

**EXPERIMENTAL ANALYSIS ON PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER**

Pranav Jadhav

Aniket Ingle

Rushikesh Dalave

**Guided By**

Dr. J. R. Dhanuskar

JSPM's Rajarshi Shahu Collage of Engineering, Tathwade Pune 411033

**ABSTRACT**

This project describes the feasibility of using marble dust in concrete production as a partial replacement of cement, in India marble and granite stone processing is one of the most thriving industries the effects of varying marble dust contents on the physical and mechanical properties of hardened concrete have been investigated. Waste marble dust can be used to improve the mechanical and physical properties of conventional concrete. The compressive strength of strength concrete was measured for 7, 14, and 28 days. Marble is used as a building material. There are several reuses and recycling solutions for this industrial byproduct both at an experimental phase and in practice applications these industrial wastes are dumped in then by land, and the natural fertility of the soil gets spoiled. The use of waste marble by-products as aggregate has greater potential because 75% of concrete is composed of aggregate the use of marble dust in construction might be cost-effective. After all, marble waste is available free of cost. In addition to this, due to the fineness of marble powder, it will easily mix with aggregate so that perfect bonding is possible. Marble powder will fill the voids present in concrete and will give sufficient compressive strength when compared with conventional concrete.

**INTRODUCTION**

The present-day world is witnessing the construction of a challenging civil engineering structure. Quite often, concrete is the most important and widely used material with sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concrete with special characteristics.

This project describes the feasibility of using marble dust in concrete production as a partial replacement for cement. In India, marble and marble stone processing is one of the most thriving industries. The effect of varying marble dust contains on the physical and mechanical properties of hardened concrete has been investigated. Waste marble dust can be used to improve the mechanical and physical properties of conventional concrete the compressive strength of concrete is measured for 7,14 and 28 days.

Marble is used as a building material. There are several reuse and recycling solutions for this industry by-product, both at an experimental phase and in practice applications. These industrial wastes are dumped on the land, and the natural fertility of the soil gets spoiled.

Waste can be used to produce new products and can be used as admixtures so that natural resources are used more efficiently and the environment is the product of waste deposits. Marble stone industries generate both solid waste and stone slurry is a liquid substance consisting of particles originating from the sawing and polishing process.

**LITERATURE SURVEY**

The research work related to the experimental analysis on the partial replacement of cement with marble powder in different percentage. Marble dust has been replaced with cement in proportion to 5%,7.5%,10%,15% and 20%.In this research work the percentage of 10%,15%and 20% are selected.

**R. C. Gupta, A. Misra, and M. Raisinghani (2009)** The present research aims to use marble powder in bulk quantities for the manufacture of tiles. This paper presents the results of an investigation on flexural strength and flexural creep characteristics of the flooring tiles containing marble powder. Four different mix proportions (1:5 to 1:8) were chosen for the investigation. The strength testing was carried out as per IS: 1237 and creep specimens were subjected to sustained central line load at 0.75 stress-strength ratios (applied stress: ultimate flexural strength) for a period of up to 81 days. The change in deformation was found to become negligible between 45 to 60 days. The results indicated that the tiles satisfying flexural strength requirement as per IS: 1237 can be manufactured having marble powder content up to approximately 87%. These specimens also indicated that the creep deformations are lesser for tiles having greater proportions of marble powder.

**Baboo Raiand Khan Naushad (2011)** studied the influence of marble powder in the cement concrete mix. In this paper, the effect of the use of marble powder and granules has been studied by partially replacing them with mortar and concrete constituents and checking the different properties like relative workability and compressive and flexure strengths. By partially replacing the constituents it reveals that increased waste powder or waste marble granules ratio resulted in increased workability and compressive strengths of the mortar and concrete.

**Veena G Pathan and Md Gulfam Pathan (2014)** Studied the feasibility of marble powder as the constituent of concrete mix. He studied that compressive strength increases with the addition of waste marble powder as a replacement for cement. This research also investigates how marble dust greatly impacts properties such as consistency, setting time, insoluble residue, and soundness. The use of cheaper constituents like waste can solve economic problems as well as environmental problems. Therefore there is a scope for research in the field of durable concrete with their waste.

