PLANNING MALAYSIA:
Journal of the Malaysian Institute of Planners
VOLUME 22 ISSUE 6 (2024), Page 567 – 577

BIOPHILIC DESIGN ELEMENTS PREFERENCES AMONG GOVERNMENT OFFICERS IN PUTRAJAYA, MALAYSIA

Fadhlizil Fariz Abdul Munir[1], Abdul Razak Sapian[2]*, Nabilah Huda Zulkifli[3], Mazlina Mansor[4], Putri Haryati Ibrahim[5]

[1,2,3]*Department of Architecture,*
Kulliyyah of Architecture and Environmental Design,
UNIVERSITI ISLAM ANTARABANGSA MALAYSIA
[1]*Centre of Studies for Architecture,*
Department of Built Environment Studies and Technology,
College of Built Environment,
UNIVERSITI TEKNOLOGI MARA
[4,5]*Department of Landscape Architecture,*
Kulliyyah of Architecture and Environmental Design,
UNIVERSITI ISLAM ANTARABANGSA MALAYSIA

Abstract

The theory of human dependence on other living things and their processes is called the “biophilia hypothesis”, and has been discussed in various literature. The theory was then translated into design features, namely "biophilic design", to be assimilated with the built environment, including residential areas, the medical sector and commercial property such as office buildings. Through the implementation of biophilic design in office buildings, the building occupants can improve their physiological and psychological well-being as they spend a lot of time at work. The study examines the selected government office buildings in Putrajaya to identify the preferred biophilic design elements among government office workers that can be used to reduce their stress, and thus improve their productivity. Based on the questionnaire survey that was answered by 977 respondents from different types of work schemes, different working space environments, and different employment periods among the government office workers in Putrajaya, the findings have revealed that natural ventilation, external view to nature, and daylighting are the most preferred biophilic design elements that can help them feel less stressed in the office working spaces; these are followed by attraction and beauty, prospect and refuge.

Keywords: Biophilia, Biophilic Design Elements, Government Office Malaysia, Public Service Malaysia

[2] Corresponding Author: arazaks@iium.edu.my

INTRODUCTION

The need to connect with nature has always been part of the human conscience. Humans are wired to be interconnected with nature or another form of life, and this ideology was noted by Roger Ulrich in 1973 and later expanded by Edward Osborn Wilson in 1984 through the concept of the Biophilia Hypothesis. The absence of contact with nature can have negative effects on the psychological and physiological aspects of human life. The transition into the modern world and urbanisation have severed the ties between humans and nature. In order to reduce the impact of urbanisation, the integration between nature and humans needs to be celebrated and encouraged. Most people spend most of their time indoors and at work. The ability of workers to perform their work depends on the design of the work environment (Hedge, 2017). Work is a necessity as a source of livelihood, which may impact the physical and mental health based on the environment of individuals at the workplace.

LITERATURE REVIEW

Biophilic Design

Aduwo and Akinwole (2020) summarised biophilic design as an approach in space designs where natural elements are incorporated into it to create a holistic connection between humans and nature. Biophilic design has been introduced into the built environment as one of the approaches to connect people with nature while reducing the impact of urbanisation. Notably, three most vastly referred biophilic design characterisations have been structured by Stephen Robert Kellert (2008) in his work "Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life", followed by Browning et al. (2014) with "15 Patterns of Biophilic Design: Improving Health and Well-being in the Built Environment", and Kellert and Calabrese in 2015 with "The Practice of Biophilic Design".

Kellert (2008) listed 72 biophilic design attributes that can be applied and implemented into design processes, which are categorised into six main elements, namely, (1) environmental features, or materials that are available all around, (2) natural shapes and forms, that may be related to the natural forms and characters, (3) natural patterns and processes, or description of spaces, (4) light and space which is related to lighting and space conditions, (5) place-based relationships, or the human connections and interaction to the place, and lastly (6) evolved human-natural relationships which can be described as the reaction and sensorial aspects of the place towards the occupants.

