GREEN VERNACULAR ARCHITECTURE OF TRADITIONAL HOUSES IN BENA AND WOGO VILLAGE FLORES

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ABSTRACT

Vernacular architecture began when human was provided with only by natural resources around him to create a proper and comfort shelter which respond to its climate well. Vernacular architecture not only talks about the local material, but also the local craftsmanship which developed within limited knowledge over long time period. Despite of its significance, the existences of vernacular architecture keep declining, especially in modern architecture nowadays. On current term, actually the most important principle in vernacular architecture is similar with the popular green architecture which pointed out on energy efficiency and maximizing used of natural materials and resources around the site.

Indonesian traditional house, which perfectly demonstrate the principle of climate-oriented vernacular architecture in Indonesia, recently become a popular studies by more researchers. Mainly, the pattern of different forms in Indonesian traditional architecture is divided into two reasons. First is based on the program of the dwellings needed. Second is based on the geographical condition on regions. These reflect on a necessary response to topography, climate, and distribution of ethnic peoples, cultures, and vernacular architectural traditions. One of the interesting examples is traditional houses in Flores. The area is composed of independent and self-enclosed diverse micro regions, due to its special mountain geography and climate. This diversity and independence have encouraged the enhancement of uniqueness and varieties on the local ethnic cultures and dwellings. These points caused the traditional houses in Flores Island become an interesting example of Indonesian traditional house used the green vernacular principle.

This research has an objective to demonstrate the ideas similarity between old Indonesia vernacular architecture and the current global green building principle. There are several architectural elements which might be related, such as roof and walls covering. In order to define more architectural elements related to the issues, there are several Indonesian traditional houses used as precedent. The precedent used to find commons elements between various Indonesian traditional houses typologies. While the specific traditional houses in Bena and Wogo Villages would be used as the main measurement objects.

Keywords: *Indonesian traditional house, indoor climate, dwellings, green vernacular, Flores.*

A. INTRODUCTION

Vernacular architecture is the architecture that civilized and grown from the traditional architecture born in ethnic communities and is derived from ethnic traditions, and built by worker based on practice (trial and error), using local materials and techniques as well as a reaction to the environmental background where the building is and always vulnerable for adjustment (Sahroni, 2012). According to Sahroni, 2012, there are some categories of vernacular architecture in Indonesian building types, such as: traditional building build based on Austronesia Old Tradition, traditional building with mixed culture, and traditional building build within transformation. These categories mostly happened in dwelling spaces, which are well known as Indonesian Traditional Houses.

Each category happened because of different grounds. Traditional building build based on Austronesia Old Tradition related to the old tradition and culture of Hinduism – Buddhism, Islam, and Colonialism. While the traditional building with mixed culture consists of old local vernacular mixed with newer foreign architectural style. Last,

traditional building within transformation occurred with political and cross culture reasons.

There are many previous researches about Indonesian traditional houses. Mainly they study and describe about the traditional and cultural value of its local people resemble in its dwelling spaces. In the book "Mengenal Arsitektur Lanskap Nusantara," the author described well about the various types of Indonesian traditional houses from Sabang to Merauke. While in the academic paper written by Agung Murti Nugroho, he does research about thermal assessment in one traditional house in Indonesia.

Still, there are rarely researches about the relation between Indonesian vernacular architecture and the green building principle from architecture point of view. Thus, this research aims to study about its relation from architectural studies point of view. Which architectural elements are related to it, and in what kind of architecture forms.

Some of the examples of famous Indonesian traditional houses are The Long House of Dayak, The House of Minangkabau, and The Tongkonan of Toraja. These houses have a deep traditional and cultural values growth since a very long time ago.

B. LITERATURE STUDIES

The majority of Indonesian peoples share a common Austronesian (Australian and Indonesian) ancestry, therefore traditional homes of Indonesia share a number of characteristics with traditional houses from other Austronesian regions. The earliest Austronesian structures were shared timber longhouses on stilts, with steep sloping roofs and heavy gables. One of the best examples is Torajan Tongkonan. The distinctions on the communal longhouse philosophies also could be found among the Dayak People of Borneo, as well as the Mentawai People.

Figure 1. Mentawai Uma
(commons.wikimedia.org/wiki/File:Mentawai_Uma.jpg)

The main structure of this model is post, beam, and lintel structural system that transfers the load straight to the ground with shrink wooden or bamboo walls that are non-load bearing. Traditionally, rather than nails, tendon joints and wooden pegs are used. Traditional houses always use natural materials, such as timber, bamboo, thatch, and fiber. Not only on the structure, the use of natural resources also applied in the façade, floor and the roof.

