

Creativity in the Dynamics of Vernacular Architecture of Pre-Colonial Indonesia

Rahadhian P. Herwindo*, Y. Basuki Dwisusanto, & Enrico Nirwan H

Department of Architecture Parahyangan Catholic University,
Ciumbuleuit Street 94, Bandung, 40142, Indonesia

*Corresponding author: dodo@unpar.ac.id

Abstract

The presence of variants and the development of pre-colonial architecture in Indonesia show that this archipelago has strong vernacular traditions in architecture. This paper examines how the shape of the local classical architecture was able to hold a dialogue with various points of contact, both external and local historical ones; for example in the context of architectonic reflected in stone and wood architecture.

The research employed a case study and a descriptive-argumentative method on the architectural creativity as reflected in the building shapes and their tectonic in the pre-colonial era in Indonesia. These points as a transformation process have yielded a new form of architecture. Their uniqueness is indicated by the dialogical creativity of the ability to blend on elements from the outside with a pre-existing ones or between the new and the past.

The findings indicate that there are stone tectonic innovations such as the terraced corbel technology that allows buildings to be tall and large. The Prambanan temple shows an innovative technology to build a stone-high-rise temple in the early 9th century. It has inspired the outside world such as India and Cambodia. In addition to tectonic stones, tiered wooden roofs have also been used persistently until the Islamic era: for example in the temples and the mosques. Moreover, this tradition is closely related to the local traditions—Ancient Austronesian influenced before the entry of the hybrid Hindu-Buddhist culture that has been employed until the Islamic era.

Keywords: Corbel, Creativity, Stone, Wooden, Tectonic.

Introduction

In the past, the ancestors of the Indonesian people were thought to have had reliable knowledge in the face of globalization in their era. Cross culture (Lombard, 1996) is unavoidable considering the fact that the archipelago is located between two oceans and two continents. Synchronically and diachronically, this architecture can be recognized as a manifestation of the excellence of the architectural arts in Indonesia, both in terms of dynamism, variety of forms and its influence on Southeast Asia or Asia. Previous research has shown that the *Prambanan* and Borobudur temples have become the main reference for the temple designs in Southeast Asia (Herwindo, 2018) and South India. These advantages show that Indonesia has a superior architectural tradition.

The richness of Indonesian architecture can be shown through the variety of buildings from the pre-colonial period (before the entry of the western culture) to the present. The existence of variants in architecture shows the idea of being open to contacts with Asians outside their own culture and be creative in processing these external sources to produce new forms or new identities. This can be shown through architecture resulting from a creative effort in responding to globalization in the past (Herwindo, 2011). Indonesian architecture in the pre-colonial period was dynamic architecture, and it moved creatively and was open to cultural intersections. The result is a novelty but still does not leave the previous 'identity' behind (Hidayatun, 2014)

A description of the architectural forms hold a dialogue with intersections, both from outside Indonesia and from the past. This intersection is not addressed by imitating the form from the outside or the past but undergoing a transformation of form that produces a new architectural art (Priyotomo, 2007). Therefore, an example will be taken to ascertain how many forms are able to describe the transformation process. The process of transformation cannot be separated from the efforts of creativity. Local genius (Magetsari, 2010) is a depiction of this creative ability (Hasbi Ali, 2019) manifested through its architectural tectonics.

In relation to this background, this study aims to recognize the peculiarities in the development of Indonesian pre-colonial architecture, including its architectural forms such as tectonics in relation to space, figures, details, and possibly other aspects that are considered important. This particularity can be reviewed based on the use of stone and wood materials. The goal of this study is to find out about the innovations in its architectural design which show a uniqueness that distinguishes it from others outside Indonesia at its time.

Pre-colonial buildings in Indonesia from the Hindu-Buddhist era to the Islamic era had very diverse characteristics. In each era, the buildings also show variations in the processing of their forms. These differences illustrate that creativity in the processing of architectonic form also developed, such as in the Ancient Hindu-Buddha Era (4th-8th centuries), the Middle Era (8th-12th centuries), and the Late Era (13th-15th centuries). Before the entry of Hindu-Buddhists in Indonesia, patterns had developed which referred to the ancient Austronesian culture which became a local genius. The entry of influences from outside such as India is synergized with these local aspects so that they merge with the local traditions and create a new appearance.

As a matter of fact, the characteristics of India were actually slowly disappearing and it seems that they were just imaginary. The temples in Indonesia show a strongly managed or processed character (Santika, 1995). Previous studies have shown that the stone corbel construction techniques of old temples in Indonesia show differences with old temples in South India (Herwindo, 2019). This corbel technique was consistently used in all temples in Indonesia in the 7th – 15th centuries, with a wide variety of forms, while in South India this corbel model has been used only in the 11th century (However, there is a possibility of backflow).

The Backflow Theory has been put forward by FDK Bosch (1974) in the context of archaeology and culture. In the architectural context, previous research shows that in South India before the 11th century, the temple buildings had a much lower height than Prambanan in Java, in the 9th century, so that the technology of building tall buildings like Prambanan could possibly have inspired temples in South India in the later period, namely the 11th century. This can be seen in the use of corbel tectonics which has been widely used in Indonesia since the 7th century.

The temples are not only made of stone, but some are also made of wood as depicted in the reliefs of temples such as the ones at Borobudur (in the 8th century) in the form of pagodas/tiered roofs. According to literature studies, the oldest wooden pagoda in China was built in the 10th century. In the artifacts in the field, remains of foundations were also found as a place to support wooden columns such as in Sambisari, Kedulan, Klero, and Bayalangu temples, and some others, both old and more recent temples. Religious buildings using wood elements are employed today in the form of Hindu temples (*Pura*) such as those in Bali and

various mosques in Indonesia. The dynamics of the use of stone and wood in relation to locality will be studied further, such as the tectonic characteristics of architecture. Previous studies refer more to archaeological studies. Therefore, in relation to understanding the form of creativity, the processing of architectural forms is particularly associated with the tectonic aspects of rock and wood. Previous research has carried out studies of its relationship with South India and Khmer. This study will expand its relation through field studies in North India.

Theoretical Basis

Originally, the word "architectonic" pertained to architecture, specifically the construction of buildings. However, unity is achieved without architectonics, one merely conforming technically to the requirements of a form, is more limited. As a concept, architectonics can help composition scholars understand the relationship between parts and the whole. In this sense, architectonics began to appear after the late eighteenth century in England to describe architectural or artistic elements in accordance with a single design that harmonizes (Greer, 2013). Building construction cannot be separated from its shape and tectonic aspects. Changing the shape and its tectonics is part of creativity in producing architectural forms.

The study was carried out in an argumentative descriptive manner, namely to explain architectonic aspects in the architectural creativity reflected in the form of buildings during the pre-colonial period in Indonesia. Creativity, according to Antoniades (1992) is the final process of imagination, namely a change from the concept stage to the realization stage. Imagination is in the mind, while creativity is in the realm of making. This creativity can be triggered by tangible (which can be stated) and intangible (which cannot be stated) creativity according to Danny and Davies (1982), which includes: sensitivity problems, meaning sensitivity to problems that arise; originality, meaning solving problems in a new way, not imitating other problem solving; ingenuity, meaning ingenuity in solving problems; breadth, meaning accuracy in solving problems and useful; and finally, recognition by peers, meaning that there is a recognition from a group of areas of expertise on the innovation (Elin, 2013).

It can be concluded that producing something new is an important aspect of creativity. Sensitivity and a lateral, divergent, and different way of thinking of individuals in general, form the basic capital for producing an architectural creative product that has an original value. However, an original design is not merely a product that must be new or has never been created before. The originality of the architectural design can be seen from the distinctive and unique processing concept, even though the resulting product has the same function or form that is similar to existing architectural products (Elin, 2013).

Creativity in the context of architecture is very clearly shown through its tectonic aspects. The architectural design cannot be separated from the expressions shown. The creativity of building processing and its expression is highly dependent on how the building is realized which is closely related with the tectonic aspect. The tectonic aspect basically includes technical aspects but on the other hand it can contain symbolic values in it. An architectural work can be realized with materials that meet a buildability requirement, which includes being 'stable' (able to stand up) and strong (able to withstand working forces) as well as other technical requirements (Juniawati, 2003).

Architectural form cannot be separated from the creative processing of the elements of a structural system and material properties. Architects can choose the exact material to be used, to decide the appropriate construction method. This is where the role of tectonics is shown in architectural forms through their creativity so as to produce varied and meaningful forms. Tectonics plays the role of giving articulation to shapes that describe the distribution of loads through structural elements. Innovative processing of shapes can produce expressions of beauty shown through connection details of the construction including symbolic values in it. In the development of temple architecture in Indonesia, the types have a tendency to produce something new so that they can be detached from external and past influences. Producing something new is far from easy, so it requires careful creativity especially in producing shapes in relation to its tectonics.

