

Analysis of Biophilic Design in Communal Space of an Office Building. Case Study: Pertubuhan Arkitek Malaysia (PAM) Centre

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Abstract. Biophilic design is an innovative way of designing a space to bring about sense of connection to nature through various mean of approaches. Today, there are various studies and researches done with proven empirical evidences to examine the benefits and impacts of biophilic design to our health and well-being. With growing interest in biophilic design, increase in its usage can be seen implemented abundantly in spaces and buildings nowadays. Aim of this study is to examine various biophilic design that can be used in communal spaces of office building based on existing researches from other countries and to observe how biophilic design elements and attributes are implemented and adapted to address the climatic context of the selected case study in Malaysia and occupant's perception on its effects towards them with possible identification of preferred biophilic design in the tropical climate context. The study will focus on selected case study of office building, which is Pertubuhan Arkitek Malaysia (PAM) Centre at Bangsar, Kuala Lumpur. The findings show that visual connection with nature attribute in biophilic design of a space is the one most agreed to provide the best outcome towards the occupants through its implementation in a space, based on survey study conducted.

INTRODUCTION

Biophilia is described as innate tendency to focus on life and lifelike processes [1]. It is being said to be a natural desire for human to connect to nature and in a way, help us to feel better emotionally and psychologically. Biophilic design, an extension of biophilia defined as incorporation of natural materials, natural light, vegetation, nature views and other experiences of the natural world into the modern built environment as biophilic design advocated by and involves a process that offers a sustainable design strategy that incorporates reconnecting people with the natural environment [2,3]. Biophilic design has been closely relate to induce sense of connection towards nature and proved to be able to reduce stress, improve cognitive function and creativity, improve our well-being and expedite healing [4]. The use of biophilic design through introduction of plants in the office significantly helps in enhancing occupants work performance and well-being such as improvement of their morale, cooperation, mentoring and mitigation against stress [5].

Biophilic Design Elements And Attributes

There are several interpretations of biophilic design attributes that can be used and implemented in architecture, spaces, and buildings. The purpose of defining these elements and attributes of biophilic design is to make connection

towards the human well-being and health, aiming to ease architects and developers to design with better understanding of suitable selection of the biophilic design to be implemented, that best suit the specific type and purpose of the space and building. Based on author's literature reviews and study on biophilic design, there are several acknowledged version of this interpretation identified [2,4,6,7]. In this study, few aspects of the studied literature were taken to be used as parameter but the main literature to be used is the literature by [4] due to its clear explanation and listed with detail specification which refined from the previous publications of elements and attributes by Kellert. The fourteen biophilic design patterns or elements and attributes which were specified in this publication will be used extensively throughout this study because of its detail specification and linkage on biological responses and straightforwardness in the elements and attributes which will further simplify and help in constructing analysis on the selected case study and perception study.

Biophilic Design Parameters

The biophilic design elements and attributes to be used as parameter can be categorized into 3 elements accordingly as tabulated in the Fig. 1 below. **Nature in the Space** is the first element which addresses the direct, physical, and ephemeral presence of nature in a space or place. This includes plant life, water and animals, as well as breezes, sounds, scents and other natural elements. The strongest Nature in the Space experiences are achieved through the creation of meaningful, direct connections with these natural elements, particularly through diversity, movement and multi—sensory interactions. **Natural Analogues** addresses organic, non-living and indirect evocations of nature. Objects, materials, colors, shapes, sequences and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the but environment. Mimicry of shells and leaves, furniture with organic shapes and natural materials that have been processed or extensively altered, each provide an indirect connection with nature: while they are real, they are only analogous of the items in their 'natural state. **Nature of the Space** addresses spatial configurations in nature. This includes our innate and learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and revelatory moments; and sometimes even phobia-inducing properties when they include a trusted element of safety. The strongest Nature of the Space experiences are achieved through the creation of deliberate and engaging spatial configurations commingled with patterns of Nature in the Space and Natural Analogues.

