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# Experimental Study on Partial Replacement of Cement with Marble Dust Powder in M25 and M30 Grade Concrete

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***Abstract:** In today's era, "concrete" is proving to be a very important component of the level of construction, due to which 6 million tonnes of concrete is being produced annually. Due to the continued development, cement is being consumed very fast in the field of construction. This component of concrete, such as cement and other raw materials, is emitting CO2, which is proving to be very harmful for those living in our environment and environment. Along with this, there is a great impact on the economy. Keeping in view the growing need for development and the environment, the cement is being changed in different ratios with different types of pozzolans. In this research, cement has been partially substituted in different proportion with Marble Dust and various types of tests have been done. In this test, the marble dust has been altered with cement ratio of 0%, 5%, 7.5%, 10%, 12.5%, 15% and 20%, and as a result (concrete two grade M-25 and M-30) Tensile Strength and Compression Strength of the concrete, The test has been done in 7 days, 28 days and 56 days intervals.*
***Keyword:** Concrete M25&M30grade, Marble Dust Powder, Compressive Strength, Tensile Strength, Workability*

## I. INTRODUCTION

In today's development phase, concrete is a very important contribution to the world. From the ancient times to the present day many amazing constructions are being done with the help of this concrete (1). Buildings, historic buildings, roads, bridges, highways, dams and others are being built in the form of constructions with the help of this concrete (2). Concrete is made up of many main components, cement is the main component in these components. Due to the growing needs due to development, cement is also being consumed very fast in concrete. Due to the high consumption of cement consumption, there is a very harmful effect on the environment. The main reason for the harmful effects of the environment is gas emitted from cement like CO2 and others (3). In order to overcome these problems caused by the construction, some researchers have replaced cement with partial amounts of pozzolans to reduce the consumption of cement and improve the manufacturing sector's economy, due to which the environment A fair prospect of improvement has been demonstrated (4). In this research work, cement has been substituted in partially form of marble dust powder. Marble dust has been replaced with cement in proportion to 0%, 5%, 7.5%, 10%, 12.5%, 15% and 20%.Concrete mix design is made for two grades M 25 and M 30, then both grades of concrete have been observed. In this paper, concrete results have been detected by testing split tensile strength and compressive strength in 7 days, 28 days & 56 days intervals.

### A. *Objective*

1) Profiling the impact on concrete by partially replacing cement with marble dust powder.
2) Find out the result of testing of tensile strength and compressive strength in Concrete of M 25 and M 30 grade.
3) To reduce the consumption of cement, move towards a successful endeavor.

## II. LITRATURE REVIEW

1) *Gurcharan Singh:* In his research work, he replaced the marble dust with cement in 0%, 10% and 15% ratio and tested on concrete of M 25 and M 30 grade. He has known the results of compressive strength and workability in the form of a test. He found best suited result of Marble Dust at 10% (5).
2) *Ms. Ruchi Chandrakar(2017):* In her entire work, She 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. She prepared the mix design for the M20 grade and on this basis She tested the concrete and made the results known (6).
3) *Vijaya Kumar YM(2016):* He has replaced marble dust in cement with different proportion (0%, 5%, 10%, 15% 20%, and 25%) of M20 grade concrete. He takes cement of two different type OPC and PPC. The test was conducted in 7 days & 28 days interval as comp. strength and Tensile strength (7).
4) *Deepanshu Patel (2016):* "Deepanshu Patel" has observed the effects of Marble Dust in Concrete. In his research, he has changed the various ratios with Marble Dust with cement. The ratio of Marble Dust has been taken (0%, 5%, 10% & 15%), so

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that he 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 (8).

5) *Kapil Katuwal (2017):* In his research, Marble Dust is mixed in different ratios with cement and fine aggregates. Marble Dust ratios have been taken 0%, 5%, 10%, 15%, and 20%. M35 grade concrete test is done. This test was done in the interval of 7 days and 28 days and during the test the result of compressive strength of concrete has been detected (9).

## III. MATERIAL USED

### A. *Cement*

The cement is away from the primary element of concrete, in which it presents binding material for discrete elements. Cement is produced from raw materials and buried waste in the bottom of the earth (10). In this experimental paper, the cement of OPC 43 grade has been used. Ordinary Portland cement used in this experiment was absolutely fresh and without knot. Various types of tests have been done before the use of concrete for cement, the results of Final Setting Time, Initial Setting Time and Consistency of Cement have been detected in these tests. The results of the chemical and physical properties of cement are shown in Table-1 and 2 below.