Comparing to Europe, Fletcher (2019) shows that the development of classical architectural styles look still continuous except for the Gothic building mass. Its roots come from the Greco-Roman tradition and were subsequently developed to produce architectural styles with interpretations according to the era, for example ranging from Romanesque, Renaissance styles to Neo-Classical ones, while Gothicism can be interpreted as a new architectural style, regardless of the architectural style that became its roots, namely Roman and Greek ones. The Gothic style can be regarded as the result of new creativity in its era, especially shown through the architectural shapes and their tectonics in producing high-rise buildings (Leupen, 1997)

The intersection of ancient Indian and Chinese cultures can be felt in the pre-colonial architecture in Indonesia (Tjahjono, 2009). However, in the view of the Indian Imagery (Purwasito, 2002), it is stated that India only affects the upper and aristocratic levels compared to the realm of the common people. Thus, local elements are still remarkably strong and tend to affect the products in the tectonic culture. Unlike in India, in the Indonesian Archipelago (Acridi, 2022), it is estimated that creativity was not born from the clergy or the upper class but is also distributed among the wider community. This is what makes creativity expand widely so that it can produce extraordinary works.

Prambanan shows the existence of local architectural creativity in the development of high-rise building technology reflected in the tectonic aspects of its era. The essence of tectonics is a paradoxical dualism between the physical and the metaphysical, and the core form and the artform, as well as ontology and representation. Generally, tectonics is understood as the art of construction, with construction itself being the subject that conduces art. *Boetticher* has clearly stated that the discourse of tectonics would constantly develop along with mankind's understanding of the laws of Nature, and the development of tectonics can only be done in the context of structure and construction, but nothing else (Widjaja, 2021). Tectonic is the nature of expression revealed due to the 'static resistance' of the existing forms, so that the resulting expression is seen not only in the scope of structure and construction but does not actually contain aesthetics in it. The building is a structure designed and built by the people with art and skills obtained from the learning processes or cultural processes (Frampton, 1995; Surya, 2016)

Thus, through the study above, it shows that cultural crosses cannot be avoided in influencing the creativity of tectonic processing. However, through creativity, new tectonics will emerge in the processing of the architecture. Therefore, this study seeks to see the uniqueness of architecture resulting from this dynamic creativity, such as the tectonics of stone and wooden buildings in the pre-colonial era. This stepped corbel processing technique is one of the peculiarities and architectural advantages of stone temples in the archipelago. The stepped corbel is used not only for small but also large temples such as *Prambanan*, *Kalasan*, and others.

The Research Method

The research employs a qualitative approach through exploratory studies with surveys and field studies in Indonesia since 1997 until present day: 113 temples in the islands of Java-Bali-Sumatra, old mosques on Java and Sumatra, vernacular buildings in Java-Bali-Sumatra, Outside Indonesia: Rock Cut and Free Standing technique temples: Dravidian style in the Tamil region - South India, Caves in Maharashtra, Nagara style Temples in North India to Odisha, as well as the Khmer Temples – Angkor Cambodia, and some old pagodas in China have been examined. To strengthen the background, historical studies have been used which are linked to the results of field surveys in Indonesia and India. This study also uses documentation drawings, images with spatial elements, masses, figures, sections and architectural details, and the tectonics of buildings as material for analysis from National archives, Leiden Library, and outside Indonesia.

The study was conducted in an argumentative descriptive manner, namely to explain in architectural terms the creativity reflected in the form of buildings during the pre-colonial period in Indonesia. There are important milestones in the form of architecture, namely the

temple (*candi*), the overlapping mosque for example, in the tectonic context of stone and wood technology. Through a typo-morphological approach (Nuralia, 2019), which includes transformation, it is hoped that the elements of architectural creativity can be seen holistically. Understanding of architectural typologies is an assessment of architectural types (Yasemin, 2007) by paying attention to the tectonic elements (structures/elements/components) and their compositions without ignoring the functional elements that apply to the object (Herwindo, 1999).

This approach examines the extent to which the representation of the types of temple design elements is used in the context of their relation to the external influences and pre-existing buildings (Herwindo, 2011). It analyzes forms and tectonic aspects in synchronic and diachronic historical studies (Banfi, 2022). Not all locations can be reached through field surveys due to limitations and will be selected by purposive sampling. Assessments are made of the elements of the floor plans, appearance, placement and various components such as façades and ornaments, and materials including tectonics. In general, the research steps taken are:

1. Studying relationships between the architecture of temples, mosques in the islands of Java-Bali-Sumatra with buildings in two major cultures in Asia, such as those encountered in India and China to find the correlation between the design elements of the architectural type of the buildings.
2. Interpreting and analyzing the potentials of interconnectedness in the framework and the unique characteristics of Indonesian architectural forms. The variables used are architectural elements, namely figure and technology-construction-materials. These elements are important aspects in architectural design, both traditional buildings of the past and other ones, so that the correlation between objects can be known.

The Tectonic Dialogue in the Pre-Colonial Architecture

Temples in Indonesia have special features in their tectonic aspects. Construction of the temple basically follows the type of material, namely stone, brick, and wood (Dumarcay, 1991). These three types can be used in mono-material or multi-material or a combination of materials as shown in Fig 1. Each material demands different processing characteristics. The use of material can also be associated with the architectural development of the temple building.

The development of temple architecture in Indonesia can be divided into three eras, namely the Early Classical Era (4-7 AD), the Middle Classical Era (8-12 AD), and the Late Classical Era (13-16 AD). Each era shows a different tectonic character, especially related to the processing of the building figure. The interesting element is that the tectonics of the temple shows a development, especially its construction (Tjahjono,2009).



Fig 1: Early Classical Era (4-7 AD) (left), the Middle Classical Era (8-12 AD) (middle) , and the Late Classical Era (13-16 AD) (right). Temple materials in Indonesia: Stone (Upper), Brick (middle), A picture of a wooden building and its combination with brick or stone (below) Source: Herwindo, 2022

Stone temples are tectonically arranged based on the flowing static style, that the higher the building is arranged, the smaller it becomes. This is identical to the pre-Hindu-Buddhist ancient building structures in the form of terraced *punden* which was built in the Megalithic era (before the 1st century) (Pradipta, 2017). This arrangement then developed after the entry of the Hindu-Buddhist traditions from India by placing buildings to house the gods, such as the Hindu god *Shiva (ShivaGrha)*. Local belief in the form of worship of Nature in the name of *Hyang* (the ruler of Nature) who lives in Nature (mountains, rivers, forests, and so forth) subsequently shifted to worship of the gods who made houses in the form of temples. Therefore, it is necessary to construct a building for the place or realm of the Gods.

Dumarca (1991) says that it is possible that the temple buildings were originally made of wood. These shrines were originally made of wood and later developed into stone structures, although wood was still used. Most of these wooden buildings have been destroyed because they are thought to have been damaged by age and climate, while all that remain are those made of stone. These buildings came to be known as temples, although temples in the past were most likely made of wood. In this analysis, due to the development of materials and technology, stone came to be used. Although it has been transformed, the figures and details still do not leave the image of a wooden building. This can be seen in the artificial use of pillars (pilaster pillars or rectangular columns) carved into the corners of the temple walls and the roof vestibule (entrance) which depicts a wooden roof. This description can be seen in the Fig. 2.



Fig. 2: From wood, to brick and stone
Source: Herwindo, 2022

Analogies with Khmer Tradition in South East Asia (Hoppe, 2016, Jacques, 2007) the dwellings of the gods should be made of stone because it is more permanent and not easily damaged, while for non-gods such as human beings, wood can be used. Stone is considered a strong and durable material compared to wood. However, this idea also developed with the reuse of wooden materials because wood is more relevant in responding to seismic events considering that Indonesia is located in the Ring of Fire region, which often triggers earthquakes. The use of wood is not necessarily abandoned but can be combined with stone/brick. In addition, wood processing is considered easier and more rapid than stone, which requires a relatively longer time. Sacred buildings in Hindu temples in the island of Bali such as *meru* whose roof is made of wood are generally used to honor ancestors, while buildings made of stone such as *Padmasana* are used to worship the Gods (Herwindo, 2016), as can be shown in Fig 3.



Fig. 3: Meru (Wooden Roof) and Padmasana (Stone)
Source: Herwindo 2022; 2001.

According to National Archeological Research, traces of the tradition of using stone as was common in the Megalithic Era are still displayed in the form of the temple buildings which were known later as *candi*. The depiction of the dialogue with the past also indicates that using the architectural frame of terraces/steps is a remnant of the pre-Hindu-Buddhist Era. Borobudur represents a concrete example of the *punden* terraced shape reserved for holy places such as ancestral graves in the temple architecture (Santiko, 1995). The latter are buildings used by the local community that were used again in the middle of the Early *Mataram* Era. The concept of terraced stairs or steps was also employed in the *Prambanan* complex, though they were decidedly less steep than the *Borobudur* model.

However, Borobudur is a building that does not have an interior space, while other temples generally have an interior space. In temples that have inner space, the presence of a *punden* with terraces can be placed on the feet, body base, or the head of the temple. The roofs of classical temples clearly show the presence of steps that resemble *punden* terraces. The tectonic steps on the roof are also recognized not only on the exterior but also on the interior of the building's ceiling, as in Fig. 4.



