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BIOPHILIC DESIGN IN INTERIOR SPACES INTEGRATING NATURE AND SUSTAINABLE PRINCIPLES

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Biophilic design is an emerging approach in contemporary interior design, aimed at re-establishing the connection between humans and the natural environment in built spaces. In the context of urbanization and lifestyle changes, the interior becomes the main setting of everyday experiences, requiring spaces that support comfort and psychological balance.

The study examines the integration of natural elements not only as an aesthetic solution, but also as a mechanism for perceptual and cultural reconnection. The results show that the perceptual, spatial and material dimensions contribute to the creation of sustainable, multisensory spaces, oriented towards user well-being and the strengthening of the human–nature relationship.

Key words: *biophilic design, interior spaces, sustainability, multicolor perception.*

INTRODUCTION

Accelerated urbanization and modern lifestyles have reduced direct human interaction with nature, making interior spaces the primary context of daily experience. Biophilic design offers a means of reconnecting with nature by integrating natural elements alongside perceptual, material, and cultural principles that support psychological and physiological balance. Beyond the mere introduction of vegetation indoors, the biophilic paradigm fosters a complex relationship between users, nature, and the built environment. Recent research emphasizes the benefits of multisensory engagement in promoting cognitive stimulation, reducing stress, and enhancing the quality of spatial experience.

PURPOSE

This study examines the application of biophilic design principles in various interior settings and evaluates their impact on user comfort, multisensory perception, and environmental sustainability. The research problem focuses on identifying coherent strategies for implementing these principles in diverse interior environments to optimize both user experience and building performance. Emphasis is placed on the integration of natural, perceptual, material, and technological elements to support the psychophysiological well-being of occupants.

RESULTS AND DISCUSSION

Analysis of the application of biophilic design principles in various types of interior spaces highlights that integration of natural elements goes beyond the mere introduction of vegetation into the built environment, generating complex effects on



users' perception and experience. Recent research in architecture and environmental psychology indicates that visual and sensory engagement with natural elements significantly contributes to reducing stress levels, enhancing well-being, and stimulating cognitive functions within interior spaces [1].

In this context, combining natural light, vegetation, water features, and tactile, olfactory, or auditory elements facilitates creation of multisensory spatial experiences capable of supporting psychological restoration and emotional balance for users. Recent studies emphasize that such biophilic interventions contribute to development of restorative interior environments, where users can experience a deeper connection with nature, even within densely urbanized contexts (Browning et al., 2020; Kellert, 2020). Spatial dimension of biophilic design is reflected in use of atriums, green walls, hanging gardens, or modular areas, which enhance perception of ecological complexity and provide depth to interior space. Such solutions contribute to establishing a balance between visibility, privacy, and safety - an essential factor for interior environmental quality. Simultaneously, selection of natural materials - such as wood, stone, or plant fibers - strengthens sensory relationship between the user and the space, generating authenticity and visual harmony [2].

Integration of technological strategies, such as optimized natural lighting, green infrastructure, or passive climate control systems, contributes to improving energy performance of buildings and supporting users' circadian rhythms. From this perspective, biophilic design can be interpreted as an interface between aesthetic, functional, and sustainable dimensions of the built environment. Psychosocial dimension results from cumulative interaction of all these components, demonstrating that value of biophilic design derives from coherent orchestration of natural, spatial, and technological elements, rather than from mere addition of decorative components [3].

To synthesize relationship among these dimensions and their effects on user experience, Table 1 presents main components of biophilic design and their impact on interior environment.

The application of biophilic design principles in residential, office, educational, or HoReCa spaces demonstrates a considerable adaptability of these design strategies. Green walls, solid wood furniture, plant partitions between work areas, ambient lighting aligned with natural rhythms, and decorative elements inspired by nature contribute to the creation of interior spaces that are comfortable and psychologically balanced.

Recent studies indicate that the integration of biophilic elements in work environments can lead to improved cognitive performance, increased professional satisfaction, and reduced mental fatigue [4]. In educational spaces, such interventions are associated with enhanced creativity and the development of environments conducive to learning, while in HoReCa contexts they support the creation of multisensory experiences that positively influence users' perception of the quality of the interior environment.



Table 1.

