Enhancing Building Energy Efficiency Through Integrated Thermal Energy Storage and Fan Coil Unit Cooling Systems in Hot Climate

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Abstract:

This study investigates an innovative approach to enhancing building energy efficiency by integrating a thermal energy storage unit with a fan coil unit (FCU) and a chiller system for improved space cooling and thermal management. The experimental setup involves supplying chilled water from the chiller to a test room equipped with an FCU, where the room temperature is studied under varying chilled water flow rates. Crucially, the excessive chilled water flow is diverted and utilized to solidify a phase change material (PCM) in the thermal energy storage unit, enabling thermal energy storage. Furthermore, the refrigerant from the chiller's compressor is bypassed and supplied to the thermal energy storage unit and then fed to the condenser, allowing an evaluation of the temperature drop achieved through this configuration. ANSYS Fluent simulations are employed to numerically model and analyze the thermal energy storage unit to complement the experimental investigation. The study explores the potential of integrating thermal energy storage with building space cooling systems for enhanced energy efficiency and thermal management. The findings of this research contribute to the development of innovative cooling strategies and the optimal utilization of available thermal energy resources, ultimately leading to improved building energy performance and reduced environmental impact.

Keywords:

Building energy efficiency, Thermal energy storage (TES), Phase change material (PCM), Thermal management.