Figure 1: OPC 43 Grade Cement

Table 1: Chemical Properties of Ordinary Portland Cement 43Grade

| S. No. | Chemical Properties | Percentage |
|---|---|---|
| 1. | $SiO_2$ | 20.98 |
| 2. | $Al_2O_3$ | 5.42 |
| 3. | $Fe_2O_3$ | 3.92 |
| 4. | CaO | 62.85 |
| 5. | MgO | 1.76 |
| 6. | $Na_2$ | 0.28 |
| 7. | $K_2O$ | 0.53 |
| 8. | $SO_3$ | 2.36 |
| 9. | Loss on ignition | 1.90 |

Table 2: Physical Properties of Ordinary Portland Cement 43 Grade

| S. No. | Physical Properties | Test Result (As per IS Code) |
|---|---|---|
| 1. | Initial Setting Time | 75 Min. |
| 2. | Final Setting Time | 255 Min. |
| 3. | Soundness | 3 mm Expansion |
| 4. | Normal Consistency | 32% |
| 5. | Specific Gravity | 3.14 |
| 6. | Colour | gray |

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*B. Marble Dust Powder*

Marble stones are produced during the excavation of Metamorphic rocks all over the world (11). Many buildings and large scale monuments are being constructed using the marble stone since ancient times. The buildings are being made attractive using marble stones (12). When the marble stone is obtained during excavation, it is non-shaped. To make this stone use in the construction area, the stone is sculpted, cut in shape and the stones are made to glossy (1) (13). The chemical and physical properties of marble dust powder used in this experimental work have been studied and results are given in Table 3 and Table No.4 below.



Figure 2: Marble Dust Powder

Table 3: Chemical Component of Marble Dust Powder

| S. No. | Chemical Properties | Percentage |
|---|---|---|
| 1. | $SiO_2$ | 4.99 |
| 2. | $Al_2O_3$ | 1.09 |
| 3. | $Fe_2O_3$ | 1.09 |
| 4. | CaO | 32.23 |
| 5. | MgO | 18.94 |
| 6. | $Na_2O$ | 0.63 |
| 7. | $K_2O$ | 0.91 |
| 8. | $SO_3$ | 0.02 |
| 9. | LOI | 40.63 |

Table 4: Physical Properties of Marble Dust Powder

| S. No. | Physical Properties | Test Result (As per IS Code) |
|---|---|---|
| 1. | Colour | White |
| 2. | Size of Particle | Passed out 90micron sieve |
| 3. | Water Absorption | 0.97% |
| 4. | Specific Gravity | 2.71 |
| 5. | Fineness Specific Surface | 128 |

*C. Coarse Aggregate*

Course aggregate is an important component of concrete. Two types of aggregates(20mm & 10mm) have been used in this research paper. Before using these concrete, the dust has been thoroughly released and the result has been determined after testing these aggregates in various forms. The results of all these tests and the results of its properties are given in Table 5 below.



Figure 3: Coarse Aggregate (20mm & 10mm)

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Table 5: Properties of Coarse Aggregate (20mm & 10mm)

| S. No. | Physical Properties | Test Result (As per IS Code) |
|---|---|---|
| **1.** | Specific Gravity | 2.73 |
| **2.** | Water Absorption | 1.50% |
| **3.** | Fineness Modulus | 6.51% |
| **4.** | Compacted Bulk Density | 1570Kg/m$^3$ |
| **5.** | Particle Size | 20mm & 10mm |

*D. Fine Aggregate*

The fine aggregate used in this experimental work is the sand obtained from the rivers. The entire properties of the fine aggregate used in the experiment are given in Table 6 below, results have been known by various types of testing.

