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Study on Concrete with Replacement of Fine Aggregates by Vermiculite

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Abstract— **Concrete is the single most widely used construction material in the world. Concrete is used in such large amounts because it is simply, a remarkably good building material. Aggregates generally occupy 60 to 80 percent of the volume of concrete and greatly influence its properties, mix proportions and economy. Use of vermiculite in concrete, enhances the shrinkage and crack resistance, fire resistance and reduces environmental impact and also reduces the cost. Important characteristics of a good quality aggregate include resistance to abrasion, resistance to freeze/thaw action, resistance to sulfates, correct shape and surface texture, proper gradation, density, and compressive and flexural strength. The main purpose of the research is to study the strength parameters such as compressive strength, split tensile & flexural strength of concrete using vermiculite as partial replacement with 40%, 50% and 60% by weight. The main aim of this study is to make economical and eco-friendly concrete.**

Index Terms—**Vermiculite,Compressive strength, Split tensile test, flexural test.**

I. INTRODUCTION

As concrete is the good building material it is used world wide in various structural members such as slabs, beams, columns, foundation,etc.,Due to its low thermal conductivity property, fine aggregates are replaced with vermiculite and its compressive strength, tensile strength and flexural strength are tested. Generally vermiculite can resist the temperature up to 1200°C and it has high thermal insulation co-efficient of λ>0.046 W/m° C. Because of this property vermiculites are added in concrete by replacing fine aggregates by 40% , 50% and 60% by weight and their strength parameters are found.

II. MATERIALS USED

A. *Vermiculite*

Vermiculite is a hydrous phyllosilicate mineral. It undergoes significant expansion when heated. Vermiculite is chosen to replace fine aggregates in concrete because of its specific properties such as it is lighter in weight, improved workability, improved fire resistance, improved resistance to cracking and shrinkage and mainly inert chemical nature. Vermiculites taken for concrete preparation which pass through 2.36mm sieve size.

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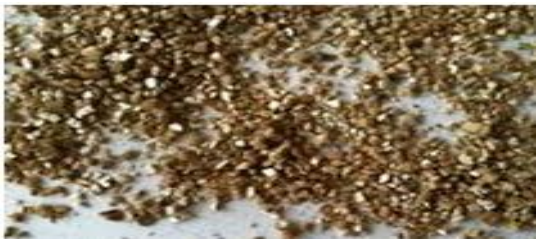

Figure-1 Vermiculites passing through 2.36mm sieve

B. *Cement*

Cement used to prepare the specimen was 53 grade Ordinary Portland cement, conforming to IS 12269:2013 with a fineness of 1%, standard consistency of 34% and Initial setting time 80 min.

C. *Course aggregates*

Course aggregates of 4.75mm to 12.5mm size aggregates were used.

D. *Fine aggregates*

Fine aggregates are taken for concrete preparation which pass through 2.36mm sieve size.

E. *Water*

Portable water was used for mixing and curing of concrete specimens.

III. MIX DESIGN

As per IS 10262:2009 design mix for M 30 grade of concrete was prepared by replacing fine aggregates by 40%,50% and 60% by weight.

IV. MATERIALS TEST RESULT

Table-1 Physical properties of cement

Fineness Modulus	Normal consistency	Initial Setting time	Final Setting time
1.0	34%	80min	260 min

Table-2 Physical properties of fine aggregates

Fineness Modulus	Specific gravity	Water absorption
2.85	3.1	1.92

Table-3 Physical properties of Vermiculites

Fineness Modulus	Specific gravity	Water absorption
2.46	3.0	2.65

Table-4 Physical properties of Coarse aggregates

Fineness Modulus	Specific gravity	Water absorption
7.73	2.7	1.5

IV TEST RESULTS

A. *Compressive Strength*

Compressive strength was tested in compressive testing machine .Cube specimens of size 150mm x 150mm x 150mm were adopted for the test. Compressive strength was tested after 7,21 and 28 days of curing. The results of the tests are tabulated below.

Table-5 Compressive strength of vermiculite concrete

Type of Mix (Cube specimen)		Age of curing	Average strength
40% of vermiculite	60% of fine aggregates	7	16
		21	28
		28	44
50% of vermiculite	50% of fine aggregates	7	15
		21	27
		28	41
60% of vermiculite	40% of fine aggregates	7	14
		21	19
		28	32

B. *Split Tensile Strength*

The test was conducted in compression testing machine. Cylindrical specimens were 150 mm diameter and 300 mm height. The results of the tests conducted are tabulated below.

Table-6 Split tensile strength of vermiculite concrete

Type of Mix (Cylindrical specimen)		Age of curing	Average strength
40% of vermiculite	60% of fine aggregates	7	4.0
		21	4.5
		28	5.0
50% of vermiculite	50% of fine aggregates	7	3.8
		21	4.4
		28	4.8
60% of vermiculite	40% of fine aggregates	7	3.6
		21	4.1
		28	4.4

C. *Flexural Strength*

Flexural strength was tested in compression testing machineThe test was carried out on beams of size 100x100x50mm.The results of tests are tabulated below

Table-7 Flexural strength of vermiculite concrete

Type of Mix (Rectangular specimen)		Age of curing	Average strength
40% of vermiculite	60% of fine aggregates	7	5.2
		21	6.3
		28	7.9
50% of vermiculite	50% of fine aggregates	7	5.0
		21	6.0
		28	7.5
60% of vermiculite	40% of fine aggregates	7	4.9
		21	5.9
		28	7.3

V. CONCLUSIONS

- The strength parameters such as compressive strength, split tensile strength test and flexural strength of vermiculite concretes of various percentages are found.
- The optimum strength in comparing the strengths for different vermiculite was observed to be 50%.
- Addition of vermiculites in concrete makes it heat resisting & resists shrinkage and cracks in concrete.
- Because of inert chemical nature of vermiculite when it is used in concrete it will not undergo any chemical reaction and also it is an eco-friendly material.

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