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Design and Analysis of Concrete Building without Insulation and with Insulation using ANSYS 15 Software

Gowtham[1], Rajakumar[2]

[1]*PG scholar & Department of Mechanical Engineering, Anna University Regional Campus, Tirunelveli.*
[2]*Assistant Professor & Department of Mechanical Engineering, Anna University Regional Campus, Tirunelveli. Tamil Nadu, INDIA*

Abstract - *Concrete without insulation and with insulation panel cooling system has advantages of comfort and energy saving. This study presented heat transfer and cooling characteristics of the concrete roof panel with and without insulation. Heat transfer in the concrete without insulation and with insulation was simulated in software. Heat flux is applied to top of concrete without insulation and with insulation and which convective coefficient value is applied to bottom surface of concrete and temperature difference for the concrete without insulation and with insulation is determined. According to calculated results temperature distribution of concrete without insulation and with insulation was analyzed under variation of time in hours. The simulation models of concrete without insulation and with insulation were developed using ANSYS 15 APDL software.*

Key Words: with insulation, without insulation, Energy efficiency, concrete, temperatures.

1. INTRODUCTION

The building sector has the world's total energy consumption due to the increasing demand for buildings. Several attempts have been made to improve energy efficiency in the building sector. To reduce carbon emission energy efficient building is one of the energy saving method of the energy demand utilization. Energy consumption in buildings is getting more importance as it represents a high amount of the global energy consumption. In fact, the panels are used for the construction, especially in walls, roof and ceilings. Indeed the fibers are a naturals and renewable product with the thermo physical properties and chemical properties for the development of efficient insulating materials. It reduce energy consumption rate of the building and avoid environment effects. Energy is a basic requirement for the existence and development of human life. The building sector has the world's total energy consumption due to the increasing demand for buildings. Several attempts have been made to improve energy efficiency in the building sector. To enhancement of building materials thermal properties is great importance. To reduce carbon emission energy efficient building is one of the energy saving method of the energy demand utilization. Energy consumption in buildings is getting more importance as it represents a high amount of the global energy consumption. In fact, the panels are used for the construction, especially in walls, roof and ceilings. In order to energy consumption the present aims to enhance the thermo physical properties of the jute, sisal and flax fibers. Indeed the fibers are a naturals and renewable product with the thermo physical properties and chemical properties for the development of efficient insulating materials. It reduce energy consumption rate of the building and avoid environment effects. Low thermal conductivity of roof, wall and ceilings reduces the heat gain at a steady state condition. Therefore, high thermal insulation materials are commonly used in building material. The density, specific heat, thermal conductivity and latent heat of the building material also affect the heat gain rate of the building.

Roof is the structure located at top of a ceiling. It is surface that directly opposite the floor and the covering for roof which prevent thermal influx to the room there by preventing discomfort. The materials for roof are either natural insulation panel. The natural ones are originated from plant fiber such as sisal, flax, jute, plywood, cardboard etc. Nature will realize that the solution to human comfort is in understudying the origin such as the cooling system of gives comfort to users without the use of refrigerator. The building sector consumes about 57% of the total electric energy production in India. The air conditioning system of building about 60% of electrical energy consumed by the building sector. This suggests that about 34% of country's total electrical energy production is being consumed for air conditioning of building alone. The heat gains through the envelope surfaces constitute about 30% and 11% of roofs and 20% of walls of total power consumption air conditioning of the building. The solar energy absorbed by the external envelope of buildings produces the rise in their surface temperature by several degrees above the outdoor air temperature and also increase in heat flux incoming through them especially in summer. All of these effects can be mitigated by the use of cool roof materials characterized by the solar reflectance. Actually, when applied to the external surfaces of roofs in buildings, these materials limit the amount of solar irradiance absorbed by the roof and increase the rate of heat flux released by irradiation to the environmental, during night time and lower than external surface temperature. The benefits of application of cool material to a roof and in terms of reduction of internal surface temperature and varying the time depend upon the indoor air temperature and energy savings. Heat transfer

through roof is a mixed mode heat transfer phenomenon. The roof surface heat transfer exchanges mainly consist of the radiation component and convection component.

