Embracing Nature in the Built Environment: Evaluation of Biophilic Design Patterns in Selected Resorts

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Abstract The integration of natural elements into the built environment, commonly referred to as biophilic design, has garnered interest due to its capacity to improve well-being and foster sustainable lifestyles. Resorts, which serve as temporary retreats for individuals seeking relaxation and leisure, offer a range of amenities and the opportunity to engage with nature. This paper aims to investigate the implementation of biophilic design patterns within selected resorts. Given its rich heritage and abundant natural resources, Ibadan, Nigeria was selected as the study location for this study. The research employed a quantitative methodology, employing convenience sampling to ensure a representative sample from the population. Questionnaires were distributed using a census sampling technique. The results of this study demonstrate a substantial implementation of biophilic design strategies in the chosen resorts. It is strongly advised to incorporate biophilic design strategies right from the inception of the design process, rather than considering them as an afterthought.

***Index Terms*— Biophilia, Biophilic Design, Design Strategies, Resorts**

I. INTRODUCTION

One facility that has become central to addressing the relaxation and leisure needs of man is the resort. This is because it has proven to be a place of recuperation and rejuvenation from the stresses of daily living [1]. Resorts are temporary dwelling places that offer visitors a range of amenities, including accommodation, food, drink, recreation, and relaxation, while also providing a chance to engage with the natural beauty of the surrounding area [2]. Essentially, resorts serve as a retreat from the pressures of urban centres, enabling individuals to temporarily disengage from their daily routine and reinvigorate their bodies and spirits [3].

Urban centers are often characterized by high population densities and a lack of natural elements [4]. However, research has shown that natural elements are crucial for stress reduction, creativity promotion, and the facilitation of healing processes [5]. The concept of infusing nature and its elements into the built environment is referred to as biophilia [6].

Bio means "life" or "living things," and philia means "love." The term "biophilia" refers to a love of life and living things. It was first used by Erich Fromm in 1964 to describe a psychological inclination towards all that is alive and active. Wilson (1984, 1993), cited by Zhong et al., [6], defines biophilia as an emotional reaction that is "innate," "hereditary," and encoded in the genes.

Architects are increasingly drawn to the notion of integrating natural elements into the built environment, through this concept of ‘biophilia’, which has resulted in the emergence of biophilic design [7]. This pursuit is fuelled by the recognition that biophilic design may yield eco-friendlier and healthier spaces that offer numerous benefits to occupants. Through the integration of natural design elements, biophilic design represents a promising framework for aligning architecture with sustainable and healthy living.

The existing literature on resort architecture encompasses various themes, including ecological architecture, traditional/indigenous/vernacular/neo-vernacular approaches, landscape integration, modern/postmodern and green architecture, as well as nature integration and harmony with nature. These themes have been explored in studies conducted by Ediae et al. [1], Febyola et al. [8], Hu et al. [4],.

In recent years, the concept of biophilic design has gained significant attention in the field of architecture, focusing on its potential to enhance health and well-being in the built environment. Researchers such as Bolten & Barbiero (2020), Downton, Jones, Zeunert, & Roös [3], Lei, Lau, Yuan, and Qi [6], Aduwo, Akinwole, and Okpanachi (2021), and Movahed [3] have highlighted the application of biophilic design in various building types, such as offices, hospitals, libraries, mosques, and shopping malls. This growing body of research has demonstrated the positive impacts of incorporating biophilic design principles.

However, there is a dearth of research specifically investigating the application of biophilic design in the context of resort design. This study aims to fill this research gap by examining the biophilic design patterns adopted in selected resorts.

This paper is crucial as it addresses the growing interest in biophilic design and its potential benefits for well-being and sustainable living. By investigating the implementation of biophilic design patterns specifically within resorts, the study offers valuable insights into how these principles can be effectively integrated into leisure and relaxation environments. This paper contributes to the existing body of knowledge by emphasizing the importance of biophilic design in resort settings and highlights the practical recommendations for future design practices.

II. Literature Review

Resorts serve as full-service lodging establishments that offer a wide range of amenities and recreational activities, emphasizing leisure and relaxation [9]. These temporary accommodations provide guests with comfortable spaces to sleep, eat, drink, vacation, exercise, and rest, all while immersing themselves in the natural beauty of the surrounding area [2].

