

Smart biophilic patterns: a study on guidelines as an innovative tool for the renovation of internal environments of social housing


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Abstract: Studies on biophilic patterns emerge as an essential and ongoing tool for improving connections between nature, human biology, and user interaction in built environments. This work aims to apply guidelines in social housing, using analysis of biophilic patterns. The study in question analyzed thirty proposals for different housing complexes Imburi I, II, and III, located in the village of Mangabeiras, in the city of Pilar, metropolitan region of Maceió-AL, which demonstrated the intuitive application of the aforementioned standards in the residences, aiming at projects and layouts based on the needs of the residents. The selected guidelines include the following parameters: to evaluate the feasibility of incorporating biophilic standards into the built environment through user experience (UX) design; enable the application of Maslow's Hierarchy of Needs, taking a holistic approach that considers the diverse needs of people in different contexts; and benefit from Lidwell's needs to create functional, user-friendly, reliable, desirable and accessible spaces, promoting the well-being and quality of life of the people who use them. These suggestions can provide the proposition of new functional solutions, which will help from the conception of new ideas to realistic simulation. In this way, it is expected to promote more sustainable, welcoming environments that are conducive to the well-being of users. Future developments will use artificial intelligence to prospect new use scenarios for built spaces.


Keywords: Design - Biophilic Patterns - User - Social Housing - Built Environment - Naturalistic Intelligence - Image Generator - UX Design - Biophilic Design - Sustainability

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1. Introduction

Biophilia, an interdisciplinary concept, is widely studied in a variety of academic fields, with a special focus on the built environment due to the growing recognition of the benefits of incorporating natural elements to improve people's health, well-being, and productivity. Through the application of biophilic concepts, interior designers seek to evoke the sensation and connection between the user and nature, through the introduction of color, vegetation, ventilation and natural lighting, natural materials, and decorative elements inspired by nature. Such an approach aims to benefit both the occupants and the environment. The study and application of the concept of biophilia in space has gained prominence in recent decades, especially since the introduction of the term by biologist Edward O. Wilson in his book 'Biophilia' (1984). In recent years, there has been a significant increase in biophilic design research and practice as more scientific evidence highlights the benefits of incorporating natural elements into environments.

To understand biophilic design, it is important to understand that standards are organized into three categories and have fundamental concepts for the applicability of the environment. The first corresponds to nature in space –it refers to the direct, physical, and ephemeral presence of nature in a space or place– this includes plant life, water, animals, breezes, sounds, scents, and other natural elements. The second, natural analogs, 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. Finally, the nature of space deals with spatial configurations in nature. These include the innate and learned desire to be able to see beyond our immediate surroundings, the fascination with the slightly dangerous or unknown; obscured visions and revealing moments; and sometimes even phobia-inducing properties when they include a reliable element of security. Thus, while the concept has been around for decades, its study and specific application in design have been more prominent and wide-ranging over the past two decades.

2. Methodology

Biophilic design, inspired by the connection between humans and nature, aims to incorporate natural elements and biological patterns into built spaces. On the other hand, Maslow and Lidwell's Hierarchy of Needs offers a theoretical framework for understanding human needs, from the most basic to self-actualization and creative freedom, respectively. However, the application of these concepts in the design of social housing can promote more sustainable, welcoming, and conducive environments for the well-being of users.

To evaluate the feasibility of incorporating biophilic standards and the applicability of hierarchical needs guidelines, we will initially demonstrate concepts related to biophilic standards, user experience design, and Maslow's and Lidwell's theories. The research in question has a qualitative nature, we will present an analysis of 30 houses in the village of Mangabeiras, in the city of Pilar, metropolitan region of Maceió-AL. We selected three residences among the Imburi I, II, and III complexes, without having undergone structural changes, which served as a basis for the definition of new guidelines for future projects and layouts based on the needs and quality of life of the residents who use them.

3. Applicability of Concepts

3.1. Biophilic Standards

The book "Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life", by Stephen Kellert, highlights the innate connection of humans with nature and the importance of introducing natural elements into built areas to improve people's quality of life, arguing that places that encourage interaction with nature tend to be more attractive, effective and sustainable. In addition, it highlights the economic, social, and environmental gains related to the incorporation of biophilia into the built environment. The text also highlights the importance of considering biophilic patterns in design, which can decrease stress and foster a sense of harmony, as well as guide the mind and encourage inventiveness in different contexts and areas.