Fig. 4: Terraces Punden and Borobudur (upper), Shape of Minaret Temple and its feet, head and ceiling, using the staircase corbel
Source: Herwindo, 2022

This idea of terraces is different from South India before the 11th century which used post-and-lintel techniques for building construction. The temple in South India has the dimensions of the main internal space that is not large because it must be covered by a fairly heavy stone slab on top (Herwindo, 2020). Temples in South India after the 11th century only used different construction techniques so that they could produce the size of the temples with a large main room in the form of a terraced corbel arrangement. This technique of using corbel is also known in old temples in North India, namely in *Bhithargaon*, but there, it was processed without terraces corbel (Samuel, 2021). The material of this temple is made of brick so that the *kosot* (rubbing) technique is used for it to stick together to form a monolith in the corbel interior roof construction. In India, the corbel staircase technique for the new ceiling is seen being used by temples that are more recent, namely the 11th century, such as the Khajuraho temple in North India and the *Brihadeeswara* Temple in the South. The temples are indeed not made of brick but of stone, so that some of the constructions employ the terraced corbel technique in addition to the post-and-lintel technique like the old temples. This description can be seen in Fig. 5.

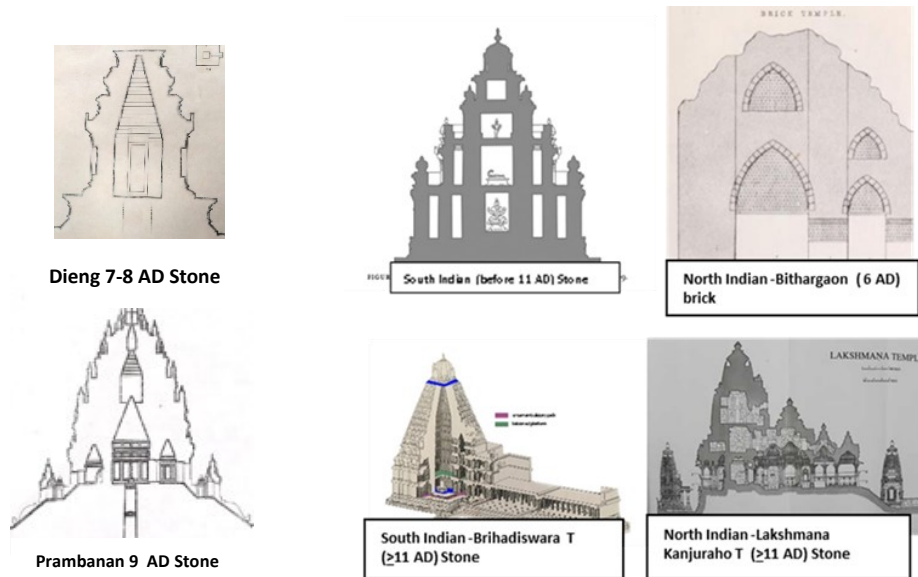


Fig. 5: The Development Construction of Temple in Java (left) ; North and South India (right)
Source: Herwindo, 2022; Hardy 2007

According to the observations, this staircase corbel technique has been used in Indonesia since the 7th-8th century, which can be seen in the corbel processing of old temples in Indonesia. However, the ceiling corbel of the Arjuna Temple in Dieng is processed not in steps but smoothly, like *Bhitargaon*. The difference is that the Arjuna Temple is made of stone while *Bhitargaon* is made of brick. Based on the tectonics, the two corbels should show different techniques because processing stone into a smooth surface is bound to be more difficult than brick. Judging from its age, it is possible that there was indeed an Indian influence on the corbel smoothing technique at the Arjuna temple in Dieng, because *Bhitargaon* is estimated to have been built during the Gupta era of the 5th century. The comparison can be seen in the Fig. 6.

At first, the Indian influence was still visible at a glance in the processing of the corbel and several other elements such as the kudu ornament. However, the smoothed corbel technique was not used later on other major temples in Dieng. It is undeniable that the tradition of housing the gods by building temple buildings was originally influenced by the Hindu-Buddhist culture from India while in Nusantara, the gods (Dewa or Hyang) were considered to live in the Nature realm or the Universe (Soekmono, 1988) The temple building was slowly adapted to the different contexts of Nusantara. This clearly shows the strong role of the Local Genius (Fontein, 1990). Significant differences appear later in the tectonics of architecture, especially in shaping the figure of the building as in the corbel ceiling of the main room as seen in the Fig. 6.



Fig. 6: The Ceiling Development in Dieng Temple
Source: Rodriguez, 2020

Terraced Corbel of the Main Ceiling Room

Temples in Indonesia have a different construction technique from those found in India. The corbel ceiling of the temple is arranged using the terraced stacking technique instead of the post-and-lintel technique encountered in India. This staircase stacking technique appears to have been inspired by:

1. The concept of stacking terraces describes the arrangement of *punden* terraces in the ancient tradition of the archipelago before the entry of Hindu-Buddhist traditions from India. The tradition is considered to have been rooted in the ancient Austronesian tradition that existed in Indonesia before the entry of Hindu-Buddhist culture.
2. The concept of stacking terraces arises as a consequence of the material and technology to build it or its tectonics as a response to the description of the ancient buildings of Indonesia that use stone.
3. In subsequent developments, this terraced structure cannot be separated from the analogy of the arrangement of brick materials which were already used in Nusantara since AD. The oldest known brick building in the archipelago can be seen in the relics of the *Batujaya* temple in *Kerawang* around the 4th century AD. The discovery of temples on the coast of Java also uses brick-based technology and is estimated to be older than Dieng. Brick is a material considered more permanent than wood, so it will be eminently suitable if used in combination for temples. This can be seen in the *Batujaya* temple in *Kerawang*.

This technique is used considering the condition of the stone material in Indonesia. Stone material in Java is cut with limited dimensions so that it cannot be large, considering that the type of stone is very hard, namely andesite. How to arrange this material then refers to the stacked bricks. The use of bricks in Java based on their shape and arrangement is strongly influenced by the techniques developed at Nalanda. The Nalanda inscription describes students from Indonesia studying there.

The oldest stone temple constructions in Ancient India were originally made using the rock-cut technique so that they could form monolithic structures. In subsequent developments, a stacking technique was carried out using arranged stone pieces (Hardy, 2007; Acharya, 1979). However, the pieces of rock look large, resembling the chunks of rock cut. Apart from that, temples made of brick were also found there. The use of these bricks is thought to have had Mesopotamian/Persian influences such as those found at Nalanda, while stone structures using the post lintel technique can be linked to ancient Greek architecture.

In the island of Java, in particular, there is no technique for arranging stones with large chunks but cutting them into smaller sizes. The small stones allow them to be arranged upwards to resemble a pile of stones or bricks. The technique of arranging stones such as arranging bricks is one of the peculiarities of temple architecture in Indonesia, even though the pieces of stone arranged are much larger than the brick arrangement itself. This arrangement technique shows the existence of new creativity in presenting stone processing technology for buildings that are different from India as the origin of Hindu temples/houses of gods. This arrangement technique may also have been influenced by the *punden* terraced tradition rooted in Nusantara. The development of this construction technology can be seen in Fig. 7.

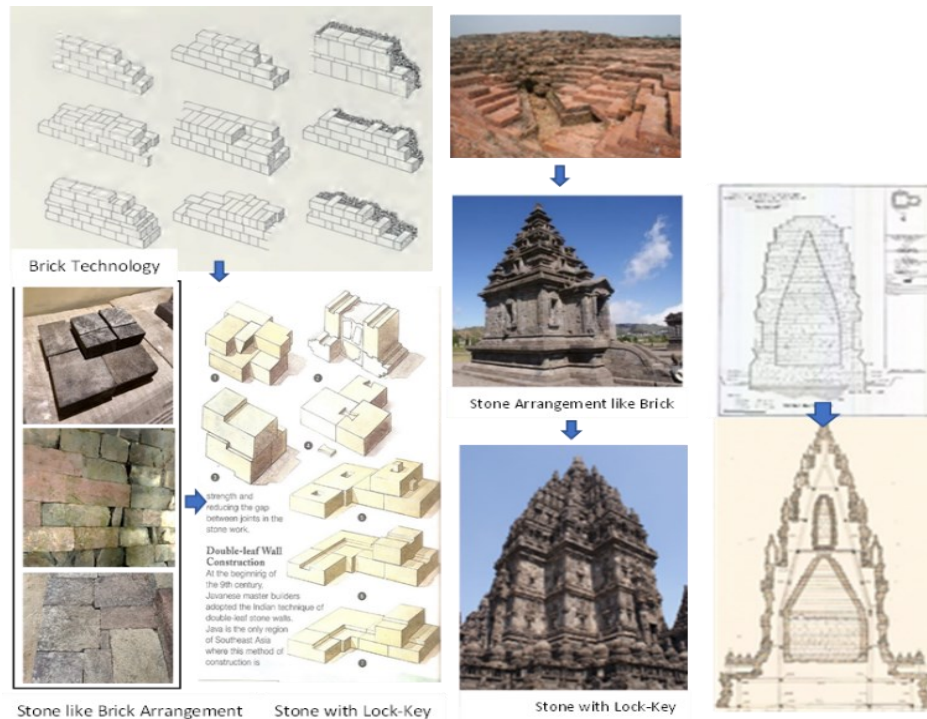


Fig. 7: The Development of Arrangement Temple Construction from Brick to Stone in Indonesian Temple (Batujaya-Brick, Dieng-Stone, Prambanan-Stone)
Source: Herwindo, 2022 ; Rodriguez, 2020 ; Tjahjono, 1989

A significant difference in India is that the temples before the 11th century tended to be smaller in size due to the limitations of their heavy stone construction with these large boulders on top. In Java, old temples such as the ones in Dieng allow the rooms to be wider and higher with thinner walls because the material also consists of an arrangement of stones with smaller pieces arranged in steps upwards.

