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Experimental Study of Effect on Concrete Properties with Partial Replacement of Cement with Dolomite Powder

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Abstract: ***Concrete is a building material consisting of cementations material, fine aggregate, coarse aggregate and water Presently a days the value of those materials are accrued thus, we would like to appear at the simplest way to decrease value of building materials generally cement one in every of the modern development in housing industry is additional of materials in concrete. The partial replacement of materials reduces price, energy savings and protection of environment. To reach these we are partially swapping the cement with marble powder produced from marble industries. Progressive concrete technology becomes advanced to the concrete properties. This paper current and mechanical property of concretes made with and dolomite powder as cement replacement in different amounts. Research in this field and progressive results are essential so as to continue all developments with minimum damage to surrounding environment and tracking down all infrastructures for services and convenience which are preferred to get.***

Keywords: Concrete, Concrete Properties, Dolomite powder, Replacement, Environment.

I. INTRODUCTION

Concrete is the simple civil engineering material used in most of the civil engineering structures. Many materials are used to manufacture good quality concrete. Cement, fine Cement is one of the most important constituents of concrete. Most of the properties of concrete depend on cement. Cement is manufactured by calcimine argillaceous and calcareous materials at a great temperature. During this process, huge amount of CO^2 is released in to the earth atmosphere. India is the second largest manufacturer of cement in the world. It is estimated that the manufacture of one ton of cement outcomes in the emission of 0.79 ton of CO2. The drop in the consumption of cement will not only decrease the cost of concrete but also the emission of CO^2. Dolomite powder developed by grinding the sedimentary rock creating mineral dolostone can be used as a replacement material for cement in concrete up to certain percentage. Dolomite powder has some similar physical characteristics of cement. Dolomite is a carbonate material composed of calcium magnesium carbonate CaMg $(CO3)_2$. Dolomite is a rock forming mineral which is noted for its significant wettability and dispensability. Dolomite has a good weathering resistance. Dolomite is a preferred for construction material due to its higher surface hardness and density. The strength properties of concrete with partial replacement of cement with dolomite powder is to be examine, because of dolomite has same configuration as of the cement such as dolomite has same specific gravity as cement and also finesse, because the properties it can be good replacement of cement in construction industry.

Fig.1.Dolomite powder

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II. METHODOLOGY

1) *Cement:* Cement is a binder, a substance that sets and hardens separately, and binds other materials together numerous types of cements exist in the market. The commonly used cement is Portland cement. Portland cement of 53 grades was used for the project. The specific gravity of Portland cement was 3.15.
2) *Course Aggregate:* The coarse aggregate is the biggest constituent of concrete. It is chemically a stable material. Occurrence of coarse aggregate decreases the drying shrinkage and other dimensional variations occurring on account of movement of moisture. Hard broken granite stones were used as coarse aggregate in concrete. Size of coarse aggregate was used in the investigation is 10mm. The specific gravity of the coarse aggregate was found to be 2.68
3) *Fine Aggregate:* The most significant role of the aggregate is to support in producing workability and uniformity in mixture. The fine aggregate also supports the cement paste to grip the coarse aggregate particle. This action helps plasticity in the mixture and stops the possible segregation of paste and coarse aggregate. It should be stand long enough, clean and be free from organic matters. It should not contain any considerable value of clay and impurities such as alkalis, salt, coal, decayed vegetation etc. River sand will be used as fine aggregate. The specific gravity of sand is found to be 2.56.
4) *Water:* Water is a significant element of concrete as it actively participates in the chemical reaction with cement. The water, which is used for creation concrete should be clean and free from harmful impurities like oil, alkalis, acids etc. Nearby available drinking water will be used in project.
5) *Dolomite:* Dolomite is a carbonate material composed of calcium magnesium carbonate CA Mg $(CO3)_2$. The term is also used to define the sedimentary carbonate rock dolostone. Dolostone (dolomite rock) is calm mainly of the mineral dolomite with a stoichiometric ratio of 50% or better content of magnesium swapping calcium, often as a result of digenesis. Dolomite is a rock forming mineral which is noted for remarkable wettability and dispensability as well as moderate oil and plasticizers absorption.
6) *Mix Design:* Mix design for M 30 grade concrete, Reference – IS 10262: 1982 and IS 10262:2009 &various papers of mix design of concrete. Characteristics compressive strength = 30 N/mm^2, Max. Size of coarse aggregate = 20mm, Degree of quality control = Good, Type of exposure = Mild, Min Cement content = 320kg/m^3 (IS- 456-2000), Max. W/c ratio = 0.45
7) *Test Data for Materials:* Cement used = Ordinary Portland cement (53grade), Specific gravity of cement = 3.15, Specific gravity of Coarse aggregate = 2.78 Specific gravity of fine aggregate = 2.63 Water absorption Coarse aggregate = 0.5%, Fine aggregate = 1.0%
8) *Proportion of Volume of Coarse Aggregate and Fine Aggregate Content*: From Table 3 (IS: 10262-2009) volume of coarse aggregate matching to 20mm size aggregate and fine aggregate (Zone I) for water cement ratio of 0.60 In the present case water cement ratio is 0.45, therefore volume of coarse aggregate is essential to be improved to reduction the fine aggregate content. As the water cement ratio is lower by 0.10, the proportion of volume of coarse aggregate is increased by 0.02 (at the rate of -/+ 0.01 for every +/- 0.05 change in water cement ratio) Therefore, modified quantity of volume of coarse aggregate for the w/c ratio of 0.45= 0.62. For pump able concrete these values should be reduced by 10 percent.