A study released by the National Association for Built Environment Technology demonstrates that biophilic design is a fundamental biological requirement for the relationship of human beings with the environment in which they live and work, strengthening the individual's connection with his surroundings. The latest results in this area further highlight the relevance of biophilic design not only for well-being but also as a valuable source of insights in the field of UX user experience design.

3.2. User Experience Design or UX Design

UX Design is a design discipline focused on improving products, systems, and services to provide positive and meaningful experiences to users, making the interaction between the user and the product efficient, enjoyable, and intuitive. Pioneering authors such as Donald Norman, Steve Krug, Jesse James Garrett, and Jakob Nielsen have contributed significantly to the field of user-centered design and usability, emphasizing the importance of simplicity, clarity, and understanding of human needs. By considering human needs in design projects, it is possible to create experiences that meet not only the functional needs of users but also promote their well-being and satisfaction on a deeper level.

3.3. Maslow and Lidwell's hierarchy of needs

Abraham Maslow, an influential humanistic psychologist and expert on human motivation, became famous for his theory of the Hierarchy of Needs. According to Maslow, people have diverse needs that must be satisfied in a certain order, starting with the fundamental needs for survival and evolving to more elaborate and psychological needs.

In his article "A Theory of Human Motivation" (1943), the author expounds a theory that describes the diverse needs of human beings in a hierarchy, illustrated by Maslow's famous pyramid. This pyramid encompasses everything from fundamental needs, such as food, to more advanced needs, such as self-fulfillment.

According to Maslow (1975), the base of this pyramid is composed of physiological needs (See Figure 1). These are the most fundamental needs for human survival, such as food, water, shelter, and sleep, which dominate the consciousness of the individual when all these physiological needs are not being met (Maslow, 1975).

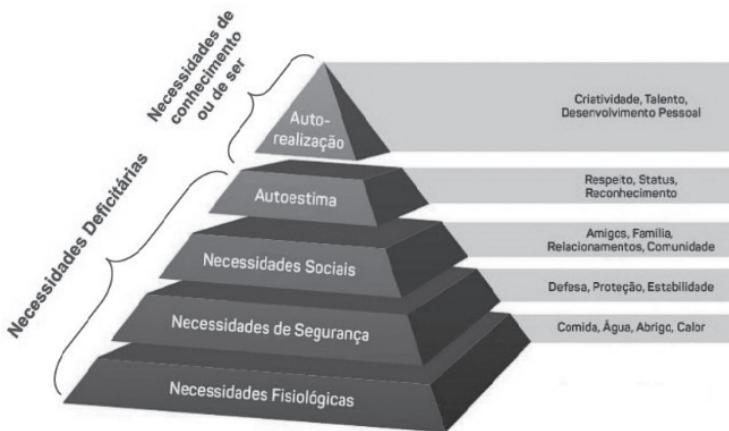


Figure 1. Maslow's pyramid. Source: Costa, Arruda, Olivera (2023).

As a result, other needs higher in the hierarchy, such as security, social, esteem, and self-actualization, may become less evident or "latent." However, it is crucial to highlight that the most basic needs must be met before the highest needs can become prominent in a person's consciousness.

Lidwell's idea is based on the use of the Lidwell model (See Figure 2) to underscore the importance of the hierarchy of needs in design. According to Lidwell (2003), the principle of

the hierarchy of needs states that a design should first satisfy basic needs before thinking about higher ones, such as innovation.



Figure 2. Lidwell's pyramid. Source: Costa, Arruda, Olivera (2023).

This hierarchical approach, inspired by Maslow's model, outlines the essence of the design process, highlighting the need for a structured progression to ensure that fundamental needs are fully met before pursuing higher levels of innovation and creative expression. Says Lidwell (2003).

Understanding Maslow's hierarchical needs can direct the design process to meet the essential needs of individuals, while Lidwell's (2003) ideas make it possible to create more attractive and meaningful experiences. The combination of these theories offers an engaging approach to interior planning, resulting in visually appealing spaces that meet the essential needs of users. This connection drives more integrated and individual-focused creations, considering not only the visual aspect but also the emotional and psychological experience of the users, resulting in more complete and striking interior design projects. These guidelines guide how to develop products that are efficient, accessible, and satisfying for users.

