DEPOSITORY
ARCHITECTURAL DESIGN JOURNAL

IRAH-IRAHAN PAVILION: INTEGRATING SUSTAINABILITY AND INDONESIAN CULTURAL STORYTELLING THROUGH PAVILION BAMBOO DESIGN IN NANSHA BIRD PARK

Dara Citra Saraswati Tutuko [1*], Rizal Qunaini [2], Krisna Wijaya Nagata[3], Tyastuti Cahyani Pancaputri [4], Ari Rifki Ramanda Putra[5], Anisatur Robi'ah[6], Pindo Tutuko[7].

[1] Graduate School of Natural Science and Technology, Geoscience and Civil Engineering, Kanazawa University, Japan
[2] Anma Studio, Malang, Indonesia
[3]Dinas Pekerjaan Umum dan Penataan Ruang Kabupaten Konawe Selatan, Indonesia
[4]Leora Indonesia, Harka Office, Jakarta, Indonesia
[5] Fede Interior, Surabaya, Indonesia
[6]Department of Magister Architecture, University of Merdeka Malang, Malang, Indonesia
[7] Department of Architecture, University of Merdeka Malang, Malang, Indonesia.
- *Email of Corresponding Author: daratutuko@gmail.com*

ABSTRACT

The Irah Irahan Pavilion is a sustainable bamboo structure designed to embrace Indonesia's cultural heritage while integrating eco-friendly construction techniques. Inspired by Wayang, particularly the headpiece (Irah-Irah) of Gatotkaca, this pavilion symbolizes strength, resilience, and traditional craftsmanship. The design incorporates bamboo weaving (*anyaman bambu*) and active-bending techniques, allowing for a lightweight yet durable form that minimizes material waste. Located in Nansha Bird Park, the pavilion harmonizes with its natural surroundings, enhancing the visitor experience while promoting environmental consciousness. The project explores bamboo's structural potential, utilizing modular assembly and efficient construction methods to ensure sustainability and adaptability. Through the fusion of cultural symbolism, and ecological responsibility, the Irah Irahan Pavilion demonstrates the potential of bamboo construction in creating aesthetic, functional, and environmentally sustainable design.

Keywords: *Bamboo Architecture; Indonesian Culture- Inspired Design; Sustainable Pavilion.*

INTRODUCTION

The Irah Irahan Pavilion was designed as an entry for a competition organized by University of Warmadewa, Bali in collaboration with the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN International Colleges and Universities Construction Competition. Hosted by the School of Architecture at South China University of Technology and Guangzhou Nansha Bird Park, this competition is recognized as the largest construction competition in China. The pavilion serves as a functional and aesthetic structure, providing shade and enhancing the landscape of Nansha Bird Park. To align with the competition's theme, the design incorporates bamboo construction, while embracing traditional architectural characteristics.

In some architectural events or in recreational places, a pavilion is a small-scale architectural work designed for the purpose of an installation or exhibition, as presented on figure 1. Japanese pavilion designed for Venice Biennale 1956, an exhibition pavilion that floats on a forested area (TOMIOKA et al., 2022). The pavilion is aiming to show fusion of Japanese and International style especially in a post-war era. At Milan Expo 2015, Designed by Atsushi Kitagawara Architects, the Japan pavilion aims to showcase traditional techniques influenced by extreme natural events such as earthquakes (Cipollini et al., 2016). In Canada, the 2019 Gridshell Research Pavilion at the School of Architecture, Planning and

Landscape at the University of Calgary, a grid shell structure pavilion is built to show the blend of traditional physical form-finding techniques with digital design(Rubio et al., 2019). In Beijing Expo 2019, a Chinese Pavilion was created to symbolize the shift of lifestyle in China by displaying the national cultural and technical characteristics of the country with a green building approach (Jing et al., 2021). Participating in the world expo 2025 in Osaka, Indonesia create a pavilion that shows identity as an archipelago country, a boat shaped pavilion serves as a powerful cultural symbol that is embedded in Indonesian history (Nour Fakharany, 2024). In conclusion, a pavilion is a typology that serves as a medium of communication through forms and creations that represent a philosophy or message from its design.

Figure 1 Precedent Study of Various Pavilion Design (Source: Author, 2025)

Pavilion design provides architects with an opportunity to explore innovative methods and materials, challenging the limits of conventional architectural concepts(Tuncbilek, 2020). Pavilions, as temporary structures commonly built in parks and gardens, offer flexible and open architectural forms that adapt to various functions and environments(Jung & Park, 2023). The temporary nature of pavilions enables the exploration of cost-effective and environmentally friendly design solutions (Łątka & Święciak, 2021). Pavilions serve as a space for cultural exchange and artistic expression, showcasing diverse creative expression(Reaver, 2022). Therefore, this typology allows for greater freedom of expression in form and concept. The design aims to show the identity of Indonesian culture within a bamboo pavilion.