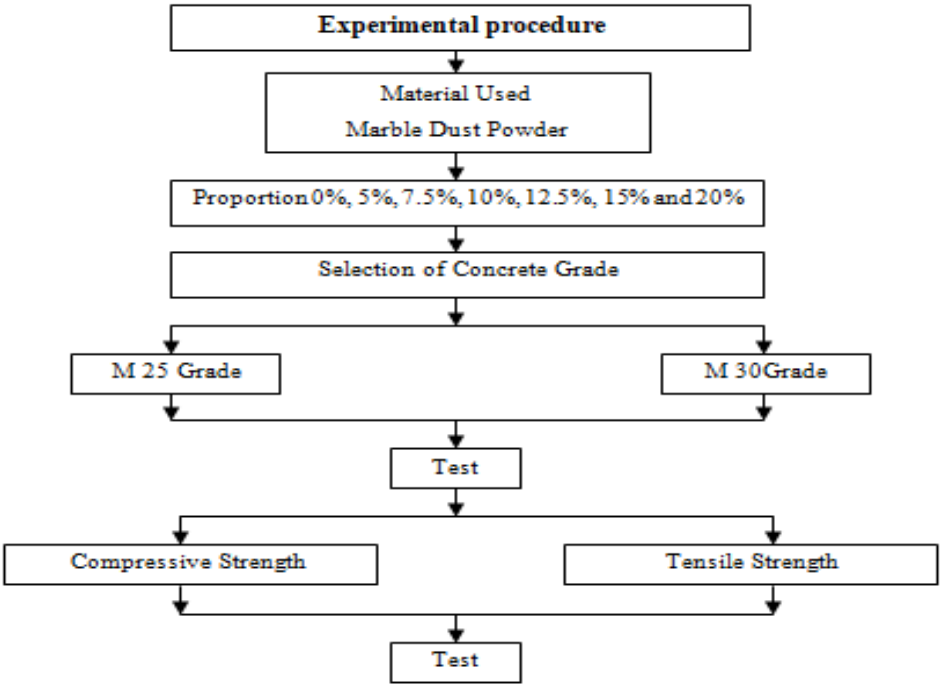


Figure 4: Fine Aggregate

Table 6: Properties of Fine Aggregate

| S. No. | Physical Properties | Test Result (As per IS Code) |
|---|---|---|
| 1. | Specific Gravity | 2.60 |
| 2. | Water Absorption | 1.10% |
| 3. | Fineness Modulus | 3.30% |
| 4. | Compacted Bulk Density | 1644Kg/m$^3$ |
| 5. | Zone | II |

## IV. METHDOLOGY




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## V. RESULT

### *A. Compressive Strength*

The main reason for the power of concrete is hydration reaction. Due to this hydration reaction, the ability to bond tightness inside the concrete is formed. Due to this reaction, the age of concrete increases (14). In this experimental work, two grades of concrete have been used. In order to know the result of Compressive Strength, concrete is first made in these two grade mix designs. Concrete has been molded into the cube in the test of compresses, then they have been soaked in water for 7 days, 28 days and 56 days interval, and after this interval, they have been evaporated from the water and dried in the atmosphere. After drying these cube, testing with the help of "CTM" machine has given results, resulting in the following table 7 and 8. These results have also been demonstrated by the graph, which will be seen in graph figure 7 and figure 8.




Figure 5:Compressive Testing Machine



Figure 6: Compressive Strength Test

Table 7: Compressive Strength of M25 Grade Concrete

| Trial Mix. | Percentage of Marble Dust Powder | Curing Day's | Compressive Strength |
|---|---|---|---|
| M1. | 0% | 7 Days | 21.63 |
| M2. | 5% | | 22.98 |
| M3. | 7.5% | | 23.83 |
| M4. | 10% | | 25.05 |
| M5. | 12.5% | | 24.14 |
| M6. | 15% | | 22.95 |
| M7. | 20% | | 20.22 |
| M1. | 0% | 28 Days | 30.742 |
| M2. | 5% | | 32.227 |
| M3. | 7.5% | | 33.473 |
| M4. | 10% | | 34.197 |
| M5. | 12.5% | | 32.448 |
| M6. | 15% | | 31.654 |
| M7. | 20% | | 27.934 |
| M1. | 0% | 56 Days | 33.217 |
| M2. | 5% | | 34.846 |
| M3. | 7.5% | | 36.226 |
| M4. | 10% | | 37.163 |
| M5. | 12.5% | | 35.874 |
| M6. | 15% | | 32.790 |
| M7. | 20% | | 29.573 |

