

PROPOSING REHABILITATION SOLUTIONS FOR NON-FUNCTIONAL SPACES WITHIN THE FACULTY OF AEROSPACE ENGINEERING

Abstract:

3D modeling is an essential tool in architectural rehabilitation, enabling precise planning and visualization of design interventions. This paper details the creation of a 3D model of a building within the Faculty of Aerospace Engineering, developed in Autodesk Revit based on the building's original architectural plans. The model serves as a foundational element for proposing rehabilitation solutions for non-functional spaces within the building. Furthermore, the paper outlines the interior design approach applied to these spaces, with a focus on the selected design style and principles. This study highlights the contribution of modern digital tools in enhancing both the functionality and aesthetics of academic infrastructure.

Key words: 3D modeling, Revit, architectural rehabilitation, interior design, Faculty of Aerospace Engineering.

1. INTRODUCTION

Within the Faculty of Aerospace Engineering, the efficiency of infrastructure and the optimal use of space are critical elements in fostering an academic environment conducive to innovation and excellence. The need for such optimization becomes increasingly evident in the context of technological advancements and the continuous evolution of design methodologies. This project focuses on rehabilitating non-functional spaces within the faculty, employing a forward-thinking approach. By leveraging 3D modeling techniques and implementing innovative design solutions, the aim is to transform these areas into functional and inviting spaces for study, relaxation, and social interaction.

The creation of a detailed plan based on 3D modeling and spatial design is integral to this process. It ensures that proposed interventions are not only visually coherent but also functionally effective, aligning with the needs of students and faculty members. This approach underscores the importance of modern digital tools in addressing architectural challenges and highlights their role in enhancing the usability and aesthetic appeal of academic environments.



Figure 1. Building T [11]

The rehabilitation of non-functional spaces within academic institutions offers an opportunity to enhance the overall experience of students and staff, promoting both productivity and well-being. In this project, the

focus is on reimagining selected areas within the Faculty of Aerospace Engineering as multifunctional spaces dedicated to studying, relaxation, and social interaction. By incorporating a blend of practical and aesthetic design principles, the goal is to create environments that not only meet the immediate needs of the users but also foster a sense of community and belonging.

Central to this initiative is the application of 3D modeling as a foundational tool for planning and visualization. Using Autodesk Revit, a detailed digital model of the building was developed based on its original architectural plans. This model serves as a framework for exploring design possibilities and ensuring the feasibility of proposed interventions. The spatial design integrates modern styles and user-centered approaches, prioritizing comfort, functionality, and adaptability.

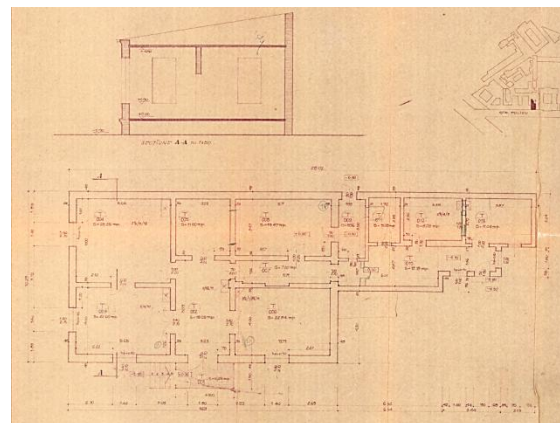


Figure 2. Original Architectural Plan

By transforming these spaces, the project demonstrates the potential of innovative design methodologies and digital tools to repurpose underutilized infrastructure effectively. It emphasizes the role of thoughtful planning in creating environments that balance academic rigor with opportunities for relaxation and informal interaction, thereby enriching the overall academic experience.

2. 3D MODELING OF THE BUILDING

The 3D modeling process began by creating a detailed digital representation of the building using Autodesk Revit. The original architectural plans served as the foundation for this model, ensuring accuracy and consistency in terms of dimensions and structural elements. The building's walls were first modeled using Revit's wall creation tools, followed by the placement of windows, doors, and other essential architectural features. This step established a clear framework, helping to visualize the structure's overall layout and spatial organization. Through these foundational modeling steps, the non-functional spaces were identified, contributing to the rehabilitation strategy.

