

# Identification of Application of Biological Architecture in the South Nias's Traditional House in Indonesia

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**Abstract.** Nias Selatan is located in the west of the island of Sumatra, Indonesia, has a unique traditional house in the form of a stilt house with a sloping roof, and a wooden frame construction where all the building materials are made of biological materials, obtained from the natural surroundings. Buildings are strongly influenced by the environment and its inhabitants, which are in harmony with the principles of biological architecture. This study aims to identify the application of biological architecture in South Nias traditional houses. The research method used is qualitative content analysis, namely research methods with in-depth conceptual integration. The environment (climate, location, vegetation, land and water) and people / inhabitants (basic human needs, culture, beliefs / religions, and livelihoods) are important indicators as well as factors causing the birth of the traditional house of South Nias. These factors will be analyzed to determine the impact (architectural design, materials, construction) on the building. From the research results, it can be concluded that the traditional houses of South Nias apply biological architecture that reflects the genius locus of their ancestors.

## 1. Introduction

Indonesia is an archipelagic country, which is unique in the presence of islands and their respective characters. As an archipelagic country, Indonesia has a diversity of traditional houses, which were born from the cultural local of society and its geographic location. Indonesia's Vernacular architecture, which is very rich, and reflection of the local wisdom of the ancestors of the Indonesian people, who always respect nature and always maintain the sustainability of the environment in which they are. Armed with local technology, which adapts to natural resources or local materials, the ancestors of the Indonesian people were able to build traditional house construction, which was largely dominated by wood materials, which at that time were very easy to get around. This also happened to the traditional houses of South Nias, located in the southern part of the island of Nias. Their ancestors were able to create wooden frame building structures, which had been proven robust when the Nias island was hit by an earthquake in 2005 and many traditional houses remained standing without damage, which meant.

As for the formulation of the problem in this study are any biological architectural factors that are identified by the application in the traditional house in South Nias. Thus, this study aims to identify it, with case studies of the South Nias traditional house.

The term biological architecture was introduced by several building experts, including Prof. Mag. Arch, Peter Schmid, Rudolf Doernach, and Ir. Heinz Frick. This theory means the science of connecting between humans and their environment as a whole. It also studies knowledge about the integral

relationship between humans and the environment. According to Heinz Frick, It is also an architecture that fits the occupants and local climate [4]. In biological architecture, planning no longer departs from plans to construction and finally to building materials, but building materials determine optimal construction and construction influences building form [6]. This is as seen in figure 1.



**Figure 1.** Systematic planning of Biological Architecture.

Source: Siahaan, Fanny, 2014

Biological architecture has several characteristics, including the following [8]:

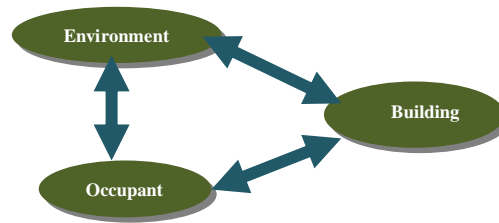
- Generally applied to traditional buildings, such as houses and other traditional buildings.
- Generally, a simple building.
- Using local building materials.
- Generally, a genius locus of the local community, especially in terms of technology and design
- Has three important indicators that are very influential, namely: environment, people/residents and the building itself

From the above characteristics there is a characteristic, namely that biological architecture is generally the result of local genius of the local communities which using building materials obtained from the surrounding area the environment can create suitable construction to design traditional houses or buildings.

For understanding biological architecture, must understand it from several indicators contained in biological architecture. The indicators are [8]:

1. Environment, which has the following variables:
  - a. Climate and temperature
  - b. Site
  - c. Vegetation
  - d. Soil
  - e. Water
2. Building with the following variables:
  - a. Floor plan
  - b. Building material/materials
  - c. Building construction
3. Humans/occupants with the following variables:
  - a. Basic human/occupant needs
  - b. Belief and Habit of resident /culture/customs
  - c. Livelihood

By understanding the indicators, and the variables above, it will facilitate the systematic identification of biological architecture. Every environmental indicator, building indicators and indicators of human have mutual relations in biological architecture, such as the scheme seen in Figure 2 [8]. It explains simply that the building where it's location automatically influenced by its environment. Otherwise, the environment will be affected by buildings contained in it. In addition to environmental influences, there are also influences from the culture/customs and livelihoods of the inhabitants.



**Figure 2.** Schematic influence of indicators in Biological Architecture.  
Source: Siahaan, Fanny, 2014

Astronomically, South Nias Regency is located between 1o 4' 5" North latitude and 0o 33' 25" South latitude, and between 97o 25' 59" and 98o 48' 29" East longitude and lies on equator line located at 00 latitude line. Based on its geographical position, South Nias Regency has boundaries: North - Nias Regency and West Nias Regency; South - Indian Ocean and the Mentawai Islands, West Sumatra; West - Indian Ocean; East - Indian Ocean, Marsala Island and Mandailing Natal District [6].



**Figure 3.** Map of Nias Island and South Nias

When viewed from the location of the settlement of traditional houses in South Nias, it is always found in the highlands such as hills or mountains. This implies the cosmological philosophy of the Nias people, where they assume that the higher the location of their settlements, the more prosperous their lives will be because they are closer to the world above (upper world/ancestor word). Based on their cosmology, the people of Nias set three worlds the world over as the upper world (ancestor's world), the middle word (human's world), and the underworld (departed spirit's world). Its application can be seen in the traditional house, which is divided into under / foot, house/body, roof/head [8], see figure 4. Besides that, throughout the island of Nias in the past there had been a war between villages and with invaders from outside the region and even abroad. This condition causes the ancestors of the Nias tribe, often to move around looking for a safe location for their settlements, namely on high hills/mountains with dense forests, which are difficult to reach by the enemies [8], see figures 5, 7.