The project explores bamboo construction techniques, aiming to create a form that reflects Indonesia's cultural identity through innovative craftsmanship and structural expression. Bamboo, valued for its

strength, versatility, and sustainability, is a rapidly renewable resource widely used in structural and decorative construction as an eco-friendly alternative. Bamboo is an eco-friendly material known for its fast growth and minimal energy demand for cultivation, making it a renewable resource that can be harvested sustainably with minimal environmental impact(Adebowale & Agumba, 2024; Deb & Sen, 2025). Bamboo is an ideal material for outdoor construction due to its durability and versatility. The main design challenge lies in creating a pavilion that is both aesthetically pleasing and structurally strong, while also harmonizing with the landscape and enhancing the functionality of the bird park.

LOCATION DESCRIPTION

Nansha Bird Park is a sanctuary wetland as a habitat for various bird species. As a famous eco-tourism destination, the park provides an ideal setting for a bamboo pavilion that blends with nature. It is located at the southernmost part of Guangzhou, Guangdong Province, China, shown in figure 2. As presented in figure 3, the site is characterized by lush greenery, water features, and open spaces, offering both aesthetic and functional potential for integrating the pavilion seamlessly into the environment. The considerations in selecting the site were ensuring that the pavilion complements the existing landscape and does not disrupt the natural ecosystem. The design process took into account bird-friendly principles, such as minimizing reflective surfaces to prevent bird collisions and using natural, sustainable materials that harmonize with the surroundings. By integrating local site conditions with sustainable bamboo construction, the pavilion not only supports the park's function as a recreational and educational space but also serves as a symbol of eco-conscious architecture.

Figure 2 Nansha Bird Park Location at Guangzhou, Guangdong Province, (Source: Google Earth, 2025)

Figure 3 Nansha Bird Park Site View (Source: Google Earth, 2025)

THE SITE ANALYSIS

Nansha Bird Park is a very wide area, the particular site on a figure 4 was selected for its beautiful landscape captivating scenery. The area merges aquatic and bird land features, create a balanced ambiance that is perfect for the installation of pavilions and the observation of birds. The existence of wetlands in this area has a rich biodiversity, offering a diverse habitat for numerous avian species. Furthermore, the wetland ecosystem provides a great atmosphere, perfect for educational and leisure activities. Thus, the pavilion design should integrate the habitation, water area, and existing access on the site. As presented on figure 5, The integration of 3 main item of pavilion area should be considered in design and construction process.

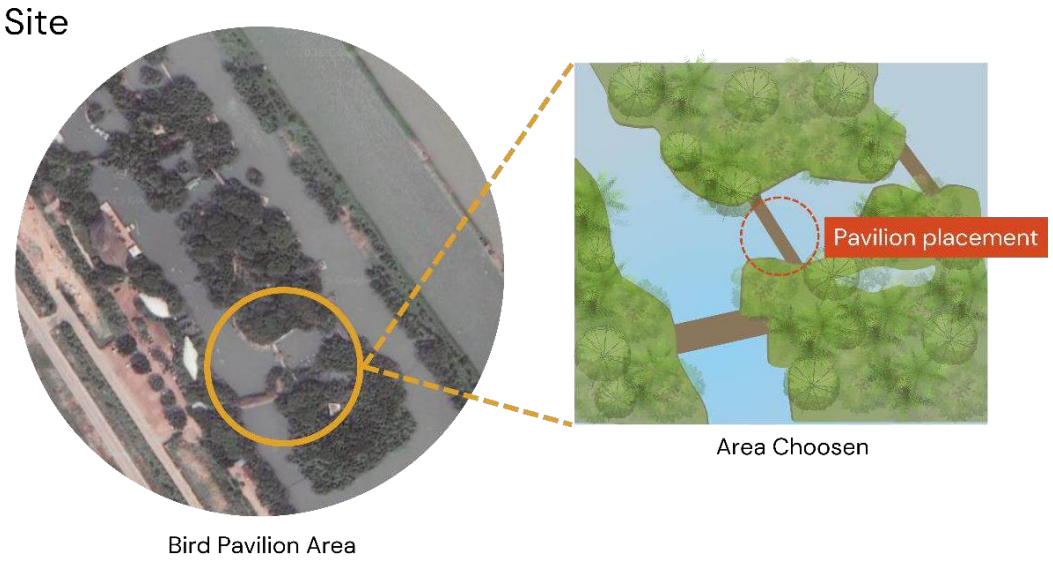

Figure 4 Bird Pavilion Area (Source, Author, 2025)

