www.cafetinnova.org

ISSN 0974-5904, Volume 10, No. 01

DOI:10.21276/ijee.2017.10.0109

International Journal of Earth Sciences and Engineering

February 2017, P.P.58-61

Thermal Resisting and Reverberant Proof Smart Wall Panels

HARSHA VARDHANA BALAJI M, DIVYA R, GAVIYAA MA, GAYATHRI DEVI N R AND RESHMA R

Department of Civil Engineering, Knowledge Institute of Technology, Salem 637504, Tamil Nadu, INDIA

Email: *gaviyaama@gmail.com*

Abstract: *Due to climatic change, interior temperature inside the structure changes periodically. In order to control the temperature change, we are in need of external appliances. Usage of these appliances causes environmental change along with increased operating cost. This paper aims to deal with the mentioned issue to compensate environment changes. Thermal resisting wall panel reduces heat, low cost of productivity and low maintenance cost. These panels can be fixed easily and it shows more economical result during its application.*

Keywords: *Smart materials, green material, thermal resistant, interior temperature*

1. Introduction

The thermal resistance is a property by which the material resists heat flow passing through it. Thus the wall panel is designed to resist the heat penetrating inside the structure. The wall panel is a composite material which is made up of naturally available materials like clay, sawdust and water. Clay has a property to resist heat conduction and so the sawdust. As the sawdust is used it remains as a good binding material for clay and improve strength. The main property of sawdust is sound absorption.

Now-a-days, partially false ceiling is used for heat resisting. But they have many disadvantages like height of ceiling, installation cost, pesticide formation and maintenance cost. The wall panel satisfies the disadvantages and have advantages like eco-friendly and also economic.

Thermal resisting property

The general thermal conductivity property of the basic construction materials and materials of the wall panels are as follows [5],

Table 1: *Thermal conductivity of materials*

Materials	Thermal conductivity (W/m/k)
Clay soil	0.52
Saw dust	0.08
Brick	0.6-1
Concrete mix(dense)	1-1.8

2. Literature Review

Drawing up on "Analysis of thermal and electrical properties of some clay materials" [6] and noise pollution being the main factor, the review on "Sound insulation of walls, floors and door construction" the saw dust and clay material can be the best eco-friendly and low cost material. The amount of materials was batched for different proportions by replacing 10%, 15%, 20%, 25%, 30%, 35%, 40%, and 45% of clay with saw dust to get comparative results of compressive strength and thermal resistance and to obtain the best result with it's corresponding proportions to prepare final model of wall panel. The table 2 shows the amount of saw dust and clay, in Kg, to be batched for different proportions.

Table 2: *Amount of Materials*

% of saw dust replacement	Amount of saw dust (kg)m	Amount of clay (kg)
10	0.142	1.279
15	0.213	1.208
20	0.284	1.136
25	0.355	1.065
30	0.426	0.994
35	0.497	0.923
40	0.568	0.852
45	0.639	0.727

3. Design:

With these review the design mix and proportionality of the materials were made and the panel was designed with the given dimensions as per fig 1.

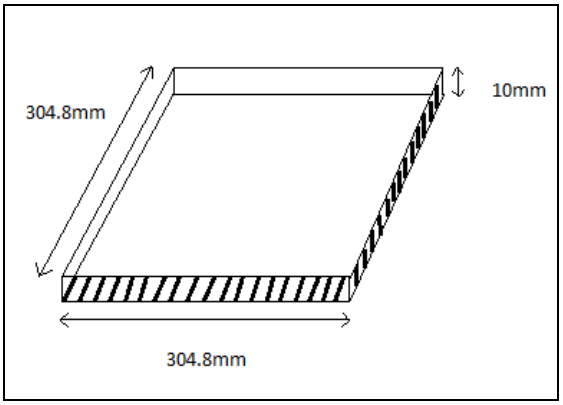

Figure 1: *Wall panel (Diagrammatic representation)*

4. Mix Design

Unit weight of clay = 15KN/m^3.

Received: June 08, 2016; Accepted: November 30, 2016; Published: February 28, 2017
International Journal of Earth Sciences and Engineering, 10(01), 58-61, 2017, DOI:10.21276/ijee.2017.10.0109

$= 15x10^3 N/m^3$.
In Kg $= (15x10^3)/9.81$.
$= 1529.052 Kg/m^3$

Calculation:
(Volume) = (304.8x304.8x10) mm.
$= 929030.4 mm^3$
Weight of clay $=1529.05x9.29030x10^{-4}$Kg.
= 1420.533gms.
=1.420533Kg.