Traditional housing has developed to respond the Indonesian local climate. As is common throughout South East Asia and the South West Pacific, most traditional houses are built on stilts, with the exception of Java and Bali. Housing on the stilts is famous because of a lot of factors. First, building houses off the ground allows breeze to modest wind passing through the buildings in the hot tropical temperatures. Second, it lifts the dwelling on top of storm water runoff and mud. Third, it also allows houses to be built on rivers and wetland margins. Last, the under part could be a storage room to keep properties and foods.

Figure 2. Traditional House of Riau
(www.pinterest.com/pin/573294227535807465/)

The last characteristics of Indonesian traditional houses are its roof. The roof shape is sharply inclined to respond the heavy tropical rain which can make the water quickly slip off. The huge overhanging roof outside also provides sun shading to protect the indoor space from the heavy daily sunlight.

Figure 3. The Roof of Traditional Batak Houses
Source:www.pinterest.com/pin/18788523415965726/

There are some examples of the famous Indonesian traditional houses that are more significant and distinctive, such as:

The Long House of the Dayak

The Dayak located in Borneo, Kalimantan. The longhouse was the most widespread house form in the interior of Borneo, even until the World War II (Guerreiro, 2004). In general, this longhouse consists of massive timber structure and layout which similar with other houses in western part of South East Asia built by Austronesian and Austroasiatic peoples.

Figure 3. A Dayak Longhouse
(//id.pinterest.com/pin/10414642863404629/?lp=true)

In most common type, The Dayak usually builds their long houses on stilts, using ironwood for the structure and tree bark for the walls. The floor is finished with a simple plank of wood which placed side by side. Originally, the length of these houses was around 110 meters (over 360 feet), but now, since it is more difficult to find the resources, they generally make it shorter and have a length around 10 to 70 meters (33 to 230 feet) (Artasia, 2018).

On Borneo, the long house became a center for both social life and for rituals. In this house, people have a community gathering, spiritual ceremony and ritual activities. The length of this house adjusts with the number of activities and families live inside. In one case, the length could be over 200 meters long.

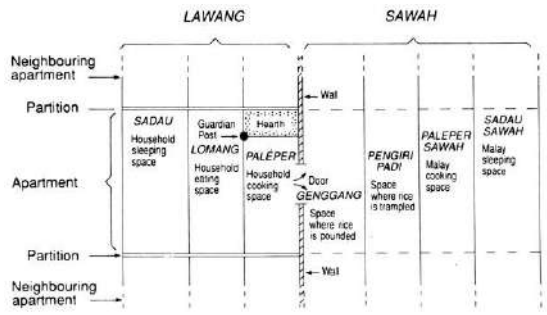


Figure 4. Example of Dayak Longhouse's Plan
(http://press-files.anu.edu.au/downloads/-press/p129191/html/ch03.html)

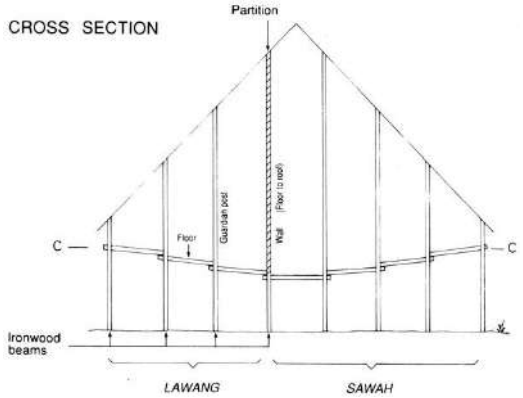


Figure 5. Example of Dayak Longhouse's Section
Source:http://press-files.anu.edu.au/downloads/-press/p129191/html/ch03.html

The Dayak takes the center of the long house as an important part. They always take this center part as a connection between under and the upper world, and have strong relation with their ancestors. The long house usually decorated with snake or bird ornaments. The snake resembles the underworld, which bird resembles the upper world (Artasia, 2018).

The House of Minangkabau

Actually the origin of Mingkabau is people who migrate from Malaysia to Padang (West Sumatra) at the earlier time. The strong character of the house of Minangkabau is its roof, which shaped like a buffalo horn. The word "Minangkabau" actually comes from the words menang (win) and kerbau (buffalo).

