



The Beauty in Javanese Architecture: Exploring Proportional Systems and Aesthetic Insights on Joglo and Limasan House

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Abstract. In the last decade, there has been growing concern about preserving cultural heritage, especially regarding traditional architecture like Joglo and Limasan houses. Joglo architecture, with its intricate proportions and symbolic designs, reflects the deep cultural and spiritual values of Javanese society. This study uses vanishing point detection (VPD) to document the key ratios of Joglo and Limasan structures, comparing them with both traditional and modified versions found along the Pantura Highway. These ratios were analyzed against aesthetic theories, like Palladio's, which emphasize harmony and balance through mathematical precision. Despite challenges, the findings highlight the importance of these proportions in maintaining architectural harmony, showing that Joglo and Limasan houses not only preserve cultural heritage but also reflect universal architectural principles. The study provides valuable insights for future preservation and construction.

Keywords: Joglo Architecture; Cultural Heritage, Limasan House, Architectural Aesthetic, Proportional Systems.

1 Introduction

Over the past decade, growing concerns have emerged within the cultural heritage community regarding various interventions and management strategies that challenge traditional conservation methods, potentially jeopardizing the authenticity and integrity of heritage sites [1, 2]. These discussions emphasize the importance of local culture, which has developed through a close relationship with nature, as a fundamental aspect of community knowledge and a key contributor to educational quality. Cultural values are changing due to modernization, with new elements being integrated into society [2]. The significant role of culture in fostering social integration and promoting environmental sustainability, especially within the framework of sustainable development [3].

Joglo architecture, a quintessential representation of Javanese traditional architecture, is renowned for its high aesthetic value, which is reflected in the proportions and dimensions of its structure [4]. Proportions in Joglo architecture are not only crucial for structural stability but also for creating harmonious beauty. Originally, Joglo houses were reserved for the elite due to their symbolic importance and high construction costs. Over time, they adapted to serve a wider economic range, undergoing typological changes [5]. In the context of Joglo design, proportions encompass the ratios of height, width, and other dimensions such as the ratios of penanggap, pengakur, and saka, as well as the spans of saka, penanggap, and the lower spans of pengakur and penanggap [6]. The study of these proportions aims to provide a guide for designers in constructing Joglo and Limasan houses in the future while determining the aesthetic qualities inherent in this traditional structure.

However, despite the recognized importance of these proportions, there is a significant lack of precise documentation regarding the ratios and dimensions of Joglo and Limasan structures. Many of the houses were constructed based on traditional knowledge passed down orally, without detailed written records. This lack of documentation presents challenges for efforts in reconstruction or restoration, as it becomes difficult to ensure that the correct proportions are maintained without accurate records. This study aims to provide a clear guide for future designers in the construction of Joglo and Limasan houses, especially from North Coast Road of Java by documenting these critical ratios and evaluating their aesthetic qualities. One central focus of this research is to explore whether these traditional proportions align with well-established aesthetic theories, particularly those concerning proportion and harmony in architecture.

Existing studies, such as Sitanggang et al. (2019), have explored the role of spatial proportions in human-centric design through Ashihara's Enclosure Theory (1971)[7] [8]. These works highlight the D/H (distance-to-height) ratio as a determinant of external spatial quality. Similarly, Sani & Supriyadi's (n.d.) analysis of the Bugis Bola Soba house revealed how proportional systems like 1:1 and 1:1.23 harmonize built forms with human dimensions [9]. While these works underscore the significance of scale in vernacular architecture, their scholarly focus remains confined to external spatial metrics, neglecting the internal structural ratios between each of the building elements that define the aesthetic and functional integrity of traditional designs.

This study redefines the perspective by systematically measuring key proportions in Javanese Joglo architecture, including the penanggap (main beam), pengakur (connector), and saka (pillar), and aligning them with universal aesthetic principles such as Palladio's geometric harmony and the Golden Ratio (1:1.618) [10–12]. For instance, the $\sqrt{2}$:1 ratio observed between the saka guru (central pillar) height and pendapa (main hall) width not only mirrors Palladian principles but also aligns with Javanese cosmological concepts of balance. The urgency of this work lies in its dual role:

1. preserving endangered architectural heritage by codifying ratios essential for authentic reconstruction (e.g., deviations from the traditional 3:2 penanggap ratio risk distorting symbolic meaning), and

2. challenging Western-centric aesthetic paradigms by demonstrating how Javanese proportional systems offer empirically grounded alternatives for sustainable, culturally resonant design. By bridging abstract aesthetic theory with precise structural documentation, this study provides a replicable framework for analyzing vernacular architectures globally, ensuring their philosophical and technical legacies endure in an era of rapid cultural homogenization.

2 Literature Study

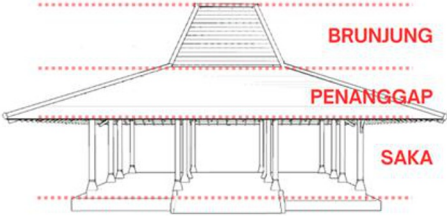
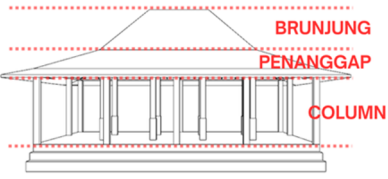
2.1 Architecture of Joglo and Limasan.

Joglo houses, with their iconic four central pillars (*soko guru*) and layered roof structure (*tumpang sari*), represent a deep connection between Javanese architectural practices and the region's cosmological and spiritual beliefs [13]. The presence of these core elements, alongside other traditional styles like *tajug*, *Limasan*, and *kampung*, illustrates a comprehensive architectural philosophy. Ancient manuscripts that document these styles emphasize the inherent balance and harmony within the Joglo design, reflecting an alignment with the cosmic order [14].