The article in question focuses on the progress in the field of interior design, expanding the investigation carried out in thirty residences in the Imburi I, II, and III housing complexes, located in the community of Mangabeiras, in Pilar, in the metropolitan region of Maceió-AL. After the evaluation, the following guidelines were established for the built spaces under study, briefly described in Table 1.

Table 1. Guidelines for Built Environments (Source: Costa, Arruda, Olivera, 2023).

UX DESIGN Applied in the built environment	MASLOW'S HIERARCHY OF NEEDS Applied in the built environment	LIDWELL'S HIERARCHY OF NEEDS Applied in the built environment
1. User-Centered Design; 2. Journey Mapping user; 3. Environmental Design; 4. Technology Integration; 5. Universal Accessibility; 6. Layouts fluxo; 7. Testing and Iteration; 8. Sustainability.	1. Physiological Needs; 2. Social Needs (Love and Relationships); 3. Personal Fulfillment 4. Security Needs; 5. Esteem Needs.	6. Functionality (Utility); 7. Reliability (Credibility); 8. Accessibility; 9. Usability and Disafability.

Within UX design concepts, various principles and approaches can be recommended to be applied in the built environment. However, it is important to adapt these concepts to the specific needs of each project and to take into account the characteristics of the target audience and the space in question.

Applying Maslow's Hierarchy of Needs in the built environment requires a holistic approach that considers the diverse needs of people in different contexts. Architects, urban planners, and urban planners must take into account not only the physical functionality of space but also their impact on the psychological and emotional needs of users.

On the other hand, Lidwell's Needs, when applied in the built environment, allow the creation of functional, easy-to-use, reliable, desirable, and accessible spaces, effectively meeting the needs of the users' needs. These approaches result in environments that promote the well-being and quality of life of the people who use them.

The applicability of the aforementioned guidelines, in conjunction with artificial intelligence, will play a key role in problem-solving, scenario creation, pattern recognition, natural language understanding, and decision-making for the user.

3.4. Artificial intelligence (AI)

In the context of design, some authors and researchers address artificial intelligence (AI) in a significant way. Herbert Simon, a renowned cognitive scientist, economist, sociologist, and psychologist, was one of the first to explore the application of AI in complex problem-solving and the field of design. In his book "The Sciences of the Artificial" (1969), the author discusses how the principles of AI can be applied in various areas, including design. Another relevant author is Christopher Alexander, an architect, urban planner, and design theorist, whose works have influenced the discussion on design and artificial intelligence. In his books "The Timeless Way of Building" (1979) and "A Pattern Language" (1977), he offers insights into how pattern language can be applied to the design of complex systems, being relevant to the design of AI systems.

Terry Winograd, a computer scientist who pioneered the field of user interfaces and interactive systems, also contributed significantly. In his work "Understanding Computers and

Cognition: A New Foundation for Design” (1986), he discusses how cognition theory and AI can be effectively integrated into the design of interactive systems.

Donald Norman explored the intersection between AI and design in “The Invisible Computer” (1998), emphasizing the importance of staying focused on human needs and capabilities when designing intelligent systems. Brenda Laurel, in “Computers as Theatre” (1991), discusses how AI can be utilized to create more meaningful and engaging user experiences.







These authors have contributed significantly to the understanding of the relationship between AI and design, offering valuable insights into how to integrate artificial intelligence effectively to improve the user experience and make the technology more human and satisfying.

4. Analysis of the Imburi I, II and III housing complexes

The analysis of social housing in the Imburi-AL Housing Complex is an important and complex topic, which requires an in-depth understanding of the housing conditions and quality of life of the residents. This study aims to investigate and evaluate various aspects related to social housing in this particular housing complex, including the effectiveness of housing policies, the impact on the lives of beneficiaries, and the associated socio-economic and environmental issues. The insights gained will help to understand the complex dynamics involved, the implications on the local community and the possible improvements to optimize the living conditions of the inhabitants.

Regarding the field research, we initially planned a sample of 100 participants, with 20 families and 5 individuals per household. However, due to the lack of availability and the freedom of choice of the participants, we cut the sample to 30 participants, with 1 per family and 5 individuals per household. Another limitation was the division of the Imburi Pilar-AL housing complex into Imburi I, Imburi II, and Imburi III, with 30 residences in total, 10 in each Imburi. Considering that each housing complex has about 600 houses, during the research we reached only 25 houses visited, as shown in Table 2, including 10 in **Imburi I**, 7 in **Imburi II**, and 8 in **Imburi III**, with a total of 30 participants.