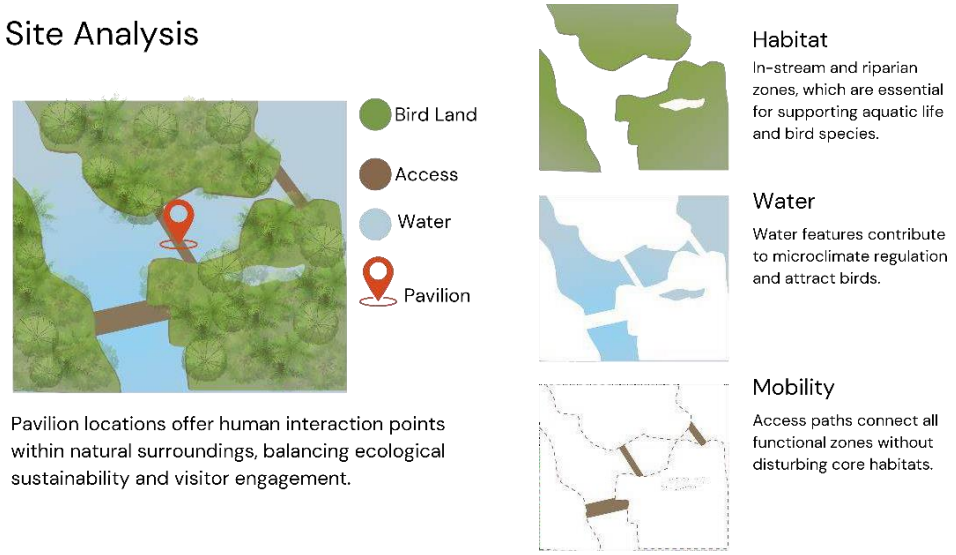

Figure 5 Site Analysis (Source: Author, 2025)

Presented on figure 6, the design is emphasizing site assessment on solar and wind conditions, as the pavilion is an exterior structure that is intricately connected with the natural surroundings. Understanding the solar path help to optimize shading and thermal comfort for visitors throughout the day. The pavilion is located in the southern region of China, where the weather is comparatively warm-mild. The elevated

sun angle signifies intense midday illumination, particularly from the south-southeast angle. Consequently, the design should integrate shading features, especially on the south-facing aspects, to enhance visitor comfort. Wind strength in this area is moderate, fluctuating between 5.0–7.0 m/s. As a design strategy, the pavilion should accommodate the airflow for pavilion's envelope or shading constructs. The design considerations not only enhance comfort for visitors but also for birds, offering them sheltered areas to alight and rest, shielded from direct strong breezes or high sunlight.

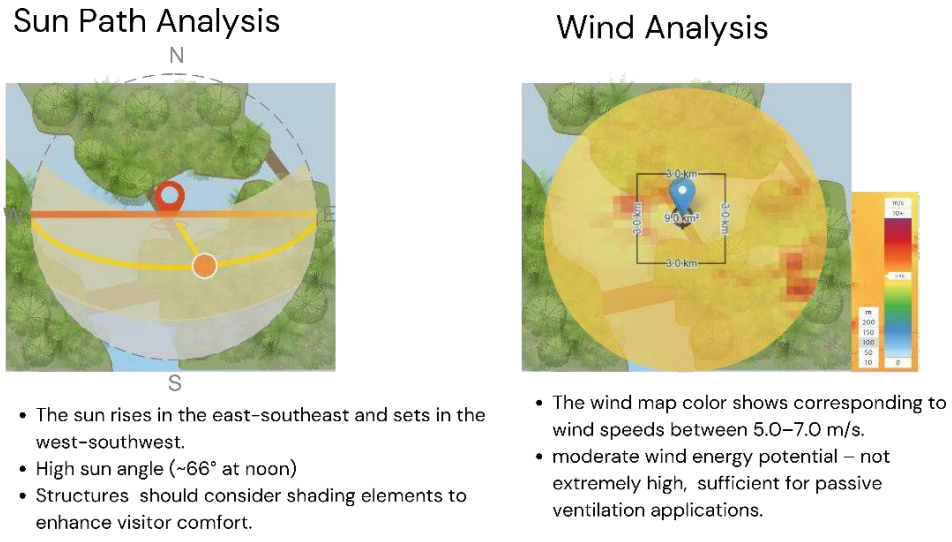

Figure 6 Sun Path and Wind Analysis (Source Author, 2025)
Sun Path generated with www.suncalc.org, Wind Analysis generated with globalwindatlas.info