Preparation of Wall Panel:

- Soil and saw dust sieved to 1mm.
- Mixed with water.
- Initial setting for 2days.
- Heated for 1 hour at 180°C in oven.

Figure 2: *Mixing of Ingredients*

5. Test Parameters

Tests on wall panel are as follows,

1. Sound absorption test.
2. Compressive strength.
3. Thermal conductivity test.

5.1 Sound absorption test

The material absorbs sound as opposed to reflecting the energy when sound energy is experienced. A part of the absorbed energy is converted into heat and is conveyed through the absorbing body. The Reverberation time was calculated based on Sabine's Formula,

$$T= (0.161V)/A$$

Where, V=Volume of the room.
A=Co-efficient area of absorption (m^2).
Modelling of room,
Height = 3m.
Length = 12m
Width = 8m.
a_{wall} = 0.2 (wall panel)
a_{floor} = 0.02 (Normal vinyl or mosaic floor)
$a_{ceiling}$ =0.4 (Concrete ceiling).
Effective absorbing area = 692.335 ft^2
Volume of room =10170.62 ft^3
Reverberation time = 0.721 seconds.

Hence the wall panel is an excellent reverberant proof material.

Table 3: *Reverberation time*

Reverberation time in sec	Acoustics
Below 1.5	Excellent
1.5-2	Good
2-3	Fairly Good
3-5	Bad
Above 5	Very bad

5.2 Compressive strength

Compressive strength is the primary property of a material and is generally tested on every structural member. It is one of the fundamental properties used for quality control of light weight material. Compressive strength may be defined as the measured maximum resistance of the specimen to axial loading. It is found by measuring the highest compression stress that a test cylinder or cube will bear. The wall panel is tested for compressive strength in CTM (Compressive Testing Machine) shown in fig 3. The effect of saw dust on compressive strength is studied [2] and optimum replacement percentage was chosen from the comparative results from table 4.

Figure 3: *Panel on CTM*

Table 4: *Comparative compressive strength*

Sl. No.	Sawdust (Kg)	Clay (Kg)	Water (Kg)	Average Compressive Strength (KN/m)
1	0.142	1.279	0.5	4.0
2	0.213	1.209	0.7	4.5
3	0.284	1.136	0.8	5.5
4	0.355	1.065	0.9	6.5

5	0.426	0.994	1.0	6.0
6	0.497	0.923	1.2	5.5
7	0.568	0.852	1.4	5.5
8	0.639	0.727	1.5	5.0

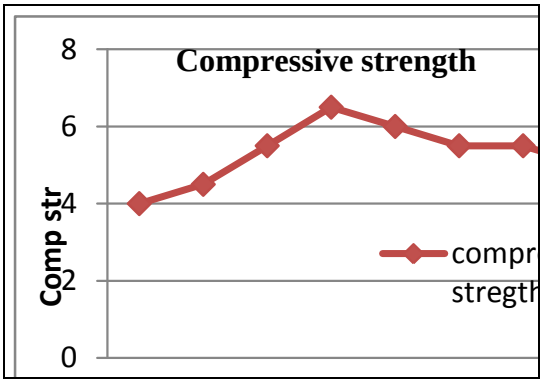

Figure 4: *Compressive Strength*

5.3 Thermal Conductivity

The degree to which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field which causes the flow of current. The conductivity test was tested by thermometer. Taking successive ten different points, temperature was measured on the surface exposed to sun and surface not to sun. The difference between the two temperatures was taken. Table 5 represents the comparative results of thermal conductivity.

