



## Exploration of the Fala house construction system in Alor Regency

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| ARTICLE INFO  | ABSTRACT  |
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| <p><i>Article history:</i><br/>Received March 05, 2024<br/>Received in revised form May 05, 2024<br/>Accepted July 25, 2024<br/>Available online August 01, 2024</p> <p><i>Keywords:</i><br/>Bracing system<br/>Construction systems<br/>Exploration<br/>Fala house</p> <p>*Corresponding author: Pilipus Jeraman<br/>Architecture Study Program, Faculty of<br/>Engineering, Universitas Katolik Widya<br/>Mandira, Indonesia<br/>Email: <a href="mailto:pilipusjeraman@unwira.ac.id">pilipusjeraman@unwira.ac.id</a><br/>ORCID: <a href="https://orcid.org/0000-0002-4113-1088">https://orcid.org/0000-0002-4113-1088</a></p> | <p><i>The fala house is one of the traditional houses of the Abui tribe in Alor which is also known as a warehouse house. This building is ± 16 m high and consists of 4 floors with functions as a residence, barn, and storage area for heirlooms. This building's design and dimensions are also tailored to withstand the frequent high winds and earthquakes in the Alor region. To provide the Alor community as a whole with literature and a reference for creating disaster-resistant dwellings, this study intends to investigate the fala house construction system. An ethnographic design in conjunction with an exploratory description is the methodology employed to examine the Fala House's construction system. One of Takpala Village's thirteen fala homes serves as the research item. Purposive sampling was used to identify the home of the village chief, who served as the resource person, to choose this item. While secondary data was gathered through a review of the literature, primary data was acquired through close inspection and recording of the artifacts as well as technical information on workmanship and local names of fala house construction through interviews. According to research, the Fala house is built using a traditional method in which the main pillar is buried directly in the ground. The attic pillars that rest on the main beam are braced and connected to the building using a tie system. Because fala houses are built with a building method that can withstand shocks from earthquakes and severe winds, they have withstood a lengthy time of disaster adaptation and are still standing today.</i></p> |

### Introduction

Across the Austronesian region, Austronesian houses are characterized by a rectangular layout with many pillars and thatched roofs. It is believed that Indonesian stilt houses also belong to the Austronesian cultural legacy (Fajrin et al, 2017; Sari et al. 2020). The surrounding

environment, which offers materials and adaptations to existing geographical circumstances, as well as culture, has a significant influence on the typology and shape of traditional dwellings prevalent across the archipelago (Achmad et al. 2017). With its harmonious forms that can adapt to the natural surroundings and its use of locally sourced building materials,



traditional architecture demonstrates very strong sustainable qualities (Michelle and Purbadi 2021). The surrounding environment becomes a place with economic opportunities for survival, and socio-cultural life is preserved there for generations (Hatta and Sudrajat 2020; Lake 2016). Traditional building structures have unique structural features that allow them to effectively distribute seismic loads (Pusat Litbang Perumahan dan Permukiman 2021).

Due to Alor Island's location on the volcanic belt, frequently referred to as the "ring of fire," frequent earthquakes occur in this region. The Alor people's culture and character are also shaped by their steep terrain. The traditional architecture of Alor Island, which the community erected as a haven of safety and refuge, is influenced by the island's natural surroundings. Two other tribes occupy Pura Island and Pantar Island in addition to the several big tribes (Abui, Alor, Belagar, Deing, Kabola, Kawel, Kelong, Kemang, Kui, Lemma, Maneta, Mauta, Soboda, Wersin, and Wuwuli) that are dispersed throughout the island of Alor. The Abui tribe, sometimes known as the "big mountain people," is one of the largest tribes now in existence. They live in mountainous regions practically to the southern part of the island.

In 2004, an earthquake with a magnitude of 6.0 occurred in the East Alor region, which is 37 km from Kalabahi or 23 km from Takpala village. Damage caused by the Alor earthquake; A total of 2,275 houses were damaged, 5,519 units were heavily damaged, and 12,168 units were slightly damaged, while 28 school buildings were damaged in total, 150 units were heavily damaged and 145 units were slightly damaged (Bere 2015). The Fala Foka home is still standing despite the extent of the devastation because it was built with a construction method that can adapt to disaster situations on a specific scale. Recommendations for current Alor structures that can adjust to the current climate can be based on this construction approach. To provide the inhabitants of Alor with a resource and body of knowledge for building disaster-resistant structures, this study intends to investigate the structural system's dependability and the construction of fala house constructions.

