



The comparison of thermal performance between a Bio Climatic House and a Typical House

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Abstract

This research was conducted to compare thermal performance between a Bio Climatic House and a Typical House. Both houses had a volume of 25 m³. As a Bio Climatic house, a solar chimney (SC) was attached to a Roof Solar Collector (RSC) that consisted of CPAC Monier tiles with a funnel 14 cm width and gypsum boards. The design of the partial roof was transparent to allow light pass into the house by the reflection of light. However heat could not enter the house. The walls were Modified Trombe Wall (MTW) which was made of plywood while and had ventilation channel of 14 cm. width that turned to the south. The experiment was set on January 2013 to February 2013. On the other hand, a Typical House was modified from the former house with neither Modified Trombe Wall (MTW) nor Roof Solar Collector (RSC). The experiment was arranged on April 2013 to May 2013. As a result, the conclusion indicated that a Bio Climatic House (BCH) had lower room temperature than ambient temperature 2-3o Celsius because hot air flowed out via the roof and the walls. In comparison, a Typical House had higher room temperature than ambient temperature. Thus, residents in a Bio Climatic House (BCH) would feel more comfortable than a Typical House.

Keywords: Bio Climatic House, Solar Chimney, Roof Solar Collector, Modified Trombe Wall

1. Introduction

Nowadays a design of buildings is currently being converted into western style buildings. A traditional Thai style house in the past with a high platform, gable roof and open-wide hinged windows is almost modified to a European style houses. Accordingly the European style houses have a closed system



hence ventilation in the houses has poor circulation and heat transfers from inside to outside badly as well. The European style houses are suitable for using with an air conditioner and use more electricity. In contrast to ventilation of the Thai style houses is better than the European style houses because of the high platform that has ability to circulate air through it. Besides there are many open-wide hinged windows allow sunlight and wind blows though the houses, so it makes residents feel comfortable. For this reason, The Building Scientific Research Center (BSRC) has acknowledged the importance in the design of houses with air circulation and a natural light altogether. A solar chimney is installed in the houses [4-1] so that it can save energy by reducing the use of air conditioners and electricity. The residents then sense comfortable. Because of this, Bio Climatic House is mentioned and has applications of Roof Solar Collector (RSC)[5], the Modified Trombe Wall (MTW) [6], and Bio-Climatic Roof (BCR) [7]. These comfy houses have a design based on Thailand tropical climates. The Roof Solar Collector (RSC) is designed for high air temperature floating out via the roof as similarly as Modified Trombe Wall (MTW). At the same time the external air will flow into the air inlet instead from the bottom of the door that always creates air circulation in the house. Additionally Bio-Climatic Roof is planned a natural light into the house through light reflectivity, so it prevents thermal from the roof not transfer to inside. It is able to reduce energy and use of electric light bulbs. Moreover it will help night radiation cooling [8]. Both houses, in brief, were collected data of the temperature all 24 hours inside. The Bio Climatic House's temperature record period was during January 2013 to February 2013. The Typical House was then kept during April 2013 to May 2013.

2. Configuration studies and experimental method

2.1 The Bio Climatic House was built at the 12th floor of the School of Energy Environment and Materials, King Mongkut's University of Technology Thonburi, Fig 1. Its dimension was as follows: 2.00 m height, 3.35 m width and 3.45 m length. The wall with the door and windows would face to the north. RSC, MTW and BCR would turn to the south as Fig 2. The whole house walls were made of plywood while. The BCR was composed of a combination of CPAC Monier concrete and acrylic transparent tiles at the outer side, 0.14 m air gap and another combination of gypsum with an aluminum foil board and translucent sheets at the room side as schematically shown in Fig. 3. The translucent sheets provided a diffused low-glare light source. The gap side of the CPAC Monier concrete tiles was painted white color to increase light reflectivity[9], the RSC was made by using CPAC Monier concrete tiles dark red color and the MTW was made by using plywood while.



Fig. 1. A Bio Climatic House in this research.



Table 1. Configuration of Bio Climatic House.

Configurations (dimension, mm)	Air inlet and air outlet (mm)
(MTW) W:L:T:1000:1950:140	W:L:50:750
(RSC) W:L:T:1000:1500:140	W:L:50:750
(BCR) W:L:T:1000:1500:140	W:L:50:750
(Door) W:L:700:1800	W:L:500:700

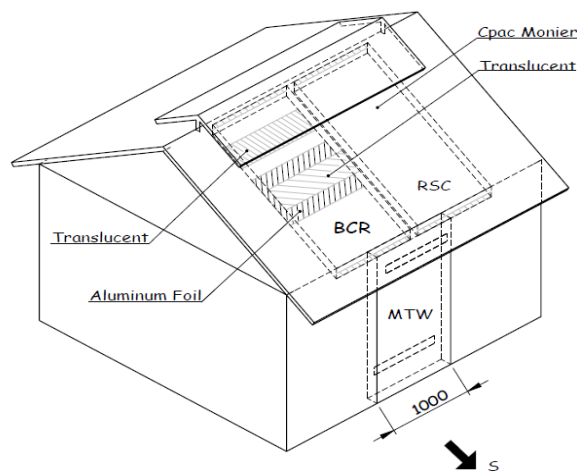


Fig. 2. Schematic of BRC, RSC and MTW.

