International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 5 Issue 10|| October 2016 || PP. 74-78

Assessment of Structural Characteristics of Ferro – Vermiculite Composite Sheets

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Abstract: *The developments in the field of construction raise the need for concrete with less weight. This is beneficial for different applications starting from the less load applied to foundations and soil. Light weight concrete proved also to be more impact and fire resistant. The revolution of structural engineering from the last century there exits as many as developed eco-friendly components. One among such components is Ferro-vermiculite wall panels. The wall panel consists of vermiculite board in its core part which is a mixture of different grades of exfoliated vermiculite as per Indian Standard specification. Why vermiculite? Vermiculite isa very versatile mineral because of its thermal stability and inertness. It is clean to handle, odourless and mould resistant ,vermin resistance, heat resistance up to 1200°C, light weight, good fillers and also sterile due to the high temperature. Vermiculite board into two different categories i.e. vermiculite mix with and without coconutfibre.Vermiculiteboardwillbecoveredby Ferro-cementtechniques*
.Wall panel in a frames structure generally be a non-load bearingcomponents
.Various testing has been done inthe wall panels such as compressive strength, flexural strength, split tension and ultra-sonic pulse velocity test and the panel is compared with market available asbestos wall panels to find out the clear result.
Key words: *Eco – Friendly, Ferro – Vermiculite Panels, Heat Resistance, Light Weight Panel, Uniaxial Compression Test.*

I. Introduction

Vermiculite is a mica mineral comprised of magnesium, Aluminium, iron, silicate. Exfoliated vermiculite, produced by the application of heat, is generally used for thermal insulation. It is suitable for use in the temperature range of –50°C to 750"C.

When used as an aggregate with Portland cement it forms an ultra-light weight concrete with an open structure ideal for void filling, suitable for use in most light industrial and domestic applications where thermal insulating and fireproof properties are required. Vermiculite can also be used as a fire proof tiles and in chimney linings also.

Here, the vermiculite of different grades is mixed with PPC to form light weight panel as a core surrounded by mesh work covered with cement mortar.The grades which has been used here are as follows:

Table 1 Details of various grades of vermiculite used

Grade	Size (mm)	Bulk Density (Kg/m^3)
I	2.60 -8	56-120
IV	0.355 - 1	80-144

1.1. Objectives

To reduce the dead load of the structure especially in prefabricated buildings.

- To overcome the usage of asbestos wallpanel.
- To create an Eco-friendly, thermal insulated, energy efficient structuralcomponent.
- To ease the complication of transportation and erection of wallpanels.

II. Experimentalinvestigation

1.2. Mixratios

The mix design we adopted consists of cement with vermiculite in the ratios of 1:0.5. The vermiculite used here were a combination of grade I and grade IV vermiculite as per the Indian standard. The vermiculite combined ratios are 0.5: 0.5 i.e. for 1 kg of vermiculite 0.5 kg belongs to Grade I and Grade IV respectively.

1.3. Cube

Cubes are casted into two different categories i.e. with coconut fibre and without coconut fibre. Compression test were done on 7, 14 and 28 days respectively. As a result the cube which has a coconut fibre has almost twice the compressive strength when comparing with the cube without fibre.

Figure 1 Compressive strength testing on with fibre cement vermiculite cubes.

Table 2 Compressive Strength of Cubes

COMPRESSIVE STRENGTH (N/mm^2)			
NATURE OF SPECIMEN	**7th DAY**	**14th DAY**	**28th DAY**
Without Fibre	2.18	2.42	4.43
With Fibre	4.43	5.24	6.617

1.4. Cylinder

In cylinder we used two different sizes one is 100 mm dia for split tensile test.

Figure 2 Split Tensile strength testing on with fibre cement vermiculite cylinders

Table 3 Split tensile strength of cylinders

SPLIT TENSILE STRENGTH (N/mm^2)			
NATURE OF SPECIMEN	**7th DAY**	**14th DAY**	**28th DAY**
Without fibre	0.802	0.796	0.974
With fibre	0.477	0.987	1.185

1.5. Slab

Slab has been casted in the size of 500 x 100 x 100 mm, in order to find out theflexural strength or capacity of the mix ratio which has been adopted. The cement vermiculite without fibrewithstands better flexural strength. Two point loading has been used in the loading case. Deflection guageused determination of thedeflection.

