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Qualitative Benefit and Enhancement in Well Being Towards the Biophilic Design in Office Building

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Abstract: ***'Nature' and biophilic design have drawn a lot of attention in architecture over the past 10 years, particularly in reaction to the mounting environmental problems. Regarding how to conceptualise and address "nature" in practise and study, there are still debates and unanswered concerns. In order to analyse biophilic design as a theoretical framework to understand "nature" in architecture, this study reviews the relevant literature. The ensuing queries are addressed:***
(1) How did the idea of "biophilic design" come about, and what does it mean? (2) How might biophilic design advance the aims of sustainable construction? (3) What are the main biophilic design principles? The basic frameworks of biophilic design are identified, contrasted, and their essential components are explained in this review. Then, we examine the advantages (such as improved health and wellbeing,
The sustainable Development Goals provide as a framework for the role of biophilic design in attaining sustainability. These goals focus on productivity, biodiversity, and circularity. The findings show that biophilic design, which encompasses various aspects of nature, including physical, sensory, conceptual, morphological, material, and spiritual nature, is more complicated and richer than simply using vegetation in buildings. Moreover, knowledge gaps are noted to spur further investigation and critical evaluations of biophilic design techniques.
Keywords: biophilic architecture, Health, ecologic, well-being design , green building element

I. INTRODUCTION

The term "biophilia" was created to characterise humans' innate affinity for the living things in the natural world and developed from research on human evolution That explains why humans favour nature since it is a deep-seated impulse in the human brain. The "biophilia hypothesis" was first put forth in 1993 to emphasise that the human-nature relationship plays a key role in human brain evolution as well as physical and psychological health . It is based on further understanding and the experience-based examination of "biophilia." Based on their expertise in numerous domains, it was the first time that researchers suggested tentative answers to describe why people enjoy nature and why nature has a favourable impact on physical and psychological health.

Since the health influences of biophilia are supported by robust empirical evidence, researchers have started to explore how to employ biophilia principles in design practice . Stephen Kellert (1943–2016) first coined the term for design activity that aimed to “rebuild a positive relationship between the natural environment and human in the modern built environment” as “biophilic design”. The innovative approach revealed that biophilia research started to transfer from basic research to practical design application and affected sustainable design strategies. Some scholars summarized and classified the natural design features into biophilic design frameworks to guide design activities.

The importance of investment in the workforce of organisations and enterprises has increased, which has sparked a renaissance of the biophilia hypothesis and, increasingly recently, biophilic design. The emotions created by the above-described mental exercise have names thanks to these notions. In addition to the fact that humans are inherently drawn to natural environments and elements, psychologists and biologists have proposed that exposure to nature (whether direct, indirect, or symbol) within the building design increases productivity, health, and general well-being.

Designers and researchers with backgrounds in the building design have recently focused on biophilic design. These projects have recently been more popular in a wide range of environmental design patterns, including commercial [13], healthcare [16,17], and urban designs. This is due to the health benefits of biophilic design. One of the typologies that draws academics' attention is the workplace. Researchers that examine the connection between both the built environment and health have discovered that people's performance at work and in school is also impacted by their environment [33]. The health and productivity of employees in an office setting are improved by biophilic design, according to studies.

In actuality, designers have included biophilic design elements or pattern into projects and stated that doing so promotes user wellbeing.

Although the significance of biophilic design appears to be widely acknowledged and some global or regional green building and good health building standards, such as the Singapore Green Mark and WELL building standard version 2, incorporate biophilic design features into the rating scale [38], more research is still required to develop building diagnostic sustainable and green design guidelines and assessment techniques. Nevertheless, it is yet uncertain whether such designs are useful for user wellbeing in real-world design initiatives. More importantly, biophilic design standards based on building typology should be properly created, as they might influence how the designer prioritises the choice of design features in practise.

Also, a 2021 study from Human Spaces called "The Global Impact of Biophilic Design in the Workplace" discovered that employees in offices with natural components, such grass and sunlight, accomplish;

6% more productivity

15% more creativity

15% higher levels of well-being

Increasing amounts of research point to a direct relationship between workplace design and employees' health and wellness. Also, one's mental health might influence their perceptions of the world and how they feel about it. The effects of biophilic design elements in offices on employees' health and wellbeing are looked at in this study. The biophilic design for workplace health and wellness is assessed using a new post-occupancy evaluation (POE) questionnaire. Two green building workplaces in Singapore and Shenzhen, China, are the subject of a survey and field observations. The primary findings are that I employees have a reasonably high opinion of the benefits of biophilic features in the workplace for enhancing health and wellbeing and (ii) there are substantial variations between self-reported health and natural surroundings.

