IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ENHANCING THE THERMAL PERFORMANCE OFBUILDING USING PHASE CHANGE MATERIALS

[1]Jessen M Reji, [2]Dr Sunila George

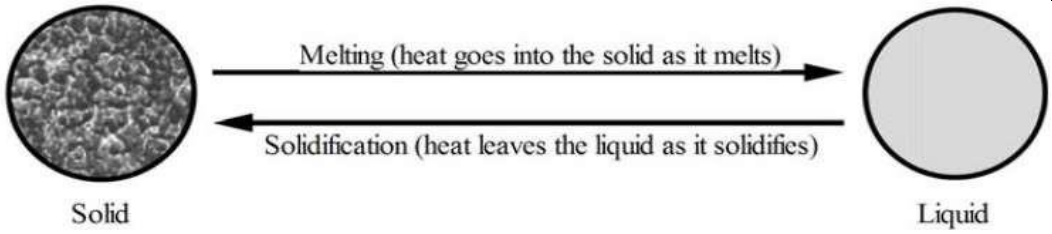
[1]PG Student, [2]Professor and Head of Department (Guide)
[1]ME Structural Engineering, Department of Civil Engineering,
EASA College of Engineering and Technology, Coimbatore, Tamilnadu, India
[2]ME Structural Engineering, Department of Civil Engineering,
EASA College of Engineering and Technology, Coimbatore, Tamilnadu, India

Abstract: When solar radiation reaches its peak value during the midday, building external wall absorb the highest amount of heat and result in dramatic increase in cooling load and energy consumption. This in turn affect the comfort of the inhabitants .This study is conducted with less energy consumption to flatten the energy peak, promote energy efficiency and preserve thermal comfort using Phase Change Materials (PCMs). Phase Change Materials (PCMs) are the materials that could initially resist the heat flow and beyond the fusion temperature it stores a large amount of energy in the form of heat at a constant temperature without any fluctuations or variations in the temperature. This property of the PCMs finds its usage in many fields conserving energy to a greater extent. The main consideration was made on the regulation ofinner temperature fluctuations along with the maximum energy of solar radiation that could be stored and retrieved later. This project aims to analyse the thermal performance of PCM in building components (brick wall and double glass panel). Using ANSYS THERMAL software the comparisons are made in terms of heat flux and temperature variations in the building components with and without PCM. It is found that the building components with PCM materials are well behaved comparatively than ordinary building component.

Index Terms **– Phase Changing Materials (PCM), Building Energy Simulations (BES), Heating Ventilation and Air Conditioning, Thermal Conductivity,Heat Resistance, Micro Encapsulation, MacroEncapsulation**

I. INTRODUCTION

Due to industrialization and increase in the vehicular traffic, there is a tremendous increase in the CO_2 emission all over the world which in turn increased the temperature inside the buidings. It is necessary to use technologies to search out the way to scale back the temperature of the buildings inside. Phase Change Materials (PCMs) or heat energy storage materials are suggested to be used together with the insulators w i t h in the building construction to scale back the inflow of warmth into the building. PCMs are theoretically ready to change state at constant temperature and thus store large quantities of temperature. Thus it stores an outsized amount of energy at a given temperature admire the temeperature of the PCM by the conversion of it phase.Its an oversized amount heat of transformation storage capacity .

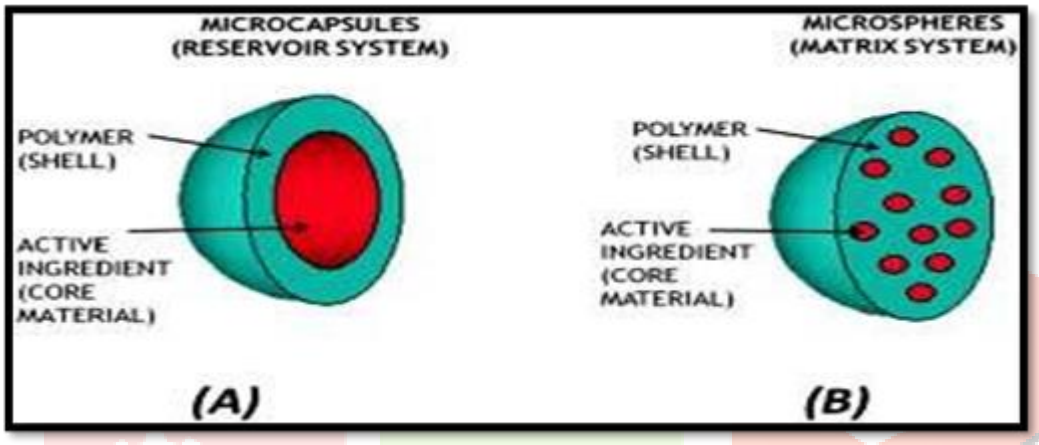


II. CLASSIFICATION

PCM can be incorporated into buildings using various methods such as microencapsulation, macro encapsulation, shape-stabilized PCM and impregnation of building material.

