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Wood Connection Techniques In The Main Structure Of Madura Traditional Houses

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Abstract.

This study briefly introduces the connection techniques used in the main architectural structures of traditional Madurese houses. Traditional Madurese houses, found throughout the island of Madura, East Java, Indonesia, are a rich manifestation of local wisdom, utilizing wood materials and nail-less construction techniques to achieve structural resilience amidst climatic and geographical challenges, including the potential for earthquakes. The primary objective of this study is to identify, describe, and document the types of wood connections in the main structures of traditional Madurese houses, such as the pillars (*sasaka*) and main beams (*soddhu'* and *brunjung*). The research method used is a descriptive qualitative approach, based on field observations, a literature review, and interviews with residents and local traditional carpenters. The study's results are expected to demonstrate that the wood structures of traditional Madurese houses rely heavily on key-jointing and precise interlocking joints, without the use of iron nails or wooden dowels. These joints not only serve as mechanical connections but also help evenly distribute loads and provide semi-rigid flexibility, which is essential for the structure's resistance to lateral forces. For example, the joints on the *sasaka* (main pillars) are designed to minimize tensile and shear stresses, utilizing the compressive forces and internal friction of the material. In conclusion, the joint techniques in traditional Madurese houses reflect sustainable design principles and a rich traditional knowledge. The reliability of these nail-less joints offers a construction model that is not only environmentally friendly by reducing reliance on industrial materials but also seismically adaptive. This study is expected to contribute to the conservation and revitalization of Madurese architectural heritage and to inspire the development of resilient, sustainable modern wood-construction techniques.

Keywords: Traditional Madurese houses, wood connection, local wisdom

1. Introduction

The traditional house of Madura represents a significant component of Indonesia's vernacular architectural heritage, shaped by environmental conditions, cultural norms, and construction techniques passed down across generations. Similar to many wood building traditions in the Indonesian archipelago, Madurese houses employ distinctive, efficient, and adaptive joinery methods that accommodate natural hazards such as earthquakes and strong winds (Barker, 2011; Santosa, 2018).

Madurese dwellings are strongly influenced by the *Bangsals* house type found in Java. The *Bangsals* consists of a large, open interior space supported by four main posts. While both Javanese and Madurese *Bangsals* share the joglo-type roof form, the Madurese variation developed into three distinct typologies: *Pacènan*, *Pègun*, and *Trompèsan*, each expressing specific adaptations to spatial function, orientation, and the social status of residents (Wiyata, 2013).



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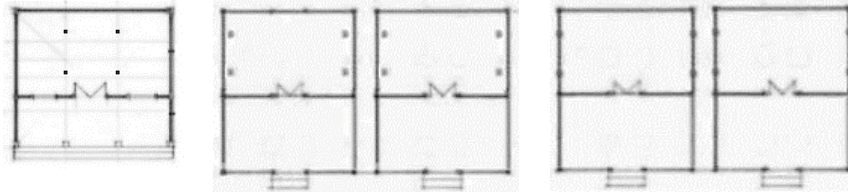


Figure 1. Foundation plan of a traditional Madurese residence
From left to right: Pacènan-Pègun-Trompèsan
(Source: Tulistyantoro, 2005)



Figure 2. Types of traditional madurese houses based on their roofs from top to bottom: *pacenan-pegun-trompesan*
(Source: Tulistyantoro, 2005)

The preservation of traditional Madurese houses is essential not only for cultural heritage but also for the architectural knowledge embedded within their construction. Their symbolic, philosophical, and technical values remain relevant today. Despite this importance, systematic academic documentation of their joinery systems remains limited, especially regarding the structural logic of their *nail-less* interlocking joints. Yet such techniques have high potential to inform modern wood structures that emphasize sustainability and earthquake resilience (Priyotomo, 2006; Nurdiah, 2014).



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Figure 3. A traditional madurese house with a pacenan-style roof
(Source: RP3KP Pamekasan Regency)



Figure 4. A traditional Madurese house with a Pegun-style roof
(Source: Akh Baidawi)



Figure 5. A traditional Madurese house with a Trompèsan-style roof
(Source: Epi Abdul Haris)

This study focuses on the core structural elements—namely the *sasaka* posts and two main tie-beam systems, the *soddhu'* and *brunjung*. These elements represent the most essential components that uphold the building and demonstrate the sophisticated craftsmanship of traditional Madurese carpenters in creating strong, flexible joints without metal fasteners.



