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## **Kajian Arsitektur Biophilic pada Arsitektur Tradisional Bali sebagai Pendukung Ekowisata di Bali (Studi Kasus: Rumah Adat Bali)**

### ***Study of Biophilic Architecture in Traditional Bali Architecture as Supporting Eco-Tourism in Bali (Case Study: Bali Traditional House)***

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#### **Abstract**

*The development of the times indirectly affects human needs which have an impact on all aspects of human life, psychology, lifestyle to architecture. There are several rules of Traditional Balinese Architecture that contrast or are not suitable when combined with modern architecture that is in demand by today's society. However, if ecotourism buildings in Bali follow the architectural trend in the world, it will violate the Bali Regional Regulation and Bali will lose its architectural identity. There is a gap between traditional Balinese architecture that must be applied with modern architecture which is the current trend. Biophilic Architecture is building's connection to the environment will affect the health of the community both physically and psychologically. In general, the Biophilic approach and Traditional Balinese Architecture are both environmentally based. Therefore, Biophilic Architecture can be a bridge between Traditional and Modern Architecture. Using comparative quantitative research methods with biophilic as an indicator of assessing traditional Balinese architecture, the results of modern architecture guidelines that have environmental-based traditional rules will be obtained. This research is expected to be a guide or reference in designing ecotourism buildings that are modern but still strong in their traditional Balinese identity.*

**Keywords:** Balinese; Biophilic; Enviromental; Ecotourism; Traditional; Modern

## **1. INTRODUCTION**

Traditional Balinese Architecture is an identity and one of the attractions of tourism on Bali Island. Traditional Balinese Architecture is based on the teachings of Hinduism which was indeed developing in its era, and is now a legacy from previous generations (Dwijendra, 2008). This architecture has principles that are based

on the environment and sustainability. So that if the Balinese people apply Balinese Architecture then indirectly sustainability in tourism will be maintained. But along with the times, there are new needs needed in the field of architecture, both of which have an impact on buildings, the environment and humans as users. The pressures and needs of people's lives

continue to increase so that in the 2000s Biophilic architecture has emerged as an attempt to eliminate the gap between modern architecture (today) and the human needs to connect with the natural world (Sharifi & Sabernejad, 2016). Biophilic is an architectural design theory that begins with examining the phenomenon that humans essentially love the natural environment (Kellert, 2008). Several studies have also proven that humans are at their optimal abilities such as increasing concentration, improving physical and psychological health when in a natural environment (Kellert, 2015). The concept of biophilic and bioclimatic architecture represents one of the most promising ideas in sustainable building. Together with its consideration of ecologically harmless materials and use of renewable energy sources, it brings an enormous quality increase in planning and workmanship, as well as an improvement in inhabitants' comfort (Almusaed, 2011).

Biophilic has several principles and elements in its design, including Visual Connection with Nature, Non-Visual Connection with Nature, Non-Rhythmic Sensory Stimuli, Thermal & Airflow Variability, Presence of Water, Dynamic & Diffuse Light, Connection with Natural Systems, Biomorphic Forms & Patterns, Material Connection with Nature, Complexity & Order, Prospect, Refuge, Mystery and Risk/Peril (Terapin, 2014). Likewise, traditional Balinese architecture has a Tri Hita Karana concept approach, the concept of cosmic balance, the *Rwabhinada* concept, the *Tribhuana-Triangga* concept, the concept of harmony with the environment and so on (Susanta, Wiryawan, 2016). It can be concluded that while these two theories have something in common, they have a close relationship with nature.

But in fact, these two theories grew and developed at different times. This will affect the level of conformity with the needs of today's society in the context of the development of Balinese Architecture. Over time, there are approaches to traditional Balinese architecture that are not suitable for today's needs and can be developed. This development is not to change the standard or rules of the Balinese Traditional Architecture itself. However, the

development means is to give a new color to the concept of modern buildings but still have the characteristics of Balinese Architecture. This new architectural concept will be a guideline for the development of residential buildings in Bali or ecotourism supporting buildings such as hotels, villas and resorts.

In the process of obtaining research results, it is necessary to analyze the relationship between Traditional Balinese Architecture and Biophilic Architecture, such as (1) are there any similarities between Balinese Traditional Architecture and Biophilic Architecture? (2) whether all patterns of Biophilic approach have been applied or not applied to traditional Balinese house buildings, (3) How is the influence of Biophilic Architecture on Traditional Balinese Architecture in creating new standards for ecotourism supporting buildings? In general, the result of this study is evaluate Balinese Traditional Architecture has a relationship with Biophilic Architecture, so researchers can conclude new innovations of Balinese Architectural design for the future is contemporary, modern and sustainable.

