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Energy efficiency optimization strategies for university research buildings with hot summer and cold winter climate of China based on the adaptive thermal comfort

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Abstract

Hot summer and cold winter zone is a typical climate region in China with high temperatures and stuffiness in summer and low temperature and moisture in winter. The existing buildings bear of both poor thermal performance of building envelope and poor indoor thermal environment. With the development of social economy, increasing demand towards building indoor thermal environment is much more urgent than before, and hence energy consumption has rapidly risen. Energy efficiency retrofit with low cost has become a priority in this region.

Universities and colleges are one of the typical energy consumers in this region, which are insufficient in research. Over all the campus buildings, research building occupies a large part in total campus energy use, and hence becomes the main retrofit objects. Research buildings have complicated functions of offices, scientific research and laboratories, and space heating and cooling behaviors have their own characteristics, which have the large effect on space heating and cooling use. However, there is little knowledge about adaptive thermal comfort and corresponding heating and conditioning energy-use behaviors.

In view of this, in this paper, a typical research building located in Hangzhou was chosen and the measurements on indoor thermal environment heating and cooling behaviors, fenestration and energy consumption were carried out during July 2016 to October 2017. By the analysis on field investigation, delivered questionnaires and measured data, the typical space heating and cooling behaviors, fenestration and thermal environment are analyzed. On this base, energy efficiency optimization strategies in terms of building envelope thermal performance, sun shading, and adaptive space heating and cooling behavior are explored by the simulation. The study provides the technic support for energy saving retrofitting of campus buildings in this region.

Keywords

Research buildings, hot summer and cold winter zone, adaptive occupant behavior, energy efficiency optimization strategies

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