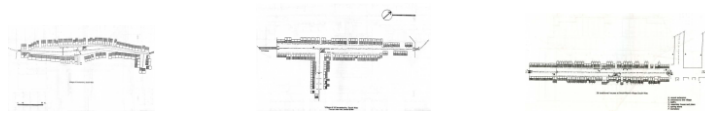


**Figure 4.** The Cosmology of Nias's society.

The pattern of settlement of the people of South Nias in general, has almost the same pattern, as the row of houses (Omo Hada) facing each other and the public courtyard/space in the middle as a place for socializing communities meant to carry out traditional activities [2], [9]. The king's house or a large traditional house (Omo Zebua) is generally located in the middle, occupying a strategic position as the center of government, see figures 5, 6, 8. Besides that, there is also a traditional hall (Omo Bale) located not far from Omo Zebua, as a gathering place for solving traditional problems [11], see figure 8.



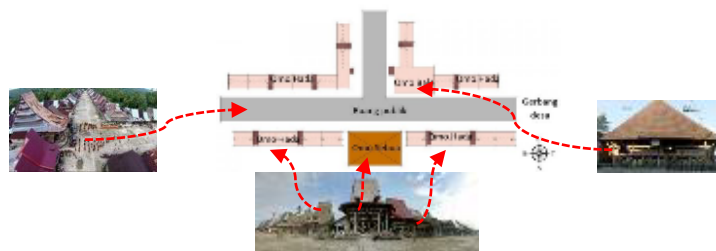
**Figure 5.** The pattern of settlement in the village of Bawomataluo in South Nias Regency, Nias island



**Figure 6.** The pattern of settlements in the village of North Nias; village of Onohondro (left), village of Hiliamaetaniha (center), and village of Botohilitano (right)



**Figure 7.** Villages in Nias, especially in the south, are often built on hills for defensive purposes.

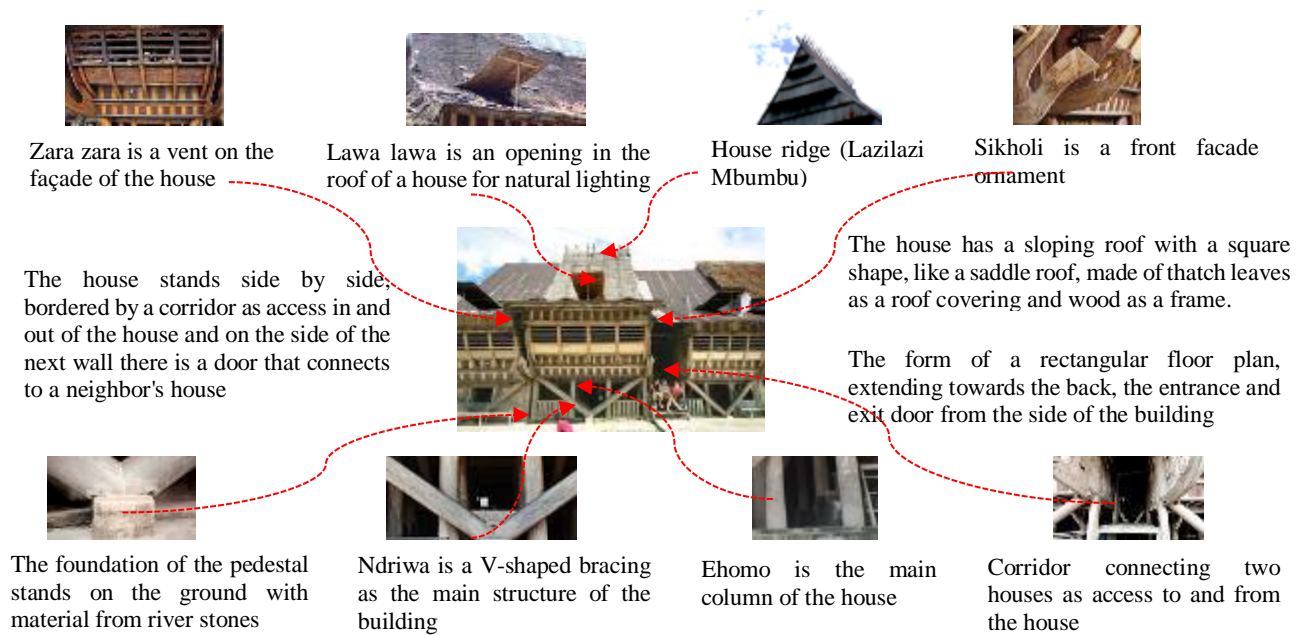


**Figure 8.** Forming elements of settlements in the village of Bawomataluo, South Nias

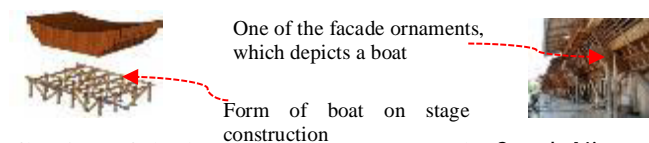
There are several characteristics in the traditional South Nias house "Omo Hada," consist of :