Element	Attribute	Explanation
Nature in the Space	1. Visual Connection with Nature	A view to elements of nature, living systems and natural processes through visual perception.
	2. Non - Visual Connection with Nature	Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.
	3. Non - Rhythmic Sensory Stimuli	Stochastic and ephemeral connections with nature that may be analysed statistically but may not be predicted precisely.
	4. Thermal and Airflow Variability	Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
	5. Presence of Water	A condition that enhances the experience of a place through seeing, hearing or touching water.
	6. Dynamic and Diffuse Light	Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
	7. Connection with Natural Systems	Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.
Natural Analogues	8. Biomorphic forms and patterns	Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
	9. Material connection with Nature	Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.
	10. Complexity and Order	Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.
Nature of the Space	11. Prospect	An unimpeded view over a distance, for surveillance and planning.
	12. Refuge	A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.
	13. Mystery	The promise of more information achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
	14. Risk / Peril	An identifiable threat coupled with a reliable safeguard.

FIGURE 1. Biophilic Design Element and Attributes with brief explanation used as study parameter [4].

METHODOLOGY

This study focuses on analysis of several biophilic design found in communal space of office building in Malaysia and its benefit to the occupant's perception in promoting well-being and working experience. As stated earlier, Pertubuhan Akitek Malaysia (PAM) Centre at Bangsar, Kuala Lumpur was selected as the case study because of its known approach to incorporate nature and biophilic design in the building. Firstly, observation and analysis of the communal spaces in the selected building will be conducted. However, in a biophilic design study, it is known to pose a challenge in term of measuring its efficiency and impact to the human well-being. Therefore, questionnaire-based survey was done to the occupants and through this evaluation of perception of occupants in the space with biophilic design, it serves an easier way for understanding of its benefit and impact to the human well-being. Fig. 2 below shows the overall methodology flowchart of the study.

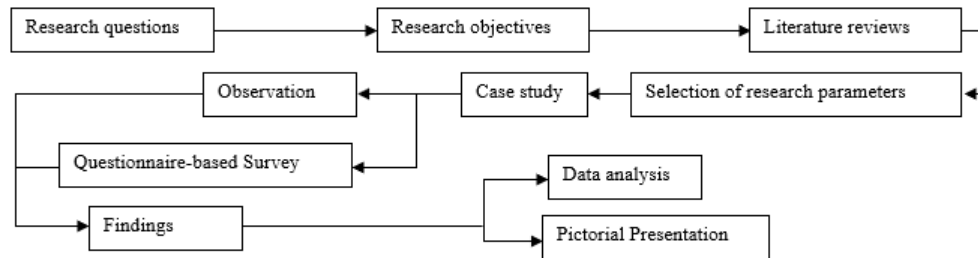


FIGURE 2. Methodology flowchart.

RESULTS AND DISCUSSIONS

Biophilic Design Analysis

The main design feature where biophilic designs can be seen are mainly from its communal spaces, the stepped atrium or pocket open space lounge which designed to follow the flow of the building's straight-flight steel stairs which provides opening to selected floors with introduction of planted trees and creepers. This diagonal stack gives that dramatic sense and unifying the entire building through a central connecting space which allows people to have visual connection to the floors below. The pocket space serves as the main communal space for the building acting as lounge for various different rooms such as the training room, halls and offices which equipped with seating and furniture for any gathering or meeting up in the spaces. The pocket spaces are designed as a multi-volume space with openings and enclosure of louvered windows which paired with trees and creepers to allow smooth breeze and airflow to the space. The space possesses various biophilic design attributes which obtained through the architectural design of the space which utilize the use of nature in the space, natural analogues and nature of the space.

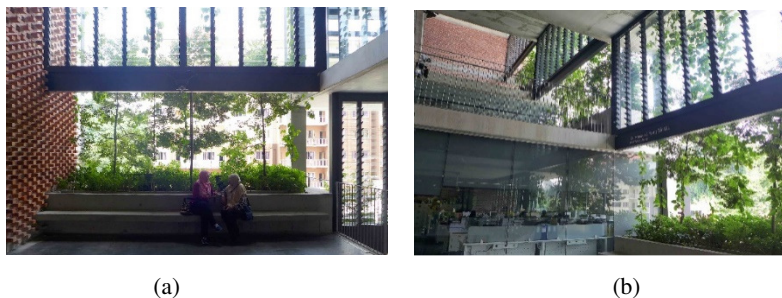
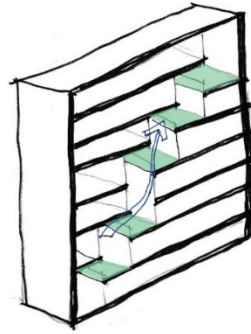


FIGURE 2. (a) Communal space in the building and (b) the diagonal open stacked design of the communal space



PAM Centre cross section illustration of stepped atrium showing continuous flow of communal space area interior opening

FIGURE 3. Illustration of PAM Centre stepped atrium layout of the communal spaces.

