PARRIALLY REPLACEMENT OF COARSE AGGREGATE BY USING VERMICULITE

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ABSTRACT

Concrete is the single most widely used building material throughout the world. Concrete is used in large amounts because it is only and extremely good building material. Exfoliated vermiculite is a versatile light weight material and it is used as an calcium silicate boards, roof and floor screeds and insulating concretes, loose fill insulation etc. In this case coarse aggregate is partially replacement of vermiculite. Use of vermiculite in concrete it will enhance shrinkage and crack resistance, fire resistance and reduce the environmental impact and also reduce the cost. In this present study, an attempt has been made to study the mechanical properties of M25 grade concrete with different percentage at a range of 10%, 20%, 30% & 40% as partially replacement with vermiculite to the total weight of coarse aggregate. The main purpose of the research is to study the strength parameters such as compressive strength, split tensile strength & flexural strength of concrete using vermiculite as partially replacement with 10%, 20%, 30% & 40% by weight. The main aim of this study is to make economical and eco-friendly concrete.

Key words: Exfoliated Vermiculite, compressive strength, split tensile strength, flexural strength, light weight.

1. INTRODUCTION

Vermiculite is a type of Light weight concrete which includes as an expanding agent in that it increases the volume of the mixture. The mortar is produced by adding a light weight mortar. Vermiculite is an inert material was first described in 1824 for an occurrence in Millbury Massachusetts, USA means ‘to breed worms’ in which it exfoliates when heated. The Vermiculite is group of hydrated laminar mineral which are aluminium–iron–magnesium silicate, resembling mica in appearance.Vermiculite incorporate sample having a high workability, low self-weight, loose fill insulation properties.

The density range from 300 to 1950 kg/m³ can be application to filling grade,insulation, roof and floor screeds, and soil amendment.

Light weight concrete can be defined as a type of concrete which includes an expanding agent in that it increases the volume of the mixture while giving additional qualities such as nail ability and lessened the dead weight. Focused were on the performance of aerated lightweight concrete such as compressive strength tests, water absorption and density and supplementary tests and comparisons made with other types of lightweight concrete.

2. OBJECTIVES

- To study the strength properties with increasing the percentage values of vermiculite.
- To study the increasing in strength properties by adding mineral admixture.
- To study the optimum percentage varying at different percentage values of mineral admixture like silica fume and fly ash.
- To study the bulk density and cubes weight at various replacement levels of vermiculite.
- To produce a light weight concrete.
- To reduce the cost of construction.
- To minimize the utilization of coarse aggregate.

3. METHODOLOGY

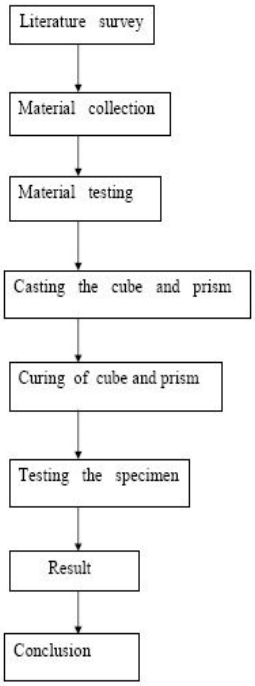

Fig 1: Methodology

4. CONSTITUENT MATERIALS USED

Materials that are used for making concrete for this study were tested before casting the specimen. The preliminary tests were conducted for the following materials.

1. Cement
2. Fine aggregate
3. Coarse aggregate
4. Water
5. Vermiculite

4.1 VERMICULITE

Vermiculite is a one type of mica minerals its alight weight material. Because of its improve the workability, fire resistance, resistance to cracking and shrinkage and mainly inert chemical nature. Vermiculite is a hydrated lamellar mica group of minerals, when heated to a high degree of minerals, when heated to a high degree of temperature exfoliated and expands 8 to 14 times in volume and yields exfoliated vermiculite by loss of water molecules.

4.2 Chemical composition: Moisture - 7.89 %, Loss on ignition - 11.05 %,Sio_2 - 30.52 %,Fe_2O_3 - 16.32 %, Tio_2 - 2.63 %,Al_2O_3 - 14.74 %,Cao - 9.47 %,Mgo - 3.68 %,Alkalies - 3.68 %

Light weight concrete can be defined as a type of concrete which includes an expanding agent in that it increases the volume of the mixture while giving additional qualities such as nail ability and lessened the dead weight. It is lighter than the conventional concrete. The use of lightweight concrete has been widely spread across countries such as USA, United Kingdom and Sweden. The main specialties of lightweight concrete are its low density and thermal conductivity. Its advantages are that there is a reduction of dead load, faster building rates in construction and lower haulage and handling costs. Focused were on the performance of aerated lightweight concrete such as compressive strength tests, water absorption and density and supplementary tests and comparisons made with other types of lightweight concrete.

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5. EXPERIMENTAL INVESTIGATION PROCEDURE

5.1 MIXING OF VERMICULITE CONCRETE

Fig 2:Mixing of Concrete

5.2 Compaction factor test

Compaction Factor is used to indicate workability of concrete where nominal size of aggregate does not exceed 40mm. It is a measure of density of concrete to which a fresh concrete mix can be compacted for a standard energy input relative to the theoretical maximum density corresponding to zero air content. This theoretical maximum density can be estimated in the laboratory as that obtained by full compaction under mechanical vibration.

