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EXPERIMENTAL INVESTIGATION ON THERMO PROOF CONSTRUCTION USING VERMIPLAST

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ABSTRACT

Vermiculite is the name used in commerce for a group of micaceous minerals that expand or exfoliate many times the original thickness when heated. Its chemical composition varies widely consisting of a complex hydrated aluminium, magnesium silicate and hence the analysis of the mineral is of little use in determining the vermiculite for commercial utility. Providing thermal insulation for the building is oneof the developing areas in the field of Civil Engineering. Due to the increase of global warming the room temperature is increased. Vermiculite, a mineral of natural occurrence of the group of hydro micas, when heated to above 300°C, expands to become a highly efficient heat-insulating material. In order to reduce the temperature, we are using vermiplast in plastering. For structural application of thermo proof concrete, the density is often more important than the strength. A decreased density for the same strength level reduces the self-weight and construction cost. Structural lightweight aggregate concrete generally used to reduce dead weight of structure as well as to reduce the risk of damage due to high temperature to a structure because the blast load. In this study, structural thermo proof 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 and heat resistant concrete by the use of vermiculite power as a partial replacement of fine aggregate.

KEYWORDS: Vermiculite, thermo proof, vermiplast, compressive strength and split tensile strength.

INTRODUCTION

In many places of the world the temperature is raising day by day. Many investigations are carried out throughout the world to decrease the environmental temperature. The aim of our project is to decrease the room temperature of the building lower than the surrounding environmental temperature and providing thermal insulation to the building. It is done by 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. This material is widely used in many places in the world to control the room temperature. The vermiculite added concrete is used for plastering purposes to resist the entry of heat from the surroundings into the room. For structural application of thermo proof concrete, the density is often more important than the strength. A decreased density for the same strength level reduces the self-weight and construction cost. The material seems to be very economical so all class of people mainly poor and middle family are benefited. It also resists the entry of fire inside the building as the materials are light weight.

Vermiculite exists in a wide range of colors from black through various shades of brown to yellow. Its chemical composition varies widely consisting of a complex hydrated aluminum, magnesium silicate and hence the analysis of the mineral is of little use in determining the vermiculite for commercial utility; a technical trial of the material provides the only satisfactory test. Vermiculite owes its commercial utility to its property of exfoliation when heated.

MATERIALS AND METHODS

Materials used

- ✓ Ordinary Portland cement: Conforming to IS 456 – 2000
- ✓ Graded fine aggregates: Local clean river sand (fineness modulus of medium sand equal to 2.46) conforming to grading zone III of IS-383 - 1970 was used.
- ✓ Graded coarse aggregates: Locally available well graded aggregates of normal size greater than 4.75 mm and less than 12 mm.

Vermiculite used

The vermiculite collected from Andhra mines, India was used in as modified form by physical, chemical and thermal activation. Figure shows the vermiculite and mixing of concrete. The composition of Ordinary Portland Cement (OPC) and Vermiculite (VER) used are reported in Table 1.

Figure 1: Vermiculite.

Table 1 - Composition Of OPC And Vermiculite.

Constituents	OPC (%)	Vermiculite (%)
Sio_2	22.14	46
Fe_2o_3	3.35	13
Al_2o_3	11,85	16
Cao	58.76	3
Mgo	1.30	16
Loss on ignition(LOI)	2.60	0

Replacement of sand

Vermiculite has high silica content and this lets out a strong constrain for replacing sand with vermiculite. Also the carbon content is nil. In addition to that vermiculite is good in bonding and covering of voids. it also comparatively lighter than that of the fine aggregate. The replacements were done in 5, 10 and 15% of fine aggregate.

Strength tests

Following are the tests conducted for evaluating the strength properties of vermiculite blended cement concrete.

Compressive strength and split tensile strength test:

150 mm x 150 mm x 150 mm concrete cubes and cylindrical specimens of 300mm x150 mm dia were cast using 1:1.5:3 mix with W/C ratio of 0.45. Specimens with ordinary Portland

cement and OPC replaced by vermiculite at 5%, 10%, 15%, replacement levels were cast. After curing, the tests were carried out on triplicate specimens and average compressive strength values and split tensile strength values were recorded and the values are given in Table 2.

Table 2 – Test results on companion specimens.