## **2. METHODS**

The research was conducted in traditional Balinese residences in several locations in Bali. The residence is classified into two, there are Traditional Bali Aga house and the Traditional Balinese Majapahit house. The location is not specifically specified in one place. This is motivated by the fact that each traditional house in each district has its own characteristics. To minimize bias, the hope of choosing different locations is that the research results are universal and can be applied to all districts in Bali.

The quantitative research method in this study uses comparative research. According to Silalahi Ulber (2009) comparative research is research that compares two or more symptoms. Comparative research can be in the form of descriptive comparative. Descriptive comparative compares the same variable for different samples. Therefore, the use of the quantitative-comparative method in this study is to compare the Bali Age Traditional House and the Bali Majapahit Traditional House. Biophilic will be a variable or assessment indicator. So it can be concluded that the overall

elements of the Balinese Traditional House have similarities and differences with Biophilic Architecture.

Data collection methods used are observation, interviews and documentation. Researchers made observation sheets containing tables of 14 Patterns of Biophilic Architecture as a medium for assessing buildings. 3 stars will be given if the Balinese architecture apply Biophilic Patterns, 2 stars about apply Biophilic but it is not optimal enough and 1star states that the traditional Balinese house does not apply the pattern of biophilic elements. The assessment will be carried out by all members of the research team so that the assessment is more universal and unbiased.

Lampiran 5  
**Lembar Observasi**  
**ARTRIBUT RUMAH TINGGAL**

Identitas Surveior	
Nama:	
Jabatan:	
Narasumber:	

No	Indikator	Keterangan
1	Lokasi	Desa Batuan, Kec. Sukawati, Kab. Gianyar
2	Fungsi	Rumah Tinggal
3	Pemilik	Pak Gung Aji
4	Kategori	Bali Majapahit
5	Luas Tanah	8 are
6	Luas Rumah	169m <sup>2</sup>
7	Jumlah Bangunan	5
8	Dibangun tahun	1990an awal

**ASSIGNMENT DIRECT OBSERVATION**

No	Indikator	Penjelasan
1.	Visual Connection with nature	
	***	Terdapat banyak bukaan sebagai penerapan dari koneksi secara visual terhadap lingkungan sekitar.
	**	Terdapat bukaan sebagai penerapan dari koneksi secara visual terhadap lingkungan sekitar.
	*	Tidak terdapat bukaan sebagai penerapan dari koneksi secara visual terhadap lingkungan sekitar.
2.	Non-Visual Connection with nature	
	***	Terdapat banyak area yang rangsangan berupa suara, aroma, dan tekstur mengingatkan kita berada di luar ruangan atau alam.
	**	Terdapat area yang rangsangan berupa suara, aroma, dan tekstur mengingatkan kita berada di luar ruangan atau alam.
	*	Tidak terdapat area yang rangsangan berupa suara, aroma, dan tekstur mengingatkan kita berada di luar ruangan atau alam.
3.	Non-Rhythmic Sensory Stimuli	
	***	Terdapat banyak area yang dapat menikmati perubahan alam baik itu hayati maupun cuaca.
	**	Terdapat area yang dapat menikmati perubahan alam baik itu hayati maupun cuaca.
	*	Tidak terdapat area yang dapat menikmati perubahan alam baik itu hayati maupun cuaca.
4.	Thermal & Airflow Variability	

Figure 1. Observation Sheet

### 3. RESULT AND DISCUSSION

Traditional Balinese architecture in this study is classified into 2 groups, namely the Balinese Traditional Houses during the Bali Aga and the Balinese Traditional Houses during the Majapahit period. The two types of houses have different approaches and visual appearances based on the influence of beliefs, times, technology and human development. In this study, the concept of biophilic as an indicator of the assessment of the traditional Balinese house. This aims to find out how big the relationship between Biophilic and Traditional Balinese Architecture with a residential case study.

