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Experimental Analysis and Performance Evaluation of Cavity Walls with Burnt Brick for Building Envelop

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Abstract - *Cavity walls are used to reduce thermal load in building envelop. It helps to maintain comfort in adverse conditions. The various composite cavity walls have been tried. The air cavity walls create problems such as dampness and water leakages due to lack of constructional abilities. The composite walls with insulation are costly and hence are limitedly used. It is necessary to try different composite cavity walls with local material.*

This research work has tried different cavity walls ranging from 50mm to 200mm as air gap and composite walls with cavity filled using materials such as Expanded PolyStyrene, wheat husk, Expanded PolyEthylene. These composite walls are experimentally tested and are evaluated for its U values.

It is observed that the composite cavity walls using 200mm Expanded PolyStyrene insulation has least U value (W/m²K) followed by Expanded PolyEthylene and Wheat Husk as 0.5647, 0.5796, 0.5962 respectively.

Key Words: Energy conservation, composite wall, Cavity Wall, Insulation, Building Envelop, Building Insulation

1. Introduction

Insulation and energy-efficient construction materials are used in order to reduce the air-conditioning load needed to maintain comfort conditions in buildings, especially in adverse climates. This is an effect of heat transfer across a building envelope via transmission through the walls and roof. There are a number of insulation materials and design practices available that can be used to reduce this transmission load. Insulation materials vary considerably with regard to their thermal and physical properties as well as cost. The most economical type of insulation to use and its optimum thickness depend upon the climatic conditions, building element structure and a number of economic parameters. Cavity walls are among the types of wall structures used worldwide. [2]

1.1 Test Setup

The test setup is made in wooden box of dimensions 3'X6'X3'. The first wall is built at middle of box. Another wall is built on the trolley, which gives us the freedom of varying the cavity width. The cavity widths are taken as 50mm, 100mm, 150mm, 200mm. The insulation materials selected are Expanded Polystyrene, Wheat husk, Expanded PolyEthylene..

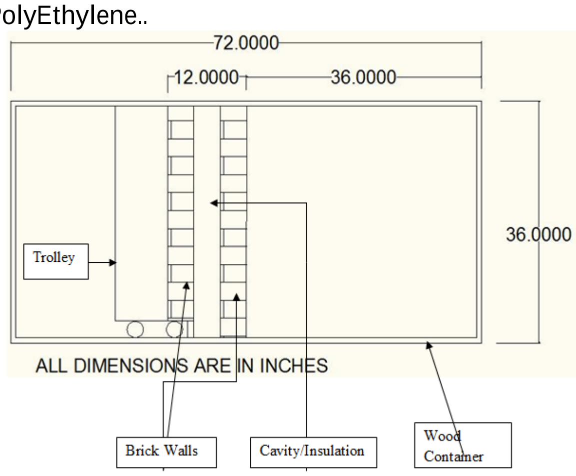

Fig- 1 : Test Setup

1.2 Material Selection:

(a) Burnt Brick

Fig- 2: Burnt brick
Thermal Properties:
Density (Kg/m3): 1820
Thermal Conductivity (W/m-K): 0.811

(b) Expanded Polystyrene (EPS):

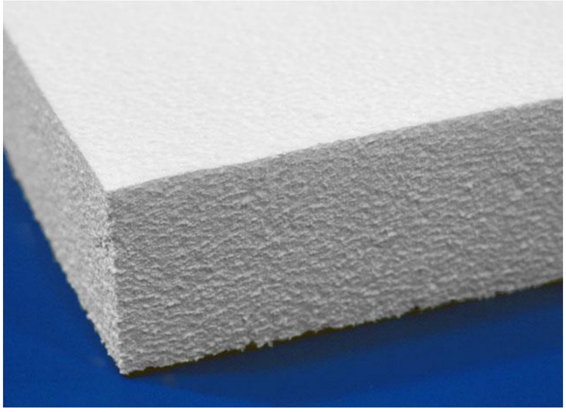

Fig- 3: Expanded Polystyrene

Thermal Properties:

Thermal Conductivity (W/mK)

K = 0.0341 W/mK

(c) Wheat Husk:

Fig- 4: Wheat husk

Husk or Chaff is the dry, scaly protective casings of the seeds of cereal grain, or similar fine, dry, scaly plant material such as scaly parts of flowers, or finely chopped straw. Chaff is indigestible by humans, but livestock can eat it and in agriculture it is used as livestock fodder, or is a waste material ploughed into the soil or burnt. Thermal Properties: Properties are unknown.

(d) Expanded PolyEthylene (EPE):

Fig- 5: Expanded Polyehylene

Thermal Properties:

K=0.28 W/mK

Density: 920 Kg/m3

2. Results

The research work is concentrated on effect of walls, cavity walls and associated building skin on thermal performance of the building. The methodology is developed to find out how much thermal transmissivity can be reduced using different cavity and composite walls for which following walls are selected with its U- values evaluated at the Department of Energy Technology, Shivaji University with standard setup.

a. Cavity wall with cavity width 50 mm, 100 mm, 150 m and 200 mm.
b. Composite wall with insulation of EPE with insulation thickness of 50 mm, 100 mm, 150 mm, and 200 mm.
c. Cavity wall with insulation of Wheat Husk with insulation thickness of 50mm, 100mm, 150mm, 00mm.
d. Composite wall with insulation of EPS with insulation thickness of 50 mm, 100 mm, 150 mm and 200 mm..