The roof of the Joglo house, with its resemblance to the mountainous shapes often seen in Hindu temples, further underscores the philosophical link between sacred temple architecture and domestic structures. This symbolic roof reflects a broader connection to the Javanese spiritual worldview, where the organization of space within the home, from public to private zones, mirrors the hierarchical structure of Javanese society. This spatial organization, deeply rooted in agricultural traditions and the worship of Dewi Sri, the goddess of fertility, highlights the Joglo as not only a physical structure but a spiritual one as well [14].

Limasan House, like other traditional structures, uses natural materials such as wood and stone. Its design is similar to Joglo but lacks the *tumpang sari* beams. "Limasan" comes from the Javanese language, meaning "fifteen," referencing the proportional measurements of key structural elements. The *molo*, or top beam, is paired with the *blandar*, the roof-supporting pillar. The structure includes columns, beams, a roof, and *umpak*, creating good insulation with its closed-wall design, supporting resilience and sustainability [15]. The *Limasan House* reflects the Javanese people's humble nature. Unlike the more elaborate Joglo, it uses simpler colors, ornaments, and materials, allowing for faster construction. *Limasan's* neutral status in ownership also mirrors the modesty of rural Javanese life. Javanese culture places strong importance on proper conduct, humility, and the avoidance of selfish behavior, which is reflected in architectural features such as the lowered front area (*emper*) designed to convey respect toward guests [16].

Table 1. Comparison of joglo and limasan characteristics.

Joglo House	Limasan House
	

The Joglo house is a traditional Javanese architectural style associated with the nobility, distinguished by its tiered, steeply pitched roof (tajug) that resembles a mountain and is supported by four main pillars (soko guru). Its design reflects social hierarchy and sacred cosmology, with a formal spatial layout comprising the pendopo (public space), pringgitan (transitional space), and dalem (private inner sanctum), arranged to express harmony with nature and spiritual order. Constructed from high-quality teak wood and decorated with intricate carvings, the Joglo exudes a sense of prestige and reverence. Symbolically, its towering roof represents Mount Meru in Hindu-Javanese belief, reinforcing its role as a cosmic and ceremonial structure.

Limasan house represents a more modest and pragmatic form of Javanese vernacular architecture, commonly associated with the middle class. It features a pyramid-shaped roof (limas) with four triangular sides and does not include the central soko guru pillars found in the Joglo. Rather than emphasizing ritual and symbolism, the Limasan prioritizes functionality, with flexible spatial divisions: a front area for guests, a central living space, and a back area for sleeping. Built with accessible materials like wood, bamboo, and clay tiles, the Limasan is simpler, faster to construct, and more earthquake resistant. Its philosophy centers on the Kekijing principle, which is balancing the five life elements and includes a surrounding emperan (terrace) that supports climate responsiveness and reflects values of humility and social respect.

2.2 The Philosophies of Joglo and Limasan Architecture.

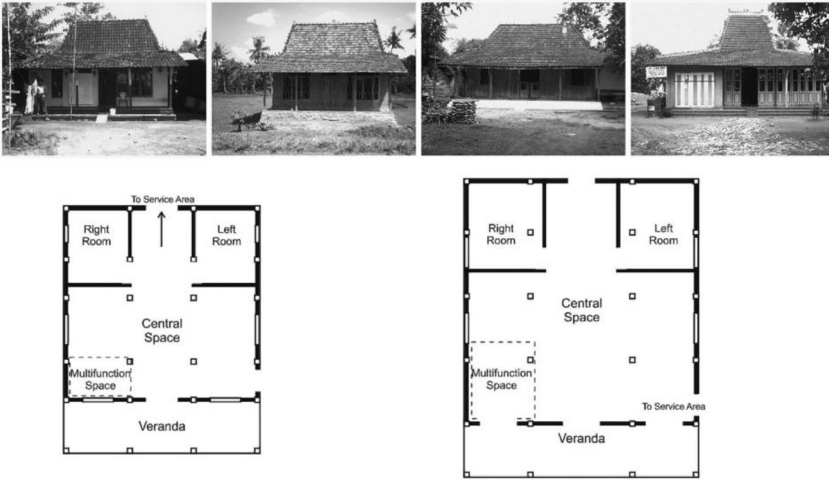


Fig. 1. Pati (Tayu) Coastal Limasan and Joglo House. Source: Idham (2018)

Based on the journal by Idham, in 2018, Pati coastal Joglo and Limasan houses are characterized by their wooden structures and brick walls (can be seen in figure 1), typically topped with clay tile roofs [17]. Both types of houses generally face the street and feature large openings that ensure good air circulation, which is essential for maintaining comfort in the humid coastal climate. Joglo houses in the Pati coastal areas are smaller than other vernacular houses in Java, reflecting the community's agricultural and fishing lifestyle. They often include secondary doors with holes and grilled windows to enhance ventilation. In contrast, Limasan houses are designed to provide functional spaces suitable for agricultural and fishing activities. The architecture of these coastal houses in Pati showcases the community's adaptation to their environment through the thoughtful use of materials and structural designs that prioritize functionality and comfort [17].