Table 1: Biophilic Design Elements cited from Kellert (2008)

Biophilic Design Elements	**Biophilic Design Attributes**
Environmental Features	Colour, Water, Air, Sunlight, Plants, Animals, Natural Materials, Views and Vistas, Facade Greening, Geology and Landscape, Habitats and Ecosystems, Fire
Natural Shapes and Forms	Botanical Motifs, Tree and Columnar Supports, Animal (mainly vertebrate) motifs, shells and spirals, egg, oval and tubular forms, arches, vaults, and domes, shapes resisting straight lines and right angle, simulation of natural features, biomorphy, geomorphology and biomimicry
Natural Patterns and Processes	Sensory variability, information richness, age, change and the patina of time, growth and efflorescence, central focal point, patterned wholes, bounded spaces, transitional spaces, lined series and chains, integration of parts to wholes, complementary contrasts, dynamic balance and tension, fractals, hierarchically organised ratios and scales.
Light and Space	Natural Light, Filtered and Diffused Light, Light and Shadow, Reflected Light, Light Pools, Warm Light, Light as Shape and Form, Spaciousness, Spatial Variability, Space as shape and form, Spatial Harmony, Inside-Outside Space.
Place-Based Relationships	Geographic Connection to Place, Historic Connection to Place, Cultural Connection to Place, Indigenous Materials, Landscape Orientation, Landscape Features that Define Building, Landscape Ecology, Integration of Culture and Ecology, Spirit of Place, Avoiding Placelessness
Evolved Human-Nature Relationships	Prospect and Refuge, Order and Complexity, Curiosity and Enticement, Change and Metamorphosis, Security and Protection, Mastery and Control, Affection and Attachment, Attraction and Beauty, Exploration and Discovery, Information and Cognition, Fear and Awe, Reverence and Spirituality.

The extension of the study in biophilic design was continued by William Browning, Catherine Ryan and Joseph Clancy in 2014 where the Patterns of Biophilic Design are elaborated into three categories which are the Nature in the Space Patterns, Natural Analogues Patterns and Nature of the Space. The patterns are mostly annotated as the condition of the space whether it can be tangible or intangible features.

Table 2: The Biophilic Design Pattern cited from Terrapin Bright Green (2014)

Pattern	Attributes
Nature in the Space	Visual Connection with Nature, Non-Visual Connection with Nature, Non-Rhythmic Sensory Stimuli, Thermal and Airflow Variability, Presence of Water, Dynamic and Diffuse Light, Connection with Natural System
Natural Analogues	Biomorphic Forms and Patterns. Complexity and Order
Nature of the Space	Prospect, Refuge, Mystery, Peril

Integrating the natural environment and its processes is not definite and is still evolving from time to time, as humans are highly dependent on natural elements and vice versa for survival. In providing a sustainable and long-term engagement with nature through its implementation in the built environment, another framework of biophilic design was developed by Kellert and Calabrese in 2015. The principles have been divided into three categories, namely, the Direct Experience of Nature, Indirect Experience of Nature, and Experience of Space and Place, ensuring a more concise understanding towards the elements and effective practice.

Table 3: Biophilic Design Categories cited from Kellert et al. (2015) **

Categories	Attributes
Direct Experience of Nature	Light, Air, Water, Plants, Animals, Weather, Natural Landscapes and Ecosystem, Fire
Indirect Experience of Nature	Images of Nature, Natural Materials, Natural Colors, Simulating natural light and air, Naturalistic shapes and forms, Evoking Nature, Information Richness, Age, Change and the Patina of Time, Natural Geometries, Biomimicry
Experience Space and Place	Prospect and refuge, Organised Complexity, Integration of Parts to Wholes, Transitional Spaces, Mobility and Wayfinding, Cultural and Ecological Attachment to Place

The comprehensive biophilic design subjects that are presented in the above studies show the importance of integrating nature into normal activities and lifestyles. The wide range of studies, using a variety of methods, have attempted to produce a conducive environment for people, or in the study's context, for the working class. Nabilah et al. (2023) proposed a conceptual framework for Indoor Biophilic Design Elements for the Working Environment; analysed from the three most referred biophilic design literature, the elements are divided into six categories: Natural Elements, Natural System, Nature Experience, Natural Connectedness, Sensorial and Comfort, and Nature Infrastructure. These categories are essential and comprehensive in ensuring a

conducive working environment for office occupants to reduce their stress and improve productivity. Although some of the elements can be deemed quantified, the preferences of each element can be assessed through the preference survey, including the visual aspects, comfort, perceptions and how they perceive each element. The characterisations of biophilic designs depend on the approach and the occupants' experiences of the space.

Working Environment and Biophilic Design

The global urban population has placed new demands for sustainability, resilience and quality of life as most people spend most of their time working and being indoors. One of the approaches to reducing the impact of urbanisation is through the implementation of natural settings and their related aspects into the lifestyle and the current urban norms. The workspace and the level of stress in the office depend on the office environment. Physical office plays an important factor in motivating workers to perform well at work (Hamidi et al., 2020; Suwati & Gagah, 2016; Hogan et al., 2013; Samson et al., 2015; Kamarulzaman et al., 2011). As biophilic design can be perceived as a method or an approach to reduce the gap between humans and nature, and by extension, mitigating the alarming mental health and physical well-being of office occupants, it is vital to consider the perceptions and the preferences of the users in order to improve their working environment. The preferences of biophilic design elements can be interpreted in an aesthetic manner, and their functionality is inclusive and holistic, encompassing comfort. Working long hours in the office can take its toll on the occupants, resulting in poor performance and a lack of motivation as an outcome of a stressful working environment.