- The pattern of settlement of the people of South Nias in general, has almost the same pattern, as the row of houses (Omo Hada) facing each other and the public courtyard / space in the middle as a place for socializing communities meant to carry out traditional activities. The king's house or a large traditional house (Omo Zebua) is generally located in the middle, occupying a strategic position as the center of government, see figures 5, 6, 8. Besides that, there is also a traditional hall (Omo Bale) located not far from Omo Zebua. The long side of the house faces the street. Residential/rural orientation facing North-South.
- The house is shaped like a boat, according to the beliefs of the people of South Nias that their ancestors landed on the island of Nias by boat, see figure 9b.
- There are three main parts of house, namely: the head (roof), body (house), and feet (underneath), reflects the cosmological beliefs of its people, see figures 4, 9b.
- The house is attached to the house beside it by placed above the entrance of the house on the right and on the left wall there is a door that is connected to the neighbor next to the house. The main door of the house from the side of the house is opened into a shared corridor, see figures 11
- At the front of the row of Omo Hada and Omo Zebua there are generally megalithic stones in a standing and lying position, see figure 8. This is in line with the beliefs of the people of South Nias, namely dynamism and paganism.
- The Sloping and gable roof with wide overhang. Roof covering made of sago palm thatched woven. On the roof, there are some attic windows (Lawa lawa), as natural daylighting and ventilation. The roof is the dominant part of this traditional house, see figure 9a.
- Floor plans are rectangular, narrow and deep (generally 4 meters wide by 12 meters deep), and usually semidetached, see figures 9a.
- Upward sloping walls, like a boat, and on the upper wall, there are lattices (zara zara) for ventilation, see figures 9a.
- Constitute a building with earthquake-resistant wooden light frame construction and knock-down system. There are V-shaped beams (Ndriwa), which make the building earthquake resistant, see figures 9, 17-22.
- This house was built without using nails, but using wooden pegs. It is also knocked down, see figures 17-22.

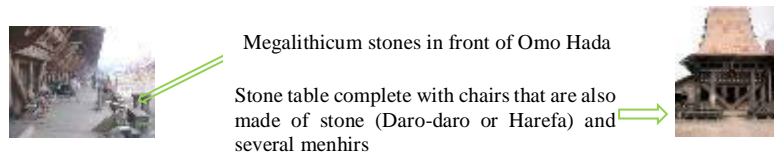
- Omo Hada is a traditional house in South Nias, which is a genius locus from South Nias's ancestors considering with environment and occupants 4, 9a.



**Figure 9a.** South Nias traditional house “Omo Hada” at Bawomataluo village, South Nias

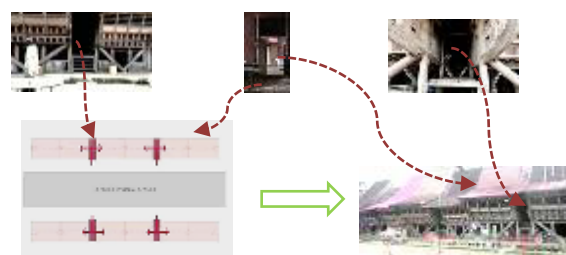


**Figure 9b.** The reflection of the boat shape on Omo Hada, South Nias traditional house

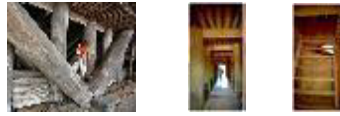


**Figure 10.** Omo Zebua (House of the king) in the village of Bawomataluo, South Nias Regency, Nias island

The interiors of both Omo Hada (ordinary houses) and Omo Zebua (houses of kings/nobles) are almost identical with a rectangular plan. Especially for Omo Hada, the entrance is on the side, which is connected to a common corridor towards the courtyard. The arrangement of traditional South Nias houses is adjacent to its neighbors, on the left side it is connected by a connecting door with its neighbor, while on the right side it is connected separately by a corridor with its neighbors [11].

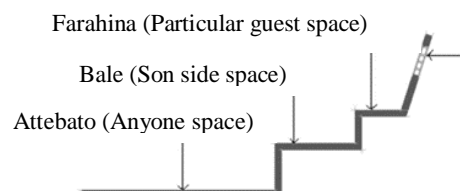


**Figure 11.** Shared corridor and connecting door of Omo Hada, in the village of Bawomataluo, South Nias Regency, Nias island



**Figure 12.** Access to Omo Zebua from under the building through the corridor to the stairs, which is connected to the main door

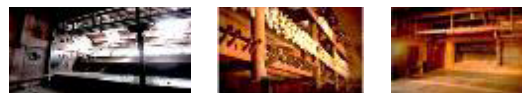
South Nias Traditional Houses, both Omo Hada and Omo Zebua, have a simple layout or floor plan, consisting of public spaces (Tawola), private rooms (Foroma), and services (kitchens). When you enter the entrance, you will find a public room, which has various functions, namely the room for receiving guests, gathering families, and carrying out traditional ceremonies [9], [11]. In this room, there is a division of seats based on the hierarchy of guests, namely: Attebato, Bale, and Farahina, whose positions lie parallel to the zara zara (lattice), as shown in Figures 13-15.