CONCEPTUAL APPROACH AND WARFARE THEME

Metaphor Architecture Concept as Cultural Storytelling

This project will prospectively be built in China, therefore, the mission behind this design is also to introduce Indonesian culture to the international visitors. The design will highlighting the popular features of *Wayang*, Indonesian traditional art. Aim to tell that the distinctive characteristics of Indonesian culture are beautiful, through the representation of a pavilion. Although it does not fully represent the form of *Wayang*, one of its noticeable features becomes a powerful storytelling element in the design. To convey the beauty of Wayang, this design uses metaphor concept.In architectural concept, metaphor refers to a symbolic comparison between a building's form and another object, aiming to evoke a response from observers or users (Asshofie et al., n.d.).

Metaphorical architecture is an expression of meaning embodied in an architectural form, creating a perceptual experience for those who observe and interact with the structure(Prihutama, 2020). It establishes an abstract rather than literal connection, identifying parallel relationships between elements (Arsitekno & Ii Juli, 2013). This concept consists of two main elements: form and meaning(Prihutama, 2020). The pavilion design incorporates both aspects of metaphorical interpretation. In terms of form, the design draws inspiration from Gatotkaca's headpiece, a distinctive element in Wayang, one of Indonesia's traditional performing arts. This element is translated into the pavilion's architectural shape, emphasizing grandeur, movement, and identity. In terms of meaning, Gatotkaca represents strength, resilience, and power, qualities that parallel the inherent characteristics of bamboo as a natural building material. Just as Gatotkaca is known for his supernatural strength, bamboo, despite its lightweight nature, possesses remarkable durability and flexibility, making it an ideal material for sustainable and robust construction.

Through this metaphorical approach, the Irah Irahan Pavilion not only celebrates Indonesia's cultural heritage but also highlights the structural and ecological significance of bamboo in contemporary architecture. The representation of the metaphor concept is presented on figure 7.

Figure 7 Methapor Concept (Source: Author 2021)

Sustainable Architecture Approach

Creating sustainable construction is an important consideration. In response, the pavilion design adopts a Sustainable Bamboo Construction approach, as illustrated in Figure 8. Sustainable architecture is a comprehensive strategy aimed at reducing environmental impact, which is why this design adopts a sustainable approach to minimize waste and ensure efficient construction. Since pavilions are often temporary structures, the design considers efficient assembly and disassembly methods to reduce material waste during both construction and deconstruction. To achieve this, the pavilion maximizes the use of bamboo, a renewable and eco-friendly material, while minimizing the incorporation of less sustainable materials. Bamboo's high tensile and flexural strength makes it well-suited for structural applications without requiring additional support(Cui et al., 2024). Its natural flexibility also allows for the integration of active-bending techniques(Wang et al., 2024), where woven bamboo strips (*anyaman bambu*) are utilized as both a structural component and an aesthetic wall enclosure. A bamboo woven wall, made from interwoven bamboo fillers, enhances construction stability and sturdiness(Umar et al., 2020). Moreover, the bending ability of bamboo enables the pavilion to form a dynamic and organic shape, reinforcing both functionality and sustainability in the design.

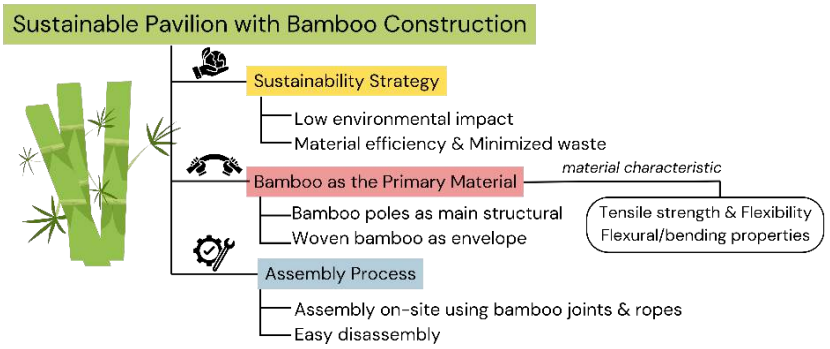

Figure 8 Sustainable Approach for Bamboo Pavilion Design (Source: Author 2021)

