Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

STUDIES ON STRENGTH CHARACTERISTICS OF NORMAL CONCRETE WITH DOLOMITE AND GGBS AS ADMIXTURES

Comparison of Strength Characteristics In Between Normal Mix Concrete And Concrete Embedded With Dolomite and GGBS

S. Jyothi[1], B. Hareesh Naik[2]

[1]*P.G student(Structural Engineering) , Department of Civil Engineering, Sreesai Shirdi Sai Engineering College, Anantapuramu, Andhra Pradesh, India,*
[2]*Assistant Professor, Department of Civil Engineering, Sreesai Shirdi Sai Engineering College, Anantapuramu, Andhra Pradesh, India,*

Abstract-*Concrete is the most widely used construction material in civil engineering construction because of its good compressive strength and stability. Concrete industry is now looking for the supplementary cementitious materials and the industrial by-products with the objectives to reduce the CO_2 emission which is harmful to the environment. Dolomite powder is one of the suitable supplementary cementitious materials, which is obtained by powdering the 'Dolostone 'mineral. Present investigations are carried out to study the feasibility of applications of Dolomite powder in effective manner to replace cement partially in concrete. Presently, the mechanical properties of M_{30} grade concrete are studied with the partial replacement of cement by Dolomite powder which ranges from 0 to 25 percent. The optimum Dolomite powder percentages in concrete to ascertain maximum compressive strength as well as tensile strength were determined. Keeping the optimum percentage dosage of Dolomite as constant in referred concrete, cement is further replaced with GGBS percentage which ranges from 5 to 20 percent. Test results reveal that the maximum strength (compressive and tensile) were attained for the mix with 10 % Dolomite powder in combination with 10% GGBS powder as partial replacement of cement.*

Keywords: *Dolostone mineral, Dolomite powder, GGBS, supplementary cementitious material, Compressive strength, Flexural strength, Split tensile strength.*

I.Introduction

Concrete is the basic civil engineering material used in most of the civil engineering structures. Cement, fine and coarse aggregates, admixtures and water are the basic constituents of concrete. Cement is the most important constituent material, since it binds the aggregates. Many supplementary cementitious materials are used to manufacture good quality concrete. Dolomite may be preferred as one of the good supplementary construction materials to replace cement partially in concrete due to its higher surface hardness and density. Dolomite is a rock forming mineral with a chemical composition of Ca $Mg(Co_3)_2$. It is a mineral formed by the replacement of calcium in a calcium carbonate limestone deposit along with magnesium. In Dolomite, calcium and magnesium ions exists in separate layers in crystalline matrix form. It has alternate layers of calcium and magnesium carbonate layers. It is hard and dense mineral compared to limestone and more impervious to acid attack. It is a chemically inert mineral. Dolomite is also preferred as a filler material in asphalt concrete applications due to its higher strength and hardness. Ground granulated blast furnace slag (GGBS) is a by - product. It is a solid waste discharged by the iron and steel industry in large quantities. It is obtained by quenching molten iron slag released from blast furnace in water or steam.

II. Experimental programme

The experimental programme consisted of procurement of materials for investigation, tests for physical properties of aggregate, concrete mix design in accordance with the Indian standard specifications (SP 23-1982 and IS 10262-1982), Preparation of test specimens and making test reports for plain and reinforced concrete of M30 grade.

III. Materials

Ordinary Portland cement, river sand, water, crushed granite aggregate of 20-mm nominal size, Dolomite, GGBFS were used in these investigations. Ordinary Portland cement (OPC) of Grade 53 was used in casting the specimens for cubes, cylinders and prisms. The test results for physical properties of cement are presented in Table 1. The initial and final setting time for the cement were found to be 32 minutes and 250 minutes respectively for 53 grade. The 28 - day compressive strength was observed to be 55.6 MPa. Locally available river sand has been used throughout the investigations. . The test results for physical properties of fine aggregates are presented in Table 2. Crushed granite

aggregate of 20 mm nominal size was used as coarse aggregate for concrete. Test results for physical properties of coarse aggregate were presented in Table 3.