**Figure 13.** Interior section of sitting area in public area

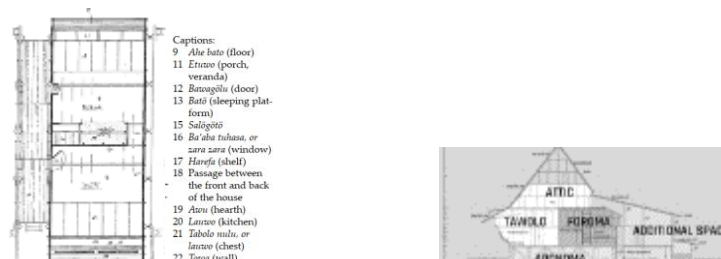


**Figure 14.** Public space (Tawola) for living room, traditional ceremonies, receiving guests (left, center) and private room (Foroma) for bedroom (right) of Omo Hada in the village of Bawomataluo, South Nias Regency, Nias island



**Figure 15.** Living room / public space (left), pig fangs, which were hung (center), and Hearth /Awu(right) of Omo Zebua in the village of Bawomataluo, South Nias Regency,

The construction of Omo Hada of South Nias is a wooden frame structure, which is lightweight and able to withstand earthquakes. Almost all materials are made of wood, without using nails, but instead of pegs and bamboo ropes or fibers, so that they resemble a knock-down building [1], [7], [9], see figures 9a, 18-22.



**Figure 16.** Traditional house of South Nias Omo Hada ; plan (left), and room Section (right)





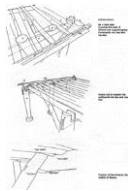
**Figure 17.** Traditional house of South Nias Omo Hada; longitudinal section (left), and cross Section (right)



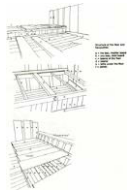
**Figure 18.** Construction of Omo Hada of South Nias [9]



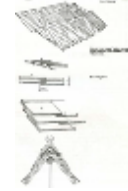
**Figure 19.** Stage construction / substructure [9]



**Figure 20.** Construction of Ndriwa / column V [9]

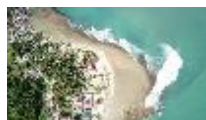


**Figure 21.** Construction of floor frame and floor covering [9]



**Figure 22.** Construction of roof covering [9]

The waters on the island of Nias become one of the characters of this island, meant in South Nias, where you can find several rivers, springs, and beaches, and are famous for the beauty of the waves of the beach so that it becomes a tourist destination for lovers of surfing, see figures 23- 25. Sorake Beach (see figure 23) in the village of Botohilitano, Teluk Dalam, South Nias is one of the beaches with wave heights up to 15 m. About 2 km, from this beach there is the Lagundri beach (see figure 24) in Teluk Dalam, South Nias with its special waves. Besides that, there are also waters of Tello Island and Mondrowe waterfalls, see figures 25- 26. The wealth of the South Nias water source becomes part of the daily lives of its people in meeting their basic needs, such as cooking, bathing, washing, farming, gardening, raising, etc.



**Figure 23 .** The beauty of Sorake Beach in Teluk Dalam, South Nias Regency



**Figure 24 .** The beauty of Lagundri Beach in Teluk Dalam, South Nias Regency



**Figure 25.** The beauty of the waters of the island of Tello, South Nias Regency, Nias



**Figure 26.** The beauty of the waterfall Mondrowe Village, Sidua Ori District, South Nias Regency, Nias Island

The Nias people call themselves Ona Niha, who have beliefs of paganism, dynamism, and animism. They really respect and adore their ancestors. According to them, they came to Nias island by boat for the first time to the Gomo river, South Nias, and it is believed to be the beginning of the birth of the Nias tribe. In every traditional activity of the people of South Nias, such as case and peace, the legal party [Fondrakö], construction of their house, personal events in a family, the birth of a child, death ceremonies, religious ceremonies/worship, hunting, must be done by slaughtering pigs, always slaughtering pigs, causing this animal to be an important part of the lives of the people and raising pigs is one of the livelihoods of the people of South Nias, see figure 29. In ancient times, the people of Nias recognized three groups of people, namely: kings/aristocrats, ordinary people, and slaves. Slavery was a trading commodity at that time. In line with the entry of Christianity to the island of Nias, slavery was abolished, leaving only kings, aristocrats, and ordinary people [7], see figures 23, 33.

Besides that, they also have the character of mutual cooperation and cooperation. Various traditional ceremonies, including building houses, are carried out together, even before there is adequate transportation, to transport wood by wooden cart (see figure 27) or transport megalithic stones with human labor, see figure 28.

The Nias community is known as a warrior society, see figures 30, 31. Their lives in the past were oriented towards self-defense against enemy attacks, so war became a part of people's daily lives. This can be seen in one of his traditional dances, war dance or Fataele dance, see figures 36, 37. This dance is performed by around 50 men complete with war clothes, which are dominated by black and yellow as well as clothes made from bark and palm fiber. Dancers are also equipped with headgear accessories, buffalo horns on the nose, weaponry, such as; Tologu's spear, shield, and sword. Fataele Dance depicts the condition of the Nias people in ancient times, who lived during the war to fight over or defend their territory. At that time there were often wars between villages, so that many cultures of Nias people, which tell the conditions of how they survive and fight enemy attacks [7].

South Nias has a rich culture, which was born from the traditions of its ancestors and is still largely maintained today. One of them, which is very well known is Jumping Stone (Fahombo or Hombo Batu), where initially as a proving ground for young men that if they can do this activity, then they are considered physically mature and ready to fight, see figure 38. Considering that at that time the people of South Nias were still living during the war so that young people were prepared to fight and become warriors [7], [11]. The height of the stone is about 215 cm and is located in the public courtyard/area. In the Bawomataluo village, this attraction is still a tourist attraction now. Until now, this dance has become one of the attractions of South Nias culture, especially in welcoming guests of honor.