DESIGN THEME

The design theme is to embrace the traditional culture of Indonesia. The Irah Irahan Pavilion is designed to express the essence of traditional Indonesian culture, specifically inspired by Wayang, the Indonesian shadow puppet theater. *Wayang* is a traditional art form that originated and developed within Javanese society (Sulaksono & Saddhono, 2018).The pavilion draws its conceptual foundation from Gatotkaca, as mentioned in (Clark, 2004) Gatottkaca is a well-known knight that have a paternalism character in wayang. His legendary figure from the Mahabharata, known as "Muscle of Iron, Bone of Steel" for his unparalleled strength and heroism. The name Irah Irahan, meaning "the greatest crown," reflects the distinctive crown worn by Gatotkaca, which serves as a symbol of power, resilience, and nobility. Just as Gatotkaca symbolizes strength, bamboo, the primary material used in the pavilion, exhibits structural integrity and sustainability. Bamboo's natural flexibility and strength allow for an architecturally express Gatotkaca legendary.

Furthermore, embracing traditional culture goes beyond philosophical inspiration, and also involves adopting traditional bamboo construction techniques. In Indonesia, bamboo crafts have long been a familiar tradition, with many people utilizing bamboo trees as a key material for crafting(Feby et al., n.d.). The pavilion applies this technique for forming the shape, especially the form and ornamental features. Applied in façades, shading panels, and structural elements, decorative woven bamboo patterns will reflect Indonesian craftsmanship. The combination of a Wayang-inspired form and traditional bamboo weaving construction techniques will effectively express traditional culture in this design, blending symbolic heritage with sustainable craftsmanship.

IMPLEMENTATION OF CONCEPT IN DESIGN

The Irah Irahan Pavilion is a result of a transformative design process, integrating traditional cultural elements with modern architectural techniques. The design concept is inspired by the Irah-Irah, the elaborate headpiece worn by Wayang characters, particularly Gatotkaca. Illustrated in figure 9, the transformation process begins with the original form of the Irah-Irah, which is then simplified into its fundamental shapes before being stylized into a dynamic architectural structure. The pavilion's form consists of three main elements derived from the traditional headpiece: Gelung, Jamang, and Sumping, each representing different parts of the Wayang crown. These elements are expressed through curved, interwoven bamboo structures, emphasizing both fluidity and structural integrity. These traditional motifs are translated into the pavilion's design through the use of curved, interwoven bamboo structures that express both fluidity and structural integrity. The bamboo framework emphasizes the pavilion's graceful, organic shape, while also ensuring that the building remains sturdy with its dome-like envelope.

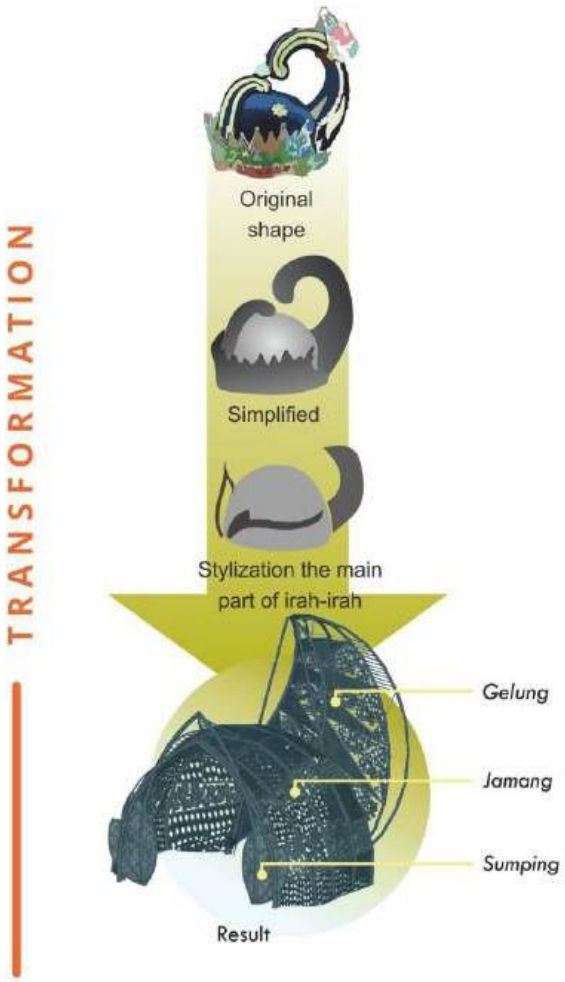

Figure 9 Design Transformation from Metaphor Concept (Source: Author 2021)