RESEARCH METHODOLOGY

The site is mainly comprised of office buildings in Putrajaya. The selection is made due to its administrative importance to the nation, which could act as a benchmark for future studies in relation to office design. The site stretches from Presint 1 to Presint 7, spanning over 2.75 million square meters, accommodating 51400 workers. In parallel with the agenda to strive for Garden City to Green City in 2025, Putrajaya's emphasis on the 'co-existence with nature', 'green', sustainable and environmental-friendly city, which correlate to the objective of biophilic design theories to strengthen the interrelationships between man and nature. The government sectors in Putrajaya comprise a multitude of professions and occupations, ranging from support groups to the top management and professional groups, which fit the needs to identify and allocate the type and characteristics of office workers in order to determine and utilise the significant biophilic design elements in the workspace.

The study attempts to identify the preferred biophilic design elements in the workforce of the administrative district in Putrajaya and, respectively, to

propose a way to reduce stress levels and improve productivity in the workplace. The study also aimed to identify the relationships between office types and the level of working schemes to formulate an optimal biophilic design framework for the working environment. To achieve these objectives, the questionnaire, which consists of biophilic design elements, has been outlined and distributed among office occupants in Putrajaya. The number of respondents who participated in this survey is 977, consisting of employees in different work schemes, which are the top management group, managerial and professional group and support group. The mean for each element is identified using the statistical analysis program SPSS Statistics 25 to obtain which biophilic design elements can help reduce stress and improve the productivity of the office occupants.

ANALYSIS AND DISCUSSION

977 office workers from various departments in Putrajaya participated in a questionnaire survey. All questionnaires were answered through the distribution of Google Forms, and later, the responses were tabulated in Microsoft Excel. A total of 4 sections of questions are presented, which comprise the Demographic Profile followed by Occupation Information, which is necessary to profile the type of respondents, their nature of work, and also their current working conditions in the office, whether it is stressful or not. The next section comprises the Biophilic Design Experience to identify the understanding and awareness of the office occupants, followed by the last section, the Biophilic Design Preferences, to determine the preferred Biophilic design elements focusing on reducing their stress and improving their productivity at work.

Current Workplace Environment

The following results were identified to assess the experience of stress in the workplace and to investigate whether improving office design and environment is necessary to enhance the office occupants' health, physical and mental well-being. This could contribute to reducing stress and improving work performance.

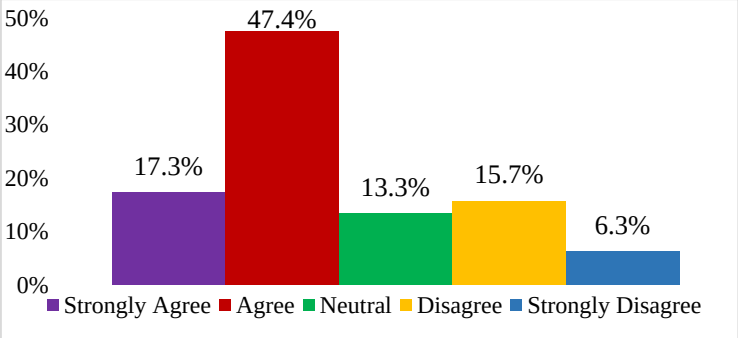

Figure 1: Experience of Stress in the Workplace

Based on the above results, 47.4% of the respondents (N: 463) experienced feeling stressed at their workplace, in which the absence or the lack of biophilic design elements in the working spaces might be a contributing factor. The factors of the long commute to work, service scheme, and line of work could be contributing factors to this result. Most of the respondents might have other types of stressors apart from work. However, the present or the current condition of their surroundings might not be effective and conducive to reducing the level of stress. The dull and non-stimulating office environment as well as limited visual and thermal comfort are some of the factors that need to be discarded in order to improve the mood and provide a sense of a spirit of place for the office occupants.

