An Experimental Study on Strength Properties of Concrete With Partial Replacement of Cement With Fly Ash, Fine Aggregate With Vermucilite And Silica Fume As Mineral Admixture

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Abstract- *Concrete is the most common building material for its inherent and unique properties like compressive strength and durability. Upon continuous utilization of the concrete, the raw materials like fine aggregates and coarse aggregates are being extinct. In order to counter this problem, many researchers are being carried out with replacement of various materials. Vermiculate is a light weight material which is being used for thermal resistance in cavity walls is proposed to be one of the alternative sources for fine aggregate.*

In the present project, Silica fume is added at 5%, 7.5%, 10%, 12.5% and fly ash is partially replaced with cement at 10%, 15%, 20%, then the optimum mix is determined and then vermiculate is replaced with fine aggregate at 5%, 10%, 15%, 20%, 25%, 30% and the test results of compressive strength and tensile strength are compared with conventional concrete for M30 grade concrete.

Keywords- Standard concrete, Silica Fume, Vermiculate, Fly ash, Compressive strength, Tensile Strength.

I. INTRODUCTION

Vermiculite is a hydrous phyllosilicate mineral group and that is micaceous in nature. It found in legion places the world but just on a restricted number of places are used as salable deposits. The vermiculite was mined and refined using as medley of manner and supplied only salable in changing of its streak size grades of vermiculite concentrate.

Vermiculite owes its salable uses to its property of slough on heated. It molts from a yellow to light bronze colored mass obtaining an aspect of a gather of worms - vermicular, an Italian decree for verm from which it derived a name as vermiculite. Some developers note the Latin decree vermicular from which the name vermiculite is derived.

Vermiculite is the only used in relation for a group of micaceous minerals will expand or slough sometimes (commercial varieties exfoliate 8 - 20 times or more) the real thickness on heated. They show the criterion micaceous structure of base disunion and occur in smooth and in-elastic lamina. Their basal disunion does not good as those of mica. Vermiculite subsists in many types of colors from black terminated motley shades of brown to yellow. Its chemical composition revise widely cohere of a complex hydrated aluminum, $mgsio_2$ and that the assay of mineral is so little used to descry the vermiculite for commercial uses a technical trial of material furnish the only perfection test. So, this is process with lot of challenges and uses to refinement. It comes two different forms with different grades i.e. crude and exfoliated

II. METHODOLOGY

The experimental investigation consists of casting and testing of 20 sets along with control mix. Every set consists of 6 cubes and 6cylinders for formative compressive, tensile strengths correspondingly. Exfoliated vermiculite is used in the cram with different percentages as a partial replacement with natural sand along the varying % of the various admixtures like Silica Fume and Fly Ash.

In the present revise, an attempt has been ready to learn 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 replaced with cement by various percentages i.e., 10%, 15% and 20% and silica fume (SF) as addition of 5%, 7.5%, 10% and 12.5% by weight of cement.

In this project, at first the optimum percentage addition of silica fume and optimum percentage replacement of fly ash was carried out and then to that optimum mixing percentage vermiculate is varied and the test results of compressive strength, split tensile strength and the weight of hardened concrete were compared with M35 grade convection concrete.

III. RESULTS

Table 1:To calculate the optimum percentage of Cubes and Cylinders with varying proportions of Mineral Admixtures is given below.

Mix Designation		Compressive Strength (N/mm²)	
% of Silica Fume added + % Replacement of Fly ash		7Days	28Days
5	10	31.85	44.26
	15	33.65	44.95
	20	30.12	43.89
7.5	10	34.85	46.45
	15	35.98	47.24
	20	33.52	45.36
10	10	35.86	47.35
	15	**37.45**	**49.01**
	20	36.74	46.23
12.5	10	35.84	45.25

Mix Designation		Split Tensile Strength (N/mm²)	
% of Silica Fume added + % Replacement of Fly ash		7Days	28Days
5	10	2.68	4.32
	15	2.78	4.37
	20	2.71	4.19
7.5	10	2.79	4.45
	15	2.91	465
	20	2.87	4.41
10	**10**	**3.01**	**4.71**
	15	2.84	4.45
	20	2.71	4.14
12.5	10	2.62	3.91

Table 2: For optimum percentage of mineral admixtures fine aggregate is partially replaced with vermiculite.

S. No	Percentage Replacement of Vermiculite (%)	Compressive Strength (N/mm²)	
		7Days	28Days
1.	0	30.01	43.92
2.	5	29.75	42.54
3.	10	28.03	41.23
4.	15	25.36	38.31
5.	20	22.98	37.15
6.	25	21.74	35.42
7.	30	20.12	30.18

Graph 2: shows the Compressive strengths for Replacement of fine aggregate with vermiculite to the Optimum percentage of mineral admixtures for cubes i.e., (10%S.F+15%F.A)