**Noha M. Soliman (2013)** presented the effect of using marble Powder in Concrete Mixes and also its effect on the strength of R. C. Slabs. This research aims to study the effect of using marble powder as a partial replacement of cement on the properties of concrete. The behavior of reinforced concrete slabs by using marble powder is also investigated. The main consideration in this investigation is the percentage of marble powder as a partial replacement of cement constituents in concrete mixes. The experimental results showed that the use of a definite amount of marble powder as a replacement for cement content increases workability, compressive strength, and tensile strength. The use of marble powder enhances the structural performance of the tested slabs as it increased the stiffness and the ultimate strength compared to the control slabs.

**Manju Pawar (2014):** have done their search on periodic research, on the significance of partial replacement of cement with waste marble powder. They found that the effect of using marble powder as a constituent of fines in mortar or concrete by partially reducing qualities of cement has mortar and concrete been studied in terms of relative compressive strength. Partial replacement of cement by varying percentages of marble powder reveals that an increased waste powder ratio results in increased. They found out the optimum % for the replacement of marble powder with cement gives strength. (VOL.III)

**Ranjan Kumar and Shyam Kishor Kumar (2015):** In this research work, the waste MDP passing through 90 microns, has been used for investigating hardened concrete properties. Furthermore, the effect of different percentage replacement of MDP on the compressive strength, splitting tensile strength (Indirect tensile strength) & flexural strength has been observed. In this experimental study, the effect of MDP in concrete on strength is presented. Five concrete mixtures containing 0%, 5%, 10%, and 20% MDP as cement replacement by weight basis have been prepared. The water/cement ratio (0.43) was kept constant, in all the concrete mixes. Compressive strength, split tensile strength & flexural strength of the concrete mixtures have been obtained at 7 and 28 days.

**Veena and G. Pathan (2014):** studied the feasibility and need for the use of Waste Marble Powder in Concrete Production. This paper presents the feasibility of the substitution of marble waste for cement to achieve economic and environmental savings. Test results indicate that the 10% of marble dust in the cement concrete gives the best results. And also increase in curing days will increase the strength of marble dust concrete when compared from 14 days to 28 days.

**Rakesh Gupta (2009):** studied "Partial replacement of cement with marble powder" and concluded that for M 20 grade concrete the compressive strength of cubes is increased with the addition of waste marble powder up to 10% replace by the weight of cement and further any addition of waste marble powder the compressive strength decreases. The split tensile strength of cylinders is increased with the addition of waste marble powder up to 10% replaced by the weight of cement and further any addition of waste marble powder the split tensile strength decreases.

**Ruchi Chandrakar (2017):** In her entire work, the author has partially replaced the Marble Dust with cement in proportion to 0%, 5%, 10%, 15%, 20%, 25%, and 30%.

The concrete test has been known as Comp. Strength in the interval of 7 days & 28 days. The author prepared the mix design for the M20 grade and on this basis, The author tested the concrete and made the results.

**Vijaya Kumar YM (2016):** The author has replaced marble dust in cement with different proportions (0%, 5%, 10%, 15% 20%, and 25%) of M20 grade concrete. The author takes cement of two different types OPC and PPC. The test was conducted in 7 days & 28 days intervals as comp. strength and Tensile strength.

**Deepanshu Patel (2016):** "Deepanshu Patel" has observed the effects of Marble Dust on Concrete. In his research, the author has changed the various ratios of Marble Dust with cement. The ratio of Marble Dust has been taken (0%, 5%, 10% & 15%), so the author has done the results by taking various tests in the 7 days and 28 days interval. In these tests, they have found the result of compressive strength and concrete potential

**Aalok D (2014):** conducted a study on the partial substitution of cement with marble dust, concluding that for M25 concrete, there was a significant improvement in the strength of the concrete. Using the right quantity of dust resulted in a 50 percent boost in strength.

**Rochak Pandey (2011):** conducted a study on the partial substitution of cement in concrete using waste marble dust. According to them, it is highly beneficial to mix a little quantity of these waste materials with concrete to minimize the mess of pollution and, more significantly, they may be utilized to increase the strength of the materials. Veena Pathan and Gulfam Pathan in 2014 researched the significance of partial replacement of cement with waste marble dust. In their opinion, the amount of marble dust added to the concrete adds to the compressive tensile and flexural strength of the concrete.

