

Energy Efficient Building Design in Nigeria: An Assessment of the Effect of the Sun on Energy Consumption in Residential Buildings

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Abstract : The effect of the sun and its path on thermal comfort and energy consumption in residential buildings in tropical climates constitute a serious concern for designers, building owners, and users. Passive design approaches based on the sun and its path have been identified as a means of reducing energy consumption as well as enhancing thermal comfort in buildings worldwide. Hence, a thorough understanding regarding the sun path is key to achieving this. This is necessary due to energy need, poor energy supply, and distribution, energy poverty, and over-dependence on electric generators for power supply in Nigeria. These challenges call for a change in the approach to energy-related issues, especially in terms of buildings. The aim of this study is to explore the influence of building orientation, glazing and the use of shading devices on residential buildings in Nigeria. This is intended to provide data that will guide designers in the design of energy-efficient residential buildings. The paper used EnergyPlus to analyze a typical semi-detached residential building in Lokoja, Nigeria using hourly weather data for a period of 10 years. Building performance was studied as well as possible improvement regarding different orientations, glazing types and shading devices. The simulation results show some reductions in energy consumption in response to changes in building orientation, types of glazing and the use of shading devices. The results indicate 29.45% reduction in solar gains and 1.90% in annual operative temperature using natural ventilation only. This shows a huge potential to reduce energy consumption and improve people's well-being through the use of proper building orientation, glazing and appropriate shading devices on building envelope. The study concludes that for a significant reduction in total energy consumption by residential buildings, the design should focus on multiple design options rather than concentrating on one or few building elements. Moreover, the investigation confirms that energy performance modeling can be used by building designers to take advantage of the sun and to evaluate various design options.

Keywords : energy consumption, energy-efficient buildings, glazing, thermal comfort, shading devices, solar gains

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