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Experimental Study on the Thermal Performance of Ventilation Wall with Cladding Panels in Hot and Humid Area

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Abstract

In this paper, we discussed the principle of thermal pressure ventilation, tested the ventilation wall in hot and humid region and obtained the hourly temperature on the outer wall surface and the calcium silicate board surface. The results showed that, on sunny days, plug-calcium silicate board surface temperature can be up to 37 °C, while the exterior wall surface temperature can be up to 31 °C, the surface temperature difference between the two walls is about 6 °C. But on cloudy day, the difference is about 2.3 °C. And during the night, it is about 1.5 °C. Lower temperatures are found for the plug-calcium silicate board surface compared with exterior wall surface temperature. The delay and attenuation effect on outdoor temperature wave by ventilation wall is conspicuous.

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Keywords: Ventilation wall; Cladding panels; Thermal performance

1. INTRODUCTION

Thermal performance improvement of the wall so as to meet the requirement of indoor thermal comfort has long been an important part of building energy-saving technologies. The ventilation wall formed by hanging calcium

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silicate boards on the outer wall surface is a new energy-saving wall construction. It will greatly reduce or even eliminate the building cooling load in summer by removing the environmental heat on the envelope structure with the influx of outdoor air. Then, it has a climate adaption to the hot and humid region.

F Stazi et al. make an experimental research on ventilated walls with an external clay cladding in a temperate Mediterranean climate and concludes that, on sunny days, the external surface temperatures are considerably higher, while during the night time lower temperatures are found for the various layers of the wall [1]. P Seferis et al investigate the thermal performance of a ventilated wall without cladding panels and find that the heat convection resulting from the buoyancy induced flow is a critical aspect of the ventilated wall's behaviour [2]. While the experimental study on the thermal performance of ventilation walls with cladding panels in hot and humid areas are vacant.

Nomenclature

T1	Indoor air temperature
T2	Outdoor air temperature
T3	Surface temperature of Plug-calcium silicate board
T4	Surface temperature of exterior wall
V1	Air velocity of inlet
V2	Air velocity of outlet

2. METHODS

The main material of this experiment is high density fiber reinforced calcium silicate board provided by NEW ELEMENT BUILDING MATERIAL CO. LTD. The plug-in board for the materials is installed by the keel of a test room in the west wall of Guangzhou area. There is a cavity between the board and the external wall, which can be used for ventilation. The width, thickness and height of the wall are 6000mm, 200mm and 3000mm, and the size of the whole board is 2300mmx110mmx2860mm. The test room is airtight without air conditioning.

There are 6 layers of temperature sensor placements in the central region of the outer wall with the consideration of temperature stratification on the wall surface and marginal effect of cladding boards, and there are 18 temperature sensor placements in total with 3 temperature sensor placements distributed on each layer. Encapsulation Digital Temperature Sensor is affixed to the surface of the outer wall to measure the temperature. There are 6 temperature sensor placements totally with 2 temperature sensor placements distributed on each layer. The distribution method of sensor placements on cladding boards is the same as those on the outer wall.

JTNT-A Multi Channel Temperature and Heat Flux Tester is used to collect temperature signal in the experiment, and it also automatically records as well as conserves the signal in the computer once every minute, while the temperature is measured by HOBO Temperature and Humidity Recorder once every minute. For the inlet and outlet wind speeds as well as the temperatures on the back cavity of cladding calcium silicate boards, HD32.3 Thermal Environment Analyzer is applied for the measurement once every hour. What is more, DAVIS Vantage Pro2 Miniature Electronic Meteorological Station is used to measure and record the outdoor meteorological parameters including air temperature, relative humidity, solar radiation, wind speed and wind direction once every minute.

3. RESULTS AND DISCUSSION

The experiment lasts four days from October 31st to November 3rd in 2014, which can well represent the transition season in southern hot and humid areas. The foregoing two days are sunny while the posterior two days are cloudy. The ventilation of the wall is induced by heat pressure, which is closely related with the intensity of solar radiation. So the experimental data is respectively classified into three processes, which is sunny days, cloudy days and night.

1 The experiment results analysis on sunny day (November 1st 8:00-20:00)

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