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## Evaluation on the energy consumption and thermal performance in different residential building types during mid-season in hot-summer and cold-winter zone in China

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### Abstract

As a result of rapid urban development and economic growth in China, the energy issue is becoming more and more important today because of a possible energy shortage in the future. In China, residential energy consumption (REC) is the second largest energy use category (10%) following the industry (Residential energy consumption in urban China: A decomposition analysis, as shown in Fig.1), and is likely to continue its rapid growth. In order to fulfill the Chinese government's commitment that Chinese CO<sub>2</sub> emissions would peak in 2030, as a result, improving the energy efficiency and reducing the emissions from the building sector is significantly important.

A survey, in the form of a questionnaire, of energy consumption and thermal situation in different residential building types (detached house, Multi-story building, high-rise building), was undertaken in three cities (Shanghai, Hangzhou in Zhejiang province, Changzhou in Jiangsu province) in hot-summer and cold-winter region, these three cities were selected to represent the most flourishing economic provinces. Hot-summer and cold-winter region in China was selected for the evaluation of energy and thermal performance analysis (EETP), because of its special weather conditions, huge energy consumption (as both heating in winter and cooling in summer are necessary), and other regional characteristics. 183 households were sampled during the survey. Energy consumption analyses showed that the amounts of energy use, in different building types were very different as their distinct characteristics. Also, experiments were separately done in typical examples of three different building types. Systematic evaluation on EETP for three different residential building types, were put forward to assess the energy efficiency and thermal performance of three different building types.

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**1. Introduction**

The residential energy consumption of China in 2007 was almost 300 million tons of standard coal equivalent (Fig.2), which approximately equals the total amount of energy consumption of Brazil in the same year and comprises 10% of the year’s total energy consumption, as in Fig.1 and Fig.2. China is a fast developing country with a vast size, and there are great differences in both the amount and structure of residential energy consumption at the unit level.

At the same time, with its rapid economic growth, people’s human thermal comfort requirement are improving. In the past, during the transition season (spring and autumn), people never used air conditioner even there was someday severely cold or hot. But this situation has changed in the recent years.

And for a long term, residential household energy consumption and the thermal performance in China are analyzed based on the intuitive sense. The researcher, always does qualitative analysis based on the “China Energy Statistics Book”, a big data for an industrial classification, and call for energy saving, but it is meaningless if the reason cannot be found and how is the thermal performance. For these reasons, quantitative analysis of energy consumption in China is an important basis for research into improving the energy efficiency and thermal performance of the residential households.

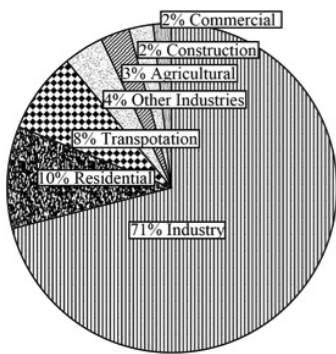


Fig. 1. China’s total primary energy consumption in 2007.

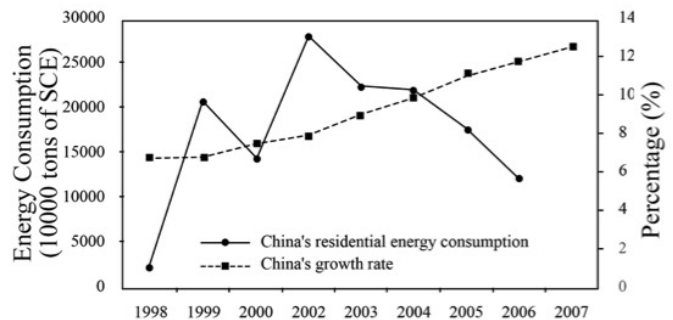


Fig. 2. Residential energy consumption and growth rate

(Data source: CSYs (1999–2008), SCE—standard coal equivalent.)

China has various types of climate due to its vast territory, complicated topography and a great disparity in elevation, hot summer and cold winter zone located at south center of China. Hot-summer and cold-winter zone in China includes 16 provinces, municipalities and special administration regions. It is sultry in summer and wet, cold in winter; the mean temperature of July is about 2°C higher than other places of the same latitude in the world while the mean temperature of January is about 8~10°C lower, and the mean temperature of the hottest month and the coldest month is between 25~30 and 2~7 °C, respectively; Besides, the relative humidity in most cities here is 75~80%, even 95~100% sometimes (not in the rainy days), which is another characteristic. The whole winter is cold and rainy and is in great short of sunshine, take some cities, for example: the percentage of possible sunshine is 43% in Shanghai. This kind of climate brings huge load to the air conditioning system (data from the China Meteorological Bureau).

The purpose of this paper is to classify the energy and thermal situation in three different residential building types (detached house, multi-story building, high-rise building) and hoping to give higher thermal performance design methods and energy-efficient equipment advices. In hot summer and cold winter zone, both the architectural quality and the usage way have many problems. How to lead the people to a better lifestyle is still needing a long way to go.

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