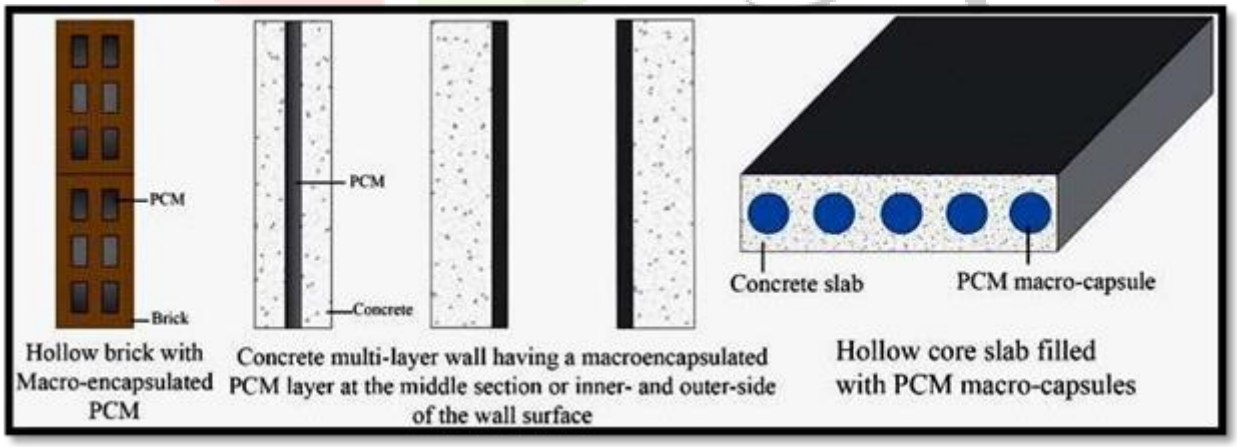
A. MICROENCAPSULATION

Microencapsulation is to enhance the integration capabilities of PCM into the building products. The PCM microcapsules are composed by polymer capsules with a diameter of micrometers and it can be done using reservoir system or matrix system asshown in fig 1.3.



B. MACROENCAPSULATION

Macroencapsulation comprises the inclusion of PCM in package or container such as tubes, pouches, spheres, panels, etc. The containers can act as heat exchangers and incorporate directly into the building in walls or hollow bricks or concrete slabs asshow in fig 1.4.



1.2 OBJECTIVE OF THE STUDY

The objective of the project is to

- To analyse the thermal performance in building components using Compositephase change materials (CPCMs).
- To compute the Heat flow, Heat flux and Thermal Gradient of PCM walls andGlazing of window panels using ANSYS Thermal software.

- To compute the heat storage capacity of PCM brick walls, glazing of windowpanels by solar indicator.

CLIMATIC CONDITION & THERMAL PERFORMANCE

The standard temperature data were obtained from the Indian meteorological department and also based on the Ministry of new and Renewable energy resources department design guidelines. The temperature criteria based on SP – 7:2005 was given under the table. The site location is considered as Chennai region where the temperature condition is warm and humid, according to the temperature criteria thermal variations are analysed using ANSYS THERMAL software

SUMMARY

In this chapter, I discussed about Climatic condition & thermal Performance Steady state heat flow, Thermal conductivity, Thermal resistance, Specific heat, Latent heat, Heat flux, Thermal gradient and Heat flow.

