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# MAJAPAHIT HOUSING ROOF: ANALYSIS OF TERRACOTTA MINIATURE HOUSES

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## KEYWORDS

Socioeconomics; Miniatur House Terracotta; Roof Material.

## ABSTRACT

This research reveals the socioeconomic conditions of Majapahit society through the roofing materials of houses in the Majapahit Kingdom. The primary data consists of stroke patterns on the roof of miniature terracotta artifacts. The shape of the strokes applied to the roof suggests the type of roofing material. This research employs mixed methods. Quantitative method was used for clustering, while qualitative method was used to analyse each material individually. Production theory guided the data analysis to determine the economic level described through materials, considering factors such as: (1) overall material quality, (2) raw materials availability and accessibility and (3) production process complexity. Clustering analysis results of 183 miniature house terracotta artifacts revealed five types of strokes: (1) asymmetric strokes, likely depicting palm fibre material (Ijuk), (2) flat vertical strokes, suggesting wood plank material, (3) cylindrical vertical strokes, indicating bamboo material, (4) square sheets representing shingle or tile material, and (5) unidentified strokes. Unidentified strokes (≤18%) are representing unique artistic expressions or the absence of strokes, showcasing the creativity of terracotta craftsmen. The observed roofing materials provide insights about three economic levels within Majapahit society. Palm fibre and bamboo roofs likely indicate the lower-middle-class dwellings, plank and wood roofs suggest lower or upper-middle-class status and finally (3) shingle and tile roofs indicate upper-middle class.

## I. INTRODUCTION

The Trowulan site is an area in Mojokerto, East Java, Indonesia that has been designated as a cultural heritage area since 30 December 2013 through the Ministerial Decree of the Indonesian Ministry of Education and Culture No. 260/M/2013. This enactment was made to preserve Majapahit heritage in Trowulan. Trowulan is considered the former capital of Majapahit which

holds many Majapahit findings. Majapahit Kingdom holds a significant value in forming the identity of the Indonesian State, for example: the concepts of 'Pancasila' and 'Bhinneka Tunggal Ika'. Both terms were adopted from the Kakawin Sutasoma written by Mpu Tantular, a Javanese literary poet who lived and worked during the Majapahit Kingdom. While Negarakertagama book by Mpu Prapanca provides a detailed description of the city of Majapahit around 1350 AD, many mysteries are yet to be revealed surrounding the life of its people, who were multicultural and lived in diversity. Knowledge of the life of Majapahit Kingdom can serve as an inspiration and case study for strengthening national identity through the promotion of harmonious life in a diverse society. Additionallyinsights into the lives of Majapahit society in the past can contribute to the advancement of science (Ruslan, 2019) and the socioeconomics of today's society. To contribute contemporary socioeconomic development, the Majapahit Kingdom area has been developed into thematic tourism destination which has been undertaken since 2014 by Balai Pelestarian Kebudayaan (BPK) Wilayah XI. The development of the tourism area was carried out through the implementation of a Majapahit House Reconstruction program. The reconstructed houses are based on the the design of traditional kawula (commoner) houses (Pratiwi & Nawangsari, 2018)

Research on commoner's houses of the Majapahit era has been conducted from various perspectives. Prasodjo (1988) Traced the description of Javanese houses and their components through temple reliefs of the IX - XVI centuries. The results of this study revealed that the temple reliefs represent the true form of Javanese houses. While the relief refers to the existing form of the house, the artist (carver) is also influenced by various factors, both internal and external. Internal factors include artistic appreciation, creativity and skill, while external factors include space, time, culture and available materials (media). These factors cam lead to a slight difference between the carved representation of the house and its actual appearance. Secondly, the architectural forms of Old Javanese houses depicted the socioeconomic status of the society. This finding aligns with Rosita's research on smaller objects depicted in temple reliefs, particularly at the Majapahit Temple in East Java. Rosita (1984) concluded that (1) the grouping of houses was done according to the environment (religious, nobles, and commoners) and (2) the reliefs on Majapahit temples corresponded to the houses of that period. The architectural approach was also used in the research of residential reconstruction at the Trowulan Site. The results showed that the terracotta miniature is a three-dimensional picture of a complete house with building components that include: the roof, body, and legs (Oesman, 1999). The terracotta roof is made of various types of materials shown through the pattern of strokes. The strokes on the terracotta roof show that the roof motif consists of tiles, wooden slabs (a type of shingle), wooden boards, bamboo, and palm fibre or thatch.

