The Role of Local Wisdom Values for Achieving Healthy Housing Concept in Humid Tropical Climate

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The Role of Local Wisdom Values for Achieving Healthy Housing Concept in Humid Tropical Climate

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Abstract

Indonesia is known as "Nusantara Architecture". The various of local wisdom values from Indonesian traditional houses have succeeded for local identity strengthening. On the other hand, residential housing currently prioritizes functional needs only, while aspects of formal characteristics and local wisdom values are not the main considerations in the design of today's residential housings. The role of local wisdom values as an approach in residential design is certainly interesting to study more deeply. Descriptive analysis research method through field observation and literature study which was carried out as an effort to answer the research problem. The results show that the optimization of the passive design strategy of residential buildings by adapting local wisdom values is expected to increase indoor thermal comfort levels, achieve building energy efficiency, strengthen the urban identity, preserve architectural styles, also develop of sustainable architecture. In this way, healthy housing with local character can be realized throughout Indonesia.

Keywords: Local Wisdom, Healthy Housing

1. INTRODUCTION

Indonesia is a country that has a variety of cultures, especially in the architectural field. It is interesting to study further. "Nusantara Architecture" ini Indonesia, has proven to have many superior values for decades. The characteristics of spatial, formal, structural and building materials, the utility of vernacular buildings are evidence that "Nusantara Architecture" was designed and built as a form of responsiveness to the geographical location and local climate so that it can survive in the present and in the future.

Over time, the development of urban communities greatly increased and ultimately contributed for housing needs. On the other hand, the land is increasingly limited. The values of the distinctive "Nusantara Architecture" in housing design are fading in each city. Functional needs in housing design are the main demands of the community, followed by considerations of formal, structural and building material aspects, as well as utilities as supporting factors for housing design. This phenomenon continues to this day, and as an architect or building designer certainly has a role for being able to maintain and preserve the variety of "Nusantara Architecture" and the values of local wisdom of each region.

Therefore, the role of local wisdom values for residential building design in order to realize healthy and comfortable housing by the users is the research problem in this study.

2. LITERATURE REVIEW

Sudikno, A. (2018) describes that the impact of progressive urban architecture development can disrupt strong historical and cultural values in an area. The demand for urban architectural works that can adapt the values of local wisdom is a challenge in itself in order to be able to walk side by side with traditionalistic urban society.

Choi, K. and Yu, C. (2011) discussed that eastern cultural design has been recognized as a healthy environmental design that achieves sustainability in the built environment. Design and construction of traditional building is considered climate responsive design. The integration of sustainable building design is pursued through a combination or reconstruction of engineering and natural principles to be reconsidered in improving the quality of human life.

Mirrahimi, S., et al. (2016) explained that the ratio and floor plan shape are influenced by the building shape. Optimization of building shape is the ratio of the length and width of the building in each climatic zone. In the formation of vernacular architecture, the height and shape of the building are influenced by several variables, such as the natural environment, climatic conditions, local materials, construction technology, and so on. The application of passive design principles in traditional buildings can achieve thermal comfort. In vernacular architecture, it is impossible to create a 100% thermal comfort zone, so it is necessary to make efforts to reduce occupant dissatisfaction (Lotfabadi, P., and Hancer, P. 2019).

Jamaludin, N., et al. (2014) explained that climate characteristics have an impact on building performance, especially the indoor thermal environment, energy performance, and the impact on the surrounding environment. The main climate characteristics are air quality, air temperature, humidity, potential sources of pollution, wind patterns, solar intensity, soil conditions, and site drainage systems. The function of sustainable building design has an impact on building operational efficiency, human productivity, and the effective use of natural resources.

The climatic parameters of a tropical climate are temperature, relative humidity, solar radiation, rainfall and wind. Tropical climates are generally characterized by high humidity, abundant rainfall and large solar radiation. In achieving thermal comfort, cooling and ventilation effects are always needed (Choi, K. and Yu, C. 2011).

The passive design strategy is developed by the architect through an architectural design approach so that the building responds adequately to climatic requirements (Kroner, W. 1997). A building designed to be responsive to local climatic conditions is called Passive Architecture (Zaki, W. R. M., Nawawi, A. H. and Sh. Ahmad, S. (2007). Climate responsive design is based on climate-adaptive building forms and structures for human well-being and reducing environmental impacts (Hyde, R. 2000).

Passive architecture approaches also termed as ecological building and green building, which are also recognised as energy efficient building and healthy building (Zhu, Y., and Lin, B. 2004). Therefore, passive design is a feature basis in an environmental sustainable design which control excessive heat gain in the building and relates the climate to human requirement (Azzmi, N. M., and Jamaludin, N. 2014).