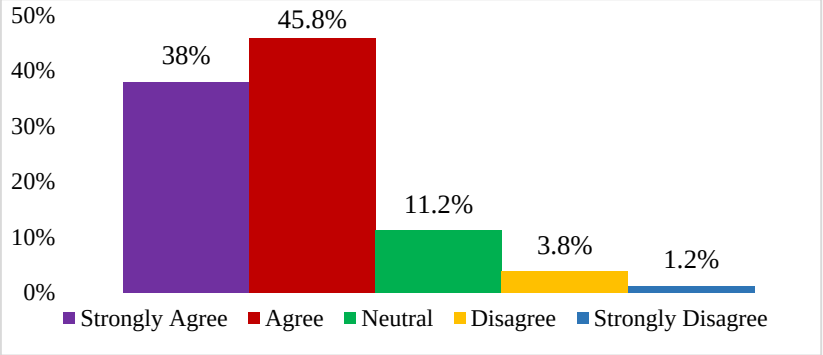

Figure 2: Improvement of Office Design

Figure 2 shows that 447 out of 977 respondents (45.8%) agree that the indoor office environment can be improved in order to reduce the stress at work thus improving the productivity of the office occupants. The higher-ups play a salient part in ensuring that the welfare of the workers is well taken care of by providing a conducive workspace through the implementation of biophilic design.

Preferences On Biophilic Design Elements in Indoor Work Settings

Table 4: Preferences on Biophilic Design Elements among Government Employees in Offices in Putrajaya

Elements	Mean	Std. Deviation
Natural Ventilation	**8.35**	1.750
External View of Nature	**8.335**	1.680
Daylighting	**8.32**	1.706
Attraction and Beauty	**8.115**	1.825
Chromotherapy	**8.1**	1.810
Prospect and Refuge	8.055	1.782
Water	8.045	1.930
Space Harmony	8	1.843
Curiosity and Enticement	7.915	1.822
Spaciousness	7.84	1.863
Utilising Vision (Sight) to Experience Nature	7.825	1.881
Indoor Plants	7.805	1.888
Outdoor Plants	7.805	1.927
Natural materials	7.775	1.924
Interplay of Natural Light	7.75	1.956
Spatial Variety	7.755	1.901
Geographical Connection to Place	7.625	1.863
Ecological and Cultural Connection to Place	7.615	1.884
Utilising Olfactory (Smell) to Experience Nature	7.59	1.915
Utilising Auditory (Hear) to Experience Nature	7.58	1.905
Form Harmony	7.545	1.990
Adaptation of Nature Color	7.53	1.970
Utilising Tactile (Touch) to Experience Nature	7.48	1.928
Area of Emphasis	7.395	2.149
Meteorology	7.325	2.125
Actual Nature Motifs and Patterns	7.26	2.011
Artificial Generated Natural Features (wind, lights)	7.22	2.048
Fractal Geometry	7.155	2.021
Imitations of Nature Motifs and Patterns	6.93	2.070
Organic and Fluid Forms	6.74	2.133
Integration of Parts to Whole	6.985	2.077
Organised Complexity	6.965	2.099
Transitional Space	6.965	2.107
Therapy Animals	5.34	2.787

The preferred biophilic design elements are scored based on a 10-point Likert Scale and compared using their means. Natural ventilation has been chosen by the respondents as the most important feature that can help reduce their stress, thus, improving their productivity in the workplace (8.35), this is followed by an external view to nature (8.335), daylighting (8.32), attraction and beauty (8.115), and chromotherapy (8.055), respectively. It can be deduced that natural ventilation is the most preferred element by the office occupants in order to work optimally in the office. Various literature has supported this result as it can enhance thermal comfort and improve concentration at work. Most of the respondents spend the majority of their time in the office. The lack of physical movement, combined with a constant ventilation rate impacted their performance at work.

The presence of daylight in the office has proven that it can boost moods and provide a comfortable ambience for the office occupants. The availability of a view towards nature also plays a part in reducing the stress of workers in a confined area. There is a myriad of literature that emphasises the needs of nature, such as plants, water and landscapes, to reduce strain while working. The presence of natural elements in indoor work settings is crucial to enhancing productivity. Apart from natural elements, the cognitive aspects have been chosen by the respondents as important, such as attraction and beauty, and chromotherapy, which is therapy using colours. These elements could be implemented in the employees' immediate working spaces, as they encourage the workers to be productive in their own workspaces, provide a sense of calmness, and reduce interference from other colleagues, hence, improving the employees' focus.

Based on Table 4, the least preferred elements for office employees in their working space are the Organic and Fluid Forms (6.74). This might be due to the unfamiliarity of the subject itself, as the employee prefers elements that are derived from natural materials compared to indirect natural applications, despite their availability to provide a sense of natural workspaces. Furthermore, consideration of office spaces in general is also not preferred, which are the Integration of Parts to Whole (6.985), Organised Complexity (6.965), and Transitional Space (6.965). These elements require less attention as compared to the immediate working area of the employees. Therapy animals, for example cats or birds, are the least preferred element in working spaces (5.34), probably due to the attention they require to manage them, which might hinder the employees from performing well at work.

