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The difference of thermal performance between houses with wooden walls and exposed brick walls in tropical coasts

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Abstract

The purpose of this study is to analyze differences between brick and wood houses related to the thermal comfort of the occupants. The measurement results are compared with a test in the field. The results of measurements of thermal variables of the formula's Fanger show that eight houses with wooden walls have an average result of 1.01, meanwhile eight houses with exposed bricks wall have an average result of 1.71. The results of field measurements indicate that occupants in houses with wooden walls feel more comfortable than occupants in houses with exposed brick walls.

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Keywords: thermal performance,brick houses,wooden house, tropical coasts, PMV, AMV

1. Introduction

As a warm and tropical region, Indonesia has some types of areas which are divided into low land and high lands. Low land is divided into coastal areas and land. Low and high lands have different thermal profiles. The low lands have a relatively hot temperature, while high lands have relatively cool temperatures. The difference makes the type of houses various. Houses in coastal areas have three kinds of walls;plastered bricks, expose bricks, and woods. Due to the economic condition of the people, majority is middle and ower class, the majority of houses in

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coastal areas have wood, and brick walls which are not plastered (expose brick). Houses are made to protect the occupants and to create comfort for the residents. One of the comforts is thermal comfort. Thermal comfort is a thought condition of someone's which expresses his satisfaction on thermal environment [1]. Measurement of thermal comfort can be done in several ways. One way to measure the thermal comfort is to use the theory of PMV (Predicted Mean Vote) and AMV (Actual Mean Vote). Many researchers have used the PMV and AMV to measure the thermal comfort of a building [2,3,4]. Although there were many experts who corrected PMV, it is considered as the most complete theory of thermal comfort among others. This study aims to measure the thermal comfort using the PMV and AMV and to compare the value of PMV and AMV to get the thermal performance of the two types of houses in coastal areas.

PMV is the thermal equilibrium theory invented by Prof. O.L.E. Fanger in 1970 [5]. This theory assumes that thermal comfort is influenced by six thermal variables, namely: air temperature Ta (Temperature), Wind Speed V (Velocity), relative humidity (RH), the average radiation temperature (Tmrt), human activity, and Clothes. PMV has been corrected by many researchers with many field studies. It has been found that there are many deviations from PMV in other locations, especially in buildings with natural ventilations. This field study is known as AMV (Actual Mean Vote). AMV is done by using a questionnaire that directly filed in field. The deviations of PMV from AMV is due to the adaptive factor by occupants. Adaptive factors are factors outside of the 6 variable thermal comfort. Sugini found adaptive psychological factors that influence these differences [6,7,8]. She conducted a research on seven office buildings in Yogyakarta, Indonesia. She found a perfect model of adaptive thermal which made PMV perfect [9]. Beside Sugini, there are several adaptive models found in other countries. Singh found adaptive models for houses in India [9]. Rijjal, Yoshida, and Umemiya found that the occupants in space between rooms, and inside room have a higher neutral [10]. These adaptive models have long been proposed by several researchers including Humphreys, De dear, Bragger, Nicol and several other researchers. Humphreys conducted a study of the theory of adaptive thermal comfort in 1998. Adaptive thermal comfort is different from static thermal comfort (PMV). An adaptive thermal comfort is theory based on the adaptation of the occupants and the occupants are considered as subjects rather than objects of thermal comfort [11].

In determining thermal comfort performance, many researchers only based on physical measurement data. Measurements were also no comparison between brick and wood houses. This study will analyze the subjective data of the occupants as the basis for determining thermal performance as well as comparisons between brick and wood houses.

Nomenclature

PMV	Predicted Mean Vote
AMV	Adaptive Mean Vote
RH	Relative Humidity
V	Velocity
Ta	Air Temperature
Tmrt	Mean Radiant Temperature
ASHRAE	American Society for Heating Refrigeration Air-conditioning Engineers

2. Method

The studied houses were houses with wood and brick walls. It was located in the coastal area in Morosari district, Demak regency, Central Java Indonesia. Collecting data by using physical measurement (thermal variables) and taking the questionnaire. Measurement of thermal variables by using the temperature measuring tools (digital thermometer), the temperature of solar radiation (globe temperature), measuring wind speed (digital anemometer) and humidity (digital hygrometer) .Pengukuran conducted at 07.00 am until 5.00 pm.

The survey was conducted in 16 houses with a total of 126 sets of data. The data were obtained from the occupants who were questioned through questionnaires three times at 07.00 am, 12.00 am and 5.00 pm. This time represents the thermal type within a day. Thermal measurements were made every one hour for 4 variables: