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CHALLENGES IN IMPROVING THERMAL COMFORT IN TENTS

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Abstract – This study investigates the opportunity of using phase change materials (PCMs) to enhance thermal comfort in temporary accommodations, with a focus on tent-based shelters. Tent-type shelters have long been widely used and remain in extensive use due to their established practicality and continued relevance across diverse applications. The research is motivated by the growing global demand for rapidly deployable housing solutions in situations where access to centralized energy infrastructure is limited or absent. Such contexts include humanitarian relief operations for populations displaced by armed conflicts and natural disasters, operational environments for military personnel, and leisure activities such as summer camps located in remote natural areas. To evaluate the practical potential of PCM-based thermal regulation, a series of controlled experiments was conducted in climate chamber using a tent equipped with a self-made thermal energy storage system. The system was designed to store excess heat when ambient temperatures are elevated and to release the stored energy as temperatures decrease, thereby moderating indoor temperature fluctuations. The experiment setup was equipped with sensors to measure indoor and outdoor temperatures, PCM temperature, and indoor thermal comfort, including a globe thermometer and a draught sensor. The experimental approach enables an assessment of how PCM integration can influence indoor thermal conditions within lightweight and low thermal mass shelters. The findings of this work are intended to contribute to the development of low-energy or passive thermal comfort solutions for temporary shelters, where conventional heating and cooling technologies may be impractical due to logistical constraints, fuel scarcity, or operational requirements. By focusing on a tent as a representative temporary accommodation, the study provides a relevant foundation for future optimization of PCM system selection, its design, and deployment strategies for off-grid temporary housing.

Keywords – Passive thermal regulation; phase change materials; temporary accommodation; thermal energy storage

Experimental test chamber and internal measurement setup

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