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MAINTANING THE COMFORT TEMPERATURE OF ROOM– A REVIEW

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Abstract— the energy consumption and conservation is an increasing important factors for the residential or offices building. The use of thermal insulation effects on the thermal performance of external walls which increases the thermal efficiency. Thermal insulation is very useful way to reduce the energy consumption in both winter and summer cooling. Modification in building design is also very helpful for reducing energy consumption. The selection of suitable materials, its position and thickness an important role for proper indoor thermal comfort. In present days to achieve maximum benefit of thermal insulation new composite materials are used and their testing with room walls with finite element methods.

Keywords— Composite materials, Thermal efficiency, Energy conservation, Finite element method, Thermal insulation

I. INTRODUCTION

The ambient temperature is increasing globally leading to increase in energy consumption for maintaining comfort levels in homes and offices. In developing countries cost of energy is very high and resources of energy production are limited. Consumption of energy is increasing in residential and commercial buildings by an average of 1.5% and 20.1% respectively by year in 2016[1]. The most common methods controlling room temperature is to use thermal insulation material. Thermal insulation may be external or internal or may be both types depending on ambient is conditions. External thermal insulation is effective for hot climate surrounding and internal thermal insulation is effective for cold climate countries [2]. The effect of ambient temperature on room temperature may also be reduced by incorporating modification in building design. Room temperature may also be controlled by using phase changing materials without increasing energy consumption [3]. Comfortable room temperature may also be maintained by using renewable solar energy as thermal energy storage (TES) which is absorbing and releasing thermal energy in form of heat as storage medium [4]. In the present work a review of technique used for maintaining comfortable room temperature is presented. The modeling and simulation plays an important role in selecting the methods of insulating the building from very high and very low ambient temperature. The present work is also includes review the modeling and simulation of thermal conductivity of insulating materials.

II. MODIFICATION IN THE ROOM DESIGN AND ADDING INSULATION TO REDUCE THE EFFECT OF SOLAR ENERGY

In the hot atmosphere nations, where sun powered vitality is higher, sunlight based radiation speaks to the most significant factor of cooling load in the structure. Decide the impact of size and introduction of the window on the temperature circulation [7]. The estimation of sun based radiation entering the structure through windows characterizes the vitality utilizations for cooling in the building [8] Analysis is performed on the diverse size of window territories. Which demonstrates the warm execution of the rooms amid the night was around equivalent toward all path of the window, expanding the window estimate caused an expansion in the warmth exchange rates all through the body of the air. Most extreme Indian solid structures have 150 mm thick fortified bond concrete (RCC) with Enduring Course (WC) having 75– 100 mm thick lime block mortar. Warmth transmitted through these rooftops represent about 40– 75% of all out warmth. It represents the real part of power bill in cooled structures. Another idea wherein empty dirt tiles (HCT) are laid over RCC instead of WC, has been proposed. The transient warmth transmission crosswise over different kinds of rooftop structures for normal Indian climatic conditions has been contemplated. The vitality investment funds acquired with the utilization of HCT rooftop is observed to be 38– 63% when contrasted and conventional WC roof. At the point when air is permitted to move through the empty entries, the wind current is found to deal with all varieties in the outside atmosphere and sunlight based radiation [9]. Increment of warm protection of existing structures is decreased structure vitality utilization for warming and cooling. Amid break down a run of the mill inner protection framework made of steel studs fixed to the divider with mediated protection layers secured by plasterboard. Utilizing already obtained experimental estimations of the warmth motion at the focal point of protection and on steel studs; the validation of a three-dimensional numerical model and a parametric examination has been done. The numerical model has been utilized to register a mean conductance of the divider demonstrating that dismissing the steel stud prompts the underestimation of divider conductance by around 20 percent. A precise numerical re-enactment has been carried on so as to reproduce the genuine execution of an inward protection framework for outer dividers in authentic structures. Usually practice by architects to represent the protection impact considering the protection boards. Utilizing numerical recreation an affectability investigation has been led to recognize the marvels and numerical models that can influence the re-enactment. The affectability investigation uncovered that the long wave radiation inside stud's cavity is the fundamental

parameter to be considered. The air development inside the studs came about an auxiliary impact, which does not alter the general warmth exchange attributes of the protection framework [10]. In present day building materials to settle indoor temperature variances for improving warm solace utilized Stage Change Materials (PCMs) have incredible potential which improve warm solace without expanding vitality utilization. Portray and measure the execution of PCMs in present day building applications under various conditions. The uncommon consideration given to natural PCMs, for example, paraffin, because of their great properties, for example, low value, synthetic dependability, non- corrosiveness, and high inert warmth emanation. PCM is a powerful substitute to customary cooling frameworks. PCM, which is a functional utilization of the LHS idea, can thereby go about as a brilliant material to control the indoor temperature of a structure. The centrality of PCM is clear when it is joined with light- weight structures on the ground that, with its significant vitality stockpiling thickness, can envision high temperature changes in day- time and equalization out temperatures in the appropriate solace go [11].