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Table 8:Compressive Strength of M30 Grade Concrete

| Trial Mix. | Percentage of Marble Dust Powder | Curing Day's | Compressive Strength |
|---|---|---|---|
| M1. | 0% | 7 Days | 26.18 |
| M2. | 5% | | 27.81 |
| M3. | 7.5% | | 28.84 |
| M4. | 10% | | 30.86 |
| M5. | 12.5% | | 29.22 |
| M6. | 15% | | 27.77 |
| M7. | 20% | | 24.47 |
| M1. | 0% | 28 Days | 37.21 |
| M2. | 5% | | 38.99 |
| M3. | 7.5% | | 40.39 |
| M4. | 10% | | 41.154 |
| M5. | 12.5% | | 39.249 |
| M6. | 15% | | 38.315 |
| M7. | 20% | | 33.813 |
| M1. | 0% | 56 Days | 40.112 |
| M2. | 5% | | 41.813 |
| M3. | 7.5% | | 43.134 |
| M4. | 10% | | 43.975 |
| M5. | 12.5% | | 42.81 |
| M6. | 15% | | 39.64 |
| M7. | 20% | | 35.796 |

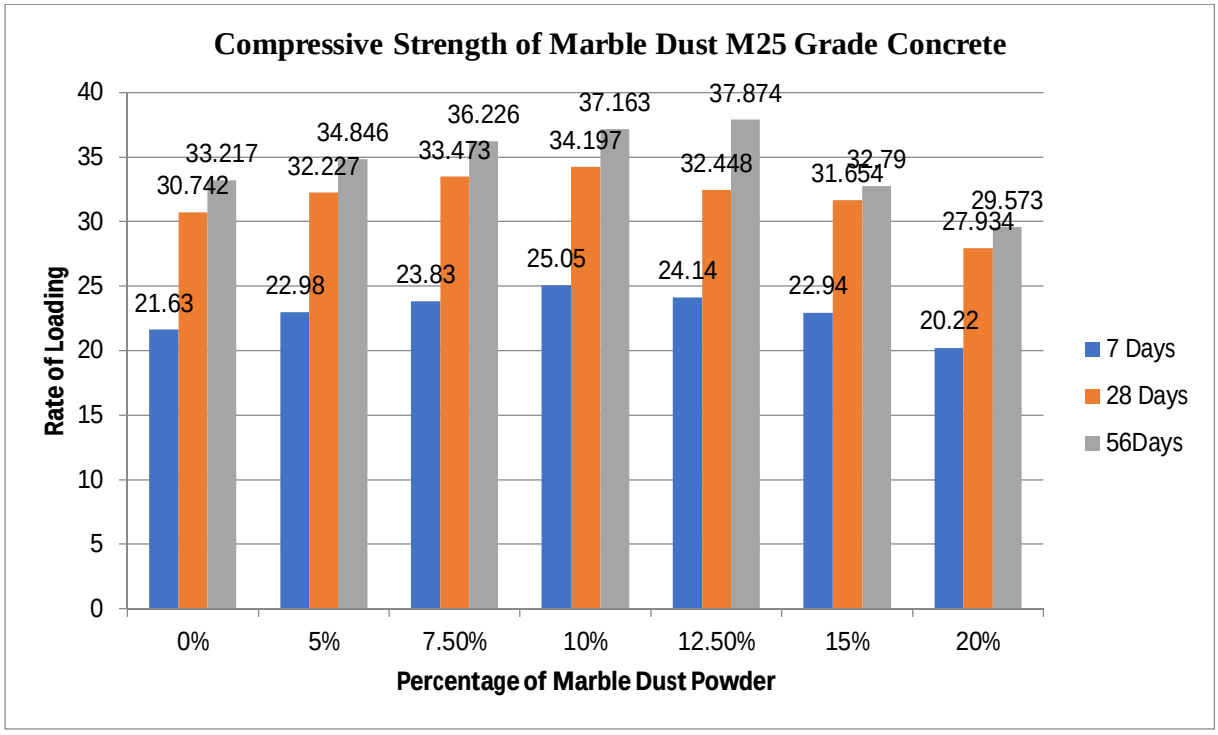



Figure 7:Compressive Strength of Marble Dust M25 Grade Concrete

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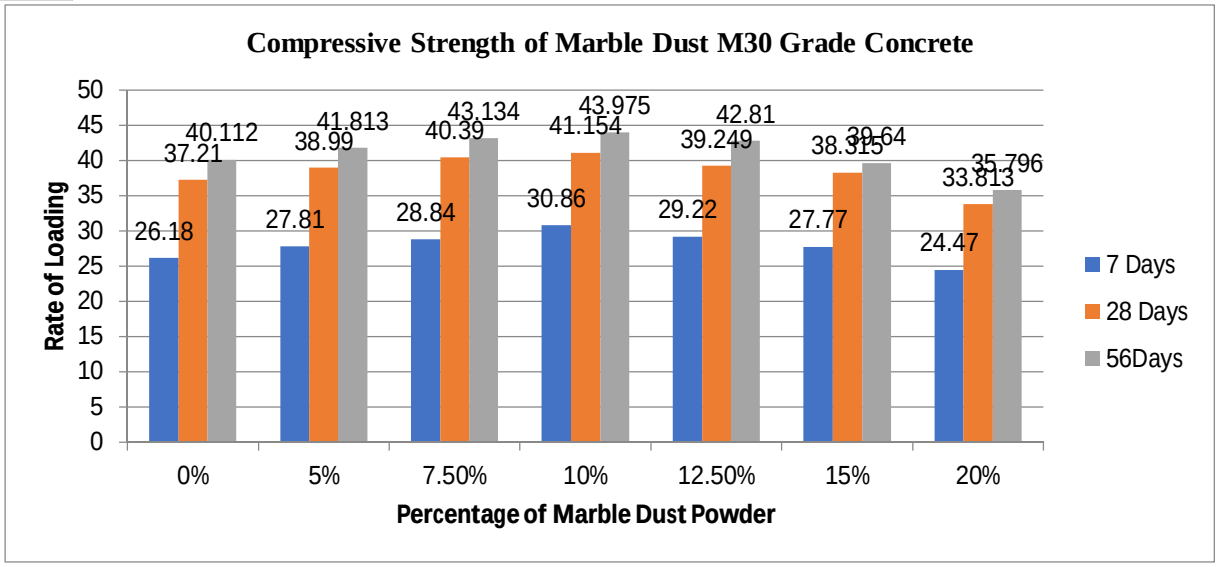



Figure 8:Compressive Strength of Marble Dust M30 Grade Concrete

*B. Split Tensile Strength*

Testing of tensile strength is on the cylinder (14). In this test, the cylinders formed after mixing different ratios of marble dust with cement. The results of the concrete tensile strength test have been known in the interval of 7 days and 28 days. The results of Split Tensile Strength of two grade M25 and M30 cylinders of concrete are given below in table 9 and table 10, as well as these results are shown in graph 10 and Figure 11.



