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# "TRANSIENT THERMAL ANALYSIS ON BUILDING WALL BY USING COMPUTATIONAL TESTING METHOD"

***Suraj Dattatray Chepurwar [1], Prof. Dharmendra Singh [2]***

[1] M.Tech. Scholar, Department of Mechanical Engineering, University Institute Of Technology, Rabindra Nath Tagore University, Bhopal (M.P.), India

[2] Professor, Department of Mechanical Engineering, University Institute Of Technology, Rabindra Nath Tagore University, Bhopal (M.P.), India

## ABSTRACT

***Wall heating is an alternative method for residential heating that is used in a limited part of India. The goal of this study was to show the feasibility of this method for the Indore market and to provide a comprehensive picture of wall heating and its functionality compared to traditional methods, i.e. radiators and floor heating. In this study CAD 2D & 3D Model create on Solidwork software and simulation is performed in ANSYS 19.2 . here thermal transient analysis has performed. Here two case are consider case I and case II . In case I here simple wall used with concrete and mortar materials and case II here PU material fill insulated wall used with concrete and mortar materials. So this computational testing help find out that Case II is better than case I . because case I temperature inside wall 38 °C. case II temperature inside wall is 28°C so overall temperature is come in room and building is reduce 73%.***

***Key Words:*** *CAD, Solidwork, Thermal transient analysis , Building , Temperature.*

## I. INTRODUCTION

As buildings are highly energy consumers [1], building energy simulation tools have been developed since the seventies aiming at improving their energy efficiency. Many tools have been reported in [2-4] and several research work focusing on energy efficiency of building envelopes can be found in the literature as in [5-13]. Wall parameters such as thermal resistance and thermal inertia are commonly investigated such as in [4-6] or thermal conductivity in [7]. Many studies are also focused on determining the optimum insulation thickness of different wall configurations [8–13]. Nevertheless, most of BES tools use purely diffusive 1-D formulation, including walls built with elements that have cavities. The purely diffusive 1-D formulation neglects important phenomena relating to heat transfer and fluid mechanics. Heat transfer phenomena that occur inside cavities are erroneously simplified. The present study investigates errors this assumption causes by developing a cosimulation using a BES and a CFD program, and comparing the results of three case studies. The main objective of the present work is to investigate the effects of considering cavity detailing with correct mass distribution, convection and radiation phenomena in the interior of walls on the results of transient simulations of the building scale. The methodology presented has the potential to increase precision in energy analysis of buildings and analysing the performance of constructive elements. To achieve the objectives, three case studies are configured, with an increasing degree of complexity in both the construction of the wall and the boundary conditions, from a model of two superimposed blocks to a ventilated wall model with short wave radiation asymmetry, as detailed in the methodology section. The simulations are transient, at the scale of a building, by means of two simulation methods: i) Traditional, 1-D, purely diffusive method where the

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layer containing elements with cavities is represented by three equivalent thermal properties; and ii) New 3-D co-simulation method using BES and CFD programs where the elements are physically modelled in more detail. The coupling of the two programs provides a refined and more realistic three-dimensional analysis of the phenomena inside the wall. The development of the cosimulation method using the BES and CFD programs was part of the present work. In a different way, the present work uses the coupling between the two programs to detail the interior of the wall. However, there have been developmental and experimental validations of coupling methodologies between these two types of formulations since 1998, such as Negrão [14], Zhai and Chen [15, 16, 17 and 18], Bartak et al. [19], Djunaedy et al. [20] and Wang and Wong [21]. The coupling between these two types of software is interesting because they complement each other.Globally, shelter remains one of the top priorities for government of nations. This is so not just in light of the fact that, structures are expected to safeguard lives, yet additionally individuals need to rest in the wake of a monotonous days' work. Besides, structures are expected to give space to keeping the acquisitions (family properties) of people. Hence, cover is a very improtant necessity with which to settle individuals in any climate. Notwithstanding, for any structure to be viable for use by people, the indoor warm circumstances should be palatable.