#### Fala house

One of the Alor people's traditional homes is the Fala House, or Fala Foka, sometimes referred to as the warehouse house. At a height of  $\pm 16$  meters, this home is situated in the Takpala

traditional village. The Fala Foka house is enormous and tall, serving as both a place to live and a storehouse to store food and family relics. This dimension affects the way that buildings are constructed, enabling levels to be added to meet the requirement for vertically arranged space. It is also crucial to prepare a building for disasters (such as earthquakes and severe winds) during construction.

#### Disaster-friendly construction system

The three primary components of architecture are structure, utility, and beauty. When examining vernacular structures from the perspective of their construction, condition, and local knowledge, they already consider sustainable structural systems (Bahri and Kamil 2023). Structure refers to the building's strength, which is determined by the materials used, and extends from the foundation, columns, and beams to the roof. Wood's mechanical qualities, including its hardness, tensile strength, compressive strength, and bending capabilities, made it a desirable material for building structures (Fantri, Buwono, Ongkojoyo, Santoso, and Hariyanto 2022). Environmentally friendly and lightweight materials can be used as earthquake-friendly building materials (Saptaningtyas, Paturusi, Dwijendra, and Putra 2023).

The flexibility of the structure and the planned building construction must have resistance to damage or ductility (the ability of the structure to deform during an earthquake) (Marwati 2014). The building structure is divided into a substructure at the bottom and upperstructure at the top which is easy to understand as the anatomy of the building (Rifai 2010). The Technical Guidelines for Earthquake Resistant Houses and Buildings state that a structure is considered strong if its rigid structural system is supported by bracing composed of concrete, steel, or wood. Because of the building's lightweight nature, homes and buildings with this structural structure have a great resilience to seismic loads (Direktorat Jenderal Cipta Karya 2006). Traditional building methods make use of nearby natural resources and are based on the local knowledge of the communities building them.

The community's local wisdom and the use of lightweight materials nearby allow the building to respond to environmental elements such as building loads, seismic energy, and other conditions that affect the building's physical structure (Irma, Syahreza, and Hari 2019).

Unprofessional construction implementation, use of substandard materials, structural failure and natural disasters are factors that influence building collapse (Qurix and Doshu 2020).

Building construction and structures that are earthquake-friendly must have the foundation's base on a level, dry, and solid surface surrounding the structure, and its slabs, beams, and columns must be attached using a system that is appropriate for the material being used (Oktavia, Prihatmaji 2019). According to Putri, a simple and symmetrical mass shape makes the building more rigid, which is the principle of a good earthquake-resistant building (Putri, 2018). There is freedom to explore forms in design but this must be commensurate with understanding the risk of damage to buildings due to earthquakes so that building design in earthquake-prone areas still prioritizes simplicity of safe forms (Teddy, Adiyanto, and Hidayat 2021). Traditional wooden structures' columns and beams are joined with enough tolerance for static movement, making them less rigid than constructions made of concrete and steel, which suffer significant deformations at their joints during seismic shaking (Katagihara 2001).

#### Bracing system

The column's compressive axial load can be supported by the stiffening structure or bracing system (Taviana and Simbolon 2018). Bracing is a structural stiffener that is used to stiffen the main structural components and become one unit when receiving earthquake loads (Kurniati 2022). Opinions from other research state that to help control seismicity in traditional houses a simple bracing system is used (Ihsan 2018). Bracing in buildings is a reinforcing element in the structural system which plays an important role in increasing the strength of the structure in withstanding loads caused by earthquakes (Uddin 2017). For a building structure to sustain loads during an earthquake, bracing components are crucial since they offer stiffness to the structure (Meena, Awadhiya, Paswan, and Jayant 2021). Storey buildings use bracing as a way to gain strength (Anggraeni, Widayanto, and Nurtanto 2017). Lateral loads on buildings are stabilized using bracing or diagonal rods in the construction (Nurdiah and Hariyanto 2013).

