EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF AGGREGATE IN CONCRETE BY GLASS AND GRANITE CHIPS

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***Abstract*- Concrete is one of the oldest manufactured construction material used in construction of various structures around the world. The increase in utilization of natural aggregate for concrete production has created negative impacts towards the environment. Thus investigation on searching for alternative material which has potential to replace the use of fine and coarse aggregate mix is very much need. In this project work, partially replace the fine and coarse aggregate with glass and granite chips. The granite and glass waste were properly crushed as per the requirement and then they were mixed with concrete in different proportions. The cubes were casted and tested for their strength at 7, 28 days of age respectively and the results obtained were compared with those of normal concrete.**

I. INTRODUCTION

This chapter provides an overview of concrete as a widely used construction material known for its versatility and environmental challenges related to CO2 emissions. It introduces the concept of partially replacing traditional fine and coarse aggregates with glass and granite chips in concrete production to address these concerns. Additionally, it discusses the recycling challenges of glass and its potential use in concrete construction. The chapter also explores the use of burnt clay bricks as an alternative coarse aggregate source and examines the potential for increased concrete strength through the addition of granite chips. The study's focus is on investigating the properties of mixed aggregate concrete.

II. AIM & OBJECTIVE

The primary objectives of this study are as follows:

- Investigate the development of concrete strength through the partial replacement of fine and coarse aggregate with waste glass and granite chips.

This project's scope encompasses the following aspects:

- Addressing the issue of waste glass disposal by exploring its potential as a viable replacement for fine aggregate in concrete at various proportions to achieve favorable engineering properties.
- Evaluating the properties of granite tiles as an alternative to traditional coarse aggregate materials, with a focus on both structural performance and cost-effectiveness.

III. METHODOLODY

This chapter deals with the experimental programs conducted to determine the properties of materials used. It also includes mix design, compressive strength and split tensile strength testing of M25 concrete.

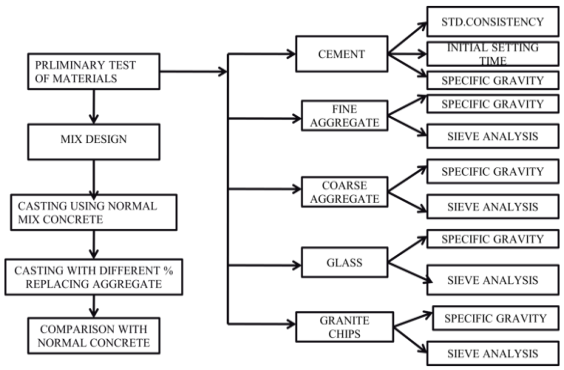

Figure 1. Work flow diagram

IV. MATERIALS

1.Cement ; Chettinad Super Grade Portland Pozzolana Cement is used and subjected to tests like consistency, setting time, and specific gravity.

2. Aggregate ; - Fine aggregate (M sand) with a size less than 4.75mm.

- Coarse aggregate conforming to IS: 383 specifications.

3. Waste Glass ; Sourced locally, waste glass is crushed to a specific size to activate pozzolanic reactions.

4. Water ; Ordinary drinking water is used, meeting IS 456-2000 standards, with a pH value generally not less than 6.

5. Granite Waste ; Polished waste granite tiles from construction sites are collected, crushed, and used in place of 20mm coarse aggregate.

V. RESULT AND DISCUSSION

i. Compressive Strength Test Result

Compressive strength of specimen was tested on CTM having capacity 1000 kN. The compressive strength after 7^{th} and 28^{th} days curing is given as follows.

a. 7th Days compressive strength test result.

Table 1. 7^{th} Days compressive strength

SL NO	Percentage replacement of granite (%)	Percentage replacement of glass (%)	7^{th} day compressive strength (N/mm^2)
1	0	0	16.7
2	20	0	17
3	20	5	17.33
4	20	10	18.2
5	20	15	16.8
6	20	20	15.73
7	20	25	14.43

From the above table it is observed that the maximum compressive strength at 7 day of curing is obtained at 10% replacement of fine aggregate with waste glass.