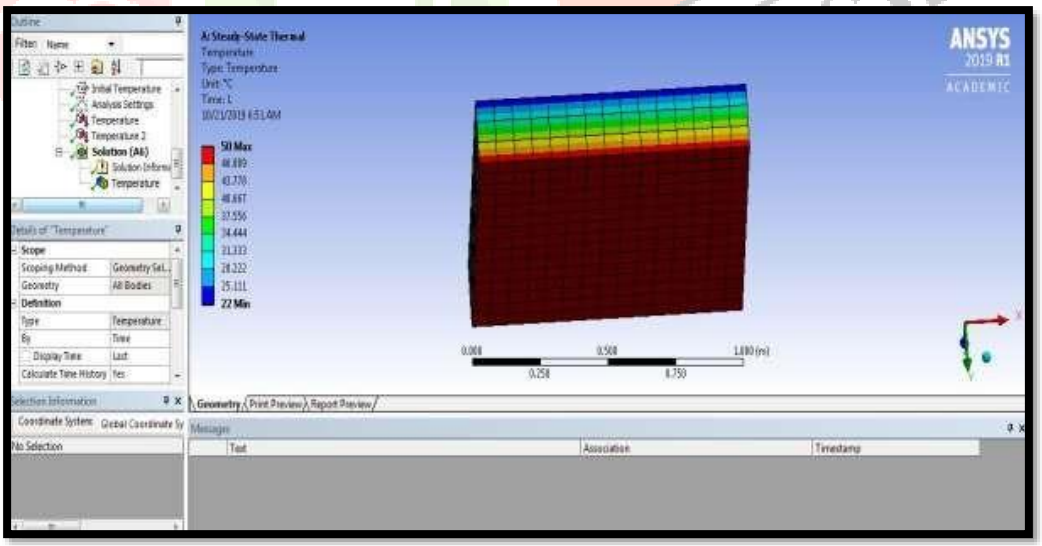
V ANALYTICAL INVESTIGATION

GENERAL

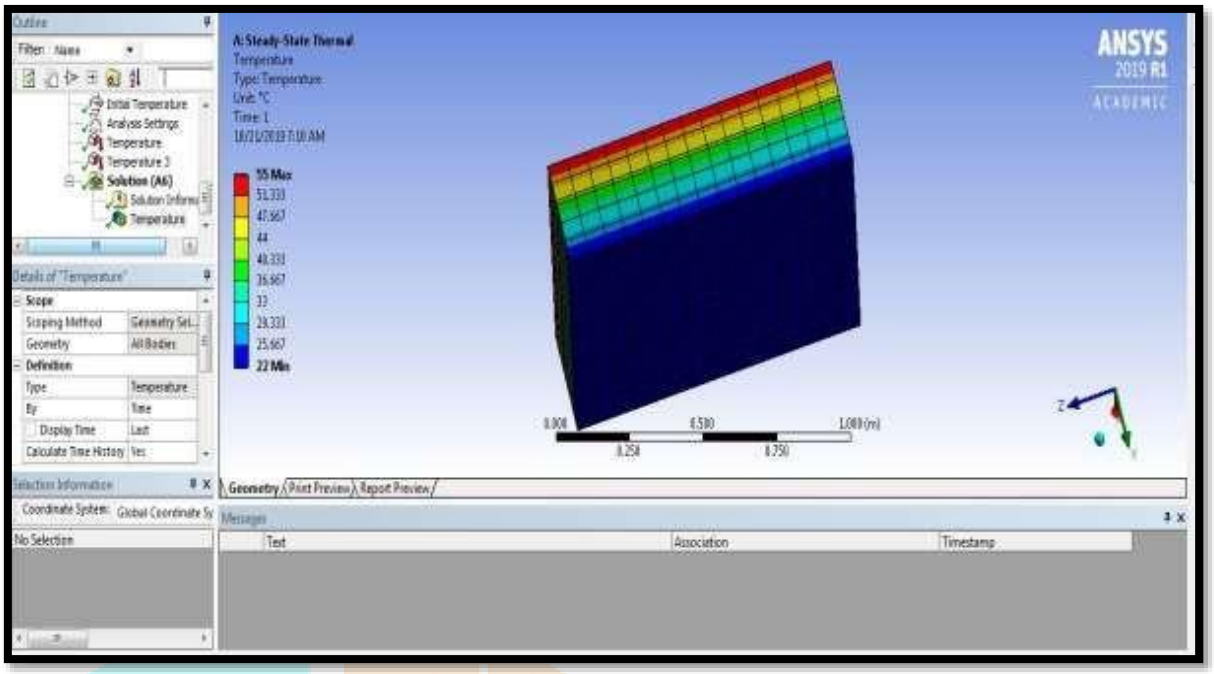
A solid boundary of a building is modelled with the help of ANSYS software and it is analysed with the help of ANSYS THERMAL software. The various constraints associated with the building model were given as input such that the simulation model created by this software should be accurate.