Figure 6. Traditional House of Minangkabau
(http://www.topindonesiaholidays.com/-blog/?p=3189)

This word derives from the local myth about the buffalo fight between local buffalo and the buffalo from the Java Island. In that fight, the local one comes up as the champion. As a result, they always called themselves as "Mingkabau" which bring strength and courage.

The traditional house of Minangkabau called Rumah Gadang (large house) and is occupied by three or four generation families who come from one ancestor. The status or family's level also can be seen from the size of the house and the layer of the roof.

Figure 7. Interior Part of Rumah Gadang
(https://www.arsitag.com/article/rumah-gadang-rumah-tradisional-minangkabau)

As its mentioned above, while we talked about Rumah Gadang, the first impression would be its sharp roof facing up, known as Gonjong. This roof resemble hope to reach God. The wall covered by bamboos' weaving symbolizes the strong unity between all people living together in their local community (Arsitag, 2018).

Rumah Gadang was supported by five main pillars, which divided the interior into four long parts, each part called Lanjar. On the back part, Lanjar become bedroom, while the other Lanjars used as common space called Labuah Gajah. The common space used as daily activities and ceremonial spaces.

Based on their cultural value, local people do believe that Rumah Gadang needs to have at least five rooms, which ideally should be nine rooms. Besides its

main building, Rumah Gadang also surrounded by supporting buildings, such as: Rangkiang Sitinjau (rice storage for ceremonial), Rangkiang Sitangka (rice storage for helping needed people), Rangkiang Sibayau-bayau (rice storage for daily used).

Figure 8. Colors and Details of Rumah Gadang (https://www.arsitag.com/article/rumah-gadang-rumah-tradisional-minangkabau)

For the details, Rumah Gadang used natural crafted, such as roots, trees, fruits, leaves, flowers, etc. These patterns related to their ancestral philosophy to learn from environment. As for the structure, they do not used nail as join but pegs as connection. The columns and pillars also not directly connected to the earth but sit on chipper. This method is used to muffle the vibration of the earth, since geographically the area is located in earthquake zone. This tectonic method showed a great knowledge of structural system of the local people since a long time ago.

The Toraja of the Sulawesi Highlands are Renowned for Their Tongkonan

Toraja refers to the ethnic groups who live in the mountain regions of southwest and central Sulawesi (Celebes). The word Toraja refers to "those who live upstream" or "those who live in the mountains". Their name is derived from Raja, which in Sanskrit means "king". In Toraja society, they always live with social strata or level. The aristocrats are called Rengnge, the common people called Makaka, and the slaves called Kaunan. This social level decides by the family status in the Toraja society.

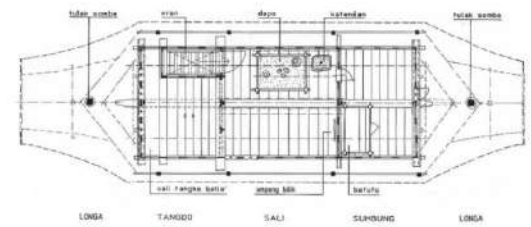
Figure 9. Complex of Toraja's Tongkonnan (www.torajaparadise.com/2014/11/orang-toraja-dan-makna-tongkonan.html)

Figure 9. Details of Toraja's Tongkonan (//bookishmomentt.wordpress.com/category/toraja/)

Toraja traditional house called Tongkonan. Tongkonan is one of the famous traditional houses in Indonesia. It is famous for the details, structural system, and the beautiful ornament inside and outside the house. The distinct element of the traditional houses is the "buffalo horns" and the roof design. The buffalo horns are a symbol of status, courage, strength and fighting spirit.

Take the universe as the house's main cultural perception, Tongkonan is constructed into three fragments. The first is the upper world (the roof), the second is the world of humans (the middle of the

building), and last is the underworld (the space under the floor). The highly distinctive roofs constructed by the Toraja have given rise to various ingenious interpretations.



The Lay-out plan of 'tongkonan'.

Figure 10. Layout Plan of Toraja's Tongkonan (http://perksofarchitect.blogspot.co.id/-2016/11/tipologi-rumah-adat-toraja.html)