Resorts have long been recognized as havens of relaxation and leisure, offering individuals a temporary escape from the bustle of busy cities [8]. With their focus on providing a range of amenities and recreational activities, resorts aim to create an environment that promotes comfort, convenience, and entertainment for their guests [9].

Certain minimum qualifications must also be met for a lodging property to be considered a resort. These are some examples:

i. Include at least one signature amenity or anchor attribute.
ii. Provide five additional recreation/leisure/entertainment opportunities.
iii. One full-service food and beverage outlet.
iv. Short-term or overnight lodging must be included in the bed-base.
v. A minimum of 25 rooms or other accommodations (with the exception of properties with two signature amenity/anchor attributes).
vi. Highlight the experience of being in a leisure or retreat environment.

In recent years, there has been an increasing focus on integrating elements of nature into architectural design, leading to the emergence of a design theory called "biophilic design." Biophilic Design is a design approach that incorporates the natural elements and processes into the built environment to enhance human connection with nature.

Resorts, by their very nature, provide an ideal canvas for the application of biophilic design and its principles. They are often situated in picturesque locations, surrounded by natural beauty, which presents a unique opportunity to leverage the inherent appeal of the environment. The integration of biophilic design strategies in resorts aims to create spaces that not only captivate guests with their aesthetic charm but also facilitate a profound connection with nature, resulting in enhanced user experiences and improved well-being.

Biophilic design represents the application of the biophilia concept - the instinctive human desire to interact with nature - in architecture and aims to create more environmentally friendly and healthier spaces through the use of natural design elements in the built environment. This was first proposed by ecologist Stephen R. Kellert [10] and is widely cited in current studies [6][7].

Research conducted over the last 30 years has shown the positive effects of nature on human health and well-being, supporting the idea that biophilic design is beneficial [11]. Research has provided evidence that the integration of biophilic design principles can yield various positive outcomes such as enhanced mental health, reduced stress levels, improved attention, increased well-being, lower rates of violence and crime, faster recovery in healthcare settings, and even a boost in altruistic behaviour [12].

People who live in environments without nature may experience negative psychological and physical effects [13]. Recent research has examined the application of nature in interior design and its impact on physical and psychological well-being. Fitri, Rachmawati, and Haristianti found that the incorporation of nature, both directly and indirectly, in the interior of a resort hotel can provide a relaxing space and enhance the health and comfort of users.

Increasing evidence substantiates the health advantages attributed to biophilia, prompting researchers to delve into exploring methodologies for integrating its principles into design practice [3]. The objective of biophilic design extends beyond mere mitigation of environmental harm caused by construction, shifting its focus towards the interaction and experiential connection between humans and the natural world.

Efforts have been made to identify key components and patterns of biophilic design, such as the "14 Patterns of Biophilic Design" proposed by Terrapin Bright Green, an environmental consulting firm, which illustrates the connections between nature, human biology, psychology, and design in order to guide designers in creating and evaluating biophilic design projects effectively (Downton et al., 2017; Abo-Sabaa; Abdel Azem; Al-Shanwany and El-Ibrashy, 2022).

Biophilic design encompasses three distinct categories - Nature in the Space, Natural Analogues, and Nature of the Space - which serve as a framework for comprehending and facilitating the intentional integration of a wide range of strategies into the built environment [14].

Nature in space patterns

i. A visual connection with nature through the presence of natural components and living things.
ii. Non-visual connections with nature through stimuli such as sound, touch, smell, and taste that evoke a positive association with nature.
iii. Non-rhythmic sensory stimuli that are random and transient and can be statistically analysed.
iv. Mild variations in air temperature, airflow, relative humidity, and temperature that mimic natural conditions.
v. The presence of water in the environment to enhance the overall perception of a location through sound, sight, or touch.
vi. The use of dynamic and diffuse light to mimic natural lighting conditions.
vii. A connection with natural systems and an understanding of the seasonal and temporal fluctuations that define a healthy ecosystem.

Natural Analogues Patterns

i. Biomorphic shapes and patterns that resemble those found in nature are used in biophilic design.
ii. The use of natural materials, such as wood or stone, that reflect the local ecosystem or geology, is a key aspect of biophilic design.
iii. Creating a sense of complexity and order in the built environment, similar to that found in nature, is an important aspect of biophilic design.

