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STRUCTURAL BEHAVIOUR OF LIGHTWEIGHT CONCRETE BEAM BY USING VERMICULITE

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Abstract - *Utilization of Vermiculite is the geological name assumed to a group of hydrated laminar minerals which are aluminum-iron-magnesium silicates, resembling mica in appearance. Concrete is the single most broadly used construction material in the world. Concrete is use in such large amounts because it is simply, a remarkably good building material. Aggregates commonly 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. In modern development scenario, the lightweight concrete is a versatile material. For structural use of light weight concrete, the density is often more important than the strength. The main purpose of the research is to study the strength parameters such as compressive strength, split tensile strength and flexural strength of concrete using vermiculite as partial replacement with 25%, 35% and 45% by weight. Finally the Cement Concrete Cubes was casted for 7th day, 14th day and 28th day curing condition.*

Key words: Vermiculite, Compressive Strength, Split Tensile Strength, Flexural strength.

1. INTRODUCTION

Vermiculite is the geological name known to a group of hydrated laminar minerals which are aluminum-iron-magnesium silicates, resembling mica in appearance. A yeyellow or brown mineral found as an alteration product of mica and other minerals, used for insulation or as a moisture-retentive medium for growing plants. Vermiculite is a unique, naturally occurring, inert laminar mineral that finds use in many construction, industrial, home, agricultural and garden products and systems. Vermiculite is exfoliates (expands) when subjected to heat, this product is lightweight, incombustible, compressible, highly absorbent, and non-reactive and it may also have high cation exchange capacity.

2.2.MATERIAL USED

2.2.1 CEMENT

Hydraulic cement more commonly known as cement (also referred to as Portland cement or OPC), is one of the most extensively used basic materials in almost all civil engineering construction.

2.2 Fine Aggregate

Fine aggregate is sand which is usually obtained from rivers or lakes. Sometimes beach sand is also used. In place where sand is not available or a large quantity of sand is to be used crushed stone dust is used. The fineness modulus of sand should be around 2 to 3.2

2.3 VERMICULITE

Vermiculite is a hydrous phyllosilicate mineral. Vermiculite is select to substitute 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 in use for concrete preparation which pass through 2.36mm sieve size.

Materials properties

Table 1: Properties Of Cement

S.NO.	DESCRIPTION	RESULTS
1	Fineness	3.33%
2	Consistency	30%
3	Initial setting time	45 minutes
4	Final setting time	192 minutes
5	Soundness	4 mm
6	Specific gravity	3.15

Table 2: Properties Of Fine Aggregate

S.NO.	DESCRIPTION	RESULTS
1	Fineness	2.79
2	Specific gravity	2.7
3	Maximum size	4.75 mm

3. RESULTS AND DISCUSSION

3.1 Compressive Strength Test

This is an important test as most of the properties of concrete are qualitatively related to it. It is an easy and most common test. The tests are conducted on cubical or cylindrical specimen. The cube specimen is of size 15 x 15 x 15 cm and the cylinder is of 15 cm diameter and 30 cm long. The major nominal size of the aggregates does not exceed 20 mm. The moulds are to be of metal moulds, preferably of steel or cast iron. The moulds are made in such a way that the specimen are taken out without damage. A tamping steel bar of 16 mm diameter 0.6 m long with a bullet end is used for compacting

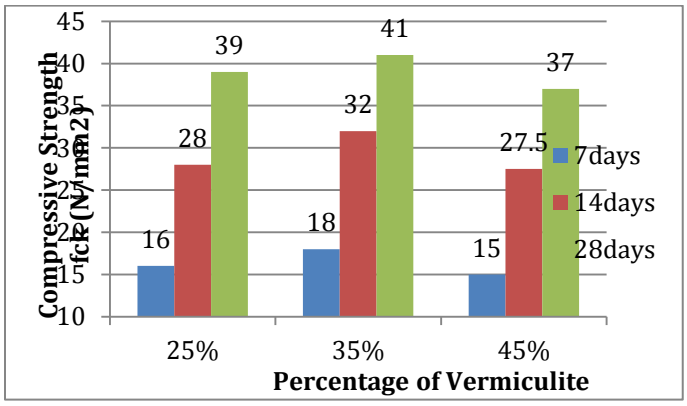
Compressive strength = ultimate load/ cross section area

Area =150 x 150 mm

Table 4: Compressive Strength Of Concrete

Compressive strength	7 days	14 days	28 days
25%	16	28	39
35%	18	32	41
45%	15	27.5	37

Chart-1 Compressive Strength Test



3.2 Split tensile strength test

This is an indirect tension test. This is also referred to as Brazilian test. In this test a cylindrical specimen is placed horizontally between the loading surfaces of a compressive testing machine. The load is applied until failure of the cylinder along the vertical diameter. When the load is applied along thegeneric compressive stresses develop immediately below the two generators to which the load is applied. But a larger portion about $5/6^{th}$ of the depth is subjected to tensile stress. The split tension test is simple to perform and generally gives more uniform results. The tensile strength from split tension test is almost near to true tensile strength than the modulus of rupture. Split tension test gives 5 to 12 % higher value than the direct tensile strength.