2. Research Method

This research adopts a **qualitative descriptive** approach, suitable for examining vernacular architecture through an understanding of meaning, process, and technique in its sociocultural context (Creswell, 2014).

2.1 Field Observation

Field observations were conducted at two traditional houses in Pamekasan Regency:

1. The house of Mrs. Faikoh, Dusun Asem, Somalang Village, Pakong District.
 2. The house of Mr. Subahri, Dusun Pancoran, Pamaroh Village, Kadur District.
- The latter was selected as the primary object of analysis due to its well-preserved Pègun typology and intact traditional joinery.

2.2 Literature Review

A literature review was undertaken to examine theoretical studies on vernacular construction, Nusantara wood joinery, and indigenous technical knowledge. Sources include academic journals, previous research reports, and published works on traditional architecture.

2.3 Interviews

Interviews were conducted with house owners and an experienced traditional carpenter, Mr. Rudi Hartono, from Dusun Kemasan, Larangan Dâlem Village, Larangan District. The interviews explored technical aspects of joinery, wood selection, assembly processes, and the structural logic of traditional joints.

3. Result and Discussion

3.1 Wood Structural System in Traditional Madurese Houses

The core structural frame, consisting of four *sasaka* posts that define the character of the three major Madurese house types (*Pacènan*, *Pègun*, *Trompèsan*). The main case study house belongs to the *Pègun* type, in which the four *sasaka* posts are positioned near the side walls—distinct from the *Pacènan* type where the posts are centrally located.



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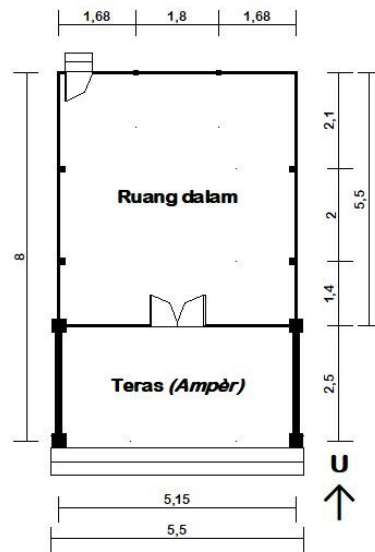


Figure 6. Floor plan of Mr. Subahri's traditional residence



Figure 7. Front, side, and back views of Mr. Subahri's house
(Source: Personal document)

3.2 Characteristics of Sasaka Posts

Sasaka posts, measuring approximately 13×13 cm, serve as the primary load-bearing elements. They are crafted from high-quality hardwoods such as jackfruit, tamarind, or sono wood, selected for their stability and resistance to insects (Roesmanto, 2012). The posts must follow the natural grain of the wood to ensure structural longevity.





Figure 8. Position of the Sasaka in a Pègun-type house
(Source: Personal document)

3.3 Tie-Beam System: Soddhu' and Brunjung

Two major tie beams secure the sasaka posts:

1. **Soddhu' beams** (15×8 cm), installed at the lower level, consisting of *soddhu' lakè'* (longer beams, front–back) and *soddhu' binè'* (shorter beams, left–right).
2. **Brunjung beams** (9×19 cm), placed above the soddhu' in an inverted orientation.

Unlike typical wall-supported beams in modern construction, these beams function as **hanging tie beams** directly interlocked with the posts, forming the stable core of the structure.