Figure 9: Split Tensile Strength Test by CTM.

Table 9:Split Tensile Strength of M25 Grade Concrete

| Trial Mix. | Percentage of Marble Dust Powder | Curing Day's | Compressive Strength |
|---|---|---|---|
| M1. | 0% | 7 Days | 2.95 |
| M2. | 5% | | 3.22 |
| M3. | 7.5% | | 3.69 |
| M4. | 10% | | 4.07 |
| M5. | 12.5% | | 3.87 |
| M6. | 15% | | 3.52 |
| M7. | 20% | | 3.03 |
| M1. | 0% | 28 Days | 3.93 |
| M2. | 5% | | 4.01 |
| M3. | 7.5% | | 4.10 |
| M4. | 10% | | 4.85 |
| M5. | 12.5% | | 4.42 |
| M6. | 15% | | 4.16 |
| M7. | 20% | | 3.43 |

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Table 10:Table 9:Split Tensile Strength of M30 Grade Concrete

| Trial Mix. | Percentage of Marble Dust Powder | Curing Day's | Compressive Strength |
|---|---|---|---|
| M1. | 0% | 7 Days | 2.992 |
| M2. | 5% | | 3.106 |
| M3. | 7.5% | | 3.279 |
| M4. | 10% | | 3.569 |
| M5. | 12.5% | | 3.254 |
| M6. | 15% | | 3.141 |
| M7. | 20% | | 2.809 |
| M1. | 0% | 28 Days | 4.304 |
| M2. | 5% | | 4.435 |
| M3. | 7.5% | | 4.652 |
| M4. | 10% | | 4.723 |
| M5. | 12.5% | | 4.447 |
| M6. | 15% | | 4.396 |
| M7. | 20% | | 3.92 |