II. VEGETATION OR GREENERY

One of the biophilic design elements most frequently employed at Office building is plants. The plants are used to beautify the entire structure in a variety of ways, including green walls, vertical greening, a roof garden, potted plants in workstations, sky gardens, and green balconies. The businesses have made use of potted plants within the offices at both locations. Plants have been added to Office A's interior, and potted plants have been positioned on the file folders closest to a workstations. On a regular basis, Office B places a plant pot on each employee's desk. Some workers decorate their desks with miniature potted plants they've bought.

III. AIRFLOW AND THERMAL COMFORT FACTOR AND AIR QUALITY

Due to its location in a tropical climate zone and high daily temperatures throughout the year, Office A depends on the air conditioning system to maintain a comfortable inside temperature. Office B's operable windows provide a staff-managed choice. All windows in both businesses have movable curtains fitted, and Office B has built-in panels.

IV. NATURAL MATERIALS

The majority of the furnishings and flooring in Office B's semi-outdoor spaces and building facade are constructed of wood and stone. With white ceilings and grey carpeting, the inside is grey. Wooden screens and floors are used as natural interior décor components in Offices.

The observational findings attest to the effectiveness of the design tactics used in the study's offices. From the viewpoint of the users, the combination of the observable with self-reported results of the questionnaire further confirms the efficiency of biophilic design for well-being and health. The findings show that the designers apply a variety of biophilic design techniques to improve user experiences. Moreover, the design techniques used to bring the outdoors into the office

In actuality, designers have included biophilic design elements or pattern into projects and stated that doing so promotes user wellbeing. Although the significance of biophilic design appears to be widely acknowledged and some global or regional green building and good health building standards, such as the Singapore Green Mark and WELL building standard version, incorporate biophilic design features into the rating scale, more research is still required to develop building diagnostic sustainable and green design guidelines and assessment techniques. Nevertheless, it is yet uncertain whether such designs are useful for user wellbeing in real-world design initiatives. More importantly, biophilic design standards based on building typology should be properly created, as they might influence how the designer prioritises the choice of design features in practise.

V. PROBLEM STATEMENT

Many Asian cities are developing rapidly, and maximising land and return of investment is every clients concern. Thus space optimization, creating a healthy work environment while maintaining productivity is of the utmost importance.

The current approach to high-rise office buildings creates an atmosphere that is not conducive for working. People are less productive, stressed out, can easily catch viruses or other health related illnesses. Poorly planned high-rise buildings often suffer from Sick Building Syndrome (SBS). Land use plays an important role in the vitality of an area, as well as that of a building. It is essential to introduce mix-use program within the building to create different activities which run throughout different times of the day. This creates a vibrant atmosphere and promotes social interaction.

The current structure lacks a strong axis and public vistas, which is a flaw that has to be fixed. There are no breakout, green, or socialising places inside the enclosed indoor environment. The health and productivity of the business structure will be considerably improved by including biophilic features into the office building, which will also help to reduce overall environmental effect on the built and natural environments. Green buildings are safe and enjoyable places to live, engage, and work since health is a crucial component of achieving sustainability. In order to create a healthy, stress-free workplace, the study explores how biophilic design in high-rise buildings works and how its principles might be used.

VI. OFFICE-OCCUPANCY ASSESSMENT

OOA is a research approach that is used to evaluate if the building design and performance match the design expectations. It is implemented to examine building function. The purpose of OOA is to conduct a post-occupancy inquiry on architectural design from the perspective of building design. The study's findings give architects advice that they can use to enhance their design approaches in later projects. Additionally, since OOA is one of the common research methodologies that can successfully identify operational issues, from the standpoint of building operations, the OOA results can provide feedback from occupants to users and building managers on workspace biophilic design. OOA is a procedure that, from the perspective of building performance, compares the evaluation results and building criteria to evaluate building performance. Data on the building system are gathered and analysed as part of the evaluation process. OOA is an appropriate evaluation method for determining whether a green building project will have the required impact on energy savings during operation. OOA concentrates on determining whether the intended environment satisfies users' demands from their point of view. The OOA of building performance and users' satisfaction are also frequently used to develop building performance evaluation (BPE). Moreover, BPE stresses physical characteristics like energy consumption and building energy savings, and considers whether a building's design influences user behaviour and satisfaction. As a result, POE combines and enhances the three aforementioned viewpoints. One of the architectural design techniques for reestablishing the relationship between people and nature in the built environment is called "biophilic design."

According to different research methodologies, POE studies are typically divided into three categories: indicative, investigative, and diagnostic POE [40]. An unrefined evaluation process known as a "indicative POE" was used to quickly collect evaluation data from the important employees. In order to conduct a thorough analysis, investigative POE uses inspection techniques such end-user survey questionnaires, interviewing, photographic recording, and field measurements.