Figure 3 Flexural strength testing on without fibre cement vermiculite slab

Table 4 Flexural strength of vermiculite slab

VERMICULITE SLAB	**FLEXURAL STRENGTH (N/mm^2)**
With Fibre	0.084
Without Fibre	0.1

1.6. Ferro - Vermiculite WallPanel

Uniaxial compression test has been conducted on the Ferro – vermiculite wall panel with and without coconut fibre. L- Clamp is attached to one side of the panel as in Fig 4 for measuring the verticaldeflection.

Figure 4 Uniaxial compression test on Ferro-vermiculite panel – 300x 450 mm

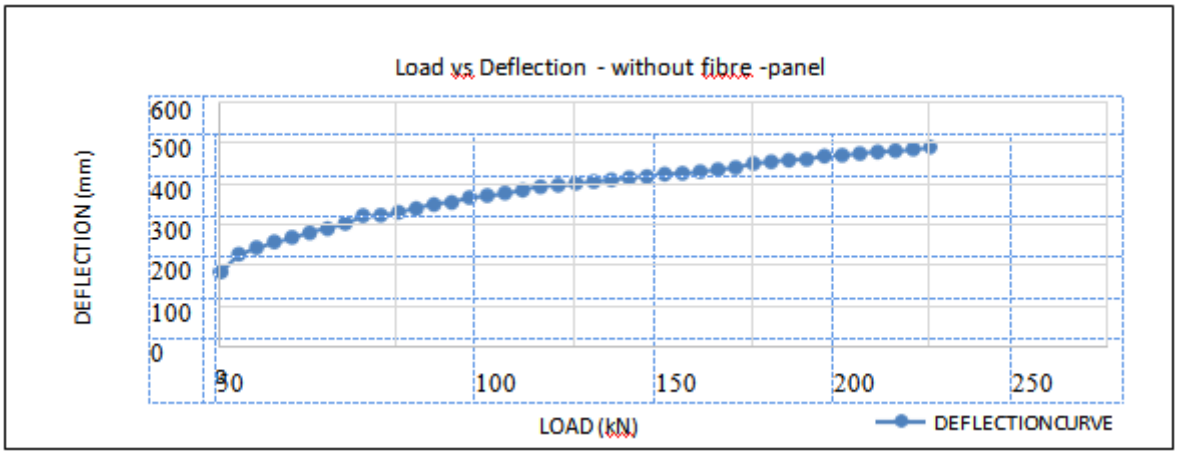

Figure 5 Load VS. Deflection Graph of Vermiculite without FibrePanel

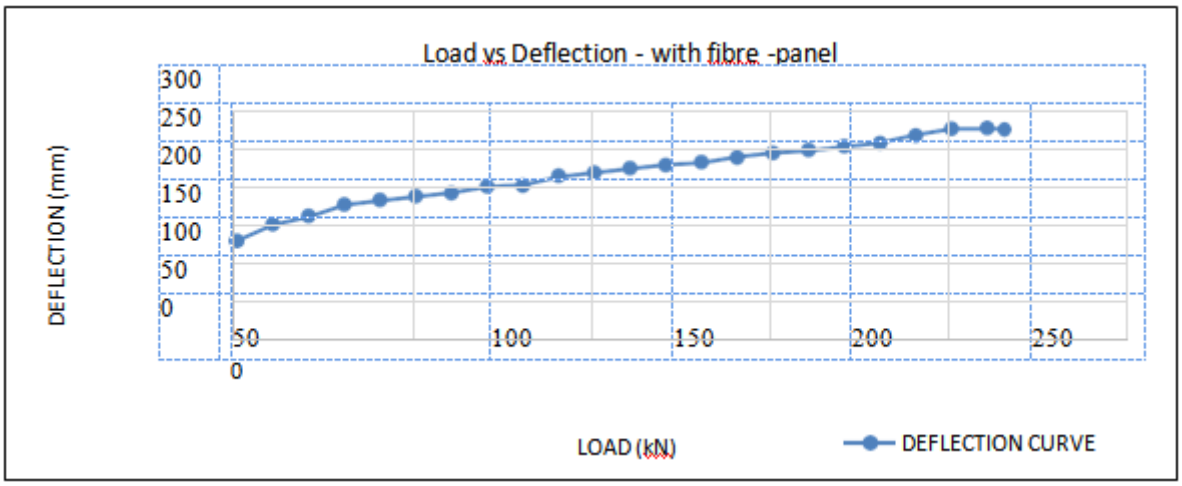

Figure 6 Load VS. Deflection Graph of Vermiculite with Fibre panel

From the uniaxial compression testing of the panel of both categories i.e. with and without coconut fibre, the panel without fibre withstands more load than the one with fibre. Now the Ferro – vermiculite wall panel without fibre is compared with asbestos wall panel available in the market.

1.7. ComparativeAnalysis

Asbestos cube has been subjected to compression test on various aspects namely, wet horizontal, wet vertical, dry horizontal and dry vertical. Out of these dry cubes with horizontal surface yields more compression loading capacity.