Roof design is an important aspect of architectural consideration, especially in the tropical climates where environmental factors highly influenced building performance. The roof is the most important part of the building in the humid and wet tropical regions. The roof is directly impacts

weather penetration and heat transfer, ultimately affecting the thermal comfort of the space below. Vijaykumar et al. (2007) said that the roof system controls ±70% of the total temperature in a building. Abdessalam (1998) also states that 60 percent of heat transfer occurs in the roof and the thermal insulation of this component is of utmost importance in controlling the room temperature. Therefore, the identification of roofing materials depicted on the terracotta miniature houses is of significant interest.

Roofing materials can offer valuable insights about the prices and socioeconomic conditions prevalent during their use, as well as the building practices of the time. Each type of material has a different market value and not everyone possessed the same purchasing power. Economists' studies can be used to determine the level or hierarchy of commodities. Economists analyze problems using economic theories that are based on assumptions about human behavior (Shapiro et al., 2022). This study makes two key assumptions. Firstly, producers do not want to lose money, considering the production costs, including both raw materials and labor, required in manufacturing the product (Hayes, 2024). This determines the initial price of the goods and services they offer in the market. Secondly, consumer behavior is assumed to align with behavioral theory. This theory assumes that people are aware of their preferences and budgets to make rational decisions effectively by weighing the costs and benefits of each commodity choice. (Kenton, 2024). Therefore, consumers will make the best decisions and buy commodities that provide the greatest benefits and satisfaction.

The study investigates the socioeconomics conditions of the community through the use of roofing materials and technology. primary data used in the form of miniature terracotta houses in Majapahit period. Terracotta miniature houses illustrate social and economic conditions through the choice of roofing materials during the Majapahit period. The choice of roofing materials often reflects the available resources, construction techniques, and cultural values of the community (Aldana & Sunarmi, 2021). The results of this study are expected to provide insight into the socioeconomic conditions of the Majapahit community and the choice of materials in the region. This knowledge enhances our understanding of the life of Majapahit society for cultural activists, historians and researchers. In addition, the research results can be a consideration and reference in the development of thematic tourism in Trowulan. Based on the results of previous studies, the focus of this research is formulated into two questions, namely (1) whether terracotta craftsmen accurately describe the strokes on the roof of terracotta miniature houses and (2) whether the strokes on the roof of terracotta miniature houses show the socioeconomics of Majapahit society.

## II. METHODS

This research uses descriptive method with qualitative approach. The primary data of this research is in the form of stroke motifs found on the terracotta roofs of miniature Majapahit houses collected by the Majapahit Information Centre (PIM). Data collection was conducted using

observation and documentation techniques. The observation technique begins with reviewing and documenting 183 terracotta miniature houses in the collection of the Culture Preservation Centre (BPK) Region XI. The terracotta miniatures in the PIM collection include intact and fragmented pieces. The data of terracotta miniature houses are shown in Table 1.

| Terracotta Type | Total |
|---|---|
| Miniature of Roof Fragment | 71 |
| Miniature of House Fragment | 17 |
| Miniature of Roof | 37 |
| Miniature of House | 58 |
| **Grand Total** | **183** |

**Table 1.** Terracotta Type Variation Distribution

Next, stroke motifs on the terracotta roofs of miniature Majapahit houses were carefully observed and classified. Furthermore, data collection employed documentation techniques. The documentation technique was carried out by the report on the analysis of stroke motifs on terracotta miniature houses of Majapahit that had been carried out by Prasodjo (1988)

The next step was to perform method triangulation to check the validity of the data. Method triangulation involved by comparing data obtained through observation and documentation techniques. In addition, triangulation was used to validate the accuracy of the results of analysis by comparing researchers' observations and classifications with findings from previous studies (Alfansyur, 2020)

Data analysis was conducted in two stages. First, a comprehensive review of the literature to gather information on the historical context, architectural features and socioeconomics of the Trowulan region. The literature study referred to various sources, namely: (1) research reports, (2) historical records, and (3) relevant academic literature to identify and analyse the materials used. In addition, the literature study aimed to identify, classify and describe socioeconomics through roofing materials.