#### Connection system

Since joints are the weakest points in the construction, they are crucial components that

require attention while building with wood (Lestari, Zain, Rudiyo, and Irwin 2016). People in the archipelago use traditional wooden construction connections in buildings which have been learned from generation to generation autodidactically (Widiati and Hartanti 2019). Building construction connectors made from vegetation which are used as a means of connecting wood ties have a stable and sturdy character (Wijaya, Umar, and Arsyad 2020). Rope fastening is a more flexible and robust method of securing wood connections against tensile, compressive, and shear pressures (Pradipto and Tristanto 2021). To preserve the compatibility of traditional buildings with the surrounding environment, the community employs local knowledge to choose and use rope materials for traditional dwellings acquired from around the site (Kapilawi, Antariksa, and Nugroho 2015).

## Methods

Research conducted to explore the Fala house construction system in Alor district, East Nusa Tenggara used an exploratory description method with an ethnographic design. This method is part of qualitative research by exploring the construction system in the Fala house which is then described clearly. Ethnographic research is qualitative research conducted to explain community traditions regarding actors, activities, and needs related to buildings (Amin and Purwanto 2021). Community activities and traditional building objects were observed directly as a stage of ethnographic research to collect complete data (Groat, Wang 2013). Data collection was carried out directly at one of Fala's houses in Takpala village. The house object was determined using a purposive sampling technique by selecting the village head's house as the research object. Observations were conducted by measuring objects, identifying materials, and construction systems supported by documentation.

#### Research sites

Takpala Village, Hamlet III Kamengtaha, West Lembur Village, North Central Alor District, Alor Regency is the location of this study. The capital of the Alor district, Kalabahi City, is 25 minutes away from Takpala Village

(figure 1). A common room in Takpala Village is frequently utilized for group Lego projects. In the center of the room is a mound of stones that forms a tiny circle, which serves as an altar for offerings

during customary ceremonies. Thirteen households, or heads of families, reside in this community in Fala Foka dwellings, which are referred to as warehouse houses in Indonesian.

