Experimental Study on Thermal Conductivity of Cavity Wall Filled with Coconut Coir

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Abstract:
Due to climate change, increasing temperature in building and rising of living standards, comfort cooling in building is very essential in today's world, but it is not easy to attain the result quickly with our current environment. The way of temperature reduction includes cavity wall construction with replacement of insulating material by natural insulator. The insulator filling work is so easy it only needs man power alone the work present the result of an experimental setup to reduce the temperature in indoor environment temperature reduction material is used in wall cavities as insulators. Our test insulation material is jute. It is one of the natural fibre available in tropical region. Jute is the cooling material and it resists the thermal penetration in wall. We hope to do an experimental way to reduce the indoor temperature with a sample of demo.

Keywords: cavity wall, coir fiber, insulator filling, thermal penetration.

I. INTRODUCTION

In southern region of India, heat plays a major role so it is necessary to introduce the new type of Construction to reduce the thermal condition of the buildings. Cavity wall type of construction plays a major role in reducing the temperature of the building. Cavity walls are not new to the construction as it was used in early times in Greek and roman structures. Cavity walls are reinvented by British in the early 19th century and by United States in the late 19th century. At early times the cavity walls are suggested to protect the moisture penetration by British. At United States the cavity walls are limited to exterior load bearing structures in low rise constructions. In 1940s the cavity walls are used in high rise buildings by designers because of its advantages. At present the masonry cavity walls are widely used in United States. Cavity walls are becoming popular because of their resistance to rain penetration and sound transmission and their excellent thermal properties. Cavity walls are separated by a hollow space in the cavity wall construction. The space between these walls is filled by insulating and non insulating materials. Based on the filling materials between the walls it is classified as Insulated cavity wall and non insulated cavity wall. This article explain about the cavity wall with the help of insulated material to reduce the atmospheric temperature using natural material called coconut coir. The test is conducted for 7 days as sessions (8-12 A.M & 1-4 A.M) between the normal wall and cavity wall.

II. MATERIALS

The materials used in this project are river sand, cement, coconut coir and conventional bricks and required quantity of water.

A. Brick
A brick is the building material used for masonry construction purposes. First class bricks are used here for the construction of cavity walls.

B. Cement
Cement is a binder, used for the masonry structures. Ordinary Portland cement 53 grade is used as the binder material in the wall construction. Specific gravity of the cement is found to be 3.15.

C. Sand
River sand of specific gravity 2.7 is used in the cement mortar for construction purpose.

D. Water
Ordinary clean portable water is used for mixing process. Water is added as peer the requirement during mixing of mortar.

E. Coconut coir
Brown coconut coir, which is a well known natural fiber extracted from the husk of coconut. The coir fiber is relatively water proof, here it is used as the insulation material. It provides excellent insulation against temperature and sound. Coconut fibre is extracted from the outer shell of the coconut. There are two types of coconut fibre such as Brown fiber and White fiber. The fiber used here is brown fiber.

Figure 1. coir fiber
III. CONSTRUCTION OF CAVITY WALLS

A. Brick calculation

Brick size = (0.240*0.125*0.085) m
= 0.00255 m$^3$.

Long wall = (1*0.23*0.8) m
= 0.184 m$^3$.

Short wall = (0.54*0.23*0.8) m
= 0.10 m$^3$.

Total no. of bricks

Long wall = 0.184/0.00255 = 72
= 72*2 = 144.

Short wall = 0.10/0.00255 = 40
= 40*2 = 80.

Total no of bricks = 224.

B. Cement mortar

Mortar is a form of paste which is used to bind the binding blocks such as bricks masonry units together. It is used to fill the gap between the regular intervals of bricks. The ratio of 1:4 cement mortars is used in this project work.

C. Construction work

The place was selected, at where the construction of structure with cavity wall is to be done. Then the place is cleaned and levelled to proceed with process. The different stages of construction works are shown in Fig.2-Fig.5.

IV. RESULTS AND DISCUSSIONS

Temperatures were measured on the built cavity wall insulated with coir fiber and solid wall to determine and compare the results regarding its temperature. Temperature is measured by wall thermometer which is capable to absorb the heat and gives the values in Degree Celsius and Fahrenheit. Temperatures were taken at time from 8 A.M and 12 P.M for a week. The results are shown in table. I, Fig.7, Fig.8 and Fig.9.

![Figure 5. With insulating material](image)

![Figure 6. Finished structure](image)

![Figure 2. stages 1](image)

![Figure 3. stages 2](image)

![Figure 4. Without insulating material](image)

![Figure 7](image)

![Figure 8](image)

Table. I. Time (8 A.M-12 P.M)

<table>
<thead>
<tr>
<th>Days</th>
<th>Time (8.00 A.M-12 P.M)</th>
<th>Temperature (°c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>W</td>
</tr>
<tr>
<td>1</td>
<td>10:00</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>9:30</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>9:00</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>11:45</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>10:30</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>11:15</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>12:00</td>
<td>3</td>
</tr>
</tbody>
</table>

Construction of cavity walls are done successfully, then the spaces between the walls have to be filled with the insulating materials (coir fiber). Now the walls are inslakted and the final structure is finished with plastering works are shown in Fig.5 and Fig.6.
Temperatures were taken at time from 1 P.M and 4 P.M for a week. The results are given in Table II, Fig.10, Fig.11.

### Table II. Time (1 P.M-4 P.M)

<table>
<thead>
<tr>
<th>Days</th>
<th>Time (1 P.M-4 P.M)</th>
<th>Temperature (°c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>3 7 3</td>
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<tr>
<td>3</td>
<td>4 7 3</td>
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<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2 7 3</td>
<td>0</td>
</tr>
</tbody>
</table>

Graph for variation in temperatures for 7 days between 1 P.M and 4 P.M is shown in Fig.12.

### V. CONCLUSION

From this study, by observing the results the following conclusions were made.

- This type of building keeps inside environment warmer when winter season and cooler in summer season than the solid wall structures.
- The insulation replacement is very simple.
- By this simple method, machinery charges of cavity wall insulators can be reduced.
- Its noted that the temperature of cavity wall insulated with coir fiber reduces massively by 10°C in comparison with the ordinary traditional buildings.
- It also provides good insulation against sound.
- Economical way of constructing of using easily available coir fiber.
- By providing cavity wall, load transfer on foundation is reduced.
- Cavity wall resists the entry of moisture from outer wall as coir fibre does not absorb moisture.

### VI. REFERENCE


[2]. Mr. Sanjay, N.Mali, Dr. Ashok, B. Mohr , Mr.D.S.Patil, “APPLICATION OF GEOTHERMAL COOLING TECHNIQUES TO IMPROVE THERMAL CONDITION OF A RESIDENTIAL BUILDING”, international journal of civil and structural engineering research ISSN 2348-7607, Vol.2, Issue 1, Month –April 2014-september 2014.