Nature of the space patterns

i. Prospect: A view that allows for long-range observation and planning.
ii. Refuge: A protected space that allows for withdrawal from the surrounding environment or main activity.
iii. Mystery: The appeal of hidden views or other sensory elements that encourage exploration of the surroundings.
iv. Risk/Peril: A recognised danger with a reliable safety measure.

To provide a broader perspective on the implementation of nature in resort settings, studies that explore related themes are explored. One such study by Ediae, Egbudom, & Abeng (2022) investigated the adoption of sustainable site strategies in three beach resorts in Lagos.

The results indicated a good implementation of sustainable site planning strategies, with daylight access, open spaces, landscaping, and conservation of cultural heritage being the most adopted strategies. However, green vehicle parking, irrigation, land reuse, and building orientation were identified as the least implemented strategies. The study recommended the efficient implementation of all sustainable site planning strategies, including those least adopted, such as providing electric car charging parks, clean energy use, adequate site water drainage, reuse of previously occupied sites, and building orientation that maximizes airflow while minimizing heat gain.

In another article, the benefits of the "green building with nature" concept in promoting sustainability in the Matano lakeside area were discussed by (Wasilah, Hildayanti, & Hamzah, 2019). This concept aims to achieve harmony between nature and physical and non-physical design components, thereby avoiding natural destruction. The study emphasized the incorporation of efficient design principles such as energy, water, and material efficiency. Implementation strategies included rainwater utilization, reforestation, and the establishment of playground areas. The article concluded that the use of the "green building with nature" concept principles in the Matano lakeside area not only preserved the local architecture but also provided recreational activities with a focus on natural interaction.

Additionally, a paper highlighted the significance of cultural identity and environmental adaptation in the success of resort architecture, using the Kampung Tok Senik Resort as a model for future vernacular resort style development (Hassan, Emalgalfta, & Hassan, 2010). The study identified key factors for improvement, including the adaptation of vernacular style to interior finishes, ceiling, toilet facilities, and bathing facilities. It also emphasized the importance of improved accessibility and the integration of vernacular design elements for ventilation, natural lighting, and artificial lighting.

Comparing these studies to this study, it is observed that there are several similarities and differences. Like this study, the aforementioned studies highlight the importance of incorporating nature in resorts. However, the focus and specific strategies vary. While this study centres on biophilic design, the Lagos study focuses on sustainable site planning strategies, and the Matano lakeside area study emphasizes the "green building with nature" concept. Nevertheless, all studies emphasize the need for a comprehensive implementation of natural eleements to maximize the environmental, social, and cultural benefits in resort settings.

The study by Ediae, Egbudom, & Abeng [8] focused on the adoption of sustainable site strategies in beach resorts. While our study specifically examines biophilic design factors, there is an overlap between sustainable site strategies and biophilic design elements., such as the use of natural construction materials, open spaces, and vegetation within the resorts. These shared elements suggest the need for a comprehensive approach that integrates both sustainable site strategies and biophilic design principles to achieve environmentally friendly and nature-inspired resort environments.

The study by Wasilah, Hildayanti, & Hamzah (2019) discusses the "green building with nature" concept and its application in promoting sustainability in the Matano lakeside area. This concept aligns with the principles of biophilic design, emphasizing the integration of natural elements and harmonious design components. The findings

of our study, such as the focus on natural construction materials, nature-inspired patterns and décor, and the presence of water features, resonate with the principles of the "green building with nature" concept. Both studies emphasize the importance of incorporating efficient design principles, such as energy and water efficiency, to create sustainable and nature-

The paper by Hassan, Emalgalfta, & Hassan (2010) explored the significance of cultural identity and environmental adaptation in resort architecture, using the Kampung Tok Senik Resort as a model. While their focus is on vernacular style development, there are similarities in terms of incorporating natural elements and adaptation to the environment. The findings of our study, particularly the emphasis on privacy, panoramic views, and seamless indoor/outdoor experiences, align with the importance of integrating vernacular design elements for ventilation, natural lighting, and artificial lighting mentioned in the paper.

The overlaps and synergies observed in the findings highlight the need for architects and designers to consider infusing nature and its elements in resorts.

III. METHOD

This study was carried out to examine the biophilic design patterns that have been adopted in selected resorts. To achieve this goal, it was necessary to visit selected resorts and investigate the biophilic design strategies that have been implemented, therefore a mixed method of design was employed in this study.

A review of the existing literature helped to identify the biophilic patterns and this informed the development of a schedule for physically identifying these strategies. A survey was also conducted to gather information from the users of the resorts. The variables used in investigating biophilic strategies were culled from Terrapin Bright Green LLC (2016).