At the time of *Syailendra* in the 8th-9th centuries in Java, it was estimated that the condition of the country was prosperous and Buddhism developed very strongly. Buddhist places of worship require a large internal space compared to Hindu temples, so the temples must be made more spacious. To make a building large, it requires at least a rich resource of human resources and sufficient natural materials. Agriculture in that era is estimated to have been very supportive, allowing the people to work properly, especially in the construction of large mega-projects such as *Borobudur*, *Prambanan*, *Kalasan*, and others.

In addition, technology has been mastered for constructing these large buildings. According to field studies of di Diengm this technology has been used and developed from existing traditions such as in the older Dieng, especially when it comes to the stacked stone technique. This Indonesian-style stacked stone technique was later developed into a construction pattern for large temples because it is highly possible to develop the arrangement technique in making the temple bigger, taller, and wider. The development of this technology is also supported by the use of key stones in the stone construction to make it sturdier and able to withstand shear forces and the building construction's own load to cope with the seismic effects. In the Early Classical period, the stone joints used very few keystones compared to the Middle Classical era, as shown in the Fig. 8.

This stone arrangement technique allowed it to produce a large temple and its zenith is the Hindu temple of *Prambanan*. The early Hindu temples were small in size and made of a combination of wood. Thus, in this era, they were built no less majestic than the Buddhist temples. The tallest and largest Hindu temple exceeding the Buddhist temples in terms of spatial dimensions is the *Prambanan* temple (Borobudur happens to be the largest but contains no

interior space). Buddhist temples with a room that are large in shape but rank below the caliber of *Prambanan* are the *Sewu* and *Kalasan* temples. To build a temple that reaches the height of *Prambanan*, one needs not only creativity to attain the proper architectural shape but the engineering aspect must also be reliable and handled professionally. This relation can be seen in the Fig. 8.

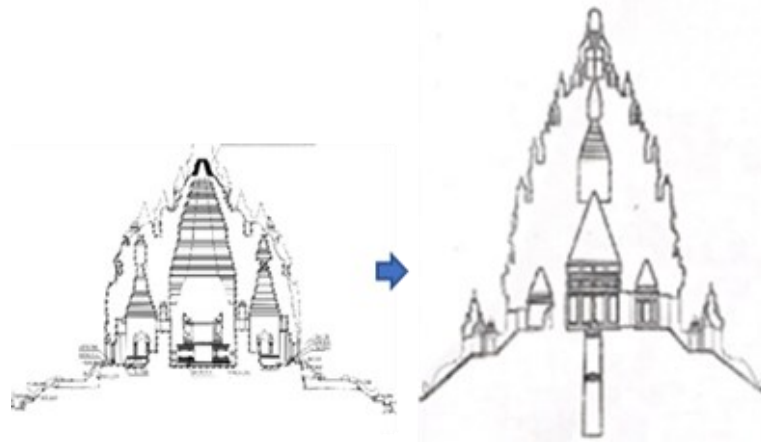


Fig. 8: From Kalasan to Prambanan- High Rise Building

Source: Herwindo, 2022

According to field research since 1997, Prambanan can be considered as the first high-rise temple in Southeast Asia or very possibly in South Asia and has managed to inspire the temple architecture in subsequent eras that made use of high-rise building technologies, as has been the case in Cambodia and India. In this era in India and Indo China, it is not known that temple buildings were built as big and as high as *Prambanan* with high interior spaces, so it can be ascertained that construction techniques such as found in *Prambanan* and *Kalasan* using terraced corbels were not yet in vogue there (see Fig. 9). In India (Hardy, 2007), there are tall and large temples or enshrinements such as those employing the Nagara style like the Khajuraho temple built in the 12th century, and others that made use of the *Dravida* style such as the Thanjavur temple of Tamil Nadu, the *Brihadeshwara* temple, Raja *Rajeswara* temple, and the *Rajarajeswaram* temple built in the 11th century. The concept for building tall stone temples began to develop in India in the early 11th century, whereas in Indonesia they had actually been built since the early 9th century, two hundred years beforehand. This phenomenon indicates that *Prambanan* actually formed the source of inspiration for the architecture of the high-rise temples. ‘The Inspiration’ from Indonesia can be seen in Fig. 9.

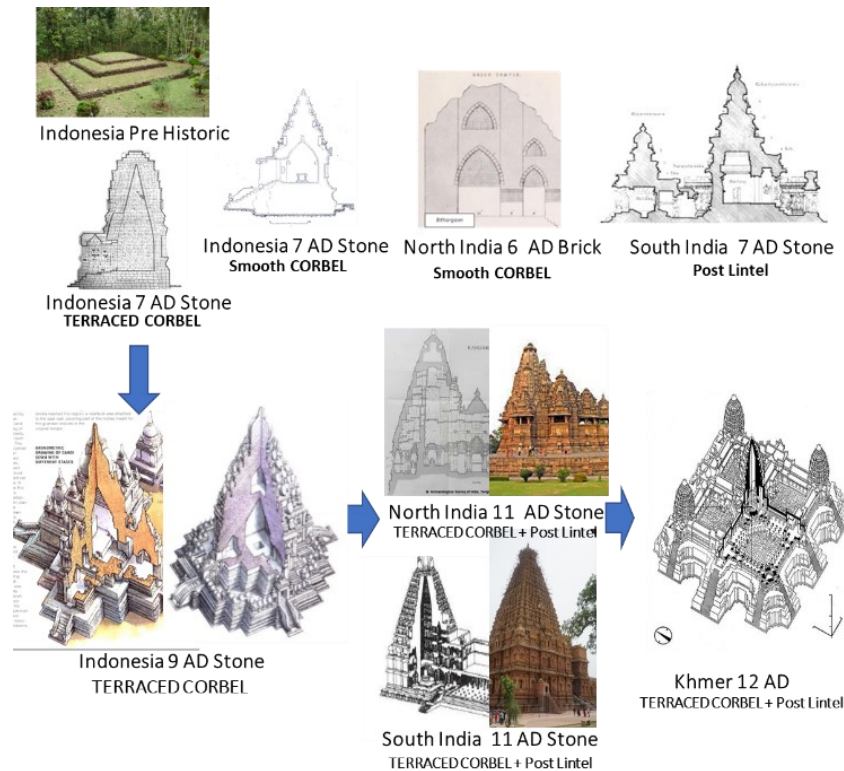


Fig. 9: ‘The Inspiration’ of temple construction from Indonesia for high rise building
Source:(Herwindo, 2022; Rodriquez, 2020; Tjahjono, 1989; Hardy, 2007; Martinus, 2018)

According to Martinus (2018) the model of *Prambanan* has served as a source of inspiration for the Angkor temple. History of Khmer has proven that Prince *Jayawarman II* from Cambodia once lived in Java (Coedes, 2015) and developed the building design of those Angkor temples there and then. According to Nalanda inscription, the relationship between Java and India had in fact been quite strong, for in the *Syailendra* Era, the *Mataram* King *Balaputradewa* once donated funds and built residence halls (*Asrama*) in India. If the Javanese king had financially supported and built temples in India, the possibility cannot be discarded that the technology and creativity behind Javanese architecture could have been spread to India, including the construction of high-rise buildings, even though those were developed in India one or two centuries afterwards.

This phenomenon shows that the technique of building temples in Indonesia does have its own uniqueness, such as the existence of a terraced corbel which was inherited until the end of the Hindu-Buddhist era. This terraced corbel is always used in temples in the archipelago, both in Java and Sumatra, both Hindu and Buddhist. Large Buddhist temples in North Sumatra such as the *Si Pamutung* Temple in the *Portibi*- group also uses this technology even though the temples are made of brick. By looking at the picture from the *Pamutung* or from the *Bahal* complex, it can be seen that the brick temples are actually also familiar with using a terraced corbel, as can be shown in the Fig. 10.