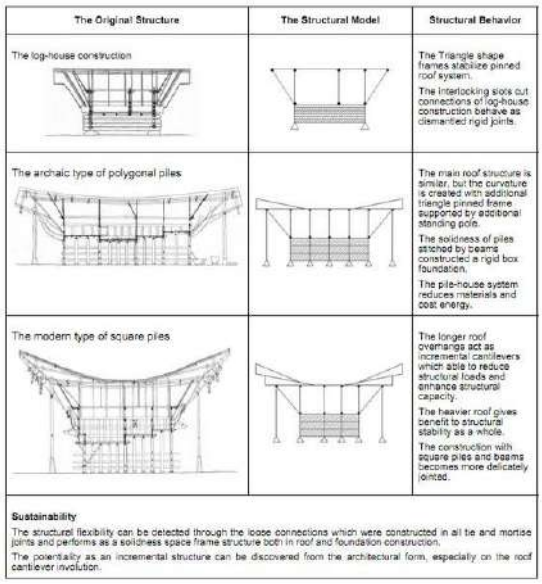


Figure 11. Tongkonan's Structure (id.pinterest.com/pin/663718063805534858/?lp=true)

Commonly, Tongkonan's floor plan is a rectangle with width and length ration 1:2. This building has divided into five parts, such as: foundation, column, floor, wall, and roof (Info Toraja, 2018). The floor consists of three layers, while the wall was made of wood panel tied up with special technique called Sambo Rinding. Roof was made of bamboo.

Each ornaments and colors use resembles the way of life of Toraja's people. Commonly they used red, white, yellow, and black. Red refers to life, white refers to human meat and bones, yellow refers to the almighty and devotion, and last black refers to sadness and death.

Figure 12. Colors and Ornaments in Tongkonan (infotoraja.com/mengenal-bagian-bagian-tongkonan-rumah-adat-toraja/)

In general, Tongkonan could be divided into five parts. First part called Banua Sang Borong which used as multipurpose room. Second called Banua Duang Lanta, it is consist of two rooms, Sumbung (bedroom) and Sali (working area, kitchen, and temporary mortuary space). Third called Banua Patang Lanta, used for daily activities. Forth called Banua di Salombe used for traditional leader's activities. Fifth called Banua Limang Lanta, majorly used for religious ceremonies routines and activities.

The Architecture of Indonesian Traditional Houses

The main ideas of the vernacular architecture in Indonesia traditional houses are the utilized of surrounding natural resources to create a shelter which also respond well to climate and geographical condition. These ideas could be seen on several similar architectural

elements found in every traditional house. The similarities consist of:

- Used of natural building materials such as timber, wood, and bamboos.
- Formed of longhouse sits on the stilts.
- Used of post and beam structure for the roof.
- The cross ventilation used in every house.
- The steep inclination of the roof to respond the heavy rain.
- Sun shading from the overhanging roof to keep the inner part from heavy sunlight.

Green Building

According to the World Green Building Council 2018, Green Building described as a building which in its design, construction, and operation process is trying to reduce or eliminate the negative impacts on our climate and natural environment. The main resolution of this green building is to preserve the precious natural resources and to increase our quality of life.

In general there are some features used in green building development (www.worldgbc.org, 2018), such as:

1. Energy efficiency.
2. Used of renewable energy.
3. Reducing the production of waste and pollution.
4. Good indoor environmental air quality.
5. Used of non-toxic material.
6. Consideration of environment in design, construction, and operation process.
7. Consideration towards life of the people in each process.
8. Adapt to the changing environment.

In its application, each feature would be adjusted to each specific climate, traditional and cultural value, building morphology, environmental, economic, and social conditions.

According to Givoni, 1994, there are seven classifications of passive cooling systems. There are:

1. Comfort ventilation which directly connected to human comfort, especially during the day time.
2. Nocturnal ventilate cooling which is providing a cooling for building structure and interior both during day and night time.
3. Radiant cooling to transfer cold energy generated during night time by radiant the heat loss from the roof.
4. Direct evaporative cooling could be provided by mechanical or non-mechanical technique.
5. Indirect evaporative cooling on the roof and the interior space.
6. Soil cooling by cooling its soil below the natural temperature to utilize it as cooling space for a building.
7. Cooling of outdoor space which using a technique that applicable for outdoor spaces.

Architecture of Indonesian Traditional House VS Green Building Development

Following the theories of green building development above, there are connections in design principle between Indonesian Architecture Vernacular and some Green Building Development Features, which are:

- The minimum used of energy (energy efficiency) by maximizing the use of natural lighting and ventilating.
- By the use of natural energy, the traditional houses are reducing the production of waste and pollution.
- The roof form allowed a good day and night indoor air quality, along with its functions as sun shading.
- Since they used local natural material, it is free from toxic.
- Within its cultural value, the traditional houses are fully respecting the living process of the local community.

- The long trial and error process, makes the houses are adapt to the changing environment.