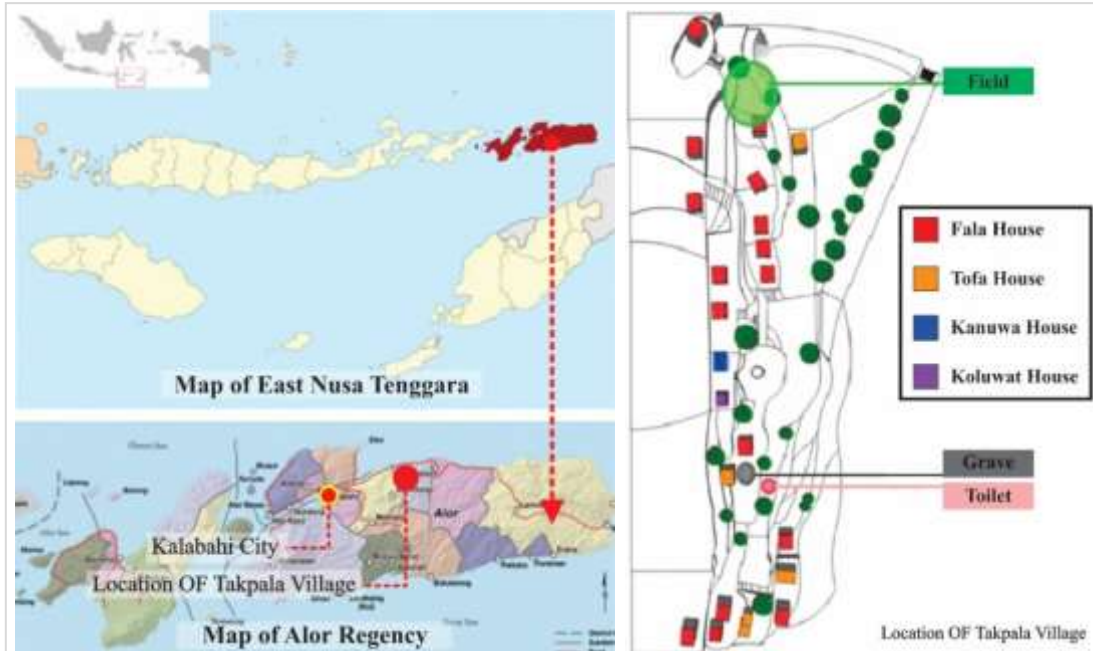


Figure 1. Research sites

## Results and discussion

The Takpala village residents utilize the Fala House as a barn to store food all year round in addition to being a place to live. This structure, also known as a warehouse home, is influenced by the barn's use as a storage facility. The Fala house features varying levels of vertical space arranged hierarchically. The spatial hierarchy in Fala's house is as follows; First, the lowest point on the stage serves as a place to bind the pigs. Second, this section serves as a public space for receiving guests and unwinding; the stage is a man only area. Third, women spend the evenings cooking and sleeping in the first attic. Fourth, the second attic is a place to store food from the garden. Fifth, the third part of the attic which is right at the top of the roof is a place to store heirlooms (figure 2).

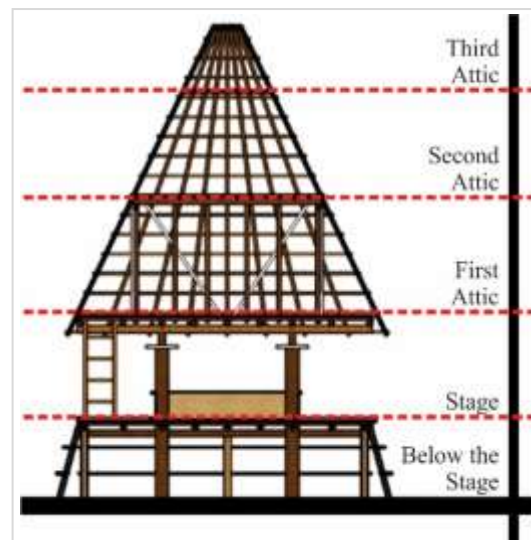


Figure 2. The spatial hierarchy of the Fala house

### Fala home construction system

The Fala house is constructed using a similar structure as other buildings, with a roof at the top, posts, and beams in the middle, and a foundation at the bottom.



**Figure 3.** Fala house sub-construction system

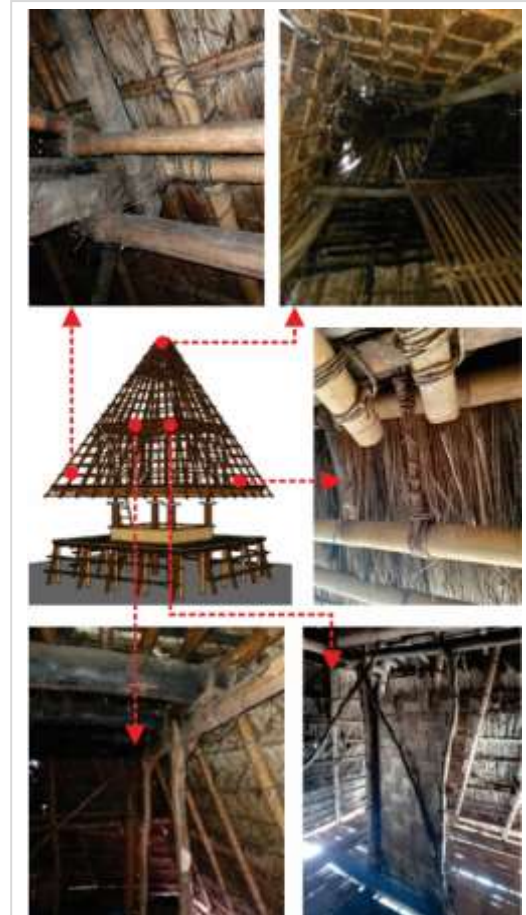
#### Upper structure

The main column is 2.6 meters above ground and has a diameter of 20 centimeters. The primary beam is made up of two 4.5-meter-long, 15-centimeter wooden rods that cross the upper curve of the column. The child beam is constructed of two layers. The first layer is constructed of ten wooden sticks that cross the main beam and have a diameter of 10 cm. The second layer sits on top of the first and is made up of sixteen five-centimeter bamboo sticks spaced thirty centimeters apart. A pelupu, or chopped bamboo sheet, serves as the attic floor and is placed on top of the bamboo sticks (figure 4).