Finally, the data was analyzed using production theory to classify materials based on the target market. Material types provide an overview of the socioeconomics of Majapahit society. Material hierarchy was determined based on production cost calculation within a production theory perspective. This is related to the assumption that producers do not want to lose money. This means that producers will not sell their merchandise below the cost of production. For example: a manufacturer has a production cost calculation related to the raw materials and labour required to make the product. There are three variables for assessing this hierarchy, namely (1) general material quality, (2) availability and ease of access to raw materials, and (3) complexity of the production process. In addition, the determination of the material hierarchy considers ethnographic records and other research. The presence or absence of strokes can be used to determine crafters' creativity or to understand the actual situation.

## III. RESULT AND DISCUSSION

Terracotta miniature houses in the PIM collection depict houses during the Majapahit period. The terracotta miniature houses have detailed depictions, showing the dimensions and components of the building. Five variations of roof strokes were observed on the miniature houses: (1) asymmetric strokes, (2) flat vertical strokes, (3) cylindrical vertical strokes, (4) square sheets, and (5) unidentified. Table 2 shows the frequency of each stroke variation observed on the terracotta roofs of the miniature house.

| Identification | Total | Distribution |
|---|---|---|
| Asymmetrical Strokes | 75 | 41% |
| Flat Vertical Strokes | 6 | 3% |
| Cylindrical Vertical Strokes | 25 | 14% |
| Square Sheet | 44 | 24% |
| Unidentified | 33 | 18% |

**Table 2.** Data on Different Variation of Strokes Found on the Terracotta Roofs of Miniature Majapahit Houses

The pattern of the strokes is quite detailed and shows the materials used for the roofs of Majapahit houses. Each material has a different currency value, so it can be used as a reference in determining the economic level and purchasing power of the people at that time.

### Asymmetrical Strokes

Three variations of asymmetrical strokes were observed on the terracotta roofs of the miniature houses: (a) asymmetrical in stroke length, (b) inconsistencies in stroke positioning and (c) asymmetrical with conflicting facing directions. Asymmetrical strokes with different lengths show horizontal strokes of unequal size (Figure 1A). Asymmetrical strokes with inconsistent positioning are shown with misaligned positions and varying proximity (Figure 1B). Asymmetrical strokes with conflicting directions show lines that do not face the same direction (Figure 1C).


A B C

**Figure 1**. Strokes (A) long asymmetric, (B) inconsistent asymmetric, and (C) colliding asymmetric

The asymmetrical strokes depict a roof made of palm fibre. Palm fibre is made from the fibre of the palm tree or Arenga Pinnata. Palm trees have been used by people for hundreds of years (Tomlinson, 1962). Palm trees as the most multipurpose tree species with very diverse functions

(Mogea et al., 1991). Almost all parts of the palm tree can be utilised to make a variety of products. In western Indonesia (Sumatra, Java, and Kalimantan), palm trees are used for furniture, straw, baskets, and food (Dransfield, 1976). Apart from palm sugar and fruit, palm fibre is the most commonly used part (Ishak et al., 2012). Black palm fibre (called palm fibre) is used to make ropes, brooms, brushes, paintbrushes, septic tank bottom filters, roofing, fishing equipment, and handicrafts (Miller, 1964).

The data obtained showed anomalies in two artifacts coded 1626 and 1627 (Figures 2A and 2B). On both artifacts, there are curvilinear asymmetrical strokes. The curved asymmetric strokes still depict palm fibre material. This classification is based on the similarity of these roof corners to those with horizontal asymmetric strokes. The anomaly regarding the curved asymmetric strokes is probably the creativity of terracotta craftsmen.


A B

**Figure 2**. Curved symmetrical lines (A and B)

The main advantage of using palm fibre is its good durability and resistance to seawater. Palm fibres also take a long time to decompose naturally (Astuti, 2016). It is also unaffected by heat and humidity and is more durable when compared to coir fibre (Sahari et al., 2012). Although fibre is heat resistant up to 150°C and has a flash point of about 200°C (Siregar, 2005), it is flammable when exposed to fire (Suparmini et al., 2014). In the Nusantara (Modern-day Indonesia), natural fibres such as palm fibre are relatively cheap due to their abundant resources (Bentar et al., 2022).