By and by, the primary variable that is thought about while working in the created world is how much solace a proposed building will have on individuals who are to stay in that, and with such solace not understood utilizing extra expense with energy. Hence, structures are planned so that, solace is offered greatest consideration, prior to thinking about the stylish attributes of the structure. In such climes, the meteorological circumstances and other natural variables are thought about while planning structures. Specialists prepared in the ability of building, and deciphering plans are utilized from the plan stage to the translation, through the finishing. As such the warm states of structures in the created world are endured by the occupants [6] [7].

In the creating scene, the case isn't something very similar. Building plans are acquired from very surprising environments and worked here. People who have no ability in building development are contracted to fabricate houses, just to turn away expense. Thus, structures are not as expected thoroughly considered and by suggestion affecting the indoor temperature qualities. Essentially, most confidential financial backers are in the land business to create gain, not lining what the ramifications of their activities would be for the people that will lease or rent such structures. This has not been assisted by the land with leasing which is so high in metropolitan communities of the creating scene, which keeps on constraining the land proprietors to augment the land space they have for building. The circumstance in Yenagoa appropriately squeezes into the above expressed issues. Moreso, monetary thought for the most part restricts the kind of structure, financial thought generally decides the sort of structures that are fabricated instead of, the solace that such structures should create for the tenants. Also, structures are not worked by guidelines, and where they are worked to standard, the expense to lease them is normally too high to even consider bearing. The ramifications is that individuals are compelled to abide in structures that they usually will not occupy. Aside from stress, medical conditions likewise radiate from warm uneasiness. A few examinations have taken a gander at the indoor and outside warm solace conditions in the past [7] - [17] yet none to the best of the information on the scientists, have taken a gander at the wellbeing impact of warm solace for building tenants.