**Figure 27.** Sled from trees to transport boulders and big logs



**Figure 28.** The transportation of large stones uses human



**Figure 29.** Every traditional ceremony / party, Nias people slaughter pigs



**Figure 30.** The group of warriors from Bawomataluo, South Nias



**Figure 31.** Warrior society



**Figure 32.** A group of villagers from South Nias





**Figure 33.** Nobleman and woman in front of Omo Zebua, South Nias



**Figure 34.** Traditional Nias clothes, made of tree bark



**Figure 35.** Traditional clothes of South Nias



**Figure 36.** Great war dance in Bawömataluo village, South Nias. (Museum Pusaka Nias)



**Figure 37.** Traditional culture Hombo Batu (Fahombo) in South Nias came from past life order

At first, the traditional clothing of South Nias people, made of tree bark, by weaving fibers from bark or grass, see figure 34. Men use vests, and loincloths, while women use cloak. Along with the times, they began to recognize textiles, so they could weave traditional fabrics became their custom clothing [7]. They also provided him with expertise in building and metalworking, for manufactured weapons, jewelry, and ornaments, see figures 30, 33, 37.

In the past, the people of South Nias were still living in conditions of war. To make ends meet they hunt animals in the forests, especially pigs, because these animals are very important in their lives, especially for traditional ceremonies, see figures 29, 40. Breeding is also one of their livelihoods at the time, to meet their needs for this animal [7]. The area of Nias referred to as South Nias has a wealth of vegetation, both in dense forests and on the coast. Throughout the area of Nias, referred to as South Nias, coconut trees are often found, so coconut and its processing are one of the largest plantation commodities in South Nias, besides that there are rubber, chocolate, and various spices. The tradition of raising livestock is still often found today in the South Nias region, especially raising pigs. Besides pigs, they also raise goats, buffaloes, chickens, and so on. Thus, it can be said that at present, people's livelihoods vary greatly, such as fishing, gardening, farming, raising livestock, and trading, see figures 38-40.



**Figure 38.** Hunting was the livelihood of the Nias tribe in ancient times.



**Figure 39.** Looking for fish is the main source of livelihood for the people of South Nias, especially in the coastal waters

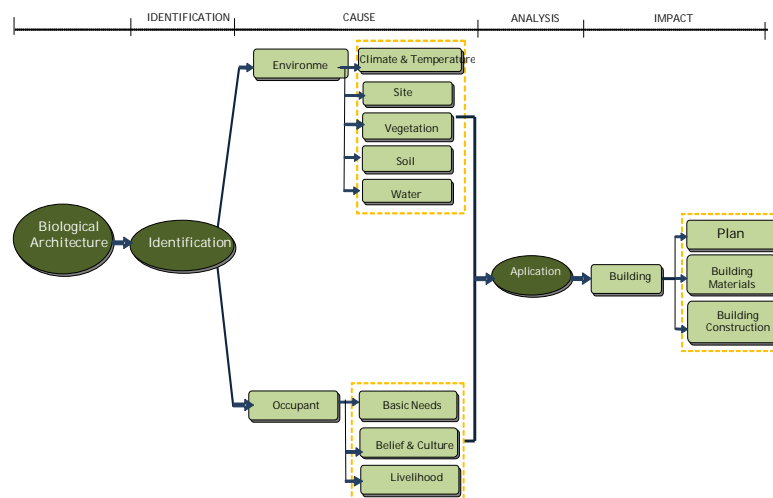


**Figure 40.** Gardening and farming are part of the life of the people of South Nias

## 2. Method

This study uses a method of qualitative content analysis (qualitative content analysis) is an analytical method with a deeper conceptual integration [3]. Data analysis is done with the data description stage, looking for trends based on data to find significance, and relevance. Furthermore, for all data obtained, identification of biological architectural indicators was then analyzed, the application of it in the traditional house of South Nias "Omo Hada" through the variables on each of these indicators.

In figure 42, a conceptual framework was described in this study where biological architecture can be identified through its indicators, namely: environment, occupants, and buildings [8]. The local area and occupants/humans are the causes of the impact on buildings in this case is the traditional South Nias house "Omo Hada," which can be described on the variables, as seen in Figure 41. Identification is carried out on the causes which are then followed analysis so that the impact is the application of the building, in this case the traditional house.



**Figure 41.** Conceptual framework of Biological Architecture.  
Source: Siahaan, Fanny, 2015

### 3. Results and Discussions

Environment and humans (occupants) are important indicators that will be identified and are causal factors. These causative factors were then analyzed to find out the impacts on buildings in the form of biological architectural applications in traditional house Omo Hada. In table 1, it can be seen the identification of indicators (environment, human, and building) along with each variable.

