# To Study The Effect Of M25 Concrete By Partial Replacement of Sand With Glass Powder And Cement By Fly Ash.

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***Abstract-*** *Concrete is the most widely used construction material, and the demand for sustainable and eco-friendly concrete has increased significantly in recent years. This study investigates the effect of partial replacement of natural sand with waste glass powder and cement with fly ash on the mechanical properties of M25 grade concrete. The utilization of industrial and waste materials not only helps in reducing environmental pollution but also conserves natural resources. In this experimental investigation, cement was partially replaced by fly ash at different percentages, and fine aggregate was partially replaced by glass powder by weight. Various concrete mixes were prepared and tested for compressive strength, split tensile strength, and workability at curing periods of 7, 14, and 28 days. The results obtained were compared with those of conventional M25 concrete.*

*The test results indicated that the inclusion of glass powder and fly ash improved the workability of concrete and showed comparable or improved strength characteristics up to an optimum replacement level. Beyond this optimum percentage, a reduction in strength was observed. The study concludes that partial replacement of cement with fly ash and sand with glass powder can produce durable and economical M25 concrete while contributing to sustainable construction practices*

***Keywords:*** Glass Powder, Fly Ash, Partial Replacement, Fine Aggregate, Cement Replacement, Compressive Strength, Sustainable Concrete, Waste Materials, Eco- friendly Construction

## I. INTRODUCTION

Concrete is the most extensively used construction material in the world due to its versatility, strength, and durability. Conventional concrete is produced using cement, fine aggregate, coarse aggregate, and water. However, the rapid growth of the construction industry has resulted in excessive consumption of natural resources such as river sand and limestone, leading to environmental degradation and scarcity of raw materials. Therefore, the development of sustainable and eco-friendly concrete has become a major area of research in civil engineering.

## II. LITERATURE REVIEW

**Kishan Jain et.al [2016][1]:**

This study focuses on evaluating the performance of M25 grade concrete when natural sand is partially replaced with glass powder and cement is partially replaced with fly ash, aiming to enhance sustainability and reduce environmental impact. With the rising demand for concrete and the depletion of natural resources like river sand, incorporating waste glass and industrial by-products such as fly ash serves as an effective alternative to minimize landfill disposal lower carbon emissions, and promote eco- friendly construction practices. The research seeks to analyze improvements in workability, compressive strength, flexural strength, and durability parameters by using specified proportions of glass powder and fly ash, while determining their optimal percentage replacement for maximum strength development. The scope of this investigation includes material characterization, mix design, preparation of specimens, and comparative testing of mechanical properties with conventional concrete to establish the feasibility of using these materials in practical construction applications.

**Sachin Sirenia et.al [2017][2]:**

The study investigates the use of fly ash (FA) and glass powder (GP) as partial replacements for cement in M25 grade concrete to improve sustainability and reduce waste. Cement was replaced by a fixed 75%portion, with the remaining 25% substituted using different proportions of FA and GP. Tests conducted at 7, 14, and 28 days showed that using 25% fly ash alone (Mix 2) produced the highest compressive and flexural strength compared to all other mixes and the control concrete, while increasing glass powder content gradually reduced strength. Overall, the results

indicate that fly ash is an effective cement substitute, whereas glass powder lowers performance, and the optimum combination for strength is 75% cement with 25% fly ash.

## III. MATERIAL USED

### Cement

Ordinary Portland Cement (OPC) of 43 grade conforming to IS: 8112 – 2013 was used in this study. Cement acts as the primary binding material in concrete. It provides strength and durability to the concrete through the process of hydration.

### Fine Aggregate (Sand)

Natural river sand conforming to IS: 383 – 2016 was used as fine aggregate. The sand was clean, free from organic impurities, and well-graded. In this study, fine aggregate was partially replaced by waste glass powder in varying proportions.

### Coarse Aggregate

Crushed angular coarse aggregates of nominal maximum size **2**0 mm, conforming to IS: 383 – 2016, were used. The aggregates were clean, hard, and free from deleterious materials. Coarse aggregate provides bulk, strength, and stability to concrete.

### Fly Ash

Fly ash obtained from a thermal power plant was used as a partial replacement of cement. The fly ash used in this study conformed to IS: 3812 (Part 1) – 2013. Fly ash is a pozzolanic material that

improves workability and enhances the long-term strength and durability of concrete.

### Glass Powder

Waste glass powder was used as a partial replacement of fine aggregate. The glass was collected from discarded glass materials, cleaned, crushed, and ground to a fine powder passing through a 75-micron

## IV. METHOLOGY

### Selection of Materials

All materials such as cement, fine aggregate, coarse aggregate, fly ash, glass powder, and water were selected in accordance with relevant Indian Standard specifications. Preliminary tests were conducted to determine the physical properties of the materials.