The Irah Irahan Pavilion integrates sustainable approach and traditional technique to minimize material waste. Given the temporary nature of pavilions, a modular assembly approach allows for efficient construction and disassembly, minimizing waste while enabling adaptability. Presented on figure 10, the bamboo frame and woven bamboo strips (*anyaman bambu*) serve as both structural and aesthetic elements, reinforcing stability and enhancing natural ventilation and shading. Additionally, the active-bending technique takes advantage of bamboo's flexibility, enabling the creation of a dynamic, curved form that reflects the fluidity. The traditional techniques used in this construction are illustrated in figure 11. Moreover, to maximize the usage of bamboo, every single piece of bamboo cuts will be arranged. The *bilah bambu* or bamboo cut is arranged as a decorative enclosure other than bamboo woven. Through these design applications, the pavilion successfully achieves ecological consciousness and cultural significance, enhancing both visitor experience and the surrounding landscape.

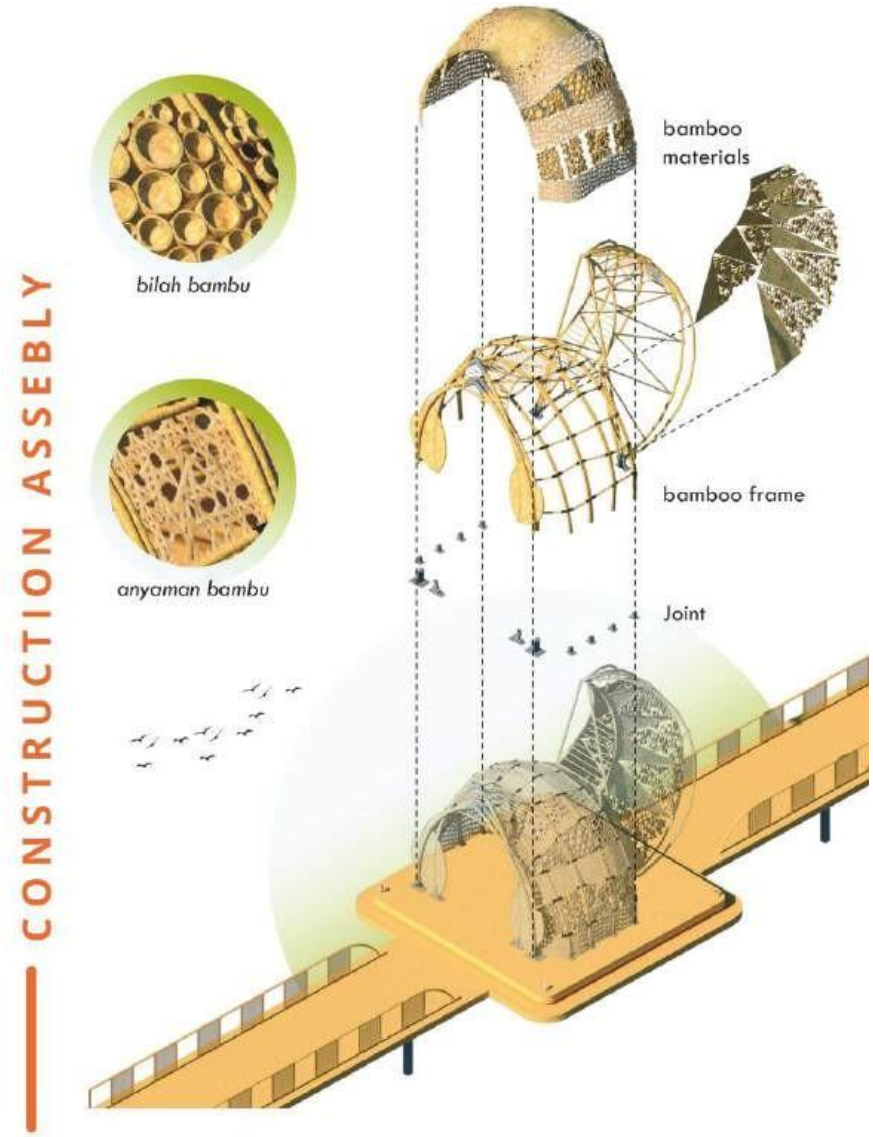

Figure 10 Construction Assembly Adapting Sustainable Approach (Source: Author 2021)