Thus, it is not impossible that the old temples made of bricks used the same technology for their interiors, both those built during the Ancient *Mataram* era and earlier. The Buddhist temples in *Portibi* clearly show the influence of the ancient *Mataram* temples even though the materials used are different (Degroot 2014), namely brick. As regards the use of brick, it is estimated that in Sumatra, there are not as many site stone materials as in Java. The brick came to be used instead. However, in Sumatra, there are also temples that use stone materials such as the *Simangambat* temple.



Fig. 10: Brick Temple in North Sumatra using the terraced corbel such as *Si Pamutung* and *Bahal* Temple

Source: Herwindo, 2022

Terraced Corbel to ‘Javanese Temple Dome’

This terraced corbel technique allows the area of the space in the temple to be wide and elevated, as in the *Bima* and *Prambanan*, *Kalasan*, *Sewu*. The *Kalasan* Temple even uses the corbel arrangement of its steps to be converted into a conical octagon which makes the construction sturdier. This conical image is reminiscent of the shape of a dome, considering that the outer roof is in the form of a stupa. The dome structure in the European tradition is the culmination of the roof building developed by Roman architecture which allows the rooms to be larger. The analogy with this is to accommodate a large space capacity, for which a special roof construction is needed. Thus the dome formed from the corbel with the conical steps forming this octagonal pattern forms the solution. This phenomenon can be seen in the Figs. 11 and 12.

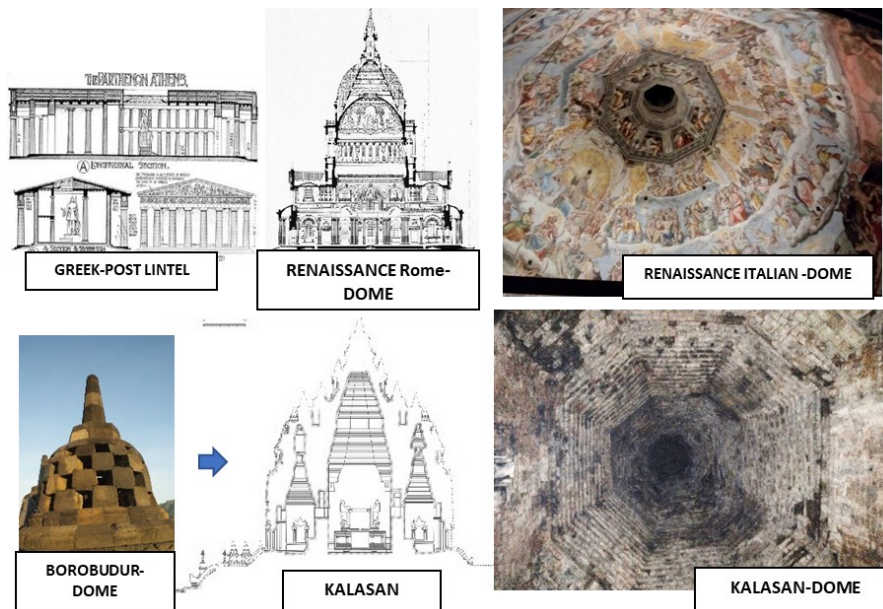


Fig. 11: Greek, Italian Dome - 15 AD (upper) and Javanese Dome-9 AD (below)

Source: Herwindo, 2022; Fletcher 2019

As a matter of fact, the construction of this dome had been recognized before, although on a small scale, namely in the hollow stupas of Borobudur. These domes are to have been developed to an enormous size, like the Kalasan temple and another temple (Fig. 12 and 13). Thus, in the ancient Nusantara, a dome-like construction has also been recognized, as in the Kalasan temple, although it differs from the one developed in Rome. The Kalasan temple is

considered the most resistant compared to others in being resilient to earthquakes, because in the 19th century, the main room looked relatively intact compared to the other temples such as Prambanan. This robustness is possible because the roof forms the octagonal pattern, making it more stable than the rectangular one. Through this example in Kalasan, it can be seen that this stepped corbel tectonically can also develop from a rectangular pattern to an octagonal pattern.

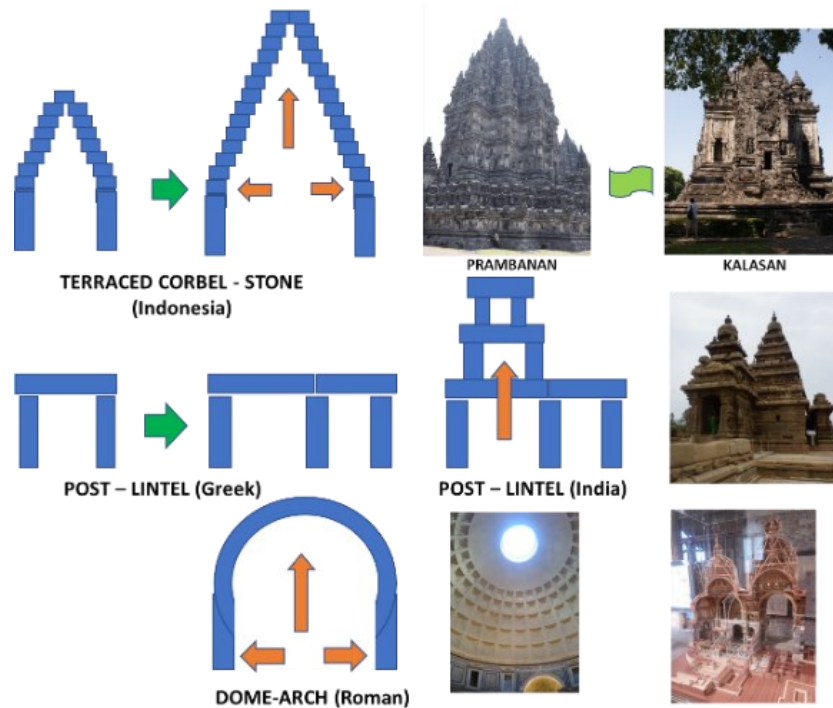


Fig. 12: Comparison construction stone tectonic culture ; Indonesia, Greek, India, and Roman Source: Herwindo, 2022

Terraced Corbel to Wooden Tiered Construction

The creativity of the terraces is also shown through other forms, namely the construction of wood on the roof of the terraced buildings for sacred and non-sacred buildings. Sacred buildings are estimated to use multi-tiered roofs compared to other types of buildings. This stacked roof is also depicted on the reliefs of the Borobudur temple and is thought to be made of wood and some resemble a pagoda. The wooden roof that resembles a pagoda was then known as the *Meru* roof. Sacred buildings such as temples with wooden roofs also show uniqueness because they were known in the 5th century and continue to be inherited until now in temples in Bali. Many temples are thought to have employed a combination of wooden roofs such as those encountered in the *Sambisari*, *Kedulan*, and other temples of the same ilk. The use of a wooden roof was chosen later because it was also a response to the seismic aspect, because seeing the experience of many stone temples that collapsed due to a terrible earthquake. This description can be seen in Fig. 14.

Meru was the answer because it was regarded as being capable of dealing with earthquakes, and in the 11th century, it was transferred to Bali, as related by Mpu Kuturan (Eiseman, 1988). The remains of the temples of that era found especially in Java are in remarkably poor condition, except for the ones encountered in Bali. Those temples have been built with brick and wood, the few that remain are just ruins.

Meru can be connected with a pagoda originating from China (Snodgrass, 1985). However, the oldest high rise wooden pagoda in China was only built in the 10th century, while in Java, based on the relief drawings in the 9th century, its shape has been recognized. The *Meru* style of Java naturally differs from that of China. The use of this tiered wooden roof illustrates that in addition to stone construction, at that time, wooden construction was also recognized and both were made for tall buildings like the Mount *Mahameru* (Snodgrass, 1985). The use of

this temple with a tiered wooden roof is thought to have been used to roof the temple building as a representation of the terraced *punden* as a symbol of the place of the gods or *Hyang*.

