

## IDENTIFICATION OF GREEN ARCHITECTURAL CHARACTERISTICS OF TENGANAN PEGRINGSINGAN VILLAGE, KARANGASEM, BALI

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### ABSTRACT

Tenganan Pegringsingan village is one of most Bali Aga villages that located at Karangasem Regency, Bali. This village has a variety of vernacular buildings especially a settlement building. The settlement buildings that is a traditional houses are dwelling that still maintain pattern and shape of the building in the past. In this article will discuss about characteristics of green architecture in vernacular architecture and the genius that applied by people to response the environmental issues. Research using qualitative descriptive method by collecting data through field observations on vernacular building objects followed by a drawing of the object. The result of this research show that there four characteristics of green architecture on vernacular buildings at Tenganan village including aspects of land use, energy efficiency, water conservation, and cycles and material sources.

**Key word:** vernacular architecture; green architecture; Tenganan Pegringsingan village; land use; efficiency energy.

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### INTRODUCTION

Awareness of the decline in environmental quality that triggers various disasters caused by climate change has aroused the thoughts of experts on the sustainability of development. In achieving sustainable development that is responsive to environmental sustainability, various approaches and concepts are needed. The main idea of environmental sustainability is basically about human reactions to the fulfillment of consumption taken from natural resources (Norouzi, Fani, & Nasiri, 2021). Architecture as a product that uses natural resources will have challenges in the future on the design, system, product, and also in its operation.

One of the efforts made as a form of responsibility in supporting development efforts is the concept of green architecture. Green architecture is a design approach that focuses on reducing environmental impact, increasing space comfort, effectively using energy sources and land, through a holistic and comprehensive process (Fachrudin & Zafira, 2021). One of the strategies taken is to increase energy efficiency by optimizing the direction of wind flow and utilization of solar energy (Mutaliyev, Samoilov, & Priemets, 2021). In the end, the concept of green architecture can be interpreted as a building design concept with high performance which is reflected in energy efficiency and the use of environmental resources.

In supporting and disseminating the concept of green architecture, parameters, criteria, and assessments of green buildings are made. Green architecture assessment is carried out by comparing criteria and indicators as an instrument for measuring green buildings. In some countries to conduct an assessment of green buildings a special certification body is formed. Some that have been formed include BREEAM (Building Research Establishment Environmental Assessment Method) in England, LEED (Leadership in Energy & Environmental Design) in America, BCA (The Building and Construction Authority) in Singapore. Especially in Indonesia, the assessment of green buildings is carried out by GBCI (Green Building Council Indonesia) which is a non-government institution that provides ratings for all green buildings in Indonesia.

However, in practice, not all buildings can be assessed using the parameters used by the certification body. As a country that has a diversity of architecture, Indonesia has various forms and types of vernacular buildings. One of the studies that have been carried out to identify the green level has been carried out by El Shabir (2014) on traditional buildings and made recommendations for green

building models in Kampung Naga, West Java. In the study, it was revealed that the green level of the buildings at the research site was included in the gold category in the GBCI ranking.

The increase in human population accompanied by excessive use of the natural environment is predicted to reduce the capacity and quality of natural resources. Utilization of these natural resources is predicted to someday experience limitations and can no longer meet the production needs of humans (Satar, Syarif, & Nadjmi, 2018). This has become the thought of experts so that a balance is needed between development, economy, human welfare, and natural preservation.

One of the human consumption activities that are suspected to consume significant natural resources is the development/construction sector. Globally, the construction sector consumes 50% of natural resources, 40% of energy, and 16% of water (Soemardi & Ervianto, 2012). The amount of use and utilization of natural resources in this sector requires a concept to be able to save and control these resources. Sustainable development is a concept and solution to bridge between economic interests, welfare, and environmental sustainability.