The building's top is constructed of a roof with three vertically oriented attics, combining the attic structure and roof construction into a single piece. Between the second layer of kid beams is an additional beam that supports the attic pillar, which is parallel to the main beam. The main ring balk is supported by the twenty 1.70 cm-tall wooden poles that make up the attic pillars. The pole ends are branched. The feet of the roof trusses can rest on the main ring balk (figure 5).



**Figure 4.** Fala house upper construction system



**Figure 5.** Fala house top/supper construction system

#### Channeling style into the fala house

##### 1. Style distribution system

The main force exerted on the Fala house is its weight. The primary frame transmits the force. Horizontal lateral forces are typically caused by seismic conditions that cause the building to vibrate, necessitating strong foundations. With the four major pillars buried between one and 1.5 meters (or until they reach a hard surface), the bottom construction of the Fala house adjusts to these conditions. Every pillar set into the pit has surrounding rocks on either side of it to accommodate construction movement under lateral loads. Above ground level, these four pillars are supported by a pyramid-shaped platform with the outermost column having a dual function as a load arrow as well as a ladder.

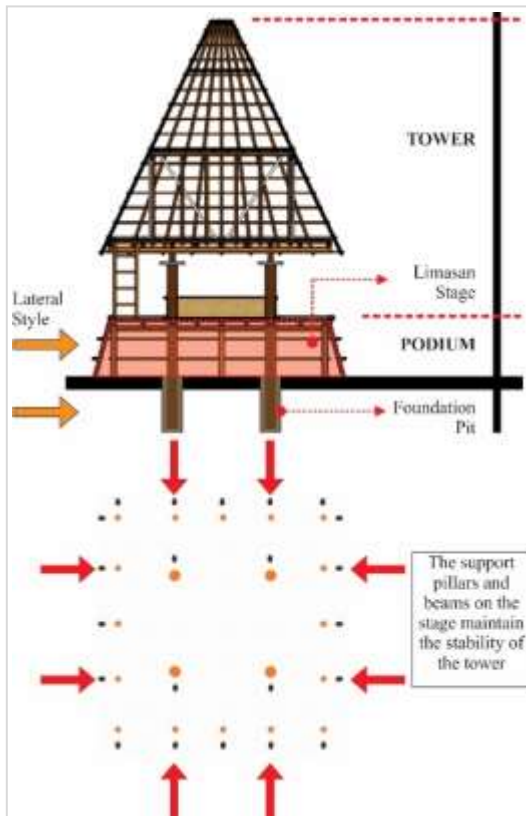


Figure 6. Lateral forces acting on the Fala house

## 2. Bracing system

The fala house's bracing system serves to reinforce the attic frame structure. V bracing, which creates a diagonal line from the top corner between the column and ring balk to the center of the main beam, is the bracing system utilized in the construction of the Fala house. When shocks occur, this offers steady rigidity in response to lateral forces.