This study utilised convenience sampling to select the resorts. The selection of the three resorts was based on a careful evaluation of various factors, ensuring they met the minimum requirements necessary to qualify as suitable research sites within the area. These resorts were chosen as they best matched the criteria for lodging properties to be considered as resorts. The questionnaire distribution was conducted through census sampling, which involved selecting members of the population based on their availability at the given time and proximity to the research site, which in this case are the selected resorts. A simple random sampling method was employed to randomly select respondents from this population.

IV. RESULT AND DISCUSSION

Table 1 describes the demographics of the respondents of the survey. The total number of participants in this study were seventy-eight. It can be observed that thirty-three (42.3%) of the participants were female, while forty-one (52.6%) were male. This shows that there were more males than females that participated in the survey.

The age distribution of the participants reveals that 39.7% (31) of the sample population fall in the age bracket of 26 years to 35 years. 21.8% (17) were in between the ages of 16 years to 25 years, 16.7% (13) were between 36 years to 45 years, 15.4% (12) were between 46 years to 55 years, while the lowest population of 5.1% (4) fell below 16 years.

Twenty-nine (37.2%) of the respondents had their highest educational qualification as bachelor's degree, twenty-four (30.8%) had OND/HND, fourteen (17.9%) had SSCE, while six (7.7%) had their master's degree. The lowest of the population had primary education and PhD at 2.6% (2) each. This shows that the majority of the respondents were educated.

Thirty-nine (50%) of the respondents were single, thirty-eight (48.7%) were married while only one (1.3%) respondent was widowed. 50% (39) of the respondents were from Resort 1, while 38.5% (30) and 10.3% (8) of the respondents were from Resort 2 and Resort 3 respectively.

TABLE I. DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Demographics	**Respondents' Characteristics**	**Frequency**	**Percentage**
Gender	Female	33	42.3
	Male	41	52.6
	No Response	4	5.1
Age	Below 16	4	5.1
	16-25	17	21.8
	26-35	31	39.7
	36-45	13	16.7
	46-55	12	15.4
	No Response	1	1.3
Educational Qualification	Bachelors	29	37.2
	Masters	6	7.7
	OND/HND	24	30.8
	PhD	2	2.6
	Primary Education	2	2.6
	SSCE	14	17.9
	No Response	1	1.3
Marital Status	Married	38	48.7
	Single	39	50.0
	Widowed	1	1.3
Resort	Resort 1	39	50.0
	Resort 2	30	38.5
	Resort 3	8	10.3
	No Response	1	1.3
User type	Visitor	40	51.3
	Worker	36	46.2
	No Response	2	2.6

The objective of this study was to examine the biophilic strategies that have been adopted in existing resorts. Table 2 presents the mean ranking of the fourteen biophilic patterns adopted generally in all three resorts. Thirty-four variables were used to determine the adoption of these patterns. It can be observed that Dynamic and Diffuse Light (multiple sources of light) is the pattern mostly adopted in the resorts.