## 3.1 Traditional Balinese Houses (Bali Aga)

### 3.1.1 Sidatapa Village, Buleleng



Figure 2. Fasade of the Building at Desa Sidata, Buleleng (Bali Aga)



Figure 3. Interior of the Building at Desa Sidata, Buleleng (Bali Aga)

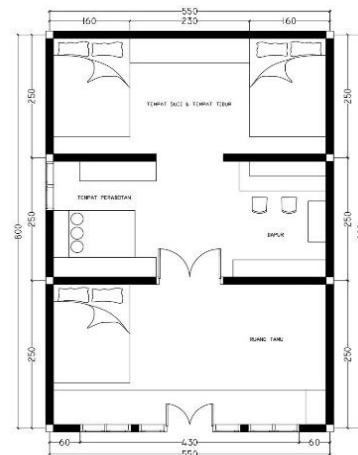


Figure 4. Site Plan of the Building at Desa Sidata, Buleleng (Bali Aga)

The traditional Balinese house during the Bali Age in Sidatapa Village has a quite unique shape compared to traditional Balinese buildings in general. The traditional Balinese house in Sidatapa Village only consists of 1 building. The building is divided into 3 rooms,

namely Utama Mandala, Madya Mandala and Nista Mandala. Utama Mandala functioned as a bedroom and a place of worship. Madya Mandala functioned as a kitchen and Nista Mandala functioned as a gathering place.

This traditional house is a transformation of the settlement in the cave that our ancestors did. Where in one building serves to perform many activities. This resulted in the absence of a privacy area for the community. The room tends to be closed and congested. These conditions are favorable for keeping the space warm. However, with global warming that is now happening, the closed concept of this traditional building is not comfortable. because the room to become hot and humid.

The concept of a facade like this also breaks the connection between humans and nature visually. However, this concept has the advantage that it still uses natural materials so that it is sustainable.

### 3.1.2 Panglipuran Village, Bangli



**Figure 5.** Fasade of the Building at Desa Panglipuran, Bangli (Bali Aga)



**Figure 6.** Material of the Building at Desa Panglipuran, Bangli (Bali Aga)



**Figure 7.** Site Plan of the Building at Desa Panglipuran, Bangli (Bali Aga)

The second building is Traditional House in Panglipuran Village. Every traditional house in Panglipuran has the same land area and building pattern. In this traditional house there are several building periods including Sanggah, Klumpu, Kitchen, Traditional Bale and Loji. Traditional houses in Panglipuran have applied the concept of natah / yard. So that it can take advantage of air circulation and natural lighting. The building materials use stone wood and bamboo from natural products around Panglipuran Village. Overall, the concept of a traditional house in Panglipuran has a high biophilic level, but there are no natural patterns adapted into design or aesthetic elements.

### 3.1.3 Tenganan Village, Karangasem



**Figure 8.** Fasade of the Building at Desa Tenganan, Karangasem (Bali Aga)



Figure 9. Interior of the Building at Desa Tenganan, Karangasem (Bali Aga)

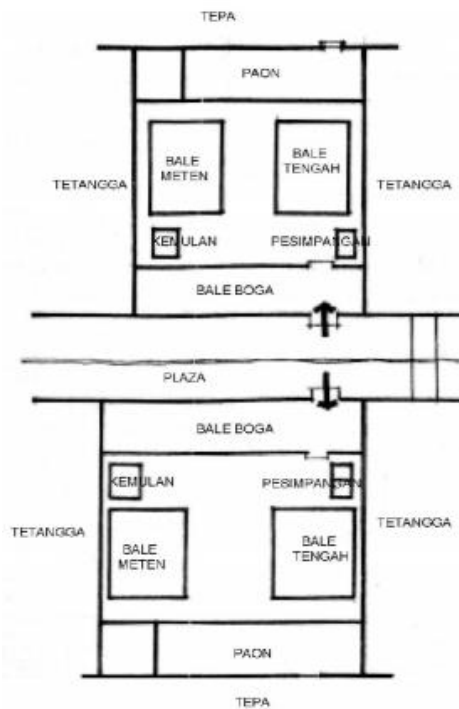


Figure 10. Layout Plan of the Building at Desa Tenganan, Karangasem (Bali Aga)

Traditional houses in Tenganan Village consist of several buildings, including Bale Boga, Bale Meten, Bale Tengah and Kitchen. Bale Boga is the front building that functions as a sacred and customary area. Bale Meten serves as a place for religious ceremonies. Bale Tengah functions as a residence and the kitchen as a place to cook. Most of the buildings are Bale or open concept. So the air circulation is quite good. However, each bale has a fairly close distance to each other. There is an asbes roof that connects the buildings to one another. This

makes it seem as if the entire bale has become one building. This concept makes it difficult for plants to grow in the yard and the sun cannot be maximally entered into the yard.