C. RESEARCH METHODOLOGY

This research focused on the Indonesian traditional houses which deeply related to its vernacular in architecture. Theories and Researches showed that the current modern term of green architecture actually has a similar principle with the vernacular architecture concept. Thus this research will used the green principle in vernacular architecture as its scope of studies.

This research will used descriptive qualitative to apprehend each general case studies used as literatures. The literatures aims to validate the similarity and difference between each other objects, in order to have a conclusion about the meaning or caused of every ideas and concepts of vernacular used. The specific green architecture principle would be tested in one selected object to confirm its relation to the vernacular architecture. The working process of this research could be seen in figure 13.

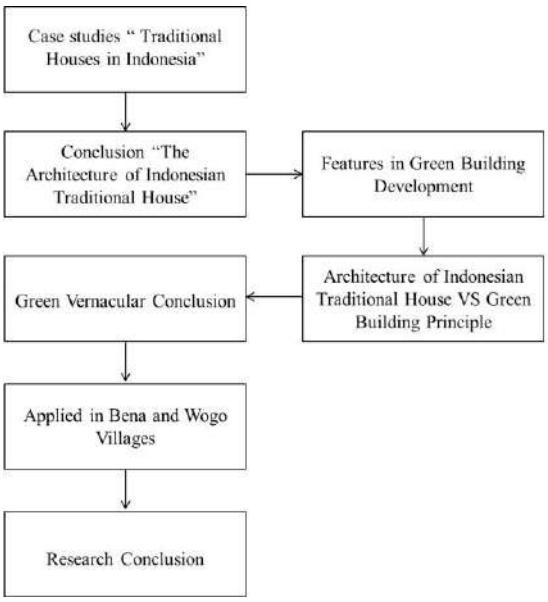


Figure 13. Working Flow of This Research

The selected object was select based on its authenticity and originality of form and cultural value. There are Bena and Wogo villages in Flores which still hold the traditions over generation, without much exposure to the outside world. Even though this villages were not as famous as other village in Flores, as well as its traditional house, the geographical and climate conditions of these areas are sufficient to be the main selection purpose.

D. ANALYSIS AND HIPOTHESIS

Flores Traditional House

Flores is one of the islands in East Nusa Tenggara Province. Geographically the island is dominated with rows of mountains with active slopes (Amin, 2016). The average air temperature around beach areas are 28-31^{o}C, while the temperature around the mountain areas are 15-20^{o}C. This temperature gap made Flores has an extreme different temperature for the whole areas.

Figure 14. Nature of Flores
(www.orangeflorestour.com/nature1/)

There are three districts in Flores, such as:

1. Manggarai District, it is including Komodo Island, Rinca Island, Todo Traditional Villages, Rutes Villages, etc).
2. Ngada District consists of Boloi Traditional Villages, Boloromzi

Villages, Langa Gedha, Langa Bela, Bena Villages, and Nage Villages, etc.
3. Ende District includes Wolotopo Traditional Villages, Jopu Traditional Villages, Nuabosi Villages, etc.

While geographically, Flores is divided into 8 different regions. There are West Manggarai, Central Manggarai, East Manggarai, Ngada, Nagekeo, Ende, Sikka, and East Flores (orangeflorestour.com, 2018). Each region has a different arrangement of traditional villages and a slightly different form of traditional houses.

Figure 15. One Traditional Villages in Flores
(www.desaseni.com/flores-ancient-rituals/)

In some of the regions, there is traditional villages with its traditional houses still exist even until now. There are several examples such as: Wae Rebo Villages in Central Manggarai, Bena and Wogo Villages in Ngada Regency, Wologai Villages in Ende Regency, etc. The traditional houses in those villages actually shared some similarity in building philosophy, structure and building materials (especially material for roof covered).

This geographic condition also divided the island into five different big ethnic groups with its different cultural value as well as its languages. The five different ethnic groups are:
1. Manggarai District with Ruteng as capital, has Manggarai Clan.
2. Ngada District with Bajawa as capital, has Ngada Clan.
3. Ende District with Ende as capital, has Ende and Lio Clan.
4. Sikka District with Maumere as capital, has Sikka Clan.
5. East Flores with Larantuka as capital has Lamalohot Clan.

Figure 16. Wae Rebo Villages Famous With Its Mbaru Niang
(http://florestourism.com/districts/wae-rebo-village/)

Figure 17. Wologai Villages with 800 Years of History
(www.mongabay.co.id/2017/04/02/wologai-kampung-adat-keren-yang-berusia-800-tahun/)

Bena and Wogo Village in Ngada District, Flores

Bena and Wogo Villages located in Ngada District, Flores, and East Nusa Tenggara Province, Indonesia. Ngada with its Ngada Clan still holds its cultural value over generation. It is resembled not only on their way of life, but also in the morphology of the villages and its architecture details.