To illustrate this process, Figure 3 shows the initial stage of modeling the building's exterior walls. These walls were created by defining parameters such as height, thickness, and materials, which were derived directly from the architectural plans. Once the walls were modeled, the windows and doors were added, aligning with the original design to ensure accuracy. These elements are crucial in establishing the building's envelope and contributing to the accuracy of the 3D model.

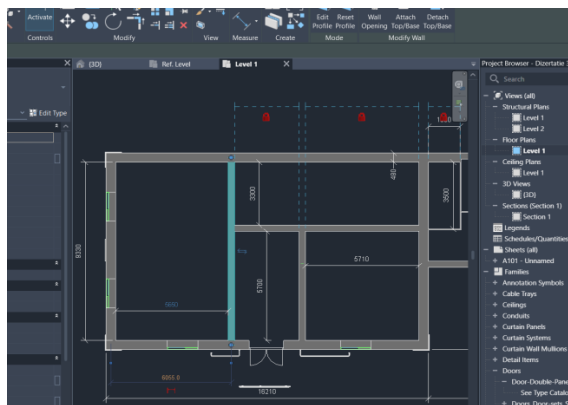


Figure 3. Initial Stage Of 3D Modeling

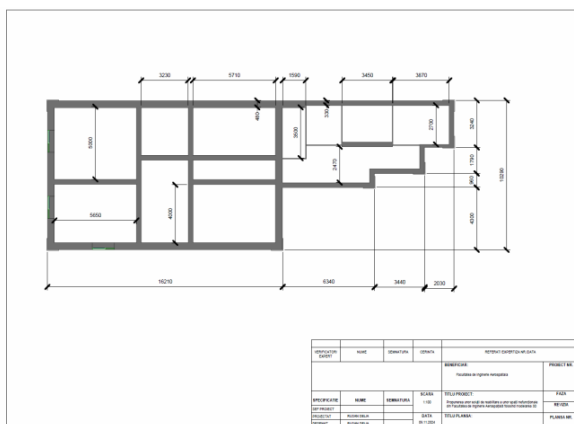


Figure 4. Plan of Building's Floor Level

After establishing the wall thickness and dimensions, a level plan was extracted from the 3D model, incorporating dimensions aligned with the original

architectural plans. This ensured accuracy in representing the building's internal layout and provided a clear reference for further design interventions.

Following the establishment of the basic geometry, the next step involved adding detailed elements such as windows, wall textures, and the roof to further enhance the 3D model. This allowed for a more realistic representation of the building's external and internal features. The following pictures illustrate how these additional components—windows, wall textures, and the roof—were integrated directly into the model, providing a comprehensive visualization of spatial layouts, external finishes, and structural relationships.