## Flat Vertical Strokes

The flat vertical strokes on the roof are very similar to the flat vertical strokes on the terracotta wall of the miniature house. Prasodjo (1988) stated that the vertical lines on the surface of the relief wall are depictions of walls made of wooden planks. The depiction of wooden planks as roofing material resembles the appearance of bamboo. Unlike bamboo, wooden planks have a flat surface without the characteristic book segments or nodes.

The flat vertical strokes on artifact 1556 (Figure 3A) were originally believed to be cylindrical strokes that had been worn or simplified due to size constraints. However, careful observation shows that there are no traces of wear or fracture of the flat vertical strokes. In addition, the small size of artifact 1615 (Figure 3B) still clearly shows the bamboo segments. Thus, the flat vertical

strokes on artifact 1556 are flat vertical strokes deliberately made by terracotta craftsmen. This is in line with the opinion of Oesman (1999) who said that one of the terracotta strokes of a miniature house shows wooden planks.

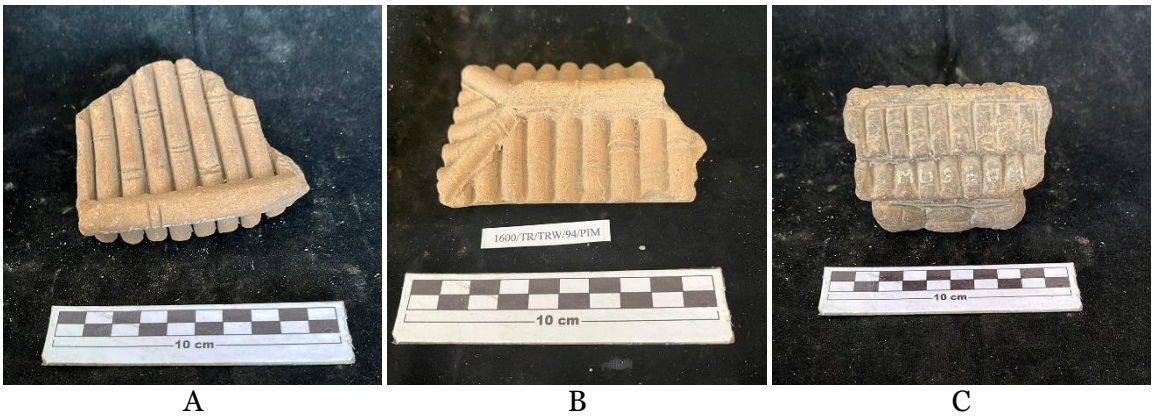
An interview with YYP (architect) revealed that not all plain wooden boards can be used as roofing. Wood is a material that is not weather-resistant and cracks easily if subjected to continuous expansion and shrinkage. However, given the similarity between the vertical lines on the roof and those on the walls of the miniature house, an alternative interpretation for wooden planks in artifact 1556 is not readily apparent. A unique finding on one of the flat vertical strokes is the presence of a *lancipan* on the terracotta (Figure 3C). This is similar to the tassel decoration along the lower edge of the roof of the house on the relief of Prambanan Temple.


A B C

**Figure 3**. (A & B) Flat vertical strokes and (C) flat vertical strokes with *lancipan*

## Cylindrical Vertical Strokes

The use of bamboo as roofing is easily identified due to the recognisable shape of bamboo. A cylindrical vertical stroke that has two transverse lines on its convex part is a description of bamboo (Figure 4A). The cylindrical vertical strokes on the bamboo roof construction of the miniature Majapahit era house are *talahab/kalaka* roofs (Figures 4B and 4C). *Talahab* roofs, which can be single-layer or multi-layer, are constructed using halved bamboo pieces. The bamboo pieces are arranged overlapping, the lower part is open (*tadah*), while the upper part covers the bamboo below (Maurina & Sukangto, 2015). The *talahab* roof is a traditional construction that can still be found on traditional houses in Cikondang, West Java and Kampung Bena, Flores.