TABLE II. MEAN RANKING FOR BIOPHILIC PATTERNS IN ALL RESORTS

Descriptive Statistics				
	No.	Mean	Std. Deviation	Rank
Multiple sources of light	78	3.67	1.213	1st
Views of the outside	78	3.51	1.029	2nd
Clear and unimpeded view of the space	78	3.44	1.169	3rd
Elements of nature such as vegetation in the space	78	3.42	1.305	4th
Views of nature likely to change over seasons	78	3.38	1.154	5th
Changes in air flow that make you feel like you are outdoors	78	3.36	1.057	6th
Openable windows or doors apart from the main entry that let in breeze into the space	78	3.33	1.158	7th
Images or videos depicting nature	78	3.28	1.104	8th
Furniture that appears to be made of natural materials	78	3.27	1.213	9th
Windows or skylights that let in light	78	3.26	1.304	10th
Details reminiscent of nature that make the space interesting and intriguing	78	3.26	1.263	11th
Changes in ambient temperature that make you feel like you are outdoors	78	3.22	1.052	12th
Spaces designated for quiet contemplation	78	3.21	1.166	13th
Changes in light and shadows over time	78	3.21	1.155	14th
Changes in relative humidity that make you feel like you are outdoors	78	3.18	1.041	15th
Views from elevated planes over a space or to the outside	78	3.10	1.202	16th
Use of natural construction materials such as wood or stone	78	3.08	1.102	17th
Water features such as a river, stream, ocean, pond, water wall, aquarium, or fountain	78	3.04	1.167	18th
Sensory experience of nature through sound	78	3.04	1.200	19th
Sensory experience of nature through touch	78	3.03	1.195	20th
Repeating patterns in the décor, such as windows or floor tiles like those encountered in nature	78	3.00	1.117	21st
Spaces that are more private than others protected from behind and overhead	78	2.95	1.043	22nd
Patterns on windows, carpets, wallpapers, or furniture that remind you of something in nature	78	2.95	1.127	23rd
Periodic sightings or noises of elements of nature such as butterflies flying or birds cawing	78	2.91	1.311	24th
Sensory experience of nature through smell	78	2.83	1.294	25th
Colour palettes that remind you of a natural landscape	77	2.83	1.342	26th
Being able to hear or touch the water	78	2.78	1.234	27th
Spaces that generate thrills looking at or walking past them	78	2.76	1.301	28th
Curving walls and pathways that make you want to find out what is beyond	77	2.70	1.171	29th
Images or artworks that depict water bodies	78	2.64	1.319	30th
Glass railings or floor to ceiling windows	78	2.63	1.320	31st
Building forms or hallways with curving edges	78	2.56	1.234	32nd
Sounds or visual stimuli whose source you cannot identify	78	2.24	1.047	33rd
Balconies, bridges, or pathways that appear to be risky at first glance	78	2.12	1.151	34th
Valid N (listwise)	76			

A cross tabulation of variables versus demographic information was conducted to examine the relationship between various aspects of biophilic design in resorts and demographic characteristics of the respondents. Pearson's chi-square statistic was used to assess the associations, and the corresponding p-values were evaluated to determine the statistical significance as presented in table 3 below. A value less than 0.05 shows a statistically significant association between the corresponding variables and demographic information. The significant values are highlighted in bold in the table. The table shows that the resort type has the most significant relationship with the variables. Only three variables were not significantly associated with the resort type. The respondents' gender was found to have a significant relationship with the variable 'changes in ambient temperature that make you feel like you are outdoors'. Age was a significant factor for the variables 'sensory experience of nature through smell' and 'views of nature likely to change over seasons'. Educational qualification influenced respondents' experience of these variables; changes in air flow that make you feel like you are outdoors, multiple sources of light, and patterns on windows, carpets, wallpapers, or furniture that remind you of something in nature. Overall, the results indicate that certain variables of biophilic design in resorts are significantly associated with demographic characteristics, particularly resort type.

TABLE III. CROSS-TAB OF VARIABLES VERSUS DEMOGRAPHIC INFORMATION

Variables/Demographic Information	**G**	**Age**	**EQ**	**Marital Status**	**Resort**	**User type**
Views of the outside	.961	.129	.684	.724	**.001**	.060
Elements of nature such as vegetation in the space	.530	.607	.095	.252	**.001**	**.001**
Images or videos depicting nature	.271	.954	.325	.642	**.014**	**.041**
Sensory experience of nature through sound	.486	.753	.670	.764	**.005**	.134
Sensory experience of nature through smell	.178	**.003**	.694	.225	**.001**	**.001**
Sensory experience of nature through	.769	.530	.662	.722	**.001**	**.006**