14 PATTERNS		*	STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	Visual Connection with Nature	* * *	**Lowered blood pressure and heart rate** (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	**Improved mental engagement/ attentiveness** (Biederman & Vessel, 2006)	**Positively impacted attitude and overall happiness** (Barton & Pretty, 2010)
	Non-Visual Connection with Nature	* *	**Reduced systolic blood pressure and stress hormones** (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991)	**Positively impacted on cognitive performance** (Mehta, Zhu & Cheema, 2012; Ljungberg, Neely, & Lundström, 2004)	**Perceived improvements in mental health and tranquility** (Li, Kobayashi, Inagaki et al., 2012; Jahncke, et al., 2011; Tsunetsugu, Park, & Miyazaki, 2010; Kim, Ren, & Fielding, 2007; Stigsdotter & Grahn, 2003)
	Non-Rhythmic Sensory Stimuli	* *	**Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity** (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)	**Observed and quantified behavioral measures of attention and exploration** (Windhager et al., 2011)	
	Thermal & Airflow Variability	* *	**Positively impacted comfort, well-being and productivity** (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)	**Positively impacted concentration** (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	**Improved perception of temporal and spatial pleasure (alliesthesia)** (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
	Presence of Water	* *	**Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure** (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006)	**Improved concentration and memory restoration** (Alvarsson et al., 2010; Biederman & Vessel, 2006) **Enhanced perception and psychological responsiveness** (Alvarsson et al., 2010; Hunter et al., 2010)	**Observed preferences and positive emotional responses** (Windhager, 2011; Barton & Pretty, 2010; White, Smith, Humphryes et al., 2010; Karmanov & Hamel, 2008; Biederman & Vessel, 2006; Heerwagen & Orians, 1993; Ruso & Atzwanger, 2003; Ulrich, 1983)
	Dynamic & Diffuse Light	* *	**Positively impacted circadian system functioning** (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) **Increased visual comfort** (Elyezadi, 2012; Kim & Kim, 2007)		
	Connection with Natural Systems				**Enhanced positive health responses; Shifted perception of environment** (Kellert et al., 2008)

NATURAL ANALOGUES	Biomorphic Forms & Patterns	*			**Observed view preference** (Vessel, 2012; Joye, 2007)
	Material Connection with Nature			**Decreased diastolic blood pressure** (Tsunetsugu, Miyazaki & Sato, 2007) **Improved creative performance** (Lichtenfeld et al., 2012)	**Improved comfort** (Tsunetsugu, Miyazaki & Sato 2007)
	Complexity & Order	* *	**Positively impacted perceptual and physiological stress responses** (Salingaros, 2012; Joye, 2007; Taylor, 2006; S. Kaplan, 1988)		**Observed view preference** (Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
NATURE OF THE SPACE	Prospect	* * *	**Reduced stress** (Grahn & Stigsdotter, 2010)	**Reduced boredom, irritation, fatigue** (Clearwater & Coss, 1991)	**Improved comfort and perceived safety** (Herzog & Bryce, 2007; Wang & Taylor, 2006; Petherick, 2000)
	Refuge	* * *		**Improved concentration, attention and perception of safety** (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
	Mystery	* *			**Induced strong pleasure response** (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)
	Risk/Peril	*			**Resulted in strong dopamine or pleasure responses** (Kohno et al., 2013; Wang & Tsien, 2011; Zald et al., 2008)

VII. IMPORTANCE OF OOA IN MEASURING THE IMPACT OF DESIGN

Contrary to basic research, building design techniques are focused on the needs of the final consumers; in other words, occupant experiences are directly impacted by building design, making "user happiness" an important consideration in building design.

OOA is essential to completing the missing piece of the sustainable design process in the built environment. For the past 50 years, it has aided professionals in getting consumer feedback [48,49]. The first international green building certification system that is based on the Building Research Establishment Environmental Assessment Method (BREEAM) [51], Leadership in Energy and Environmental Design (LEED) [50], and other current international green building and healthy structure certification systems all include POE as a requirement for certification. The healthy building certification programmes include the WELL building certification [53], the Singapore green mark [52], and the green mark for a healthy workplace [52]. The tenant satisfaction survey and building documents are the main emphasis of the credit criteria. Quality and health are treated as integral components of the current POE for evaluating a workplace environment, despite the fact that it is an indoor setting. Researchers have created analytical techniques for biophilic workplace design [54]. They mostly consist of observations and occupant surveys, which involve both questionnaire surveys or interviews with building residents and studies assessing and recording biophilic traits. Although these are common study techniques for investigative POE, there are currently no POE scales that specifically address biophilic design inside the workplace. In line with the study

VIII. RESERCH GAP

The biophilic design techniques are being practice in other countries, India in composite climate has not experiences such techniques.

