

Integrating Energy Efficiency and Thermal Comfort in Educational Buildings: Evaluating Passive and Hybrid Strategies for Improved Performance in the Climatic Context of Coimbatore, India

N. Venkatramakrishnan^{1*} and P. Sudhakaran¹

¹Amrita School of Architecture, Amrita Vishwa Vidyapeetham, Coimbatore, India

*Corresponding author: vv_nivethitha@cb.amrita.edu

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Abstract

The building sector is one of the largest contributors to global energy consumption. Therefore, the transition to energy-efficient buildings is a priority for sustainable development. Educational buildings, in particular, offer high potential for energy efficiency because of the occupancy, long operating hours, and varied spatial requirements. Coimbatore is one of South India's prominent educational cities and is home to many state-owned universities. With rising energy prices and growing concern for environmental sustainability, the need for sustainable solutions in educational buildings is becoming more acute. Thermal comfort and energy efficiency are interdependent goals in building design. In South India's tropical climate, achieving thermal comfort while reducing reliance on mechanical cooling requires an integrated approach that accounts for the local climate, building form, envelope characteristics, orientation, natural ventilation, day lighting, renewable energy, and occupant behaviour. The research will combine field-based environmental measurements, occupant perception studies, and case-study analysis. Extensive research shows that, during design, it is essential to consider passive and easy-to-use hybrid techniques in institutional settings to tailor the learning environment. The study aims to conduct an objective survey and a subjective analysis, in line with standard regulations for students' thermal conditions in an institution, supported by case studies. The study will consider comfort parameters such as air temperature, mean radiant temperature, air velocity, and humidity, documented in line with existing conditions and the tropical Semi-Arid climate of Coimbatore. This will educate and enable architects, planners, and users to understand and tailor classroom comfort conditions, paving the way for energy efficiency.

Keywords: *easy-to-use hybrid techniques; educational buildings; energy consumption; passive techniques; thermal comfort*