A B C

**Figure 4**. (A) Bamboo details, (B) single layer *talahap/kalaka*, and (C) multi-layer *talahap*

According to Kleinhenz & Midmore (2001), bamboo is one of the fastest-growing plants. Some bamboo species growing in conducive environments can grow 3 to 30 m long within 3 - 4 months (Liese & Weiner, 1996). Bamboo is sometimes called "the poor man's timber" due to its relatively low price (denotative) and the implication that its quality is not as good as wood products (connotative). This is not entirely true as in certain fields bamboo has superior technological qualities (Liese & Köhl, 2015). The main economic value of bamboo lies in its hard culms which serve the same function as wood (Scurlock et al., 2000). However, the hollow nature of the bamboo culm makes it lighter and easier to process.

Bamboo shingle roofs are effective thermal insulators, capable of reducing heat by an average of 5.09℃ during the day (Hamastuti, 2015). In reducing heat, bamboo roofs are much better than clay tiles. Das & Sarkar (2018) added that bamboo requires good maintenance as it is not resistant to mold and insect attacks. Bamboo is also prone to burning when there is friction between the stems in the wind.

**Square Sheet**

The square sheets on the terracotta miniature houses are depicted in two ways, namely 2D and 3D. The 2D depiction is that the rectangles are neatly arranged horizontally (Figure 5A). In the 3D depiction, the rectangles are arranged horizontally with visible bulge at the bottom, suggesting that each square overlap or is connected to the one above it (Figures 5B and 5C). In the 3D square sheets, the bottom of each square sheet typically has a break at the right and left ends, resembling a shape of rectangle with an additional inverted trapezoid.

A B C

**Figure 5**. (A) 2D rectangular sheet, (B), detail of a square sheet with a break at the bottom end, and (C) square sheet

According to Prasodjo (1988), the pattern of square sheets arranged neatly vertically and horizontally on the roof reliefs of temples in Central and East Java depicts roofs made of wood or shingles. The use of wood or shingles was limited to the houses of kings or people with a high economic level. While no preserved shingle artifacts exist, Chinese records from the early 15th century evidence of wooden shingles being used as roofing material during the Majapahit period, usually for palace roofs (Groeneveldt, 1960). Construction shingle roofs is complex because it

requires the wood or bamboo to be cut into small pieces (depending on the dimeter). The shingle pieces are then stacked overlapped, secured to the frame (reng) up to 4-5 layers. The overlapping shingles serve as a path for rainwater. Today, bamboo shingle roofs are still found on the traditional houses of Bayung Gede Village, Bali.

The square sheet can also be interpreted as a depiction of terracotta tiles. Terracotta is a type of fired clay commonly used for pottery items. The term 'terracotta' comes from the Italian language, meaning 'cooked earth' or 'baked clay' (Yustana, 2011). Terracotta refers to objects made of baked clay. Objects made from fired clay have been known since prehistoric times, when humans began to transit to an agricultural lifestyle (Rangkuti et al., 2019). The utilization of terracotta continued to grow and reach its peak during the classical period, particularly during the Majapahit Kingdom (Atmosudiro, 2000). This is evidenced by the numerous terracotta remains at the Trowulan Site, including 1092 terracotta statues, 333 pieces of terracotta related to miniature houses (poles, roofs, bodies, and feet), and 34 pieces of tiles and ridges made of terracotta.

Unlike wooden shingles, terracotta tiles are still well preserved and stored at PIM Trowulan. Artefact data from the BPK Region XI collection shows that terracotta roofing tiles used during the Majapahit period were rectangular slabs with thicknesses ranging from 0.5 cm to 1.9 cm. One end of the terracotta slab is curved by 1 cm, possibly used as a hook to a wooden lath (wooden frame) (Figure 6).