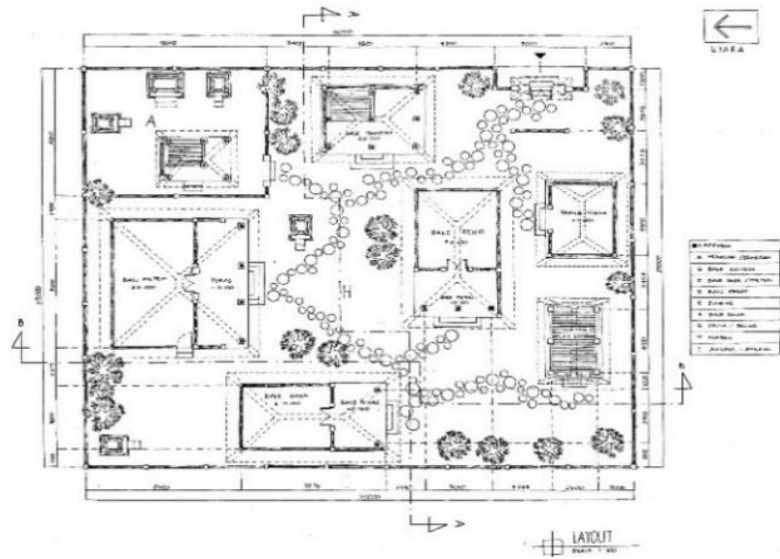
The building as a physical translation of the architectural concept is an important aspect in formulating the concept of sustainable development. Green architecture arises from various problems that occur in human activities and activities that use nature. In measuring a green level of an architectural work, certain parameters are used. According to Vale (1991) in determining green architecture, there are six basic principles in measuring green buildings, namely (1) Conserving energy/energy conservation; (2) Working with climate; (3) Minimizing new resources/ can minimize the use of new resources; (4) Respect for site/ in line with site conditions; (5) Respect for users / meet user needs; (6) Holistics / determination of the principles and parameters of architecture and green buildings are not standard.

### **Vernacular Architecture**

Architecture is an expression of evidence of cultural heritage that is manifested in various forms of buildings. As an expression of cultural traces, in the context of science, vernacular architecture is one of the topics that relates the context of space and culture. The use of the term vernacular comes from the word verna (from Latin) which means domestic, indigenous, native slave, or home-born slave to classify local architecture which is generally residential buildings (Mentayani & Muthia, 2012). Vernacular architecture refers to buildings and architecture that were erected by people or society by considering needs, social conditions, environmental factors, and materials (Rajendra, 2021).

If we pay attention to vernacular architecture as a product, the product form is mostly a residential function. Residential houses as architectural design works that are formed due to the situation and environment, are an ongoing cultural phenomenon that forms space in the context of residential houses (Rapoport, 1969). The personal relationship between residents and their homes shows a system of interdependence and mutual influence (Annisa, Suprpti, & Pandelaki, 2020). Vernacular architecture is identified with folk architecture, referred to as folk architecture because in the design process and its implementation is carried out by the people themselves without involving architects as experts (Rudofsky, 1987). It can be said that vernacular architecture is an architecture that continues to grow and develop in line with the process of life and is influenced by various factors that surround the community.

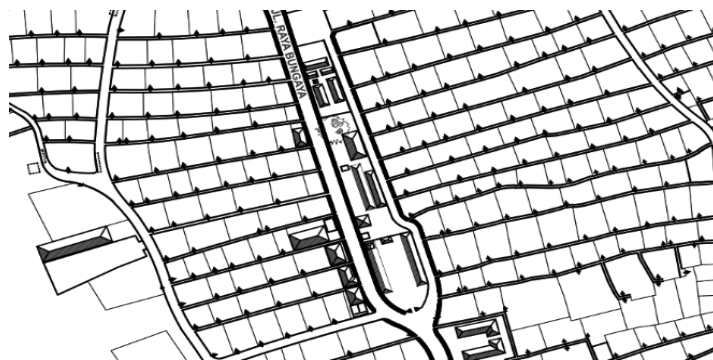
Traditional Balinese houses are an important part of the life of the Balinese people. Traditional houses are arranged to accommodate various functions, one of which is a socio-cultural function and a religious function (Putra, Lozanovska, & Fuller, 2019). The spaces in a traditional Balinese house are composed of interrelated cultural relationships as well as religious ritual activities (Aritama & Putra, 2021). The traditional Balinese house is a form of embodiment of vernacular architecture that grows and develops in the Bali area. The translation of spiritual functions in traditional Balinese houses is reflected in the division of space in the yard. The division of space is based on the philosophy of cosmological balance called bead ring *cecupu*, namely the unity between humans and the universe environment (Eiseman, 2011).