In PAM Centre, the design of the pocket spaces with opening and louvered closure which paired with a breathable skin of the screen that covers the front façade allows the wind flow and cross ventilation through the space. The stepped atrium design of the communal space further helped to create a continuous movement of airflow from the lower level of the floor to the topmost floor creating a seamless air movement to further helped cross ventilation to the communal spaces. The stepped atrium not only provides positive circulation of the air in the building but also provides visual permeability into the communal space and aesthetical view bringing visual pleasure towards the occupants in the communal space.

The pocket spaces of the communal spaces are designed as a multi-volume space with openings and enclosure of louvered windows which paired with trees and creepers to allow smooth breeze and airflow to the space. The space possesses various biophilic design attributes which obtained through the architectural design of the space which utilizes biophilic designs as can be seen in Fig. 4 below which described by the researchers' observation and experience throughout conducting the study in the site.

Attribute	Analysis of biophilic design attributes found in the communal spaces
1. Visual Connection with Nature	Obtained through the use of trees and creeper plants in the pocket spaces providing direct contact of visual and connection with nature. Can also be seen in the rooftop sky terrace where trees are also abundantly planted within the integrated concrete planter box and seating. Providing calming effect and ability to reduce stress, improve overall happiness, concentration, and comfort.
4. Thermal and Airflow Variability	Obtained in the pocket open spaces and indoor areas that is generally well ventilated with cross ventilation strategy with occasional natural breeze and wind flow to be experienced. The design of the pocket spaces with multi-volume space with opening and louvered closure which paired with a breathable skin of the screen that covers the front façade allowing the wind flow and cross ventilation through the space.
6. Dynamic and Diffuse Light	Obtained through the lush green covering of trees and creeper plants in pocket space provides comforting ambient diffuse daylight into the space. Providing soothing sensation and ability to reduce stress, improve overall happiness, concentration, and comfort.
10. Complexity and Order	Obtained through the use of use of red brick in several pocket open space floor which arranged to form fractal geometries and pattern provides visually nourishing view in the space. Provide intriguing factor which balance between boring and overwhelming which can help to improve concentration and creativity.
11. Prospect	Obtained through the open floor plans with multi-level height ceiling in the pocket open space that connects the stacked atrium which give visual connection to the diagonal opening layout. Providing feel of openness and freeing with ability to reduce stress, improve overall happiness, concentration, and comfort.

FIGURE 4. Analysis of biophilic design attributes found in the communal spaces based on researchers' observation with possible outcome by presence of the attributes which referenced based on literature analysis [4].

Perception of Occupants Towards Biophilic Design in The Communal Space

As mentioned earlier, this research will also study perception of occupants of the building to understand better on the effects of this biophilic design implementation in the space based on their experience working there. Therefore, questionnaire-based survey was conducted to obtain this data which were given to 40 people who works in the building. The questions in the survey given revolves around how biophilic design in the communal space makes them feel, its impact towards working experience and importance of the various different biophilic attributes found in the communal space of the case study in their perception. Fig. 5 shows demographic of the 40 respondents.

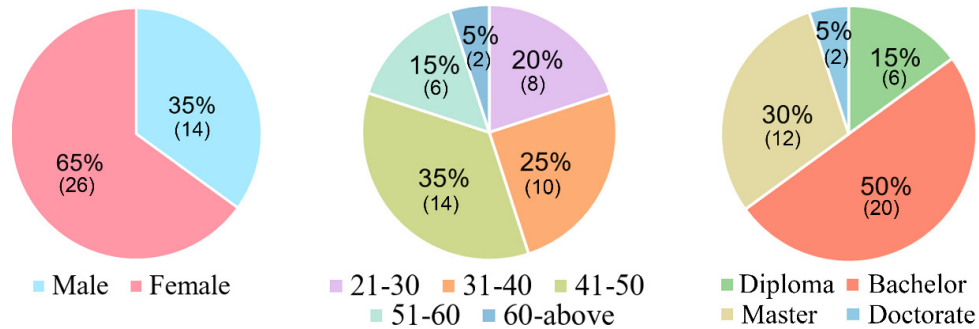


FIGURE 5. Shows respondents gender, age and education demographics.