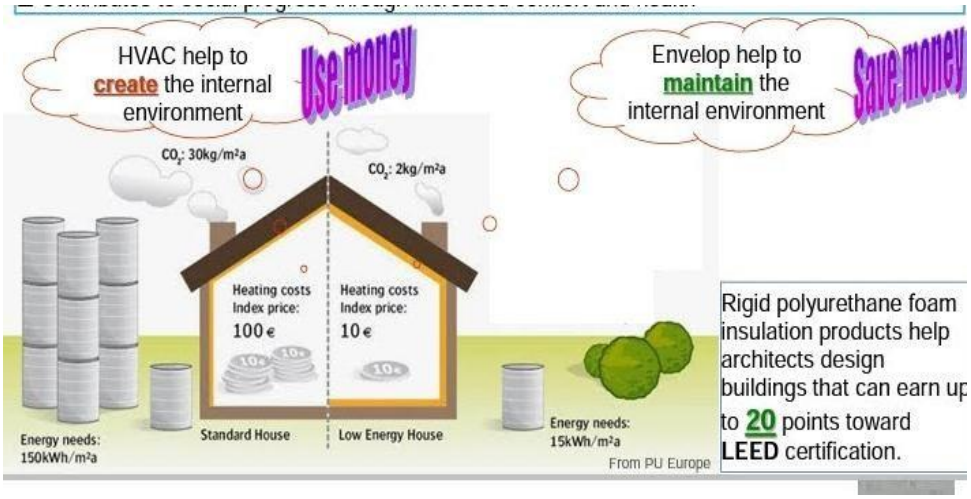


**Fig. 1.1 energy house detail photo**

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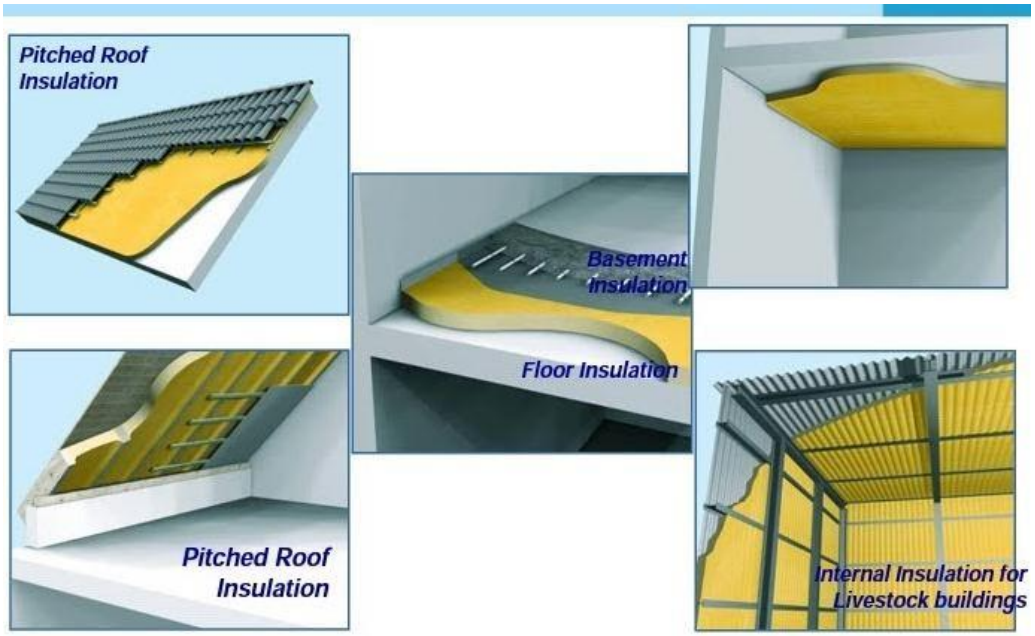


**Fig. 1.2 Internal insulation with new PU materials**

## II. RESEARCH METHODOLOGY

Transient simulations in both softwares occur simultaneously over the same period for calculating heat transfers through the wall and energy balances in the environment. BES (Domus) has a dynamic model for the analysis of building energy performance. The heat transfer on each wall is calculated by finite differences in 3-D analysis; however, in the coupled method, the threedimensional velocity and temperature fields are calculated at each time step by the CFD software (Ansys-thermal transient).

**Case I:** The outdoor temperature varies sinusoidally with a period of one day. The chosen sinusoidal function represents the winter temperatures of the southern Brazilian region. The external surface of the wall under analysis receives radiation, which includes direct and diffuse radiation. In summer season temperature 47 C is considered in may 2022 at Indore. In this way, the boundary conditions take on the natural behaviour of a day. Therefore, there is a cold night and a sunny day, causing inward and outward heat fluxes. The wall in analysis is constructed with concrete blocks of dimensions of 3048(L) x 3048 (W) x 3048 mm (H), assembled with mortar and containing plaster in both sides, as shown in Figure 1. It shows the enhanced concrete block studied by [22]. One 4" inches bricks wall with both sides cement mortar plaster are used in the workbench assembling and the results found are considered for the entire wall.

**Case II :** In this case, The outdoor temperature varies sinusoidally with a period of one day. The chosen sinusoidal function represents the winter temperatures of the southern Brazilian region. The external surface of the wall under analysis receives radiation, which includes direct and diffuse radiation. In summer season temperature 47 C is considered in may 2022 at Indore. In this way, the boundary conditions take on the natural behaviour of a day. Therefore, there is a cold night and a sunny day, causing inward and outward heat fluxes. The wall in analysis is constructed with bricks wall of dimensions of 3048(L) x 3048 (W) x 3048 mm (H), assembled with mortar and containing plaster in both sides, as shown in Figure 1. It shows the enhanced concrete block studied by [22]. One 4" inches bricks wall and Polyurethane material 50mm and with both sides cement mortar plaster 25 mm are used in the workbench assembling and the results found are considered for the entire wall. According to the time of day, strikes totally or partially on, or does not reach the wall.

