LivaS: International Journal on Livable Space

Vol. 02, No. 1, February 2017 : 53-64

Doi: http://dx.doi.org/10.25105/livas.v2i1.4449

# **PRELIMINARY STUDY:**

# THE INFLUENCE OF MICRO CLIMATE ASPECTS TO MINIMALIST LANDED HOUSES AND A VERNACULAR STILT HOUSE (CASE STUDY: HARMONIA AND BELLAROSA CLUSTERS, KAMPUNG NAGA HOUSE, INDONESIA)

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#### **ABSTRACT**

Today, minimalist building style is considered appropriate to the reasons of: the high price of land and materials. Moreover, vernacular style inspires designers to categorisize it as a simple architectural type that is responsive to the context of micro climate. Both are modest style as undecorated building. This study aimed to communicate research result on the influence of micro climate aspects to both mentioned architectural types.

Descriptive-analitic approach applied in this article is to identify the differencies between the features of minimalist landed houses (Harmonia and Bellarosa Clusters) and vernacular stilt house (Kampung Naga) components which are influenced by micro climate aspects. The result of study is that the decreasing and increasing of indoor temperature are determined by wall type and material; ventilation system; roof, eave and bottom structure types; geographical position; openings dimension.

**Keywords:** micro climate; minimalist; vernacular architecture.

## INTRODUCTION

Curently, minimalist architectural style is being popular. This phenomenon occurs in order to adjust the high price of land and materials, as well as to the efficiency and effectiveness of room's functions. The housing design of minimalist architecture was inspired from Japanese architecture that influenced by the

traditional philosophy of "Zen". Zen conceptualize that the freedom of ideas and the essence of living manifested through the "simplicity" view of life,

ISSN: 2548-7515 (online)

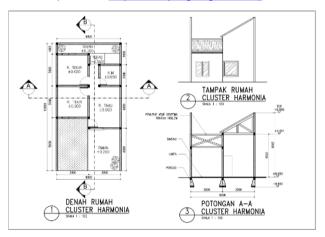
In the case of South Tangerang, there are two Clusters group in Villa Pamulang Residence, with the area of  $\pm$  8700 m2 and 6000 m2 and unit size of 42/84; 36/60; 30/66. They are tropical minimalist architecture design as figures followed.





Figure 1. Site Plan of Harmonia and Bellarosa Clusters

(Source: https://maps.google.com/)



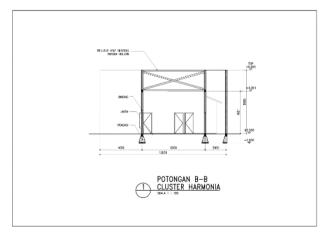
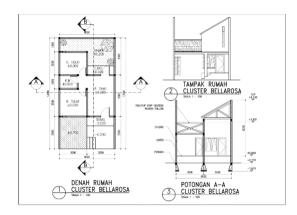


Figure 2. Floor Plan and Section of Harmonia landed house (Source: Author, 2016)



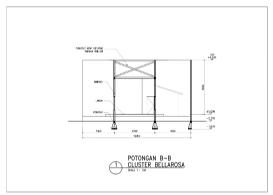


Figure 3. Floor Plan and Section of Bellarosa Cluster (Source: Author, 2016)

Japanese-minimalist architecture inspired from the Western-minimalist Architecture that is developed in 19<sup>th</sup> Century when Frank L. Wright movement was booming. The two physical features he implied are in using a big rolling door and in apllying separated rooms such as the followed samples:

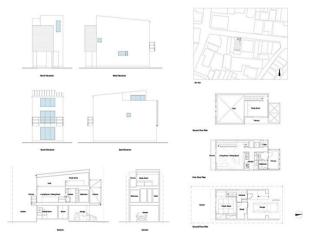


Figure 4. Floor Plan and Section of minimalist Japanese residence located in Osaka (Source: <a href="http://freshome.com/">http://freshome.com/</a>)

Japanese vernacular House has its own traditional philosophy. The philosophy seems to have similiraties with the philosophy of Kampung Naga traditional house. The occupants are still having strong belief on simple/uncomplicated life, living with nature and having the feeling that they are as part of surrounding nature (Handajani, 2015). It is manifested trough the using of simple ground plan, saving materials and unornamented house performance.