touch						
Periodic sightings or noises of elements of nature such as butterflies flying or birds cawing	.802	.929	.175	.650	**.001**	**.006**
Changes in ambient temperature that make you feel like you are outdoors	**.037**	.712	.784	.870	**.032**	.653
Changes in relative humidity that make you feel like you are outdoors	.116	.912	.201	.722	**.002**	.158
Changes in air flow that make you feel like you are outdoors	.078	.688	**.043**	.833	.161	.340
Openable windows or doors apart from the main entry that let in breeze into the space	.959	.779	.414	**.001**	**.025**	**.041**
Water features such as a river, stream, ocean, pond, water wall, aquarium, or fountain	.855	.240	.135	.788	**.001**	.088
Being able to hear or touch the water	.835	.564	.778	.411	.183	.175
Images or artworks that depict water bodies	.633	.122	.813	.738	**.047**	.194
Windows or skylights that let in light	.775	.086	.625	.723	**.001**	.716
Multiple sources of light	.602	.262	**.002**	.232	**.001**	**.001**
Changes in light and shadows over time	.655	.529	.098	.331	**.001**	.380
Views of nature likely to change over seasons	.870	**.001**	.892	.316	**.001**	.243
Building forms or hallways with curving edges	.548	.465	.805	.797	**.001**	**.015**
Patterns on windows, carpets, wallpapers, or furniture that remind you of something in nature	.889	.594	**.006**	.577	.277	.767
Use of natural construction materials such as wood or stone	.847	.473	.976	.267	**.002**	**.036**
Furniture that appears to be made of natural materials	.774	.653	.996	.791	**.006**	**.041**
Colour palettes that remind you of a natural landscape	.474	.053	.376	.295	**.001**	.347
Repeating patterns in the décor, such as windows or floor tiles like those encountered in nature	.704	.387	.510	.907	**.001**	.064
Details reminiscent of nature that make the space interesting and intriguing	.810	.378	.991	.224	**.001**	.360
Clear and unimpeded view of the space	.230	.873	.096	.636	**.001**	**.045**
Views from elevated planes over a space or to the outside	.266	.248	.544	.533	**.002**	.688
Spaces that are more private than others protected from behind and overhead	.552	.666	.377	**.027**	**.022**	.339
Spaces designated for quiet contemplation	.872	.561	.347	.808	**.047**	.914
Curving walls and pathways that make you want to find out what is beyond	.258	.662	.959	.784	**.001**	.253
Sounds or visual stimuli whose source you cannot identify	.612	.230	.148	.614	**.015**	.260
Spaces that generate thrills looking at or walking past them	.519	.255	.579	.197	**.002**	.053
Glass railings or floor to ceiling windows	.787	.413	.269	.550	**.032**	.118
Balconies, bridges, or pathways that appear to be risky at first glance	.180	.199	.825	.473	**.001**	.091

It was of interest to the study to identify the dimension of biophilic design strategies adopted by the resorts. Factor analysis was employed to determine the patterns that were best adopted in the resorts. The results are shown in subsequent tables.

Table 3 presents the results of Kaiser-Meyer-Olkin's (KMO) and Bartlett's test that were conducted on 34 biophilic patterns variables. The KMO test measures the proportion of variance in the variables that could be explained by underlying factors and values greater than 0.6 generally indicate that the data is suitable for factor analysis. The Bartlett's test examines the sphericity of the correlation matrix and small values (less than 0.05) of the significance level indicate that a factor analysis on the data could be useful. The results of the tests showed a KMO value of 0.860, a Bartlett's sphericity (chi square) of 1901.511 and a significance level of $p<0.05$. Overall, the results suggest that the sample size is adequate for modelling factor analysis.

TABLE IV. SAMPLE SUITABILITY AND ADEQUACY OF BIOPHILIC PATTERN DATA

Tests		**Results**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	1901.511
	df	561
	Sig.	.000

Table 4 presents the results of a principal component analysis that was conducted on 34 variables of biophilic patterns. Only 7 principal component factors (PCFs) were extracted, which were the ones that had high correlation and an Eigenvalue greater than 1. The study used rotation sum of matrix squared loading to explain the model and the result of the analysis was a total of 24.125, which explained 70.959% of the variance.

TABLE V. EXTRACTED PRINCIPAL COMPONENTS FACTORS (PCFS) FOR BIOPHILIC PATTERNS

Comp	Initial Eigenvalues			Extraction Squared Loadings		
	Total	% of Var	Cmltv%	Total	% Var	Cmltv %
1	14.214	41.807	41.807	14.214	41.807	41.807
2	2.563	7.537	49.344	2.563	7.537	49.344
3	2.115	6.220	55.564	2.115	6.220	55.564
4	1.589	4.674	60.237	1.589	4.674	60.237
5	1.334	3.922	64.160	1.334	3.922	64.160
6	1.223	3.597	67.757	1.223	3.597	67.757
7	1.089	3.203	70.959	1.089	3.203	70.959
8	.978	2.877	73.836			
9	.953	2.802	76.639			
10	.800	2.353	78.991			
11	.777	2.285	81.277			
12	.677	1.991	83.268			
13	.622	1.830	85.098			
14	.608	1.789	86.887			
15	.482	1.417	88.304			
16	.423	1.245	89.548			
17	.405	1.190	90.739			
18	.393	1.156	91.895			
19	.351	1.033	92.928			
20	.305	.897	93.825			
21	.270	.795	94.620			
22	.245	.720	95.340			
23	.234	.689	96.029			
24	.188	.554	96.583			
25	.183	.538	97.121			
26	.163	.479	97.600			
27	.157	.460	98.061			
28	.139	.408	98.469			
29	.129	.379	98.848			
30	.100	.296	99.143			
31	.097	.287	99.430			
32	.068	.200	99.630			
33	.064	.188	99.818			
34	.062	.182	100.000			
Extraction Method: Principal Component Analysis.						