CONCLUSION

It can be summarized that office employees prefer natural elements in their working environment compared to artificial elements that are derived from natural environments. Attraction and beauty of the working spaces may enhance

employees' productivity, including the use of colours to create a visually soothing environment. These elements can be implemented into their working spaces to improve their work productivity while reducing stress at work.

Biophilic designs can be annotated as a bridge to connect the built environment and the people. Biophilia is not limited to a specific condition or environment but can be applied to a variety of human aspects and livelihoods, such as physical interactions, the place or the habitat and even the perceptions of the individual. For the indoor working environment, biophilic design can serve as a means to reduce stress, bring comfort to the office occupants, and improve the physiological, mental and social manners that can contribute to a healthier and happier community.

ACKNOWLEDGEMENT

The authors acknowledge the Ministry of Higher Education (MOHE) for funding this research under the Fundamental Research Grant Scheme (FRGS) with reference code FRGS/1/2021/SSI02/UIAM/01/1. In addition, the authors would like to thank the Ministry of Science, Technology, and Innovation (MOSTI), the Palace of Justice, Perbadanan Putrajaya, the Ministry of Agriculture and Food Security (KPKM), the Ministry of Tourism, Arts, and Culture (MOTAC), Ministry of Natural Resources and Environmental Sustainability (NRES), Public Service Department Malaysia (JPA), Ministry of Education (MoE), Civil Aviation Authority of Malaysia (CAAM), and other government ministries and agencies for allowing the research to be conducted on their property.

REFERENCES

Aduwo E.B., Akinwole O.O. (2020) Assessing the Implementation of Biophilic Design Strategies in Selected office Buildings in Lagos State, Nigeria. *International Journal of Engineering and Advanced Technology (IJEAT)* Volume-9 Issue-5, June 2020 ISSN: 2249 – 8958 (Online)

Hedge A. (2017) Ergonomic Workplace Design for Health, Wellness, and Productivity. ISBN 9781466598430. CRC Press.

Kellert S. R. (2008) Dimensions, Elements, and Attributes of Biophilic Design. Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life. John Wiley and Sons, Inc.

Browning, W.D., Ryan, C.O., Clancy, J.O. (2014). 14 Patterns of Biophilic Design. New York: Terrapin Bright Green llc.

Kellert S. R., Calabrese E. F. (2015) The Practice of Biophilic Design. www.biophilic-design.com

Hamidi, Nur Najihah Erani and Mansor, Farah Ahlami and Hashim, Mimi Zazira and Muhammad, Norrini and Wan Azib, Wan Nor Hazimah (2020) The Relationship between Physical Workplace Environment and Employees' Performance / Nur Najihah Erani Hamidi ...[et al.]. *Journal of Contemporary Social Science Research, 4* (1). pp. 56-67. ISSN 0128-2697

Nabilah H. Z., Sapian A. R., Putri H. I (2023) Conceptual Framework of Biophilic Design

Elements (BDE) for Indoor Work Settings. *Jurnal Kejuruteraan SI 6*(1) 2023: 123-137 https://doi.org/10.17576/jkukm-2023-si6(1)-12

Suwati, Magdalena, M., Gagah, E. (2016). Influence of motivation work, career development and cultural organization on the job satisfaction and implications on the performance of employees. *Journal of Management, 2*(2).

Hogan N.L., Lambert E.G., Griffin M.L. (2013). Loyalty, love and investments: The impact of job outcomes on the organizational commitment of correctional staff. *Criminal Justice & Behavior*. 355-375.

Samson, G. N., Waiganjo, M. and Koima, J. (2015). Effect of workplace environment on the performance of commercial banks employees in nakuru town. *International Journal of Managerial Studies and Research*, Vol 3, pp. 76-89.

Kamarulzaman N., Saleh, S. Z. Hashim, H. Hashim, A. A. Abdul-Ghani (2011) An Overview of the Influence of Physical OfficeEnvironments towards Employees Procedia Engineering The 2nd International Building Control Conference 2011 10 (2011) 262-268

Perbadanan Putrajaya (2019) Putrajaya Smart City Blueprint www.ppj.gov.my

TheSmartCityJournal (n.d) Green, Smart and Connected Putrajaya. Retrieved from https://www.thesmartcityjournal.com/en/cities/green-smart-and-connected-putrajaya

Received: 6th July 2024. Accepted: 5th September 2024