Compaction Factor (C.F.)

$$= \frac{\text{wt of partially compacted concrete}}{\text{wt of fully compacted concrete}}$$

$$= \frac{W2-w1}{W3-W1}$$

5.3 Compressive strength of concrete

Testing of hardened concrete plays an important role in controlling and conforming the quality of cement concrete work. The main factor in favour of the use of concrete in structures is its compressive strength. One of the important properties of the hardened concrete is its strength which represents its ability to resist forces. The compressive strength of the concrete is considered to be the most important and is often taken as anindex of the overall quality of concrete. The compressive strength of concrete is defined as the load which causes the failure of specimen per unit cross section on compression under given rate of loading.

Fig 3: Compression testing machine

Table 1: Compression test results

S.NO	% Adding of vermiculite	Load (KN)	$Load/_{Area}$ (N/mm^2)
1	0%	520	23.111
2	10%	441.45	19.62
3	20%	385.425	17.13
4	30%	341.1	15.16
5	40%	267.525	11.89

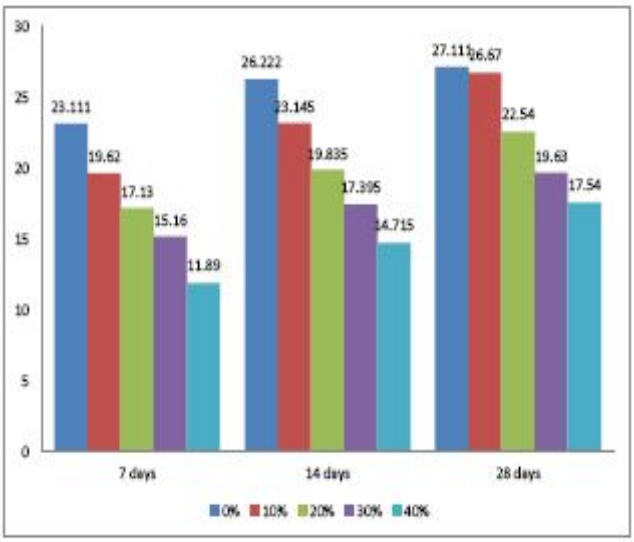

Fig 4: Compressive strength comparison for 0%, 10%, 20%, 30% & 40%

Table 2: Compressive strength test results for 0%, 10%, 20%, 30% & 40%

S.no	Test of concrete	0%	10%	20%	30%	40%
1	7 days	23.111	19.62	17.13	15.16	11.89
2	14 days	26.222	23.145	19.835	17.395	14.715
3	28 days	27.111	26.67	22.54	19.63	17.54

5.4FLEXURAL TEST

Concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However the determination of tensile strength is necessary to determine the load at which the concrete members may crack. The cracking is a form of tensile failure.

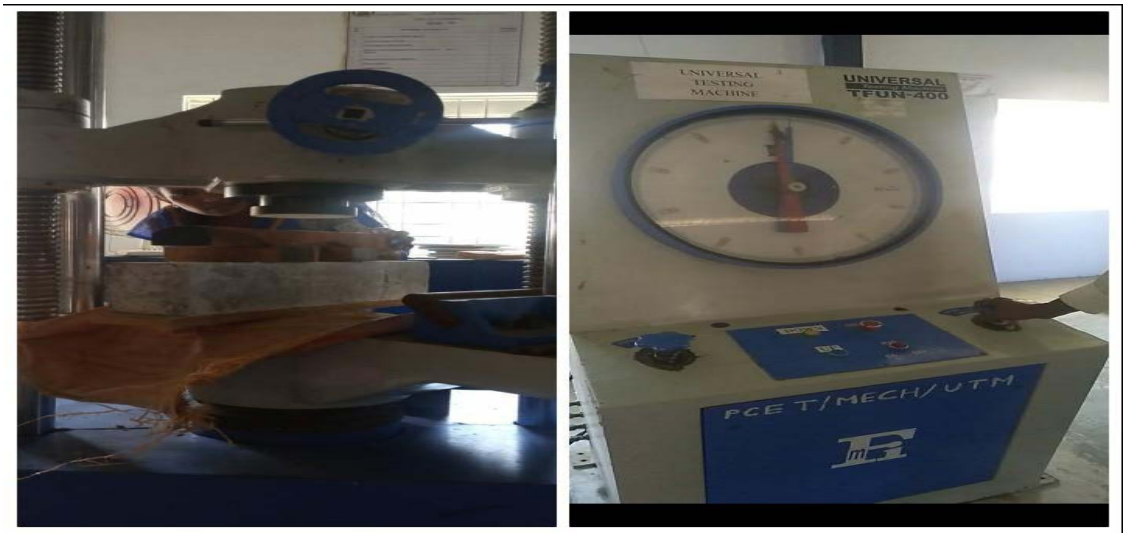

Fig 5: Flexural test value for vermiculite concrete

6. CONCLUTION

All In this case fine aggregate is partially replacement of vermiculite. Use of vermiculite in concrete it will enhance the shrinkage and crack resistance, fire resistance and reduces environmental impact and also reduce the cost. In this present study, structural light weight aggregate concrete was designed with the use of natural vermiculite aggregate that will provide an advantage of reducing dead weight of structure and to obtain a more reasonable structural light weight concrete by the use of vermiculite power as a partial replacement of fine aggregate. Three mixes were created with the cement content of 479kg/m in M30 grade and water cement ratio is 0.50. The attempt has been made to study the mechanical properties of M35 grade concrete with different percentages at a range of 5%, 10%, 15%, 20%, 25% and 30% as partially replacement with vermiculite to the total weight of fine aggregate along with mineral admixtures like Fly ash (FA) is replace with cement by various percentages i.e., 10%, 15% and 20% and silica fume (SF) as adding of 5%, 7.5%, 10% and 12.5% by weight of cement. Water cement ratio is 0.42. Optimum percentage of compressive strength is obtained.

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