IX. AIM

The current structure lacks a strong axis and public vistas, which is a flaw that has to be The main research aim is to gather, analyse and implement information on the existence of both the nature in the workplace and the criteria and purposes of implementing biophilic design features within the current urban office setting in order to design a healthy and productive working environment. The research will revolve around the implementation of suitable design approach in order to promote productivity and enhance workplace wellness to be incorporated in the current Design

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X. OBJECTIVES

The current study's goals can be summed up as follows:
To investigate and literature review related to biophilic

1) determining whether the biophilic design would have an impact on employees' self-reported wellbeing in real-world office projects.
2) creating a questionnaire for evaluating the workplace's biophilic design while taking health and wellbeing into account.
3) To evolve a new structure that would be bridge the gap between architecture and basophilic Itself.
4) offering new biophilic design guidelines, test feasibility and policy in biophilic design specifically for workplaces.
5) The study's findings can help researchers and designers make better choices when it comes to choosing design features for offices and office biophilic design practises.

XI. RESEARCH QUESTIONS

Based on the literature review research and studies, the research questions generated and produced are :-

1) How might biophilic design elements further enrich and develop a sustainable, effective, low-stress workplace?
2) How might interconnected open areas with direct and indirect visual connections promote communication between office and public users?
3) How can the users' wellness and productivity at work be improved by direct interaction with biophilic features in an office setting?

XII. SIGNIFICANCE OF STUDIES

Studies are important for this research because they highlight the direct and indirect strategies that should be used in the design of biophilic elements to promote workplace wellness and improve the working environment in order to foster a good atmosphere. In order to create research objectives for additional research projects, this chapter will establish the knowledge for the research paradigm. The methodical use of research technique results in a final product that is highlighted under the research's aim and objectives. The study papers will be helpful for academic instructors and students who follow similar tactics to improve their professional wellness. Also, office users can benefit from this research by using it as a set of criteria to assess their performance in particular working environments.

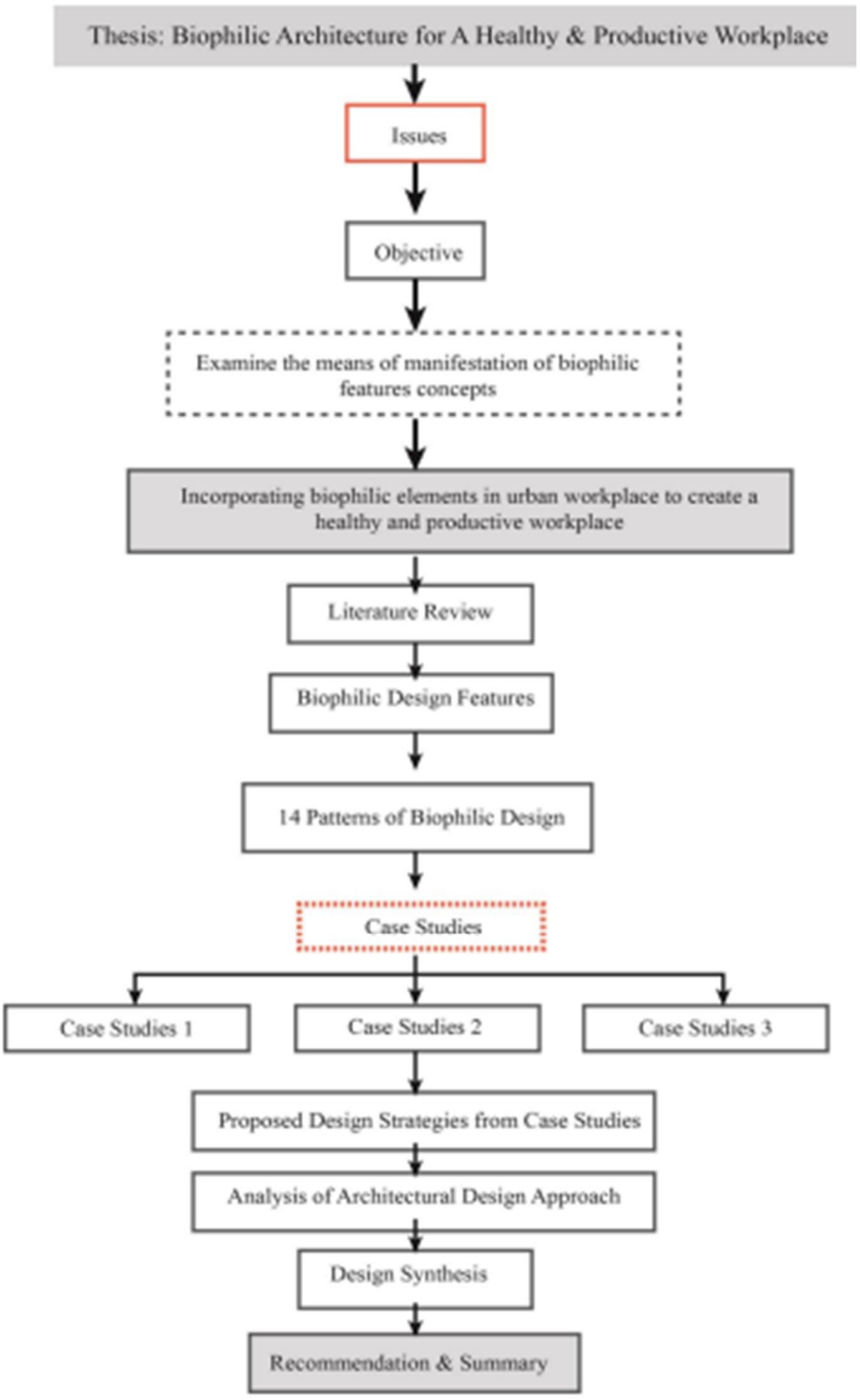
In addition, this study will be used as a guide for creating a perfect workplace in the future for corporate businesses. Understanding and simplification of the biophilic design patterns, as well as the development of an architectural design strategy based on the research, are crucial research goals in this study.