**Table 1.** Identification of each indicators and Its variables.

Identification of Each Indicators and Its Variables	
Indicators of Environment	
<b>1. Temperature and Climate</b>	<ul style="list-style-type: none"> <li>South Nias region has a humid tropical climate with relatively high rainfall because it located close to the equator. The climate situation is influenced by the Indian Ocean. Due to the large amount of rainfall the natural conditions are very humid and wet. The dry and rainy seasons change one year.</li> <li>The temperature will be in the range of 22.7 ° - 27.1 ° with an average percentage of humidity ranging from 89% - 93% .</li> <li>Average wind speed ranges from 5 - 6 knots.</li> </ul>
<b>2. Site</b>	<ul style="list-style-type: none"> <li>The geographical location of South Nias regency is located between 1° 4' 5" North latitude and 0° 33' 25" South latitude, and between 97° 25' 59" and 98° 48' 29" East longitude and lies on equator line located at 00 latitude line.</li> <li>South Nias Regency has an area of 2,487.98 km<sup>2</sup> and this region consists of 104 islands.</li> <li>The natural conditions / topography of South Nias Regency in general are narrow and steep hills and the mountains above sea level vary between 0-800 m, consisting of lowlands to bumpy reaches 20%, from bumpy to hilly land 28.8% and from hilly to mountains 51.2% of the total land area.</li> <li>Nias island is an earthquake-prone area, include South Nias regency.</li> </ul>
<b>3. Vegetation</b>	<ul style="list-style-type: none"> <li>South Nias region is a fertile area, which is overgrown with various plants, such as agricultural and plantation crops are the types that are often found, such as: coconut, rubber, rice, vegetables crops, etc. The coconut tree is the plant, which is often found in this region, see figures 5, 41.</li> <li>Besides that, there are also forests - thick forests overgrown with trees, which in ancient times used for building materials see figures 5, 41.</li> </ul>
<b>4. Soil</b>	<ul style="list-style-type: none"> <li>Generally, the soil structure on the island of Nias is soft soil. Rock structure and unstable earth structure cause frequent flash floods in this area.</li> <li>The character of the soil is volcanic soil, which be good for vegetation.</li> </ul>
<b>5. Water</b>	<ul style="list-style-type: none"> <li>Natural conditions, most of which are hilly - mountainous and mountainous, consisting of lowland to undulating, resulting in the formation of waters flowing from the mountains towards the sea waters around the island, such as Lagundri beach, Sorake beach, Tello island, Mondrowe waterfall, etc., see figures 23-25.</li> <li>Water as a primary need for the community was obtained from rivers, beaches, or lakes, which flow around their villages. The occupants have abundant access to get water for their daily needs, such as drinking, cooking, bathing, washing, planting, and raising livestock.</li> </ul>
Indicators of Occupants	

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### 1. Basic Human Needs

- Basic needs/activities of residents such as eating, sleeping, resting, cooking, bathing, and special needs, such as socializing (visiting and holding traditional meetings), working, and worship.

### 2. Belief and Culture

- The South Nias tribe of ancient times had animist beliefs and dynamism, besides that polytheism beliefs.
- The beliefs of the Nias people, emphasizing the worship of ancestors (Fonanba Adu Zatua).
- But after the entry of Christianity into the island of Nias in 1865, and mass repentance (Fengesa Sebua) in 1916, many people embraced Christianity, and some traditional practices were not allowed, such as Mengayu, Fonanba Adu Zatua, Making megalithic statues, slavery, etc.
- In the order of life of the people, known as social status, namely: Kings, nobles, commoners, and slaves, see figures 32, 33.
- The life of the people of South Nias in ancient times were surrounded by war, so they were known as warriors, see figures 30, 31.
- Hold firm and preserve its culture/customs.
- Respect their ancestors with their rituals or religious ceremonies.
- They also adhere to Megalithic culture, by making statues as a liaison with their ancestors, who are gone and social status symbols, see figure 10.
- Many philosophy or attitudes were expressed in the design of the traditional house
- They have character of mutual cooperation and cooperation. Various traditional ceremonies, including building houses, are carried out together, even before there is adequate transportation, to transport wood by wooden cart (see figure 27) or transport megalithic stones with human labour, see figure 28.
- In ancient times the Nias tribe made clothes from tree bark, or by weaving fibers from bark or grass because they were not familiar with textiles. Men wear vests and loincloths, while women use robes, see figure 33. After getting to know textiles, they make traditional clothes with three principal colors, namely: yellow, red, black, which also symbolizes the character of the community, see figures 30, 35.
- South Nias people are familiar with other body jewelry and accessories, from ancient times, as war equipment. Besides that it also shows social status, especially for nobles and warriors, see figure 30. Their jewelry was made from copper, gold, coconut shells, and shells, in the form of necklaces, earrings, and head ornaments.
- Traditional dances, one of which is famous for the Fataele dance, see figures. 36, 37.
- Each party holds a traditional ceremony (Owasa), Nias people always slaughter pig animals, see figure 29. These ceremonies include:
  - ✓ Birth ceremony
  - ✓ Death Ceremony
  - ✓ Wedding ceremony
  - ✓ Nobility ceremony

### 3. Livelihood

- The life of the people of South Nias in ancient times was surrounded by war so that to fulfill their daily needs they were hunting, farming and raising livestock, see figures 39-41. They are also experts in making metal/iron equipment, such as: weapons, jewelry, etc.
- They were also active in slave trading activities, where slaves were sold by exchanging it for gold, but this activity was removed in line with the entry of Christianity into the island of Nias.

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## Indicators of Building (Omo Hada traditional house of South Nias)