**Figure 1.** Traditional Balinese House Layout Source: Documentation, 2021.

In the hierarchy of space, the division of spaces in a traditional Balinese house is based on the conception of Tri Hita Karana (Gelebet, 1985). Tri Hita Karana translates the space in the yard of the house into three main elements, namely parhyangan, pawongan, and palemahan (Wastika, 2005). The parhyangan element is the top hierarchy which is categorized as the main element. The physical embodiment of the parhyangan element is the most sacred space, namely sanggah/merajan. The pawongan element is a middle/intermediate hierarchy, categorized as an intermediate element. The physical form of the pawongan element is seen in the residential area which is a neutral zone. Furthermore, the palemahan element is the lowest hierarchy which is referred to as the insulting element. Physically, the element of humiliation in a traditional Balinese house can be seen in the back area/teba, which is used as a place for vegetation and to put livestock.

Meanwhile, in mountainous areas of Bali, there are different characteristics and systems of traditional houses that are different from plain Bali. Most of the traditional houses located in mountainous areas belong to the Bali Aga village. Housing in Bali Aga villages has a fundamental difference with housing in plain Bali. The Bali Aga villages were the original Balinese people who were not affected by intervention by the Hindu Kingdom in Java.



**Figure 2.** Bali Aga Village Pattern in Pakraman Timbrah Village Source: Swanendri and Susanta, 2018.

In general, traditional settlements in the Bali Aga village have a linear pattern that extends upstream and downhill (Agusintadewi, 2017). The linear pattern is formed from a combination of house yards and village public facilities which are usually located in the middle forming a plaza. Each yard is limited by a barrier wall that limits the house next to it and the access road in front of the entrance. The settlement pattern in the Bali Aga village is inseparable from the conditions of the natural

contours and the activities of the indigenous peoples that form the spatial pattern of the settlements in the Bali Aga village (Aritama & Wiryawan, 2020).

All land and yards in the Bali Aga village area are mostly controlled by the village, this is because land is considered to have the value of honor, purity, and safety (Runa, 2018). Ownership of land by the village is binding on all indigenous peoples living in the village, the obligation as a consequence of the use of the village yard is manifested in traditional tasks known as village fathers. The settlement system in the Bali Aga village is generally divided into plots of yard with an area of approximately 100-200 square meters. In a yard that will be inhabited by one nuclear family, the head of the family is responsible for the entire yard of the house he occupies.

This article aims to discuss the characteristics of green architecture in vernacular house buildings in Tenganan Pegringsingan Village, Karangasem Regency, Bali. Tenganan Pegringsingan Village is one of the traditional villages that has a variety of vernacular buildings with local wisdom with its own characteristics that are different from traditional buildings in the Bali area (Runa, 2018). Especially in residential buildings, the buildings in Tenganan Pegringsingan Village are residences that maintain traditional building patterns and forms as they have been passed down in the past.

## RESEARCH METHODS

The method used in this study is a qualitative method with a descriptive approach to each research object. Qualitative methods were used to understand the physical condition of the building, data search techniques used measurement methods and redrawing of each traditional house that was used as the research sample. To identify non-physical conditions, observation was used through an in-depth interview process accompanied by a question guide. Redrawing of objects is done to find the relationship between architectural narratives and the activities and processes of the occupants of the house (Lozanovska, 2002). In addition to knowing the composition and percentage of open space in the yard of the house.