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**G. Latha (2015):** did an Experimental Investigation on the strength characteristics of concrete using Waste marble dust as a cementitious material. According to her, adding marble dust to cement concrete improves everything, including improving the strength of the concrete and lowering environmental pollutants. Marble dust, being composed of calcium carbonate, will react with many acids, neutralizing the acid. It is one of the most efficient acidneutralization materials available. Marble dust is frequently used to neutralize acid in streams, lakes, and soils. It is also used in the chemical industry for acid neutralization

#### OBJECTIVE

- To study the optimum result after partial replacement of marble powder.
- To achieve maximum strength like cement by replacing cement with marble powder.
- To study the strength after the partial replacement of cement with marble powder to find an economical solution for high-cost construction material.
- To compare the compressive strength.

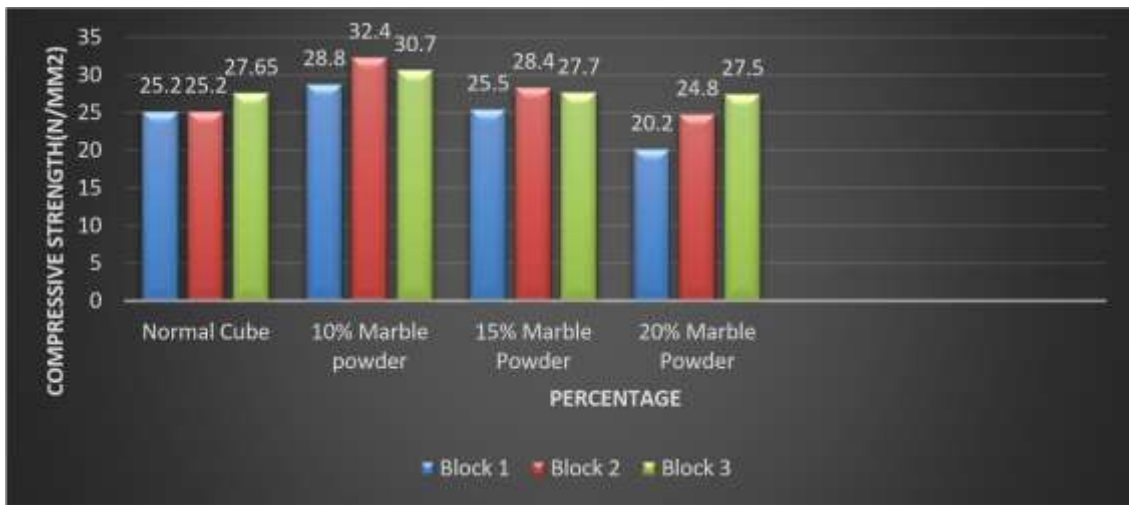
#### LABORATORY TESTING

We Performed different types of testing

##### 1. Compressive Strength Test

Sr. No	Normal Cube (N/mm <sup>2</sup> )	10% Marble Powder (N/mm <sup>2</sup> )	15% Marble Powder (N/mm <sup>2</sup> )	20% Marble Powder (N/mm <sup>2</sup> )
1	25.2	28.8	25.5	20.2
2	25.2	32.4	28.4	24.8
3	27.6	38.7	27.7	27.5
<b>Average</b>	<b>26</b>	<b>30.6</b>	<b>27.2</b>	<b>24.16</b>