Figure 5. Site Plan of Kampung Naga (Source: <a href="https://maps.google.com/">https://maps.google.com/</a> and Indartoro, 1987)

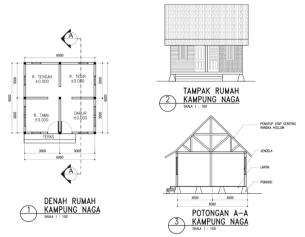


Figure 6. Floor Plan and Section of Kampung Naga (Source: Author, 2016)

Kampung Naga vernacular houses show their own local wisdom with local and simple technical knowledge and use thermal as well as natural lighting for more comfortable living.

# **METHODOLOGY**

This study implies descriptive-analitic approach. It was started with collecting the field data and literature review related to physical and micro climatic issues. The rest data was obtained by doing observations. Next, the dialogue between data and several theories as well as interpretation were conducted.

#### THEORITICAL REVIEW

# 1) Tropical Architecture Characteristics

One of tropical architecture theories related to this study is Geroge Lippsmeier's theory. He concerned on the effect of tropical climate and humidity for Indonesian architecture. He discovered that the range of air temperature of Indonesian humidity is between 28°-38C with humidity of 40-70% During dry season it is between 25°-29°C with the humidity of 80-100%, and during rainy season the rainfall up to 3000 mm / year. The higher degree of humidity, the weaker the wind would be. Lastly, the sun should be 12 hours per day.

Sangkertadi (2013) stated that the characteristics of a humid tropical climate are: (a) the average temperatures is 20°C; (b) the humidity is above 60%; (c) the rainfall intensity should be low in the dry season and be high in the rainy season.

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The good air humidity should be well-controlled with using ideal ventilation system. Its application can be in the form of a wide aperture, a wide-roof terrace that can be a backstop between exterior and interior spaces.

According to Lippsmeier (2013), the rougher wall surface and the thicker of air layer capacity can change the direction and speed of air movement. Therefore, hilly topography, as well as the density of vegetation and buildings capacities can obstruct or deflect air movement.

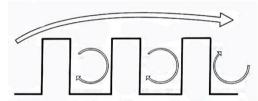


Figure 7. The direction of air movement among parallel and tight houses (Source: Georg Lippsmeier, 1997)

Wind direction commonly is considered to determine the orientation of building block in order to maximalize the air capacity flowing through ventilations on the wall of buildings. The basic physical form and orientation of building are considered relative to wind direction. Therefore, it is important to plot building mass and set composition among buildings masses wich are suitable to the direction and speed of existing airflow.

In tropical region, the steeper falling angle of sunshine the greater heat energy will be gained. For this, it is assumed that the ideal position of wide side of building mass should be directed to the north - south.

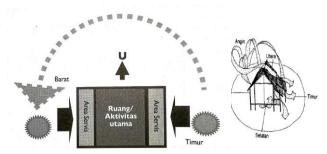


Figure 8. Building orientation toward the sun and wind direction (Source: Tri Harso Karyono, 2016 and Dwita Hadi Rahmi, 2015)

Commonly, the movement of airflow is from outdoor to indoor. Ventilation is used to create a natural cooling system. According to Lippsmeier, type, size and position of window can affect the process of natural ventilation mechanism. The airflow directly through into indoor by placing the openings appropriatelly, so that the exchange of airflow, with crossing ventilation, will make rooms comfortable.

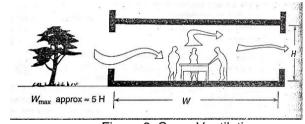


Figure 9. Cross Ventilation (Source: Susan Clare Roaf, 1995:156)

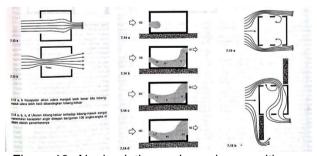


Figure 10. Air circulation and openings positions. (Source: Georg Lippsmeier, 1997)

According to Tri Harso, tropical roof cover form related to the solar heat capacity absorving into indoor. Therefore, the volume of room, the size of ventilation and the high of roof determine to reduce heat.