Figure 18. Ngada Traditional Culture
(http://www.roamindonesia.com/flores-/flores-attractions/bajawa-traditional-villages/)

Figure 19. Bena and Wogo Traditional Villages
(www.https://diytravelhq.com/bena-wogo-villages/)

A. Bena Village

Figure 20. People of Bena Village
(florestourism.com/districts/bena-village/)

Bena is a community that is located about 16km from Bajawa, at the foot of Mount Inerie. Bena is the most well-known village in the Ngada District. With its remarkable stone formations and ancestral shrines, as well as the traditional houses, Bena has turned into a distinctive element of Ngada culture. As a whole composition, Bena village consists of two parallel rows of traditional, high thatch-roofed houses. In the center of the village, there are Ngadu and Bhaga, a pair of shrines – one for each family of the village – which became a representation of the family's ancestors.

This village consists of 485 traditional buildings, with the composition of 22 units on the left and 23 units on the right side (Amien, 2016). In the middle of those two sides of unit's rows, there is courtyard, called Kisanatha, which used as public space. Kisantha is the place where the ancestral graves located, covered with a cone shape houses.

Figure 21. Overview of Bena Village
(florestourism.com/districts/bena-village/)

Basically, the pattern of traditional houses in Bena Village is the same with any other villages in Ngada District. It is a row of houses on the left and right side, completed with middle courtyard called Kisanatha.

Figure 22. Bena Villages
(http://www.roamindonesia.com/flores-/flores-attractions/bajawa-traditional-villages/)

Kisanatha of Bena's Village is divided into nine levels. The orders are made

based on the Clan's level, such as: Loka Bena, Loka Angongad, Loka Kopa, Loka Wato, Loka Wajo, Loka Deru Kae, Loka Diz, and Loka Zeu.

The front part of houses which surround the Kisanatha called Pirosao, which became communal circulation, while the side part (called Wewasao) became the private part of the owner of the house. Within its topography, the Kisanatha of Bena Village divided into different heights level of Loka. In every Loka, they are constructed Watuwae and Terelengi as placed to put holy oil used during house or village's construction period.

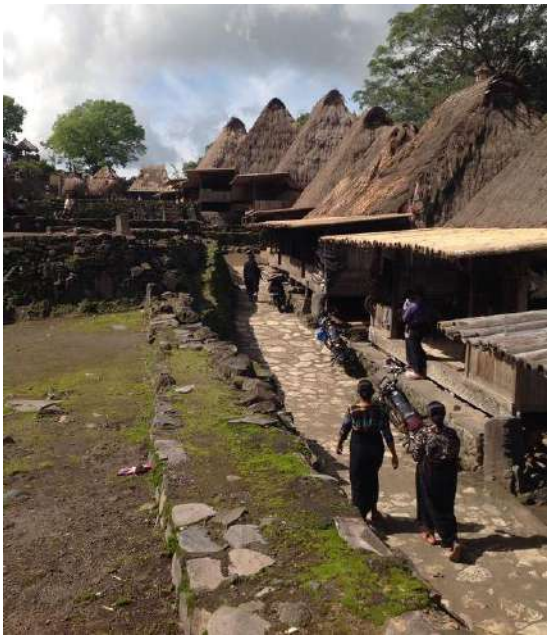


Figure 23. The Pirosao
(id.pinterest.com/pin/298715387755783984/)

Figure 24. Front Details of The House
(https://cycloscope.net/bena-gurusina-flores-traditional-villages-bajawa)

Figure 25. Buffalo Ornaments of The House
(https://cycloscope.net/bena-gurusina-flores-traditional-villages-bajawa)

In the middle part of the village, there is Ngadu and Bhaga. The Ngadu is a metaphor of umbrella-like pole embodying the male ancestor of a family. The trunk is ornamented with carvings and is covered with a warrior-like figure. The Ngadu symbolizes fierceness and virility. After a new Ngadu has been carved out of a special tree, the men of the village need to carry the pole in a ceremonial way into the village. The Bhaga, a female ancestral family shrine, is a small shelter with a thatched roof that resembles a miniature of a traditional house. It symbolizes the refuge of the house and the female body. The Bhaga offers enough space for one to two persons to hold rituals for female ancestors.

