Engineering and Technology Journal for Research and Innovation (ETJRI)
ISSN 2581-8678, Volume IV, Issue I, Jan 2022

Comparative Analysis of Suitable ways to Provide Thermal Comfort in a Building

Apoorv Verma[1], Retesh Singh[2], Prakhar Duggal[3], Ravinder Kumar Tomar[4]

[1] *Under-Graduate students, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida-201313, India, apoorv07jc@gmail.com*

[2] *Under-Graduate students, Amity School of Engineering and Technology, Amity University Uttar Pradesh,Noida-201313, India, reteshrs7@gmail.com*

[3] *Assistant Professor, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida-201313,India, pduggal@amity.edu*

[4] *Associate professor, Amity School of Engineering and Technology, Amity University Uttar Pradesh, Noida-201313,India, rktomar@amity.edu*

***Abstract*-An experiment is done by using PCM OM 37, with the intension of examining PCM"s impact over solid dividers and furthermore to discover what is best amount of PCM required to suit both thermal requirements and economic potential outcomes. It fuses the comparison between sample room consist of simple solid dividers and sample room whose dividers have been merged with PCM. The experiment was executed in the location of humid subtropical climate. The outcome of experiment shows that PCM has good sway on indoor Average temperature of room by decreasing indoor air temperature by 3.26 degree Celsius for 2% pcm used and 4.89 degree Celsius for 4% pcm used.**

***Keywords*- Thermal, temperature comfort, building, sensors.**

I. INTRODUCTION

In the recent times Phase change materials (PCMs) are being observed as quite successful where there it was needed to achieve warm comfort. PCM have the unique ability to absorb & relieve high amount of heat when they go into a transformation in their physical state i.e. solid to liquid and vice versa. PCM utilize the quality of storing energy to use it later when it is needed. At present we have enough research paper written on how PCM materials can be used to achieve thermal comfort. Such as experimental research of utilization of phase change materials (PCM) in the floor made of concrete with the intention of using it as store house of energy by sun by Entropy study on application of PCMs with light weight constructions with aim to give warm solace and energy utilization, here Phase change materials were fused in panels of the walls by Kuznik.

This work will consist of experimental comparison between sample rooms one with simple concrete walls while the other whose walls are incorporated with PCMs in different composition with goal of determining best composition of PCMs to make it more and more economic.

II. DEPICTION OF THE ROOMS

The rooms on which the whole experiment is conducted are constructed in an open area, so thermal energy of the sun can have a significant effect on the walls of the sample rooms for testing. The configuration of the sample rooms for testing are 1 m long, 1 m wide, 1 m height. The wall on one side or divider has the temperature sensor attached to it with a display which shows the inner temp of the sample room for testing. The rooftops were just a single unit of stone plates for each roof, keeping in mind the ancient buildings of India. The stone plates being used as roof are nearly 8.0 cm thick. The other walls are made of hollow bricks filled with PCM, 150 mm wide. Basically, the thermal change will happen between 8 am and 10 pm, although a

Engineering and Technology Journal for Research and Innovation (ETJRI)
ISSN 2581-8678, Volume IV, Issue I, Jan 2022

sensor installed in-side the rooms and a screen attached on the exterior walls displaying the internal temp. The configuration of the walls, floor and thermal characteristics of building material are given in Table 1.

Table 1. Configurations of the walls

Walls	Thickness (mm)	λ (W/m. °C)	ρ(kg/m^3)	*C* (J/kg. °C)
Cement mortar	20	1.4	2162	940
Hollow Brick	150	0.20	750	250
Plaster coating	15	1.2	1800	840
PCM OM37	30	0.16	973	1790

Table 2. Configurations of the roof

Roof	Thickness (mm)	λ (W/m. °C)	ρ(kg/m^3)	*C* (J/kg. °C)
Stone Plate	60	2.3	2000	1000
Plaster coating	15	1.2	1800	840

Table 3. Configurations of the floor

Floor	Thickness (mm)	λ (W/m. °C)	ρ(kg/m^3)	*C* (J/kg. °C)
Cement mortar	20	1.4	2162	940
Floor tile	10	1	2000	940

III. METHODOLOGY

In this trails there were three sample rooms each room of dimension 1m * 1m * 1m. Sample room A will constitute of simple concrete walls. Sample room B’s walls will incorporate PCMs (two percent of whole cement used in walls). Sample room C’s walls will incorporate PCMs (four percent of whole cement used in walls). With the aim to monitor the effect of these phase change materials on various rooms throughout the day, a mechanism was installed inside each room in a manner that inner temp of the room can be measured and noted from outside the room. Throughout the day readings of temperature of air inside each room is measuredin the interval of every five hours.

Fig. 1. Building up the Sample rooms with PCM embedded Bricks.

.Fig. 2. Image showing the masonry of the sample rooms

IV. RESULT & DISCUSSION

a. Evaluation of ambient temperature in summer

i. 1st Case (Two percent PCM to that ofcement installed in walls)

Fig. 3 represents the variation in the temperature of outside air, temperature inside the sample room A with simple concrete retaining walls and temperature inside sample room B which is made up of walls incorporating with two percent of OM37 PCM for the days (1st May to 7th May). The result we got out of trial resembles that the temp of air outside varies in the range of 25

Engineering and Technology Journal for Research and Innovation (ETJRI)
ISSN 2581-8678, Volume IV, Issue I, Jan 2022

degree Celsius to 38 degree Celsius, with Normal average temperature of 29.91 degree Celsius. Whereas temperature inside the sample room A (without PCM) ranges from 28.92 degree Celsius to 39 degree Celsius with average temperature of 33.64 degree Celsius which is more than that of temperature outside by 3.73 degrees. The foremost reason for this is overheating in summers. On the contrary the temperature inside sample testing room B which comprises of PCM incorporated walls shows lower temp in comparison to sample room A(without PCM). Temperature inside room B ranges from 26.12 degrees to 35.4 degrees, with average temperature of 30.38 degrees which is lower than average normal temp of room A (without PCM) by 3.26 degrees.