The Joglo house embodies Javanese cosmological principles, in which spatial organization reflects both spiritual beliefs and communal values. Its layout is anchored by four central pillars (*saka guru*), symbolizing the mandala worldview, where creation radiates from a sacred center supported by the four cardinal directions [14]. At the heart of the structure lies the *dalem* (inner sanctum), dedicated to Dewi Sri, the rice goddess, which represents divine presence within the home and positions humans as stewards rather than proprietors [18]. This spiritual hierarchy extends into a spatial gradient: the *pendapa* (front pavilion) functions as a public space for communal interaction, while the *gandhok* (side rooms) and *pringgitan* (transitional area) serve as intermediaries between the secular and sacred realms. The *dalem*, as the point of convergence between cosmic and human domains, reinforces Joglo's role as a microcosm of universal harmony [14]. In modern iterations, household appliances are integrated while maintaining

traditional aesthetics [19], reflecting attempts to balance ancestral symbolism with contemporary functionality—though deviations from original proportional ratios risk diminishing the structure’s symbolic integrity.

In contrast to Joglo’s symbolic complexity, the Limasan house emphasizes functional simplicity and social pragmatism. Its pyramid-shaped roof and open central area prioritize utility, with spatial divisions reflecting Javanese philosophical dualities: public (emper/front terrace) versus private (senthong/bedrooms), and sacred versus profane [20]. Positioned centrally within the dalem, the senthong acts as the symbolic heart of the house, echoing the Javanese emphasis on balance and humility. Unlike the Joglo, which features ornate carvings and layered roof systems, the Limasan embraces minimalist ornamentation—consistent with its historical role as a middle-class dwelling [21]. While the Limasan’s design echoes Hindu-Buddhist temple architecture, particularly in its stone wall arrangements, this influence reflects cultural continuity rather than religious adherence [21]. The lowered height of the emper, which requires guests to bow when entering, further embodies Javanese norms of respect and reinforces the social hierarchy embedded within the architecture.

Despite their differences, both the Joglo and Limasan houses express the Javanese principle of unity between the macrocosm and microcosm through spatial dualities (e.g., left–right, sacred–profane) and centralized focal points (dalem in the Joglo, senthong in the Limasan). However, where the Joglo highlights cosmological grandeur through symbolic ratios and the sacred function of the saka guru, the Limasan conveys humility and egalitarianism through its use of modest materials (bamboo, wood) and flexible spatial layouts. These contrasts reveal how Javanese architecture mediates between spiritual ideals and socioeconomic conditions, sustaining cultural identity amid evolving historical and environmental contexts.

3 Method

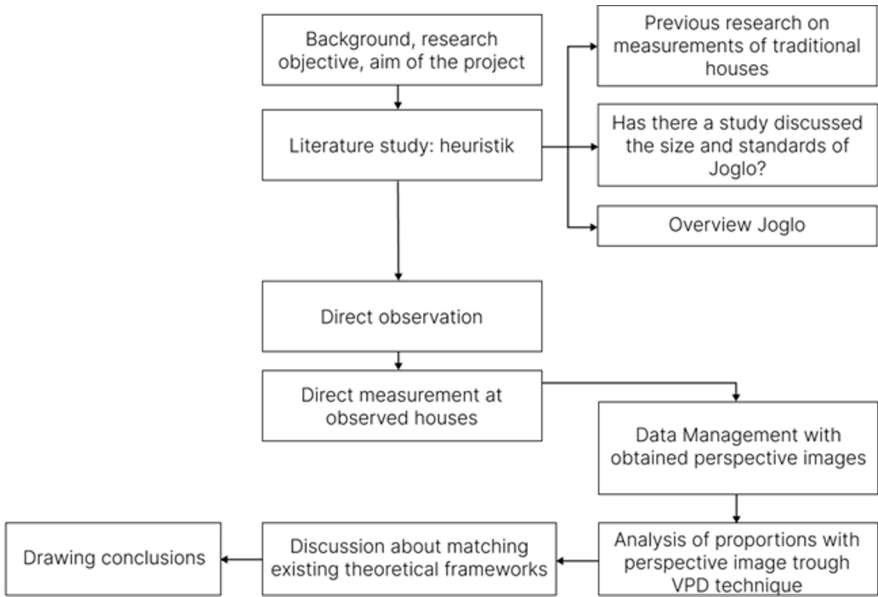


Fig. 2. Research framework. Source: Author

As shown in Figure 2, the research framework outlines the approach for studying traditional houses worldwide, including the Joglo house. Research on traditional houses worldwide, including the Joglo house, often centers around understanding the proportions and ratios used in their construction to guide future projects involving similar structures. Previous studies have examined the dimensions and design standards of the Joglo, exploring how these proportions align with broader architectural traditions and the cultural contexts that shaped them. The objective of such research is to analyze the spatial layout, cultural symbolism, and aesthetic values embedded in traditional housing designs like the Joglo. By conducting direct observation and measurement of specific Joglo houses, researchers capture data through perspective images and other tools. This data is then systematically analyzed to determine whether the observed proportions match existing theoretical frameworks regarding traditional architecture. The final stage involves drawing conclusions about the harmony between the practical measurements and the theoretical possibilities, ultimately contributing to a deeper understanding of the underlying construction principles and cultural significance of traditional homes like the Joglo.



Fig. 3. Location of the direct observation conducted. Source: Author



Fig. 4. Distribution map of Joglo observed on Pantura road. Source: Author

This research documents 12 Joglo houses located along the Java North Coast Road in Trimulyo Village, Juwana, Pati, as shown in Figures 3 and 4. The documentation process involved photographing each Joglo house, which is situated in Juwana city on the northern coast of Java, along the northern coastal route. Juwana is the second largest city in Pati Regency, renowned for its brass handicraft industry and milkfish cultivation. Due to its smaller size and more rural setting, the city has preserved its cultural and social practices, making them less influenced by external factors compared to other regions of Java. This presents a unique phenomenon where Joglo houses, even those situated along the North Coast Road, have managed to maintain their traditional "Joglo" identity.