Azzmi, N. M. and Jamaludin, N. (2014) explain that passive design elements can help to reduce the overheating problems in residential housing for warm and humid climate. Architects and building designers are stimulating creative typologies with passive design consideration for achieving energy efficiency and indoor environmental comfort. The incorporation of sustainability elements in the building design concepts will prepare more or green system in sustainable building.

Adaptation the design concept of sustainable development as a strategy for residential buildings can increase indoor thermal comfort and a healthy environment (Jamaludin, N., et al. 2014).

The benefits of sustainable building design, including:

a. To save resources and energy consumption, minimize the emission of toxic constituent, and recycle materials
b. To harmonize with the local climate, culture, traditions, and the surrounding environment
c. To maintain and improve the quality of human life and maintaining ecosystem capacity at local and global levels

Choi, K. and Yu, C. (2011) explained that good indoor thermal conditions will create comfortable (without thermal tension or heat stress for users) and healthy environment to maintain the user's quality of life. The initial stage of building design becomes top priority to reduce energy consumption during the utilization stage throughout the building's life cycle.

The optimization of climate responsive buildings will help to reduce energy consumption and improve indoor thermal environment. The large ratio of the external wall area/external window area increases the penetration of solar radiation in the building. The orientation of the building during the design phase should be considered as an important factor for saving energy cost and to reduce solar heat gain of the building. The integration of local climatic characteristics, building orientation and geometry, building site location, layout arrangement, and building envelope are important elements and have an impact on building energy efficiency and the built environment (Jamaludin, N., et al. 2014).

3. METHOD

Descriptive research method of qualitative analysis in this research is carried out through field observation also study of scientific articles, literature, books, and so on. The development analysis method is described descriptively from the data sets. The research variables studied were related to the role of local wisdom on passive design strategies for residential buildings in Indonesia, including spatial characteristics, formal (building facade) characteristics, structure and materials, and building utilities. The objects study of the research are a traditional Javanese house (*Joglo* House), a Lampung traditional house (*Nuwo Sesat* House), a Lombok traditional house (*Bale Tani*), and a Toraja traditional house (*Tongkonan* House), as well as a simple 45 m^2 house in Malang City, Indonesia.

4. RESULT AND DISCUSSION

The values of local wisdom in vernacular buildings certainly have many advantages that can be adapted to the current and future design of residential buildings. However, on the other hand, the design of the vernacular building has not yet fully achieved the thermal comfort conditions for the occupants. Therefore, the basic principles of residential building design now and in the future can accommodate or adapt the principles of passive design strategies for vernacular buildings with architectural modifications according to the socio-cultural character of urban communities.

The schematic of the plans and pieces of traditional houses from Jawa (*Joglo* house), Lampung (*Nuwo Sesat* House), Lombok (*Bale Tani*), and Toraja (*Tongkonan* House), can be seen in Figure 1.

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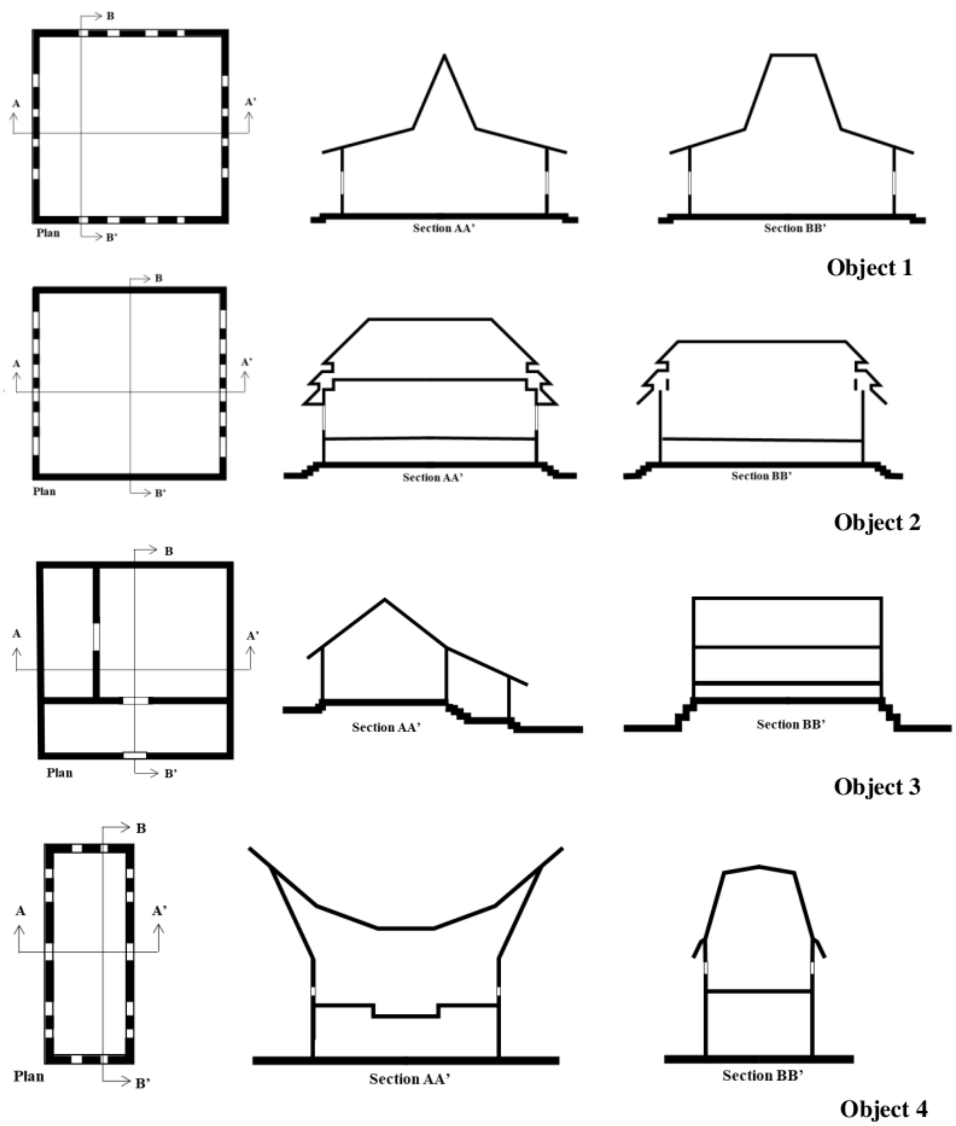

