Building Healthy and Comfortable House in Equatorial, Tropical Climate Indonesia

T Tawami* and A F Mutaqin²

¹Departemen Bahasa dan Sastra Inggris, Universitas Komputer Indonesia, Indonesia
²Departemen Teknik dan Ilmu Komputer, Universitas Komputer Indonesia, Indonesia

* tatan.tawami@email.unikom.ac.id

Abstract. This study aims at providing information on the factors that must be considered in building a house in accordance with the climate of Indonesia. The research method used related studies and supporting theories about buildings in tropical climates and interviewed the lecturer who teaches building physics in one of the private universities in Bandung. The results obtained from this research were the creation of a healthy and comfortable house that adapted to the equatorial tropical climate in Indonesia. Considering thermal comfort factors such as wind direction, indoor air temperature, humidity influenced by climate in Indonesia, radiation temperatures entering the house and human physique that will stay in the house and the factors of the creation of a healthy house with attention to the comfort of humans live and indulge in it by applying the concept of sustainable architecture. Human Friendly is a house built according to function and character, Environmentally Friendly is environmentally the friendly house and renewable energy is a house that can produce its own energy or a house that is not wasteful of energy in its use.

1. Introduction

Olesen and Seelen described the primary purpose of a building is to provide a healthy and comfortable environment for the occupants. So to get a building that could provide comfort it is necessary to establish the determining criteria [1]. Mulliner said that the house is an essential aspect of quality of life and helps in sustainable development [2]. Jacobs et al described a healthy house is a house that has conditions that can make the owner feel physically and mentally healthy in the house, so there is a complicated relationship between health, housing conditions, environmental size and clinical data [3]. Wall explained that houses in Indonesia are categorized as non-engineered buildings constructed without proper analysis of the general structure, the main ingredients of houses in Indonesia are the bricks by of simplicity and speed of construction [4].

Winston explained that the problem of achieving sustainable housing is the lack of a shared vision of durable housing, inadequate building regulations and non-compliance with existing laws, limited knowledge, and skills in green development methods. Also, contrary perceptions of higher density housing, poor quality, negative attitudes toward social mix, the emphasis on dismantling, failure to recognize the need for social regeneration and limited resources [5].

Nasrudin, et al explained the concept of traditional housing in one of the villages in Indonesia there are physical concepts in the local wisdom that house heat transfer, temperature equilibrium, the sun and
wind direction and specific heat of the material [6]. Ge and Hokao explained to plan and develop residential neighborhood effective and efficient by promoting the concept of lifestyle residential. It should clarify the diversity of preferences residential urban and demands, perception, and evaluation diversified from neighborhoods, by analyzing the characteristics of the pattern of preference housing, factor selection residence, and housing satisfaction, as well as their mutual relations [7].

Bullen et al described the Healthy Housing Program aims to improve well-being by addressing the housing circumstances of families at high risk of infectious diseases. Also, experiencing high levels of deprivation, living in areas with high concentrations of low-income, and most public and housing can achieve through improving the housing stock and better-integrating housing, health, and social services. With Thematic analysis reveals that in the households evaluated the program promotes participation in housing decisions and, indirectly, neighborhood life more generally. The visible benefit is a more significant stock of social housing units appropriate to residents' needs, increased coordination between sectors and organizations, strengthened community networks through referrals to helping agencies, and heightened insight by government officials into the housing conditions of tenants [8].

Li explained that to build a comfortable house should be attentive to the quality of indoor environment that will profoundly affect the occupant's comfort, health, and productivity. One of them is by using Heating, ventilation and air conditioning (HVAC) systems to control the indoor environmental quality. The current house HVAC system is usually controlled by a single thermostat, which is called a single zone HVAC control, making it difficult to meet the various requirements of indoor occupant comfort and minimize energy consumption. Therefore, to solve the problem of a single zone HVAC, preferably a house, or building using a multi-zone wireless HVAC control system [9].

Chambers at all describes housing as more than just a roof over one’s head, but also as something that supports the physical, mental, emotional and social well-being of people living with HIV. There are Four salient themes have emerged from our qualitative findings: the interplay between the healthy housing and economic security. The relationship between HIV, health and housing precariousness the interconnection between housing, HIV, safety, stigma, social isolation and social exclusion; and the meaning of healthy housing for people living with HIV [10].

Therefore, this study aims to discuss the factors that must consider when going to build a house in Indonesia. This study used qualitative methods by analyzing related studies and supporting theories on buildings in the tropical climate and by conducting interviews with lecturers related to the object of discussion. The expected result of this research is to identify what factors should consider creating a healthy and comfortable house that adapted to the equatorial tropical climate in Indonesia. By considering the thermal factor and adjusting to the concept of sustainable architecture. The disadvantage of previous studies by this study is the lack of research related to housing development in Indonesia that has not considered the condition of Indonesia's climate.

