Performance of Concrete using Dolomite and Vermiculite as Partial Replacement of Cement and Fine Aggregate

C. Sangeetha
M.E. Student
Department of Structural engineering,
M.I.E.T. Engineering College,
Thiruchirapalli, India.

S. Manikandan
Assistant Professor
Department of civil engineering,
M.I.E.T. Engineering College,
Thiruchirapalli, India.

***Abstract*- Several experimental studies were conducted to find an effective replacement for these raw materials of concrete to reduce cost and high strength. Huge amount of CO_2 gas is emitted in to the atmosphere during the manufacturing of cement. Dolomite is used in concrete to reduce the consumption of cement. The purpose of this project is to determine the mechanical property of dolomite and vermiculite in concrete. Lack of fine aggregate can be solved by using of Vermiculate. Dolomite is replaced in the percentage of 10 percentage and 15percentage with the weight of cement. Vermiculite is replaced in the percentage of 20 percentage and 30 percentage with the weight of fine aggregate. A design mix of M30 as per IS codes are obtained. The compressive strength and split tensile strength of the replaced concrete will be compared with the conventional concrete at 7days, 14days, and 28days. The optimum replacement percentage of dolomite and vermiculite is 15 percentage and 20 percentage respectively.**

Keywords:- Dolomite; Vermiculite; Compressive strength; Split tensile strength.

I. INTRODUCTION

Concrete is the basic material used in most of the civil engineering structures. Large amount of carbon dioxide is released in to the atmosphere during the manufacturing of cement. It was found that 0.8 tons of CO_2 is released into the atmosphere with the manufacture of 1 ton of cement. Dolomite powder is a natural form of calcium magnesium carbonate [CaMg $(Co_3)_2$]. It is a common sedimentary rock-forming mineral that can be found in massive beds several hundred feet thick. The chemical industries are using the mineral dolomite in the making of magnesium salts including magnesia, magnesium oxide (MgO), which is used in pharmaceuticals. Vermiculite is a phyllosilicate mineral group. It belongs to the family of light weight aggregates. The particle shape and size mainly depend on the mineralogical phases and collection system. Vermiculite spray coating is suitable for fire protection of structural steel columns, beams, metal ducts and cables as well as textured finishes.

II. MATERIALS USED

A. Cement

In this experiment Ordinary Portland cement of 53 grade was used as per IS code. The cement having fineness as retained on 90 micron sieves were used.

B. Fine Aggregate

River sand is most commonly used fine aggregates in the production of concrete and size of that is 4.75mm and less is preferred.

C. Coarse Aggregate

The coarse aggregate is a important material of concrete and reduces the drying shrinkage. 20mm size of coarse aggregate is used in this concrete.

D. Water

Water is necessary ingredient of concrete and it chemically react with cement. The water used in concrete should be free from acid, dust etc. PH value should be in the range of 6 to 8.

E. Dolomite

Dolomite powder is a natural form of calcium magnesium carbonate. It's found all over the world and quite common in sedimentary rock sequences. These rocks are called appropriately enough dolomite or dolomite limestone. Its greater hardness makes it a superior construction material. Its lower solubility makes it more resistant to the acid content of rain and soil.

Fig.1 Dolomite

F. Vermiculite

Vermiculite is a phyllosilicate mineral group. A decreased density for the same strength level reduces the self weight. It has high silica content and this lets out a strong constrain for replacing sand and good in bonding, covering of voids. It is typically platelets and its diameter is ranging from 0.04µ to 4mm.

Fig.2 Vermiculite

III. MATERIAL PROPERTIES

A. *Physical Property of Dolomite*

Sl.No	Property	Value
1	Specific gravity	2.64
2	Fineness modulus	6%
3	Consistency	28%
4	Color	White

B. *Physical Property of Vermiculite*

Sl.No	Property	Value
1	Specific gravity	2.6
2	Fineness modulus	2.46
3	Water absorption	2.0

C. *Chemical Composition of the Dolomite and vermiculite*

Sl.No	Chemical Composition	Dolomite	Vermiculite
1	Sio_2	21.7	46
2	CaO	23.6	3
3	MgO	15.6	16
4	Fe_2O_3	0.65	13
5	Al_2O_3	2.40	16

IV. MIX DESIGN

A. *Mix Proportion*

Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (Kg/m^3)
394	659	1283	158

Mix ratio- 1:1.7:3.2

B. *Different Mix Proportions*

Mix	Cement	Fine aggregate	Coarse aggregate
Conventional concrete	100%cement	100%Fine aggregate	100%Coarse aggregate
M1	90% Cement + 10%Dolomite	80%FA + 20% Vermiculite	100%Coarse aggregate
M2	90% Cement + 10% Dolomite	70%FA + 30% Vermiculite	100%Coarse aggregate
M3	90% Cement + 15% Dolomite	80%FA + 20% Vermiculite	100%Coarse aggregate
M4	90%Cement+ 15% Dolomite	70%FA + 30% Vermiculite	100%Coarse aggregate

V. EXPERIMENTAL RESULTS

A. *Light Weight Analysis*

The special characteristics and usage of the vermiculite would decrease the structural weight. It is quite good material. It is a inert material so to resist the heat penetration. Vermiculite used concrete weight is compared with the conventional concrete.