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**Fig 2.2 PU material**

## III. MODELING & SIMULATION

**CASE I**

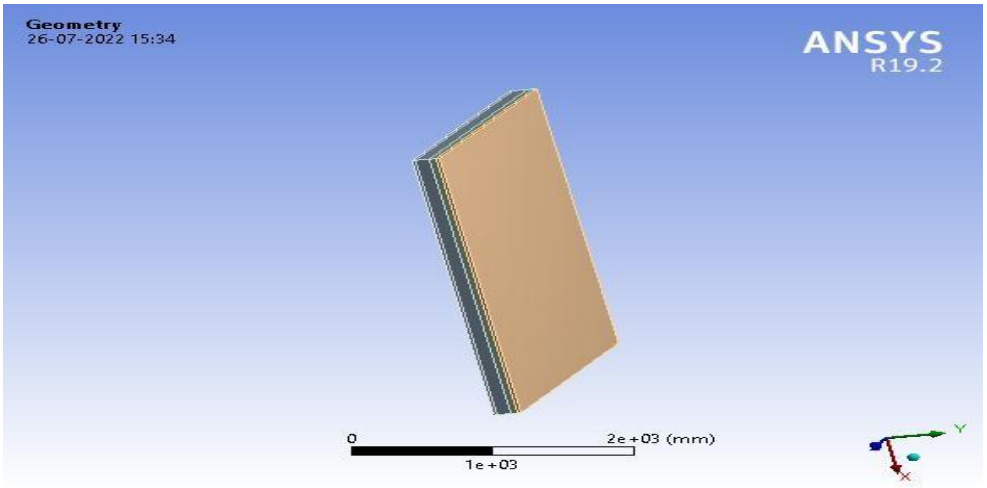


**Fig.3.1 Cement mortar wall without coating**

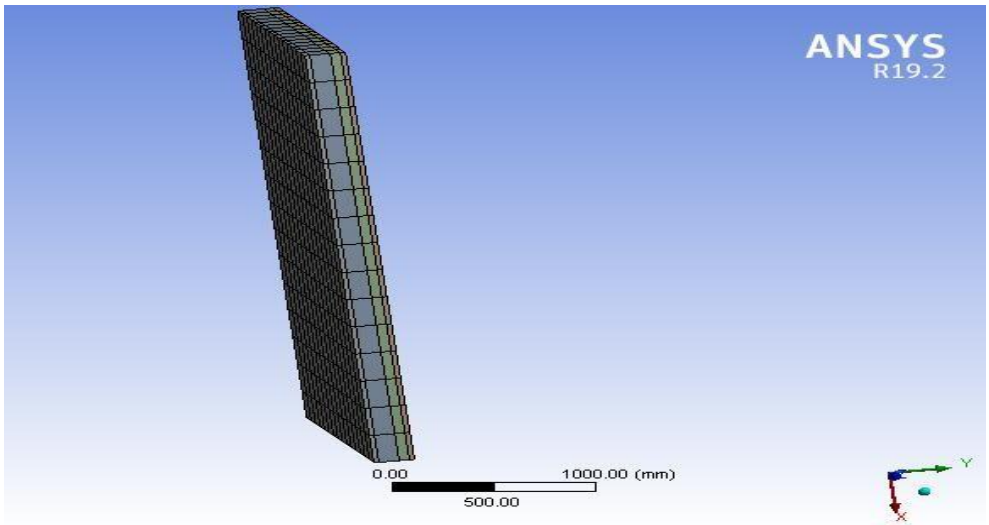


**Fig 3.2 Meshing of wall Nodes: 6912, Elements: 900**

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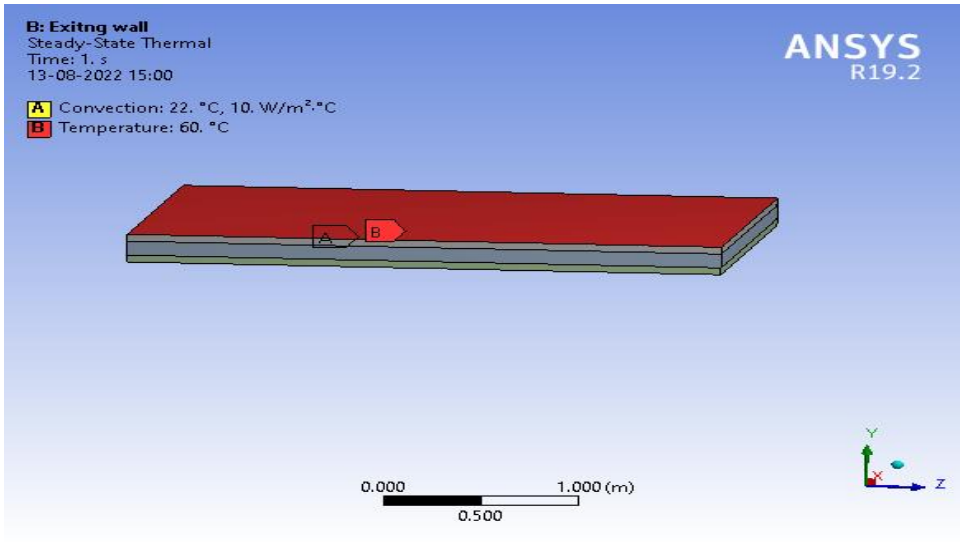