2 Method
The method used in this study was a qualitative method of analyzing the literature or literature study related to the object of research. The technique used interview research by asking directly to the lecturer associated with the physics of development and the objective of the study.
3. Results and Discussion

3.1. Comfortable house in Equatorial Tropical Climate Indonesia

Thermal comfort felt by the human body and then a healthy building is a building that concern with the wind, air temperature, humidity, radiation temperature, and human physic, among others:

   a. The nature of the wind that was not visible but felt by the body made us must be able to arrange for the building not too big wind into the building because if it feels too big, the wind will damage human health, vice versa if the wind did not run. The humidity would be high and will harm human health, then sufficient wind needed to set the condition of the atmosphere that would feel at home, to state it required adequate ventilation and relevant concepts also have openings by the environmental climate surrounding the building. Example: for a house built high, then the wind rotation that moved from the hot temperature to lower temperature needs to observe and develop. In this case, an upper built house shall give avoid chamber for the air movement below for upwards and the presence of air passages (See Figure 2).

   b. The air temperature was very influential in the climate existing around the building environment, for example, if there were buildings around the mountain the air temperature was high enough. Then set the appropriate concept for heating, open space, which was just a small vent, but in some places, and could open the lid, and then there was a chimney fire.
c. Humidity in Indonesia, high enough because it influenced by the local rain and the Asian monsoon rain, from the rain humidity temperature would increase because the rain was wet, so the need for air to drain the humid air, the concept of openings architecture need. The building has a perfect opportunity and can flow air from the ground up and out; the process was necessary to remove the moisture in the building, the second with the proper sunlight enough, the sunlight that could remove moisture, such as the room would be bright when in the sunrise hours.

d. Radiation temperature was radiation produced by sunlight, at certain hours, let us first identify the climate in this Indonesia that is at 07.00 to 10.00 hours the sun produced ultraviolet light, this light was healthy enough for humans. This radiation temperature could be lower in the presence of auxiliary accents such as ponds, gardens, fountains, land topography for air movement, ventilation, trees and greening of the like. Like trees or other plants that could produce oxygen, but it also ponds tree that produced shading that helped the local shadow that created a relaxed atmosphere in the building environment. Furthermore, at 10:00 until the afternoon, sunlight produced infrared light that was less good for human health, therefore the orientation of a building when it would build better. It was much-exposed building to the part exposed to the early morning sunlight, then to the more extended and broader the better, on the long side facing north and south, so that the sun's light did not go too long to heat the building (See Figure 3).

![Figure 3. Good orientation.](image)

3.2. Healthy House in Equatorial Tropical Climate Indonesia

a. Human-Friendly is the House built according to function and character. The house can make the owner feel comfortable, the air inside the house is always fresh, light enough, low noise, and can be enjoyed by residents of all aspects. And functions of space, and architecture vernacular, for example, using renewable materials, using materials that are easily broken down by the soil, wood, bamboo and so on. It to reduce indoor noise or acoustic levels caused by outside factors such as vehicle sounds, houses should be built with layered facades or using new facades, such as wall accents, and planting trees or plants in front of the house (See Figure 4).

![Figure 4. Overcome noise.](image)
b. Environment-Friendly, namely (1) Houses that have shading or shadow that is beneficial to the environment around the house, to add coolness. The house environment should be combined with topography, or the existence of different elevations in buildings or land, some ways to spread new impression in the house environment is building a pond or garden in the yard. This is also part of the creation of the built environment by humans. (2) Houses constructed with attention to the active role of building materials or facades, for example, if the facade is made of stone, plants, it will create a fresh impression as well as natural, then before building a house must first study the properties of all building materials such as bamboo wood and so on the most natural. (3) Houses that pay attention to the selection of the color of the house by considering the direction of the sun that affects the absorption of heat in the house. For example, the color is bright or white it will make the absorption of heat from the outside of the house wall lower if it gave a dark color or black absorption the temperature will be faster. Then the building should be facing east or west so that the color is not dark, in addition to the effects generated from the construction of the house should also be considered, for example when building a house with asbestos concrete or glass material mat then it will impact global warming. Then we have to reduce the greenhouse effect through color selection (See Figure 5).

![Figure 5. Global Warming and greenhouse effect.](image)

4. Conclusion
From the study found that should be considered a healthy and comfortable house by the tropical climate equator Indonesia. It is a house that has adequate vertical with the location of the vertical adjusted to the direction of sunlight so that the house is not damp and the air temperature inside the house can remain stable, and necessary the presence of green open spaces in every house such as making a garden or planting trees around the house, it is useful to provide coolness in the house, reduce radiation from sunlight into the house, and reduce the noise levels from outside the house such as the sound of motor vehicles, as well as aesthetically enhanced house and have a good impact on the environment, and in the selection of house colors it is advisable for house facing east or west using bright colors to reduce heat absorption from the outside to the walls of the house.

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