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Experimental study on strength property of concrete by partial replacement of fine aggregate with dolomite powder

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***Abstract*—Concrete is a building material made from a mixture of broken stone, sand, cement and water which can be spread into moulds. M60 grade of concrete is used in the mix ratio of 1:1.2:1.58. Dolomite powder is replaced for fine aggregate in the ratio of 10%, 20%, 30%, 40%. The compressive, split tensile and flexural strengths of concrete with dolomite powder were compared with those of the conventional concrete. The results indicate that replacement of fine aggregate with dolomite powder at 30% increases the compressive split tensile & flexural strength of concrete.**

***Keywords- Dolomite powder*, Compressive strength, Tensile strength, Flexural strength.**

I.INTRODUCTION

Cement is another major component of concrete. It is manufactured by calcining calcareous and argillaceous compounds at high temperature. Large amount of carbon dioxide gas is released in to the atmosphere by this process. It was found that 0.8 tons of carbon dioxide gas is released into the atmosphere with the manufacture of 1 ton of cement. It's used in almost every type of structure that we build today. It is one of the most durable building materials since it provides superior fire resistance, compared with wooden construction and can gain strength over time. Structures made of concrete can have a long service life. Dolomite powder obtained by powdering the dolostone (sedimentary rock forming mineral) can be used as a replacement material for cement in concrete up to certain percentage.Kamal M.M, et al (2012) evaluated the bond strength of self-compacting concrete mixes containing dolomite powder. Either silica flume or fly ash was used along with dolomite powder to increase the bond strength considerably.

II.PROJECT WORK

Materials used and its Properties:

2.1. Cement:

The Cement used in this study was Ordinary Portland cement (OPC) which is the most important type of cement. OPC cement of 53 grade of cement use in this experimental work. Conforming weight of each cement bag was 50kg.The property of cement is shown in Table 1

Table 1: Properties of Cement

Physical Properties	Value observed in investigation	Standard value for OPC
Specific gravity	2.85	-
Initial setting time (minutes)	112	> 30
Final setting time (minutes)	186	< 600

2.2. Fine Aggregate

M-sand was used as Fine aggregate with fineness modulus of 2.85 and it should passing through IS Sieve 4.75mm. It should have fineness modulus 2.50- 3.50 and silt content should not be more than 4.The properties of Fine aggregate are shown below in Table 2.

Table 2 :Properties of Fine Aggregate

S.NO	PROPERTY	VALUE
1	Specific gravity	2.62
2	Grading Zone	II (IS 383- 1970)
3	Fineness modulus	2.50 (2.50-3.50)
4	Sieve analysis	4.75 mm

2.3 Coarse Aggregate:

The coarse aggregate are the blue granite stone of which particles greater than 4.75mm they should be hard, strong, dense, durable and clean. It should be conical shape. Flaky pieces should be avoided. It creates much better bond between cement paste and the Aggregates. The properties of Coarse aggregate are shown below in Table 3.

Table 3: Properties of Coarse Aggregate

S.NO	PROPERTY	VALUE
1	Sieve analysis	4.75 mm
2	Specific gravity	2.53
3	Water absorption	2.71%

2.4 Super Plasticizers

Super plastizers are known as high range water reducers are chemical admixtures used where well dispersed particle suspension is required. Conplast SP430 conforms depending on the dosages used. The properties of Super plasticizers is shown below in Table 4.

Table 4: Physical Properties of Super plasticizer

S.NO	PROPERTIES	DESCRIPTION
1	Colour	Brown
2	Specific gravity	1.220 to 1.225 at 300C
3	Air Entrainment	Approx 1% additional air is entrained

2.5 Dolomite Powder

Dolomite, is one of the Type of Lime stone was employed is composed of calcium magnesium carbonate $CaMg(CO_3)_2$. Which is normally available in the form of rock they crushed into required size by local mills and they graded. The properties of fine aggregate is shown below in Table 5.