The insulation panel affects the radiation components by providing high solar reflectance and high thermal emittance. The insulation panel adds concrete to the heat conduction through roof which is coupled with the surface heat exchanges. Energy consumption in building accounts for a large proportions in the total energy use, and keeps increasing in recent years. In buildings, most energy is used for ventilation and air conditioning. The insulated panel energy conservation is thus critical to decreasing building energy consumption. In the recent years, researches on introducing insulation panels into the building envelopes have attracted an increasing interest. It has been proven that the insulation panels incorporated into the roof or other envelopes can function as reducing the indoor temperature fluctuation by improving the energy conservation of building application. In our previous reports, a composite natural fiber composed to insulation fiber panels (sisal, flax, jute) was prepared, and thermal performance of the low conductivity with panels fabricated of the insulation natural fiber at roof was investigated. It has been found that this material, epoxy resin and hardener with very low thermal conductivity, possessed both insulation property and heat storage capacity, showing great potentials in building applications. The investigation of building application to the natural fiber material in the building envelopes neglect the energy consumption originated from the variations on the temperature of air flowing into or out of building system. It has been revealed that the cold energy at night can be stored when the material at night and retracted from them to cool the building during at daytime.

2. DESIGN OF ENERGY EFFICIENT BUILDING

The building design is drawn in the solid works software. It was help to drawing required dimensions of the concrete design. First open the solid work software in windows 7 and then create the new file and select the geometry option. The selection option views click the building properties to be selected and the concrete property and insulation property will be selected. The dimension is selected meter option. The required dimensions use to create the concrete and flat roof is created. The merging options using to merge the concrete and roof.

Table -1: Dimensions of energy efficient building

SNO	CONCRETE WITHOUT INSULTION (METER)	CONCRETE WITH INSULTION 1 (METER)	CONCRETE WITH INSULTION 2 (METER)
THICKNESS	0.127	0.003	0.006
LENGTH	3	3	3

3. EXPERIMENTAL FABRICATION

Building roof is made up natural fiber and epoxy resin with hardener mixing to use. The building roof is fabricated and it is increasing the strength of the material. Sisal fibers are in form of 1m fiber mat. The sisal fiber mat of dimension 200mm*200mm was cut from fiber mat. The weight of all sisal fibers has been measured by using an electronic weight machine. Place the mould on the table and apply the wax on mould and resin on surface of the lower mould. Next place the first layer of sisal fiber and use the roller to squeeze the excess resin. Apply the resin over the first layer of sisal fiber and then place the second layer and again use the roller to squeeze the excess resin. Place the upper mould above it and close. A compression moulding machine is a kind of press which is oriented vertically with two moulding halves (top and bottom). Heat and pressure is applied as per the requirement of composite for a definite time and period. Curing of composite may carried out either at room temperature. After curing a mould is opened and composite product is removed for further processing. Repeat the above procedure with other fibers.

Fig -1: building roof mterials

a) Thermo physical properties of concrete and roof material

Thermo physical properties of the concrete and roof material used in work. The thermal conductivity of the roof materials is less than concrete and therefore the roof material act as insulator.

Material	Thermal conductivity W/(m K)
Concrete without insulation	1.4
Concrete with insulation (3mm)	0.07828
Concrete with insulation 6mm)	0.047

4. RESULT AND DISCUSSION

The graph was plotted time and roof temperature for without insulation, with insulation and thickness variation for roof material place on the flat roof of the building application. The graph shows temperature range at the top of the roof

increases as the thickness increases. The temperature initially increases till noon with respect to time and then decreases afternoon till sunset.