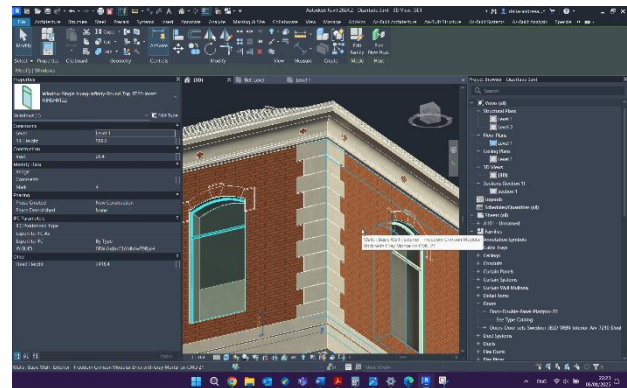


Figure 5. Texture Details of Building Walls

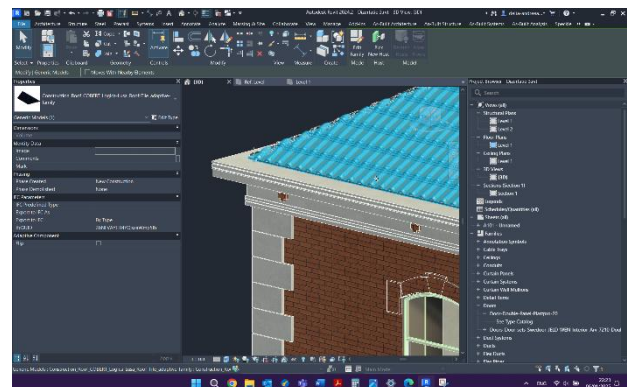


Figure 6. Roof Structure Added to 3D Model

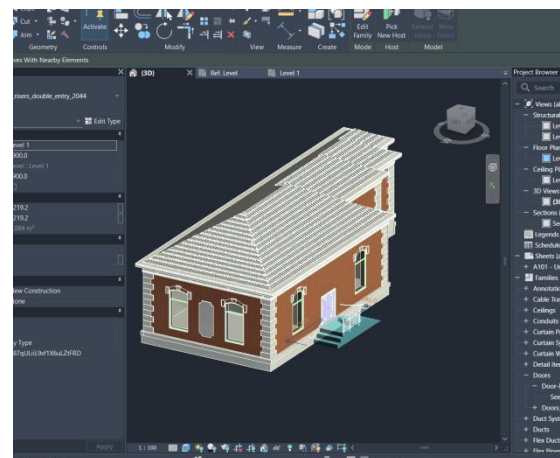


Figure 7. Final Finishes

Following the application of textures and the addition of the roof, the subsequent images represent the modifications made to the interior spaces. Figure 8 illustrate the updated layout, with attention to room dimensions, finishes, and spatial organization. These changes aim to optimize the usability of the building while preserving its structural stability.

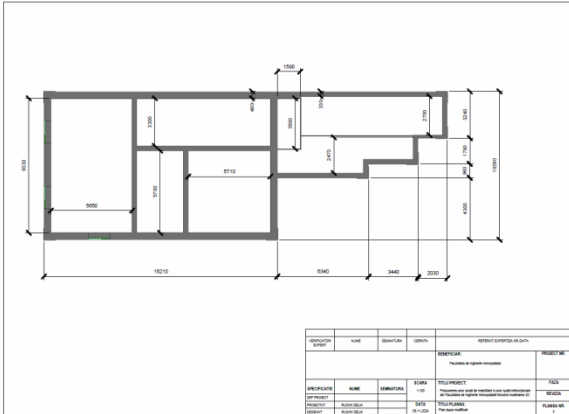


Figure 8. Final Plan After Modifications

The following images will present rendered views of the building's exterior, showcasing the final design with the applied textures, materials, and roof structure. These visualizations highlight the complete exterior elements, providing a comprehensive look at the building's overall appearance.

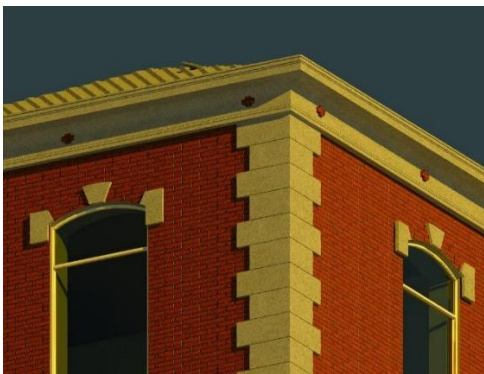


Figure 9. Rendering of the Building



Figure 10. Rendered Roof and Exterior Details

3. DESIGN APPROACH: BIOPHILIC ELEMENTS & THE INTEGRATION OF NATURE INSPIRED AESTHETICS

The design approach adopted for the rehabilitation of the building was centered on biophilic principles, which emphasize the connection between humans and nature. Biophilic design seeks to incorporate elements from the natural environment, fostering a sense of well-being, comfort, and relaxation. By blending natural materials, patterns, and textures with artistic elements, the aim was to create a space that feels both calming and inspiring, enhancing the overall academic experience for students and faculty alike.

One of the key aspects of the biophilic design was the integration of natural materials such as wood, stone, and earthy tones into the building's interior. These materials were carefully chosen to evoke a sense of warmth and connection to nature. For instance, wooden accents were introduced in various forms—such as wall panels, flooring, and furniture—to create a tactile and visually pleasing environment.



Figure 11. Wood integration

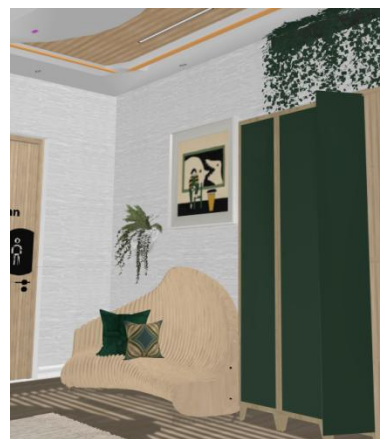


Figure 12. Wood Furniture

Figures 11 and 12 highlight how these materials were applied in the design. The wood-panelling on the walls not only adds aesthetic value but also contributes to acoustics, improving sound absorption and creating a more

comfortable environment for study and social interaction. Together, these features create a harmonious blend that supports the biophilic design philosophy.