During the observation and documentation process, the research team encountered several challenges that affected the quality of visual data collected. One of the main issues was the limited spatial conditions, such as narrow yards and dense surroundings, which made it difficult to capture photographs with adequate focal depth. As a result, the photos were taken from across the road, which meant that many of the photographs did not achieve a vanishing point centered on the building. This resulted in images that appear more as elevation views rather than true perspectives, limiting the ability to fully appreciate the architectural depth and proportionality of the structures.

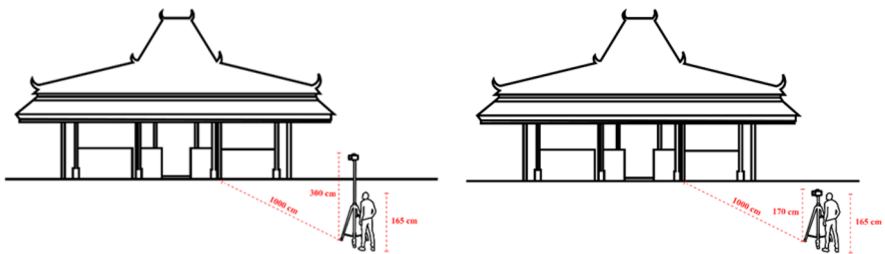
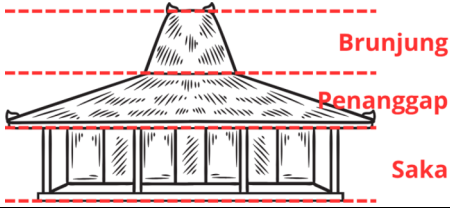
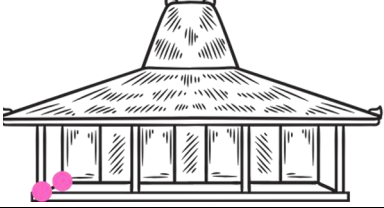


Fig. 5. Ideal camera placement and on field camera placement. Source: Author

To address this issue, lines were drawn from visible structural elements in the available photographs, as illustrated in Figure 4. These lines were extended to determine the location of the vanishing point in the photos. The identified vanishing point then served as an axis used to calculate the ratios of the Joglo’s height (including the ratios of *penanggap*, *pengakur*, and *saka*) as well as its width (including the spans of *saka*, *penanggap*, and both the upper and lower spans of *pengakur*). These ratios are illustrated in Figure 4.

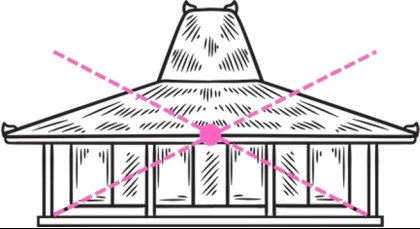
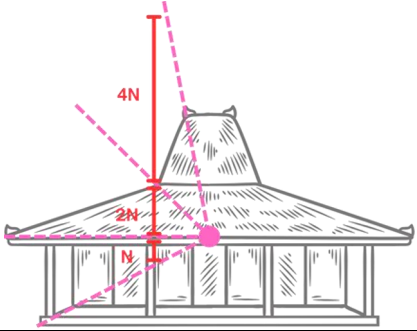
Table 2. Geometric analysis steps for Joglo perspective. Source: Author

	
<ol style="list-style-type: none"> 1. The first step involves capturing an image of the Joglo house from a proper perspective view. This perspective will allow for the main structural elements of the Joglo to be captured, which can then be analyzed geometrically. 	<ol style="list-style-type: none"> 2. From the obtained perspective image, identify two convergence points (vanishing points), which represent the points where parallel lines appear to meet due to perspective distortion. In a 2D view, these two points should correspond to parallel lines in the 3D space.

The retrieved images from the previous step generally depict the requested object from the query image, but historical images can still show considerable radiometric and geometric differences. These differences may include variations such as different lighting views or activity and location on relevant building sections. The main challenges lie in estimating the initial principal distance (focal length) and identifying distinctive feature matches.

To address this, the proposed method utilizes vanishing point detection (VPD) to initialize the principal distance. This approach builds on prior work, refining it by filtering out images that do not contain at least three significant vanishing points. For initialization, a pinhole camera model is assumed, where parallel lines in the real-world object space are projected as sets of lines in the image space. The strength of this method, particularly with the data at hand, is that parallel lines are commonly present in urban or man-made structures.

Table 3. Proportional measurement process. Source: Author

	
<p>3. From the two identified vanishing points, draw straight lines connecting these points. These lines will represent the directions of parallel lines that would otherwise be invisible in the 2D view. The intersection of these lines is considered the vanishing point.</p>	<p>4. Once the vanishing point is identified, draw lines from this point toward the part of the Joglo structure whose dimensions are to be calculated (e.g., height and width). This line will provide the geometric basis for calculating the proportions between various structural elements of the Joglo, such as the height of the penanggap, pengakur, and saka, and the width of both upper and lower spans.</p> <p>After drawing the lines, use these lines as a reference for measuring the proportions of the elements within the Joglo house. Each section measured will provide a ratio that can be compared to existing aesthetic theories to determine if the Joglo adheres to a specific proportional system.</p>

VPD is a crucial technique used in transforming perspective images into parallel projection views. In a perspective image, parallel lines in 3D space appear to converge at a vanishing point. VPD identifies these points by detecting and extending parallel lines across the image, helping to infer camera parameters like focal length and orientation. This process is vital in applications like architectural photography, where vertical and horizontal lines of buildings converge due to perspective distortion [22]. Multiple vanishing points can be detected in complex scenes, and tools like Gaussian mapping simplify calculations by projecting 3D line orientations onto a sphere [23].