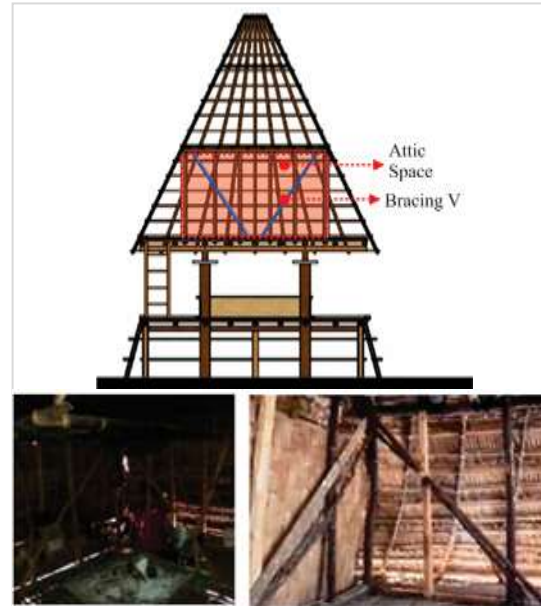
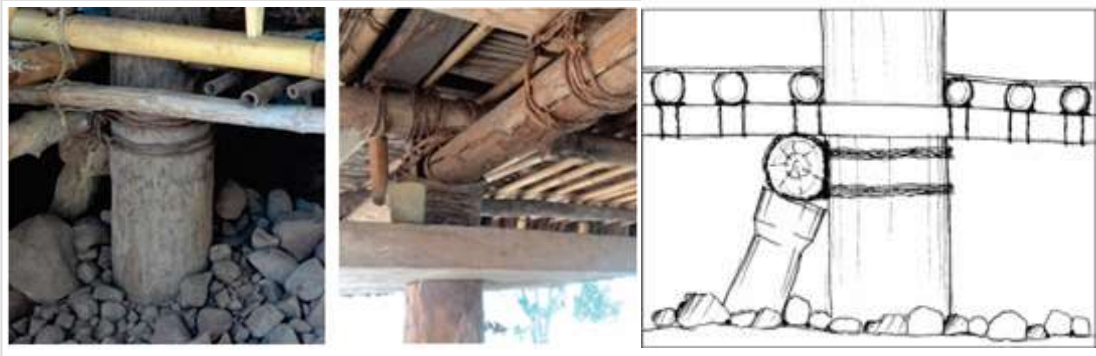


Figure 7. V bracing on the Fala house

## 3. Connection system

Tie connections are one type of connection technique used in Fala house construction. A rope is used as a connecting tool to join each component of the Fala house's construction. The following construction elements in this structure make use of a tie system:

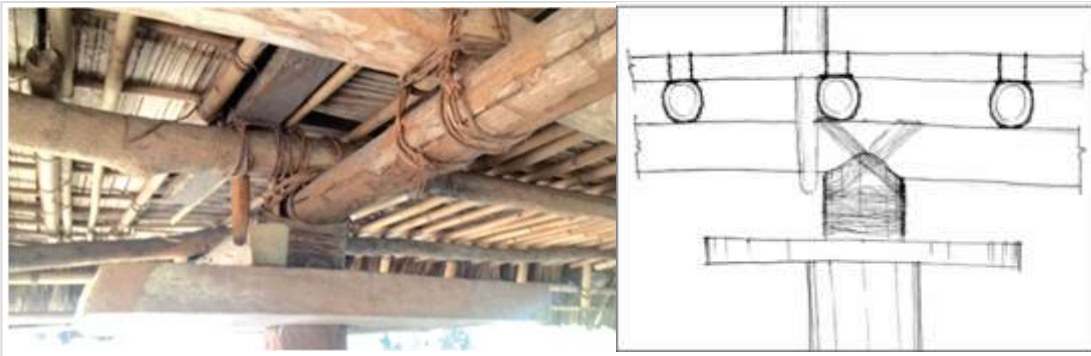
- a. Main column and beam ties: (1) The main beam is tied to the main pillar and supported by support pillars; (2) The child beams above the main beam are tied to the main beam, on top of the child beams, smaller beams are placed again for laying the floor from pelupu (chopped bamboo slats).



**Figure 8.** Column and main beam ties

- b. Bonding of main beams and child beams in the attic: (1) To maintain force distribution flexibility while enhancing stiffness between the beam and column, the main beam that rests on the main pillar is additionally linked; (2)

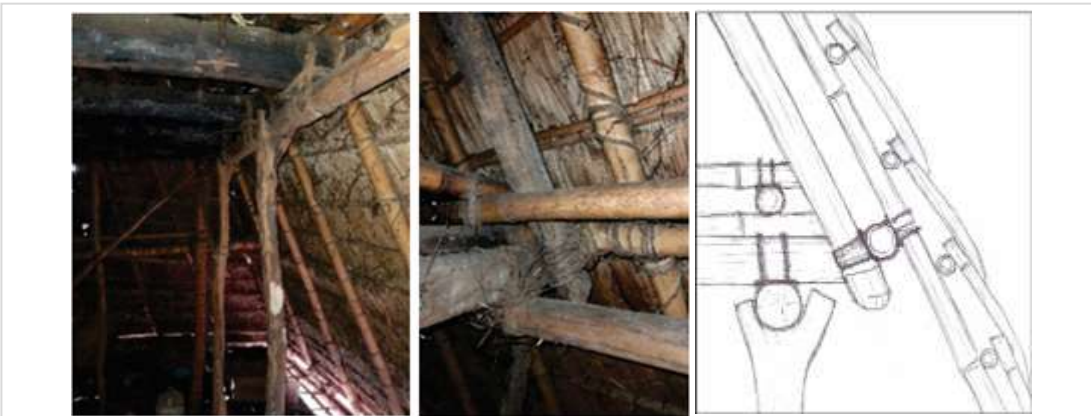
Smaller beams are positioned once more on top of the child beams to lay the pelupu (chopped bamboo slats) floor. The kid beams above the main beam are connected to the main beam.



