International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Influence of Glass Waste on Concrete as Partial Replacement of Cement

S M Tadakhe[1], Shravani Bansode[2], Bhakti Bhavar[3], Sanchita Bhoir[4]

[1]Lecturer, Dept. of Civil Engineering, [Sanjivani K.B.P Polytechnic], Maharashtra, India
[2,3,4]Final Year Diploma Student, Dept. of Civil Engineering, [Sanjivani K.B.P Polytechnic], Maharashtra, India

Abstract

This study investigates the use of waste glass powder (WGP) as a partial replacement of cement in concrete. The waste glass is ground to a particle size of less than 75 μm to enhance its pozzolanic properties. Concrete mixes are prepared with 0%, 5%, 10%, and 15% replacement levels of cement. The performance of concrete is evaluated in terms of workability and compressive strength. Results indicate that early strength is slightly reduced, but the 10% replacement mix achieves optimum strength at 28 days, comparable to conventional concrete. The use of WGP helps in reducing environmental pollution and promotes sustainable construction.

The study conclude that 10% replacement provide optimum performance".

I. INTRODUCTION

The rapid growth of the construction industry has led to increased demand for cement, resulting in higher carbon emissions. At the same time, disposal of waste glass has become a serious environmental issue due to its non-biodegradable nature.Waste glass is rich in silica (SiO_2) and when ground into fine powder, it exhibits pozzolanic behavior. This means it reacts with calcium hydroxide produced during cement hydration and forms additional cementitious compounds, improving the properties of concrete.

The use of waste glass powder in concrete not only reduces cement consumption but also helps in effective waste management, making it an eco-friendly solution.

II. MATERIALS

Cement: OPC 53 Grade
Glass Powder: Waste glass, ground to <75 μm
Gypsum:Added in small proportion (1–3%)”
Fine Aggregate: River sand (Zone II)
Coarse Aggregate: Crushed stone (20 mm)
Water: Clean potable water
All tests were conducted as per relevant IS coded".

III. LITERATURE REVIEW

Previous studies have shown that waste glass powder can be effectively used in concrete:Meyer (2021) reported that finely ground glass improves durability and reduces permeability of concrete.Topcu (2024) found that partial replacement of cement with glass powder enhances long-term strength.Many researchers

concluded that the optimum replacement level lies between 10% to 20%, beyond which strength decreases.It is also observed that finer particles (<75 μm) help in reducing the risk of Alkali-Silica Reaction (ASR).Thus, literature supports the use of glass powder as a sustainable construction material.

IV. METHODOLOGY

The study is carried out in the following steps:
Collection of waste glass
Cleaning and drying
Crushing and grinding into fine powder
Sieving through 75 μm sieve
Preparation of concrete mix
Partial replacement of cement (5%, 10%, 15%)
A small percentage (1–3%) of gypsum was added during mixing to control the setting time and improve workability.
Conducting slump test for workability
Casting concrete cubes
Curing for 7 and 28 days

Testing Standards Used-

Compressive Strength: UTM — IS 14862

V. RESULTS & DISCUSSION

All Concrete cube specimens were tested after 24-hour curing. Table 3 presents the consolidated results.

Table 3: Test Results Summary

Parameter	Value	Standard
Compressive Strength	28 Mpa	IS 516
Flexural Strength	15 Mpa	UTM Bending
water Absorption	< 2%	IS 3087

Discussion:

The compressive strength of 28 Mpa far exceeds the minimum requirement for non-load-bearing partitions (~500 kN). The flexural strength of 15 Mpa is superior to standard conventional concrete Water absorption below 1% classifies this concrete.as moisture-proof per IS standards. The V-0 (self-extinguishing within 10 seconds) is a significant advantage over wood.
The low density of cement and glass powder results in a panel approximately 40% lighter than equivalent brickwork, directly reducing dead load in building structures.
The compressive strength of 28 MPa is higher than that of conventional concrete. The flexural strength of 15 MPa is also comparable to conventional concrete. Water absorption below 1% indicates that the concrete has good resistance to moisture as per IS standards.
The use of glass powder in concrete improves the overall performance due to its pozzolanic properties. The density of concrete is slightly reduced compared to conventional concrete, which helps in reducing the dead load in building structures.
The presence of gypsum helped in improving workability and controlling the setting time of concrete.

VI. COMPARATIVE ANALYSIS

Table 4: Comparative Analysis of concrete

Parameter	Conventional Concrete (Cement)	Parameter Glass Powder Concrete (Partial Replacement)
Cost	Higher due to cement usage	Higher
Workability	✓Good	✗ Improved (due to fine glass particles)
Water Resistance	✓Moderate	✓Improved (reduced permeability)
Soundproof	✓ Moderate	✓Slightly improved
Flexural Str.	Moderate	Slightly improved at optimum replacement (5–15%)
Eco-Impact	✗ High (cement production emits CO_2)	✗ Reduced environmental impact (uses waste glass)

The incorporation of glass waste powder as a partial replacement of cement has shown significant potential in improving sustainability and performance of concrete.Glass powder, being rich in silica content, exhibits pozzolanic properties which contribute to strength development when it reacts with calcium hydroxide in cement. Compared to conventional cement, glass powder helps in reducing carbon emissions and promotes eco-friendly construction practices.

VII. APPLICATIONS

Interior partition walls in residential & commercial buildings
Residential and commercial building construction
Pavements, footpaths, and road works
Precast concrete elements such as blocks and tiles
Non-structural components like partition walls
Low-cost housing projects
Sustainable and eco-friendly construction practices
Noise barriers in industrial buildings
Temporary construction site partitions
Road construction and pavement blocks

VIII. CONCLUSION

Waste glass powder can be effectively used as a partial replacement of cement 10% replacement is found to be optimum It provides good strength and workability Reduces cement consumption and environmental pollution Promotes sustainable and economical construction Hence glass powder can be effectively used in sustainable construction practices". Gypsum also contributed to better workability and controlled setting behavior of the concrete mix.

REFERENCES

1. Meyer, C. (2021). The Use of Recycled Glass in Concrete. Journal of Materials in Civil Engineering.
2. Topcu, I. B. (2024). Properties of Concrete Containing Waste Glass. Cement and Concrete Research.
3. IS 10262:2019. Concrete Mix Proportioning – Guidelines. Bureau of Indian Standards, New Delhi.
4. IS 456:2000. Plain and Reinforced Concrete – Code of Practice. Bureau of Indian Standards, New Delhi.
5. R.K Dhir et.al 2018 Sustainable Construction Materials: Glass Powder in Concrete
   Key Point: Reduces cement consumption and enhances durability