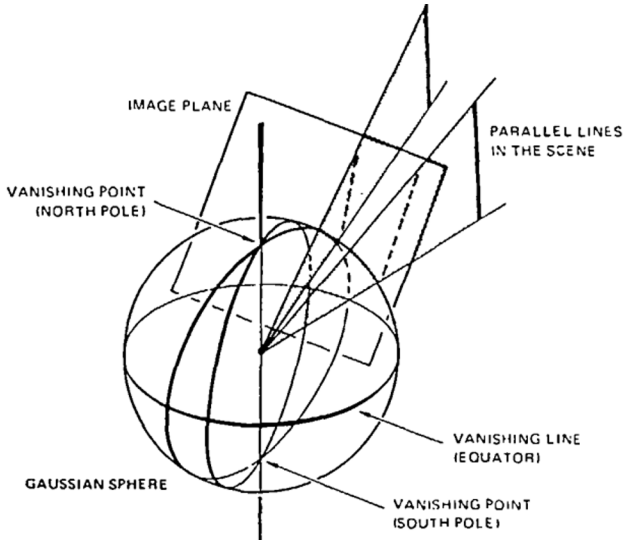


Fig. 6. Gaussian mapping. Source: Bernard, 1983

Once the vanishing points are identified, the transformation to parallel projection begins. A projection matrix is constructed to adjust how 3D points are projected into 2D, ensuring parallel lines remain parallel in the image. This eliminates perspective distortion, making the image suitable for precise applications like architectural analysis or 3D modeling, the example can be seen in figure 5. By correcting the distortion, lines that would typically converge at vanishing points are adjusted to remain parallel, achieving a more accurate geometric representation [22, 23].

As shown in Table 4, the Joglo house is depicted in a parallel projection. The identified ratios from this projection were then compared with existing aesthetic theories to establish an argument regarding which proportional system the Joglo adheres to. By analyzing these proportions, the research aims to determine whether the Joglo houses follow a specific aesthetic ratio and how these ratios contribute to the overall harmony and beauty of the structure.

4 Analysis and Discussions

4.1 Result and Analysis

The observational data gathered from the study of Joglo and Limasan houses along the Perimeter Jalan Raya Pantura offers a detailed comparison of traditional and modified architectural structures.

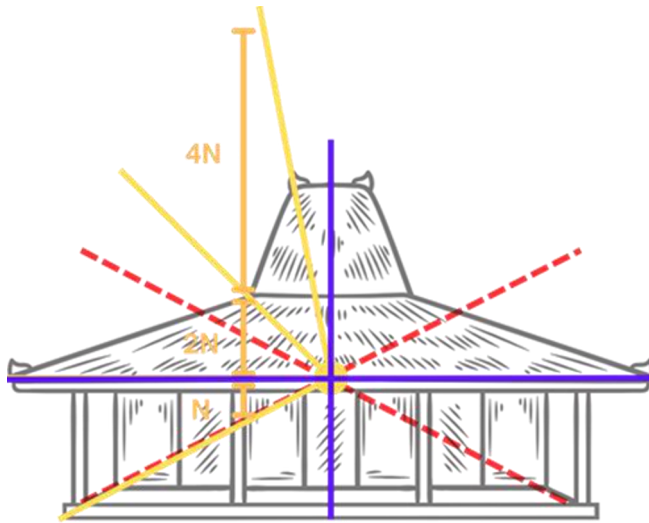


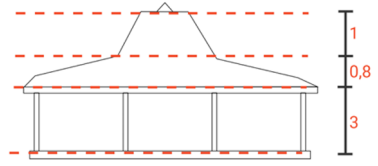
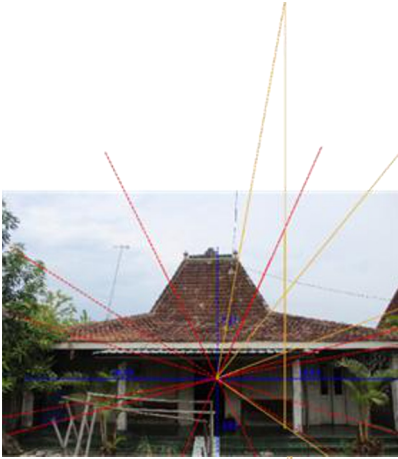
Fig. 7. Image capture and ratio measurement guide. Source: Author

Figure 7 provides guidance on image capture and ratio measurement. The blue line indicates the vanishing point, with the numbers showing its position based on the actual width and height of the house, measured using either a laser meter or a conventional tape measure. The red dashed line connects parallel points, while the yellow dashed line represents an imaginary line drawn at the ends of sections to measure their ratio. The yellow solid line is used to determine the ratio: if one line has a height of N , the corresponding height at the intersection with the yellow dashed line should also be N . This figure serves as a visual guide to ensure accurate and consistent image capture for ratio analysis.