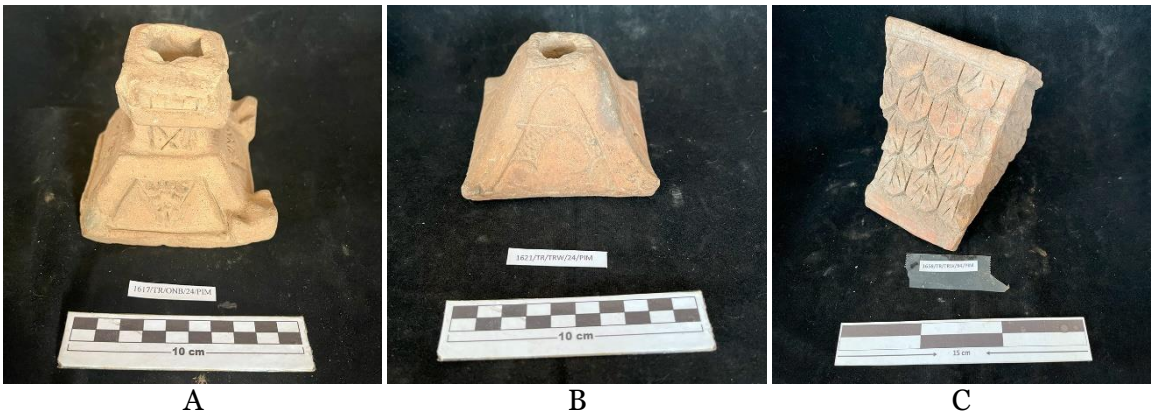
**Figure 6**. PIM Terracotta tiles collection

## Unidentified

Some terracotta artifacts of miniature house roofs could not be identified. Unidentifiable roofs are characterized by the absence of any strokes or a completely plain surface (Figure 7). Prasodjo (1988) suggests that plain roofs on temple relief represent roofs of coconut leaves that hardly depicted on the relief. This is due to the difficulty of chiselling/painting the details of the coconut leaf details onto porous stone. However, the difficulties of drawing strokes on temple stones should not apply to terracotta, as terracotta has different textural and material properties compared to the andesite stone used in temples. In addition, strokes on terracotta are made before the firing process, when the material is still soft and easy to give strokes.


**Figure 7**. Terracotta miniature plain roof house

Another difficulty identified when roofs shows motifs rather than dsitinct strokes, making material identification difficult. Artifact 1617 (Figure 8A) has a roof with strokes forming horizontally arranged isosceles triangles, the center of the triangle is inverted and patterned. Artifact 1621 (Figure 8B) depicts three mountain-like mounds with the central mound being the tallest and largest. Another unique artifact is code 1658 (Figure 8C). Artifact 1658 depicts a gable roof structure with a bamboo frame and a leaf-like roof covering. This shape may represent patterned shingles or tiles.




A B C

**Figure 8**. (A) Artifact 1617, (B) Artifact 1621, and (C) Artifact 1658

## Socioeconomics of House Roof

The use of off-the-shelf materials that do not require complex manufacturing processes indicates a focus on affordability and accessibility. The asymmetrical strokes show a depiction of palm fibre. Palm trees can be found from eastern India to Southeast Asian countries, such as Malaysia, Indonesia, and the Philippines. Cylindrical asymmetric strokes depict bamboo trees, which have an average growth rate of three times that of other plant species (Das & Sarkar, 2018). A total of 88 out of 159 bamboo species in Indonesia are endemic (Mayasari & Suryawan, 2012). Therefore, these readily available natural materials could be easily sourced locally, minimizing the risk of supply shortage. The ease with which people can access these commodities places palm fibre and bamboo in the middle to lower price bracket. However, these materials were not exclusively used by the lower-middle class, as were found on artifacts 1592 and 1593 (Figures 9A and 9B) and

bamboo roofs on artifact 1579 (Figure 9C) which often featured open walls, commonly called pendapa (Figure 9).


A B C

**Figure 9**. Open building on (A) 1579 Artifact, (B) 1592 Artifact, and (C) 1953 Artifact

Prasodjo's, (1988) research suggests that the pendapa had a screen or curtain that could be opened and closed at any time and was probably used as a residence. Rouffaer (1898) notes that in 1596 there were still pendapa buildings (open walls) in Banten. The open walls were intentional and a form of community response to the warming climate.

Wooden planks are also depicted on the terracotta roofs of miniature houses. Wooden planks are typically produced by re-sawing wooden beams. The beams are rotated to optimize their orientation and then sawn to maximize the yield of usable planks. However, it is difficult to determine the type of wood used as the strokes are not detailed. The type of wood determines the commodity quality of the wooden planks being traded. Therefore, wooden planks can be categorized as commodities with a varying value.