TABLE.1 Details OF Mix

Mix No	Water(lit)	Cement kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	Water Cement Ratio
1	197	438	759.61	1018.48	0.45

III. EXPERIMENTAL WORK

1) *Compressive Strength:* The cube compressive strength of concrete was determined by conducting test on 150mm x 150mm x 150mm cube the specimens at 7 days, 28 days of curing. After curing, cube specimens were tested on a compression machine. The samples were tested in the compression testing machine of 2000kN capacity. After insertion the samples on the compression testing machine, the load was applied at rate of 140kg/cm2/min until the specimen get cracked. The average value of the results is taken as the compressive strength. The compressive strength of concrete gives inkling about the overall excellence of concrete.

Fig.2.Compressive Strength

2) *Split Tensile Strength:* Tensile strength of concrete greatly affects the range and size of cracking in concrete. Tensile strength of concrete is less when compared with its compressive strength. Cylinders 150×300mm were used to define the split tensile strength. After curing, the samples were tested on the compression testing machine of 2000kN capacity.

Fig.3.Split Tensile Strength

3) *Flexural Strength:* The determination of flexural tensile strength is significant to evaluation the load at which concrete members may crack. The flexural tensile strength at let-down is called modulus of rupture. The knowledge of modulus of rupture is beneficial in the design of pavement slabs, airfield runways, finding deflection and crack width as flexural tension is critical in these cases. Sample of size 150 mm ×150 mm ×300mm were used to determine the flexural strength. Point loading was approved for finding the flexural strength. The samples were tested in a Universal Testing Machine (UTM) of capacity 1000kN.

Fig.4.Flexural Strength

4) *Differential Thermal Analysis Test (DTA):* The method consists of measuring the heat changes associated with physical and chemical transformation occurring during the gradual heating of a substance. With the help of this Knowledge change in physical and chemical transformation was studied of dolomite, the dolomite is place on TGA-DTA instrument at room temp the gradual temp was increased. The 40gm of Sample was taken was investigation the rate of heat increment is 50°C/Min. set of instrument is as below

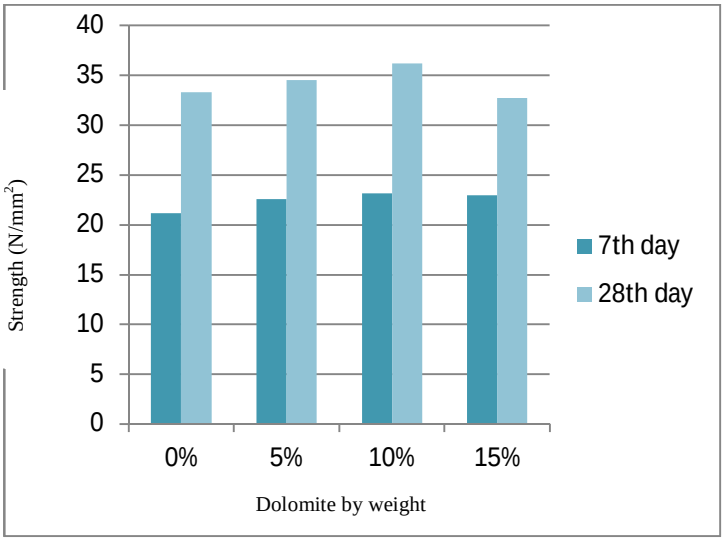
5) *Field Emission Scanning Electron Microscopic Test (FE-SEM):* The FE-SEM test was conducted for determination the Microscopic structure of specimen and also determination crystalline structure of the specimen In this investigation the Microscopic structure was determine of 5%,10% ,15% replacement of dolomite which was gives value of strength