Table 2. Research and Comprehensive View of Social Housing in the Imburi-AL Housing Complex (Source: Costa, Arruda, Olivera, 2023).

RESIDENCIAL - IMBURI I			
PARTICIPANTES	AMOSTRA	ANÁLISE	MELHORIA
<p>José Arnaldo 60 years old, resident of 6 to 7 years old, lives with 2 other people</p>		<p>Do you like to live in the house? Yes. Why? "Quiet, quiet close to commerce". What would you like your home to look like? "I'd like my environment..."</p>	<p>...Adding the pull, the bedrooms, and the larger kitchen, he was satisfied with the possibility of him giving his opinion on how to build the house, bathroom for him is not bothersome, observation, what changes is the terrain size, but the size of the houses is the same, same standard.</p>
<p>John Bridges 42 years old, 2-year-old resident, lives with 2 other people</p>		<p>Do you like to live in the house? "Yes", why? "House is good, comfortable, quiet and quiet, but a condominium owner and this makes the environment good to live in, he has his own transportation, he has access to commerce". What would you like your home to look like? "I'd like my environment..."</p>	<p>... Floor without mass, negative point, very small kitchen space, bathroom with infiltration, poor quality ceramics, there is no problem being in the living room, heater, no maintenance lasts for a year, but there is no course, maintenance, there is no crap. Some people tear down part of the living room wall to increase access to the kitchen, observation, the corner lot, and green area and not house land.</p>
<p>Alaíde da Conceição 83 years old, 2-year-old resident, lives with 2 other people</p>		<p>Do you like to live in the house? "Yes", why? "It's good, there's no fuss, you sleep whenever you want, the neighbors are nice, the house is good. What would you like your home to look like? "I'd like my environment..."</p>	<p>... the size of the rooms is ok, the living room is ok, and the bathroom has bad pottery, bad quality pottery, falling apart, I have already enlarged the kitchen, and they have a service area. The bad thing is the far away location, but it has transport, (buses). It is a location where there is no cellphone coverage, calls for help do not happen due to this problem, there's signal barely in front of the house.</p>
<p>Vera Lucia 43 years old, 6-year-old resident with 4 other people.</p> <p>Eliege Meriele 61 years old, 6-year-old resident with 3 other people.</p>		<p>Do you like the house you live in? "Yes, you just don't like the place", why? "It's far from everything, there's no transportation." What would you like your home to look like? "I'd like my environment..."</p> <p>Do you like to live in the house? "Yes", why? "Negative away from everything, starting from the sentence to be complete". What would you like your home to look like? "I'd like my environment..."</p>	<p>...Room 1 more would be good, bathroom ok, I enlarged the kitchen, because it was small, hot, quiet, but it had maintenance 1 time (between a year and a half), ceramic gets dirty, very large glass window, it should be smaller, risk of theft, poor quality door in the bathroom.</p> <p>... That the window was smaller and without glass, risk of theft, the same observation of daughter Vera Lucia., but the house is good, there are a health center, school, 24-hour ambulance and daycare at the community, and the tax to pay is about R\$ 80 - 83 reais for 10 years.</p>
<p>Joao Luiz 42 years old, 6-year-old resident with 2 other people.</p>		<p>Do you like the house you live in? "Yes", why? "It's quiet, so far I wouldn't trade it for any place." What would you like your home to look like? "I'd like my environment..."</p>	<p>"... Just the issue of the kitchen, I have a problem, the bathroom is not a living room, the bedrooms are ok, nature I am passionate about, as for the heater I don't see the point because we are in the Northeast I also have some plants in buckets because I like it".</p>
<p>Francisco Floriano 53 years old, 4-year-old resident with 5 other people.</p>		<p>Do you like the house you live in? "Yes", why? "It's quiet, and very calm." What would you like your home to look like? "I'd like my environment..."</p>	<p>... I would change the kitchen. It's too small. I would change the bedrooms, I would increase them. I don't like the bathroom in the living room. The living room is great. I would only change the color of the walls to white because it is green. The heater does not work.</p>