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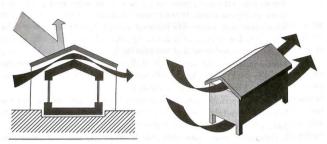


Figure 11. Roof as ventilation (Source: Tri Harso Karyono, 2016)

Natural lighting is important to support the daily activities of the occupants in addition to make rooms healthy. However, it must be noted that the capacity of natural lighting should be organized so that the used natural lighting in accordance with the capacity of rooms and activities. The techniques related to this are: 1) using sun protection; and 2) adjusting the angle of sun's rays fell to the surface of wall.

According to Lippsmeier (1997), sun protection can be opaque elements that are set on the surface of walls horizontaly or verticaly. To adjust the indoor air temperature, placing a barrier that can counteract the heat of sun is necessary, while the sunlight is naturaly able to reach the rooms.

The angle of sun's ray is determined by the relative position of sun. William M. C. Lam (1986) discovered that the use of shading is more efficient than use the low transmission glass. It is because that 10% of the sun's illumination of a low transmission glass is considered too large for a house.

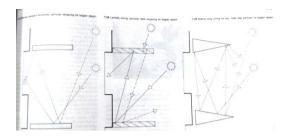
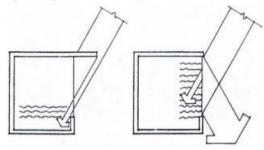


Figure 12. Sun shading device (Source: Georg Lippsmeier, 1997)

Figure 13. Shadowing Glass And Low



Transmission (Source: William M. C. Lam, 1986)

Table 1. The Various of Shading Device 1975

Shading Device	Advantages	Deficiency
Cantilever (overhang)	resistance to sunlight from above	Can't hold the sun that comes from low angle
Louver Overhang (Horizontal)	able to filter the intensity of light from above, adapted to the needs	Can't resist the light coming from a low angle Can't be applied to high-rise buildings
Panels/awning	Inhibit the sunlight at a low angle	inhibit the view to the outside inhibit the sky light, and became to the dark room
Horizontal Louver Screen	can adjust the intensity of the sun to be obtained blocking direct sunlight	Can't be applied to high- rise buildings

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Shading Device	Advantages	Deficiency
Egg Crate	capable of inhibit the sunlight from a low angle of arrival	the building facade be a rigid
Vertical Louver	blocking sunlight coming from the side at an angle of arrival of low light	still allows the entry of sunlight in large quantities

In addition to reduce the sun's ray, light diffusion is used to minimize the need of artificial lighting. High levels of lighting capacity are not efficient when it is not distributed properly.

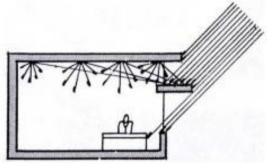


Figure 14. Daylight distribution (Source: William M. C. Lam, 1986)

# 2) Minimalist, Vernacular Architecture and Local Wisdom

There are minimalist architecture consepts that considered valuable to this study. Hari Kurniawan (2013) explained that minimalist style in Indonesia should be able to respond the features of tropical climates that are characterized by its extreme level of heat, rainfall and humidity. It also refers to the results of Troppo Architect's research, Darwin, Australia. The research discovered that there are 4 (four) tropical fundamental principles:

a) increasing the gentle of breeze; b) maximalizing natural air flowing through ventilation system; c) reducting of heat protecting radiation; d) the walls and openings. Charles Jenks (1982)conceptualized that, modern architectural style is the form of minimalist architecture that connected to the contemporary (modern) phenomena.

According to Bernard Rudofsky (1964), Vernacular Architecture is "Architecture Architect". without It means that architectural form is produced by local peoples respecting to local's ways of life and culture, using local materials, applying simple knowledge of engineering as well as stabilizing local environmental resourches. Therefore, it seems that vernacular architectture products are more concern on the considerations of local characteristic.

Charles Jenks (1982) described that Vernacular Architecture is architecture that concern to the circumstances or background, social, culture and environment.

Referring to the finding of Yudohusodo (1991), local wisdom can be defined as a basis of tradition and expressed in a man made which is culturally passed over generations of the certain community and tribes. Kampung Naga as a locus of study is a native village which has a genuine local knowledge; in addition to be occupied by the inhabitants who still take care of the simple living etiquette, traditional ritual ceremonies, and natural resources.