**Fig 3.3 Wall outer surface temperature 60 $^0$C**

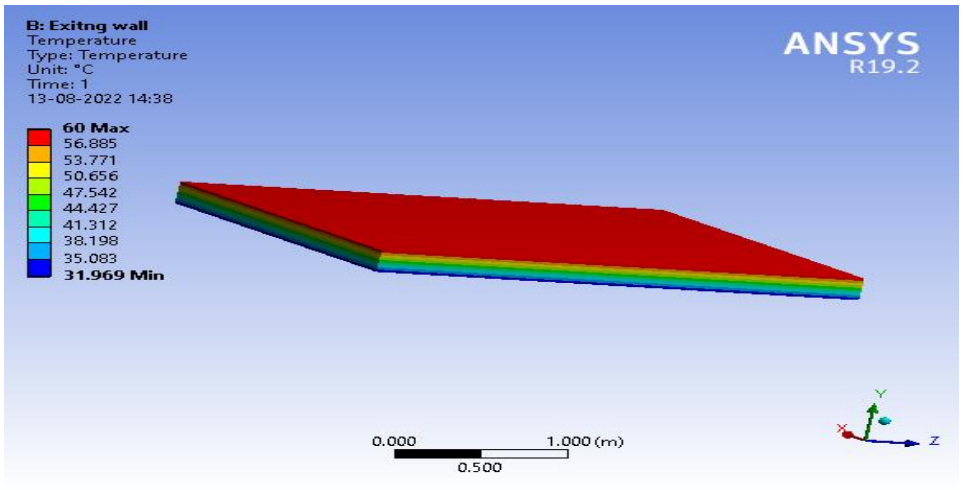


**Fig 3.4 vertical wall view inner surface temperature results 31.59 $^0$ C**

**Case II**

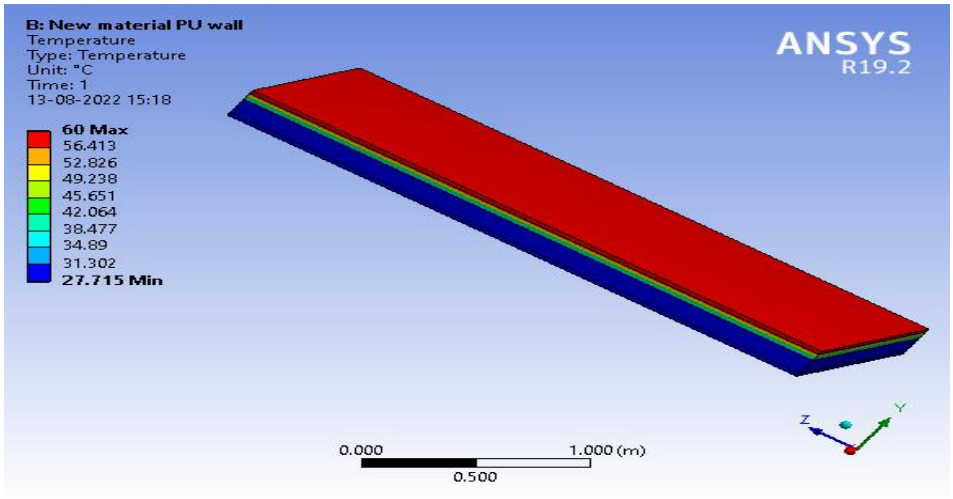


**Fig 3.5 Other view Wall inner surface temperature results 27.7$^0$C**

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## IV. RESULTS

In this study work on wall heating issue, so data of check for temperature in summer day in Indore is approx. 45 °C but at building roof and wall surface temperature is 68°C to 75°C variation due to climate condition ,But Here used 3D model concrete polyurethane bricks concrete then inner temperature of roof and wall is 35°C to 45°C . and here case I temperature inner wall find 31.9 °C and case II temperature inner wall is 27.7°C find. so overall temperature is come in room and building is reduce 4.2 $^0$C.

