

## Abstract

The typical house in Thailand experiences two common thermal scenarios: cool air is generated by the earth's surface in the crawl space and hot air is produced by solar heat near the vertical exterior walls. To take advantage of these natural thermal phenomena, this work proposes the use of a modified Trombe wall as an application to promote natural ventilation and heat gain protection using air-flow driven by the differences of temperature.

This research investigates the performance of a modified Trombe wall as a solution for improving thermal comfort and ventilation of a building in Thailand. Both computational fluid dynamics (CFD) and full scale experiments play important roles in this research. The CFD results reveal air-flow patterns which in turn impact the experimental setups. The experimental modified Trombe wall model is 1 meter in width and 3.1 meter in height. The wall consists of a layer of a 15 centimeter thick external wall made of brick and mortar, a 10 centimeter air gap, and a 0.9 centimeter gypsum internal wall. A series of 500 watt halogen lamps with adjustable control switches were used to simulate the solar heat radiation in a controlled environment.

Both the simulated and experimental results indicated two possible applications for the modified Trombe wall. The study found that the ability of wall temperature reduction was up to a maximum of 15-23<sup>o</sup>C, thus a modified Trombe wall acts as a perfect heat protection system and could be also utilized for inducing air-flow in occupied spaces, particularly during night time. The thermal mass of an external wall which remains warm because of the thermal lag could enhance air movement induced by stack effect in the wall cavity. The results showed that the operable system for using crawl space should be applied if both heat protection and night ventilation were designed within the same building.

This study proves that the modified Trombe wall can be one of the solutions for passive design in Thailand's hot-humid climate. This application not only can promote natural ventilation in the absence of wind especially during night time but also acts as a heat gain protection component which is recommended for this region. With these characteristics, the modified Trombe wall is highly applicable for residential applications.