**Figure 9.** Connection of main beams and child beams in the attic

- c. Attic column ties with ring balk and truss legs: (1) A fala house's roof is made up of four horse legs that are arranged like a pyramid, with the top node resting on a ridge beam and the base

supported by an attic ring balk; (2) On the legs of the horses, curtains, battens and rafters are placed; (3) The horses' legs are tied to the four corners of the ring balk.



**Figure 10.** Attic column ties with ring balk and truss legs

- d. Bonding rafters to battens and battens to battens: (1) The bamboo rafter rods rest on the curtains and battens are placed on top of the

- rafters with a distance of between 35-40 cm; (2) To stiffen the battens that are under load from the pile of roof covering (*alang-alang*).

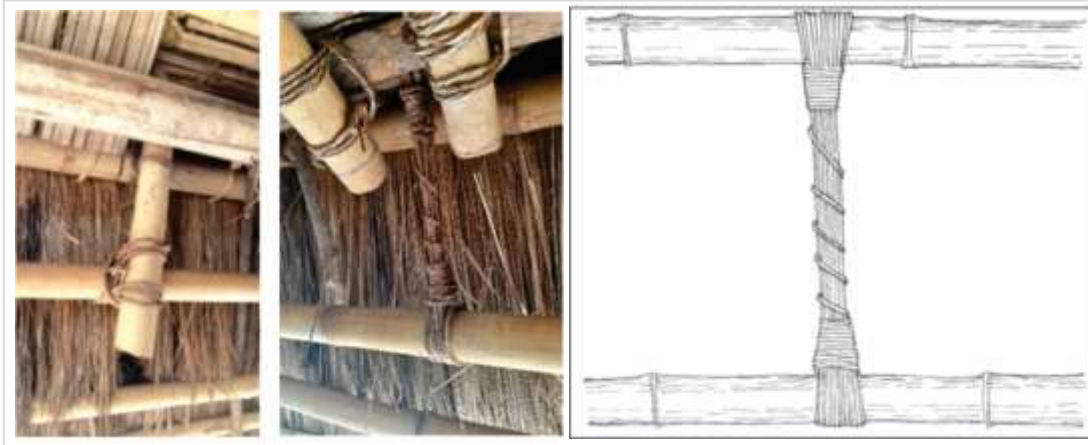


Figure 11. Bonding rafters to battens and battens to battens

In addition to the tie system, the attic pillars of the Fala house are connected by the hole and pin system, in which pins rest on beams that span over the main beam. A few examples of the holes and pins employed during Fala house construction are:

- a. Attic column and beam ties: The attic beam is above the main beam with the corners directly above the main column, forming a square space. There are 24 attic columns, they have pins at the bottom base and rest on the beam holes.

