Development of an Energy-oriented Layout Planning Framework for Healthcare Facilities

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ABSTRACT

Healthcare facilities are one of the most energy-intensive building categories due to their advanced medical equipment and continuous energy usage patterns. This is more crucial in large hospital campuses, which are consisted of multiple buildings providing a wide range of services with various functional units. Previous studies have shown that the building energy performance can be affected by its spatial layout in terms of spaces' heat gain and solar exposure. However, the relationships between the spatial layouts of healthcare facilities and their energy consumption at the campus scale was rarely explored. To address that, in this study, the authors propose a layout planning framework for healthcare facilities to optimize their energy performance. The geometric models of healthcare facilities are developed and imported into energy simulation software. Reasonable ranges of values for layout parameters can then be extracted from similar healthcare facilities which serve as the basis for parameter optimization. Finally, the optimal layout parameter configurations can be identified by comparing the energy performance of healthcare facilities using different parameters. To validate the proposed framework, three municipal hospitals located in Shanghai were chosen as the case study, in which the building use ratio (BUR) was mainly investigated. The results showed that better energy performance can be achieved by decreasing the BUR of outpatient, emergency patient, and medical technology units within an acceptable range. It is expected that this framework can serve as a tool to assist the layout planning decisions for hospital managers and designers to improve their facilities' energy performance.