# Effects of Marble Dust Powder on Flexural Properties of Concrete as a Partial Substitution of Cement

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***Abstract-*** *The most broadly used and adaptable building material is concrete which is generally used to resist compressive power.The use and production of cement creates much more environmental disputes and is expensive also. Marble Dust allows the concrete industry to produce financial profit, to optimize material use, and construct structures that will be strong, durable and subtle to the atmosphere. The use of Marble Dust can be an ideal choice forreplacing in a cementitious binder for increase in efficiency due to the presence of lime. The waste generated from the industries causes environmental problems. Hence the reuse of this waste material has to be stressed and it has been estimated that several million tons of Marble dust are produced during quarrying worldwide. Hence utilization of marble powder has become an important alternative materials towards the efficient utilization in concrete for enhancedthe harden properties of concrete. Marble is metamorphic rock follow-on from the transformation of a pure limestone. Marble dust contains high calcium oxide content of more than 50%. Marble dust, obtained as a by-product of marble cutting, sawing, shaping was characterized from physical and chemical point of view for using it as binding material in production of concrete and mortar. To avoid adverse environmental circumstances, the content of cement is concentrated in concrete and replaced by marble dust which lessensthe cost and calculation of marble dust also rises strength and durability of concrete. The marble dust was replaced with cement at 0%, 3.5%, 7%, 10.5%, 14%, 17.5% & 21% by weight for M20 grade concrete.*

***Keywords***- Replacement,Marble Dust, Flexural Strength, W/C Ratio..

## I. INTRODUCTION

It has been assessed that tons of marble waste and marble dust powder are manufactured during excavating worldwide. Thereforeconsumption of marble powder has become an important substitute towards the effectiveuse in concrete for better-qualityof concrete. Marble is a metamorphic stonecausing from the transformation of a pure limestone. The purity of the marble is responsible for its color and appearance it is white if the limestone is composed solely of calcite (100% CaCO3). Marble is used for construction and decoration; marble is durable, has ahonorablepresence, and is thus in great demand. The main contaminationswhich can affect the properties of finished cement are magnesia, leads, phosphate, zinc, sulfides and alkalis. A large quantity of marble powder is generated during the cutting procedure. The result is that the mass of marble leftover which is 20% of total marble extracted has reached as high as millions of tons. Leaving these leftover materials to the atmosphere directly can cause environmental problem.

Furthermore, the availability of natural aggregate and minerals used for making cement is very less and it is essential to lessen energy ingesting and release of carbon dioxide causing from construction developments, answer to this problem are hunted through the usage of marble powder as partial substitution of Portland slag cement. Therefore, utilization of the marble powder in various manufacturingareas especially the construction, glass and paper industries would help to protect the environment. Leftover can be used to create new products or can be used as admixtures so that natural belongings are used more professionally.

## II. PROJECT OBJECTIVE

The research will cover studying physical and chemical properties of marble waste powder blended Portland cement and studying flexural strength of concrete formed by marble dust, blended cement and marble waste blended sand. Throughout the examination, the research will be restricted to the same factories which process the marble waste powder.

The main objectives of this study are:

1. To achieve desired strength of M-20 grade of concrete.

2. To study the effects of percentage replacement of cement by marble waste powder on different properties of concrete.

3. To study the influence of percentage replacement of cement by marble waste powder on the physical properties of Portland cement paste.

## III. EXPERIMENTAL METHODOLOGY AND INVESTIGATIONS

### 3.1 Cement:

Ordinary Portland cement is used to prepare the mix design of M-25 grade. The cement used was fresh and without any lumps water/cement ratio is 0.42 for this mix design using IS 456:2007. Cement is an extremely ground material having adhesive and cohesive properties which provide a binding medium for the discrete ingredients. Chemically cement constitutes 60-67% Lime (CaO), 17-25% Silica (SiO2), 3-8% Alumina (Al2O3), 0.5-6% Iron Oxide (Fe2O3), 0.1-6% Magnesia (MgO), 1-3% Sulphur Trioxide (SO3), 0.5-3% Soda And Potash (Na2O+K2O).

### 3.2 SAND:

Natural sand which is easily available and low in price was used in the work. Particles of this sand have smooth texture and are blackish.It has cubical or rounded shape with smooth surface texture. Being cubical, rounded and smooth texture it give good workability. Sand which is used here is taken from Ganga River.. Sieve analysis was done to find out fineness modulus which comes out to be 3.14% which is under limit as per IS 383-1970.

### 3.3 COARSE AGGREGATES:

The aggregate used in this project mainly of basaltrock which comes under normal weight category.The aggregates are locally available. 50% of theaggregate used are of 10-12 mm size and remaining50% are of 20mm size.

### 3.4 MARBLE DUST:

Utilization of the marble dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. Some attempts have been made to find and assess the possibilities of using waste marble powder in mortars and concretes and results about strength and workability were compared with control samples of usual cement-sand concrete. The use of the replacement materials offer cost decrease, energy reserves, arguably superior products, and fewer hazards in the environment. These materials participate in the hydraulic reactions, contributing significantly to the composition and microstructure of hydrated product.