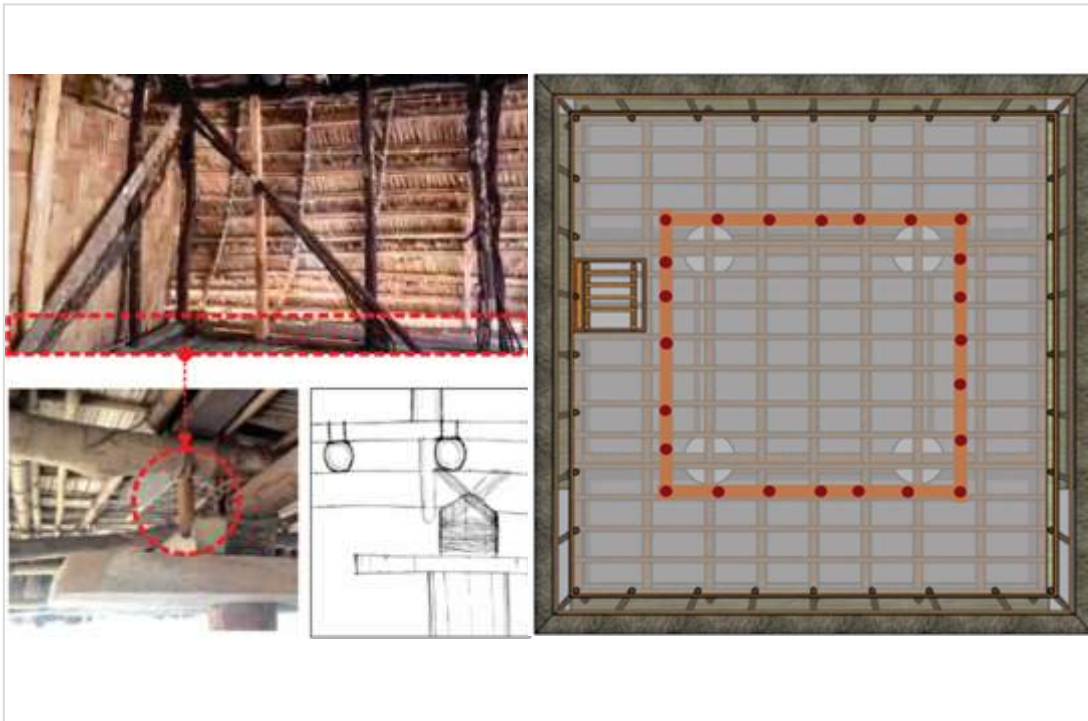
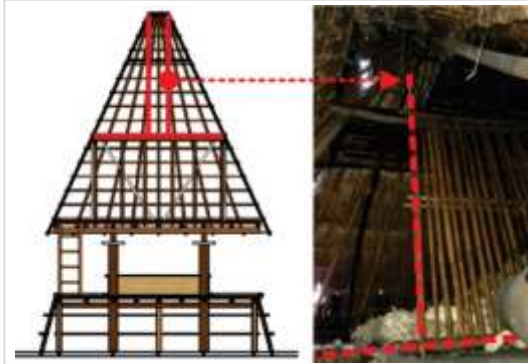


Figure 12. Hole and pin connections at the junction of columns and attic beams

- b. Bonding of roof frame columns and attic beams: The two roof frame columns are right at the level of the attic beam. This column also uses a pin at the bottom base and rests on the beam hole.



**Figure 13.** Hole and pin connection at the junction of the nock post and attic beam

## Conclusions

Fala houses are built using a customary method that has been modified to withstand local weather and natural calamities (such as strong winds and earthquakes), which are common in the Alor region. This structure is supported by multiple supporting pillars that are reinforced with beams to support the stage floor, in addition to four major pillars that are set into the hard ground surface between one and 1.5 meters. The stage area serves as a podium to keep the tower's main pillar, attic, and roof stable in the center. This house's structure uses a tie system as its connection method. A hole and pin system are employed by the attic pillars that are supported by the attic floor beams. A V bracing system is utilized to reinforce the attic construction, which bears the weight from the roof, to preserve stability. This construction system, which has been developed over the years, to serve as an appropriate guide for the construction of contemporary buildings in this area, has undergone actual, natural testing.

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**Apridus Kefas Lapenangga** contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

**Pilipus Jeraman** contribute to the research concepts preparation and literature reviews,

data analysis, of article drafts preparation and validation.

**Reginaldo Christophori Lake** contribute to methodology, supervision, and validation.

**John Petrus Talan** contribute to methodology, supervision, and validation.

**Kolawole O. Morakinyo** contribute to supervision, and validation.

**Richard Oluseyi Taiwo** contribute to supervision, and validation.

**Kolawole Olayemi Oludoyi** contribute to supervision, and validation.

**Richardus Daton** contribute to supervision, and validation.

**Andreas K. S. Mukin** contribute to supervision, and validation.

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