Data analysis was carried out by outlining each part of the traditional house by comparing it with the parameters of the green building. Measurements were made through observations on layouts, floor plans, looks, photos, as well as through measurements of room temperature and humidity that had been carried out in the field. The result is a description and characteristics of green architecture in traditional house vernacular buildings.

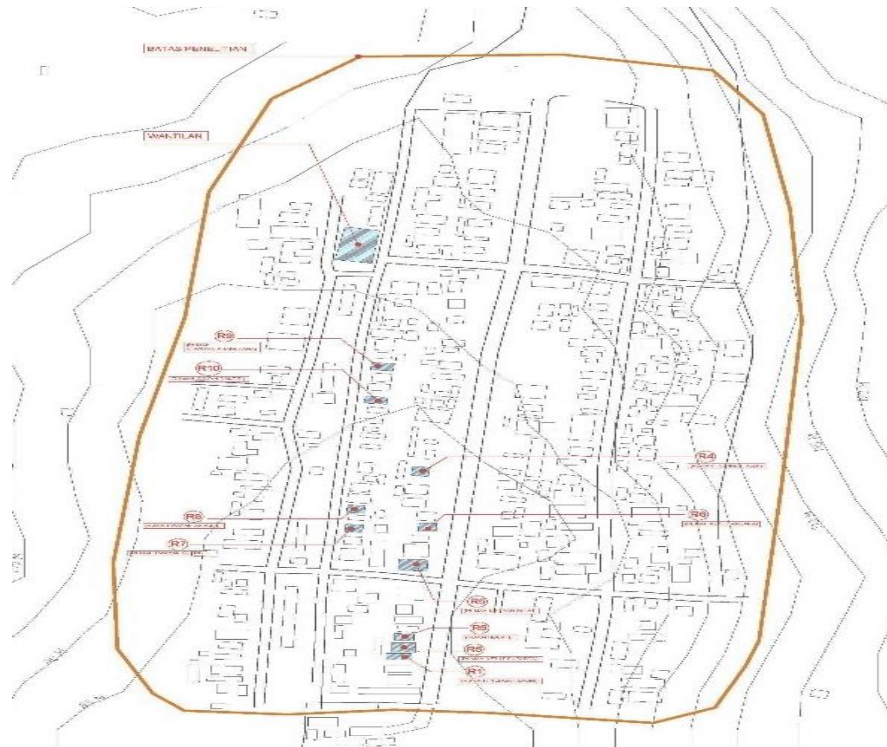
Tenganan Village is geographically located in the Manggis District, Karangasem Regency, Bali. From downtown Denpasar to reach Tenganan Village, you can access the Ida Bagus Mantra By Pass road or via the primary arterial road through the city of Gianyar and the city of Klungkung with a distance of 67 kilometers from the center of Denpasar (Runa, 2018). Tenganan Pegringsingan village can be reached in approximately two hours from downtown Denpasar, meanwhile from downtown Amlapura, it can be reached in 20 to 30 minutes.

## RESULTS AND DISCUSSION

### Tenganan Pegringsingan Village

Tenganan Pegringsingan Village as a trace of Ancient Balinese civilization is one of the villages with a population of Balinese Aga/Native Balinese people (Putra & Nugroho, 2018). Bali Aga means Bali whose people are truly Balinese. The settlement pattern in Tenganan Pegringsingan Village is a linear pattern with a typical typology of traditional Bali Aga settlements which have different structures and layouts from settlements in the South Bali area. The settlement in the village is a confined settlement complex and is limited by a dividing wall. There are four entrances (lawangan) to the village settlements in the four cardinal directions.

In the center of the village there is a common open space in the form of a plaza that extends along the axis of the village settlement, the plaza is called awangan. The plaza in the middle is a common space and public facilities, including Bale Banjar, Bale Agung, and Wantilan. Meanwhile, on both east and west sides of Awangan there are blocks of community settlement lots, some of which are connected by access to other Awangan. In addition, there is also an access road in the form of a pedestrian that connects to the rice fields, gardens, graves, and rivers.