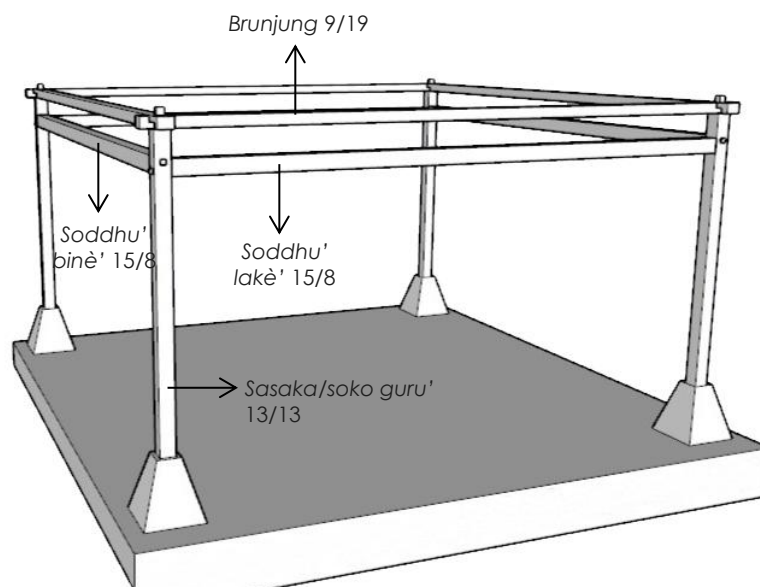


Figure 9. Sasaka, soddhu' and brunjung

3.4 Nail-less Joinery: The “Key-Lock System”

The connection between the *sasaka* posts and the tie beams uses no nails or pegs. Instead, it employs a sophisticated interlocking mechanism comprising:

- carved seating notches,
- load-bearing cuts,
- localized versions of mortise-and-tenon joints, and
- the distinctive Madurese “key-lock” system, which can only be disengaged by toppling the entire structure.

Advantages of this joinery system include:



1. **Even load distribution** across compressive and tensile elements.
2. **Semi-rigid flexibility**, allowing the structure to absorb lateral loads such as wind or seismic forces (Priyotomo, 2006).
3. **Failure prevention**, as the interconnected joints support one another.
4. **Ease of disassembly and relocation**, essential in traditional Madurese building practice.

Local craftsmen note that such structures “can only be demolished by overturning them,” underscoring the remarkable strength of the interlocked frame.

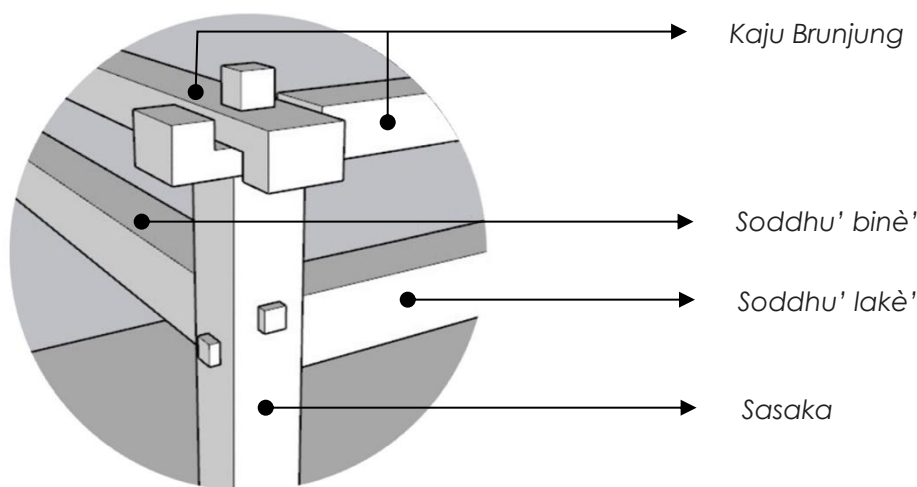


Figure 10. Details of the connection between Sasaka, Soddhu' and Brunjung

Conclusion

This paper is an output of the science project which concludes that the joinery techniques used in traditional Madurese houses demonstrate a highly advanced form of indigenous engineering. The key-lock interlocking system used to connect sasaka posts with soddhu' and brunjung beams exemplifies precise craftsmanship capable of supporting vertical and lateral loads without metal fasteners.

The *nail-less* joinery system is structurally efficient, materially economical, and environmentally sustainable. Its semi-rigid behavior provides natural seismic adaptability, making it highly relevant for contemporary wood construction seeking resilience and ecological responsibility.

The findings contribute to the documentation of Madurese vernacular construction knowledge and provide a foundation for future studies involving digital reconstruction, structural simulation, and the development of modern engineered wood systems inspired by traditional techniques.

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