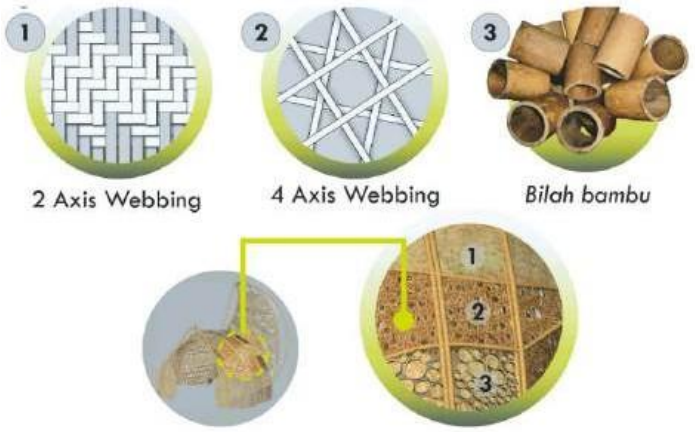

Figure 11 Traditional Technique applied in the construction (Source: Author 2021)

The Irah Irahan Pavilion is beautifully located within the serene landscape of Nansha Bird Park, seamlessly blending with its natural surroundings. As illustrated in figure 12 – figure 15, the pavilion is positioned on a floating platform along the waterfront, enhancing the scenic experience for visitors while providing a nice and shaded resting space. The organic bamboo structure and the unique form, harmonizes with the greenery and waterscape, reinforcing the pavilion's role as an eco-friendly architectural landmark within the park.

Figure 12 Perspective View of Pavilion (Source: Author 2021)

Figure 13 Side Perspective of Pavilion (Source: Author 2021)

Figure 14 Front View of the Pavilion (Source: Author 2021)

Figure 15 Back View of Pavilion (Source: Author 2021)

CONCLUSION AND SUGGESTIONS

This project successfully explores bamboo to create a pavilion that represent Indonesia's cultural identity through a fusion of traditional craftsmanship and structural innovation. By integrating Wayang-inspired forms and bamboo weaving (*anyaman bambu*), the design not only reflects symbolic heritage but also demonstrates sustainable construction practices. The pavilion leverages bamboo's natural strength, flexibility, and active-bending capabilities to achieve a dynamic yet structurally sound form, minimizing the need for additional materials and reducing waste. Through this approach, the Irah Irahan Pavilion stands as an architectural expression of cultural storytelling, material efficiency, and ecological responsibility, reinforcing the significance of bamboo as a sustainable and culturally meaningful building material.

For future development, a more detailed study on bamboo forming techniques should be conducted to identify potential construction obstacles and optimization strategies. This project is the lack of detailed exploration of bamboo forming techniques, which could provide a deeper understanding of construction

challenges and material behavior during the building process. Additionally, the specific types of bamboo used were not explicitly identified, despite the fact that different bamboo species may possess unique structural properties and aesthetic characteristics that could further enhance the design.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude for the opportunity to participate in the 2021 Guangdong-Hong Kong-Macao Greater Bay Area - Association of Southeast Asian Nations International Colleges Design and Construction Competition, Indonesia Division: International Student Competition in Architectural Design and Construction of Bamboo. This work was developed as part of the Rupadhatu Team from University of Merdeka Malang and was honored as the third winner in the competition. We acknowledge the contributions of all team members, the supervising lecturer, and the Architecture Department of UNMER Malang.

REFERENCES

Adebowale, O. J., & Agumba, J. N. (2024). Bamboo in sustainable construction: effects on productivity and safety. In *International Journal of Productivity and Performance Management* (Vol. 74, Issue 11, pp. 1–20). Emerald Publishing. https://doi.org/10.1108/IJPPM-06-2023-0307

Arsitekno, J., & Ii Juli, V. (2013). *Penerapan Arsitektur Metafora Pada Museum Tsunami Aceh Di Banda Aceh*.

Asshofie, S., Saladin, A., & Alitopan, M. (n.d.). *STUDI KOMPARASI ARSITEKTUR METAFORA PADA BANGUNAN OCEANARIUM COMPARATIVE STUDY OF METAPHORE ARCHITECTURE ON OCEANARIUM BUILDING*.