Table 1. Physical properties of cement

Test	53 grade
Fineness	10.5
Specific gravity	3.11
Normal consistency	31 percent
Setting time a) Initial setting time b)Final setting time	 32 Minutes 250 minutes
Soundness(Le Chatlier)	2.1 mm
Compressive strength at 28 days	55.6 MPa

Table .2 Physical properties of fine aggregate

Property	Value
Bulk Density(kg/m3)	1602
Specific gravity	2.66
Fineness modulus	3.22

Table.3 Physical properties of coarse aggregate

Property	Value
Max .nominal size	20mm
Bulk Density(Kg/m3)	1560
Specific gravity	2.85
Fineness modulus	4.6
Voids Loose state Compacted state	 41% 47%

Table.4 Properties of Dolomite and GGBFS

Property	Dolomite	GGBFS
Specific gravity	2.85	2.86
Colour	White	Grey

IV. Preparation and testing of specimens

Ten concrete mixes designated as Mix A (Control Mix), Mix B (5% Dolomite), Mix C (10% Dolomite), Mix D (15% Dolomite) Mix E (20% Dolomite), Mix F (25% Dolomite), Mix G (10% Dolomite + 5% GGBFS), Mix H (10% Dolomite + 10% GGBS), Mix I (10% Dolomite + 15% GGBS), Mix J (10%Dolomite + 20%GGBS), Mix K (10%Dolomite + 25%GGBFS) were used in the investigations presented in this report. Mix proportions are designed according to the principles of mix design of I.S: 10262 -1982 and SP: 23 - 1982 for M 30 grade concrete. The water - cement ratio used for the all the design mixes was adopted as 0.45. They were mixed thoroughly in the tray with water to the required quantities as per the design calculations according to I.S: 10262 - 2009. Test specimens were compacted on the vibrating table and kept for set for 24 hours. They are demoulded a day after casting and cured well in water upto the date of testing .Concrete cubes (150 x 150 x 150 mm), cylinders (150 x 300mm), prisms (100 x 100 x 500 mm) of standard sizes were casted and tested for 28 - day compressive strength, split tensile strength and flexural tensile strength properties respectively. The mean strength values were presented in Tables 5, 6 and 7 respectively.Casting and testing of specimens are presented in photo 1 and 2.

Table.5 Compressive Strength of M_{30} concrete at 28 days

Mix Designation	Compressive strength (28 DAYS)
Mix A	41.48
Mix B	42.51
Mix C	46.37
Mix D	42.28
Mix E	38.27
Mix F	37.03
Mix G	47.23
Mix H	48.34
Mix I	44.45
Mix J	38.62
Mix K	35.48

Table.7 Split tensile strength of M_{30} concrete at 28 days

Mix Designation	Split tensile Strength (28 days)
Mix A	2.78
Mix B	2.94
Mix C	3.32
Mix D	2.82
Mix E	2.80
Mix F	2.64
Mix G	3.43
Mix H	3.56
Mix I	3.13
Mix J	2.9
Mix K	2.7

Table.8 Flexural strength of M_{30} concrete at 28 days

Mix Designation	Flexural strength (28 Days) N/mm^2
Mix A	3.59
Mix B	3.71
Mix C	3.87
Mix D	3.32
Mix E	3.20
Mix F	3.16
Mix G	3.92
Mix H	3.98
Mix I	3.62
Mix J	3.13
Mix K	2.98

V. Results and Discussion

The 28 - day cube compressive strength was determined by conducting tests on standard concrete cubes (150 x 150 x 150 mm) at the age of 28 days. It is observed that the compressive strength is increased gradually upto 10% replacement of cement by Dolomite powder. It is decreased for mixes with dolomite powder ranging from 15% to 25% replacement levels. The compressive strength is observed to be maximum (46.37 N/mm^2) for Mix C with Dolomite alone at 10%

replacement level. Similarly, it is maximum for Mix H at 10% replacement of cement, individually with the combination of Dolomite and GGBS (48.34 N/mm^2).
The 28 - day Split tensile strength was determined by conducting tests on standard concrete cylinders (150x300 mm) at the age of 28 days. It is observed that the split tensile strength is increased gradually up to 10% replacement of cement by Dolomite powder. It is decreased for mixes with dolomite powder ranging from 15% to 25%. The split tensile strength is observed to be maximum (3.32 N/mm^2) for Mix C with Dolomite alone at 10% replacement level. Similarly, it is maximum for Mix H at 10% replacement of cement individually with the combination of Dolomite and GGBS(3.56 N/mm^2).