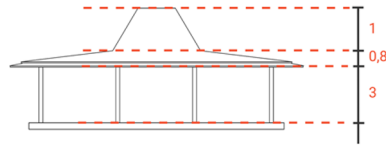
Table 4. Comparison of VPD analysis results and Joglo house ratio

Code	VPD Analysis Result	The ratio in Joglo and Limasan House
		1 : 0,8 : 3

X1

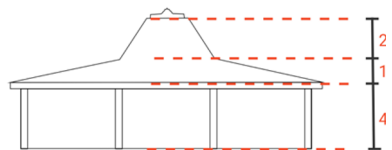


X2

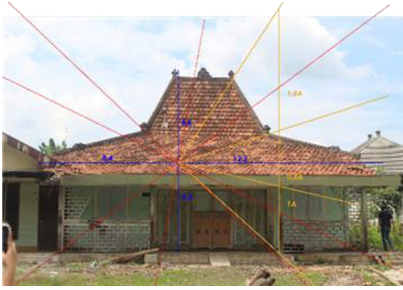


2:1:4

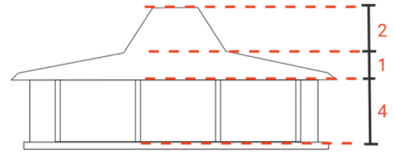
X3



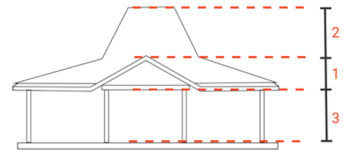
X4



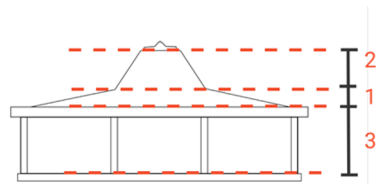
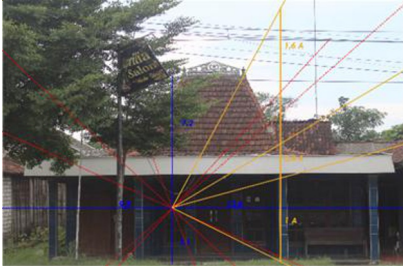
2:1:3



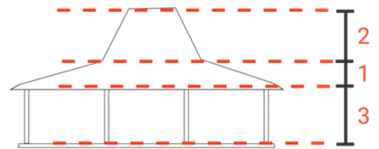
X5

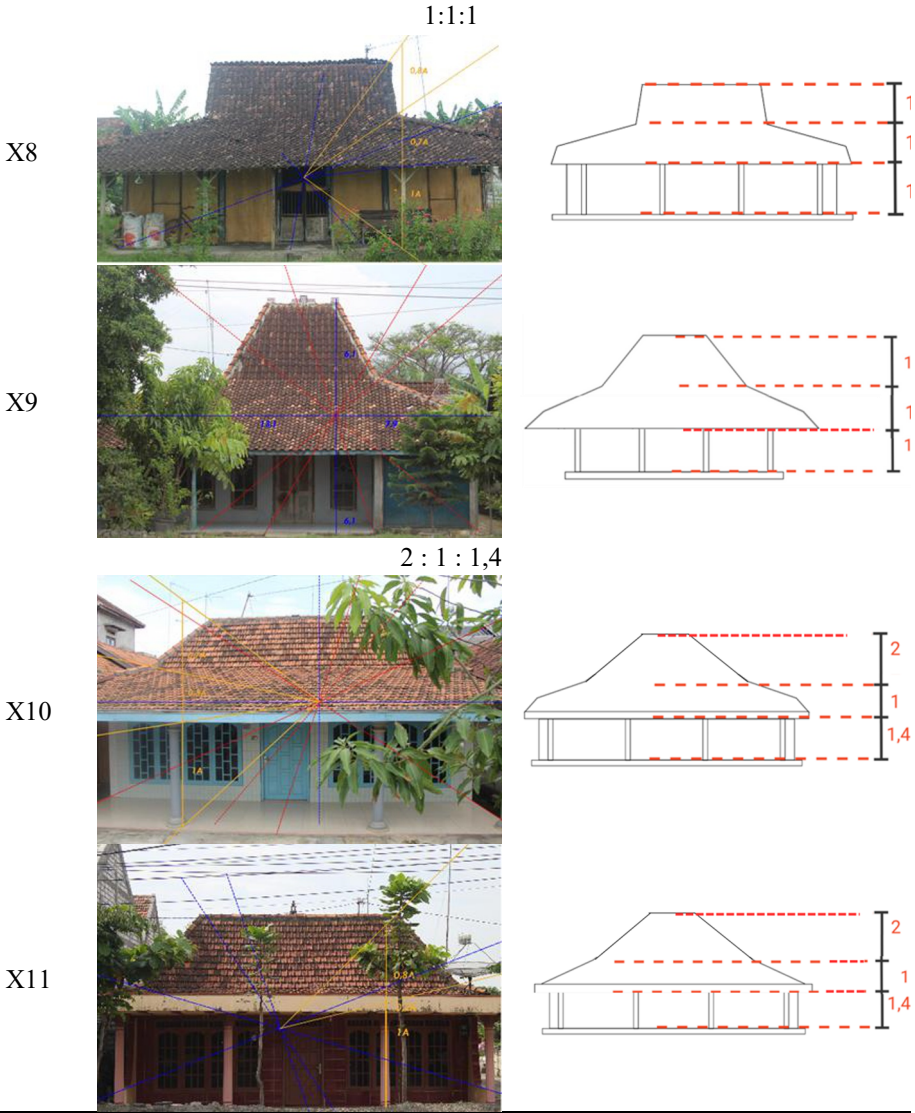


X6



X7





The *Joglo* houses in the study demonstrated several proportional variations, suggesting modifications from the traditional layout.

- Brunjung: The steep, uppermost roof section covering the central pillars (*saka guru*).
- Penanggap: The flatter, middle roof segment extending outward from the *brunjung*, covering the remaining structure.
- Saka: The vertical supporting pillars beneath these roofs.