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#### DISCUSSION

In this study, the three cases (Kampung Naga stilt house, Harmonia and Bellarosa landed houses) are analyzed based on the aspects of micro climate, such as: the weather, natural ventilation system, natural lighting system, humidity capacity, related to the weather aspect, each case has its own temperature degree because of the differencies of geographical location.

Table 2. Micro Climate and Weather

Table 2: Wildi	Table 2: Wildle Chillage and Weather			
Aspects	Kampung	Harmonia	Bellarosa	
Overview	Naga	Cluster	Cluster	
Geographic al location	Between 6° 56' 49" - 7° 45' 00" LS dan 107° 25' 8" - 108°7'30" East longitude	Between 6° 36' 49" - 7' 45' 00" LS dan 106°8" 107°7' 30" East longitude,		
Temperatur es deegre	21,5°C - 27,1°C (the peak of the dry season in January 29,2°C),	of the dry	C (the peak season in 34,2°C),	
Humidity	75% - 80%.	60% -	- 70%.	

The above table shows that Kampung Naga stilt house has lower degree of temperature but has higher precent of the humidity than Harmonia and Bellarosa landed houses. Area of "Harmonia" and "Bellarosa" are 11 664 m², located between two hills along the river. The both sites are relatively flat; almost less of slope. While the landscape of Kampung Naga almost similar to both clusters. The village located between two hills, Singaparna and Karan Mount, with Ciwulan River flowing along the village.

Table (3) shows that Kampung Naga vernacular stilt houses seem more

comfortable that Harmonia and Bellarosa landed houses. Kampung Naga stilt houses has an optimal crossing airflow capacity because of the position north-south of building mass, in addition to the proper position of the openings hanging on all side of porous walls. It is different from Harmonia landed houses that they didn't have a good quality on cross airflow capacity, although they have a similar condition on the position north-south of building mass. Roof cover form of Harmonia landed house influences to the unavailability of space which doesn't allow the movement of airflow although they have ventilation and openings hanging on opposite solid brick walls. While, Bellarosa house mass that plotted on position east-west has impacted to the low capacity of natural lighting entering into rooms.

Wall type and material influences to the level of indoor air temperature. Solid brick walls of Harmonia and Bellarosa landed houses considered as a factor causing the higher indoor air temperature compared to the degree level of indoor air temperature of Kampung Naga stilt house. The porous wall of Kampung Naga stilt house causes the air flowing through tiny holes on entire wall surface freely, so that the indoor heat relatively decreases. The porous wall then functioned as ventilation. It might be one of the factors impacting the high capacity of indoor humidity. Related to this, the above table informs that the capacity of humidity and heat in Kampung Naga (75%-80%) is higher than in Harmonia and Bellarosa landed houses (60%-70%). However, the air temperature in Kampung Naga (26,5°) relatively lower than the two of mentioned cluster (28,7° and 28,5°). It is relatively related to the micro climate that is determined by geographical location. Kampung Naga located in sub urban area while both of Harmonia and Bellarosa clusters are in urban area.

The usage of sun shading device could be a proper supported instrument to decrease the indoor air temperature. The eave and roof space on Kampung Naga stilt house are longer and higher than on

Table 3. Natural Ventilation System of Harmonia and Bellarosa landed houses, and Kampung Naga Stilt House

Bellarosa landed houses, and Kampung Naga Stilt House				
Aspects	Theories	Harmonia House	Bellarosa House	Kampung Naga House
Building Orientation	According to the theory of Lippsmeier and Tri Harsono, building orientation should be facing to the North-South in order to optimize sunlight	The orientation of houses in Harmonia cluster facing to the	The orientation of houses in Bellarosa cluster facing to the	The orientation of houses in Harmonia cluster facing to the
Cross Ventilation	According to Lippsmeier, the proper way for placing ventilation is to set the openings at opposite side with	The section of b-b shows that the airflow trapped underroof.	East - West.    Color   Color	The section of a-a shows that the air crosses between opposite ventilation hanging on each side of building's wall.
Roof cover design	According to Tri Harso, pitched roof with a large volume of roof space can reduce the indoorheat.	POTONICAN A—A  SUBJECT SHANNONA  Harmonia house does not have ventilation holes under the roof.	POLICIONA B-B-B-CALLEGOA  POLICIONA B-B-B-CALLEGOA  POLICIONA B-B-B-CALLEGOA  POLICIONA B-B-B-CALLEGOA  POLICIONA B-B-B-CALLEGOA  Bellarosa house does not have ventilation holes under the roof.	The house at Kampung Naga has ventilation holes under the roof .