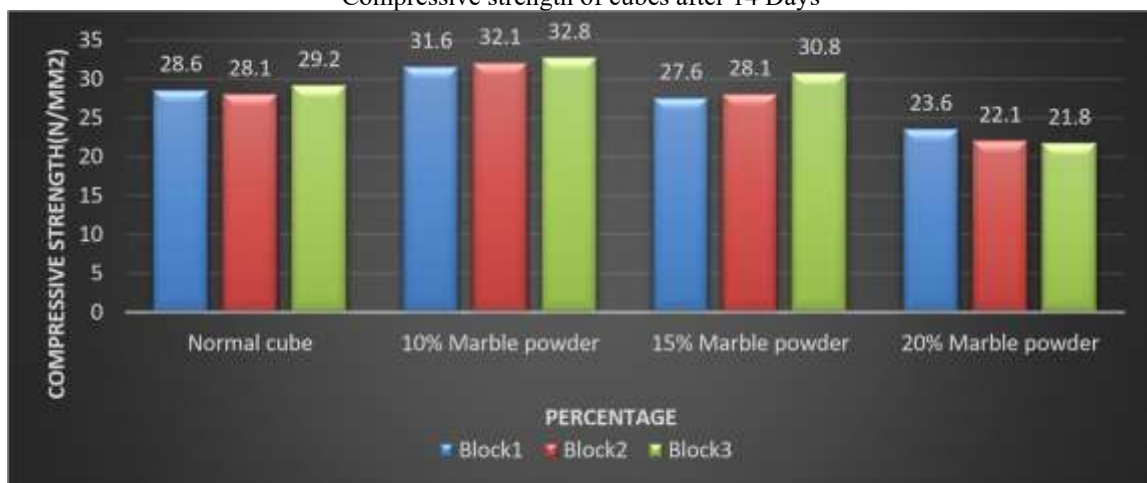
Compressive strength of cubes after 7 Days



Graphical Representation of 7 Days Compressive Strength

Sr. No	Normal Cube (N/mm <sup>2</sup> )	10% Marble Powder (N/mm <sup>2</sup> )	15% Marble Powder (N/mm <sup>2</sup> )	20% Marble Powder (N/mm <sup>2</sup> )
1	26.5	31.6	28.6	24.6
2	29.1	30.7	25.9	23.9
3	27.2	32.3	28.8	22.8
<b>Average</b>	<b>27.6</b>	<b>31.53</b>	<b>27.76</b>	<b>23.7</b>

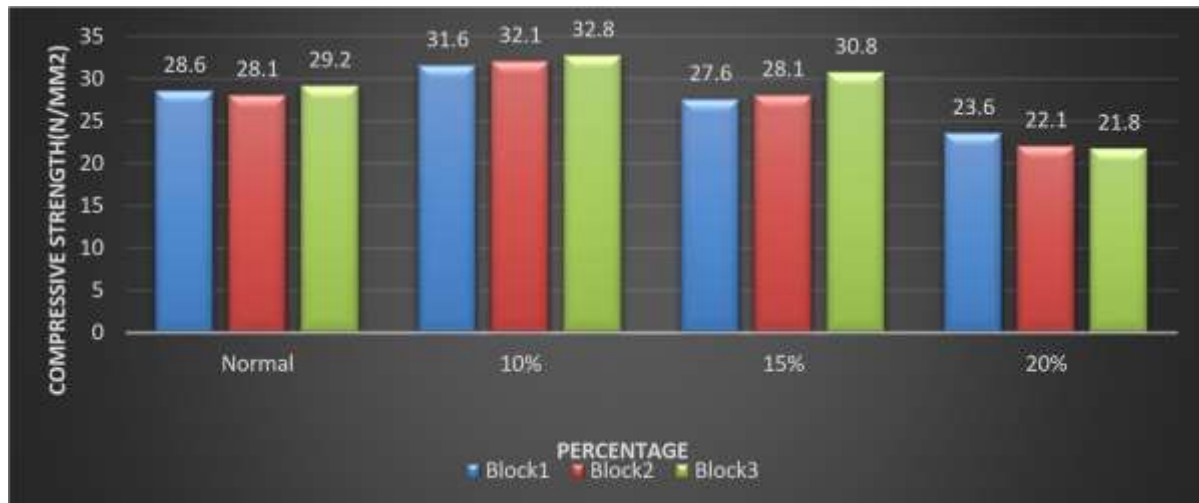
Compressive strength of cubes after 14 Days



Graphical Representation of 14 days Compressive Strength

Sr. No	Normal Cube (N/mm <sup>2</sup> )	10% Marble Powder(N/mm <sup>2</sup> )	15% Marble Powder (N/mm <sup>2</sup> )	20% Marble Powder(N/mm <sup>2</sup> )
1	28.6	31.6	27.6	23.6
2	28.1	32.1	28.1	22.1
3	29.2	32.8	30.8	21.8
<b>Average</b>	<b>28.6</b>	<b>32.16</b>	<b>28.8</b>	<b>22.5</b>

Compressive strength of cubes after 28 Days



Graphical Representation of 28 days Compressive Strength

### APPLICATION

The experimental analysis on the partial replacement of cement with marble powder has several potential applications in the construction industry.