**Figure 3.** Map of Tenganan Pegringsingan Village Source: Author's Documentation, 2021.

The pattern of Tenganan Village is a core system that stretches from north to south. It consists of three banjars, namely: Banjar Kauh, Banjar Tengah and Banjar Pande (Kumurur & Damayanti, 2012). Banjar Kauh is located in a row flanking the main village cloud in the west. Banjar Tengah consists of several houses located in the east of the Banjar Kauh and houses located in the middle cloud of the village. Banjar Pande area is located in the easternmost of all village settlements, with housing in two rows flanking the easternmost cloud.

### **Tenganan Village Traditional House**

Traditional houses in Tenganan Village stand on one parcel of land, generally the land parcels of traditional houses are rectangular. Each land parcel has the longest side in the east-west direction and the shortest side in the north-south side. Although the proportions and dimensions of the house plots are not the same, the composition of the existing buildings is still similar from one house to another. Traditional houses in Tenganan Village consist of several mass building blocks. Each building mass is connected to each other with natah access and pedestrian access to other building masses.

In the traditional house of Tenganan Village, there are several buildings that are characteristic and main elements of the house. All mass building blocks have functions and are related to traditional and cultural functions. Some of the existing buildings include *Jelanan Awang/Kori Ngeleb*, *Bale Buga*, *Sanggah Kelod*, *Sanggah Kaja*, *Bale Tengah*, *Bale Meten*, *Paon*, back door, and *teba* (Runa, 2018). In general, the shape and plan of the traditional house in Tenganan is very simple, namely a rectangle. This form is reflected in the activities carried out in the house that do not require a complicated design and mostly require a semi-open space.

Access to the Tenganan traditional house can be done through *jelanan awang/kori ngeleb*. *Jelanan Awang* is an entrance shaped like an *angkul-angkul*. However, there are also some that are integrated into the mass of the building which is only in the form of a door hole in a *pengenger* wall with a roof made of fibers or dried coconut leaves/*palpalan*. The dimensions and proportions of the entrance are adjusted to the body size of the occupants of the house.

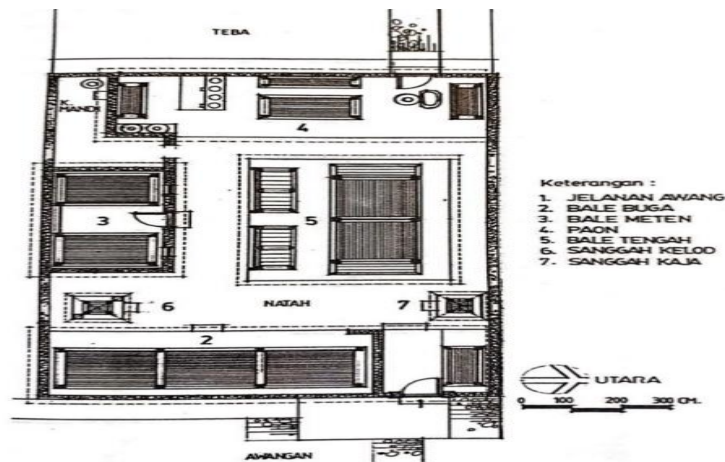


Figure 4. Layout of Tenganan Pegringsingan Village Houses Source: Runa, 2018.

In the middle area there are two mass buildings that are located opposite each other, namely Bale Meten and Bale Tengah. Between the two masses of the building there is an access road to the area behind the house. Bale meten is located in the south and has a function as a bed and a place to store valuables. Apart from being a bed, some models of bale meten have a terrace/amben that has a function to receive guests. In some models, the bale meten becomes one unit with the bale buga, thus forming a unitary mass of the building.