The primary design premise of biophilic design is straightforward, and it can be applied to our built environment to greatly improve health. The majority of the time, employers and corporate businesses view biophilic design as a luxury rather than the greatest option for increasing employee productivity in the workplace. according to Terrapin The Economics of Biophilia, a journal article by Bright Green, emphasised the idea that providing both direct and indirect access to nature will contribute to the tenure and durability of the structure itself. Although Heschong-Mahone Group did a study to demonstrate the level of productivity, the results reveal that strategically placed greenery, direct access to greenery views, and large windows considerably lower stress levels and increase worker productivity.

XIII. METHEDOLOGY

Methodology survey such as field observations and questionnaire surveys of users.

1) To study and explore different theories and application involve in biophilic design.
2) To study and explore various pattern elements and attribute status related to basophilic
3) To find out inferences and go through the literature review and case study which Represent present scenario.
4) Come out with the reconnection of biophilic design in composite climate.
5) The objective of the observation is to fairly document and summarise the biophilic design characteristics and design approaches that designers and architects actually used in the design processes to produce a suitable biophilic in the workplace.



XIV. EXPECTED FINDINGS

The author will detail the design strategies and areas needed based on biophilic design elements with specific established design criteria that may be used to current design thesis project at the conclusion of the investigation. According to the results of the performed research studies, biophilic design elements can help to increase workplace wellbeing and productivity in high rise office buildings. The overall productivity and wellness will be greatly boosted with the greater use of biophilic design characteristics, it can be concluded from reading and research sources.

The study also focused on vertical green components, which can improve the working environment by providing both direct and indirect visual connections to the outside, enhancing the office building's overall workplace wellness.

The author will highlight potential design techniques for developing office spaces that can lessen the effects of sick building syndrome in high-rise workplaces in urban settings. This analysis suggests that the author's design thesis project can make greater use of every theory, design strategy, and guiding principle.

XV. HYPOTHESIS

Biophilic Design can be experiment in office building useful space, re-establish human and Nature relationship connection among them

XVI. SCOPE

Biophilic concept is a wide range area which has important to generate in the field of Architecture building spaces of different typology like residential, commercial, offices, Institutions Building, Healthcare, and further which have numerous health benefit related to the mental and psychological problems where which act as a solving problem solutions. This Research is limited some boundaries as I am taking as an institutional building which have a live site sample, originated setup where we must have to measure design element and site attribute according to the current site and climatological affect. The study's goal was to assess the typical biophilic design features found in office settings as well as the relationship between biophilic design and workplace wellness. The research's scope is therefore quite broad. The research focus should be more focused in future studies to allow for more in-depth analysis.

XVII. CONCLUSION

This study highlights user preferences, aids in decision-making regarding workplace biophilic design, also increases the efficiency of the biophilic design.