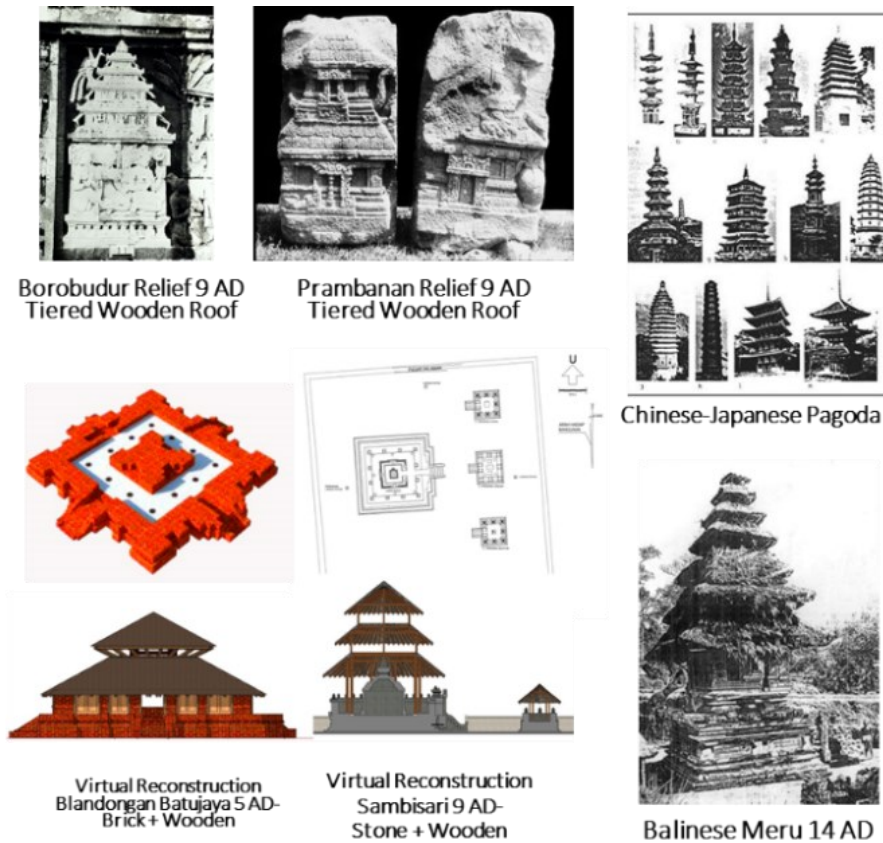


Fig. 13: The Construction of Wooden Tiered Roof (KILTV,
Source: Herwindo, 2022; Kempers, 1978; Prijotomo, 1988)

In the Field Research 2014, by looking at the arrangement of the columns and the comparison of the area and height of the building, it is estimated that old temples in the 5th century such as the *Batujaya*-the *Blandongan* temple are also estimated to have used this type of roof and then finally transformed into the form building stone temples in the next era. At the *Blandongan* temple, the remains of a large pedestal were found as the basis for wooden poles. The wooden poles erected on it are estimated to have a large diameter. If the column is large in diameter, it is possible to support the construction of a large building with a minimal terraced roof resembling the *Wantilan* in Bali, (Fig. 13 and 14).

This tiered roof was then developed and used persistently until the end of the Late Classical period, namely *Majapahit* and Post-*Majapahit*, namely the Islamic era. This can also be seen at the end of the *Majapahit* era when it converted to Islam (Pijper, 1947, Prijotomo, 1988).

Places of worship for Muslims require a large space because they are communal and sheltered, and are very different from temples. Rituals in temples are carried out outside while inside the mosques, they are generally carried out inside. The early Mosque (Setiabudi, 2006) in Indonesia is classified as a different type of architecture because it uses a terraced roof structure such as a Meru and does not use a dome. This description can be seen in Fig. 15.

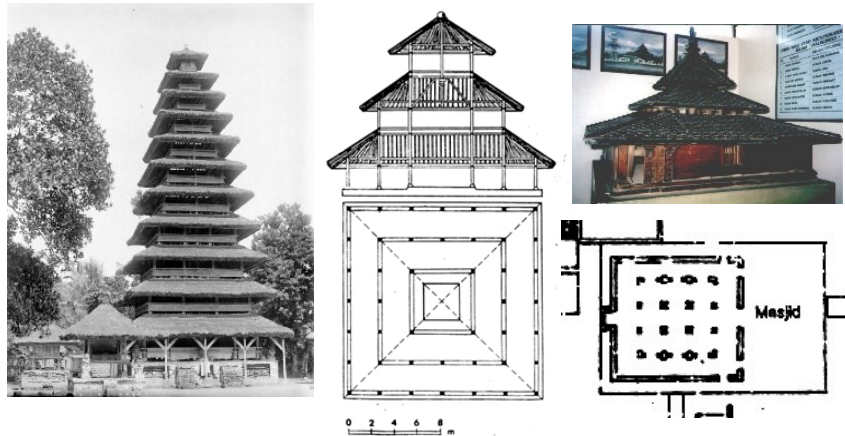


Fig. 14: *Meru* in Bali (left) *Wantilan* in Bali (middle), and Early Mosque in Java-South East Asia.
Source: Prijotomo, 1988; Southeast Asian & Caribbean Images (KITLV) Leiden; Herwindo, 2022

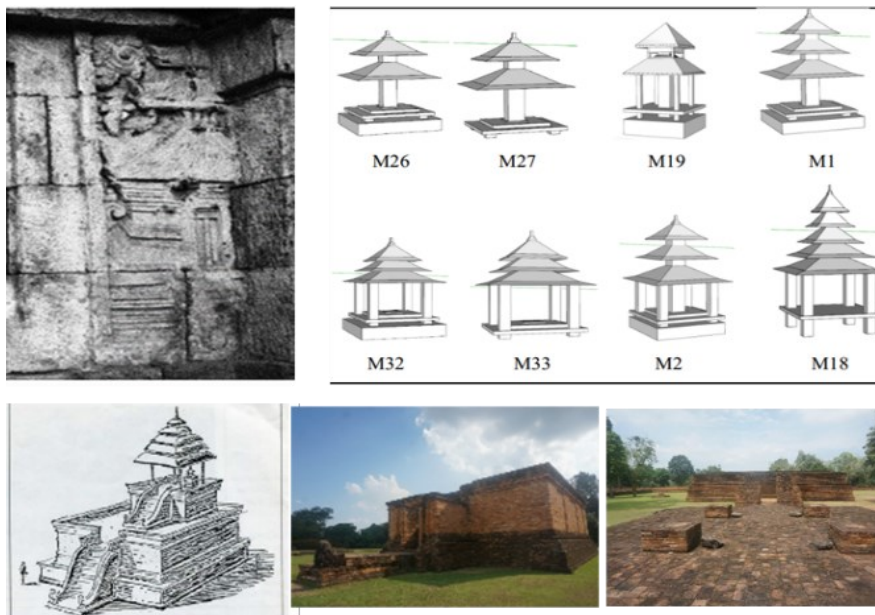


Fig. 15: Wooden Temple in Majapahit Relief (upper); Reconstruction of *Muara Jambi* by Soekmono and *Muara Jambi Temple* (below)
Source: Herwindo, 2022; Degroot 2014

Mosques that are influenced by Middle Eastern and Indian traditions tend to use domed forms, although domes are not originally from Islamic cultures. The terraced roof structure is also known in India and in China. This type of roof was apparently a popular roof in its era. Thus, it is also found in India and China. Regardless of the opinion of experts about the origin of the overlapping roof, it can be understood that the overlapping roof mosque is the result of local creativity in Indonesia which is different from other places. The *Tumpang* (tiered) roof is thought to be used in temples in Sumatra. *Muara Jambi* temples, which were built before the Majapahit era have lost most of their roofs and according to the senior archeologists such as Soekmono, using a tiered form like the roof of a mosque. This tiered roof form is then also recognized in Islamic relics such as mosques in Aceh, Padang, Jambi and other areas in Sumatra. This roof is a legacy from the Hindu-Buddhist era. The mosque building uses four main pillars or a single one or four-five pillars. One, four, five-masted buildings are also known

in Java as depicted in the reliefs of Majapahit temples. This description can be seen in Fig. 16 and 17.



Fig. 16: Old Mosque in Java and Sumatra
Source: Herwindo, 2022

However, this type of stacked roof in Sumatra can be divided into two, for sacred buildings the upper part is centered on the peak, while for non-sacred buildings such as dwellings, the roof is in the form of a saddle (similar to a boat or buffalo horn) or shield (such as the *Banjar Wantilan* in Bali) (Fig 17). Likewise, the shape of the converging tiered roof is thought to be an old tradition that has existed since the Hindu-Buddhist era in Sumatra and was later strengthened by the entry of the Majapahit influence. The shape of the roof like a boat is reminiscent of ancient Austronesian traditions as described in the *nekara* /kettledrum from the Megalithic era.



Fig. 17: The Picture of Wooden roof in *Prambanan Relief*, *Muara Jambi Relief* (upper); Wooden Roof at *Karo*, *Rokan*, *Air Tiris Vernacular Building* (below)
Source: (Herwindo 2022)

At the time of Majapahit, when viewed from one of the reliefs of the relics, it is recognized that the shape of the building was now identical to a hip roof, and the walls were open. Buildings like this in the Hindu architectural tradition in Bali (*wantilan*) have features two types, namely those with a hip roof (*berwuwung*) and a pyramidal roof (*tajug*) and are usually stacked, as can be seen in Fig. 18.

During the Majapahit era, the *wantilan*-shaped building with a converging roof was the main or sacred building. Most likely during the Islamic era when ideology changed, its function and form were transformed into a mosque. The *Wantilan* has a concentrated shield-roof and the walls are closed, just like the temples at that time (the *meru* building). The interior space can be used to accommodate large numbers of people.