Table 5: Properties of Dolomite Powder

S.NO	PROPERTY	VALUE
1	Specific gravity	2.62
2	Grading Zone	II (IS 383 – 1970)
3	Fineness modulus	2.50 (2.50-3.50)
4	Sieve analysis	4.75 mm

Table 6: Physical Properties of Dolomite

S.NO	PROPERIES	DOLOMITE POWDER
1	Formula	CaMg(Co3)2
2	Specific gravity	2.85
3	Color	White, grey and pink
4	Tenacity	Brittle
5	Moisture content(%)	Nil
6	Crystal system	Trigonal
7	Sieve analysis	Zone III

Table 7: Quantity of material

S.No	Description	Value	Kg/Lit
1	Total quantity of cement	163.56	Kg
2	Total quantity of coarse aggregate	323.04	Kg
3	Total quantity of fine aggregate	183.41	Kg
4	Total quantity of water	52.34	Lit
5	Total quantity of dolomite	44.98	Kg
6	Total quantity of admixture	0.98	Lit

III. RESULT AND DISCUSSION

3.1 Workability of fresh concrete

Influence of dolomite content on the workability of fresh concrete. The slump test was used to measure workability as a function of dolomite content for constant w/c ratio, the effect of dolomite content on the slump. The slump value seems to decrease with higher percentage of limestone filler content, this result is related to the relatively high water absorption capability which is attributed mainly to the large specific surface of dolomite.

3.2 Compressive Strength Test

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform and partly because most of the desirable properties of concrete are qualitatively related to its compressive strength. The strength of concrete is usually defined and determined by the crushing strength of 150mm x 150mmx150mm, at an age of 7 ,14 and 21days. The mould and its base rigidly clamped

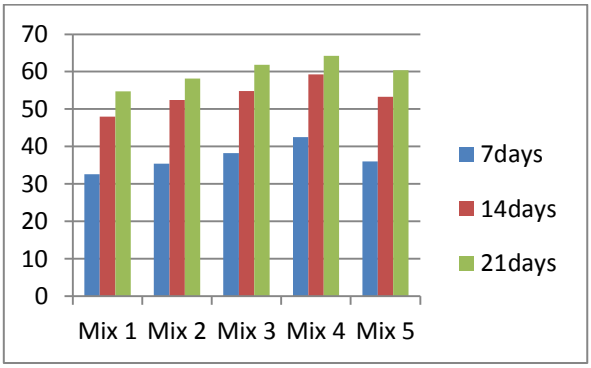
together so as to reduce leakages during casting. The sides of the mould and base plates were oiled before casting to prevent bonding between the mould and concrete. The cube was then stored for 24 hours undisturbed.

The testing of cube under compression was shown in figure

Table 8: Test results for compression strength

Mix	COMPRESSION STRENGTH N/mm^2		
	7DAYS	14DAYS	21DAYS
Mix 1 (0%)	32.6	48	54.7
Mix 2 (10%)	35.4	52.42	58.2
Mix 3 (20%)	38.2	54.8	61.8
Mix 4 (30%)	42.5	59.23	64.2
Mix 5 (40%)	36	53.25	60.4

Graph 1 : Compression strength Test



3.3. Split Tensile Strength Test

For tensile strength test, cylindrical specimens of dimension 150 mm diameter and 300 mm length were cast. In this test three cylinders were tested and their average value was reported. The split tension test was conducted by using digital compression machine having 2000 kN capacity.

Split tensile strength was calculated as follows:

Spilt Tensile strength (MPa) = $2P / \pi DL$

Where, P = Failure Load (kN)

D = Diameter of Specimen (150 mm)

L = Length of Specimen (300 mm)

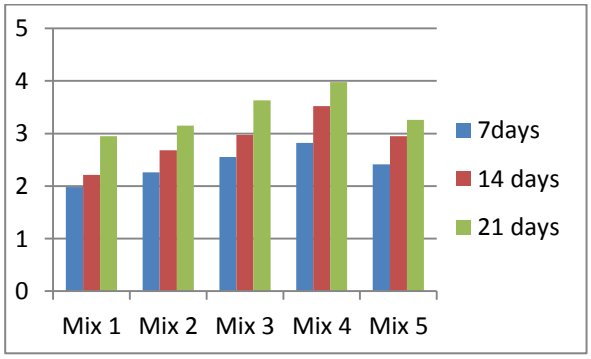
Test Results of splitting tensile strength for M_{60} grade of concrete shown in table 8