- Sustainable Construction:** One of the primary applications is promoting sustainability in construction practices. By using marble powder as a partial replacement for cement, the demand for cement production can be reduced. Cement production is energy-intensive and contributes to significant carbon emissions. Utilizing marble powder, which is a waste product generated by the marble industry, helps in minimizing environmental impact and conserve natural resources.
- Cost-effective Concrete:** The use of marble powder as a cement substitute can offer cost benefits. Marble powder is often readily available and can be obtained at a lower cost compared to cement. By partially replacing cement with marble powder, construction projects can achieve cost savings without compromising the desired concrete properties, making it an attractive option for budget-conscious projects.
- Enhanced Workability:** Marble powder has shown potential in improving the workability of concrete. The fine particles of marble powder act as fillers, reducing the water demand and enhancing the flowability of the mixture. This can result in improved ease of concrete placement and compaction, making it suitable for applications where workability is a critical factor, such as in decorative concrete works.

4. **Aesthetic Considerations:** The use of marble powder in concrete can provide unique aesthetic qualities. The natural colors and patterns present in marble powder can add visual appeal to architectural and decorative concrete elements. This can be particularly advantageous for projects where aesthetics play a significant role, such as in high-end residential or commercial buildings.
5. **Reduced Heat of Hydration:** Marble powder has been found to contribute to lower heat of hydration in concrete. This property can be beneficial in large-scale concrete placements, such as dams or massive infrastructure projects. By reducing the heat generated during the curing process, the risk of thermal cracking and subsequent durability issues can be minimized.
6. **Surface Finish and Polishing:** Concrete containing marble powder can be polished to achieve a glossy and reflective surface finish. The unique characteristics of marble powder can be leveraged to create visually appealing polished concrete floors, countertops, and architectural elements. This application finds relevance in both residential and commercial spaces.
7. **Non-structural Applications:** Marble powder-based concrete can find applications in non-structural elements, such as tiles, pavers, and precast concrete products. The use of marble powder in these applications can enhance their aesthetic appeal, durability, and performance while reducing the consumption of cement.

It is important to note that the specific application and suitability of marble powder-based concrete may vary depending on factors such as the source and quality of marble powder, the desired concrete properties, and the local construction practices. Conducting experimental analysis allows for a deeper understanding of the material's behavior and enables its effective implementation in various construction applications.

#### **CONCLUSION**

After comparing the average strength of cubes for 7 days for 10% replacement of cement with marble powder the gain in strength is observed which is **17.69%** more than the normal cube.

After comparing the average strength of cubes for 14 for 10% replacement of cement with marble powder days the gain in strength is observed which is **14.24%** more than the normal cube.

After comparing the average strength of cubes for 28 days for 10% replacement of cement with marble powder the gain in strength is observed which is **12.45%** more than the normal cube.

The use of marble waste powder shows great performance due to its efficient micro-filling ability. The test shows that industrial waste can improve harden concrete performance. The use of marble dust exhibited excellent performance due to its efficient filling ability. It can also affect shrinkage & plasticity.

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#### **GUIDE**



Dr. J. R. Dhanuskar is Head of the Department in JSPM's Rajarshi Shahu College Of Engineering, Tathawade Pune

### AUTHOR



Pranav Jadhav Pursuing Graduation in a BTech in Civil Engineering from JSPM's Rajarshi Shahu College of Engineering Pune.



Aniket Ingle Pursuing Graduation in a BTech in Civil Engineering from JSPM's Rajarshi Shahu College of Engineering Pune.



Rushikesh Dalave Pursuing Graduation in BTech in Civil Engineering from JSPM's Rajarshi Shahu College of Engineering Pune.