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### 1. Building Designs

- In ancient times, the settlements of the people of South Nias were on hilly plateaus, which were still dense forests, see figures 5.
- The pattern of settlement of the people of South Nias in general, has almost the same pattern, as the row of houses (Omo Hada) facing each other and the public courtyard / space in the middle as a place for socializing communities meant to carry out traditional activities. The king's house or a large traditional house (Omo Zebua) is generally located in the middle, occupying a strategic position as the center of government, see figures 5, 6, 8. Besides that, there is also a traditional hall (Omo Bale) located not far from Omo Zebua. The long side of the house faces the street. Residential/rural orientation facing North-South.
- The house is shaped like a boat, according to the beliefs of the people of South Nias that their ancestors landed on the island of Nias by boat, see figure 9b.
- There are three main parts of house, namely: the head (roof), body (house), and feet (underneath), reflects the cosmological beliefs of its people, see figures 4, 9b.
- The house is attached to the house beside it by placed above the entrance of the house on the right and on the left wall there is a door that is connected to the neighbor next to the house. The main door of the house from the side of the house is opened into a shared corridor, see figure 11
- At the front of the row of Omo Hada and Omo Zebua there are generally megalithic stones in a standing and lying position, see figure 8. This is in line with the beliefs of the people of South Nias, namely dynamism and paganism.
- The Sloping and gable roof with wide overhang. Roof covering made of sago palm thatched woven. On the roof, there are some attic windows (Lawa lawa), as natural daylighting and ventilation. The roof is the dominant part of this traditional house, see figure 9a.
- Floor plans are rectangular, narrow and deep (generally 4 meters wide by 12 meters deep), and usually semidetached, see figures 9a.
- Upward sloping walls, like a boat, and on the upper wall, there are lattices (zara zara) for ventilation, see figures 9a.
- Constitute a building with earthquake-resistant wooden light frame construction and knock-down system. There are V-shaped beams (Ndriwa), which make the building earthquake resistant, see figures 9, 17-22.
- This house was built without using nails, but using wooden pegs. It is also knocked down, see figures 17-22.
- Omo Hada is a traditional house in South Nias, which is a genius locus from South Nias's ancestors considering with environment and occupants.

### 2. Building Materials

Building material was a biological material, and obtained from the surrounding environment, which consists of [1]:

- Foundation

- Made from river stones, which are formed in boxes and obtained from rivers in the surrounding locations.
- **Column**  
Made from hardwood material which was left in a round shape which is cleaned by bark. Columns was made from Nia's epidemic wood, namely Berua or Manawa Dano wood
- **Beam**  
Ndriwa Beams and all beams made from Berua or Manawa Dano wood
- **Floor**  
The floor plate was made from wooden boards from Berua or Manawa Dano wood, which was arranged on the floor beams
- **Walls**  
The walls were made of Berua or Manawa Dano wooden panels, arranged horizontally on the frame of the wall
- **Roof Truss**  
The main roof frame was made of Berua or Manawa Dano wood and bamboo as additional material
- **Roof cover**  
The roof cover was made of dried palm sago leaves.
- **Connections**  
Connections do not use nails, but use pegs, which was made of palm wood.

### 3. Building Constructions

Construction of buildings is a stilt house with a wooden structure, which is lightweight, with the following components [1], see figures 17-22:

- **Foundation**  
It is a single-footing foundation, which was made of river stone in the shape of a box (Gehomo stone).
- **Column**  
The substructure column (Ehomo), derived from intact wood, is placed on a stone foundation so the column does not touch the ground. The number of columns depends on the area of the house. While the column/pole on top (upper structure), consists of four main pillars (Silalo Yawa), which function as the main structure in the building.
- **Beam**  
Ndriwa Beams is V beam, which is below the building block and was placed on a rock (Ndriwa stone), which provides resistance to earthquakes.
- **Floor**  
The floor is wooden boards, which were mounted on a floor frame with a system pen.
- **Walls**  
The wall panels were made of timber panels, slotted into the big side beams of the house using tongue-and-groove joins.
- **Roof Truss**  
The roof construction is an arrangement of wooden frames, which are made terraced to form a high, gable roof with wide gutters.
- **Roof cover**  
The roof cover is made of woven rumbia leaves, which are dried and arranged on top of bamboo ribs.
- **Connections**  
All connections in this building use wooden pegs so building is knock-down. As a binder, coconut fiber was used.

Source: Siahaan, Fanny, 2020

After identifying environmental, and occupant indicators, along with their respective variables, see table 1, then an analysis of the impacts on the building is carried out, which in this case is a traditional South Nias house, as shown in table 2.

**Table 2.** Impact on Building (Traditional House in South Nias “Omo Hada”)

Indicators/ Variables		Impact on Building (Traditional House in South Nias “Omo Hada”)
<b>Indicators of Environment</b>		
<b>Temperature and Climate</b>	•	With a humid tropical climate, the roof of the building implements a sloping roof, see figure 9a. Gable roof with a wide overhang, provide shade to the inside of the house.
	•	Wood is a hygroscopic material, that is, it can absorb or release moisture as a result of changes in humidity and air temperature around it. The more humid the surrounding air is, the higher the humidity of the wood is until it is balanced with the environment. Wood material as the dominant building material capable of adapting to the existing temperature and humidity, see figures 9a, 18-22.
<b>Site</b>	•	Matting of thatch leaves as a roof covering can protect the building from the sun's heat, see figures 9a, 22.
	•	High rainfall, which causes moisture, the humidity was anticipated by laying the column above the stone foundation and not touching the soil directly, so that it avoids decay/weathering, see figures 9a, 19.
	•	The interior of the building, protected from moisture, with the roof window (Lawa lawa) and lattices on the walls of the building, which become a way of sunlight into the building, as well as lighting and natural air, inside the building. The roof space, which is high, helps air circulation take place optimally in the building, see figure 9a.
	•	In the pattern of Omo Hada settlement, in South Nias, all houses face North-South. This orientation gives natural lighting and airing, which is optimal for every home, see figures 5, 6.
	•	The foundation of the building is a single-footing foundation because it was located on a contoured soil surface, see figure 9a.
	•	Houses are raised from the surface of the land (house on stilts), to avoid flooding and moisture, which can damage building materials see figure 9a.

