

Author's Accepted Manuscript

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PII: S2352-7102(17)30576-4
DOI: <https://doi.org/10.1016/j.job.2018.04.025>
Reference: JOBE470

To appear in: *Journal of Building Engineering*

Received date: 28 September 2017
Revised date: 20 April 2018
Accepted date: 27 April 2018

Cite this article as: Li Pan, Qiang Xu, Yue Nie and Tong Qiu, Analysis of Climate Adaptive Energy-Saving Technology Approaches to Residential Building Envelope in Shanghai, *Journal of Building Engineering*, <https://doi.org/10.1016/j.job.2018.04.025>

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Analysis of Climate Adaptive Energy-Saving Technology Approaches to Residential Building Envelope in Shanghai

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Abstract:

In areas having both a hot summer and cold winter, there are two features that affect energy use. One is the high demand for cooling and heating, especially the cooling requirement in summer; the other is the intermittent energy use mode, which depends on whether people are at home. Over recent decades, the average environmental temperature has risen continually, and thus the building cooling load has increased significantly. At present, technological approaches to the building envelope are based on the continuous energy use mode, which needs to be optimised to fit in with local climate characteristics and energy use habits. The orthogonal analysis method is used to optimise the index values of the building envelope capacity by using energy consumption simulation, and experiments are performed to verify a suitable way of using thermal insulation layers to insulate the envelope structure. From the results, it is concluded that thermal reaction rate can be used as a factor to judge the performance of different thermal insulation types. Under an intermittent energy use mode, interior thermal insulation has a higher thermal reaction rate and lower energy consumption. In order to conserve energy, different combinations of envelope index levels are proposed for heating and cooling modes. After building with this optimised energy technology approach, it is expected that thermal comfort can be achieved with a relatively low level of energy use.

Keywords: Residential building envelope, energy conservation, simulation method, technology approach, thermal response rate

1 Introduction

The contradiction between the climate warming, the supply and demand of energy is becoming more and more prominent, and the maximum reduction of the energy demand has become the key concern of the world, and the energy saving technologies for domestic building demand are also actively carried out. Passive design, also known as 'bio-climatic design', helps maximise occupant's comfort and health by harmonizing local climatic and site conditions with architectural design and building technologies [1]. As highlighted in their pioneering works by Olgay [2] and Givoni [3], the concept of passive design is to heat, to cool and to light buildings using ingenious design techniques and materials by reducing or even without using any energy system.

Generally, the existing evaluation index of the envelope energy-saving system in Shanghai

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