Figure 26. Ngadu and Bhaga in Bena Village
(http://www.roamindonesia.com/flores-/flores-attractions/bajawa-traditional-villages/)

Another distinct feature of Ngada culture, of which is in Bena village is the

megalithic formations in the center of the village. Megaliths are an important "tools" in this society ritual ceremony to have a connection into the supernatural realm and to communicate with the ancestors. This ceremony often follows by sacrifice some animals as a give to the ancestors.

Besides of those architectural elements above, there is Turesak Barajo. Turesak Barajo is big stone slab sits on some stone columns. Turesak Barajo used as the hero's grave or meritorious elderly's grave. There are six Turesak Barajo in Bena Village.

Figure 27. Turesak Barajo inside Bena Village
(http://indonesiaexpat.biz/travel/javanese-sailors-in-the-giants-homeland-the-traditional-houses-of-bena-flores/)

As with the Ngadu and Bhaga shrines, there is also a stone altar for each of the families. In addition, there is a massive mound of flat stones, called Lenggi, represents a courtyard where the different families of the village resolve their legal discussion. In every house façade, there are some ornaments, such as water buffalo horn and pig jaws. These ornaments are coming from the animal's sacrifice ceremony.

B. Wogo Village

Figure 28. Situation in Wogo Village
(florestourism.com/districts/bena-village/)

Lying to the east of Bena, Wogo is another fascinating village which features all the prosperity of the traditional Ngada culture. The village of Wogo is actually a newcomer in the Ngada landscape, compare to Bena Village. Indeed, it has been occupied only since 1932, when the population of the 'Old Wogo' decided to leave their original village with their ancestral megaliths behind.

Figure 29. Old Wogo Village
(florestourism.com/districts/bena-village/)

Figure 30. Ngadu in Wogo Village
(www.travelyourassoff.com/2011/08/inielika-wogo-flores-indonesia.html)

Figure 31. Bhaga in Wogo Village (www.travelyourassoff.com/2011/08/inielika-wogo-flores-indonesia.html)

In Wogo, there are nine sets of these structures representing nine different Clans. And so, there are many ceremonies are happened there. Traditional ceremonies usually contain the bloody sacrifice of buffaloes and pigs and are conducted for births, marriages, deaths, and new house construction. There is also a grave in front of one of the houses. This grave is used for the newly deceased, which are positioned right in the front yard.

Figure 32. Jawbones of Animals (www.travelyourassoff.com/2011/08/inielika-wogo-flores-indonesia.html)

Back in the old times, they were positioned in the center area of the village. Then since the numbers getting higher, those dead folks were getting in the way. As resulted, they started burying their relations' right in front of their houses.

When a new house is built a obligatory ceremony is conducted to guarantee good fortunate. This also involves the sacrifice of pigs and buffaloes. They hang the jawbones of those animals on the front entranceway to celebrate the event.

Figure 33. Ornaments of the Villages (http://www.roamindonesia.com/flores-/flores-attractions/bajawa-traditional-villages/)

Indoor Climatic Principle

Since *Bena* and *Wogo* village located close to each other, the typology of the house is also almost similar. The *Bena* and *Wogo* traditional houses principle is simply responding to the local climate, which are cold, hot, wet, and rainy along the year. Typically, *Bena* and *Wogo* traditional houses are unoccupied on the ground floor, and create a stilt house, which the ground floor will function as a storage room. Living room, bedrooms and kitchen will be located in the first floor.

Most of the houses have several layers roofs and each layer has a large overhang to protect the interior space from daylight

sunshine exposure. In hot humid weather, the main consideration is to bring the air comes in to increase the comfort level by providing a cross ventilation system through the windows. The orientation of most of the housing usually takes the east-west orientation.

Figure 34. Close Side View of Traditional House in Bena Village
(www.pinterest.com/pin/287526757432364962/)

The floor of the building is usually covered with wood and bamboo. For the interior space layout, usually the hall and the master bedroom will locate next to each other, which the master bedroom will has a slightly higher floor level than the other rooms. By doing this, it can create a damp-proof and dehumidification effects by letting the air circulate in the space between the different levels. Every room will cover by the wooden wall and also the wooden floor.

Figure 35. Roof of Traditional House in Bena Village
(id.pinterest.com/pin/99219998010648950/)

Figure 36. Close Perpective of Wogo Traditional Houses
(travel2unlimited.com/indonesia-flores-wo-go-traditional-village/)

Houses with two or more storey are common in Flores area, the main function of the second storey or above is for storage purpose. But indirectly, this can also function as an insulation layer of the building. It is very common that the roofs of the traditional houses are designed as a double-pitched raft, with an overhead double layer structure.