Based on the literature review, Browning et al., [9] specified that there is a significant impact in working performance and experience by having biophilic design in the workplace. However, does communal space in the office building also provides the same positive impact and help to increase work experience? Through responses by the occupants on this question, it will help to see whether biophilic design in communal space also brings positive impact to the occupant's work experience in general.

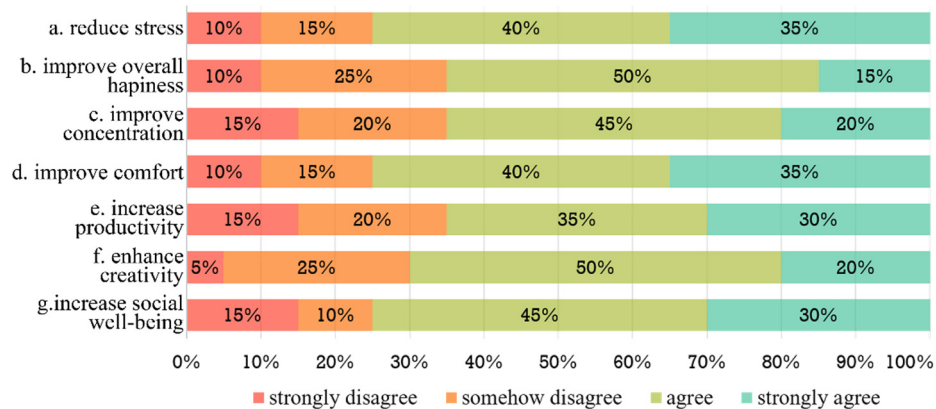


FIGURE 6. Benefits of Biophilic Design in Communal Spaces that Helped to Increase Work Experience

According to the Fig. 6 above, it was shown that majority of the participants strongly agree and agree on the various benefits of biophilic design which obtained from parameters from the literature review. Benefits that possess the most agree and strongly agree responses are through reduction in stress (a) and improvement of comfort level (d). According to Lottrup et al., [10], it is really important for a workplace to maximize their view of natural elements from workplace windows and physical access to green outdoor environments for employees in order to reduce stress levels amongst employees and to stimulate a positive attitude toward the workplace. The result of the perception on the benefits of biophilic design reflects the parameters expected from the literature and further justify the positive benefits of biophilic design in communal space. In context of the office building and workplace, the biophilic design in communal space does provide beneficial outcome towards working experience to the occupants.

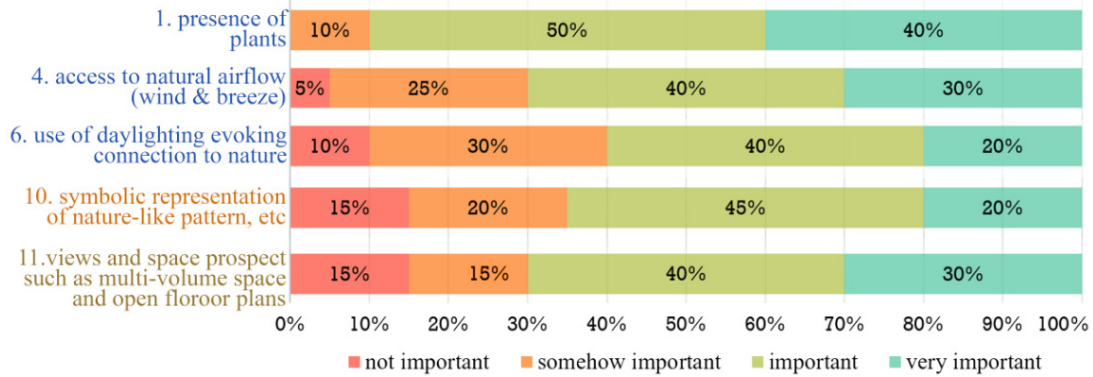


FIGURE 7. Importance of the following Biophilic Design in Communal Spaces that Helped to Increase Work Experience.

As shown in the Fig. 3 above, all of the case study participants responded to prefer having presence of plants which underline the first biophilic design attribute which is having a visual connection with nature. The visual connection with nature were already expected to be one of the main preference due to the fact that it gives direct and closest connection towards nature which backed by various researches to support the huge benefit that it possesses. With the next preference to be the access to thermal and airflow variability which is the fourth attribute which closely followed by eleventh attribute, prospect. Then, tenth attribute which is complexity and order with the last one the sixth attribute which is dynamic and diffuse light. Therefore, from response of the occupants as respondent of the survey, it can be said that the occupants agreed that biophilic design found in the communal space of the building is important with different attributes provide different impact towards their experience working in the building.