Case 1: Reference wall

- Wall type: Brick wall with mortar
- Dimension: 1m x 1m
- Thickness: 200mm
- Thermal conductivity: 0.77 W/m k

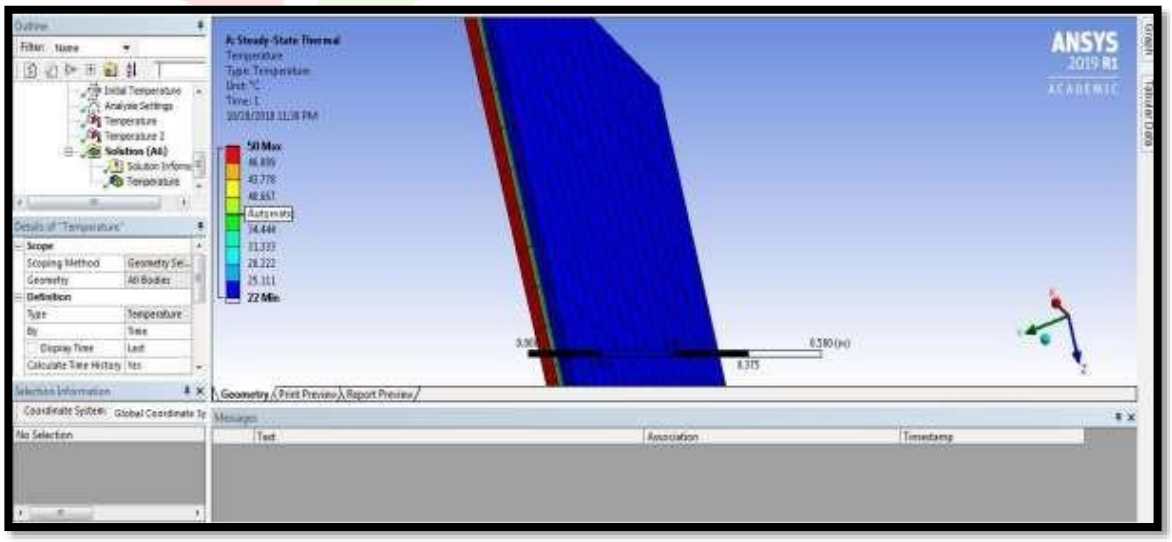


Case 2: Brick wall with PCM



- Wall type: Composite wall
- Dimension for brick wall: 1m x 1m
- Thickness of brick wall: 100mm
- Thermal conductivity for brick: 0.77 W/ m K
- Thermal conductivity for PCM: 0.2 W/ m K
- Thickness of PCM: 20mm

Case 3: Glass panel with air gap

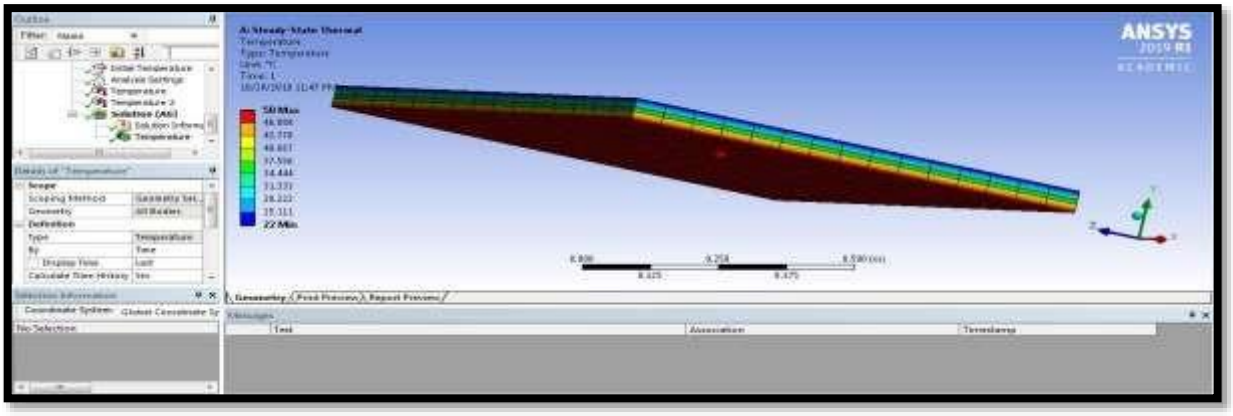


Double glass panel with air gap

- Dimension: 30 cm x 30 cm
- Thickness of the glass panel: 20mm
- Air gap: 10mm

- Thermal conductivity of glass: 1 W/m k

Case 4: Glass panel with PCM



- Double glass panel with PCM
- Dimension: 30 cm x 30 cm
- Thickness of the glass panel: 20mm
- Thickness of PCM: 10mm
- Thermal conductivity of glass: 1 W/m k
- Thermal conductivity for PCM: 0.2 W/