Then Asbestos panel was chiseled or cut in the size of the Ferro vermiculite wall panel sizeof 300 x 450 for comparative purpose. The sametest of uniaxial compression test has been conducted on the asbestos wall panel, in which Ferro vermiculite without coconut fibrepanel with stands double the t imesof asbestos panel.

Figure 7 Uniaxial compression test on Asbestos panel – 300x 450 mm

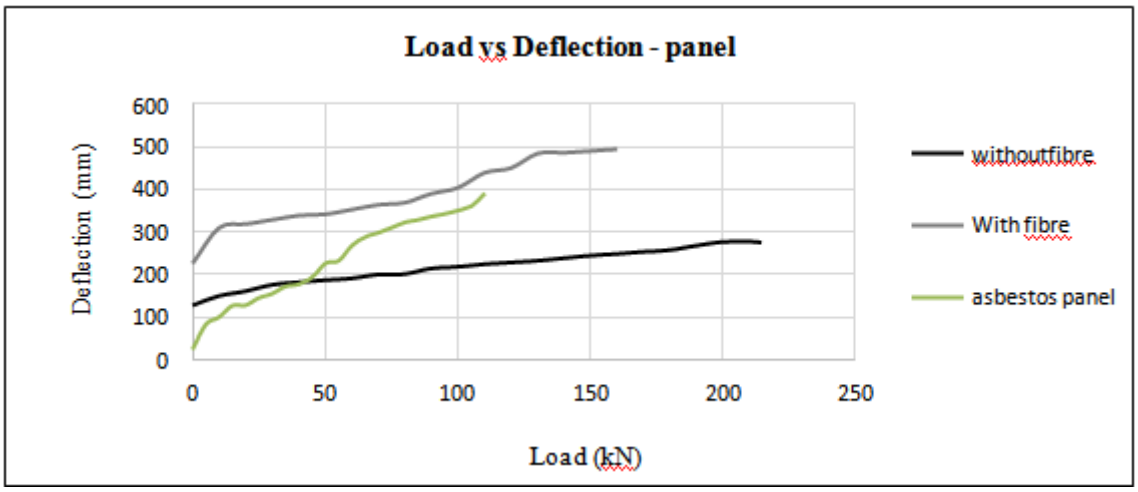

Figure 8 Load VS. Deflection Graph of Asbestos Vs. Ferro -Vermiculite panel

III. Conclusion

1. Comparing the vermiculite & asbestos material has always makes the result onthe sides of vermiculite as it is an Eco-friendlymaterial.
2. Especially when comparing with vermiculite with fibre&vermiculite without coconut fibre, vermiculite without coconut fibrewithstand the uniaxial compression in a better way.
3. Asbestos panel of various height namely(300 X 450)&(300 X550) has been subjected to uniaxial compression test which results in increase in height of panel yields less strength (i.e.)300 X 450 gives better results than 300 X550.
4. Finally comparing the Ferro-vermiculite without fibrewall panel of size (300 X 450 mm) with asbestos wall panel of (300 X 450 mm) size gives the result as the vermiculite withstand the more load then asbestospanel.

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