Fifteenth-century Chinese records mention that palace roofs usually used shingles (Groeneveldt, 1960). This suggests that wood or bamboo shingles would've been categorized as middle-to-upper roofing materials. Shingles became an expensive commodity due to the complicated manufacturing (production and installation) process. Shingles are also able to retain the sun's heat radiation, making the room cooler. This is in accordance with the findings of a case study conducted by Ulrich et al., (2019) in Pendapa Mangkunegaran.

Another material used as the roof of the house is terracotta tiles. Terracotta tiles are described as identical to shingles. Terracotta tiles are commodity goods with basic materials that are not easily available (clay) and require a long manufacturing process. Making tiles is done in 4 stages, namely: (1) material processing and mixing, (2) moulding, (3) drying with wind and sunlight, and (4) firing (Nariani et al., 2021).

(Rangkuti et al., 2019) categorized terracotta in Hindu-Buddhist sites into two categories: coarse dough and fine dough. These two categories are distinguished by the characteristics of the material (body). The identification results of BPK region XI show that the tiled artifacts at PIM use coarse dough because there is a mixture of sand, so it looks rough and has many pores (Rankuti, 2001). In modern times, the drying process of moulded tiles takes 1-2 days and requires additional

raw materials (wood and wood chips) for burning (Najib, 2018). Terracotta tiles are easily mossy and overgrown with mould. The original colour also fades quickly when exposed to sunlight and rain.

The production process and the main raw materials are complicated and difficult to obtain, making clay tiles a middle to upper-class commodity. Terracotta tiles became the main preference of the Majapahit people because of their advantages, namely light weight, resistance to pressure (not easily broken), and long service life. It is also not affected by hot or cold temperatures. This is a preference for some people because the use of tiled roofs makes their houses less hot during the day and less cold at night.

The five materials described above are local materials that were easily available in the environment at that time. This means that the Majapahit community preferred to use existing materials rather than importing materials for roofing. (Winarto et al., 2015) said that the use of natural local materials is part of Majapahit culture. The Majapahit community did not import building materials even though Majapahit was a maritime country with strong associations with international trade. Commodity grouping is also based on the exchange rate, namely: (1) lower middle class (palm fibre and bamboo), (2) lower and upper middle class (wooden planks), and (3) upper middle class (shingles and terracotta tiles). This finding is in line with Prasodjo's (1988) opinion that wood or shingle materials were used only in the homes of kings or people with upper-class economic levels. Records from China in the early 15th century also mention that thin wooden arrangements (shingles) were used as roofs, especially for palace roofs (Groeneveldt, 1960). This implies that shingles were used by the upper economic classes. In this case, the selling price of each material is not the same and is influenced by the complexity of production and the availability of materials.

## IV. CONCLUSION

The identification of Majapahit period roofing materials was carried out through observation of miniature terracotta houses. The majority of roof strokes on the miniature houses accurately reflect the roofing materials used during the Majapahit period. Some strokes (≤18%) that exhibits motifs or lack distinct strokes, likely reflecting the artistic liberties taken by creativity of terracotta craftsmen. Terracotta miniature houses that do not depict the material are probably toys or home decorations.

The strokes on the miniature houses show the use of local materials in the area around the Majapahit Kingdom. This reflects the Majapahit culture that utilized more local resources. Based on the estimated relative cost, the roofing materials can be categorized into three tiers: (1) lower middle class (palm fibre and bamboo), lower and upper middle class (wooden planks), and (3) upper middle class (shingles and terracotta tiles). The choice of roofing materials for Majapahit houses is a complex consideration of various social and economic factors. The choice of roofing

materials and construction methods depicted on the terracotta roofs of miniature houses reflect the socioeconomic conditions and cultural preferences of the inhabitants.

The results of this research add knowledge about the life of Majapahit society, especially in the socioeconomic field. The selection of roofing materials provides insights into the socio-economic condition of the Majapahit people. However, this study has some limitations, including: (1) limited examples of the use of wooden planks, (2) incomplete records of the distribution of plant species used and (3) data gaps due to damaged or unidentified artifacts. This may reduce the accuracy of the conclusions drawn. Therefore, the results of this study need to be confirmed with research on existing flora resources in order to obtain valid results. In addition, the socio-economic condition of the Majapahit community is only associated with the use of roofing materials. Socio-economic conditions can also be known from other materials used in the components of the house and the architecture of the house form.

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