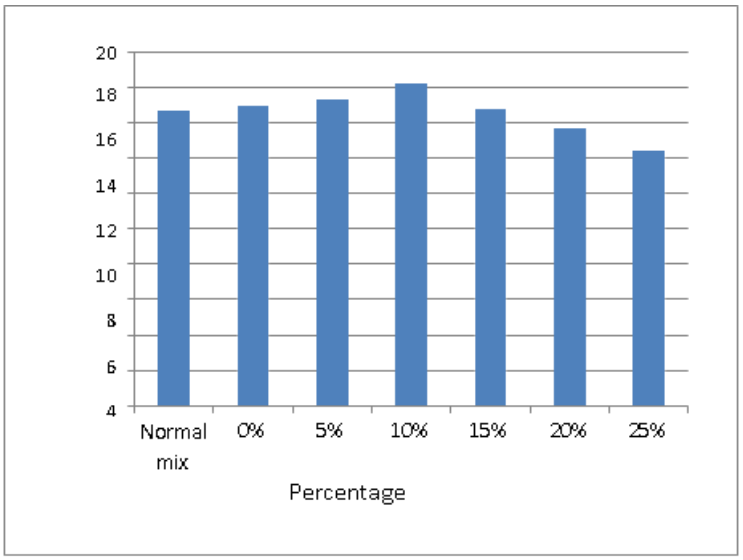

Fig 2. 7th day compressive strength test result

b. 28th Days compressive strength

Table 2. 28th day compressive strength

SL NO	Percentage replacement of granite (%)	Percentage replacement of glass(%)	28^{th} day compressive strength(N/mm^2)
1	0	0	28.95
2	20	0	29.30
3	20	5	30.90
4	20	10	31.80
5	20	15	30.56
6	20	20	29.56
7	20	25	28.5

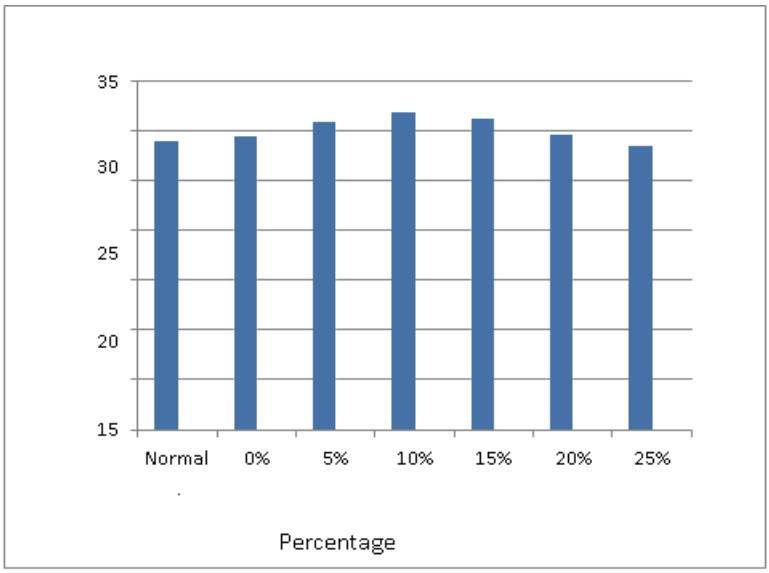

Fig 3. 28th day compressive strength test result

ii. Split Tensile Strength Test Result

Cylinders of size 150 mm dia and 300 mm length was used for split tensile strength test after 7th and 28th days curing. CTM of 1000 kN capacity was used for testing of specimen.

a. 7 th days split tensile strength

Table 3. 7th day split tensile strength

SL NO	Percentage replacement of granite (%)	Percentage replacement of glass (%)	7th day split tensile strength(N/mm^2)
1	20	0	1.96
2	20	0	2.05
3	20	5	2.16
4	20	10	2.27
5	20	15	2.12
6	20	20	2.02
7	20	25	1.88