The measured vertical proportions in *Joglo* houses were:

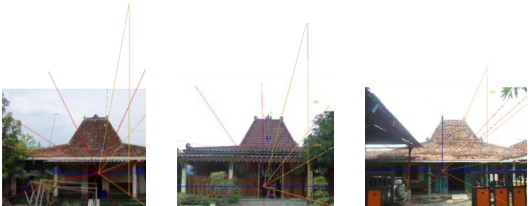
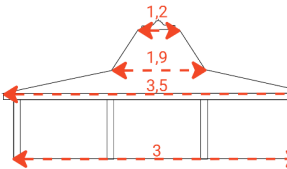
- **1:0.8:3 (2 houses):** The saka pillars displayed slight vertical elongation relative to brunjung and penanggap heights.
- **2:1:3 (3 houses):** These houses exhibited balanced vertical proportions between brunjung, penanggap, and saka components.
- **2:1:4 (2 houses):** A noticeable vertical emphasis, with the saka height notably greater in proportion relative to the brunjung and penanggap segments.

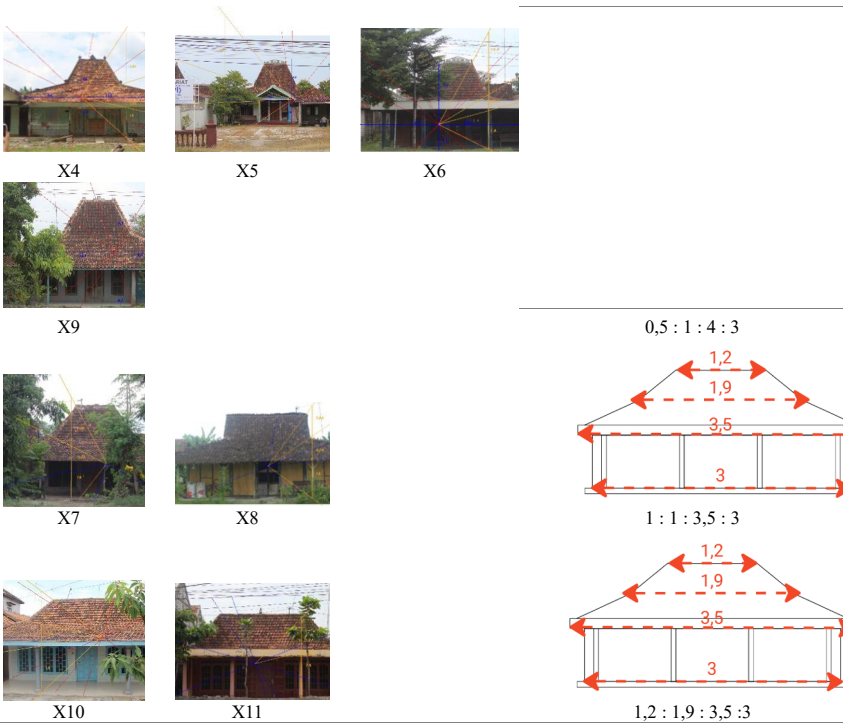
Limasan houses demonstrated the following vertical ratios:

- **1:1:1 (2 houses):** Equal proportions between brunjung, penanggap, and saka elements.
- **2:1:1.4 (2 houses):** Slight increases observed in the saka height compared to brunjung and penanggap dimensions.

The observation at the house coded X8 reveals that it is a type of "kampung jompongan," a traditional Javanese house with a limasan roof, which has specific characteristics and social functions, particularly in areas like Kotagede, Yogyakarta. This house features a simple limasan roof with a surrounding porch. The limasan house and the kampung jompongan are interconnected, as the latter is a variant or form of the limasan house within Javanese culture, with its own unique social functions and philosophy, especially in rural areas. The limasan house evolved from the joglo, with modifications in size and shape that influenced the architectural style of the kampung jompongan. In short, the kampung jompongan can be seen as one type or pattern of the limasan house in Javanese architectural tradition, both reflecting the history and social functions of Javanese society, ranging from the nobility to the common folk in rural areas [24].

Table 5. Comparison of VPD analysis results and Joglo house width ratio. Source: Author

VPD analysis and House Code	The Width ratio in Joglo and Limasan House
 <p>X1 X2 X3</p>	



The Joglo and Limasan houses in the study displayed several proportional variations in width, indicating adaptations from their traditional forms. Horizontal proportions were measured across structural widths from the top of the *brunjung* roof downward to the lowest structural elements, including *brunjung* widths, *penanggap* widths, and the widths of house walls or pillars. Measured horizontal ratios include:

- **0.5:1:4:3 (7 Joglo houses):** These structures displayed progressively wider horizontal proportions from the narrow upper *brunjung* to the broader *penanggap* and lower supporting elements.
- **1:1:3.5:3 (2 Limasan houses):** Horizontal proportions appeared balanced and relatively symmetrical from top *brunjung* widths through lower structural components.

- **1.2:1.9:3.5:3 (2 Limasan houses):** Increased horizontal dimensions were recorded, especially in middle roof segments (lower *brunjung* and *penanggap* widths), compared to other houses studied.

5 Discussion

5.1 Joglo and The Aesthetic of Vernacular Architecture

The Joglo and Limasan house reflects Javanese cosmological beliefs, where balance and harmony are key principles. The design of the house is not just functional but symbolic, representing social hierarchy and spirituality. The spatial arrangement and central pillars in the Joglo and Limasan house are a direct reflection of Javanese cultural values, with the house structured to integrate with nature, ensuring the well-being and prosperity of its inhabitants. This illustrates how the Joglo functions as an embodiment of the relationship between humans and the universe in Javanese culture [25].