TABLE II. LIGHT WEIGHT RESULT

Sl.no	Mix	Weight of concrete at 28 days (Kg)
1	CC	8.21
2	M1	7.40
3	M2	7.51
4	M3	7.35
5	M4	6.91

B. *Compressive Strength Test*

The compressive strength of M30 grade conventional concrete cubes obtained from compression testing machine. The strength in compression of concrete is determined from cubes of 15 cm x 15 cm x 15 cm.

TABLE III. COMPRESSIVE STRENGTH TEST RESULT

Mix No	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
CC	27.66	29.51	34.93
M1	27.91	29.80	35.37
M2	27.70	29.72	35.14
M3	28.23	30.13	36.62
M4	28.12	29.93	36.04

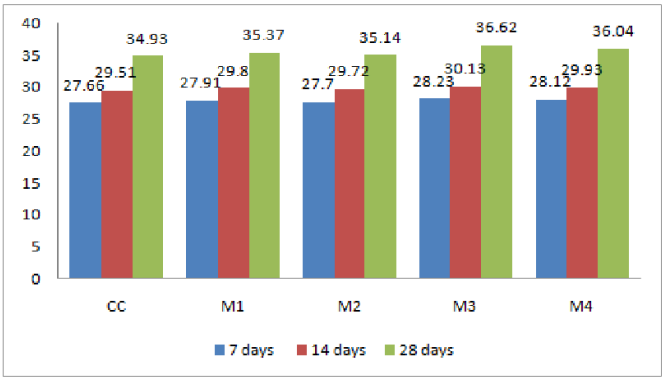

Fig.3 Compressive strength (N/mm^2) at 7, 14, 28 days

C. *Split Tensile Strength Test*

The split tensile strength of concrete is determined from cylinder of radius 75 mm and height 300 mm.

TABLE IV. SPLIT TENSILE STRENGTH TEST RESULT

Mix	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
CC	2.40	2.81	3.22
M1	2.46	2.87	3.41
M2	2.41	2.81	3.33
M3	2.60	2.94	3.57
M4	2.53	2.89	3.42

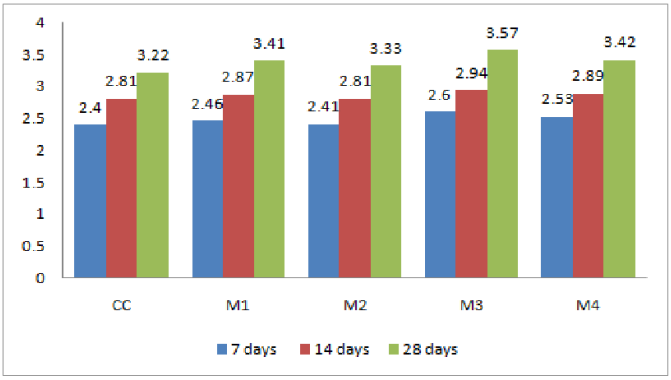

Fig.4. Split tensile strength (N/mm^2) at 7, 14, 28 days

VI. CONCLUSION

The compressive strength of this percentage increased up to 16% and Split tensile strength increased up to 4% than conventional at 28 days. From the test results, the replacement of cement with dolomite of 15% replacement gives a good result when compared to the conventional concrete. Replacement of fine aggregate with vermiculite of 20% gives a good result further increase of vermiculite in concrete reduces the strength when compared to the conventional concrete.

VII. ACKNOWLEDGMENT

This paper was supported by my professor Mr.S.Manikandan and I thank our colleagues from M.I.E.T Engineering college who provide insight and expertise that greatly assisted the research. I also like to show our gratitude to the college for sharing their pearls of wisdom with me during the course of this research.

REFERENCES

[1] Deepthi.C.G, Shindon Baby"Study on Compressive Strength of Concrete With Dolomite Powder & Crused tiles" International Journal of Innovative Research in Science, Engineering & Technology. Volume 5, issue 9, sep 2016.page no:16584-16590.

[2] DeepaBalakrishnan.S, Paulose.K.C "Workability And Strength Characteristics Of Self CompactingConcrete Containing Fly Ash And Dolomite Powder" American Journal Of Engineering Research, Volume 2, February 2013. Page No:43-47.

[3] Dinesh.A,Padmanaban.I, Maruthachalam.M "Study On Low Density Concrete With Partial Replacement Of Coarse Aggregate" International JournalOf Modern Trends In EngineeringAndScience,Volume 3, Issue 8,January 2016. Page No:97-1083.

[4] Divya.M.R,"Study On Concrete With Replacement Of Fine Aggregate By Vermiculite" International Journal Of New Technology And Research, Volume 2, Issue 5, May 2016. Page No: 87-89

[5] Gowtham.S, Mercy Shanthi.R, Sheela.V " Studies On Flexural Behavior Of Beams Using Non Conventional Aggregates" International Journal Of Engineering Research And Technology, Volume 2, Issue 4, April 2013. Page no:528-533.

[6] S.SyedAbdul Rahman,Gijo K Babu"An Experimental Investigation on Light Weight Cement Concrete Using Vermiculite Minerals" International Journal of Innovative Research in Science, Engineering and Technology, volume 5, Issue 2, February 2016. Page no:2389-2392.

[7] Yuvraj Chavda, Shilpa Kewate"Use of Vermiculite for Light weight Floating Concrete" International Journal of Scientific & Engineering Research, Volume 6, Issue 12, December 2015.