Fig. 18: *Wantilan* Piramidal (left); *Wantilan* with *Wuwungan* (right) (KILTV; Source: Herwindo 2022)

The architecture of this Early Mosque is the result of the creativity of the people who lived at that time in responding to the entry of Islam as a new religious ideology in *Majapahit*, including the involvement of the role of the guardians (*Wali*) in it. The guardians are thought to have mastered the science of building like the priests during the *Majapahit* era. For example, *Sunan Kalijogo* and his students built several mosques in Java. *Majapahit* has a strong influence in the Nusantara so that the form of this early mosque with overlapping roofs can be found in areas of the *Majapahit* region which are written in the *Negarakrtagama* book including outside Indonesia.

Dialog with the Vernacular House

Creativity is basically not only recognized through architectural tectonics so that it can produce large but also tall buildings. In addition, it can be recognized by the use of forms and ornamentation which also shows a uniqueness. The use of this ornamentation is especially recognized through the persistent symbols used, namely the presence of *Kala* and *Makara* elements in ancient and middle classical temples.

Kala and *Makara* ornaments are not always found in temples in India and their location if recognized is not persistent, in contrast to Indonesia where *Kala* is definitely located above the door and *Makara* is on either side of the door. Specifically for *Makara*, these are encountered in the form of symbols derived from sea creatures that are used persistently in buildings on land. The use of *Makara* can be interpreted as a dialogue between the sea and the land (Herwindo, 2016). A strong maritime tradition in Indonesian culture has influenced the thinking of the people of that era, so that religious symbols related to the sea like *Makara* were subsequently used as important elements in sacred buildings.

Respect for the sea is shown by placing the symbols of the sea on buildings that are considered main and sacred. Most likely the use of this *Makara* is closely related to the ancient Austronesian culture which in turn is closely related to the marine aspect, although in Hindu mythology, it is the vehicle of *Dewa Baruna*- the God of the ocean and is a guardian in the transition between the world and the throne of the gods. By synergizing with Hindu Mythology, the use of *Makara* was chosen and highlighted in temples in the archipelago as a picture of dialogue with the ancient traditions of the archipelago. On the other hand, Based on the

similarity of the representations shown, Makara elements are also used in non-stone buildings, especially in their vernacular architecture. This can be seen later in Austronesian-derived vernacular buildings in the detailed processing of the ends of the beams that support the body of the building that resembles a shape like *Makara*. This description can be seen in Fig. 19. According to the study of Arismunandar (2012), the influence of the ancient Austronesian tradition has been acculturised with the Hindu-Buddhist traditions which entered later in Indonesia.

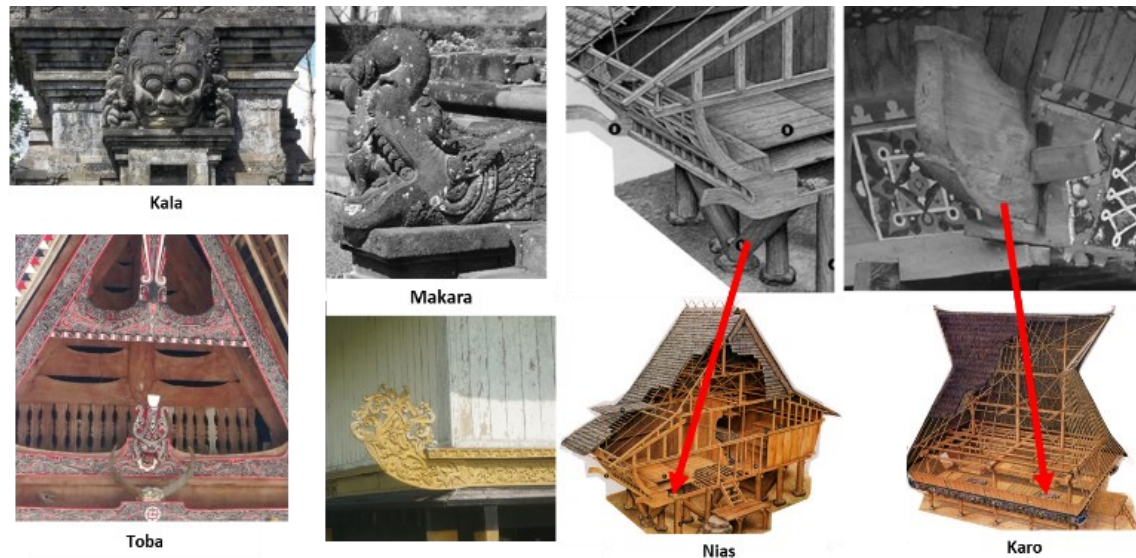


Fig 19: *Kala - Makara* and relationship with vernacular traditional building
Source: Herwindo, 2022

Conclusions

In the pre-colonial traditions in Indonesia, the dynamics of architectural processing, which varies from era to era shows that there is a strong architectural tradition in Indonesia. This technology has been demonstrated through architectural tectonics, such as the use of terraced corbels which could subsequently be developed to resemble the shape of a conical dome. This terraced corbel allows the building to be bigger and taller. In addition, creativity is also shown through wood tectonics for tiered roofs that have been persistently used until the Islamic era even today. The tectonics of wood for this tiered roof is considered capable of responding to seismic challenges. The presence of the *Tumpang* Mosque architecture or the *Meru* roof is the result of local creativity that has evolved over the long term. It is conceivable that the tradition of building architectural *Meru* roofs for tall buildings does come from the Indonesian archipelago, as does the terraced structure in the corbel.

Prambanan in the past has inspired temples outside Indonesia. The varied dynamics of temple processing and the development of high-rise building construction technology, including the *Meru*-level roof technology, show an adequate level of creativity and ability, as well as the qualifications of the ancestors of the Indonesian people, especially in the field of architecture. The results of this creativity not only affect internally but also return to their country of origin. In the pre-colonial tradition in Indonesia, respect for the past can be recognized. This respect is shown through the preservation of Austronesian traditions such as *punden* terraces and maritime affairs through architectural transformations. The tradition of respect for the terraced concept is reflected in the shape of the building to the architectural details and tectonics with the emergence of terraced corbel technology in the interior of the temple and the tiered wooden roof of the temple or mosque.

In addition, the ‘Maritime Footprint’ is shown through the use of symbols originating from the sea such as boats, and *Makara* ornaments. Ancient architecture and vernacular designs

in the hinterland (hinterland) shows the use of symbols that come from the sea was significant. This can be recognized in the sacred building in the form of the use of *Makara* and several forms and details of the boat in the residential building. The symbols originating from the sea are expected to continue to be used because they have become part of our collective memory and are passed down from generation to generation.

Thus, the creativity of the Nusantara in the pre-colonial period was basically built not only in dialogue with external sources outside of Indonesia but also with the past, and then knitted together in creating new products that could inspire in other places outside Indonesia. The ancestors of the archipelagic inhabitants were not only skilled sailors but also formed a creative nation – one of creative architects. At the present time, supported by postmodernism, this kind of spirit needs to be built more firmly, especially in strengthening the identity of Indonesia in the face of unavoidable globalization.

Acknowledgment

- Indonesian Education and Culture Ministry - RISTEKDIKTI
- Institute for Research and Community Services, Parahyangan Catholic University-LPPM UNPAR
- BPCB Jawa Tengah, BPCB D.I.Yogyakarta, BPCB Jawa Timur, BPCB Aceh, BPCB Jambi
- Department of Architecture, Parahyangan Catholic University, Indonesia

References

- Acharya, P. K. (1979) *Hindu Architecture in India and Abroad*, New Delhi : Oriental Books Reprint Corporation.
- Acri, A. (2022) *The Creative South: Buddhist and Hindu Art in Mediaeval Maritime Asia*, volume 1, ISEAS – Yusof Ishak Institute.
- Antoniades, A.C., (1992). *Poetics of Architecture: Theory of Design*, New York: Van Nostrand Reinhold.
- Aris M, A. (2012) *Kebudayaan Austronesia sebagai Akar Peradaban Nusantara: Ornamen pada Nekara dan Artefak Perunggu Lainnya*, *Majalah Arkeologi Indonesia*, Seminar Internasional Indonesian Studies Update Seminar Series, “Mengurai Kembali Peradaban Manusia (Rethinking Human Civilization)”, FIB UI, Depok, 28—29 November 2012.
- Bosch, F. D. K.(1974) *Masalah penyebaran kebudayaan Hindu di kepulauan Indonesia; diterjemahkan dengan pengawasan dewan redaksi*, Monograf, Jakarta : Bhratara.
- Banfi, F. (2022) *Diachronic and Synchronic Analysis for Knowledge Creation: Architectural Representation Geared to XR Building Archaeology*, 15, 4598. <https://doi.org/10.3390/en15134598> (accessed July, 2022)
- Coedes, G. (2015) *Asia Tenggara masa Hindu-Buddha*, Jakarta : Kepustakaan Populer Gramedia, Ecole francaise d’Extreme-Orient, Forum Jakarta-Paris, Pusat Penelitian Arkeologi Nasional.
- Collectie Tropenmuseum – KILTV (accessed August, 2022)
- Degroot, V. (2014) *The Architecture of Si Pamutung. Between local traditions and Javanese influences*. In Daniel Perret & Heddy Surachman (dir.), *History of Padang Lawas. I. The Site of Si Pamutung (9th century-13th century AD)*, 37-63. Paris, Archipel.
- Dumarcay, J. (1991) *The Temples of Java*, Singapore: Oxford University Press.
- Eiseman, Fred B (1988) *Bali : Sekala and Niskala Vol I-II* Singapore, Periplus.
- Elin M, Barliana, S, Krisnanto, E (2013), *Hubungan Pengalaman Berarsitektur Dengan Kreativitas Desain Mahasiswa*, *Jurnal Invotec*, Volume IX, no.1, p: 1-16
- Fletcher, B, (2019), *Global History of Architecture*, Bloomsbury Publishing
- Fontein, J, (1990) *The Sculpture of Indonesia*, Washington: National Gallery of Art.
- Greer R, (2013) *Architectonics and Style in The Centrality of Style*, The WACClearinghouse; Parlor Press. <https://doi.org/10.37514/PER-B.2013.0476>