Christian Norberg-Schulz explores the idea that architecture should engage deeply with the environment to express the unique character of a place. He believes that buildings should connect with the landscape, climate, and cultural context, creating spaces where people feel a sense of belonging and connection. His work highlights the importance of emotional and sensory experiences in architecture, suggesting that a building should resonate with human identity and perception. This aligns with the traditional Javanese Joglo and Limasan house, which embodies Norberg-Schulz's concept of *Genius Loci*, or the spirit of place. The Joglo and Limasan, with its use of local materials and design that harmonizes with the natural environment, reflects the landscape and societal values of Java. Its open layout and symbolic features, like the central pillars (*saka guru*), create a deep sense of unity with the surrounding nature [26].

5.2 The Relation with Renaissance's Proportion Theory

This study provides empirical documentation of proportional relationships in Javanese Joglo and Limasan architecture along the Pantura Highway in Pati, bridging structural analysis with broader architectural aesthetics. The proportional analysis of 12 selected houses revealed clear variations in both vertical (height) and horizontal (width) ratios. Vertically, the Joglo houses exhibited distinct proportional patterns: 1:0.8:3 (2 houses), 2:1:3 (3 houses), and 2:1:4 (2 houses) (*brunjung:penanggap:saka*). Limasan houses demonstrated proportional regularity in vertical measurements, specifically 1:1:1 (2 houses) and minor modifications such as 2:1:1.4 (2 houses). Horizontal measurements also indicated structural variation, including ratios of 0.5:1:4:3 (7 Joglo houses), 1:1:3.5:3 (2 Limasan houses), and 1.2:1.9:3.5:3 (2 Limasan houses), reflecting pragmatic adaptations.

The identified proportions provide clear evidence of structural variation within Javanese vernacular architecture. The proportional relationships documented here suggest an intuitive approach to spatial balance and organization, demonstrating numerical patterns that share conceptual parallels with universal aesthetic principles such as those

articulated by Renaissance architects like Andrea Palladio. However, it is essential to emphasize that these proportional patterns were observed empirically and do not imply explicit derivation from Western mathematical or theoretical traditions. Javanese architectural practice has historically emphasized philosophical, environmental, and practical considerations rather than explicit numeric calculations.

Furthermore, this research contributes toward addressing the scarcity of standardized documentation for Joglo and Limasan proportional ratios. The observed empirical data and methods introduced—such as the use of Visual Proportional Diagrams (VPD)—provide valuable tools for future conservation and reconstruction efforts, aiding in the preservation of structural authenticity and cultural integrity.

Regional factors in Pati, including its coastal geography, relative distance from the Mataram Sultanate's historical core in Yogyakarta, modernization, and infrastructural changes (notably, Pantura Highway development), have influenced observed proportional variations. These regional distinctions underline the need for further comparative analyses between Joglo and Limasan houses in coastal areas like Pati and those from central regions around Yogyakarta. Future research could beneficially extend this methodological framework to original Mataram-era Joglo and Limasan structures, establishing clearer baseline proportions and assessing regional adaptations and the impacts of modernization more comprehensively.

In conclusion, this study documents proportional variations empirically, offers methodological clarity for future architectural studies, and positions Javanese vernacular architecture within broader global discussions of proportion and aesthetic theory. By providing a precise and replicable analytical framework, the research supports both architectural conservation and cross-cultural understanding, emphasizing the importance of preserving architectural diversity amid global modernization trends.

6 Conclusions

The results of this research on the proportions of Joglo architecture reveal distinct variations in structural ratios across the 12 Joglo houses studied along the Pantura Highway. Key ratios, such as *penanggap*, *pengakur*, and *saka*, were documented, highlighting both traditional and modified designs. For example, two houses exhibited a ratio of 1:0.8:3, indicating a slight elongation of the structure while maintaining the traditional relationship between the pillars and roof. Additionally, three houses were found to follow a 2:1:3 ratio, reflecting a broader width compared to the classical layout without compromising the building's vertical height. Further, two houses demonstrated a 2:1:4 ratio, indicating owner-driven modifications that expanded the internal space while preserving the core architectural elements of the Joglo design. Joglo architecture and Palladio's aesthetic and proportion theory shared emphasis on mathematical harmony and balance. Both architectural styles use specific ratios to create structural coherence and beauty, with Palladio employing ratios like 2:1 and 5:3, while Joglo houses feature ratios such as 1:0.8:3 and 2:1:3. In both cases, these proportions ensure that each element of the building relates harmoniously to the whole, reflecting a broader understanding of spatial aesthetics.

This study employs VPD techniques to calculate accurate dimensional ratios from available images. One significant limitation lies in the difficulty of capturing precise measurements due to the limited perspective and narrow space around the studied houses. Photography documentation, while effective for general analysis, did not always achieve optimal perspectives, which could affect the precision of calculated ratios. Additionally, the study focused primarily on a specific geographic location along the Pantura Highway, limiting its generalizability to other Joglo variations across Java or Indonesia as a whole.

Further development of this research could involve expanding the dataset to include Joglo houses from diverse regions, incorporating different environmental and cultural influences. More advanced imaging technology, such as 3D scanning or drone photography, could improve the accuracy of future measurements by overcoming the limitations of ground-level perspectives. Additionally, exploring the structural integrity and material resilience of these buildings in the context of modern construction techniques could provide insights into how traditional architecture can adapt to contemporary needs while preserving cultural heritage.

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