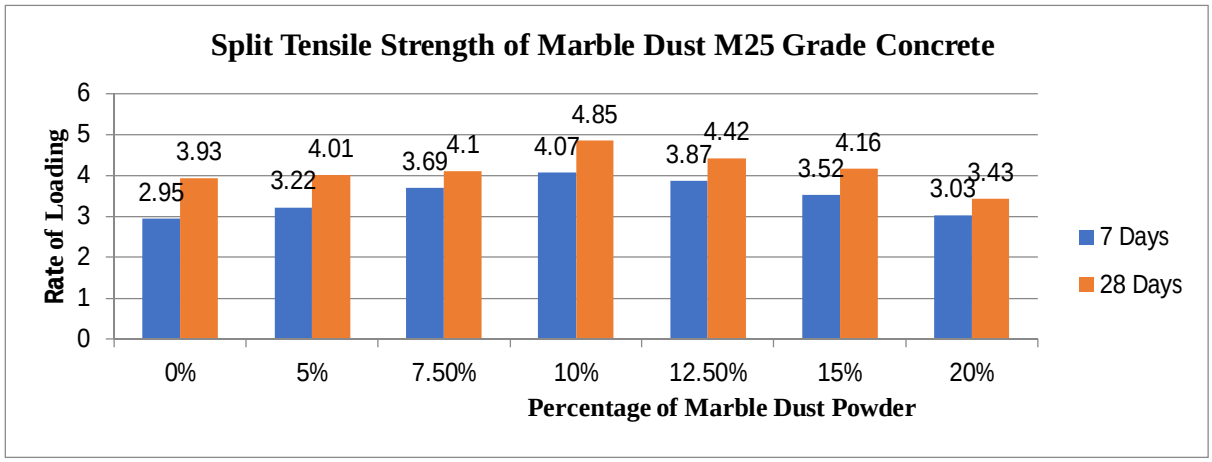



Figure 10:Split Tensile Strength of Marble Dust M25 Grade Concrete

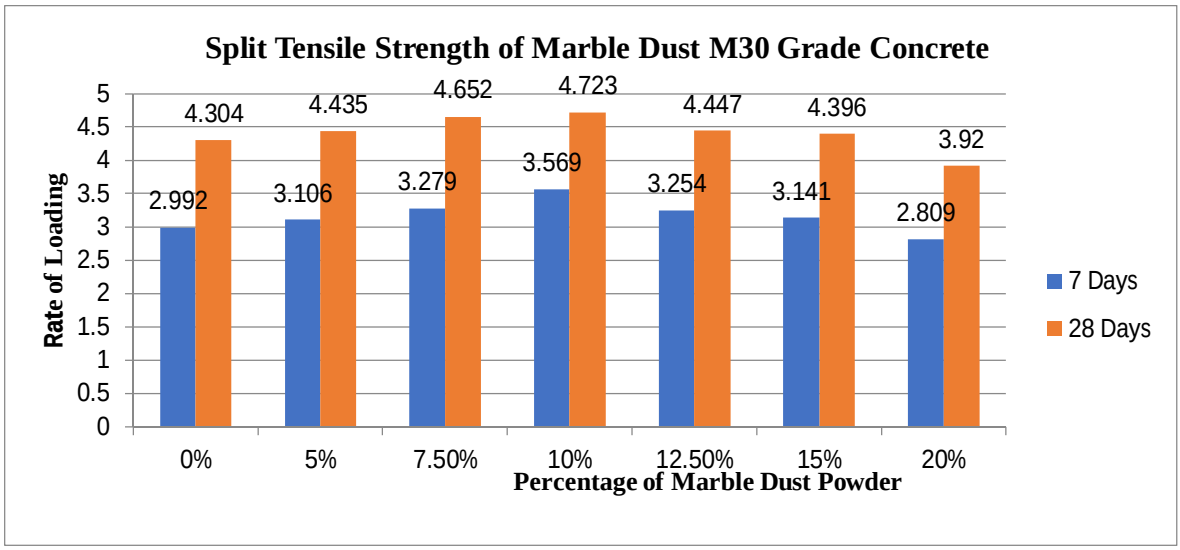



Figure 11:Split Tensile Strength of Marble Dust M30 Grade Concrete

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## VI. CONCLUSION

*A.* In both grades of concrete M25 and M30, the result of high strength is obtained when adding marble dust powder to 10% ratio with cement.