IV. RESULTS AND DISSCUSSION

A. *Compressive Strength*

Table 2. Result of compressive strength (n/mm^2)

Sr.no	Dolomite by weight	Compressive Strength (N/mm^2) 7th day	Compressive Strength (N/mm^2) 28th day
1	0%	21.15	33.30
2	5%	22.57	34.56
3	10%	23.14	36.24
4	15%	22.96	32.72

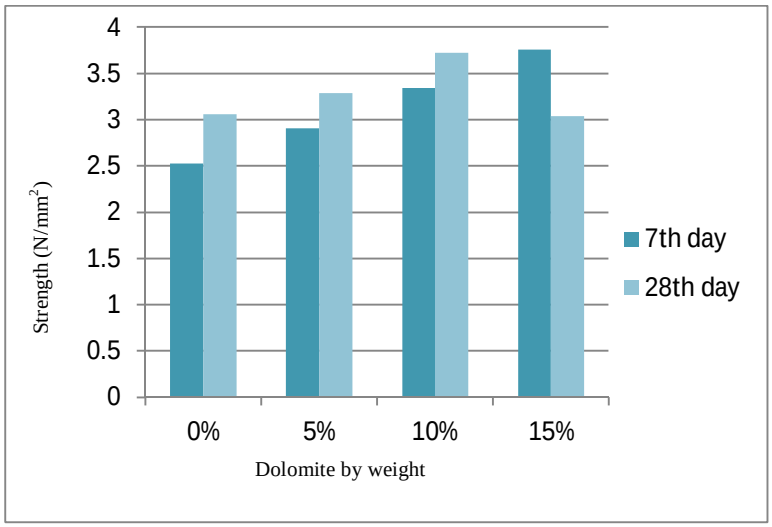


Graph.1 Result of Compressive Strength (N/mm^2)

B. *Split Tensile Strength*

Table.2. Result of split tensile strength (n/mm^2)

Sr.no	Dolomite by weight	Split Tensile Strength (N/mm^2) 7th day	Split Tensile Strength (N/mm^2) 28th day
1	0%	2.53	3.06
2	5%	2.91	3.29
3	10%	3.34	3.72
4	15%	3.76	3.04

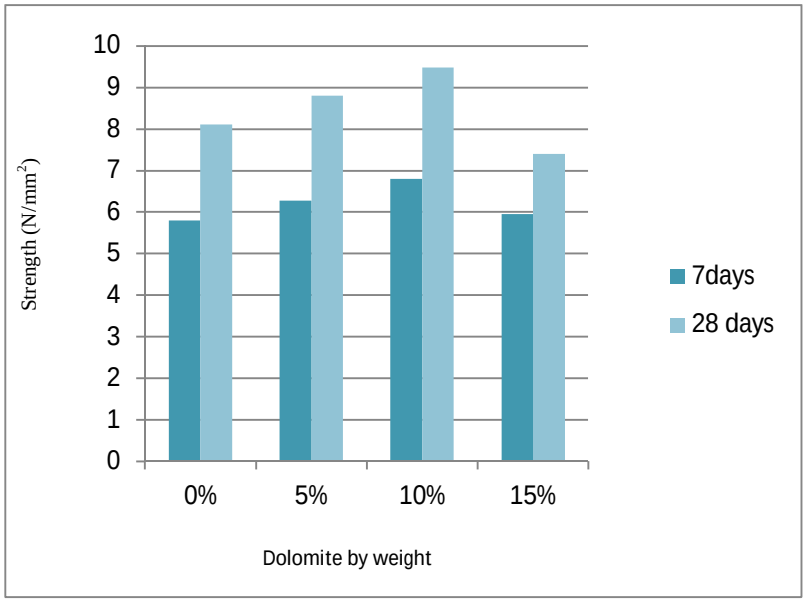


Graph.2 Result of Split Tensile Strength (N/mm^2)

C. Flexural Strength

Table 3. Result OF Flexural Strength (N/MM^2)