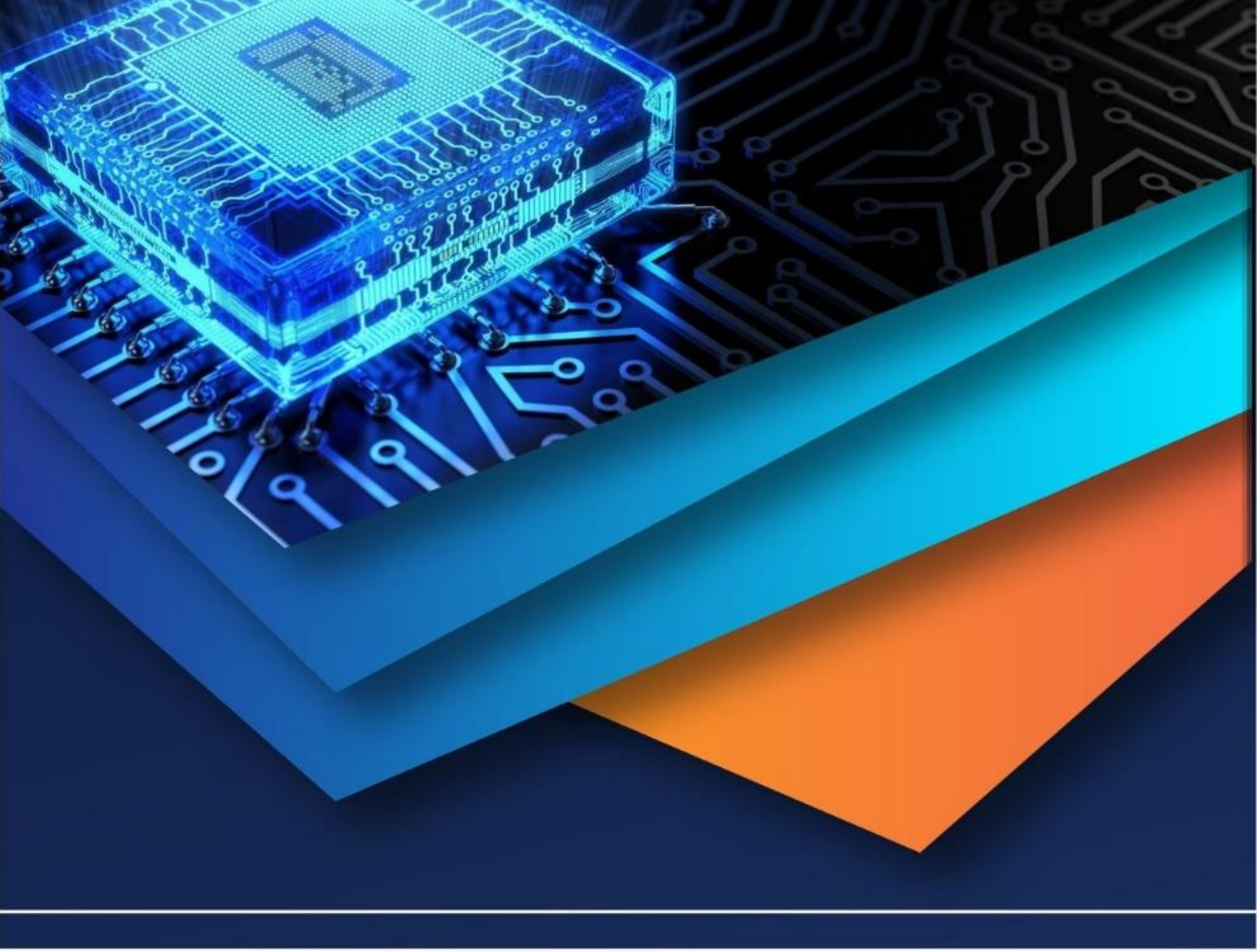
Since the beginning of time humans have been living in involving with nature that being surrounded by nature is in our DNA. We are wired to respond positively the natural environments, biophilic means the love of Living systems and it can dramatically improve the way we feel and perform in our life. Scientist discovered genetic links that illustrate how human have adopted their biological response mechanism to natural environment. Several responses system wake up and to get positive reaction in our physical and psychology that's why we found our self in nature we automatically feel more relaxed. Our molecules respond to biophilic design. Biophilic principal have been established now which help us to inform urban design or all landscape design. Some of those principles are providing natural with urban space, natural can reduce stress promote positive feelings and enhance concentration recovery. Many research has shown that hospital patient who can see tree and garden from their bed recover faster than those who cannot.

REFRENCES

[1] Biophilia; Harvard University Press: Cambridge, MA, USA, 1984. [Google Scholar]
[2] Fromm, E. The Heart of Man; Harper & Row: New York, NY, USA, 1964. [Google Scholar]
[3] Parsaee, M.; Demers, C.M.H.; Potvin, A.; Hébert, M.; Lalonde, J.-F. Window View Access in Architecture: Spatial Visualization and Probability Evaluations Based on Human Vision Fields and Biophilia. Buildings 2021, 11, 627. [Google Scholar] [CrossRef]
[4] Irons, W. Adaptively relevant environments versus the environment of evolutionary adaptedness. Evol. Anthropol. 1998, 6, 194–204. [Google Scholar] [CrossRef]
[5] Crawford, C.; Krebs, D. (Eds.) Handbook of Evolutionary Psychology: Ideas, Issues and Applications; LEA: New York, NY, USA, 1997. [Google Scholar]
[6] Julia Ayuso Sanchez, T.I. Sergio Vega Sanchez, Quantitative improvement in workplace performance through biophilic design: A pilot experiment case study. Energy Build. 2018, 177, 316–328. [Google Scholar] [CrossRef]
[7] Korpela, K.; De Bloom, J.; Sianoja, M.; Pasanen, T.; Kinnunen, U. Nature at home and at work: Naturally good? Links between window views, indoor plants, outdoor activities and employee well-being over one year. Landsc. Urban Plan. 2017, 160, 38–47. [Google Scholar] [CrossRef]
[8] Moksnes, U.K.; Espnes, G.A.; Haugan, G. Stress, sense of coherence and emotional symptoms in adolescents. Psychol. Health 2013, 29, 32–49. [Google Scholar] [CrossRef]
[9] Van Den Berg, A.E.; Hartig, T.; Staats, H. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. J. Soc. Issues 2007, 63, 79–96. [Google Scholar] [CrossRef][Green Version]
[10] Wolhihill, I.A.F. (Ed.) Kaplan&Talbot, Psychological Benefits of a Wilderness Experience, in Human Behavior & Environment: Advances in Theory and Research; Human Behavior and Environment Series; Plenium Press: New York, NY, USA, 1983; pp. 163–203. [Google Scholar]
[11] Berman, M.G.; Jonides, J.; Kaplan, S. The Cognitive Benefits of Interacting with Nature. Psychol. Sci. 2008, 19, 1207–1212. [Google Scholar] [CrossRef]
[12] Kaplan, S. The restorative benefits of nature: Toward an integrative framework. J. Environ. Psychol. 1995, 15, 169–182. [Google Scholar] [CrossRef]
[13] Katcher, A.; Wilkins, G. Dialogue with Animals: Its Nature and Culture. In The Biophilia Hypothesis; Kellert, S.R., Wilson, E.O., Eds.; Island Press: Washington, DC, USA, 1993. [Google Scholar]