In addition to natural materials, the incorporation of greenery and living elements played a significant role in enhancing the biophilic design. Indoor plants and green walls were strategically positioned throughout the building to promote a connection with nature, providing a visual and sensory experience. The presence of plants helps reduce stress, improve air quality, and foster a sense of tranquility.



Figure 13. Wall Plants

Figures 13 and 14 showcase examples of green walls and indoor plants incorporated into the building design. These living elements not only beautify the space but also contribute to a more dynamic and rejuvenating environment. The use of plants, such as ferns, ivy, and low-maintenance species, ensures that the interior spaces remain vibrant and sustainable over time.

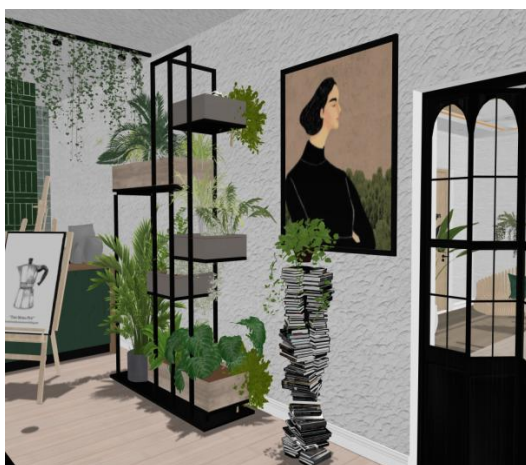


Figure 14. Indoor Plants

To enhance the biophilic experience, artistic elements inspired by nature were blended seamlessly into the design. The combination of natural patterns, textures, and forms with contemporary art helped to evoke a sense of

creativity and inspiration. Artistic features such as murals, abstract patterns, and sculptural elements were introduced to complement the natural materials and create a visually engaging space (see Figures 15 and 16).



Figure 15. Integrating Art into the Design



Figure 16. Incorporate art

Figure 17 highlight how abstract art and natural motifs were integrated into the design. Sculptural elements resembling organic shapes contribute to a visually stimulating and emotionally uplifting atmosphere. This fusion of art and nature enhances the overall biophilic experience, encouraging a deeper connection with the environment.



Figure 17. Sculptural element

Figures 18 and 19 demonstrate how various design elements work together to create a cohesive and inviting atmosphere. Comfortable furniture, soft lighting, and the integration of natural materials contribute to a sense of ease and relaxation. These design choices aim to reduce stress and promote a positive, nurturing environment where users can feel connected to both nature and the academic setting.



Figure 18. Coffee shop design

While the biophilic design focused on creating a warm and inviting atmosphere, spatial organization and functionality remained key considerations. The goal was to ensure that the interior spaces were not only aesthetically pleasing but also practical and adaptable to the needs of students and faculty.

4. RENDERING THE INTERIOR SPACES

Following the completion of the design process, rendering was employed to visualize the final appearance of each interior space. This step was critical in showcasing how the design elements come together to create functional, visually appealing, and inviting environments. Each room was rendered individually, highlighting the specific details, textures, and finishes tailored to its intended use.

4.1 Entrance Area

The entrance area serves as the first impression of the rehabilitated building, and its design emphasizes warmth, functionality, and a welcoming atmosphere. The rendered visualization highlights the integration of natural textures, such as wood-paneled walls and plants accents, which create a harmonious blend of modern and natural aesthetics.

Lighting played a crucial role in the entrance design, with soft, diffused illumination enhancing the materials and adding depth to the space. Comfortable seating areas, surrounded by greenery, were included to provide a relaxing and functional space for students and faculty as they enter the building. The renders also showcase the use of large windows that allow natural light to flood the area, further reinforcing the biophilic theme.



Figure 19. Entrance Area



Figure 20. Entrance Room



Figure 21. Entrance Design



Figure 22. Hallway Design

4.2 Women's Restroom

The women's restroom was designed with a focus on cleanliness, comfort, and aesthetic harmony. Its layout mirrors that of the men's restroom, ensuring uniformity and efficient use of space. The design employs calming, neutral tones and high-quality materials, such as ceramic tiles and sleek countertops, creating a sophisticated and welcoming atmosphere.