Figure 1. Schematic building design of the traditional house study object's; Object 1 - Javanese traditional house (*Joglo* House), Object 2 - Lampung traditional house (*Nuwo Sesat* House), Object 3 - Lombok traditional house (*Bale Tani*), and Object 4 - Toraja traditional house (*Tongkonan* House). Source: Adapted from Susilo, G. A., Umniati, B. S., and Pramitasari, P. H. (2019); Suhendri and Koerniawan, M. D. (2017)

The need for function in the layout of today's residential buildings is a major requirement. The fulfillment of local character in the spatial design and building facade is not the main thing. The typical 45 m2 residential building can be seen in Figure 2.

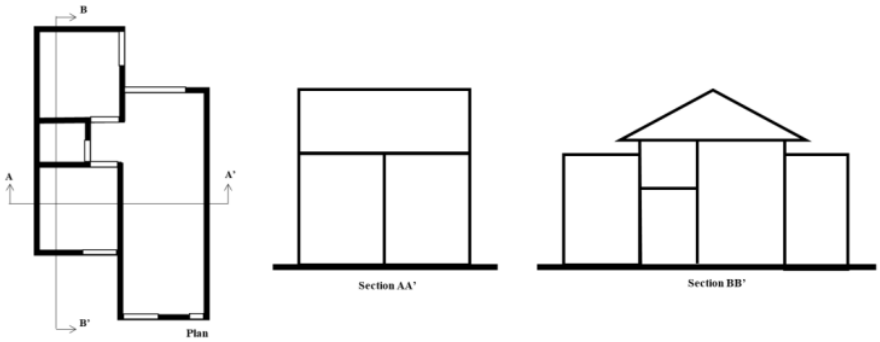

Figure 2. Schematic building design of the typical 45 m^2 residential building

Vernacular building design has been proven to have many advantages as can be seen in the following table.

Table 1. Characteristics of vernacular buildings with simple houses

No	Aspect	Vernacular Building	Simple House
1.	Spatial Characteristics		
a.	Land Use	KDB (building base coefficient) 40-70%, the function of the building as a residence, a place of business, a barn, worship facilities, a place to relax, toilets	KDB (building base coefficient) 60-70%, the function of the building as a residence, public housing facilities (if any)
b.	Land Boundaries	Fields, forests, mountains, hills, and/or settlements	Settlements, vacant land
c.	Mass Arrangement	Mass arrangement with a central, linear, or cluster pattern	Row houses with linear, grid, or cluster patterns
d,	Plans Ratio (length:width)	1:1, 1:2, 1:3	1:1, 3:2
e.	Inddor Planning	Divided into two zones; public zone (Guest room, family room, bedroom) and private zone (girls bedroom, kitchen, sacred room or heirloom room)	Divided into three zones; public (guest room), semi-public (dining room, kitchen) and private zone (bedroom)
f.	Outdoor Planning	Green area or opening space 30-50%	Green area or opening space 30-40%
g.	Topography	Contoured land and flat land	Flat land dominance
2.	Formal Characteristics		
a.	Building Orientation	Parallel and perpendicular to the contour (North-South, Northwest-Southeast)	North-South, East-West
b.	Building Shape (Ratio of Head : Body : Foot Building)	2:2:1; 4:3:1	2:2:1
c.	Opening Characteristics	Window material in the form of wooden lattice, WWR (Window to Wall Ratio) 0-30%, roof ventilation openings 0-10% to the the roof surface	Window material in the form of glass windows, WWR (Window to Wall Ratio) 10-40%, roof ventilation openings 0-10% to the roof surface
3.	Structure and Material Characteristics		
a.	Structural Systems	Structural system of beams, stage, V-shape, tie, pegs	Beam structure system
b.	Roofing Insulation	Bamboo, fibers, weeds, wood	Tile roof
c.	Wall Insulation	Woven bamboo, wood, bricks, clay walls mixed with cow dung	Bricks, bricks, aerated concrete
4.	Utility Characteristics		
a.	Water Supply, Waste Water, and Drainage System	Clean water wells, rivers, infiltration wells, site drainage channels	PDAM, clean water wells, absorption wells, city riol