		<ul style="list-style-type: none"> <li>• Located in mountainous and forested areas, the form of a stilt house can avoid occupants from wild animal attacks, see figure 9a.</li> <li>• Geographically located in earthquake-prone areas, buildings are made of wooden structures, which are lightweight, with columns, which were located above the stone shelf, so that when an earthquake occurs, flexible buildings follow earthquake movements without damaging the main structure of the building, see figures 9a, 17, 18.</li> <li>• Beams that are V-shaped, and located on a rock (Ndriwa beam), as a structure, which forms bracing, so that it can withstand earthquake vibrations, see figures 9a, 17.</li> </ul>
<b>Vegetation</b>		<ul style="list-style-type: none"> <li>• Buildings were built with biological materials, namely: Berua wood, thatch leaves, bamboo, Palm wood, river stones, which were local materials, which are obtained from surrounding areas, such as forests and rivers, see figures 5, 40.</li> </ul>
<b>Soil</b>		<ul style="list-style-type: none"> <li>• Soil conditions that tend to be soft and the soil surface is bumpy - lumps were anticipated by making single-footing foundations, which are made of stone and laid on the ground surface, by making a runway under the foundation of the stone pair, see figure 9a.</li> </ul>
<b>Water</b>		<ul style="list-style-type: none"> <li>• The source of water is one of the considerations in choosing a site location. The South Nias region has many water sources, which come from rivers, beaches, waterfalls, and lakes, see figures 23-26. The source of water for the community for daily needs, such as cooking, washing, bathing, raising livestock, farming, which the ancients set the site near water sources.</li> </ul>
<b>Occupants</b>		
<b>Basic Human Needs</b>		<ul style="list-style-type: none"> <li>• Vertically, the building consists of three parts. Under the house/Aronoma (underneath of the house) as a storage area (carpentry, hunting, and gardening tools), and gardening areas. The middle floor as shelter (sleeping, cooking, resting, visiting) and the roof as a storage area (to store heirlooms), see figures 9a.</li> <li>• Floor plan (see figure 16), which consists of: <ul style="list-style-type: none"> <li>✓ Public space (Tawola), as the front room, which functions to receive guests, holding traditional events.</li> <li>✓ Private room/bedroom (Foroma), used for resting or sleeping.</li> <li>✓ Kitchen (Lauwo) and hearth (Awu) serves as a place for cooking</li> </ul> </li> <li>• Some activities are carried out in outdoor, namely: <ul style="list-style-type: none"> <li>✓ Traditional ceremonies on the street/yard and inside the house</li> <li>✓ Socialize on the page/yard</li> <li>✓ Farming and farming in the fields and fields</li> <li>✓ Hunting in the forest</li> <li>✓ Wash and bathe in rivers or lakes</li> </ul> </li> </ul>
<b>Belief and Culture</b>		<ul style="list-style-type: none"> <li>• Based on their cosmology, the people of Nias set three worlds the world over as the upper world (ancestor's world), the middle word (human's world) and the underworld (departed spirit's world). Its application can be seen in the traditional house, which is divided into under / foot, house / body, roof / head, see figure 4. Besides that, throughout the island of Nias in the past there had been war between villages and with invaders from outside the region and even abroad. This condition causes the ancestors of Nias tribe, often to move around looking for a safe location for their settlements, namely on high hills / mountains with dense forests, which are difficult to reach by the enemies, see figures 4, 5, 7.</li> <li>• The location of the settlement of traditional houses in South Nias, it is always found in the highlands such as hills or mountains. This implies the cosmological philosophy of the Nias people, where they assume that the higher the location of their settlements, the more prosperous their lives will be because they are closer to the world above (upper world/ancestor word), see figures 4, 7.</li> <li>• The walls of the building tilted upward like a boat because the people of Nias thought their ancestors had come to Nias island by boat, see figure 9b.</li> <li>• Placement of megalithic stones in front of the house, as a symbol of relations with the dead and social status This is in line with the beliefs of the people of South Nias, namely dynamism and paganism, see figure 10.</li> <li>• In ancient times, Nias people lived in, warfare so almost all aspects of their lives were defensive, include in their traditional homes, placement of attic windows (Zara-Zara) with a high roof space, which serves to lurk enemies, see figure 9a.</li> <li>• Traditional ceremonies or parties, as part of people's beliefs and culture are carried out on the village road as a public area, see figures 29, 38.</li> </ul>
<b>Livelihood</b>		<ul style="list-style-type: none"> <li>• In the past, the livelihood of Nias people was hunting, for their food and re-bread. Raising pigs is one of the livelihoods of the people of Nias. This was supported by the importance of pig as part of the requirements, which must be present at each of their traditional ceremonies/parties.</li> <li>• Farming and gardening were community activities to fulfil their daily needs, and are usually carried out on land close to their village while managing garden produce was done in the yard.</li> <li>• Iron or metal carpentry, is also one of the expertise, which is a livelihood, the people of Nias at that time, and carried out in open spaces in residential areas.</li> </ul>

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Source: Siahaan, Fanny, 2020.

#### 4. Conclusions

In the discussion above, it has been described how the relationship between biological architecture and traditional South Nias houses, where the South Nias architecture adapts to the environment and its inhabitants. Thus, it can be concluded that:

- 1 The application of Biological Architecture to traditional South Nias houses can be reflected in the plan/space organization, building materials, and building construction, see table 2.

- 2 Besides that, the traditional South Nias house, omo hada, was also built consider to the occupants' factors, namely the basic needs of the inhabitants, culture/beliefs, and livelihoods, see table 2.
- 3 Application of Biological Architecture in South Nias traditional houses is the result of the genius locus of his ancestors.

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