Comp	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Var	Cmltv %	Total	% of Var	Cmltv %
1	14.214	41.807	41.807	5.890	17.324	17.324
2	2.563	7.537	49.344	3.728	10.964	28.288
3	2.115	6.220	55.564	3.548	10.437	38.725
4	1.589	4.674	60.237	3.287	9.667	48.392
5	1.334	3.922	64.160	3.062	9.007	57.399
6	1.223	3.597	67.757	2.560	7.531	64.930
7	1.089	3.203	70.959	2.050	6.029	70.959
8	.978	2.877	73.836			
9	.953	2.802	76.639			
10	.800	2.353	78.991			
11	.777	2.285	81.277			
12	.677	1.991	83.268			
13	.622	1.830	85.098			
14	.608	1.789	86.887			
15	.482	1.417	88.304			
16	.423	1.245	89.548			
17	.405	1.190	90.739			
18	.393	1.156	91.895			
19	.351	1.033	92.928			
20	.305	.897	93.825			
21	.270	.795	94.620			
22	.245	.720	95.340			
23	.234	.689	96.029			
24	.188	.554	96.583			
25	.183	.538	97.121			
26	.163	.479	97.600			
27	.157	.460	98.061			
28	.139	.408	98.469			
29	.129	.379	98.848			
30	.100	.296	99.143			
31	.097	.287	99.430			
32	.068	.200	99.630			
33	.064	.188	99.818			
34	.062	.182	100.000			

As presented in Table 5, the first factor accounted for 17.324% of the variance in the data and was labelled *Nature Inspired Design*. The second factor accounted for 10.964% of the variance in the data and was labelled *Sensory Connection with Nature* The third and fourth factors accounted for 10.437% and 9.667% respectively and were labelled *Thrilling Nature Vistas* and *Light and Shadows* respectively. The fifth factor was labelled *Privacy and Panoramic Views* and accounted for 9.007% of the variance in the data. Finally, the sixth and seventh factors accounting for 7.531% and 6.029% of the variance in the data respectively were labelled *Indoor/Outdoor Experience with Air and Water* and *Open Views* respective.

TABLE VI. ROTATED COMPONENT MATRIXA FOR BIOPHILIC PATTERNS

Rotated Component Matrix[a]							
Features	Component						
	1	2	3	4	5	6	7
Factor 1: *Nature Inspired Design*							
Use of natural construction materials such as wood or stone	.774						
Patterns on windows, carpets, wallpapers, or furniture that remind you of something in nature	.723						
Repeating patterns in the décor, such as windows or floor tiles like those	.720						

encountered in nature							
Furniture that appears to be made of natural materials	.718						
Details reminiscent of nature that make the space interesting and intriguing	.717						
Colour palettes that remind you of a natural landscape	.707						
Curving walls and pathways that make you want to find out what is beyond	.581						
Building forms or hallways with curving edges	.559						
Images or artworks that depict water bodies	.544						
Factor 2: *Sensory Connection with Nature*							
Sensory experience of nature through smell		.708					
Sensory experience of nature through touch		.648					
Sensory experience of nature through sound		.646					
Elements of nature such as vegetation in the space		.623					
Factor 3: *Thrilling Nature Vistas*							
Sounds or visual stimuli whose source you cannot identify			.693				
Balconies, bridges, or pathways that appear to be risky at first glance			.686				
Periodic sightings or noises of elements of nature such as butterflies flying or birds cawing			.642				
Spaces that generate thrills looking at or walking past them			.619				
Views of nature likely to change over seasons			.581				
Glass railings or floor to ceiling windows			.569				
Factor 4: *Light and Shadows*							
Multiple sources of light				.696			
Changes in light and shadows over time				.695			
Factor 5: *Privacy and Panoramic Views*							
Views from elevated planes over a space or to the outside					.802		
Spaces that are more private than others protected from behind and overhead					.780		
Spaces designated for quiet contemplation					.619		
Factor 6: *Indoor/Outdoor Experience with Air and Water*							
Being able to hear or touch the water						.702	
Changes in air flow that make you feel like you are outdoors						.574	
Changes in relative humidity that make you feel like you are outdoors						.529	
Water features such as a river, stream, ocean, pond, water wall, aquarium, or fountain						.520	
Factor 7: *Open Views*							
Views of the outside							.596
Openable windows or doors apart from the main entry that let in breeze into the space							.596
Clear and unimpeded view of the space							.509