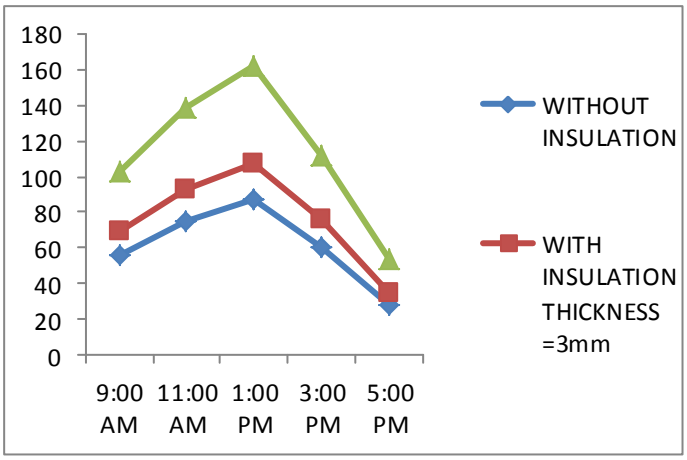

Chart -1: Time vs Roof temperature

The without insulation of flat roof building which analysis the room temperature and with insulation and thickness variation for roof material for building were analysis room temperature and time using plot of graph. The room temperature is lower when compare to roof temperature. The temperature range is lower for higher insulation thickness.

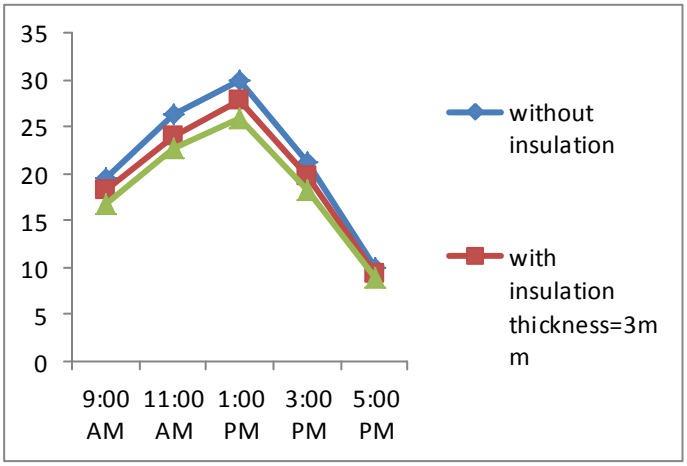

Chart -2: Time vs Room temperature

From graph the heat transfer is higher for building without insulation when compared to building with insulation.

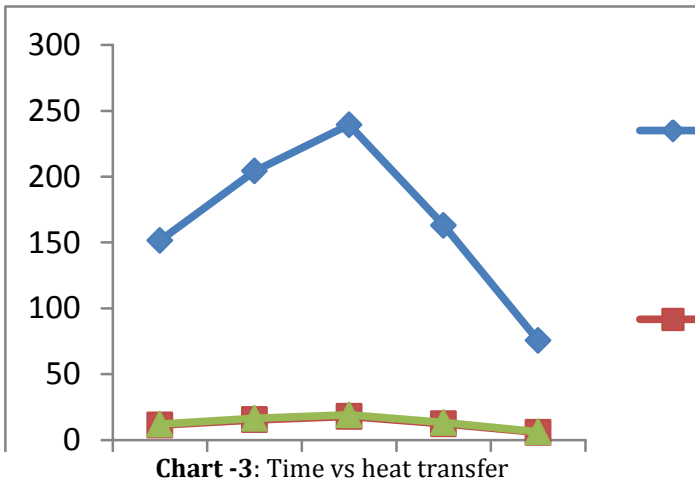

Chart -3: Time vs heat transfer

3. CONCLUSION

Energy efficient insulating materials contribute in reducing the heat losses from buildings and allow energy and money saving for heating and cooling. The thermal conductivity test has been conducted among three natural fiber materials and material with low thermal conductivity is selected. The simulation in ANSYS 15 is carried out by creating concrete model without insulation and with insulation thickness of 3mm and 6mm. Heat flux load is applied at top of concrete and air convection load is applied at bottom. The temperature difference between the top and bottom surface is obtained from the results of simulation. Theoretical calculation is done to determine the heat transfer through the concrete without insulation and with insulation. The heat transfer is low for concrete with insulation when compared to concrete without insulation with respect to time.

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BIOGRAPHIES

Gowtham. S, PG scholar, anna university regional campus, tirunelveli, tamilnadu, india.