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## Partial Replacement of Cement with Glass Powder, Metakaolin and Marble Dust.

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### Abstract

The growth of concrete technology during the last decade has been mainly based on finding a suitable and eco- friendly substituent for cement. This project is synonymous to the same perception of finding an eco-friendly and feasible cementitious material. The main aim of this project is to investigate the behavior of concrete as a partial replacement of glass powder, metakaolin and marble dust with mix proportion of M30 grade of concrete is adopted in accordance with IS 456-2000 on the compressive strength of the concrete in which partial replacement was done with 5%, 10% and 15% of glass powder, metakaolin and marble dust. The compressive test was carried out on the specimen for 7 days and 28 days..

**Keywords:** Glass powder, Metakaolin, Marble dust.

### INTRODUCTION

The waste generated from the industries cause environmental problems. Hence the reuse of this waste material can be emphasized. The waste of glass from shops and houses industries is deposited in landfill waste but the demand in the construction industry is increasing every day, the utilization of river sand as fine aggregate leads to deterioration of natural resources, falling of ground water table. Attempts have been made in using crushed glass as fine aggregate in the replacement of sand. A major concern regarding the use of glass in concrete is the chemical reaction that takes place between the silica – rich glass particle and the alkali in pore solution of concrete, which is called Alkali – Silicate reaction can be very detrimental to the stability of concrete, unless appropriate precautions are taken to minimize its effects. Metakaolin can be used as a concrete integral, swapping part of the cement content ever since it has pozzolanic

property. The use of metakaolin as a partial cement replacement material in mortar and concrete has been considered widely in past few years. Efforts have been made in using as a partial replacement for cement to get the performance of concrete containing glass powder, metakaolin and Marble dust and compare it with the performance of conventional concrete. Marble Dust Powder (MDP) is a developing composite material that will allow the concrete industry to optimise material use, generate economic benefits and build structures that will strong, durable and sensitive to environment. It has been estimated that several million tons of MDP are produced during quarrying worldwide. Hence utilization of marble powder has become an important alternative materials towards the efficient utilization in concrete for improved harden properties of concrete. Marble is a metamorphic rock resulting from the transformation of a pure limestone. The purity of the marble is responsible for its colour and appearance it is white if the limestone is composed solely of calcite (100%  $\text{CaCO}_3$ ). Marble is used for construction and decoration; marble is durable, has a noble appearance, and is consequently in great demand.

## PRELIMINARIES

### Literature -

#### I. Strength And Durability Properties Of Concrete With Partial Replacement Of Cement With Metakaolin And Marble Dust -

Er. Amritpal Kaur and Er. Rajwinder Singh Bansal Civil Engineering Dept. R.I.E.T H.O.D Civil Engineering Dept. R.I.E.T Phagwara, Punjab ,INDIA had Researched that the replacement of cement with 9% Metakolin and 10% Marble powder, give better results better for strength as If the percentage of Metakaolin is increased above 9% keeping the percentage of Marble powder as 10%, there is reduction in strength of concrete. The permeability test shows that there is decrease in permeability of concrete with the increase in amount of Metakaolin and Marble powder the optimum percentage for replacement of cement with Metakaolin and Marble powder was 9% and 10 % respectively for both cubes and cylinders.

#### II. Mechanical Properties of Glass Powder and Metakaolin in Concrete –

Mukund Kumar, Ajay Kumar Singh M.Tech Scholar, Assistant Professor Department of Civil Engineering SSTC-SSGI, Bhilai, India had researched that The compressive strength of the concrete for 7 days was increased in comparison to plain mix when cement and fine aggregate were replaced by metakaolin and glass powder by 10% in mix. The compressive strength of the cubes for 28 days attained the maximum compressive strength when metakaolin and glass powder incorporated in the mix by 10% of cement and fine aggregate. The split tensile strength of the cylinders showed improvement when 10% cement was replaced with the metakaolin and fine aggregate with the glass powder. The flexural strength of the beam increased in comparison to the plain mix. From the test it was seen that 10% replacement of the cement and fine aggregate showed maximum strength.

#### III. Study of Partial Replacement of Cement by Marble Powder –

Ramya Raju, Geetha K. Jayaraj, Abuzar Aftab Shaikh Department of Civil Engineering, Shivajirao S. Jondhle College of Engineering and Technology, Asangaon had researched that The compressive strength is increases at 0.4 w/c ratio, but decreases the tensile strength. The partial replacement of cement by marble powder is used up to M25 grade concrete. The strength decreases beyond the use of M 25 grade, but shall be improved on the addition of super plasticizer. As per the comparative study on use of super plasticizer the strength is increased by 2% for M30 in 28 days, whereas by using only marble powder the strength increases by 9% for M25 with 0.4 w/c ratio in both the cases. Use of super plasticizer with marble powder as a

partial replacement of cement in higher grades shall be useful for high rise structure to reduce the economy.

## 2.1 Preliminaries1

### Methodology -

For the Research of entitled project which is partial replacement of Cement with glass powder, Metakaolin and Marble Dust as this is an experimental topic need to compare the results of normal concrete and the concrete when materials are added to check the durability and strength of concrete. So the process done for the following is as follows:

- Need to select the materials use for testing the specimen. i.e Cement, sand aggregate, replacement materials, Instruments to take the initial test on cement. Eg- sieves, vicat apparatus, pan, weighing machine, slump cone.
- Preparation of mix design proportion of materials to be used as per the IS standards.
- Initial level Testing on Cement, sand, aggregates as per IS standards.
- For the compression test need to cast cubes of 150x150x150 MM According to IS: 10080-1982 for 7 days and 28 days. With normal concrete and materials which are to be used as replacement and after the curing for the specified days need to take test.