- Jacques, C (2007), *The Khmer Empire: Cities and Sanctuaries from the 5th to 13th Century*, Thailand: River Books.
- Juniwati A, Widigdo W (2003), *Perlunya Pengetahuan Tektonika pada Pengajaran Struktur di Arsitektur*, *Jurnal Dimensi Teknik Arsitektur* Vol. 31, No. 2, p: 120-123
- Hardy, A (2007) *The Temple Architecture of India*. Chichester: Wiley.
- Hasbi A, Candrasari, R (2019) *Preservation of Local Genius Culture as Efforts to Maintain Nation Existence*, *International Journal of Recent Technology and Engineering (IJRTE)* ISSN: 2277-3878, Volume-7, Issue-6S5, April 2019.
- Herwindo, R (1999) *Kajian Tipo-Morfologi Arsitektur Candi di Jawa*, Thesis, Arsitektur Institut Teknologi Bandung, Bandung.
- Herwindo, R (2018) *Eksistensi Candi sebagai Karya Agung Arsitektur Indonesia di Asia Tenggara*, Yogyakarta, PT Kanisius.
- Herwindo, R., Prijotomo, J & Nugrahani, D. S. (2022) *Virtual Reconstruction of Architectural Heritage made of wood, stone, and their combination in the Ancient Mataram Era*. *International Journal of Multidisciplinary and Current Educational Research (IJMCER)* ISSN: 2581-7027, Vol 4, Issue 4, Pages 191-206.
- Herwindo, R. (2022) *Field Research - Data Survey 2000-2022 diolah berdasarkan data Balai Pelestarian Cagar Budaya Banten, Jawa Tengah, Yogyakarta, Jawa Timur, Aceh, dan Jambi*.
- Herwindo, R. (2016) *A Conversation with the sea in Ancient Hinterland Architecture in Indonesia*, ISVS-8, *Proceedings of the International Seminar on Vernacular Settlements, Conversations with the Sea: People, Places and Ideas of Maritime Vernacular Settlements*, October 20-22, 2016, Universitas Hasanudin Makasar.
- Herwindo, R. (2011) *Representasi Candi dalam Dinamika Arsitektur di Indonesia*, Disertasi Doktor, Unpar.
- Herwindo, R. (2020), *A Reinterpretation of the Relationship between the Architecture of Ancient Mataram Era Temples in Indonesia and of 7th-10th century Temples in South India*, *IJERT*. ISSN 0974-3154, Volume 13, Number 2, 2020, pp. 271-279
- Herwindo, R. (2001) *Meru*, *Jurnal Tatanan*, Fakultas Teknik Jurusan Arsitektur Unpar.
- Herwindo, R. (2016) *The Typology of the Balinese Meru Shape and the Roots of Its Development* *Journal of Applied Environmental & Biological Science*, Vol. 6 No. 12.
- Hidayatun, M, Prijotomo J (2014) *Arsitektur Nusantara Sebagai Dasar Pembentuk Regionalisme Arsitektur Indonesia*, *Seminar Rumah Tradisional 2014*, Kementerian PU (accessed July, 2022)
- Hoppe, S (2016) *A Review of Sources for Visualising the Royal Palace of Angkor, Cambodia, in the 13th Century*, *Virtual Palaces, Part II, Lost Palaces and their Afterlife*, *PALATIUM e-Publications*, Volume 3.
- Holzer, M.S., Andruet, RH. 2000. *Active Learning in Classroom*. *Proceedings, ASEE Southeastern Section Annual Meeting, Roanoke, VA, April 2-4*
- Kempers, A. J. (1978) *Monumental Bali Periplus*.
- Kempers, A. J. (1978) *Herstel in Eigen Waarde*, Zutphen, De Walburg Pers Zutphen.
- Kenneth Frampton (1995), *Studies in Tectonic Culture, The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, MIT Press.
- Leupen, Bernard (1997) etc, *Design and Analysis*, New York, Van Nostrand Reinhold, 1997
- Lombard, Denys (1996) *Nusa Jawa : Silang Budaya* Vol 1,2,3, Jakarta, Pt Gramedia Utama.
- Magetsari Noerhadi (2010) *Local Genius*, *Jumantara* Vol. 01 No.1, (accessed July, 2022)
- Martinus, Andreas (2018) *Comparative Study of Typo-morphology Architecture Borobudur-Prambanan Temple of Angkor Wat* *Jurnal RISA* ISSN 2548-8074, Volume 02, Nomor 04, Oktober 2018; hal 335-359, <https://doi.org/10.26593/risa.v2i04.3046.335-359> (accessed July, 2022)
- Nuralia, L. (2019) *Typo-morphological Characteristics of Architecture of Colonial Residential at Settlement of Panglejar Plantation, Cikalong Wetan, Districts of West Bandung*, *PURBAWIDYA* Vol. 8 (2), pp 113 – 134 DOI: <https://doi.org/10.24164/pw.v8i2.299>

- Pradipta, M (2017) The Characteristic Features of Megalithic Culture in Tthe Architecture of Temples on The island of Java, *Jurnal RISA* Vol 01, No 03, Juli 2017; hal 286-306, DOI: <https://doi.org/10.26593/risa.v1i03.2596.286-306>
- Pijper, G.F., (1947) The Minaret in Java, in F.D.K. Bosch et.al. (eds) *IndiaAntiqua. A Volume of Oriental Studies presented by his friendsand pupils to Jean Philippe Vogel*, Leiden: Brill, Kern Institue, pp.274-283
- Prijotomo, J, (2007), *Pasang Surut Arsitektur Indonesia*, Surabaya, Wastu Lanas Grafika,
- Prijotomo, J, (1988), *Ideas and Form of Javanese Architecture*, Yogyakarta, Gadjah Mada University Press.
- Purwasito, Andrik, (2002), *Imajeri India : Studi Tanda dalam Wacana*, Surakarta, Yayasan Pustaka Cakra.
- Rodriquez, L, (2020), *Komparasi Bentuk dan Tektonika Candi Hindu era Klasik Tua di Jawa dengan Kuil Hindu era Pallava di India Selatan*
<https://doi.org/10.26593/risa.v4i03.3934.306-323>
- Samuel H, (2021), *Relation of Ancient Mataram Temple Based on North India and South India's Characteristics*, *Jurnal RISA (Riset Arsitektur)* ISSN 2548-8074, Vol 05, No 04, Oktober 2021; hal 334 – 347 <https://doi.org/10.26593/risa.v5i04.5298.334-347> (accessed August, 2022)
- Santiko, H,(1995), *Seni Bangunan Sakral Masa Hindu-Buda di Indonesia Analisis Arsitektur dan Makna Simbolik, Pidato Pengukuhan Guru Besar Madya Tetap pada Fakultas Sastra Universitas Indonesia*, Depok.
- Setiabudi, B. (2006) *A Study on the History and Development of the Javanese Mosque*, JAABE
- Snodgrass, A (1985) *The Symbolism of The Stupa*, New York: SEAP.
- Soekmono, R (1988), *Pengantar Sejarah Kebudayaan Indonesia 1-3*, Yogyakarta: Penerbit Kanisius.
- Surya R, Priyomarsono, N (2016) *Aspek Tektonika Menjawab Arsitektur Masa Kini, Prosiding Seminar Nasional Avoer 19-20 Oktober 2016 Palembang, Indonesia*.
- Tjahjono, G (2009), editor, *Sejarah Kebudayaan Indonesia, Arsitektur*, Jakarta: Raja Grafindo Perkasa.
- Tjahjono, G, editor (1989) *Indonesian Heritage - Architecture*, Singapore: Editions Didier Millet.
- Widjaja, A (2021) *Reading the Rationality of Manguwijaya's Architectural Tectonics*, *Civil Engineering and Architecture* 9(6): 1759-1775, 2021 <http://www.hrpub.org> DOI: 10.13189/cea.2021.090610
- Yasemin Đ. (2007) *Type and typology in architectural discourse*, Balıkesir University Faculty of Architecture and Engineering, BAÜ FBE Dergisi, Cilt:9, Sayı:1, 3-18.