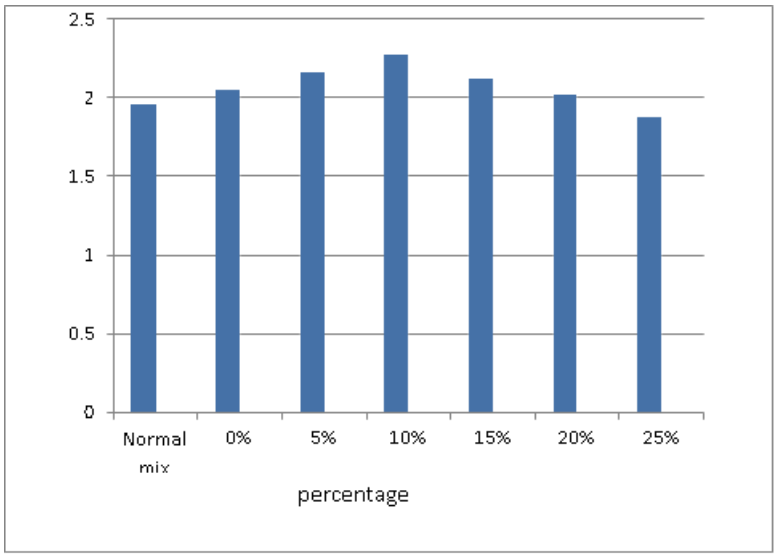

Fig 4. 7th days split tensile strength

b. 28th Days split tensile strength

Table 4. 28th day split tensile strength

SL NO	Percentage replacement of granite (%)	Percentage replacement of glass (%)	28^{th} day split tensile strength(N/mm^2)
1	0	0	3.825
2	20	0	4.12
3	20	5	4.39
4	20	10	4.44
5	20	15	4.29
6	20	20	3.99
7	20	25	3.726

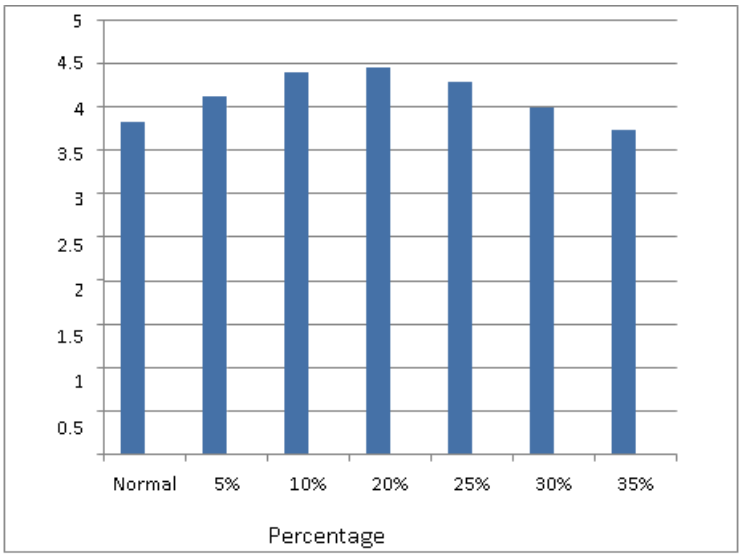

Fig 5. 28th day split tensile strength

In summary, our experiments showed that replacing both fine and coarse aggregates with waste granite and glass generally improved concrete strength. The best results were seen with a 10% replacement of fine aggregate with waste glass, resulting in a 10% higher 28th-day compressive strength compared to normal concrete and a 16% higher split tensile strength. Notably, a 15% glass replacement resulted in lower strength compared to the 10% replacement.

VI. RESULT & CONCLUSION

Through experiments involving partial replacement of fine aggregate with waste glass and coarse aggregate with waste granite chips, the following conclusions were drawn:

- The best results, in terms of compressive strength, were achieved with 10% glass and 20% granite chip replacements.
- A 10% replacement of fine aggregate with waste glass increased compressive strength by 10% compared to normal concrete.
- The split tensile strength of 10% glass replacement exceeded normal concrete by 16%.

In summary, waste glass and granite chips can be effectively used as partial replacements for aggregates in concrete, offering promising results. This approach not only reduces environmental pollution but also addresses the shortage of natural aggregates in construction.

REFERENCES:

[1] Vandhiyan R, Ramkumar K and Ramya R(2013), Experimental study on replacement of fine aggregate by glass powder International journal of engineering Research and Technology (IJERT), Vol.2 issue 5, may , ISSN:2278- 0181 .

[2] A.Sattainathan,N Vinoth kumar,J Harish and A Sathish, Utilisation of granite chips as a supplementary coarse aggregate material Indian journal of science and technology, Vol 9, January 2016, ISSN:0974-6846

[3] Nwaubani sunny O. and Poutos Konstantinos I.(2013), The influence of waste glass powder fineness on the properties of cement mortars International Journal of Application or Innovation in engineering and Management (IJAIEM) ,Volume 2,Issue 2,ISSN 2319-4847

[4] Divakar Y,Manjunath S and Dr.Aswath M.U, Experimental investigation on behaviour of concrete with the use of granite fines, International Journal of Advanced Engineering Research and studies , Vol.1 Issue 4 july -sept.2012 pp.84-47