% of replacement	Average Compressive strength (N/mm2)	Average Split tensile strength (N/mm2)
0%	23.1	3.39
5%	21.3	3.32
10%	20.5	3.29
15%	19.4	3.26

Thermo proof

The objective of this test is to achieve in decrease in room temperature when compared to the atmospheric temperature. A prototype of a building was made to act as a specimen. The above models were made with dimensions 50 x 70 x 25 cm with the use of available concrete blocks in the site. The outer surfaces of the models were plastered with OPC blended with different proportions of vermiculite ranging from 0% to 15%. the models were cured as same as the curing done to normal buildings. Holes were dug in the bonding area between two respective blocks to insert the thermo couple. A thermo couple is an instrument that is used to measure the internal temperature. After curing period the models were left to normal atmospheric conditions. The internal temperature and the atmospheric temperature were noted at every 1 hour interval for the various models plastered with various proportions.

Figure 2: preparation of specimen to be plastered for thermo proof test.

TABLE 3 Comparison of Atmospheric and Room Temperature with Various Proportion Plastering (Day-1).

Time	Environmental Temp(^{O}C)	OPC Room Temp(^{O}C)	5% Room Temp(^{O}C)	10% Room Temp(^{O}C)	15% Room Temp(^{O}C)
10	30	29	28	26	26
11	32	30	29	28	27
12	33	32	31	29	28
1	34	33	32	30	29
2	36	35	34	33	31
3	37	36	35	35	33
4	35	35	35	34	32
5	31	35	34	33	32
6	30	34	33	32	31

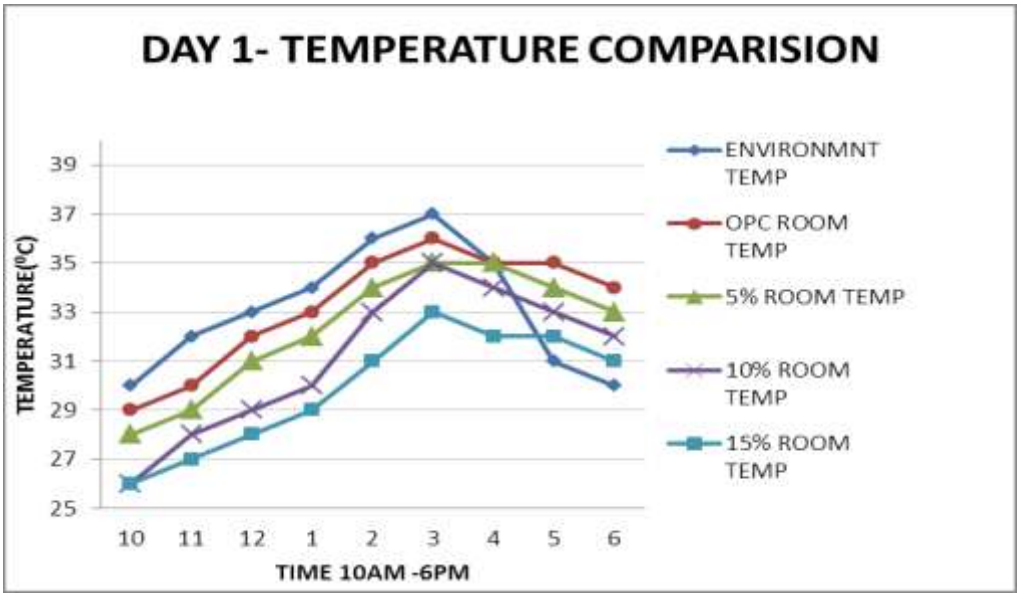

Figure 3: Line Chart for Overall Comparison of Room Temperature and Atmospheric Temperature.

CONCLUSION

The following conclusions can be drawn from the above investigation. After 14 days curing, Vermiculite replaced concrete shows marginal decrease in density up to 15% when compared to control concrete. In spit tensile test no much variance in split tensile strength when compared to control concrete. Environment heat test comparing with control concrete 15% replacement shows better insulation. There was a notable change in difference in room temperature and environmental temperature Thermal insolent concrete is thus achieved. Replacement of fine aggregate with vermiculite results in light weight concrete. From our studies it is concluded that the replacement of vermiculite shows that by designing a building

with dynamic loading and with the replacement of vermiculite up to 15% in concrete and in plastering, will lead to light weight thermal insulated concrete.

REFRENCES

1. Ali karaipekli," Capric–myristic acid/vermiculite composite as form-stable phase change material for thermal energy storage", Solar Energy, March 2009; 83(3): 323–332.
2. Abdulkadir Kan,"A novel material for lightweight concrete production", Cement and Concrete Composites, August 2009; 31(7): 489–495.
3. Osman Gencel "Properties of gypsum composites containing vermiculite and polypropylene fibers: Numerical and experimental results", Energy and Buildings, 2014; 70: 135–144.
4. S Syed Abdul 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, Februray 2016; 5(2).