*B.* It has been learned from this experimental work that if the marble dust is replaced with cement in some proportion, the power of the concrete will have a good effect. As well as helping to make the environment friendly, the economy will also have a good effect.

*C.* Marble dust powder has the ability to provide the option of cement and it helps in maintaining the economic balance along with the environment.

*D.* From the results obtained in the letter of this research work and from experiments it has been found that Marble Dust reduces the workability of concrete on a continuous increase with cement.

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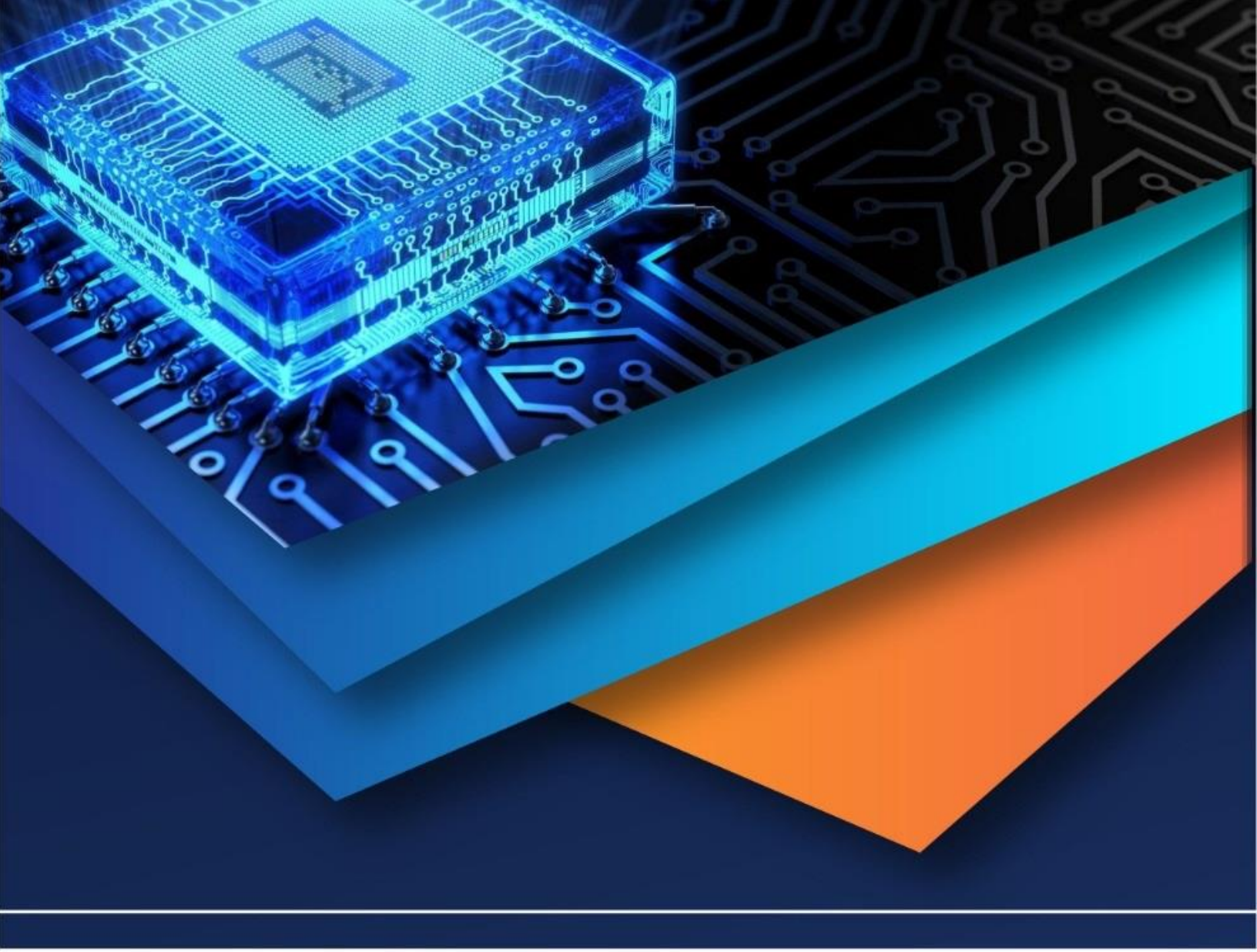
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