Three cylinder specimens were casted in each percentage, in order to find the average value of split tensile strength. These cylinder specimens were left for 21days curing in a curing tank. After the course of curing, the specimens were ready for testing. All the cylinders were tested. From the split tensile strength test, it has been clear that the F.A percentage of 20% (M3) has greatest strength than others. The addition of F.A increased up to 14% strength, whereas more addition of F.A decreased the strength of the cylinders.

Table 9: Test results for Split Tensile strength test

Mix	SPLIT TENSILE STRENGTH TEST N/mm^2		
	7DAYS	14DAYS	21DAYS
Mix 1 (0%)	1.98	2.12	2.95
Mix 2 (10%)	2.26	2.68	3.15
Mix 3 (20%)	2.55	2.97	3.63
Mix 4 (30%)	2.82	3.52	3.98
Mix 5 (40%)	2.41	2.95	3.26

Graph 2: Split Tensile Strength Test



3.4 Flexural strength test

For Flexural strength test, specimen of 150 mm X 200 mm X 1500 mm was casted. A beam specimen is placed in the ultimate testing machine of 2000kN capacity for testing. Rollers are placed at a centre to centre distance of the beam specimen. The load is increased until the specimen fails and the maximum load applied to the specimen during the test is recorded.

The Flexural strength is calculated by using the formula

$$\sigma = P\ l/\ bh^2$$

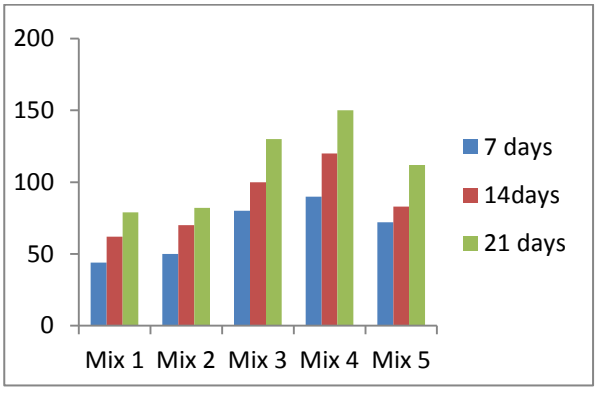
Where,
P = load in Newton shown in dial gauge
l = length of rectangular prism in mm i.e. 1500 mm
b = breadth of rectangular prism i.e. 150 mm
h = height of rectangular prism i.e. 200 mm.

Test Results of flexural strength for M_{60} grade of concrete is shown in table 10.

Table 10: Test results for Flexural strength test

Mix	FLEXURAL STRENGTH TEST N/mm^2		
	7DAYS	14DAYS	21DAYS
Mix 1 (0%)	44	62	79
Mix 2 (10%)	50	70	82
Mix 3 (20%)	80	100	130
Mix 4 (30%)	90	120	150
Mix 5 (40%)	72	83	112

Graph 3 : Flexural strength test



V. CONCLUSIONS

In summary of the above investigations, the following conclusions are made from the experimental results indicated following:

- The compressive strength of Cubes are increased with addition of dolomite powder up to 30% replaced by weight of fine aggregate and further any addition of dolomite powder the compressive strength decreases.
- The Split Tensile strength of Cylinders are increased with addition of dolomite powder up to 30% replaced by weight of fine Aggregate and further any addition of dolomite powder the Split Tensile strength decreases.
- The flexural strength of Prism are increased with addition of dolomite powder up to 30% replaced by weight of fine aggregate and further any addition of dolomite powder the flexural strength decreases.
- We found out the optimum percentage for replacement of dolomite powder with fine aggregate and it is 30% for all Cubes,Cylinders & Prisms.

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