To enhance the aesthetic appeal, natural elements like wooden frames and plant-inspired artwork were incorporated. These details, along with the careful selection of modern fixtures, contribute to a cohesive design aligned with the overall theme of the building. The use of greenery and soft lighting further adds warmth and elegance, making the restroom a pleasant environment while maintaining its functional purpose.



Figure 23. Women's Restroom Design

4.3 Men's Restroom

The men's restroom mirrors the design and layout of the women's restroom, with a similar focus on modern aesthetics, comfort, and functionality. Like its counterpart, it features neutral tones, high-quality ceramic finishes, and sleek fixtures, ensuring a cohesive look throughout the building.

While the general design remains consistent, the distinguishing element lies in the artwork. In the men's restroom, the framed pieces reflect a different selection of nature-inspired themes, complementing the use of wood accents and greenery.

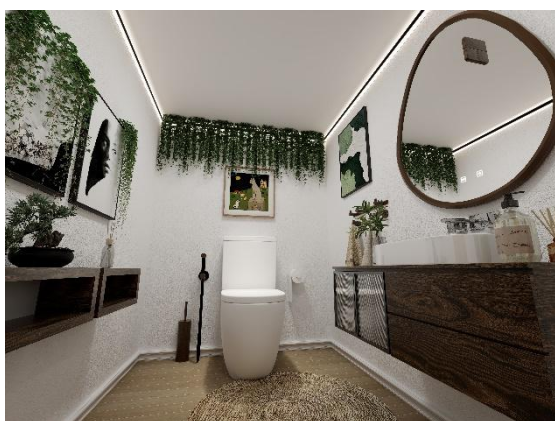


Figure 24. Men's Restroom Design

4.4 Café Area

The café area stands as a central feature of the rehabilitated building, embodying the principles of relaxation, socialization, and community engagement. This space was carefully designed to serve as both a retreat for individuals seeking a quiet moment and a dynamic hub for informal gatherings and meetings. The rendered images capture the inviting atmosphere of the café, where elements of nature, artistic expression, and modern functionality converge harmoniously.



Figure 25. Café Design

The design prominently incorporates greenery, with lush plants thoughtfully positioned throughout the space, creating a biophilic environment that promotes well-being and reduces stress. Textures inspired by nature, such as wooden furniture and panelling, further enhance the organic feel of the café. The use of these natural materials not only adds warmth but also fosters a connection to the outdoors, even within the interior space.



Figure 26. Café Design

Artistic elements play a significant role in elevating the character of the café. Walls are adorned with nature-inspired artwork and abstract pieces that complement the earthy tones of the furniture and decor. Unique design elements, such as hanging planters, custom light fixtures, and accent walls with textured patterns, lend a modern yet approachable vibe. These features ensure that the café feels both visually stimulating and comforting, inviting students and faculty to linger longer.



Figure 27. Café Vibes

The seating arrangements were designed with flexibility in mind, catering to a variety of needs. Cozy armchairs and small tables offer intimate spaces for focused work or casual conversations, while larger communal tables encourage collaboration and group discussions. The diverse seating options make the café an adaptable space for all users.



Figure 28. Art and Greenery

Natural light plays a crucial role in shaping the ambiance. The inclusion of large windows floods the space with sunlight during the day, while strategically placed soft, warm lighting creates a soothing atmosphere in the evenings. The interplay of light and shadow highlights the textures of the materials used, such as the grain of the wooden surfaces and the vibrant green tones of the plants.



Figure 29. Art and Greenery

The counter area, an essential element of the café, was designed to combine aesthetics with functionality. With its clean lines and durable materials, the counter serves as both a practical workspace and a focal point of the design. The sleek countertop create an inviting spot for quick refreshments, while the use of subtle accents—like metallic trims and decorative shelving—adds a touch of sophistication.



Figure 30. Counter Area

Every detail of the café reflects a commitment to creating a space that feels welcoming and engaging. By blending biophilic design, artistic expression, and functional furniture, the café becomes more than just a place to enjoy a coffee. It transforms into a versatile and inspiring environment where students and faculty can unwind, connect, and thrive.