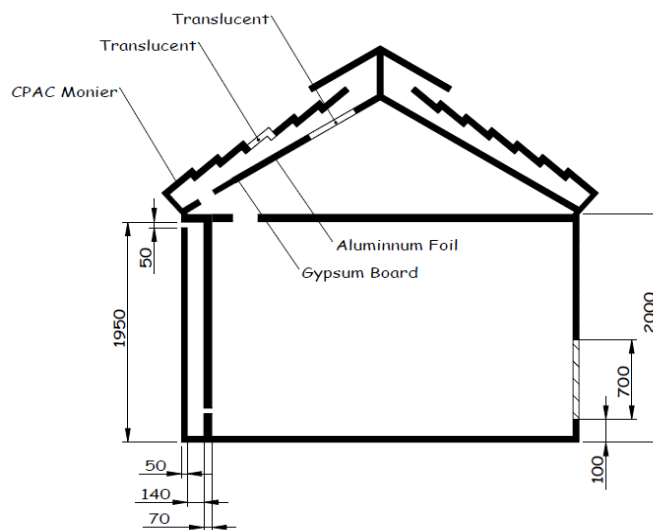


Fig. 3. Cross section of a Bio Climatic House.

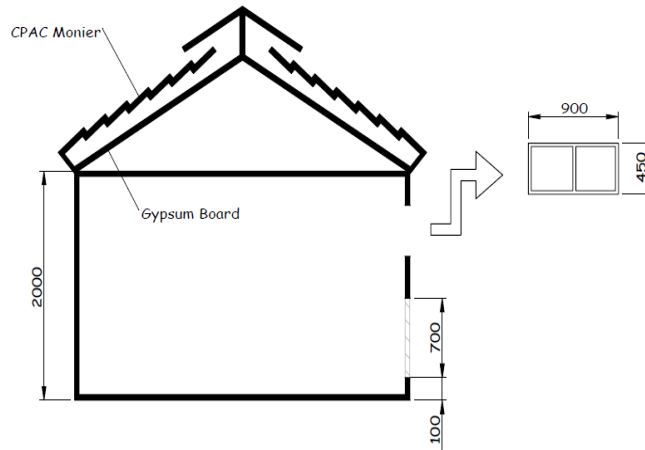


Fig. 4. Cross section of a Typical House.

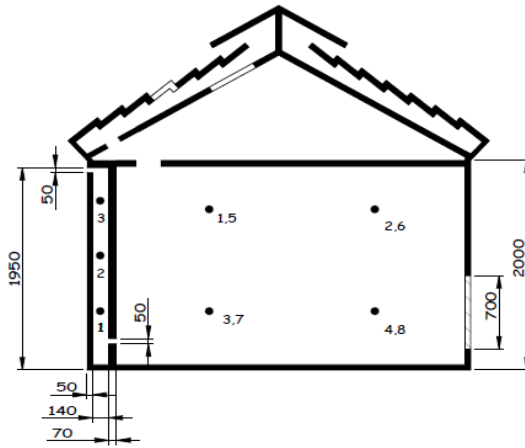


Fig. 5.(a) A Bio Climatic House configuration and the position measurement.

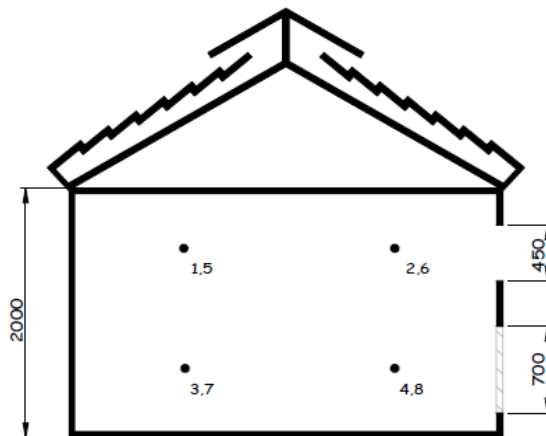


Fig. 5.(b) A Typical House configuration and the position measurement.

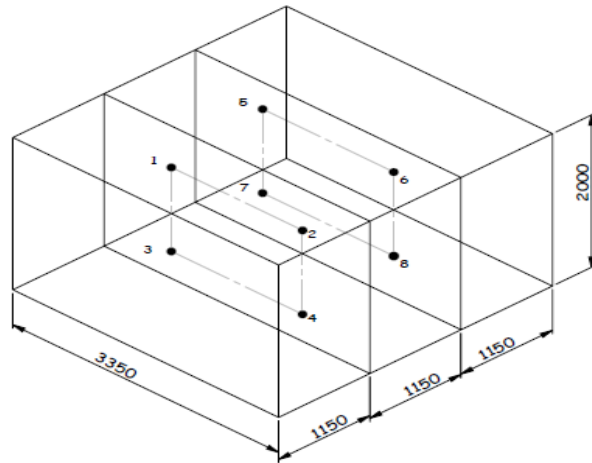


Fig. 5. (c) Configuration and the position measurement in BCH , Typical House.

