

Passive Building Design Approach in Iban Long houses

N.Viviellenie¹, B. Azhaili², AB. Ruzanah³, Hasim Awang⁴, Imran Ali⁵

1 Faculty of Built Environment, University Malaysia Sarawak, Kota Samarahan, Malaysia

2 Faculty of Engineering, University Malaysia Sarawak, Kota Samarahan, Malaysia

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Abstract: Passive Design is design that uses the advantage of the climate for maintaining the thermal comfort inside the room. Comfort inside the house can be achieved with less dependence on artificial lighting and mechanical ventilation, and the application of eco-friendly materials. Timbers and bamboos are examples of eco-friendly materials which are excellent in lessen heat flow and with proper inlet and outlet allow natural ventilation thus giving comfort to occupants. These materials are widely used in the construction of Iban longhouses in Sarawak, Malaysia. Therefore, a study has been conducted to assess the presence of passive building design approach in the Iban longhouse in Sarawak. In the study, site observation with photo analysis, experimental work and CFD simulation by Autodesk CFD software were carried out at eight selected Iban longhouses in Sarawak. This study found that Iban longhouses practice passive building design. Iban longhouse implements passive design strategies in achieving comfort for occupants. This contributes to natural adaptation to the hot and humid weather conditions in the tropical climate. The findings are expected to generate ideas for bioclimatic building design for other modern terrace houses in a tropical climate. In conclusion, the Dayak traditional longhouse in Sarawak, Malaysia is a good example of bioclimatic building design of the past.

Keywords: Passive Design, Long House, Thermal Comfort, Computational Fluid Dynamics

1. Introduction

Borneo is the third largest tropical island in the world after Green Island and New Guinea. Borneo Island is one of the tropical islands which experience hot and humid weather throughout the year. Its climate has influence the architecture design of the Bornean dwelling. In order to maintain the thermal comfort in dwelling, the architecture design was design to adapt the surrounding climate. According to J. Ting [1], most Bornean traditional houses are built from local low thermal mass and permeable materials such as sago palm leaves, ironwood and bamboo. These materials properties can reduce heat gains. Besides, the arrangement of these materials has allowed natural ventilation. Longhouse is one of the traditional buildings that can be found in Borneo Island. Longhouse is popular for Dayak, Murut and Rungus community dwelling. Research by H. Steiner [2] and T.T Sim [3] state that Dayak community lives in Sarawak and Kalimantan, Indonesia while Murut and Rungus community can be found in Sabah, Malaysia. Dayak community can be divided into two difference races which are Iban and Bidayuh. However, this study will focus specifically on the Iban longhouse in Sarawak. Furthermore, studies of indoor air movement and to proof that the Iban longhouse having passive design will involve computational fluid dynamics (CFD). The distribution of air flow and concentration can be simulating by using CFD. According to Zhang Lin et al [4] CFD have being used to solve building and environment problem for over 20 years ago. Besides, CFD was used to determine the optimal way of ventilation design to prevent smoke release by vehicle exhausts reach pedestrians. CFD simulation is very popular method to monitor the condition of indoor environment, inclusive of simulating airflow patterns, thermal comfort and pollutant concentration [5][6][7]. The modern techniques of conducting research and reliability, make CFD a powerful tool for simulation and the visualization of environmental problems.

The main objectives of this study are:

- To identify passive design of the existing Iban Long Houses.
- To validate the CFD simulation with the experimental data. (air velocity and indoor air temperature)
- To suggest possible passive design features in terrace houses.