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Research on Passive Energy - saving Renovation of the Roof of Traditional Residences

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Abstract

With the rapid development of social economy and people's living standards continue to improve, summer air-conditioning energy consumption has gradually become the focus of modern society energy consumption. At the same time, the traditional residences are an important part of the ancient Chinese architecture culture and heritage, which contain rich experience in ecological construction, but limited to the economic level and construction technology at that time, and the traditional residences have their flaws. As one of the largest energy consumption of the envelope, the roof is the need for renovation. In this paper, energy-saving renovation of the demonstration building on the town of Chongqing was taken as an example. It puts forward the practice of using the controllable ceiling and uses DesignBuilder software to compare the energy consumption before and after the transformation and the indoor temperature in summer. The results show that the building energy efficiency rate is 54.35%, and the cumulative percentage of the length of the temperature of bedroom1 over 30 ℃, while over 28 ℃ is reduced by 7%. The cumulative percentage of the intermediate bedroom temperature over 30 ℃ is reduced by 16 %, and over 28 ℃ by 12%. By taking the control of the ceiling to reduce the cumulative time of the indoor high temperature, which can be delayed air conditioning opening time by the next day, to achieve energy-saving effect.

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Keywords: Traditional residence; Night ventilation; Passive cooling; Energy saving;

1. Introduction

In recent years, reducing the energy consumption of summer air conditioning has become an important aspect of building energy-efficiency research. As one of the technologies to reduce summer energy consumption, night ventilation cooling technology is more and more attention by scholars [1]. Many studies have shown that nighttime ventilation uses low temperatures at night to remove the heat that the building heaters have stored in the daytime, which can reduce indoor air temperature, and reduce cold load and then delay the open time of air conditioning the next day [2-6].

One of the weak links in the traditional residential insulation is the roof [7]. Its thermal performance is very poor, resulting in indoor environment comfort cannot meet the living requirements of modern people. The traditional

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residences below the ceiling to increase the roof is to improve the thermal performance on the roof of the common measures [8, 9], which can effectively reduce the outdoor heat into the room, but this will greatly reduce the cooling effect of the roof at night. Studies have shown that the energy-saving renovation of the roof heat loss is significant, indicating that the renovation of the traditional residential thermal environment, and the roof of the renovation potential is very large, which is urgent and the most effective part of the renovation [10].

This paper proposes a combination of ceiling insulation and tile roofing. The controllable ventilation device is increased in the ceiling, using night ventilation cooling technology to renovate the traditional residential roof energy-saving.

2. Method

A typical residential building in Anju ancient town of Chongqing, China is chosen as an experimental building. It is situated at the west of a mountain, due east of Vulcan Temple Street, and the north and south sides are closed to neighbors (Fig.1). The main building was the wooden bone wall, and the roof was the roof, and the ground was the simple cement floor before the renovation. It was two layers. The height of the first layer was 3. 00m, while the second was 2.65m (Fig.2).

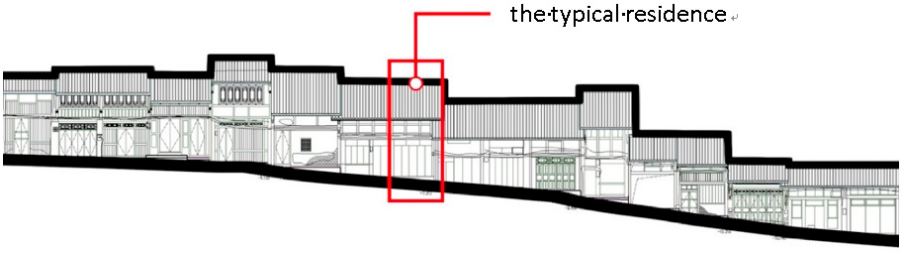

Fig. 1 the location of typical traditional residence

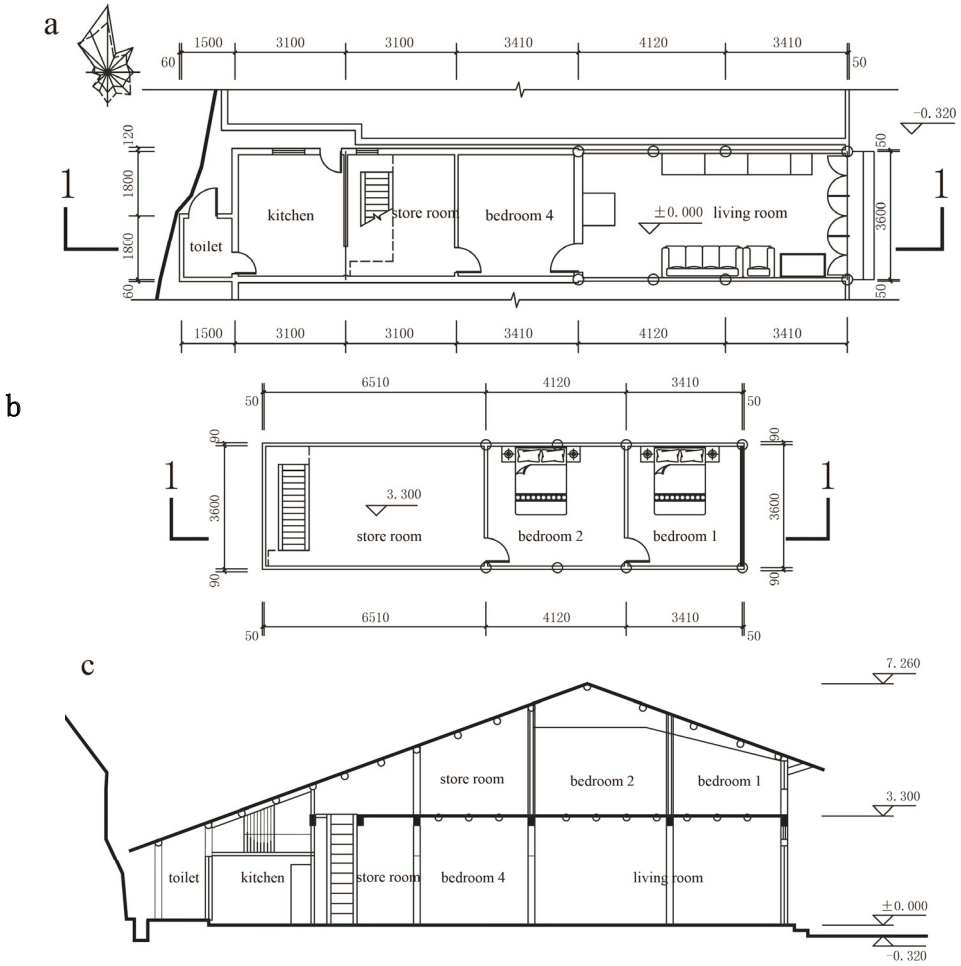

Fig. 2 (a) first floor plan; (b) second floor plan; (c) 1-1sections