Chart 1 is presentation of thermal transmittance U plotted against temperature difference on either side of wall in case of Air Cavity wall. From above graph it is observed that as the cavity width increases the U value decreases

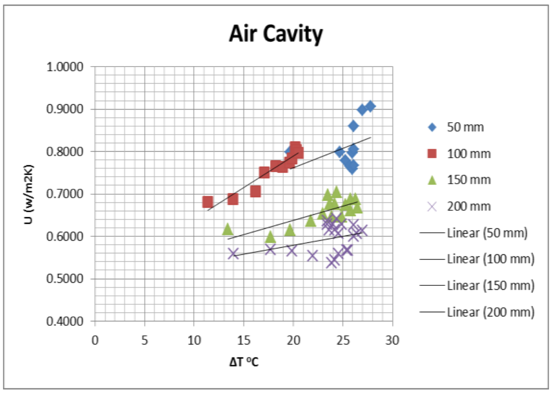

Chart -1: U values for different gap width for air cavity wall

Chart 2 is presentation of thermal transmittance U plotted against temperature difference on either side of wall in case of EPS insulated wall. From above graph it is observed that as the insulation width increases the U value decreases.

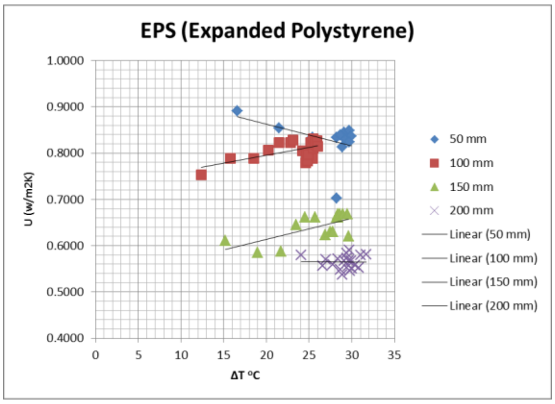

Chart -2: U values for different insulation width for EPS insulated composite wall

Chart 3 is presentation of thermal transmittance U plotted against temperature difference on either side of wall in case of Wheat Husk insulated wall. From above graph it is observed that as the insulation width increases the U value decreases.

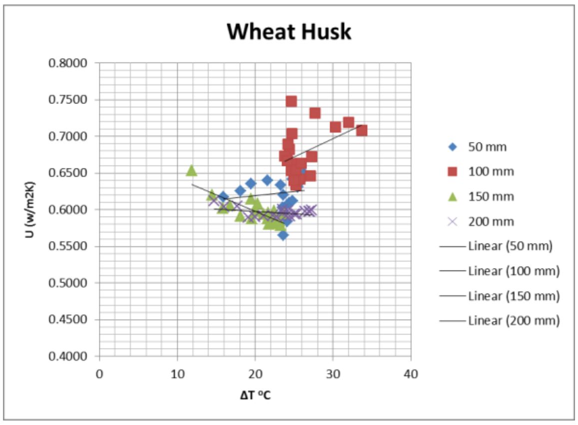

Chart -3: U values for different insulation width for wheat husk insulated composite wall

Chart 4 is presentation of thermal transmittance U plotted against temperature difference on either side of wall in case of Heatlon insulated wall. From above graph it is observed that as the insulation width increases the U value decreases.

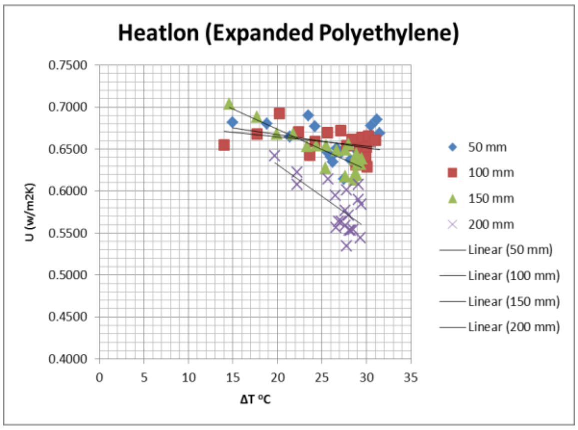

Chart -4: U values for different insulation width for EPE insulated composite wall

3. CONCLUSIONS

The thermal performance in terms of thermal transmittance using these materials are evaluated and analyzed as under:

1. Average U values (W/m^2K) of composite wall using air cavity of 50mm, 100mm, 150mm, 200mm are observed as 0.8120, 0.7643,0.6591, 0.5939 respectively.
2. Average U values (W/m^2K) of composite wall using Expanded PolyStyrene insulation of 50mm, 100mm, 150mm, 200mm are observed as 0.8294, 0.8064, 0.6408, 0.5648 respectively.
3. Average U values (W/m^2K) of composite wall using Wheat Husk insulation of 50mm, 100mm, 150mm, 200mm are observed as 0.6229, 0.6782, 0.5977, 0.5962 respectively.
4. Average U values (W/m^2K) of composite wall using Expanded PolyEthylene insulation of 50mm, 100mm, 150mm, 200mm are observed as 0.6575, 0.6577, 0.6462, 0.5797 respectively.

Finally it is concluded that the U value of composite wall using Expanded Polystyrene material with 200mm thickness is lowest and hence it is recommended for energy saving and energy conservation in building envelop.

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