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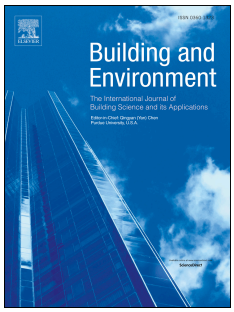

Retractable membrane ceiling on indoor thermal environment of residential buildings

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Retractable membrane ceiling on indoor thermal environment of residential buildings

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Abstract: Indoor thermal environment of residential buildings has attracted considerable attention due to increasing requirements of building performance and dramatical reduction in non-renewable energy. Utilizing new methods to enhance building performance is necessary to achieve low-energy consumption or sustainable buildings. In this study, a retractable membrane ceiling used as part of the second floor in a typical residential building is proposed to address this research topic.

The effects of retractable membrane ceiling on indoor thermal environment are composed of temperature distribution, thermal comfort and energy consumption. It is found that temperature distribution and characteristics are spatial and temporal dependent and that performance enhancement with membrane ceiling unfolding is validated compared with membrane ceiling folding, i.e. 3.7 ^{o}C and 0.9 ^{o}C. To assess thermal comfort, a revised PMV–PPD method is employed to calculate predicted mean vote and predicted percentage of dissatisfied values. The specific values are within comfort ranges during 11:00–18:00 for both folding and unfolding cases. Moreover, thermal comfort curve with respect to membrane unfolding is smooth and wide, which means that the membrane ceiling can ensure smooth indoor environment. For energy consumption, dynamic energy consumption with membrane unfolding is lower than that with membrane folding. The relationships between outdoor air temperature and energy consumption are established on the basis