In this study CAD 2D & 3D Model create on Solidwork software and simulation is performed in ANSYS 19.2 . here thermal transient analysis has performed.

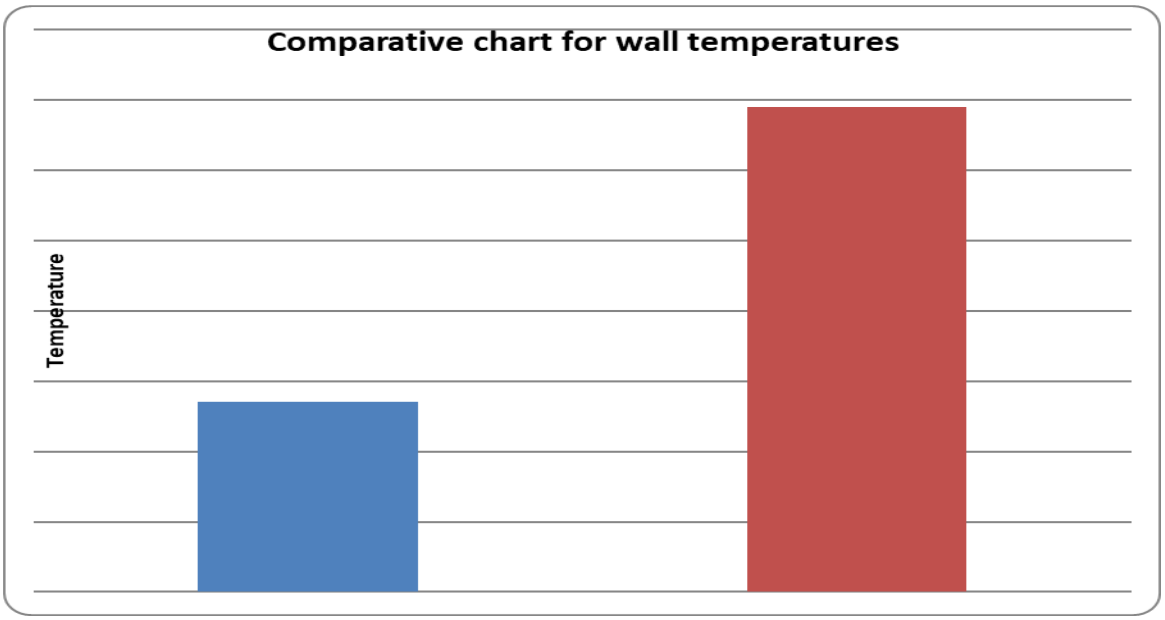


Fig.4.1 Comparative chart for wall temperatures

## V. CONCLUSION

In this study CAD 2D & 3D Model create on Solidwork software and simulation is performed in ANSYS 19.2 . herethermal transient analysis has performed. Here two case are consider case I and case II . In case I here simple wall used with concrete and mortar materials and case II here PU material fill insulated wall used with concrete and mortar materials. So this computational testing help find out that Case II is better than case I . because here case I temperature inner wall find 31.9 °C and case II temperature inner wall is 27.7°C find. so overall temperature is come in room and building is reduce 4.2$^0$C

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