III. NEW MATERIAL AND COMPOSITE

For improving the warm execution of a room or make it increasingly disengaged new sorts of materials are presents. Composite materials are likewise utilized for better outcomes. Also it is important to examine the thermal properties of polymer composites made out of graphene foam (GF), graphene sheets (GSs) and malleable polydimethylsiloxane (PDMS). The outcomes were the thermal conductivity of GF/PDMS composite achieves 0.56 W/m*K, which is about 300% that of unadulterated PDMS, and 20% higher than that of GS/PDMS composite with the equivalent graphene stacking of 0.7 wt%. Its coefficient of thermal expansion is (80-137) × 10-6/K inside 25-150^{o}C, much lower than those of GS/PDMS composite and unadulterated PDMS [12]. It explored the impact of carbon fibre (CF) on the mechanical and thermal properties with the Graphene foam (GF)/polydimethylsiloxane. In this investigation the CFs with various weight rates (2, 4, 6, 8 and 10 wt %) were altogether scattered in the PDMS framework utilizing a fast shearing and mixing strategy and afterward the GF was loaded up with the blend. The CF/GF/PDMS composites were portrayed as far as microstructure, mechanical and thermal properties utilizing different testing strategies. The outcomes uncover that the expansion of CF noticeably improved the mechanical and thermal properties of GF/PDMS composites. For 10 wt% CF/GF/PDMS composite, the rigidity and Young's modulus are expanded by 52% and 71% separately contrasted and GF/PDMS composite. Likewise, its thermal conductivity achieves 0.55 W/m*K, i.e., an expansion by about 41% and 162% contrasted with GF/PDMS composite and unadulterated PDMS, individually [13]. Thermal limited component examination of cell aluminium with non-uniform pore structures is finding by finite element model (FEM). In this FEM were created with registered tomography pictures. A lattice calculation was utilized where each limited component relates to CT voxels. FEM thermal examination of closed cell alporas aluminium froth and open cell M-Pore aluminium wipe was done deciding the compelling thermal conductivities of these materials in three opposite ways so as to research the anisotropic properties of the two structures. The viable thermal conductivities have been considered for the three opposite bearings in each sub-volume finding a significant anisotropy if there should arise an occurrence of M-pore examples however isotropic conduct for alporas type froths. The result finished up the presence of nearby dissipating of the powerful thermal conductivity related commonly to neighbourhood meso in homogeneities and low sub-volumes estimate registered [14]. Electronic things are broadly utilized in homes and workplaces which is additionally delivering warmth. The thermal administration is basic to the execution, life time, and unwavering quality of electronic gadgets. With the scaling down, mix and working of gadgets and the rise of new applications, for example, light radiating diodes; thermal dispersal turns into a difficult issue. Tending to this test requires the improvement of novel polymer-based composite materials with upgraded thermal conductivity [15].

IV. FEA METHODS USED TO FIND THE THERMAL CONDUCTIVITY OF MATERIAL

Numerous sorts of strategies are utilized to locate the thermal conductivity of the materials which are relying on the kind of materials is explored. There are FEA technique are utilized to descried for finding the thermal conductivity of the material and its impact on stay with appropriate temperature. In this paper some writing is likewise on utilization of FEA. Limited Component Technique (FEM) with ANSYS programming is utilized for recreation of the heat transfer process in Empty Glass-Dab (HGB) filled polymer composites. FEA is utilized to distinguish the impacts of the substance and size of the HGB on the successful thermal conductivity (k_{eff}). The successful thermal conductivity was evaluated at temperatures shifting from 25 to 30^{0}C. In FEA the outcomes demonstrated that the simulated k_{eff} diminished directly with increment of the volume division ($Ø_f$) of the fillers, and afterward decreased to some degree with expanding filler estimate. Besides, the reproduced k_{eff} by the three-dimensional model was higher than that by the two-dimensional model. The re-enactments were contrasted and the deliberate k_{eff} from trials and found that reproductions were genuinely near the deliberate k_{eff}. Polymer/empty small scale circle composite is a ternary framework, and the heat exchange process for the most part includes three different ways are thermal conduction through solid and gas, thermal radiation between empty miniaturized scale circle surfaces, and characteristic convection of gas in empty smaller scale circle [16]. Thermal physical property of empty silica circles was contemplated by the exploratory test 3ω strategy, hypothetical count and limited component recreation. The test estimations of the thermal conductivity, under 0.02 W/m*K, demonstrated that the powder silica empty circles are without a doubt the high productive heat protecting materials. The impacts of the molecule size and pressing thickness on the thermal conductivity were watched. The inside measurement and thickness are entombing subordinate parameters influencing the thermal conductivity of the silica empty circles. At

that point the recipe translating air gels were utilized to compute the thermal conductivity of empty silica circles. The determined qualities were bigger than the exploratory ones. In addition, ANSYS programming was connected to build up a heat conduction model for these sort materials dependent on their empty structure highlights. The re-enacted qualities were near that of air. In spite of the fact that the reproduced qualities than the exploratory and determined ones, the limited component model can mirror the tiny attributes of heat exchange through the empty circles. The powder silica empty circles materials are the high productive separators, which are utilized in air space and common structures fields [17].