Fig 1: Marble Dust Powder

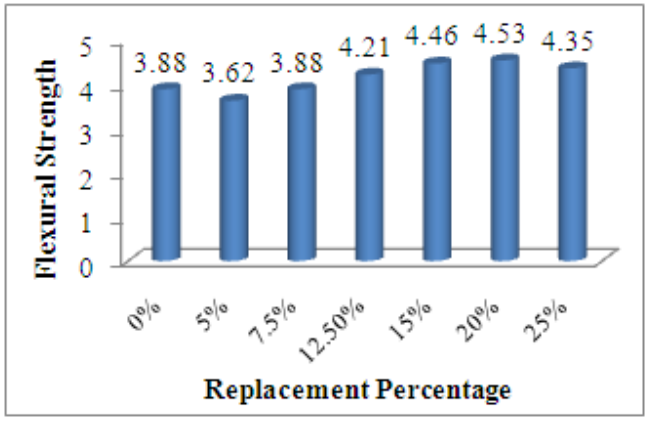
## IV. RESULT & DISCUSSION

### Flexural strengthTest:

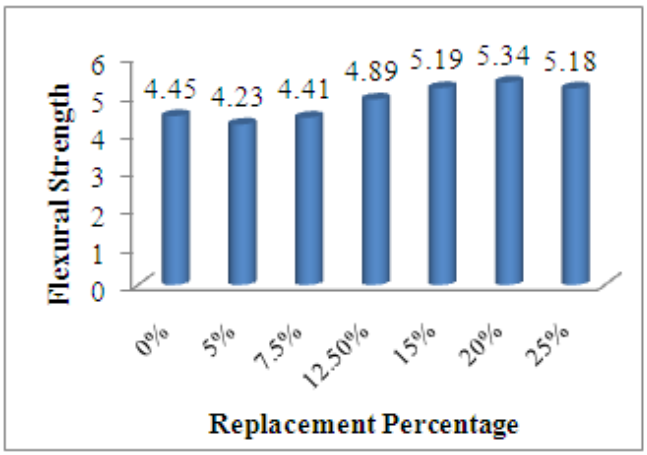
Beams of size 10cm*10cm*50cm are casted for determining flexural strength. Test on beams are performed at the age of 28 days of the specimen. Placement of specimen in machine is done as per IS: 516-1959 in the clause no 8.3.1 page no 17. Load is applied at increasing rate of 108KN/min. Load is applied until specimen fails and load at which specimen fails is recorded. As specified in the IS code flexural strength is calculated and tabulated below:-

Table1: Flexural Strength Test Result

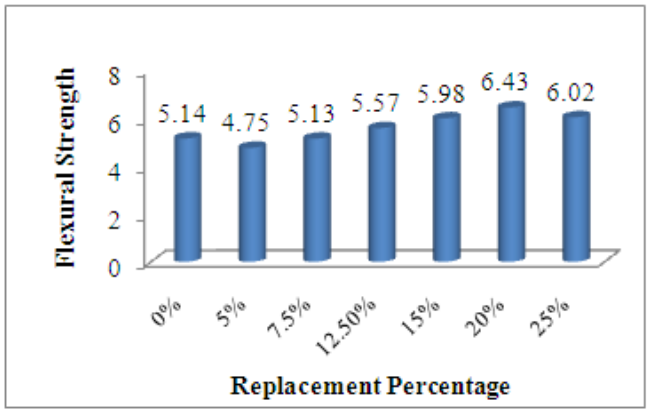
| Mix | Replacement % | Flexural Strength ($N/mm^2$) | | |
|---|---|---|---|---|
| | | 7 days | 14 days | 28 days |
| M-1 | 0 | 3.88 | 4.45 | 5.14 |
| M-2 | 3.5 | 3.62 | 4.23 | 4.75 |
| M-3 | 7 | 3.88 | 4.41 | 5.13 |
| M-4 | 10.5 | 4.21 | 4.89 | 5.57 |
| M-5 | 14 | 4.46 | 5.19 | 5.98 |
| M-6 | 17.5 | 4.53 | 5.34 | 6.43 |
| M-7 | 21 | 4.35 | 5.18 | 6.02 |



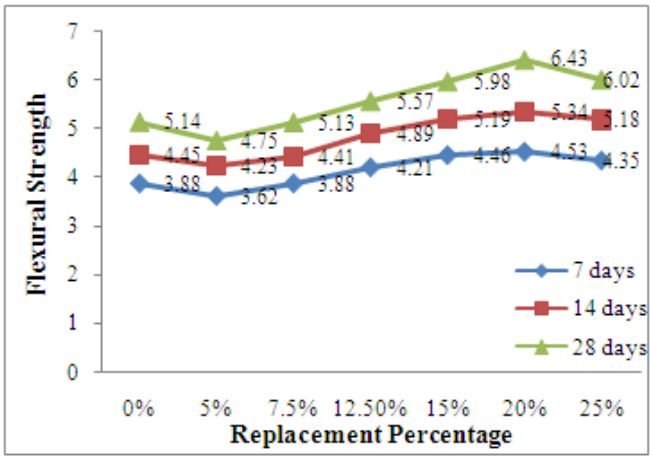

Graph 1: Flexural Strengthfor 7 days(in N/mm2)




Graph 2: Flexural Strengthfor 14 days(in N/mm2)




Graph 3: Flexural Strength for 28 days(in N/mm2)




Graph 4: Flexural Strengthat various age(in N/mm2)

As shown in the graph: (7 days strength), when cement is partially replaced 20% by MD, flexural strength is increased by 4.53. Afterwards when % of MD is increased the strength starts decreasing.

When (14 days strength) is analyzed, 20% replacement of MD gives 5.34 more flexural strength when compared with normal concrete. Here also, when % of SF is increased, strength starts decreasing.

28 days strength in graph: 3show an increment of 20% of strength of 6.43 replacement of marble dust as compared with conventional concrete. Again strength is decreased when % of marble dust is increased.

As discussed here, it can be said that an increment in flexural strength of 20% replacement of marble dust, nearly 26% is achieved as compared with conventional concrete mix.

## CONCLUSION

After performing the test and analyzing their result, the following conclusions have been derived:

1. The results achieved from the existing study shows that marble dust is great potential for the utilization in concrete as replacement of cement.

2. Workability of concrete decreases as proportion of marble dust increases.

3. Maximum flexural strength was observed when marble dust replacement is about 17.5%.

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