For traditional Bali Aga houses, researchers took 3 samples of Bali Age houses, namely in Si-datapa Village, Buleleng, Tenganan Village, Karangasem and Panglipuran Village, Bangli. Although these three villages are classified as Bali Age villages, they also have similarities and differences. The observation process is assessed using Observation Sheets. The assessment is carried out in detail based on 14 points of the Biophilic Concept, namely Visual Connection with Nature (P1), Non-Visual Connection with Nature (P2), Non-Rhythmic Sensory Stimuli (P3), Thermal & Airflow Variability (P4), Presence of Water (P5), Dynamic & Diffuse Light (P6), Connection with Natural Systems (P7), Biomorphic Forms & Patterns (P8), Material Connection with Nature (P9), Complexity & Order (P10), Prospect (P11), Refuge (P12), Mystery (P13) and Risk/Peril (P14). Observations were made as well as documentation of general matters such as photos of the area, buildings, interiors to the most specific thing, namely building materials. The results of these observations are transferred into Anova diagrams to generate and conclude data so that they are easy to understand and read. The following are the results of the analysis or observation of the traditional house of Bali Aga. The X line shows the biophilic patterns and the Y line is the researcher's assessment based on field conditions.

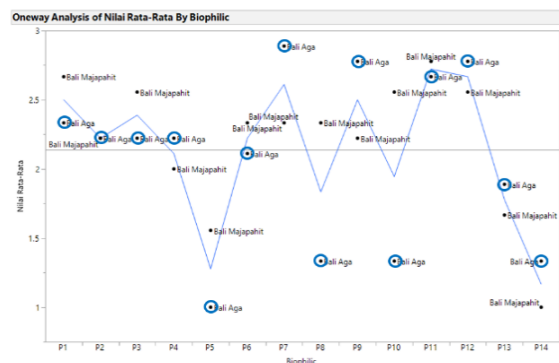


Figure 11. Anova Diagram of Biophilic Patterns in Bali Age House

From the results of interviews, observations are the results of the analysis which are transformed into Anova diagrams. The blue circle

represents the assessment or position of the Biophilic patterns that have been applied or not by the traditional Balinese Aga house. If the blue circle is below the average line, the hypothesis is that the biophilic pattern is not applied to traditional Balinese Aga houses. However, if the blue circle is above the average line, it means that the hypothesis of the biophilic pattern has been applied by the traditional Bali Aga house. The results of the observations on the 3 Bali Aga houses concluded that the Biophilic patterns that had been applied were

- P1, Visual Connection with Nature

The concept of bale and window provides a direct connection with nature. So that the community can enjoy the scenery around the building.

- P2, Non-Visual Connection with Nature

The use of natural materials in buildings provides good physical benefits to users. Building users can feel and smell the aroma of natural materials.

- P3, Non-Rhythmic Sensory Stimuli

The bale concept provides a direct connection for building users with the climate outside the building. For example, users can sunbathe and feel the hot sun and cold rain.

- P4, Thermal & Airflow Variability

The bale concept makes air circulation very good throughout the building so that the thermal temperature remains stable.

- P7, Connection with Natural Systems

The terrace in the building allows building users to feel climate changes that occur outside the building

- P9, Material Connection with Nature

Using natural materials that are environmentally friendly.

- P11, Prospect

The Bale concept allows building users to see widely around the building site.

- P12, Refuge

There is a semi bale or walled building so that there is a privacy area in the bali age house.

In addition to the points above there are several patterns that are not applied to Balinese Traditional Houses Bali Age Era, which is P5, P6, P8, P10, P13, P14.

## 3.2 Traditional Balinese Houses (Bali Majapahit)



**Figure 12.** Fasade of the Building at Batuan Village, Gianyar

### 3.2.1 Batuan Village, Gianyar



**Figure 13.** Material of the Building at Batuan Village, Gianyar

Traditional Balinese houses in Batuan Village have used the concept of natah or asta kosala kosali. This house consists of several buildings, In the arrangement of traditional Balinese houses, in general, there are several building periods, including: Merajan (Holy Place), Bale Meten (Bel Daje, Bale Dangin, Bale Dauh, Kitchen (Paon) and Jineng/Kelumpu a place to store rice or garden produce (Parwata.2019). The concept of the building varies, including open and semi-closed bales. So that this traditional house really utilizes natural lighting and natural ventilation. The building materials used are natural materials such as earthen walls, river stone floors, wooden and bamboo structures and alang-alang roofs. The distance from one building to another is far enough so that there is land for gardening and drying food ingredients. Overall, the traditional Balinese house Majapahati in Batuan Village, Gianyar is very sustainable.