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Table 4. Natural Lighting System of Harmonia and Bellarosa landed houses, and Kampung Naga Stilt House

Aspects	Theories	Harmonia House	Bellarosa House	Kampung Naga House
National	Barra Utlara Selatan	TOWN TOWNS TOWNS TO SECURE AND THE SECURE	TOTAL FAMILIES AND THE PARTY OF	TOTAL FRANCE  TO
Natural Lighting Sources And Effect	The placement of building, ideally located across the direction of the wind, in order to optmalize air circulation, and natural lighting.	POTOGORA B-A  CHICAGOR B-A  ANDROPAS	POPERAR F-A-O	Natural Lighting entering the room come optimaly through the porous wallmaterials.
		Plan and the placement of openings influence to the proportion of indoor light and dark area.	The opening size is relatively larger than the previous cluster. Almost 85% of natural light illumines indoor area.	
Sun Shading Device System	Susan C Roaf said on her Journal of Climate Responsive Architecture –	side of house impacted to the	Shading devices hang on the top of openings influenced to the decreasing of indoor air temperature.	The long eaves and the usage of porous wall materials influence to the decreasing of indoor air temperature.
	Natural Ventilation of Building in India, Natural lighting sources can be supported by the addition of shading device elements to maximize daylight can enter into the room, but did not bring the heat from the sun.			

Harmonia and Bellarosa landed houses. This condition influences to the decrease of indoor air temperature and the increase of indoor humidity. Air flows not only passing through openings and porous walls but also crossing through hollow space under wooden floor. It is why the indoor air temperature of stilt house relatively lower

than landed house. Its means that the indoor high humidity and low heat capacity of Kampung Naga stilt house is influenced by six aspects: 1) porous wall; 2) cross ventilation system of openings; 3) higher roof space; 4) hollow space under wooden floor; 5) longer eave of roof, and 6) geographical position of sub urban land that surrounded by hills.

The forms of three mentioned building types are rectangle with crossing simple openings. However, there are differences wall materials on types. One unornamented porous wall, while the two others are unornamented solid brick wall. Building orientation rather affects to the magnitude degree of sunray angle, but the most important is related on the building construction system of Kampung Naga stilt house itself. The structure supports in stabilizing the indoor and outdoor air temperature because of the air flows in and out through porous wall at left, right, back and front sides; and passing by roof cover at the top and hollow space at the bottom of building. Landed houses of Harmonia and Bellarosa have different properties of building construction system. The air flows only through openings at the left, right, back and front solid brick walls. Ceiling roof and landed floor do not allow the air flows either from top to bottom or vice versa.

In term of micro weather, the sub urban geographical position of Kampung Naga is possible to affect the lower capacity of carbon emission because of the lower of air pollution. On the contrary, the capacity of carbon emission tends to be higher in urban geographical position Harmonia and Bellarosa landed houses because of the higher of air pollution. Although the three cases were in the plain surrounded by hills, but the level of air pollution influences the differences of micro weather condition. The high level of carbon emission affects to the high level of the air temperature.

#### CONCLUSION

The preliminary findings of this study are:

- Architectural product should be understood in a holistic view as integrated system that sensitively responds to the context of micro climate.
- 2) The integrated system related to the context of micro climate should consider: the tectonic of building structure and its components; the features of building material; and the aspects of climate.
- 3) The decreasing indoor air temperature is influenced by the usage of: porous wall; cross ventilation system of openings; higher roof space; hollow space under wooden floor; longer eave

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of roof, and geographical position of sub urban land that surrounded by hills.

4) The increasing indoor air temperature related to: building mass orientation; the size and number of openings; lower roof space, shorter eave of roof compared to the height of openings; and capacity of air pollution.

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