## 2.2 Preliminaries2

### Properties of the materials used -

The proportion of replacement in the project is given below in table

REPLACEMENT MATERAILS	CEMENT, SAND, AGGREGATE.
5%	90%
10%	80%
15%	85%

**TABLE 1:**

**CEMENT:** Ordinary Portland cement, 53 Grade

**COARSE AGGREGATE:** Locally available irregular broken stones or natural occurring rounded gravel conforming to graded aggregate of nominal size 10mm and 20 mm Materials which are retained on 4.7mm sieve size and maximum size up to 63mm was used.

**CRUSHED SAND:** It is a eco-friendly material gives higher durability and strength to concrete to overcome deficiencies like segregation, bleeding, honeycombing and voids.

Higher cohesion and compressive strength water retentively of mortar is also less.

**GLASS POWDER**

**METAKAOLIN**

**MARBLE DUST**

## 2.3 Preliminaries3

### Experimental Results and Conclusion -

- Fineness Test of Cement was 9%
- Standard Consistency was 33%
- Initial setting time was 30 minutes and Final setting time was 600 minutes.
- Fineness modulus of crushed sand was 3.34
- Fineness modulus of coarse aggregates was 3.55
- Specific gravity of cement 3.15
- Workability of concrete by Slump Cone Test –

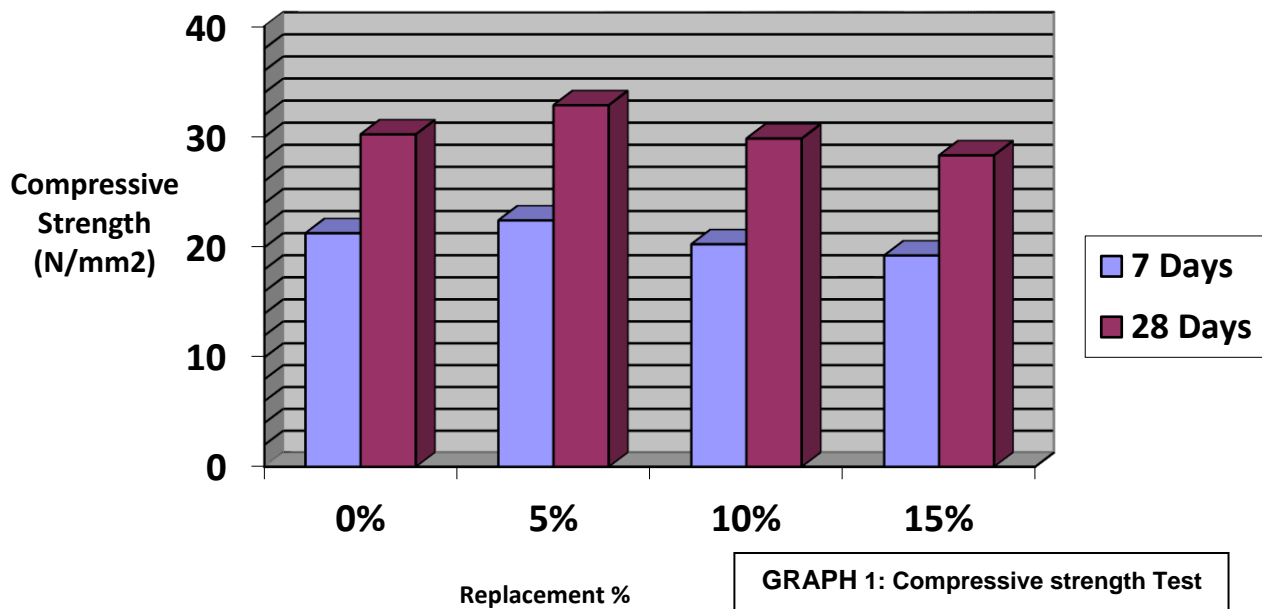
Replacement Materials	Slump in mm
0%	86
5%	85
10%	80
15%	82

TABLE 2:

## Compression Test Results –



FIGURE 1: Compression Testing Machine



GRAPH 1: Compressive strength Test

## CONCLUSION –

- Compressive Strength of Concrete was tested at different percentage of glass powder, metakaolin and marble dust of 0%, 5%, 10% and 15% for calculating the compressive strength 18 cubes were casted for four samples of each percentage variation Curing was done for 7 days and 28 days to check the initial gain strength and final gain strength of concrete.
- So from the above graph we can see that the Compressive strength for curing of 7 days gains the strength it starts increasing form 5% replacement of material is done Whereas,

it start decreasing from 10% to 15% the approximate increase in strength for 7 days of curing was found out to be 23 N/mm<sup>2</sup>.

- For the curing of 28 days it was observed that When 5% mix of glass powder, metakaolin and marble dust attained increase in compressive strength of cube. The approximate increase in strength for 28 days of curing was found out to be 33 N/mm<sup>2</sup>.
- It can be concluded that after adding the materials i.e. Glass powder, Metakaolin and Marble dust the Durability and workability on concrete was also seen to be increased.

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