### 3.2.2 Taman Bali Village, Bangli



**Figure 14.** Anova Diagram of Biophilic Patterns in Bali Age Building



**Figure 15.** Anova Diagram of Biophilic Patterns in Bali Age Building

Traditional Balinese House in Taman Bali Village, Bangli has applied the concept of *natah*. The number of buildings and the concept of arrangement on the site are almost the same as traditional Balinese houses in Batuan Village (Figure 12). However, there are things that distinguish, among others, this building has used a lot of fabricated materials. The materials used are beautiful materials but do not use sustainable materials. Finishing the floors, walls and roofs, there are many ornaments inspired by natural forms such as plants and animals. Based on the sustainable value, the traditional house in Taman Bali Village is lower than the traditional house from Batuan Village.

### 3.2.3 Gianyar City



**Figure 16.** Anova Diagram of Biophilic Patterns in Bali Age Building

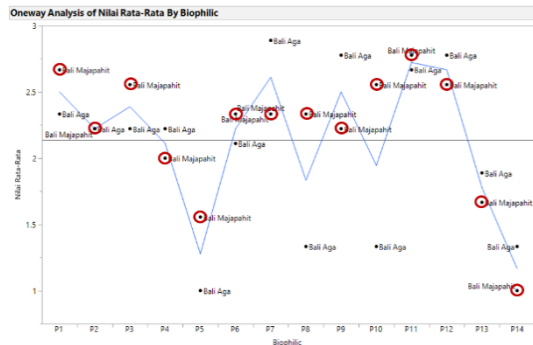


**Figure 17.** Anova Diagram of Biophilic Patterns in Bali Age Building

Traditional Balinese house in the city of Gianyar have a building concept that is almost the same as the pattern of Balinese Majapahit houses in general. The building consists of several buildings. So the building is a very close connection between humans and nature outside of the building. The concept maximizes natural lighting and ventilation. The building applies many ornaments from nature. The Building apply natural materials such as wood and natural stones. However, there are is fabricated materials such as ceramics and tile roofs. As the times progressed, traditional Balinese house rules began to be combined with modern building concepts. So that overall the basic concept of *natah* or *asta kosala-kosali* begins to erode. With a combination of modern buildings in traditional Balinese houses, traditional Balinese houses will be more functional but not sustainable.

For traditional Balinese Majapahit houses, researchers took 3 samples of Balinese Majapahit houses, namely in Batuan Village,

Gianyar, Taman Bali Bangli Village, and Gianyar City. Although these three locations are classified as Balinese Majapahit house architecture, there are similarities and differences based on the year of construction.



**Figure 18.** Anova Diagram of Biophilic Patterns in Bali Majapahit House

The results of interviews, observations are the results of the analysis which are transformed into Anova diagrams. These results illustrate that there are differences in the results of the Anova diagram of the traditional Balinese Aga house. The red circle represents the assessment or position of the Biophilic patterns that have been applied or not by the traditional Balinese Majapahit house. If the red circle is below the average line, the hypothesis is that the Biophilic pattern is not applied to the traditional Balinese Majapahit house building. However, if the red circle is above the average line, it means that the hypothesis of the biophilic pattern has been applied by the traditional Balinese Majapahit house. The results of the observations on the 3 houses of Bali Majapahit concluded that the Biophilic patterns that had been applied were

- P1, Visual Connection with Nature,

The bale concept gives building users to see the environment around the building.

- P2, Non-Visual Connection with Nature

The concept of natah makes the relationship between building users and nature around the building feel closer. The bale concept allows building users to interact directly with the surrounding nature.

- P3, Non-Rhythmic Sensory Stimuli

Openings in buildings provide stimulation to the five senses of building users.

- P6, Dynamic & Diffuse Light

Overall, each building period has openings so that it maximizes natural lighting.

- P7, Connection with Natural Systems

The concept of bales and openings allows building users to feel the climate change outside the building.

- P8, Biomorphic Forms & Patterns

There are Patra and traditional Balinese carving patterns adapted from animal and plant forms.