**Green Architecture Characteristics of Tenganan Village**

Tenganan Village is one of the Bali Aga villages that still maintains the concept of vernacular architecture in spatial planning in the yard of the house. Some of the green architectural parameters formulated by GBCI will be seen in traditional houses and adapted to the characteristics and conditions of the locality of the region. In accordance with the GBCI green architectural assessment basis, the greenhome criteria are used as an assessment of the green level of a house.

**Land Use**

On land use parameters, the selection of the right site is based on land use regulations. If you look at the situation of traditional settlements, the use and utilization of land is regulated in the joint rules of the village community as stated in the awig-awig/village customary regulations. The regulation contains the coverage of the village area, the division of the area in each banjar, as well as the division of village space zoning which is divided into parhyangan/God, palemahan/nature, and pawongan/human zones. The pawongan zone is a zone designated for human activities, one of which is a residential area. People are prohibited from building houses outside the pawongan zone.



Figure 5. Arrangement of Traditional Houses in Tenganan Pegringsingan Village Source: Documentation, 2021.

In addition, excessive engineering or tread arrangement is not recommended. Efforts are made to arrange through site optimization by not changing the physical environment too much, such as minimizing cut and fill. The arrangement of the building mass is done by selecting a small building mass to provide a larger percentage of open space. Overall, the vernacular building of the traditional house of Tenganan Village is arranged in such a way with the provisions of the site designation for local housing.

### Energy Efficiency

Sources of energy acquisition for traditional houses in Tenganan Village come from government subsidies by providing energy in the form of electricity (PLN), gas, kerosene, and firewood. The efficiency of energy use in traditional houses in Tenganan Village is done by minimizing the use of fuel and the use of electrical energy. Efforts are being made to maximize the potential of natural energy that is already available, namely the sun and wind. Meanwhile, for artificial lighting using electricity supply from the PLN network. The average power capacity of the PLN connection in each house ranges from 450-900 watts.

Based on the survey results in ten sample houses, the average monthly electricity usage for each house is 88 kWh with an average load cost of Rp. 130,200. Table 1 shows the use of electricity costs per month for each residential house. In addition to using energy sources from PLN, other energy sources are used for cooking purposes. Some of the sources that are often used include LPG, kerosene, and firewood. Firewood is still used as an energy source by the people of Tenganan Village. This is related to the sacred nyakan ritual, which is a special cooking ritual carried out in a series of local traditional ceremonies (Putra & Nugroho, 2018).

**Table 1.** Average Electricity Usage of Traditional Houses in Tenganan Pegringsingan Village

No.	House owner	Electricity usage	
		Cost (Rp)	Load (kWh)
1	I Nengah Sadri	200.000	135
2	Ketut Suparta	200.000	135
3	Ibukti	75.000	51
4	I Nengah Abdi	250.000	169
5	Nengah Suja	50.000	34
6	Ketut Arsana	200.000	135
7	I Wayan Sutri	100.000	68
8	Wayan Ariasih	150.000	101
9	Ni Wayan Suadnyana	52.000	35
10	Wayan Candri	25.000	17
Rerata penggunaan listrik per bulan		130.200	88

Source: Documentation, 2021.

### Water Conservation

There are various types of sources of clean water that are used by the people of Tenganan Village. Based on the results of the field survey, most of them utilize the use of wells and others use local springs, namely Dauh Bebandem Springs. In addition to water sources that already flow directly to each house. There is also clean water sourced from drilled wells which is stored in a special reservoir and can be accessed by all village communities located in the east of the village environment. The use of clean water from drilled wells is used at any time if there is a long dry season which causes a decrease in the debit of the main spring.

Efforts made to conserve water by the community can be seen from the provision of space as water absorption. The space is located at the back of the house called the teba area. Wastewater from rainwater runoff, water from bathing and washing will be seeped into the soil in the teba area. Especially for rainwater runoff, if there is an excess it will be channeled into a water channel with a

width of 40 cm out of the yard. In addition to functioning as rainwater infiltration, the teba area is also used as a place to grow crops and place various household appliances.