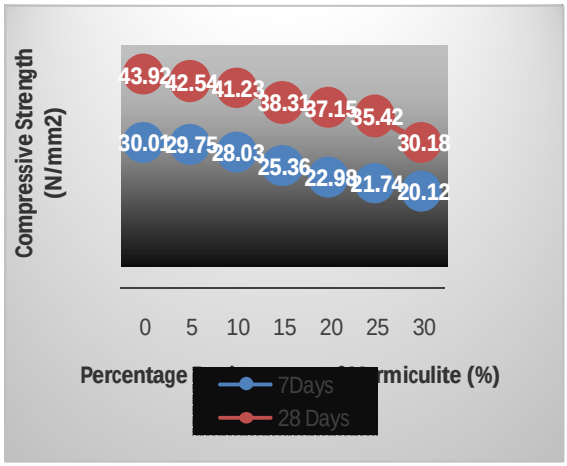
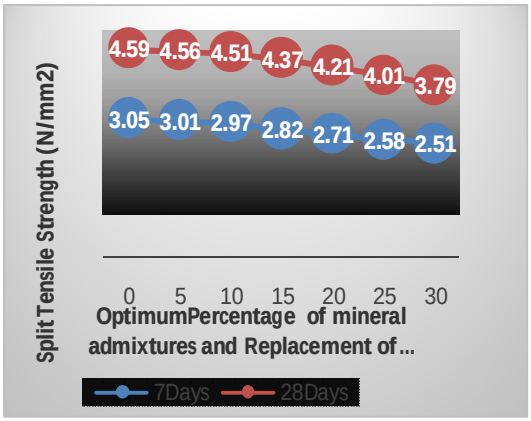


Table 3: For optimum percentage of mineral admixtures fineaggregate is partially replaced withvermiculite(10%S.F+10%F.A)

S.No	Percentage Replacement of Vermiculite (%)	Split Tensile Strength (N/mm²)	
		7Days	28Days
1.	0	3.05	4.59
2.	5	3.01	4.56
3.	10	2.97	4.51
4.	15	2.82	4.37
5.	20	2.71	4.21
6.	25	2.58	4.01
7.	30	2.51	3.79

Graph 2: shows the Compressive strengths for Replacement of fine aggregate with vermiculite to the Optimum percentage of mineral admixtures for cubes i.e., (10%S.F+10%F.A)



IV. CONCLUSIONS

Based on the experimental investigations conducted on the casted cubes and cylinders the following conclusions were drawn

- The compressive strength is increased 10.73% for replacement of cement by 15% fly ash and addition of 10% silica fume when compared with the nominal mix and it is considered as the optimum mix
- The Split tensile strength is increased 9.03% for replacement of cement by 10% fly ash and addition of 10% silica fume when compared with the nominal mix and it is considered as the optimum mix.
- Though the compressive strength of concrete decreases with increase of percentage of vermiculite, but with the replacement of fly ash at 15% and addition of silica fume at 10% to cement with replacement of vermiculite to fine aggregate up to 20% may be accepted as it is giving required target mean strength.
- Though the Split Tensile strength of concrete decreases with increase of percentage of vermiculite, but with the replacement of fly ash at 10% and addition of silica fume at 10% to cement with replacement of vermiculite to fine aggregate up to 20% may be accepted as it is giving required target mean strength.
- with increase in percentage replacement of vermiculate the self of weight of concrete is reduced to a considerable amount of 14.25% at 10%partial replacement of vermiculate to fine aggregate.

REFERENCES

[1] M.R.Divya, Prof.M.Rajalingam, Dr.Sunilaa George (2016) “Study on Concrete with Replacement of Fine Aggregates by Vermiculite” The main purpose of the research is to study the strength parameters such as compressive strength, split tensile & flexural strength.

[2] Chandra Sekar G, Hemanth Kumar Ch, V Manikanta, M Simhachalam (2016) “Effect of Fly Ash on Mechanical Properties of Light Weight Vermiculite Concrete” in which up to 20% shows optimum results and a significant increase in density and compressive strength of light weight vermiculite concrete.

[3] S Syed Abdul Rahman, Gijo K Babu (2016)”An Experimental Investigation on Light Weight Cement Concrete using Vermiculite Minerals” In this 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 economical structural light weight concrete by the use of vermiculite power as a partial replacement of sand.

[4] Mr. M. Gunasekaran et al., (2016) “Study on Vermiculite Incorporate in Mortar” Study on Vermiculite replacing natural sand is investigated. Design mix having the mix proportion 1:3 with the water cement ratio 0.5

[5] Indian standard recommended guidelines for concrete mix design IS 10262-1982.

[6] Dinesh A, Padmanabani and Maruthachalam M (2016) Have done their experiment on structural low density aggregate concrete it was designed with the used of expanded perlite aggregate, expanded vermiculite aggregate that will provide an advantage of reducing dead weight of structure and to obtain a more economical structural low density of the concrete by the using of these materials as a replacement of the coarse aggregate.

[7] Dharma Prakash R andDr.Sreevidya V (2016) Have studied the focus of the present study the explores the strength and durability properties of light weight vermiculite concrete. Two varied types of light weight aggregates namely vermiculite and perlite is been partially replaced with coarse aggregate.

[8] S.Sharmila and L.Vijayan (2016) Have study replacement of the fine aggregate with the material called vermiculite. It belongs to the family of light weight aggregates. The exfoliated vermiculite is used as a replacement of fine aggregate. This project is mainly applicable in places where the environmental temperature is very high. The Replacements were done in 5, 10 and 15% of fine aggregate

[9] Hariharan A R, Santhi A S and Mohan Ganesh G (2011), “Study on Strength Development of High Strength of

Concrete Containing Fly Ash and Silica Fume", International Journal of Engineering Science and Technology, Vol. 3, pp. 2955-2961.

[10] B. Krishna KumariBai, M. KantaRao Have their study high performance concrete with mineral admixtures, lower water cement ratio and super plasticizers are used. Fly ash (FA) is replaced with cement by various percentages i.e., 5%, 10%, 15%, 20%, 25% and silica fume (SF) as addition of 10% by weight of cement.

[11] IS 456- 2000 "Plain and reinforced concrete code of practice".

[12] IS 10262 - 2009 "Recommended guidelines for concrete mi design".

[13] Shetty.M.S (2005), "Concrete Technology Theory and Practice" S.Chand& Co, ltd., published in New Delhi.