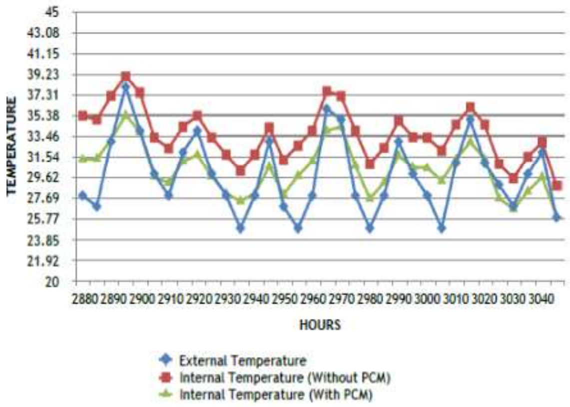

Fig. 3. Temperature reading in degree Celsius for 2% PCM used (1st may - 7th may)

ii. 2nd Case (Four percent PCM to that of cement installed in walls)

Fig. 4 represents the variation in the temperature of outside air, temperature inside the sample room A with simple concrete retaining walls and temperature inside sample room C which is made up of walls incorporating with four percent of OM37 PCM for the days (1st May to 7th May). The result we got out of trial resembles that the temp of air outside varies in the range of 25 degree Celsius to 38 degree Celsius, with normal average temperature of 29.91 degree Celsius. Whereas inner temp of the sample room A (without PCM) ranges from 28.92 degree Celsius to 39 degree Celsius with average temperature of 33.64 degree Celsius which is more than that of temperature outside by 3.73 degrees. This is a result of overheating in summers. On the contrary the internal temp of sample room C which comprises of PCM incorporated walls shows less temperature in comparison to sample room A (without PCM). Temperature inside room C ranges from 24.72 degree Celsius to 33.6 degree Celsius, with average temperature of 28.75 degree C which is 4.89 degrees, less than that of average temp of sample testing room A (without PCM) and hence even more comfortable than room B (With 2% of PCM).

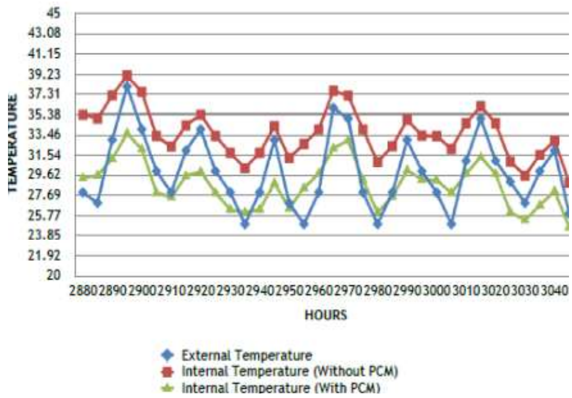

Fig. 4. Temperature reading in degree Celsius for 4% PCM used (1st may - 7th may).

V. CONCLUSION

The experiment was conducted to verify the temperature variance in an ambience made with the use of OM37 PCM used in different composition, on compared with ambience made with usual building materials. The graphs can easily predict the temperate variance between the different rooms. The normal contrast b/w the rooms with different composition are 3.26 degree Celsius (For 2% PCM) and 4.89 degree Celsius (For 4% Phase Change

Material) in the month of may summer 2021. Hence, as per research we can say that yes! the use of pcm must be done in construction as this will lead to the expanded warm solace or thermal comfort in a building ambience, which may lead to the energy preservation and less use of energy for the future of the world, where clean energy would be a huge demand.

REFERENCES

[1]. Kenisarin M, Mahkamov K. Passive thermal control in residential buildings using phase change materials. Renewable and Sustainable Energy Reviews 2016.

[2]. Zhu N , Liu P, Liu F, Hu P, Wu M. Energy performance of double shape-stabilized phase change materials wallboards in office building. Applied Thermal Engineering 2016.

[3]. Venkateswara, Rao; Parameshwaran, R; Vinayaka, Ram. PCM-mortar based construction *materials* for energy efficient *buildings*: A review onresearch trends 2018.

[4]. Ana Radivojevic, ljiljana Dukanovic. Material aspects of energy performance and thermal comfortin a building2018.

[5]. Mary Felix, Eslam Elsamahy. The Efficiency of Using Different Outer Wall Construction Materials to Achieve Thermal Comfort in Various Climatic Zones 2017

[6]. P.K. Latha, Y. Darshana, Vidhya Venugopal. Roleof Building material in thermal comfort.

[7]. Vahid Safari, Hossein Abolghasemi, Babak Kamkari. Thermal performance investigation ofconcentric and eccentric shell and tube heat exchanger with different fin configurations containing PCM material.

[8]. Sara Rostami, Masoud Afrand, Amin Shahsavar. A review of melting and freezing process of PCM and their application in energystorage.

[9]. Khaireldin Mohammed Khair Faraj, Mahmoud Khaled, Jalal Faraj, Cathy Castelain. But if you want fish and potatoes of term and I've just ordered in buildings heating on hybrid locations.

[10]. Ewelina Radomska, L. Mika, Karol Sztekler. The impact of additives on the main properties ofPhase Change material.