Figure 31. Unique Elements



Figure 32. Café Entrance

7. CONCLUSIONS

This study highlights the transformative potential of 3D modeling and biophilic design in rehabilitating non-functional spaces within the Faculty of Aerospace Engineering. By leveraging modern technology and innovative design principles, this project successfully reimagined spaces into environments that foster comfort, productivity, and social interaction.

The use of 3D modeling proved instrumental in visualizing the building's current conditions, enabling precise planning and design interventions. Through the detailed rendering of the interior spaces, such as the café, restrooms, and entry areas, the proposed solutions seamlessly integrated aesthetics, functionality, and sustainability. The design choices—rooted in biophilic principles and inspired by natural textures, greenery, and warm tones—created an inviting and modern atmosphere, reflecting a commitment to both environmental and human well-being.

In conclusion, the integration of cutting-edge 3D modeling technologies and thoughtful design practices underscores the potential of interdisciplinary approaches to redefine spaces in academic institutions. This initiative not only addressed immediate functional issues but also set a precedent for future projects that aim to harmonize technology, design, and sustainability in creating environments that support academic excellence and community building.

REFERENCES

- [1] Dori, Y., Belcher, J., Besette, M., Danziger, M., McKinney, A., & Hult, E. (2003). Technology for active learning. **Materials Today,** Vol. 6, pp 44–49. Available at: <https://www.sciencedirect.com/science/article/pii/S1369702103012252> . Accessed: 2023-11-15.
- [2] Hunley, S., & Schaller, M. (2009). Assessment: the key to creating spaces that promote learning. **EDUCAUSE Review,** Vol. 44, pp. 26–35. Available at: <https://eric.ed.gov/?id=EJ833675> . Accessed: 2023-11-15.
- [3] Smith, J. (2018). Benefits of 3D Modeling in Infrastructure Analysis. **Journal of Architectural Engineering,** Vol. 45, pp. 45–60. American Society of Civil Engineers.
- [4] Lippincott, J. (2009). Learning spaces: involving faculty to improve pedagogy. **EDUCAUSE Review,** Vol. 44, pp. 16–25. Available at: <https://eric.ed.gov/?id=EJ833674> . Accessed: 2023-11-15.
- [5] Lomas, C., & Oblinger, D. (2006). Student practices and their impact on learning spaces. In: **Learning Spaces,** D. Oblinger (Ed.), pp. 5.1–5.11. EDUCAUSE, Washington, DC. Available at: <https://www.webofscience.com/wos/woscc/full-record/WOS:000237851000004> . Accessed: 2023-11-17.
- [6] Montgomery, T. (2008). Space matters: experiences of managing static formal learning spaces. **Active Learning in Higher Education,** Vol. 9, pp. 122–138. Available at: <https://journals.sagepub.com/doi/abs/10.1177/1469787408090839> . Accessed: 2023-11-18.
- [7] Engelbrechts, S. (2013). **Eclectic Interiors: Ideas and Inspiration from the World's Best Designers,** Universe Publishing, New York, USA.
- [8] Autodesk. Features of Revit LT. Available at: <https://www.autodesk.co.uk/products/revit-lt/features> . Accessed: 2023-11-19.
- [9] Oblinger, D. (2006). Space as a change agent. In: **Learning Spaces,** D. Oblinger (Ed.), pp. 1.1–1.4. EDUCAUSE, Washington, DC. Available at: https://scholar.google.com/scholar_lookup?hl=en&publication_year=2006&pages=1.1-1.4&author=D.+Oblinger&title=Learning+spaces . Accessed: 2023-12-02.
- [10] Faculty of Aerospace Engineering, History. Available at: <http://www.aero.pub.ro/ro/istoria-facultatii/> . Accessed: 2024-01-04.
- [11] Google Maps: Faculty of Aerospace Engineering. Available at: <https://www.google.com/maps/place/Facultatea+de+Inginerie+Aerospa%C8%9Bial%C4%83> . Accessed: 2024-05-08.
- [12] **The Impact of Physical Environment on Employee Well-Being and Performance.** Available at: <https://www.sciencedirect.com/science/article/pii/S0277953689901536> . Accessed: 2024-05-08.
- [13] Kellert, S. R., Heerwagen, J. H., & Mador, M. (2008). **Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life,** Wiley, Hoboken, NJ, USA.
- [14] Mehta, G. K., & Tada, K. (2007). **Japan Style: Architecture, Interiors & Design,** Tuttle Publishing, Vermont, USA.

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