- P9, Material Connection with Nature

Although not all materials use natural materials. However, there are some undeniable natural wood and stone materials that complement the facade of the traditional Balinese Majapahit house.

- P10, Complexity & Order

There are repeating patterns like Patra on the building decoration elements.

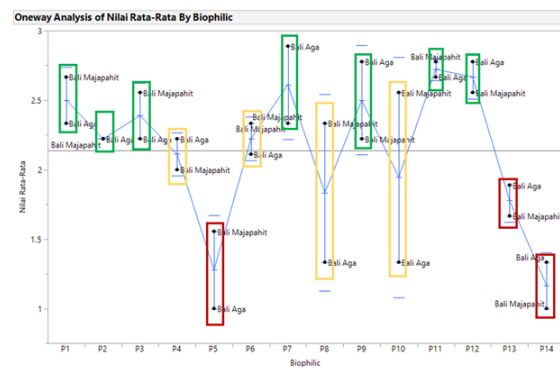
- P11, Prospect

The open bale concept allows building users to see and monitor the situation around the building.

- P12, Refuge

There are closed areas as a place for building users to take shelter and rest.

In addition to the points above there are several patterns that are not applied to Balinese Traditional Houses Majapahit Era, which is P4, P5, P13, P14.



**Figure 19.** Anova Diagram of Biophilic Patterns in Bali Age Building

The Anova diagram depicts the green color as a biophilic pattern that has been well applied by traditional Balinese houses and must be maintained. The yellow color depicts a biophilic pattern that has the potential to have a good influence on traditional Balinese houses so that they can be developed. The red color depicts a biophilic pattern that is not applied in traditional Balinese houses. These results have two possible hypotheses, which are that they do not have to be applied to residential homes or



recommendations can be made in their application but take into account the comfort rules of the house.

Based on the results of the study, it can be concluded that the new standard in designing an ecotourism facility such as hotels, villas and resorts is the application of 11 patterns of Biophilic Architecture. These 11 patterns have the same essence with Traditional Balinese Architecture. So with the application of these 11 patterns, the building has indirectly applied the rules of Traditional Balinese Architecture. 3 Biophilic patterns that are not applied to traditional Balinese houses can be applied or not. This is because these three patterns are considered not too important in the design of the residence. However, if an architect wants to give a new touch to a house in Bali, then these 3 patterns can be applied. An example the application of Presence of Water (P5) is to design a swimming pool or fish pond or just a fountain on the land of the house. Mystery (P13) by designing a mysterious journey rhythm such as winding alleys or dark alleys to get to a beautiful room. Risk/Peril by designing a stepping stone in the middle of the pond to get to a room. With this analysis, it can be a guide for building design in Bali in the future. So that buildings in Bali are not only comfortable to live in but also have an identity that can have a positive effect on tourism development in general.

#### 4. CONCLUSION

Biophilic architecture and Balinese Traditional Architecture have similarities in responding to the environment. However, what makes the difference is that Balinese Traditional Architecture is based on Hindu beliefs about a good human relationship with God, Humans and Nature. While Biophilic Architecture focuses on restoring natural elements into human life, one example is buildings. So that it provides positive benefits for the physical and psychological health of the building's users. The 14 Patterns of Biophilic Architecture, there are 11 Biophilic patterns that must be maintained for the future building in Bali, there are Visual Connection with Nature, Non-Visual Connection with Nature, Non-Rhythmic Sensory Stimuli, Thermal & Airflow Variability, Dynamic & Diffuse Light,

Connection with Natural Systems, Biomorphic Forms & Patterns, Material Connection with Nature, Complexity & Order, Prospect, Refuge. However, there are 3 Biophilic patterns are not accommodated by the Balinese Traditional Residence, there are Presence of Water, Mystery and Risk/Peril, so these things need to be improved. In hotels, villas, resorts or residences that support ecotourism by applying the 11 biophilic patterns, the building is declared to have complied with the rules of the Balinese Traditional Residence. The other three patterns can be accommodated or not, for example (Presence Of Water) placing a fish pond or swimming pool on the home page as an aesthetic element. (Mystery) designed a dark alley before entering a main room and (Risk) design a path or stepping stone in the middle of the pool to get to a room/place. However, these three things are optional depending on the purpose or depending on the architect wants to tell in the design of the building.

#### ACKNOWLEDGMENT

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