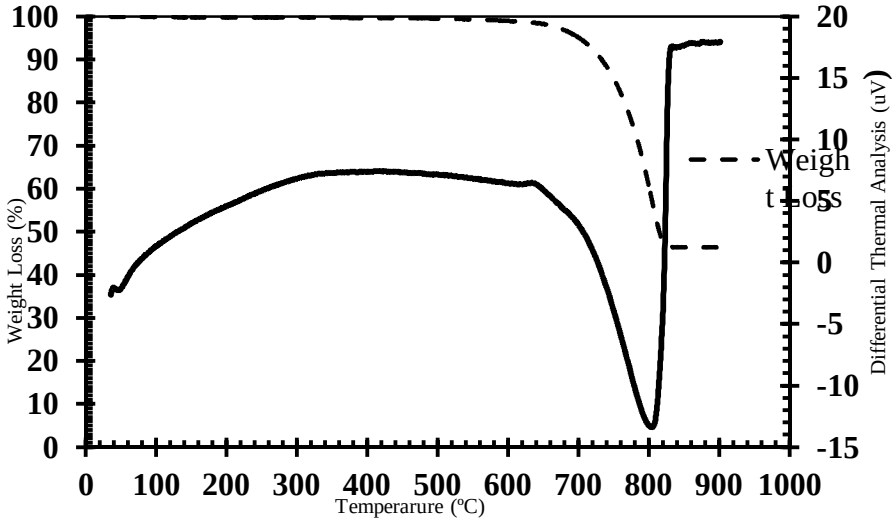
Sr.no	Dolomite by weight	Flexural Strength (N/mm^2) 7^{th} day	Flexural Strength (N/mm^2) 28^{th} day
1	0%	5.80	8.11
2	5%	6.28	8.80
3	10%	6.80	9.48
4	15%	5.96	7.40



Graph.3 Result of Flexural Strength (N/mm^2)

D. Differential Thermal Analysis Test (DTA)

In TGA-DTA analysis the physical and chemical changes of Dolomite compositing were found out, The weight loss was found when there was further increase in Temperature; the gradual increase in temperature is 50°C/Min, as shown in figure, the Endothermic effect found out 470°C to 480° C Related to calcium hydroxide dehydration. The characteristic of dolomite such as Endothermic was found out at 810°C because of CaMg $(CO3)_2$



Graph.4 Result of Differential Thermal Analysis Test

E. Field Emission Scanning Electron Microscopic Test (FE-SEM)

The FE-SEM test was conducted for determination the microscopic structure and crystalline structure of the dolomite for as partial as replacement shown below.

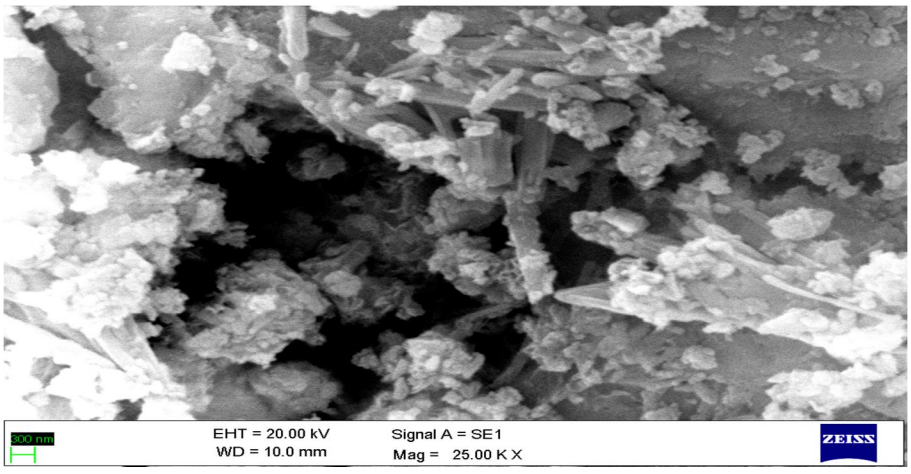


Fig.6.Field Emission Scanning Electron Microscopic Test Result

V. CONCLUSION

A. Fractional Replacement of cement with dolomite powder is found to increase the strength of concrete.

B. The idyllic replacement percentage of cement with dolomite powder is found to be 10% and at this replacement level, the extreme increase in the 28th day compression and flexural strength were found to be 10.4% and 17.8% respectively.