In addition, other efforts made to save water are carried out by treating used water. The used water in question here is used for washing kitchen needs. This is due to the use of laundry soap derived from natural ingredients to wash kitchen utensils. Utilization of used water is used for fish ponds, in its distribution using used barrels filled with membranes and filter material as water filters before the water is flowed into the fish pond. Furthermore, the used water is recycled again and the rest is disposed of and flowed to teba.



**Figure 6.** The Teba Area of the Traditional House of Tenganan Village Source: Documentation, 2021.

### Cycle and Material Source

In the construction of traditional houses in Tenganan Village, the selection and use of materials mostly uses materials from nature. The use of natural materials is intended so that these materials can synergize with the environment and the carpentry technology capabilities of the local community. The use of materials in the manufacture of traditional houses includes bamboo, river stone, jackfruit wood, taab wood, coconut wood, pal-palan/rumbia roof coverings. All these natural materials are obtained from forests or gardens around the Tenganan Village environment. Meanwhile, the natural materials used as the foundation material in the form of bricks are obtained from local houses and some of them come from outside the village, especially bricks.

The use of fabricated materials in traditional houses is still allowed as long as local materials and substitutes are difficult to find. However, its use is limited only to residential buildings and services, specifically for places of worship and bale buga are not allowed to use fabricated materials. In the process of building a traditional house, it is not allowed to use used materials, especially in the main building which is classified as a sacred building. There is even a local belief which states that stone materials in one area of the house cannot be moved, sold, or exchanged for other houses to ensure the sanctity of the building materials.





**Figure 7.** Use of Natural Materials for Traditional Houses in Tenganan Village Source: Documentation, 2021.

## CONCLUSION

The traditional house is a form of vernacular architecture that is evidence of the traces of local wisdom in protecting the environment and preserving nature. Apart from containing historical and cultural values, vernacular buildings teach how to live side by side with nature without intervening between the two. The settlement in Tenganan Pegringsingan Village is a traditional Balinese Aga settlement that has been preserved for hundreds of years. In a house yard in Tenganan Village, there are several mass buildings and spaces, namely *jalan awang/kori ngeleb*, *bale buga*, *sanggah kelod*, *sanggah kaja*, *bale tengah*, *bale meten*, *paon*, *back door*, and *teba*.

It can be seen that the traditional houses in Tenganan Pegringsingan Village have applied the concepts and principles of green architecture. This green architectural characteristic is seen from the green building parameters that have previously been compiled by GBCI with the green home criteria. In principle, the characteristics of green architecture in vernacular buildings in Tenganan Village are based on social, cultural, and natural conditions of the village. Based on the results of the study, there are four characteristics of green architecture in vernacular buildings in Tenganan Village, including aspects of land use, energy efficiency, water conservation, and cycles and material sources.

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## REFERENCES

- Agusintadewi, N. K. (2017). Pola Spasial Permukiman Tradisional Bali Aga di Desa Sekardadi, Kintamani. *Jurnal RUAS*, 14(2), 47-57.
- Annisa, L. D., Suprpti, A., & Pandelaki, E. E. (2020). Tipologi Rumah Vernakular Berdasarkan Sistem Fisik di Kampung Bandar Pekanbaru, Riau. *Jurnal Arsitektur ARCADE*, 4(3), 285-291.
- Aritama, A. A. N., & Putra, I. D. G. A. D. (2021). Tourism Activities in the Traditional Balinese House: The Challenges of Designing a Homestay in Gianyar Bali. *Journal of Social and Political Sciences*, 4(1).
- Aritama, A. A. N., & Wiryawan, I. W. (2020). Identifikasi Bentuk dan Karakteristik Rumah Tradisional Desa Bungaya, Karangasem, Bali. *Undagi: Jurnal Ilmiah Jurusan Arsitektur Universitas Warmadewa*, 8(2), 65-71.