Cipollini, M., Bonannini, E., Cinotti, M., & Sassu, M. (2016). Design, production, and installation of wooden walls for the Japan Pavilion at Expo 2015. *Buildings*, *6*(4). https://doi.org/10.3390/buildings6040043

Clark, M. (2004). Too many Wisanggenis: Reinventing the Wayang at the turn of the century. *Indonesia and the Malay World*, *32*(92), 62–79. https://doi.org/10.1080/1363981042000263462

Cui, J., Luo, H., Chen, G., Wang, R., Ba, Z., & Guo, Z. (2024). Fe3O4 nano particles filled densified bamboo with improved strength, fracture toughness, fire and water resistance. *Construction and Building Materials*, *422*. https://doi.org/10.1016/j.conbuildmat.2024.135792

Deb, S., & Sen, T. (2025). Bamboo reinforcement towards sustainability: An overview. *Interactions* , *246*(1). https://doi.org/10.1007/s10751-024-02213-4

Feby, L., Setiyowati, A., Mursidi, A., & Nurullita, H. (n.d.). *International Journal of Social Culture HISTORY OF GINTANGAN BAMBOO WEAVING IN 1990 (HISTORY OF GINTANGAN BAMBOO WAVING IN 1990)*. https://journal.nurulimanbwi.org/index.php/ijsc/index

Jing, Q., Li, J., Li, L., Jia, M., Zhou, Y., & Zhao, X. (2021). Passive design of green public buildings adapted to cold climate: A case study of China pavilion of the international horticultural exhibition 2019 Beijing China. *IOP Conference Series: Earth and Environmental Science*, *768*(1). https://doi.org/10.1088/1755-1315/768/1/012130

Jung, H., & Park, S. (2023). Pavilion as an architecture of new placeness : a case of Serpentine Pavilion project. *Journal of Asian Architecture and Building Engineering*, *22*(1), 84–95. https://doi.org/10.1080/13467581.2021.2024197

Łątka, J. F., & Święciak, M. (2021). The obverse/reverse pavilion: An example of a form-finding design of temporary, low-cost, and eco-friendly structure. *Buildings*, *11*(6). https://doi.org/10.3390/buildings11060226

Nour Fakharany. (2024, October 24). *Indonesia Pavilion Reveals Boat-Inspired Design at Expo 2025 Osaka.* Https://Www.Archdaily.Com/1022814/Indonesia-Pavilion-Reveals-Boat-Inspired-Design-at-Expo-2025-Osaka.

Prihutama, M. (2020). KAJIAN KONSEP ARSITEKTUR METAFORA PADA BANGUNAN BERTINGKAT TINGGI. *Jurnal Arsitektur ZONASI*, *3*(2), 220–232. https://doi.org/10.17509/jaz.v3i2.25057

Reaver, K. (2022). Mixed Reality in Multiuser Participatory Design: Case Study of the Design of the 2022 Nordic Pavilion Exhibition at the Venice Biennale. *Buildings*, *12*(11). https://doi.org/10.3390/buildings12111920

Rubio, M. S., Karl, C., Rubio, S., Karl, T., Tomanek, P., & Ca, M. S. (2019). *Digital Design and Fabrication of Gridshell Structures in Academia: SAPL Research Pavilion 2019* (Issue 2). https://www.researchgate.net/publication/337499464

Sulaksono, D., & Saddhono, K. (2018). Strengthening Character of Environment Preservation Using Wayang Story Lakon Dewa Ruci: an Ecological Literature Analysis. In *ELite Journal : International Journal of Education, Language, and Literature E-ISSN* (Vol. 1, Issue 1). https://journal.unesa.ac.id/index.php/elite

TOMIOKA, Y., TABATA, C., & OJIKA, T. (2022). DESIGN PROCESS OF JAPANESE PAVILION IN VENICE BIENNALE (1956) BY TAKAMASA YOSHIZAKA. *Journal of Architecture and Planning (Transactions of AIJ)*, *87*(799), 1786–1797. https://doi.org/10.3130/aija.87.1786

Tuncbilek, G. (2020). Experimentation in Architecture: Pavilion Design. *ATHENS JOURNAL OF ARCHITECTURE*, *6*(4), 397–414. https://doi.org/10.30958/aja.6-4-5

Umar, M. Z., Arsyad, M., Santi, S., & Faslih, A. (2020). PRINCIPLES OF SUSTAINABLE ARCHITECTURE IN THE PRODUCTION OF BAMBOO WOVEN WALL MATERIALS (DENDROCALAMUS ASPER). *SINERGI*, *24*(1), 57. https://doi.org/10.22441/sinergi.2020.1.008

Wang, J., Shi, D., Zhou, C., Zhang, Q., Li, Z., Marmo, F., & Demartino, C. (2024). An active-bending sheltered pathway based on bamboo strips for indoor temporary applications: Design and construction. *Engineering Structures*, *307*. https://doi.org/10.1016/j.engstruct.2024.117863