

Abstract

Climate responsive building is determined by the local micro-climate and the ability of the building envelope to regulate the indoor thermal environment. The building envelope characteristics are based on the available/accessible building materials. Studies on vernacular architecture across the world showed that wall configurations and the thermo-physical properties of the building materials are used intelligently to maintain comfortable indoor comfort across the seasonal weather variations. Vernacular buildings of North-East India are naturally ventilated. Hence, it is important to find out an optimum wall configuration which will provide enough time lag, reduced discomfort hours as well as optimum thermal performance. Various studies on building simulation/modeling show that building dynamic simulation tools can be effectively used to study the building wall characteristics over entire year. In this study, a typical vernacular building in warm and humid climatic zone of North-East India has been considered to study the effect of thermo-physical properties of wall, thickness and material assembly, increasing window to wall ratio and glazing effect on the indoor environment. Solar energy modular simulation tool TRNSYS 16 is used to carry out the simulations of this building with an objective to improve the indoor thermal environment. Building model is generated in TRNSYS and parametric simulations for different wall characteristics by varying thermo-physical properties, wall thickness, and changing the position of insulation material on external wall are carried out. Simulation results are obtained in terms of temperature profiles inside the zone of the building. It has been found that lowering the overall heat transfer coefficient by increasing the wall thickness helps in achieving better indoor temperature profile. Overall heat transfer coefficient can also be lowered by varying the material's thermo-physical properties. The location of insulation materials on different positions of the wall shows different effect on the surface temperature of the wall. The finding of the study also suggest that less window to wall ratio and window replaced by double glazing shows improved thermal performance. The two very important characteristics which determine the heat storage capabilities of any material are also calculated and it has been found that thermal mass of the wall and thermo- physical properties of the wall materials have a profound impact on these two factors. In this study, it is also found that other climate oriented features such shading mechanism by roof over hangs (very common feature in vernacular buildings) significantly influence the thermal performance of walls.