The 28-day Flexural tensile strength was determined by conducting tests on standard concrete prisms (100 x 100 x 500 mm) at the age of 28 days. It is observed that the flexural strength is increased gradually up to 10% replacement of cement by Dolomite powder. It is decreased for mixes with dolomite powder ranging from 15% to 25%. The flexural strength is observed to be maximum for Mix C (3.87 N/mm^2) with Dolomite alone at 10% replacement level. Similarly it is maximum for Mix H at 10% replacement of cement individually with the combination of Dolomite and GGBS (3.98 N/mm^2).

The maximum values of compressive strength, tensile strength in split tension and flexural tension at the age of 28 days for Mixes A to K are shown graphically in Figures 1 to 6 respectively. The high calcium content present in the dolomite powder may cause increase in the compressive strength of concrete. This increase in strength has been observed up to 10% replacement level. No significant increase in strength has been observed for the replacement levels of Dolomite powder above 10%.The same trend has been observed for the increase in split tensile as well as flexural strength for Mixes A to K. Fineness of Dolomite powder may be the reason for developing the strength as it is incorporated as a filler material to replace cement partially.

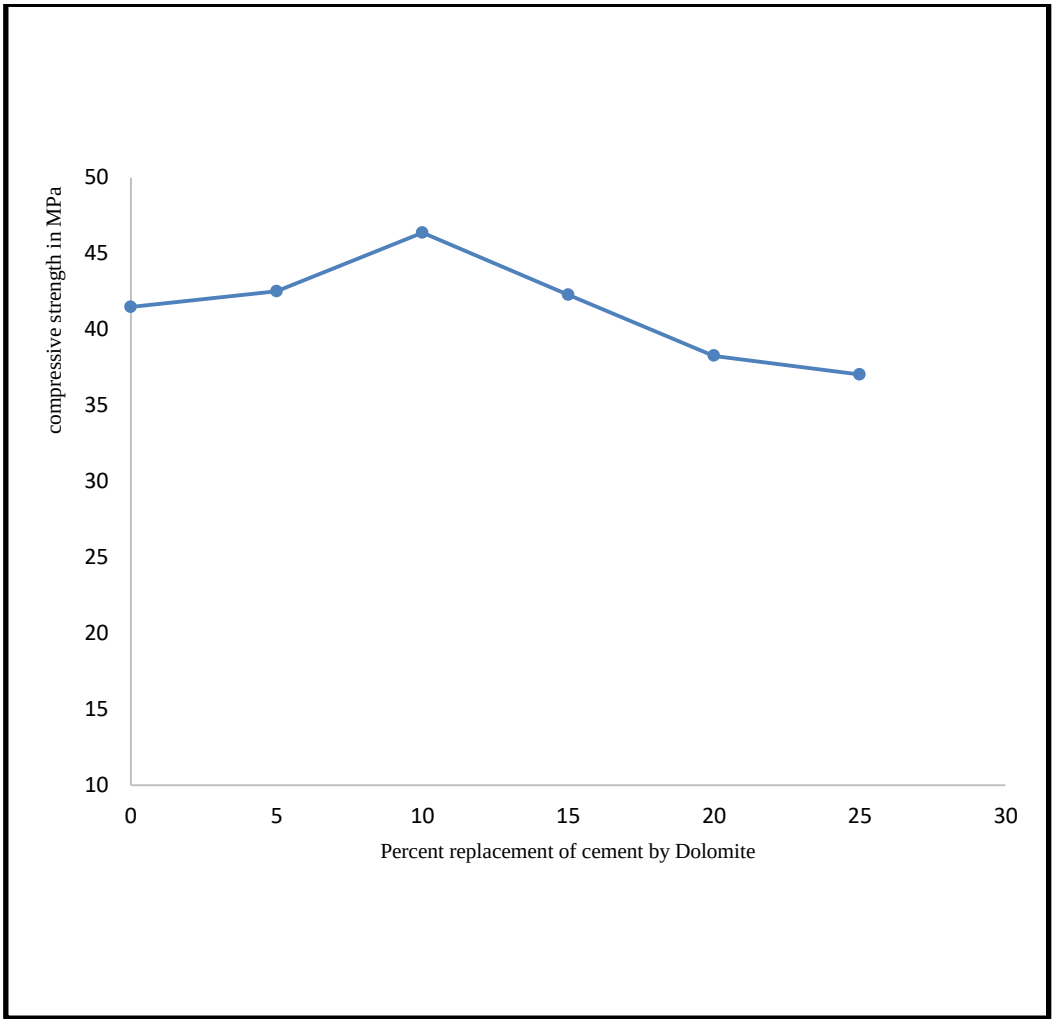

Fig.1 Compressive strength at 28 days for Mixes A to F

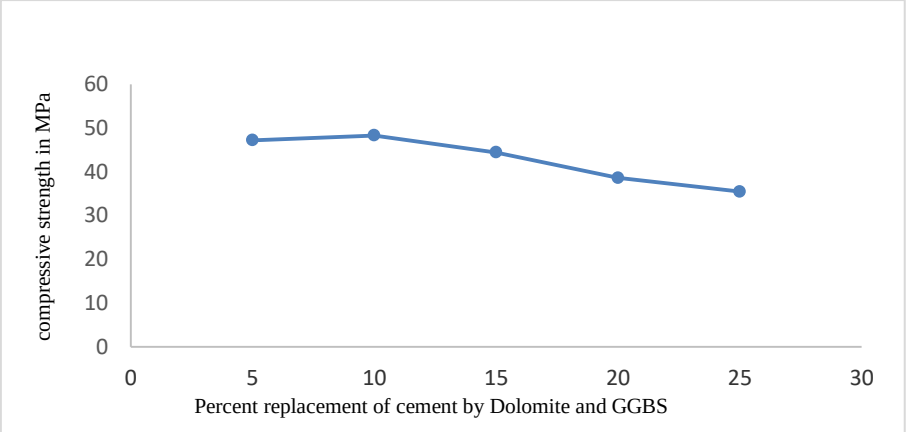

Fig.2Compressive Strength at 28 days for mixes G to K

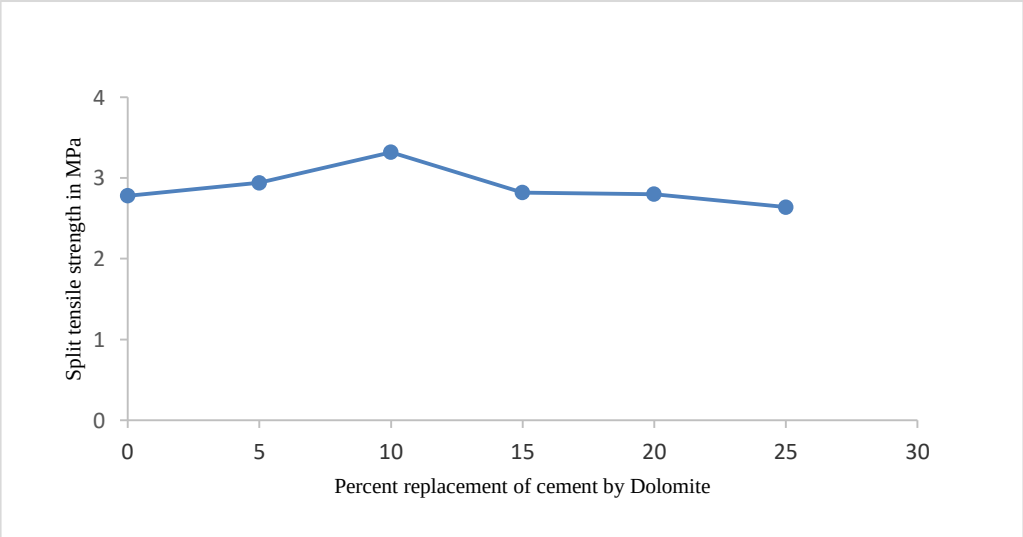

Fig.3 Split Tensile Strength at 28 days for Mixes A to F

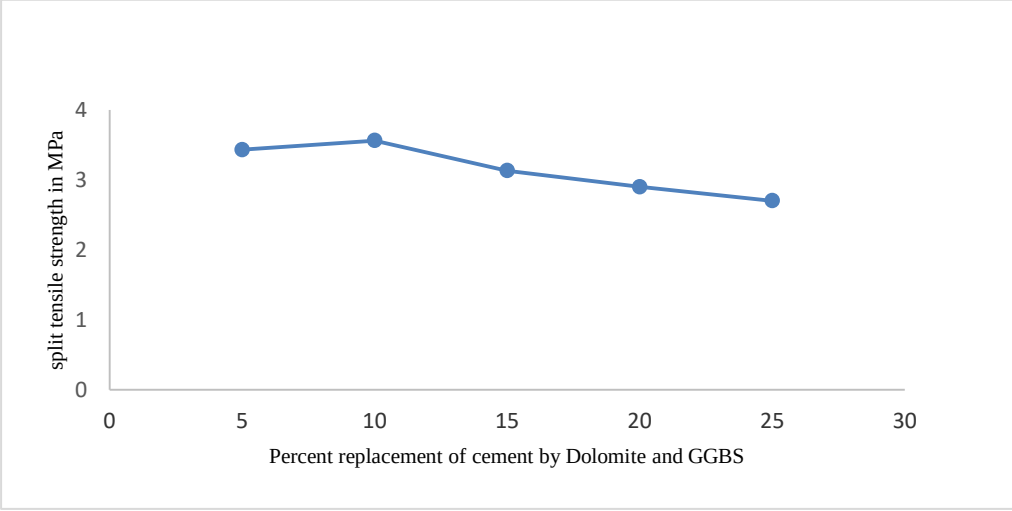

Fig.4 Split Tensile Strength at 28 days for Mixes G to K

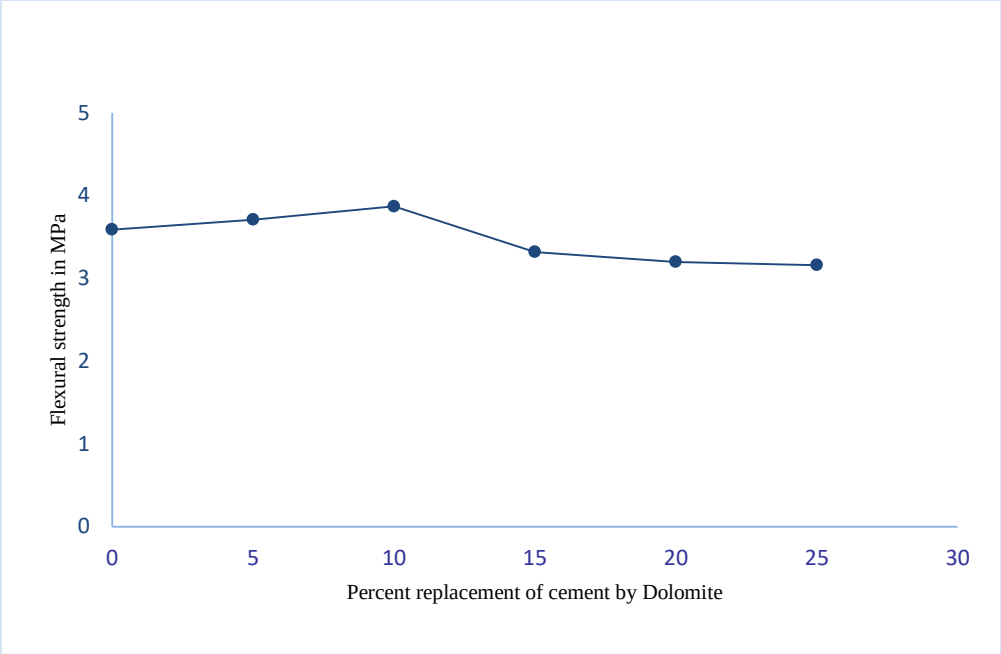

Fig.5 Flexural Strength at 28 days for Mixes A to F.