No	Aspect	Vernacular Building	Simple House
b.	Daylighting System	Minimum source of natural light to indoor space	Natural and artificial light sources
c.	Air Ventilation System	Optimation of natural ventilation	Natural and artificial air ventilation

The benefits of local wisdom values are applied to the design of simple healthy residential buildings:

a. Strengthen the local identity of the region or city
b. Optimization of passive design strategies in low-rise buildings
c. Preservation of architectural styles
d. Implementation of sustainable architecture

On the other hand, the opening system for optimizing natural lighting in vernacular buildings is considered to be lacking. Therefore, it is necessary to adjust the natural lighting system in the optimum residential building to enter the room.

The passive design strategy of healthy residential buildings by applying local wisdom values can be pursued through the following alternatives:

a. Spatial characteristics
   1) Building orientation and layout
      Optimizing the north-south orientation of the building for the main function of the building, while the west-east orientation is optimized for the function of the service room.
   2) Building geometry
      The ratio of length : width of the building is 1:1, 1:2, or 1:3 for optimum lighting and natural ventilation systems.
   3) Interior planning
      Divided into public, semi-public, and private zones with flowing inter-space relations also good daylighting, air circulation, and cross ventilation systems for indoor.
   4) Outdoor planning
      Utilization of green open space is 30-40% of the site.
   5) Building interval
      Building interval and density settings are optimized for indoor thermal comfort.
b. Formal characteristics
   1) Opening characteristics
      Window material in the form of glass windows, optimum wide opening in the north-south orientation of the building, WWR (Window to Wall Ratio) 10-40%, roof ventilation opening 0-10% to the surface roof.
   2) Building shape
      The rasio of head : body : foot of building are 2:2:1 with a rectangular shape base.
   3) Building facade
      Using ornaments or architectural styles based on local wisdom to be appointed.
c. Structural and material characteristics
   1) Structural system
      Beam structure system and the development of earthquake - resistant building structure modules.
   2) Construction system
      Development of earthquake resistant construction system.
   3) Material type
      Use of low embodied energy materials, development of light weight materials, optimation of local materials, utilization of waste and/ or used materials.
d. Utility characteristics
   1) Water supply, waste water, and drainage system

Sources of clean water supply from wells, sewers for sewerage of waste water to riols or infiltration wells, drainage channels to riols, biopori holes, or infiltration wells.

2) Daylighting system
Through daylighting optimization by considering aspects of visual performance, illuminance, glare, uniformity, and daylight technology.
3) Passive cooling system
Through passive cooling such as natural ventilation; stack ventilation, cross ventilation, single-sided ventilation, and evaporative ventilation to induce air movement in the building.

e. Passive solar technology
Through passive solar heating (thermal wall) or solar control/shading device (internal; external).

5. CONCLUSION

The values of local wisdom in traditional buildings and vernacular buildings have a big role in improving the quality of residential buildings now and in the future. Passive design strategies in residential buildings through the inculcation of local wisdom values can be carried out through setting the design of the spatial characteristics of the building (building orientation and layout, building geometry, indoor layout, outdoor layout, building distance); the formal characteristics of the building (characteristics of openings, the shape of the building, the appearance of the building facade); structural characteristics and building materials (structure systems, construction systems, types of materials), building utility characteristics (systems for providing clean water, dirty and waste water, drainage; optimizing daylighting to indoor spaces; passive cooling); and passive solar technology. Optimization of passive design strategies in residential buildings with the right approach to local wisdom values plays a very important role in strengthening the image of the city or region, preserving local architectural styles, as well as supporting the implementation of sustainable architecture. Further research is certainly needed to dig deeper into the concept of a passive design strategy for healthy residential buildings with an approach to local wisdom values in one area.

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