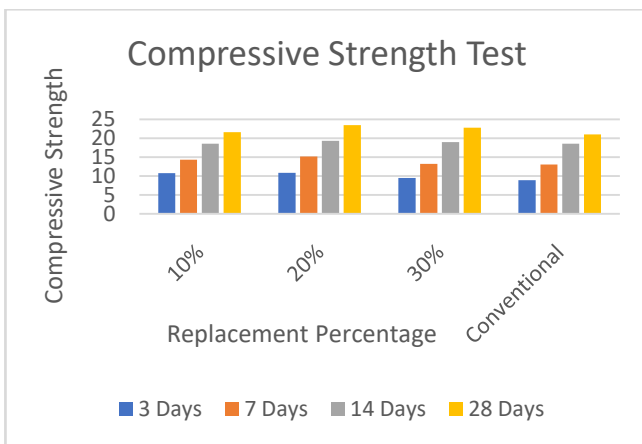
Fig 4: Compressive Strength Testing

The cubes at 3,7,14,28 days of curing is taken for the test.The compressive strength of conventional concrete and new proportions such as 90% cement and sand with 10%

glass and granite powder, 80% cement and sand with 20% of glass and granite powder, 70% of cement and sand with 30% glass and granite powder are noted.

Table 5: Compressive Strength Test Results

Sl. No	Description	3days N/mm <sup>2</sup>	7 days N/mm <sup>2</sup>	14days N/mm <sup>2</sup>	28days N/mm <sup>2</sup>
1	10% of glass & granite	10.8	14.311	18.57	21.6
2	20% of glass & granite	10.88	15.15	19.29	23.5
3	30% of glass & granite	9.51	13.2	18.96	22.8
4	Conventional	8.92	13.06	18.53	21.08



Graph 1: Compressive Strength Test Results

## 2. Tensile Strength

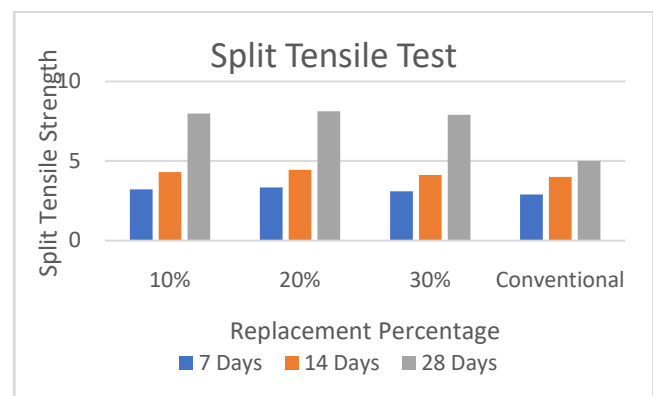
The cylinder at 7,14,28 days of curing is taken for the test. The split tensile strength of conventional concrete and new proportions such as 90% cement and sand with 10% glass and granite powder, 80% cement and sand with 20% of glass and granite powder, 70% of cement and sand with 30% glass and granite powder are noted.



Fig 5: Split Tensile Testing

Table 6: Split Tensile Test Values

Sl. No	Description	7Days N/mm <sup>2</sup>	14Days N/mm <sup>2</sup>	28Days N/mm <sup>2</sup>
1	10% of Granite & Glass	3.21	4.31	7.99
2	20% of Granite & Glass	3.33	4.44	8.12
3	30% of Granite & Glass	3.1	4.12	7.91
4	Conventional	2.9	4	7.8



Graph 2: Split Tensile Test Results

## VII. CONCLUSION

Based on the above results we reached on the following conclusion

- In order to increase the compressive strength and split tensile strength of concrete the cement is replaced by Granite powder as 20 % and fine aggregate by Glass powder by 20 % in M20 grade concrete.
- It can be concluded that Granite powder and Glass powder can be effectively used in concrete.
- Availability of Granite powder and Glass powder are more and helps to reduce the increase of waste by products.
- The usage of Granite powder and Glass powder improves the strength due to the presence of silica in it.

## VIII. FUTURE SCOPE

- The work can be extended to high performance concrete like M25, M30, etc.....
- We can continue this test, replacement of cement by granite powder and fine aggregate by glass powder with admixtures.

- When we use admixtures, we can reach more results but cost is high.
- We can also do this test by changing like, replacement of cement by glass powder and fine aggregate by granite powder.

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