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Analyzing Indoor Environment of Minahasa Traditional House Using CFD

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Abstract

Raised floor can be found in many traditional buildings throughout Indonesia, however this element currently disappears from Indonesia modern architecture. One of possible reason is limited study conducted on raised floor house, therefore the benefits of raised floor element; especially its application in tropical climatic is never exposed. Minahasa Traditional House is a traditional raised floor house that still exists today. This paper will investigate thermal comfort conditions particularly wind velocity inside of Minahasa Traditional House using Computational Fluid Dynamic (CFD) analysis. Simulation on several variations of openings and stilts height is conducted to measure its effectiveness in creating thermal comfort. The result of the study will become a reference for modern architect to design modern house that incorporate design features from vernacular architecture.

Keywords: raised floor; vernacular architecture; minahasa traditional house; CFD; thermal comfort;

1. Introduction

Minahasa Traditional House is wooden raised floor house originated from Tomohon, North Sulawesi. This house is build on top of 16-18 wooden stilts with 1.5 - 3 meter of height. Its roof shape is a combination between Hip and Gable Roof.

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Minahasa Traditional house consist of four rooms. First is 'Kolong', area beneath the floor that was used to store crops. Second is 'Lesar' is a terrace with no walls located before main entrance. Third is 'Sekey', located after main entrance, a reception room where resident receiving guest. Last area is Living room or 'Pores'. In the living room there are bedrooms, dining room as well as kitchen.

Minahasa traditional building is designed by adapting to tropical climate using passive design principles. These principles are:

- Roof opening and high ceiling to create stack effect.
- A large roof overhang and verandas to reduce solar gains.
- Wall and Roof opening to remain open for natural ventilation.
- Floor opening to allow air from beneath to flow into building.

Minahasa Traditional house's raised floor structure and roof shape, is allowing opening made not limited on the wall but also on the roof as well as on the floor. Thus allowing more wind to flow into the house.

Fig. 1 Minahasa traditional house

1.1. Raised Floor House and Natural Ventilation

Airflow beneath the floor cooling the building's floor as well as decrease humidity. Raised floor will make positive impact on thermal comfort inside the building. Idea of using cross air under the floor as passive design was introduced by Tahir [1]. They studied raised floor house in relation to its potential as a model for ultralow energy building. They mentioned that there are five advantages of the raised floor in a hot and humid climate. These advantages are:

a. The raised floor increases air movement in and out of building.
b. Increasing the floor level from ground may require additional cost but the cost could in the long run be justifiable considering the addition space achieved and the possible functions.
c. Effective counter measures from animals and insects as well as comfort from the constant havoc of flash floods.
d. More privacy with additional consideration to detailed wall design. Floor rose at a level of more than that of a normal human height automatically restrict views from pedestrians.
e. Better security and fewer requirements of specific facilities normally associated with most terrace housing schemes.
f. Better views and option for integration of landscape design.

In addition, a method of improving thermal comfort on raised floor house was also suggested by introducing alternative floor construction, adjustable floor louvers. They argue that adjustable floor louvers could assist in diverting some of the cross air from under the floor into the house and through to the rear. Another study by Sapian [2], who conducted a study on high-rise residential buildings using Computational Fluid Dynamic (CFD) simulation