[14] Alvarsson J, Wiens Nilsson S (2010) Stress recovery during exposure to nature sound and environmental noise. Int J Environ Res Public Health 7(3):1036–1046 https://www.researchgate.net/publication /285328585_Biophilic_theory_and_researc h_for_healthcaredesign
[15] Applying the benefits of biophilic theory to hospital design March 2018, City Territory and Architecture 5(1) DOI:10.1186/s40410-018-0077-5https://www.researchgate.net/publication/323524692_Applying_the_benefits _of_biophilic_ theory_to_hospital_design
[16] A Study of Biophilic design and how it relates to the children's hospitals design To cite this article: S G Abo Sabaa et al 2022 IOP Conf. Ser.: Earth Environ. Sci. https://iopscience.iop.org/article/10.1088/1755-1315/992/1/012003/pdf
[17] Applying the benefits of biophilic theory to hospital design Published: 02 March 2018 https://cityterritoryarchitecture .springeropen.com/articles/10.1186/s40410-018-0077-5
[18] Biophilic design impact on Healthcare facilities interior design in Egypt Dr. Shaimaa Samir Fahmy Mohamed DOI: 10.21608/jdsaa.2021.30348.1051 https://cityterritoryarchitecture.springeropen.com/articles/10.1186/s40410-018-0077-5
[19] Application of Biophilic Patterns in Health Care Environments to Enhance Healing Rania El Messeidy Rania Ahmed HamdyEL Messeidy/et al/Engineering Research Journal 163 (September 2019) A87 – A99
[20] Biophilic Design as an Important Bridge for Sustainable Interaction between Humans and the Environment: Based on Practice in Chinese Healthcare Space Published online 2022 Jul 6. doi: 10.1155/2022/818453 https://www.ncbi.nlm.nih.gov/pmc/art ic les/PMC9271008/
[21] Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review Frontiers of Architectural Research Volume 11, Issue 1, February 2022, Pages 114-141
[22] Biophilic theory and research for healthcare design https://www.researchgate.net/publication/285328585_Biophilic_theory_and_research_for_healthcare_design
[23] Applicable Biophilic principles on hospitals retrofitting. The case study of Turkish public hospitals- September 2018 Universitat Politècnica de Catalunya https://www.researchgate.net/publication/327231119_Applicable_Biophilic_ principles_ on_hospitals_retrofitting_The_case_study_of_Turkish_public_hospitals
[24] A Review of Psychological Literature on the Health and Wellbeing Benefits of Biophilic Design Academic Editor: Mallory Taub Buildings 2015, 5(3), 948-963; https://doi.org/10.3390/buildings503094 Received: 7 July 2015 / Revised: 13 August 2015 / Accepted: 19 August 2015 / Published: 25 August 2015 https://www.mdpi.com/2075-5309/5/3/948./htm
[25] Guidelines and considerations for biophilic interior design in healthcare environments Author Locklear, Kendra Michele Date: 2012-05 https://repositories.lib.utexas.edu/handle/2152/ETD-UT-2012-05-5643
[26] Hospital Landscape Sustainability: Case Study in Turkey Theory and practice in sustainable planning and design Planning, Design, Applications, 2020 Alev Perihan GÜRBEY,Nazlı Kanbur https://www.academia.edu/44272837/Hospital_ Landscape_Sustainability_Case_Study_in_Turkey
[27] AN EVALUATION OF BIOPHILIC DESIGN PARAMETERS IN HOSPITAL BUILDINGS Güneş Mutlu Avinç*,1, Semra Arslan Selçuk2 Department of Architecture, Faculty of Architecture, Gazi University, 06560 Ankara, Maltepe, Yükseliş Street, Turkey
[28] Biophilic Design: How to enhance physical and psychological health and wellbeing in our built environments by B Bolten, G Barbiero - Visions for Sustainability, 2020 - univda.it DOI: 10.13135/2384-8677/3829
[29] The Role of Biophilia in hospital Humanization.pdf https://issuu.com/sinaetezadifar/docs/the_role_of_biophilia_in_ hospital_ humanization_sey