- Eiseman, F. B. (2011). Bali: Sekala & Niskala: Essays on Religion, Ritual, and Art. California: Tuttle Publishing.
- El Shabir, F. H. (2014). Kajian Konsep Arsitektur Hijau Kampung Naga, Jawa Barat. Tesis Tidak Diterbitkan. Bogor: Fakultas Agrikultur IPB Bogor.
- Fachrudin, H., & Zafira, K. (2021). Green Architecture Approach in Waste Management Building Design Concept. Makalah disajikan dalam seminar IOP Conference Series: Materials Science and Engineering.
- Gelebet, I. N. (1985). Arsitektur Tradisional Bali. Denpasar: Departemen Pendidikan dan Kebudayaan.
- Kumurur, V., & Damayanti, S. (2012). Pola Perumahan dan Pemukiman Desa Tenganan Bali. Sabua: Jurnal Lingkungan Binaan dan Arsitektur, 3(2).
- Lozanovska, M. (2002). Architectural Frontier/Spatial Story: The Problematic of Representing the Everyday. *Journal Space Culture*, 5(2), 140-151.
- Mentayani, I., & Muthia, P. (2012). Menggali Makna Arsitektur Vernakular: Ranah, Unsur, dan Aspek-Aspek Vernakularitas. *LANTING Journal of Architecture*, 1(2), 68-82.
- Mutaliyev, A., Samoilov, K., & Priemets, O. J. (2021). The Interpretation of the Principles of "Green Architecture" in The Concept of Transregional Mono-Stylism Company "Skidmore, Owings and Merrill". *Vestnik Kazrtu*, 143(1), 205-216.
- Norouzi, N., Fani, M., & Nasiri, Z. (2021). The Development of a Nexus Based Green Architecture Ranking System in Iran. *Civil Engineering Beyond Limits*, 2(2).
- Putra, I. D. G. A. D., Lozanovska, M., & Fuller, R. (2019). From Spiritualistic Toward More Pragmatic Pattern: Re-ordering Balinese Houses and Viability of The Household Traditions in Tourism Economy. *Journal of Architecture Urbanism*, 43(1), 47-61.
- Putra, P. G. P., & Nugroho, S. (2018). Strategi Pelibatan Generasi Muda dalam Pengelolaan Pariwisata di Desa Tenganan Pegriingsingan, Kecamatan Manggis, Kabupaten Karangasem. *Jurnal Destinasi Pariwisata*, (2), 211-219.
- Rajendra, A. (2021). Contemporary Challenges of the Indonesian Vernacular Architecture in Responding to Climate Change. Makalah disajikan dalam seminar IOP Conference Series: Earth and Environmental Science.
- Rapoport, A. (1969). *House Form and Culture*. Englewood Cliffs: Pearson.
- Rudofsky, B. (1987). *Architecture without Architects: A Short Introduction to Non-Pedigreed Architecture*. Albuquerque: UNM Press.
- Runa, I. W. (2018). *Arsitektur Publik Bali Kuno & Sistem Spasial Desa Pegunungan*. Denpasar: Udayana University Press.
- Satar, A. E., Syarif, E., & Nadjmi, N. (2018). Arsitektur Vernakular di Sulawesi Selatan dan Perannya terhadap Arsitektur Hijau. Makalah disajikan dalam Seminar IPLBI, Makassar.
- Soemardi, W. I., & Ervianto, B. W. (2012). Kajian Reuse Material Bangunan dalam Konsep Sustainable Construction di Indonesia. *Jurnal Teknik Sipil UAJY*, 12(1), 141.
- Swanendri, N. M., & Susanta, I. N. (2018). Transformasi Permukiman Bali Aga di Desa Pakraman Timbrah Kabupaten Karangasem. *Jurnal SPACE*, 5(2).
- Wastika, D. N. (2005). Penerapan Konsep Tri Hita Karana dalam Perencanaan Perumahan di Bali. *Jurnal Permukiman Natah*, 3(2), 62-105.