V. CONCLUSION

Modification in room or building material and adding thermal insulations are useful to maintain comfortable room temperature. It adds extra cost at initial stage but results in reducing energy consumption, thereby reducing the recurring cost. It has been reported that for cold environment internal thermal insulation material such as mineral wool, Phenol formaldehyde etc. result in batter control of room temperature. For hot environment external thermal insulation material such as polyurethane rigid penal, silica aerogel etc. and phase changing material such as salt, salt hydrates, paraffin are better options for controlling the room temperature. Also it has been reported that modeling and simulation plays an important role in selecting effective insulating materials for maintaining comfortable room temperature.

REFERENCES

[1] U.S. Energy Information Administration, International energy outlook; 2016. ⟨www.eia.gov/forecasts/ieo/pdf/0484 (2016).pdf⟩.
[2] Zhang, X., & Cheng, F. (2019), "Comparative assessment of external and internal thermal insulation for energy conservation of intermittently air-conditioned buildings" *Journal of Building Physics*, *42*(4), 568-584.
[3] Abuelnuor, A. A., Omara, A. A., Saqr, K. M., & Elhag, I. H. (2018), "Improving indoor thermal comfort by using phase change materials: A review, *International Journal of Energy Research", 42*(6), 2084-2103.
[4] Solomon LD. "The use of sodium chloride & aluminum as phase change materials for high temperature thermal energy storage characterized by calorimetry", 2013.
[5] Tenorio JA, Sánchez- Ramos J, Ruiz- Pardo Á, Álvarez S, Cabeza LF, "Energy efficiency indicators for assessing construction systems storing renewable energy: application to phase change material- bearing façades", *Energies*. 2015;8: 8630- 8649.
[6] Prim EO, Cabeza LF, "*Thermal energy storage (TES) using phase change materials (PCM) for cold applications"*, Spain: University of Lleida; 2012.
[7] Fayadh Mohammed Abed, Omer Khalil Ahmed and Ahmed Emad Ahmed, *"Effect of Climate and Design parameters on the Temperature Distribution of a Room"*, Journal of Building Engineering, Elsevier (2018).
[8] M. N. Inanici and F. N. Demirbilek, "Thermal performance optimization of building aspect ratio and south window size in five cities having different climatic characteristics of Turkey," *Build Environ*, vol. 35, no. 1, pp. 41–52, 2000
[9] K.C.K. Vijay kumar , P.S.S. Srinivasan, S. Dhandapani, "*A performance of hollow clay tile (HCT) laid reinforced cement concrete (RCC) roof for tropical summer climates"*, Science Direct, Energy and Buildings 39 (2007) pp. 886–892.
[10] Marco Manzan, EzioZandegiacomo De Zorzi, Walter Lorenzi, "*Numerical simulation and sensitivity analysis of a steel framed internal insulation system"*, J. Energy and Buildings, Elsevier, vol 158(2018) pp.1703–1710.
[11] A. Abuelnuor, Adil A. M. Omara, Khalid M. Saqr, *Ibrahim H. I. Elhag, "Improving indoor thermal comfort by using phase change Materials*, Energy Research", Wiley (2017).
[12] Zhao, Y. H., Wu, Z. K., & Bai, S. L, "*Study on thermal properties of graphene foam/graphene sheets filled polymer composites. Composites Part A: Applied Science and Manufacturing", 72*, (2015), pp. 200-206.
[13] Zhao, Y. H., Zhang, Y. F., Bai, S. L., & Yuan, X. W. (2016), "*Carbon fibre/graphene foam/polymer composites with enhanced mechanical and thermal properties*, *Composites Part B: Engineering", 94*, (2016) pp. 102-108.
[14] J.Z. Liang, F.H. Li, "*Simulation of heat transfer in hollow-glass-bead-filled polypropylene composites by finite element method"*, Science Direct, Elsevier, Polymer Testing 26 (2007) pp. 419–424.
[15] Chen, Ginzburg, V. V., Yang, J., Yang, Y., Liu, W., Huang, Y& Chen, B, "Thermal conductivity of polymer-based composites: Fundamentals and applications", *Progress in Polymer Science*, *59*, (2016) pp. 41-85
[16] Yuchao Liao, Xiaofeng Wu, Haidi Liu, Yunfa Chen, "Thermal conductivity of powder silica hollow spheres", Thermo-chimicaActa, Elsevier, vol. 526 (2011) pp. 178– 184.
[17] T. Fiedler,E. Solorzano,F. Garcia-Moreno, A. Ochsner, I.V. Belova ,G.E. Murch, "*Computed tomography based finite element analysis of the thermal properties of cellular aluminium"*, Wiley 2009.