Table 5: *Comparative thermal conductivity*

Sl No	Saw dust (kg)	Clay (kg)	Water (ltrs)	Average thermal (°) conductivity
1.	0.142	1.279	0.5	0.25
2.	0.213	1.209	0.7	0.24
3.	0.284	1.136	0.8	0.22
4.	**0.355**	**1.065**	**0.9**	**0.19**
5.	0.426	0.994	1.0	0.21
6.	0.497	0.923	1.2	0.23
7.	0.568	0.852	1.4	0.24
8.	0.639	0.727	1.5	0.25

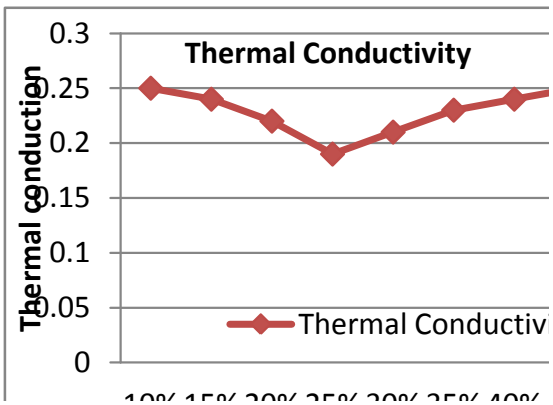

Figure 5: *Thermal Conductivity*

6. Test Result:

The thermal resisting wall panel shows greater thermal resisting property with sample 4 (25% saw dust) as lower thermal conductivity of 2° (as per fig.5). When compared to concrete the panel has four times lower thermal conductivity. When compared to brick it has two times lower thermal conductivity. The reverberation time is less than 40 seconds for saw dust but the conventional concrete has a reverberation time greater than 1 minute. From graph 1, it is clear that the compressive strength is maximum for sample 4 (25% saw dust).

7. Applications

- Thermal resisting material can be used for maintaining the cold temperature in interior structures.
- Acoustic control and in industries that produce sound.
- When fixed in the exterior that can be used as decors by applying cement coating over it and making the designs.
- Auditorium.
- Cinema Hall.
- Recording room.
- Musical Room.
- Home Theatre room in residential structures.
- Interior decors.

8. Advantages over the Conventional One

- Heat insulating
- Sound Absorbing property
- Applicable for all structures
- Most economical
- Architectural purposes
- Energy efficient
- Emits less CO_2

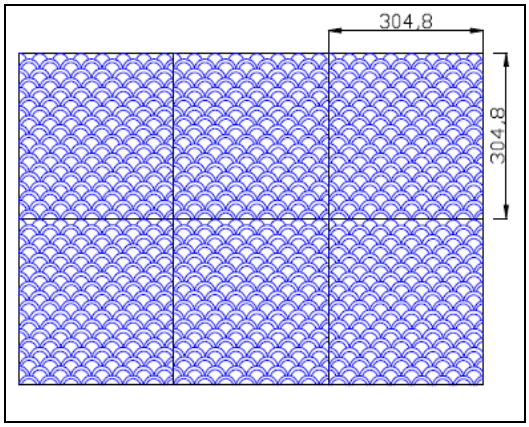

Figure 6: *Decorative wall panel,* All dimensions are in mm.

9. Conclusions and Recommendations

By application of 25% of saw dust in the wall panel, it shows 0.19°C conductivity which is a reasonably less conductivity comparing to conventional panels or concrete blocks and has 6.5 KN of compressive strength. This wall panel will reduce the heat transfer into the interior structures. It will remain as best economic material with pollution free applications. These wall panel shows the materials used are cheap and saw dust is considered as one of the main agricultural waste product, the wall panel is considered to be eco-friendly product.

The wall panel can be upgraded by introducing water entraining admixtures to make it water repellent and addition of low heat admixtures make them efficient as they emit low carbon dioxide. This panel is applicable for all structures, emits very low greenhouse gases, when fixed in the interiors it serves as an architectural green material.

Figure 7. *(Title)*

References

[1] A.H. Buckman M. Mayfield Stephen B.M. Beck, "*What is Smart Building*", Emerald Insight, 19th September 2014.

[2] H.Chemani, "*Valorisation of wood sawdust in making porous clay brick*", Scientific research and essays, 2013.

[3] Augustine Elinwa, "*Effect of addition of sawdust to clay bricks*", Civil engineering and environmental systems, Volume 23, issue 4, 2006.

[4] P.Turgut, H.M.Algin, "*Lime stone dust and wood saw dust as brick material*", Building and Environment, 2007.

[5] E.Bwayo, S.K. Obwaya, "*Thermal conductivity of insulation Brick developed from sawdust and selected Uganda clays*", International journal of research in Engineering and Technology.

[6] P. Bund, "*Analysis of thermal and electrical properties of some clay materials*", EJGE journal, Vol-14, 2009