	Without PCM	With PCM
Brick wall		
i. Heat flux	3.478 x 10^{-2} W/m^2	2.40 x 10^{-2} W/m^2.
ii. Temperature variations	1ºC	3.5ºC
Double Glass Panel		
i. Heat flux	6.107 x 10^{-2} W/m^2	4.72 x 10^{-2} W/m^2
ii. Temperature variations	1.55ºC	3.77ºC

SUMMARY

In this chapter I discussed about Analytical modeling on brick wall and double glazed window panel in ANSYS software and heat flux was reduced by 69% in brick wall when compared from the reference wall to the wall with Phase Change Material. The heat flux was reduced by 77% in glass panel when compared from the reference wall to the wall with Phase Change Material.

VI MATERIAL INVESTIGATION

1. Porotherm bricks
2. Double glazing glass panel
3. Paraffin wax
4. Sodium sulphate
5. Infrared thermometer

SUMMARY

In this chapter I discussed about the experimental investigation which includes material procurement, test for the materials and model set up inside the college premises and with the help of infrared thermometer temperature variation was measured in the model setup in peak summer.

RESEARCH FINDING

- The PCM enhances more comfort in the building compared to ordinary brick wall.
- In analytical investigation is done for heat flux and temperature variations, it is also analysed for both brick wall and glass panel consists with and without PCM in ANSYS THERMAL software.
- In experimental investigation, the required material are produced, physical properties are tested and the model is in the college premises.
- From the model setup temperature variations are measured in the exterior and interior surface using Infrared thermometer. Readings are planned to take around peak of summer mostly in March, April and May to have more variations in temperature difference.

REFERENCES

1. Chengbin Zhang, Yongping Chen, Liangyu Wu, Mingheng Shi, "Thermal response of brick wall filled with phase change materials (PCM) underfluctuating outdoor temperatures", 2011.
2. Zhengguo Zhang, Xiaoming Fang, "Study on paraffin/expanded graphite composite phase change thermal energy storage material", 2014.
3. Changyu Yang Wu, "Effect of PCM thickness and melting temperature on thermal performance of double glazing units", 2017.
4. J.E. Braun, K.W. Montogomery, N. Chaturvedi, "Evaluating the performance of building thermal mass control strategies", 2001, page no: 403-428.
5. Lavinia Gabriela, "Thermal Energy Storage with Phase Change Material, Leonardo Electronic Journal of Practices and Technologies", ISSN 1583-1078, Issue 20, June 2012, page no: 75-98.
6. Atul Sharma, V.V. Tyagi, C.R. Chen, D. Buddhi, "Review on thermal energy storage with phase change materials and applications", Elsevier Ltd., October 2007.
7. Lifang Liua, Jiayu Chenb, Yue Qua, Tao Xu, "A foamed cement blocks with paraffin/expanded graphite composite phase change solar thermal absorption material", Elsevier, 2019.
8. Romeu Vincente and Tiago Silva, "Brick masonry walls with PCM macrocapsules: An experimental approach",2014.
9. Alvaro de Gracia and Lusia F Cabeza, "Phase change materials and thermal energy storage for buildings",2015, page no: 414-419.
10. P.Schossig, H.M. Henning, S.Gschwander, T.Haussmann, "Micro-encapsulated phase-change materials integrated into construction materials", 2005.
11. Kecheng Zhong, Shuhong Li, Gaofeng Sun, Shanshan Li, Xiaosong Zhang, "Simulation study on dynamic heat transfer performance of PCM-filled glass window with different thermophysical parameters of phase change materials", 2015.

    Tyagi VV, Kaushik SC, Tyagi SK, Akiyama T. Development of phase change materials based microencapsulated technology for buildings: a review. Renew Sustain Energy Rev2011;15:1373–91.
12. Yeliz Konuklu, Milan Ostry, Halime O. Paksoy, Pavel Charvat, Review on using microencapsulated phase change materials (PCM) in building applications, , Energy and Buildings 106 (2015) 134–155.
13. F. Kuznik, D. David, K. Johannes, J.-J. Roux, A review on phase change materials integrated in building walls, Renew. Sustain. Energy Rev. 15 (1)(2011) 379–391.
14. C. Castellón, M. Medrano, J. Roca, L.F. Cabeza, M.E. Navarro, A.I. Fernández, B.Zalba, Effect of microencapsulated phase change material insandwich