Figure 37. Front Area of Wogo Traditional Houses
(travel2unlimited.com/indonesia-flores-wo-go-traditional-village/)

The roof of a *Bena* and *Wogo* traditional houses is usually very steep, which helps rain to drain away quickly. As for the structure, this house uses a simple wooden structure, which a big column will support the whole house, and transfer the load into the ground. Basically, the houses in these two villages are simple, humble, and natural. Even for

some houses, it is still utilizing the most primitive colligation, instead of the more advanced rabbets method.

Figure 38. Wall Covering in Wogo Traditional Houses
(travel2unlimited.com/indonesia-flores-wo-go-traditional-village/)

Figure 39. Outside Layer of Wall Covering in Wogo Traditional Houses
(travel2unlimited.com/indonesia-flores-wo-go-traditional-village/)

The walls in *Bena* and *Wogo* traditional houses have a lot of functions. The wall itself, not only use to respond the climate, but also as a safety guard from the wild animals surround. The walls became a boundary between interior and exterior space. As its mention above, the wall was made from local bamboo, which arranged to prevent the cold air, but at the same time absorbs the sunlight to heat the interior space. The wall layer consists of bamboo for the outside layer (which usually has an 8 cm as its diameter), and wooden board as the inside layer. Located in the mountain area which the air will be low during night time, these two layers walls can provide a natural heating to its interior space.

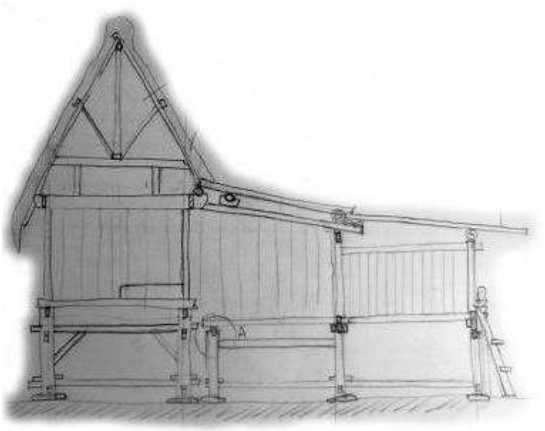


Figure 40. Sections of Wogo Traditional Houses
(Nugroho, 2012)

The *Bena* and *Wogo* traditional houses also have some ecological values, despite its primitiveness. First, its lifted floor (stilt house) minimizes the site damaged by the house's structure, protects the original ecosystem on the earthen surface and potentially reduces the landslides. Second, natural resources from the local mountain are used in building. Even the roof is made of a special kind of grass. Moreover, local material and simple construction endow it with a kind of purity and natural beauty.

E. CONCLUSION

Indonesia located on the equator line; therefore it has a tropical climate, which causes the temperature almost stabile along the year. Because of this reason, actually it is simpler to make an

architectural respond the climate, compare to some other country with more various seasons. Since the whole areas of Indonesia have the same climatic typology, it causes the basic concept about how to respond the climate of the whole part of Indonesia are almost the same. Basically to respond the tropical climate, the main concerns are to provide sun shading for the heavy sunlight and create a natural ventilation to increase the comfort level in interior space.

As it is describe above, it is prove that there are many similarities between Indonesian Architecture Vernacular and green building features (Green Vernacular). Even though it is not completely applied the whole green building features, but it is already trying to conduct a harmonized between building, environment, and human. With a long trial and error system, the local community comes up with a basic shape, which truly accommodates their needs. Which at the same time, it also responds to the local climate. The different geographical and cultural condition became the major aspects in giving a significance influences into its difference architectural form.

In the case of Bena and Wogo Villages, even though it creates by local community with limited knowledge and resources, it is very successful in applied the green building features, like any other Indonesian Traditional Houses.

In specific architectural elements, there are the most distinctive parts of Bena and Wogo traditional houses, such as:

- The form of steep roof which respond to heavy rainfall, along with its function to protect the interior form the daytime sunshine.
- Existences of windows allowed cross ventilation to cover the hot humid weather.
- East west building orientation responds well to the sun orientation.
- The common two storey houses provide a good insulation system.
- There is a small split level on the first storey between the bedroom and others room which provide a dehumidification effect.
- Used of bamboo not only provide a strong wall protected from wild animals, but also prevent the cold air by absorbing the heat from sunlight during daytime.
- Lifted house minimizes the damage towards its surrounding environment.

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