Dimension and effects of biophilic design in interior spaces

Biophilic dimension	Elements used	Effects on users
Direct connection with nature	Plant, green walls, natural light	Stress reduction, increased well-being
Indirect connection with nature	Natural materials, organic textures, biomorphic forms	Psychological comfort and positive spatial perception
Multisensory stimulation	Natural sounds, dynamic lighting, natural scents	Improved cognitive performance
Integration nature in architecture	Interior gardens, large windows, integrated vegetation	Health and well-being in the built environment
Biophilic design in the environmental context	Green spaces, natural lighting, natural ventilation	Physical and mental health of occupants.

In residential settings, the incorporation of nature indoors supports the creation of restorative spaces capable of reducing daily stress and strengthening the emotional connection between the user and the built environment [5].

Therefore, biophilic design should not be interpreted solely as an aesthetic trend but as a complex design strategy aimed at supporting users' psychophysiological health, social cohesion, and the consolidation of spatial identity. The coherent integration of perceptual, spatial, material, and technological dimensions enables the configuration of healthier, more sustainable interior spaces that are adapted to the needs of contemporary society, strengthening the relationship between humans, nature, and the built environment.

CONCLUSIONS

Biophilic design represents a significant direction in the evolution of contemporary interior design, offering solutions for reconnecting the individual with the natural environment within built spaces. The integration of natural elements into the interior space contributes to improving the quality of the interior environment, stimulating multisensory perception and increasing the level of well-being of users.

The research results highlight the fact that the efficiency of biophilic design depends on the coherent integration of perceptual, spatial, material and technological dimensions. In this sense, biophilic design must be approached as a complex design strategy, capable of simultaneously responding to the functional, aesthetic and sustainable requirements of the interior environment.

In the future, the development of biophilic design can contribute to the configuration of healthier interior spaces and better adapted to contemporary needs, strengthening the relationship between man, nature and the built environment



REFERENCES

1. Effects of biophilic indoor environment on stress and anxiety recovery: A between-subjects experiment in virtual reality / J. Yin et al. *Environment International*. 2020. Vol. 136. P. 105427. DOI: <https://doi.org/10.1016/j.envint.2019.105427>.
2. Asojo A., Hazazi F. Biophilic Design Strategies and Indoor Environmental Quality: A Case Study. *Sustainability*. 2025. Vol. 17, no. 5. P. 1816. DOI: <https://doi.org/10.3390/su17051816>.
3. Biophilic Design in the Built Environment: Trends, Gaps and Future Directions / B. H. Tekin et al. *Buildings*. 2025. Vol. 15, no. 14. P. 2516. DOI: <https://doi.org/10.3390/buildings15142516>.
4. Valor C., Redondo R., Carrero I. Explaining the influence of biophilic design on employee well-being. *Scientific Reports*. 2024. Vol. 14, no. 1. 32090. DOI: <https://doi.org/10.1038/s41598-024-83791-9>.
5. Gong Y., Zoltán E. S., János G. Healthy Dwelling: The Perspective of Biophilic Design in the Design of the Living Space. *Buildings*. 2023. Vol. 13, no. 8. P. 2020. DOI: <https://doi.org/10.3390/buildings13082020>.

МАЦКАН-ЛІСЕНКО І., УРСУ І.

БІОФІЛЬНИЙ ДИЗАЙН У ІНТЕР'ЄРНИХ ПРОСТОРАХ: ІНТЕГРАЦІЯ ПРИРОДИ ТА ПРИНЦИПІВ СТАЛОГО РОЗВИТКУ

Біофільний дизайн є новітнім підходом у сучасному інтер'єрному дизайні, спрямованим на відновлення зв'язку між людиною та природним середовищем у побудованих просторах. В умовах урбанізації та змін способу життя інтер'єр стає основним середовищем щоденного досвіду, що потребує просторів, які підтримують комфорт і психологічну рівновагу.

Дослідження розглядає інтеграцію природних елементів не лише як естетичне рішення, а й як механізм перцептивного та культурного відновлення зв'язку з природою. Результати показують, що перцептивні, просторові та матеріальні виміри сприяють створенню сталих, мультисенсорних просторів, орієнтованих на добробут користувачів і зміцнення взаємозв'язку людини з природою.

Ключові слова: біофільний дизайн, інтер'єрні простори, сталий розвиток, мультиколірна перцепція

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