[30] Gillis K., Gatersleben B. A review of psychological literature on the health and wellbeing benefits of biophilic design. Buildings. 2015;5(3):948–963. doi: 10.3390/buildings5030948. [CrossRef] [Google Scholar]
[31] Ryan C. O., Browning W. D., Clancy J. O., Andrews S. L., Kallianpurkar N. B. Biophilic design patterns: emerging nature-based parameters for health and well-being in the built environment. Archnet-IJAR . 2014;8(2):62–76. doi: 10.26687/archnet-ijar.v8i2.436. [CrossRef] [Google Scholar]
[32] Izutsu T., Tsutsumi A., Minas H., Thornicroft G., Patel V., Ito A. Mental health and wellbeing in the sustainable development goals. The Lancet Psychiatry . 2015;2(12):1052–1054. doi: 10.1016/S2215-0366(15)00457-[PubMed] [CrossRef] [Google Scholar]
[33] Cronk R., Bartram J. Environmental conditions in health care facilities in low- and middle-income countries: coverage and inequalities. International Journal of Hygiene and Environmental Health. 2018;221(3):409–422. doi: 10.1016/j.ijheh.2018.01.004. [PubMed] [CrossRef] [Google Scholar]
[34] Totaforti S. Applying the benefits of biophilic theory to hospital design. City, Territory and Architecture. 2018;5(1):1–9. doi: 10.1186/s40410-018-0077-5. [CrossRef] [Google Scholar]
[35] Söderlund J., Newman P. Improving mental health in prisons through biophilic design. Prison Journal . 2017;97(6):750–772. doi: 10.1177/0032885517734516. [CrossRef] [Google Scholar]
[36] designing with nature in mind makes financial sense. Available via DIALOG: http://www.terrapinbrightgreen.com/ report/ economics-of- biophilia/. Accessed 29 Sept 2017
[37] Browning WD, Ryan CO, Clancy JO (2014) 14 patterns of biophilic design. Available via DIALOG: http://www.terrapinbrightgreen.com/wp-content/uploads/2014/04/14-Patterns-of-Biophilic-Design-Terrapin-2014e.pdf. Access ed 15 Sept 2017
[38] Kellert, S.R., 2018. Nature by Design: The Practice of Biophilic Design. Yale University Press.
[39] United States Environmental Protection Agency, Indoor Air Quality. 2018. Available online: https://www.epa.gov/report-environment/indoor-air-quality (accessed on 23 August 2019).
[40] The practice of integrated design: The case study of Khoo Teck Puat Hospital, Singapore TS Yen - Degree of Masters of Science in Sustainable Building , 2012 - academia.edu
[41] Khoo Teck Puat Hospital. Examples of Successful Integration of Greenery with Buildings T Schröpfer, S Menz - Dense and Green Building Typologies, 2019 – Springer
[42] Meyer Children's Hospital: A Pilot Study |Volume 3 |Article ID 514528 | https://doi.org/10.1093/ecam/nel029 Accepted04 May 2006 https://www.hindawi.com/journals/ecam/2006/514528/
[43] Concord Medical Purchases Additional Proton Therapy System for It's Shanghai Concord Cancer Center NEWS PROVIDED BY Concord Medical Services Holdings Limited Sep 10, 2021, 07:02 ET https://www.prnewswire.com/news-releases/concord-medical-purchases-additional-proton-therapy-system-for-its-shanghai-concord-cancer-center-301373268.html
[44] Taikang Nanjing International Medical Center | HDR https://www.hdrinc.com › portfolio › taikang-nanjing

[45] Practice and exploration of modern hospital management system construction in Beijing Tsinghua Changgung Hospital / Yuehong ZHOU; Kexia WANG; Huimin SHI; Jing WANG; Liubao ZHU. https://pesquisa.bvsalud. org/portal/resource /pt/wpr-872338
[46] SANYA FUWAI INTERNATIONAL CARDIOVASCULAR HOSPITAL & RESORT HOTEL https://en.warnerasia. Com /project/sanya-fuwai-international-cardiovascular-hospital-resort-hotel/
[47] Four-year review of open eye injuries at the Royal Adelaide Hospital Robert J Casson FRANZCO, James C Walker MB BS, Henry S Newland FRACO MPH First published: 24 November 2002 https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1442-9071.2002.00484.x



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