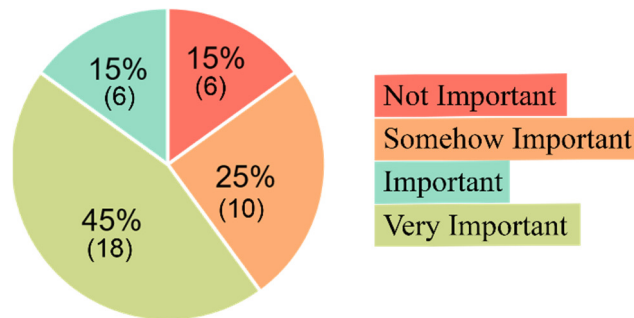


FIGURE 8. Importance of Incorporation of Biophilic Design in Communal Space of Office Building.

Based on the previous responses and data from participated occupants of the case study, it can be expected that majority of the occupants agreed that biophilic design in communal space plays an important role for them for their working experience in the office building. According to Fig 8, participants in majority agreed that biophilic design is an important aspect in communal space of an office building.

Through this study, it can be seen that biophilic design elements and attributes provide varying different positive impact towards human health and well-being which analyzed through the site visit and perception study of the buildings' occupants. In addition, through the outcome of the perception study, it can be concluded that implementation of biophilic design in communal spaces in office building brings about considerable impact towards occupants, enhancing their working experience which can be benefited in various different biological responses and ways. Based on studies conducted by Ryan et al. [11] it is stated that biophilia in design helps in improving the overall health of the occupants and works positively for their levels of satisfaction, quality of performance and productivity. Besides, based on the survey analysis, majority of the occupants agreed that biophilic design is an important aspect that can help to increase working experience in an office building through alleviating them from stress, improving overall happiness, concentration, comfort, productivity and creativity. As it has been analyzed from the survey, several biophilic design can be seen to be more preferred and were perceived as more beneficial design strategy in promoting good environment for communal space of office building. As expected, the visual connection with nature is the one

most preferred. However, the access to thermal and airflow and prospect attributes were preferred by the occupants of the case study building most probably because of the context of Malaysia as a tropical climate region that brings bigger importance of those attributes in a space that connect people with sense of natural environment by having natural breeze flowing through the space and huge volume to further help the ventilation process. These attributes and feature were observed to be dominant in Malaysia's context most probably because of the fact that it enhances the natural occurrence of the Malaysia's climate and alleviating the climatic issues regarding the comfort factor in a space and building.

CONCLUSIONS

This study utilized an exploratory approach in analyzing various aspects of biophilic design in context of communal space of office building in Malaysia. In order to achieve the objectives, analysis of biophilic design attributes were done through site visit of selected case study by observation and experiencing the spaces in accordance to the established biophilic design parameters and also through survey of perception of the occupants of the case study building. In conclusion, based on the overall findings and results from this study, biophilic design was found to be beneficial towards well-being of occupants of the space. Hence, local designers should be encouraged to look at biophilic design as one of important aspect in design process especially in office building development as it brings positive impact towards work experience of the occupant in the building. As discussed in the summary of findings, preferred biophilic design attributes need to be more focused in the design process with visual connection with nature as the topmost priority with next important consideration is the climatic context which provides biophilic design benefit and also addressing the climatic issues and potentiality which are prospect and access to thermal and airflow variability. This approach can be used through adaptation of the building orientation, openings, volume and other strategies as discussed previously which are used in the case study building to use the airflow, wind and breeze of the site to enhance and increase comfort level of the space. These three attributes should be placed as essential strategies in design process of communal space in office building of Malaysia's context to further benefit in the biophilic design positive impact. Other biophilic design attributes should also be considered as it were also discovered to be beneficial towards the occupant of the building and improve their working experience through the occupant's perception analysis. As for limitation of this study, it did not cover on few of the biophilic design attributes such as non-rhythmic sensory stimuli, presence of water, connection with natural systems, biomorphic forms and patterns, material connection with nature, refuge, mystery and risk or peril. Biophilic design attributes that were analyzed in this study are only those which can be found in the selected case study building. Despite that, all of the available attributes found were analyzed and observed to bring about significant impact towards the occupants of the building.

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