C. In case of split tensile strength, the ideal replacement is 15% and at this replacement level, the percentage increase in split tensile strength was found to be 39.8%. Use of dolomite powder decreases in the cost of concrete.

D. The characteristic of dolomite such as Endothermic was found out at 810°C because of CaMg $(CO3)_2$ and Endothermic effect found out 470°C to 480° C Related to calcium hydroxide dehydration.

E. No hair crack found out when specimen was tested on FE-SEM.

F. Crystalline structure of specimen whose optimum replacement was 10% was found which gives higher strength.

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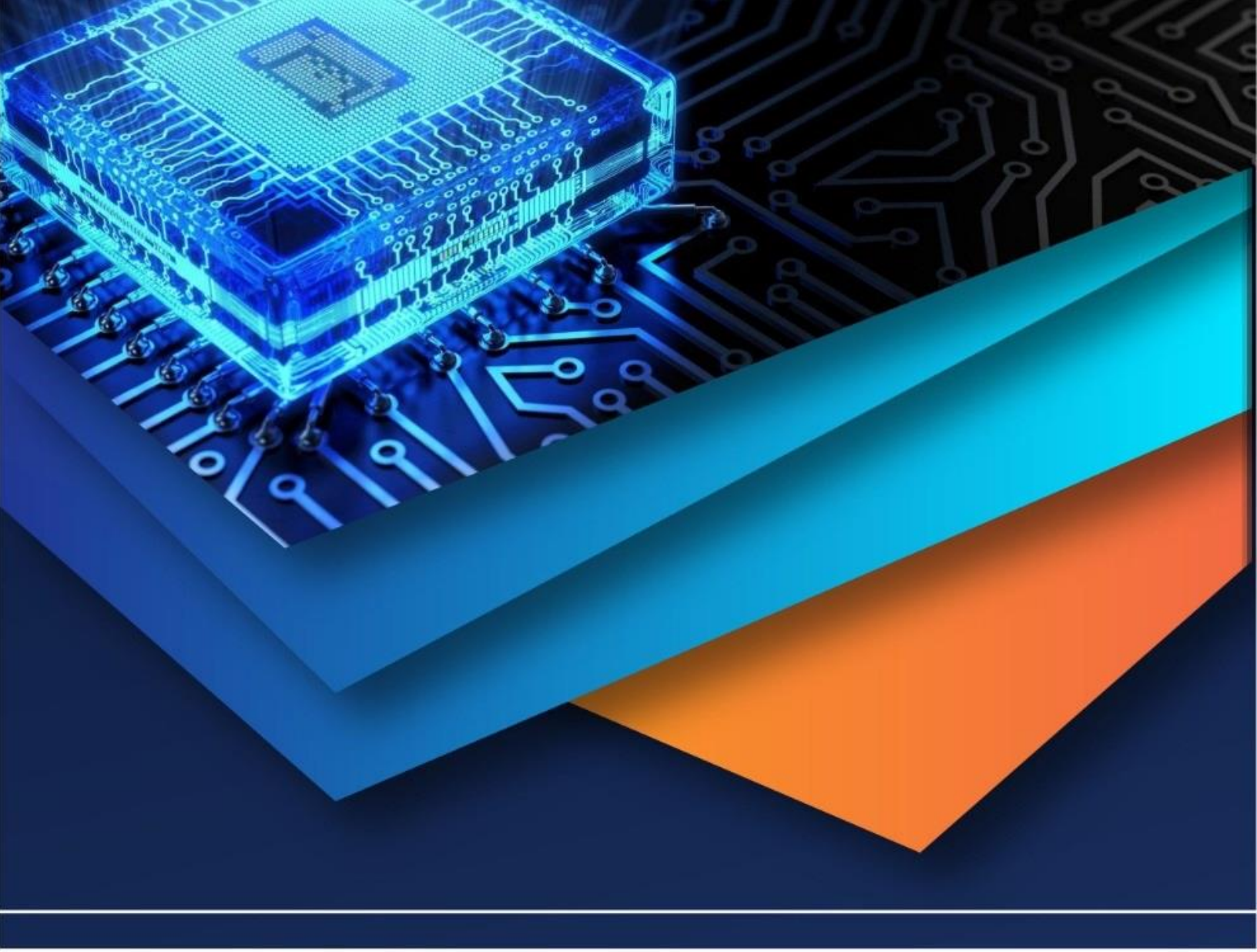

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