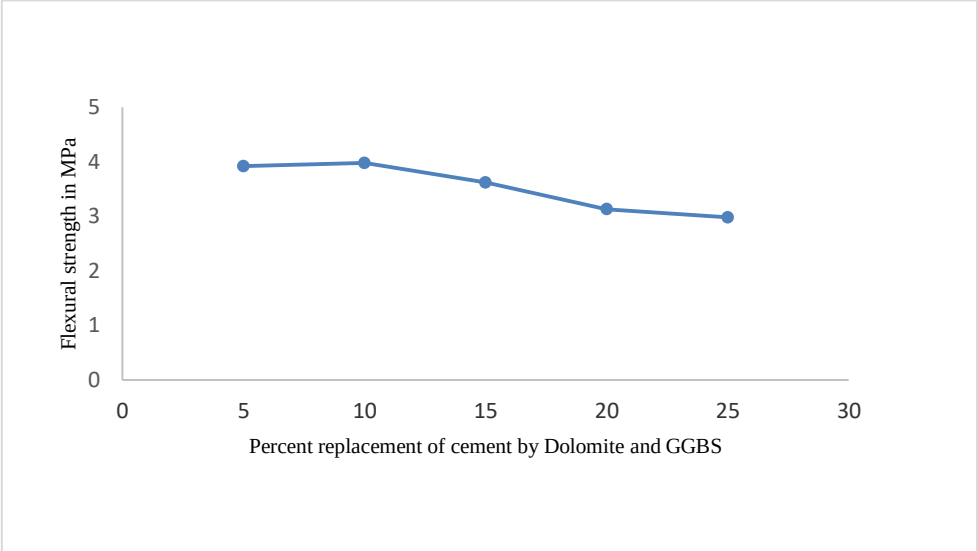

Fig.6 Flexural Strength at 28 days for Mixes G to K.

CONCLUSIONS

The following conclusions can be drawn from the experimental investigations.

1) Dolomite powder along with GGBS can be used as pozzolonic materials to replace cement partially up to 10% in preparing concrete .Use of dolomite powder along with GGBS may enhance strength at 28 days.
2) Dolomite along with GGBS may act as a filler material which acts as a volume matrix to reduce the porosity of concrete.
3) Workability characteristics of concrete admixtured with Dolomite and GGBS are similar to those of normal conventional concrete.
4) Plastic and Shrinkage properties in concrete with Dolomite powder and GGBS are yet to be investigated.
5) Dolomite and GGBS may be used partially to enhance the strength properties of concrete which makes the mix economical than conventional concrete.
6) Based on the experimental investigations, the strength properties of concrete are significantly improved with the use of Dolomite powder and GGBS in preparing concrete.

REFERENCES

[1]S.Deepa Balakrishnan., and K.C.Paulose, "*Workability and Strength Characteristics of Self-compacting Concrete Containing Fly ash and Dolomite Powder*", American Journal of Engineering Research (AJER), Volume.2,2013.

[2]M. M. Kamal, M. A. Safan, and M.A AlGazzar,"*Experimental Evaluation of Steel-Concrete Bond Strength in Low-Cost Self-Compacting Concrete"*,Concrete Research Letter,volume 3(2),2012, pp.439-451.

[3]Salim Barbhuiya, "*Effects of fly ash and dolomite powder on the properties of self-compacting concrete",*Construction and Building Materials, Volume. 25, 2011, pp.3301-3305

[4]Olesia Mikhailova and Grigory Yakovlev "*Effect of Dolomite Limestone Powder on the Compressive Strength of Concrete"* Procedia Engineering 57(2013) 775-780.

[5]Chaitra H.L,et.al *"An Experimental Study On Partial Replacement of Cement by GGBS and Natural Sand by Quarry Sand In Concrete*" International journal of engineering research and technology (IJERT) vol.4 2015.

[6]S.Arivalagan *"Sustainable Studies on Concrete with GGBS as Replacement Material inCement*"Jordan Journal of Civil Engineering, Volume 8, No.3, 2014.

[7] Chander Garg*"Behavior of Ground Granulated Blast Furnace Slag and Limestone Powder as Partial Cement Replacement"* International Journal of Engineering and Advanced Technology (IJEAT)vol-3,2014.

[8] M.V.Nagendra "*Analysis of Strength Characteristics of GGBS Concrete"*International Journal of Advanced Engineering Technology".vol-5,2014.

------I.S:456-2000,*Recommended code of practice for plain and reinforced concrete*,Bureau of Indian standards,New Delhi.

------I.S:10262-2009, *Recommended guide lines for concrete mixes*, Bureau of Indian standard,New Delhi.