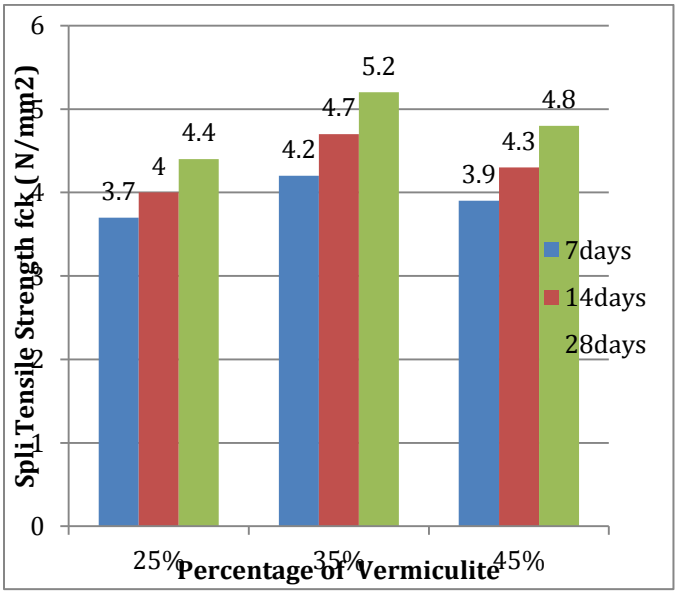
Tensile strength = Compression load along axis / Area in tension

$$= 2P / \pi DL$$

Table 5: Split Tensile Strength Test

Split tensile tensile strength	7 days	14 days	28 days
25%	3.7	4.0	4.4
35%	4.2	4.7	5.2
45%	3.9	4.3	4.8

Chart-2 Split Tensile Strength Test



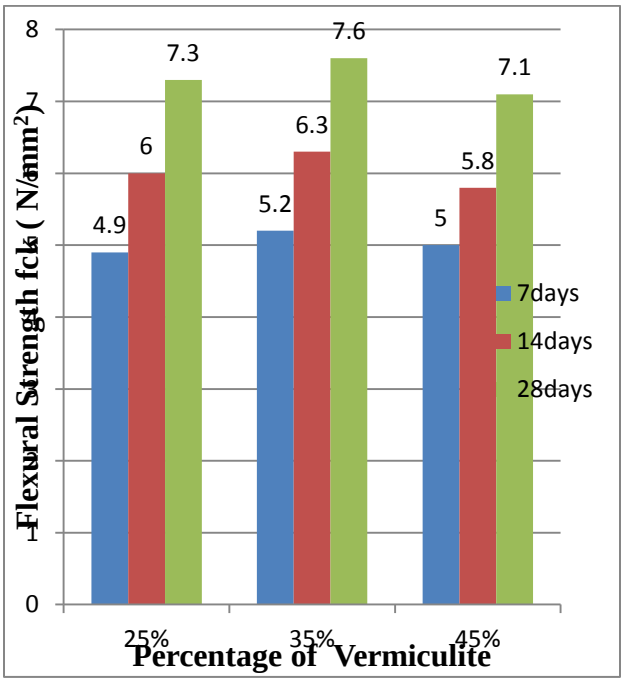
3.3. Flexural Strength Test

The beam specimen of size 100mm x 100mm x 500mm was casted to determine the flexural strength of concrete with various percentage of vermiculite. Specimens were dried in open air after 28 days at curing and it is subjected to flexural strength test. Spread over the load at a rate that constantly increases the maximum stress until rupture occurs. The rupture showed in the tension surface with in the middle third at span length. Lastly the flexural strength is planned by using simple bending equation the bending stress.

Table 5: Flexural Strength Test

Compressiver Strength	7 days	14 days	28 days
25%	4.9	6.0	7.3
35%	5.2	6.3	7.6
45%	5.0	5.8	7.1

Chart-3 Flexural Strength Test



- This project work primarily focused on studying the properties of the material used adopting proper mix proportion, preparation of concrete specimens, curing and testing the hardened concrete.
- The strength parameters such as compressive strength, split tensile strength test and flexural strength of vermiculite concretes of various percentages are found.
- Replacement of vermiculites in concrete makes it heat resisting & resists shrinkage and cracks in concrete.
- On comparing the results of vermiculite concrete with that of conventional concrete, 35% replacement of vermiculite showed maximum compressive strength value.
- On 35% replacement of vermiculite concrete, the compressive strength is 28.57%, 39.13%, and 17.14% higher than that of conventional concrete at 7 days, 14 days and 28 days curing respectively.
- On comparing the results of vermiculite concrete with that of conventional concrete, 25%, 35% and 45% replacement for vermiculite showed maximum compressive strength value at 28 days.
- The split tensile strength of concrete percentage is 23.52%, 27.02% and 23.80% replacement of vermiculite 35% hence the split tensile strength value is higher that of conventional concrete at 7 days, 14 days and 28 days curing in that order.
- The flexural strength of concrete percentage is 20.93%, 21.15% and 16.92% replacement of vermiculite 35%. Hence the flexural strength value is higher than of the conventional concrete ay 7 days, 14 days and 28days curing respectively.
- The optimum strength in comparing the strengths for different vermiculite was observed to be 35%.
- since of inert element 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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