### Mix Design of M25 Concrete

The concrete mix wasdesigned as per IS: 10262 – 2019 for M25 grade concrete. A control mix was prepared using conventional materials without any replacement Additional mixes were prepared by partially replacing cement with fly ash and fine aggregate with glass powder in varying percentages by weight.

### Proportioning of Materials

Cement was replaced by fly ash at predetermined percentages, and natural sand was replaced by glass powder at different replacement levels. The total binder content and aggregate content were maintained constant for all mixes to ensure uniformity.

### Workability Test

The workability of fresh concrete was determined using the slump cone test as per IS: 1199 – 1959. The slump values were recorded for each mix and compared with the control mix.

### Casting of Specimens

Concrete specimens were cast in standard mounds: Cubes (150 mm × 150 mm × 150 mm) for compressive strength

Cylinders (150 mm diameter × 300 mm height) for split tensile strength The specimens were compacted using a vibrating table eliminate air voids.

### Curing of Specimens

After 24 hours, the specimens were demolded and cured in clean water at room temperature for curing periods of 7, 14, and 28 days.

### Testing of Hardened Concrete

The following tests were conducted on hardened concrete specimens:

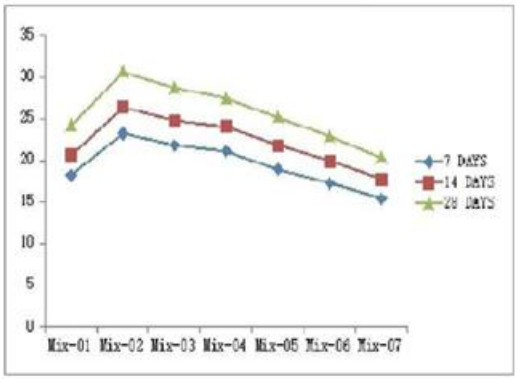
Compressive Strength Test as per IS: 516 – 1959 Split Tensile Strength Test as per IS: 5816 – 1999 The test results were recorded and compared with conventional M25 concrete.

**Analysis of Results**

The experimental results were analyzed to determine the optimum replacement levels of fly ash and glass powder. Strength variations, workability trends, and overall performance were evaluated.

| Mix | Combination (%Replacement) | Compressivestrength ($N/mm^2$) | | |
|---|---|---|---|---|
| | | 7 Days | 14 Days | 28 Days |
| M1 | C+S+NCA | 18.17 | 20.63 | 28.13 |
| M2 | C(75%)+S+NCA+ FA(25%)+GP(0%) | 23.20 | 26.40 | 30.61 |
| M3 | C(75%)+S+NCA+ FA(20%)+GP(5%) | 21.74 | 24.72 | 28.67 |
| M4 | C(75%)+S+NCA+ FA(15%)+GP(10%) | 21.08 | 24.72 | 27.36 |
| M5 | C(75%)+S+NCA+ FA(10%)+GP(15%) | 18.91 | 21.75 | 25.16 |
| M6 | C(75%)+S+NCA+ FA(5%)+GP(20%) | 21.08 | 19.87 | 22.86 |
| M7 | C(75%)+S+NCA+ FA(0%)+GP(25%) | 21.17 | 17.71 | 20.32 |

Compressive strength Result




Graph Compressive strength in ($N/mm^2$) At various age (day)

## V. CONCLUSIONS

From the above graphs and previous discussion, following conclusion is drawn: -

1. The replacement of cement at an optimum percentage by FA (25%), improved compressive and flexural strengths as compared to traditional concrete.
2. On decreasing percentage replacement of FA (25% 0%) by increasing percentage replacement of GP(0% to 25%), a decreased strength is determined, i.e. WhenGP is used as a replacement material, strength of concrete
3. Overall MIX 2 have a great efficiency of flexural and compressive strengths.

## REFERENCES

[1] IS: 456 – 2000, Plain and Reinforced Concrete– Code of Practice, Bureau of Indian Standards, New Delhi.
[2] IS: 10262 – 2019, Concrete Mix Proportioning– Guidelines, Bureau of Indian Standards, New Delhi.
[3] IS: 383 – 2016, Coarse and Fine Aggregate for Concrete – Specification, Bureau of Indian Standards, New Delhi.
[4] IS: 1489 (Part 1) – 2015, Portland Pozzolana Cement Specification, Bureau of Indian Standards, New Delhi