These results imply that these seven variables have been applied in existing resorts namely:

i. Nature Inspired Design
ii. Sensory Connection with Nature
iii. Thrilling Nature Vistas
iv. Light and Shadows
v. Privacy and Panoramic Views
vi. Indoor/Outdoor Experience with Air and Water
vii. Open Views

The first factor includes features such as the use of natural construction materials like wood or stone, patterns, and décor reminiscent of nature, furniture that appears to be made of natural materials, and colour palettes inspired by natural landscapes. The second factor encompasses sensory experiences of nature through smell, touch, and sound, as well as the presence of natural elements such as vegetation within the space.

Factor three involves elements that evoke excitement and intrigue, such as unidentified sounds or visual stimuli, balconies or pathways with perceived risk, periodic sightings or noises of nature, and views that change over seasons. The fourth factor emphasizes the importance of multiple sources of light and changes in light and shadows over time to create a dynamic and engaging environment.

Factor five focuses on views from elevated planes, spaces that offer privacy and protection, and areas designated for

quiet contemplation. focuses on views from elevated planes, spaces that offer privacy and protection, and areas designated for quiet contemplation. Factor six includes features that simulate an indoor/outdoor experience, such as being able to hear or touch water, changes in airflow and relative humidity, and the presence of water features. The seventh factor highlights the importance of unobstructed views of the outside and the inclusion of openable windows or doors to allow for a refreshing breeze. These findings indicate that these seven factors, representing different aspects of biophilic design, have been applied in existing resorts. The findings of this study indicate that biophilic design strategies have been adopted to a significant extent in the selected resorts. However, it is apparent that the implemented strategies may fall short in fully harnessing the potential benefits of biophilic design. Observation reveals that these strategies often manifest as isolated experiences of nature, rather than a comprehensive integration of diverse approaches that would yield the desired effect.

V. Conclusion

The study examined the biophilic design patterns that have been adopted in the selected resorts. A questionnaire was distributed to the users of the resorts to evaluate the level of adoption of biophilic design strategies. The respondents were asked to indicate the extent to which the biophilic design patterns were adopted in the resorts based on 5 Likert-type scale.

The findings of this study indicate that biophilic design strategies have been adopted to a significant extent in the selected resorts. However, it is evident that the strategies implemented may be insufficient in fully harnessing the potential benefits of biophilic design. The analysis of the buildings reveals that the application of biophilic strategies often occurs as isolated experiences of nature, rather than a holistic integration of various approaches that would yield the desired effect. Architects should aim for a cohesive integration of various biophilic design elements and strategies to create a truly immersive and impactful biophilic environment within resorts.

To achieve the full potential of biophilic design, it is crucial to recognize the importance of integrating all the elements and strategies into a cohesive whole. The successful implementation of biophilic design requires a comprehensive and integrated approach that considers the synergy among various components. By considering the interplay of nature-inspired design, sensory connections with nature, thrilling nature vistas, light and shadows, privacy and panoramic views, indoor/outdoor experiences with air and water, and open views, it ensures that all aspects work together synergistically to enhance users' experiences and well-being.

Furthermore, it is highly recommended that biophilic design strategies are integrated into the design process from the very beginning, rather than being treated as an afterthought. Early integration allows for a more thoughtful and cost-effective implementation of biophilic design principles. By incorporating biophilic elements from the outset, architects and designers can optimize the efficiency and effectiveness of these strategies, resulting in long-term cost savings and enhanced user experiences.

The findings of this study indicate that biophilic design strategies have been adopted to a significant extent in the selected resorts. Architects should strive for a more comprehensive integration of biophilic design elements, recognizing the importance of a holistic approach. It is highly recommended that biophilic design strategies are integrated into the design process from the very beginning, rather than being treated as an afterthought.

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