2.2 A typical house converted from a Bio Climatic House had walls which made of plywood while. It was not applied to use of Modified Trombe Wall (MTW) and Roof Solar Collector (RSC). The walls which had a door and windows would face to the north as a regular residence.

Instruments and equipment used data logger HIOKI: model 8422, 32 channels (Thermocouple Inputs Accuracy $\pm 0.005\%$ and Voltage Inputs Accuracy $\pm 0.1\%$) with thermocouples type K (range 0–1,250 °C) was used to measure, record temperatures and a CM 11 Kipp&Zonen pyranometer.

3. Results

The comparison of thermal performance between a Bio Climatic House and a Typical House showed as Fig. 6 and Fig.7 indicated that temperature inside the Bio Climatic House had air ventilation from an air inlet of the channel with a 0.5 m width and 0.7 m length. In the same way, high temperature would flow out via the MTW wall and RSC Roof. On the contrary, a Typical House had air circulation pass through only a door and windows. As a result, the conclusion indicated that a Bio Climatic House (BCH) had lower room temperature than ambient temperature 2-3° Celsius because hot air flowed out via the roof and the walls. In comparison, a Typical House had higher room temperature than ambient temperature. Collecting data started at 12:00 am – 12:00 pm.. The Bio Climatic House was kept a record during January 2013 to February 2013, and the Typical House was between April 2013 and May .2013

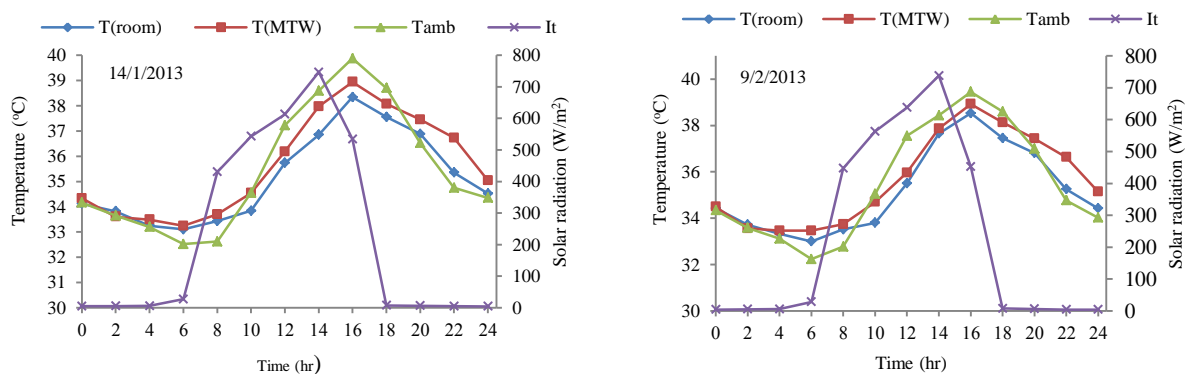


Fig. 6. Hourly variations of T (room), T(MTW) and ambient temperature of BCH.

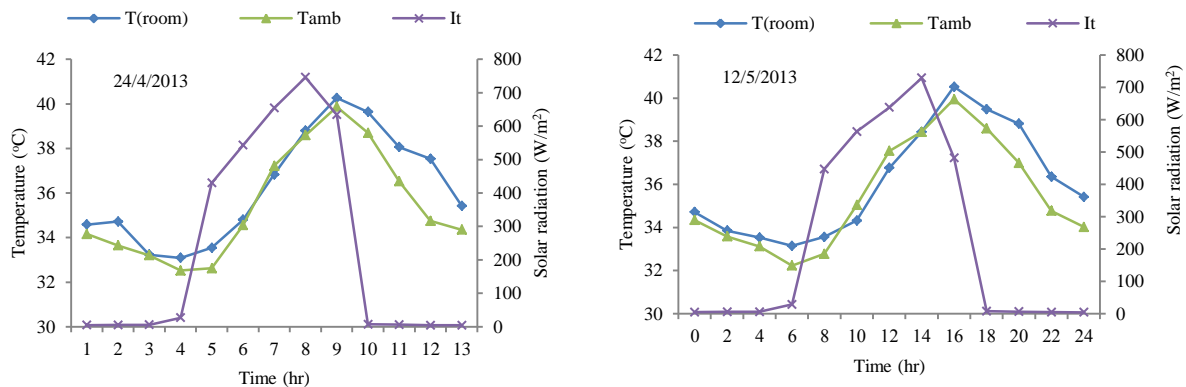


Fig. 7.Hourly variations of T (room), ambient temperature of Typical House.

4. Conclusion

The study found that a Bio Climatic House had more air ventilation than a Typical House because the Bio Climatic House was applied to use Modified Trombe Wall (MTW) and Roof solar Collector (RSC). If the Bio Climatic House is designed to be larger or has two storey commercial building in the future, it will actually have a better performance in terms of an energy saving. An air conditioner is not equipped for the house to cool temperature down. Even though the cooling performance of the Bio Climatic House is a bit lower than using of an air conditioner, it is another option for residents who are willing to save energy for Thailand.

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