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AQUILA HOOP ARENA: AN INTERNATIONAL BASKETBALL COMPETITION FACILITY DESIGN IN SIDOARJO REGENCY WITH A SUSTAINABLE ARCHITECTURE APPROACH

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ABSTRACT

The Design of Aquila Hoop Arena aims to provide international basketball competition facilities that are adaptive to the tropical climate in Sidoarjo Regency. Sidoarjo was chosen based on considerations of its strategic location near Juanda Airport and adequate infrastructural support. The main challenges in this design are high solar heat intensity and noise pollution from aviation activities. The design method employs a sustainable architectural approach by integrating local fauna. The design results not only implement these two approaches but also a metaphor of a basketball hoop on the building mass and the silhouette of the Garuda bird's wings as a symbol of national strength. Ecological strategies are implemented through a building envelope that adapts the morphology of Pangolin scales to optimize thermal comfort and energy efficiency in the building. Furthermore, the application of the urban forest concept serves as a noise buffer and heat reduction for the arena area. This design is expected to not only become a new sports icon but also a model for public buildings that are responsive to environmental context and locality.

Keywords: International Basketball; Sustainable Architecture; Metaphorical Architecture

INTRODUCTION

Indonesia has experienced rapid development in the field of sports, particularly basketball. The achievements of national athletes in various international competitions indicate that the coaching and development system within this sport has progressed significantly. However, the availability of international-standard competition facilities within the country remains limited. This condition hinders the organization of global tournaments and constrains athletes' preparation for international events. Therefore, the design of an International Basketball Arena is expected to address the existing gap in facility provision, strengthen urban identity through an iconic, dynamic, and expressive architectural form, incorporate a modern sustainable design approach, function as a landmark, and enhance the city's overall image.

The design of sports facilities, especially international-standard arenas, has evolved beyond serving merely as venues for competition and has become an essential component of urban infrastructure networks that support social, economic, and cultural activities. Sports arenas not only function as

platforms for athletic events, but also contribute to the formation of inclusive public spaces, create dynamic social experiences, and reinforce a city's identity within the global context. According to contemporary studies on sports facility design, arenas must be responsive to user needs, environmental integration, and functional adaptability in response to evolving times and the demands of modern audiences (Akhmanova, 2025).

Within this context, Surabaya, as one of Indonesia's largest urban centers, possesses strong potential to host an international basketball arena designed not only as a sports facility but also as a globally competitive city icon. Surabaya has demonstrated a strong fan base and solid institutional support for sports development, making the design of the "Aethra Nexus" Basketball International Arena a relevant and urgent topic. A deconstructivist architectural approach is selected to create a dynamic and expressive form that reflects continuity and global connectivity, while also responding to contemporary issues such as unequal access to international-standard facilities and the need for sustainable athlete regeneration (Adhima Faidir & Ashadi, 2024).

The identification of issues concerning the role of sports arena architecture and its design response indicates that the development of sports facilities should not merely meet functional standards, but must also consider social, cultural, and aesthetic integration within contemporary urbanism. Therefore, this study aims to explore innovative design solutions through a deconstructivist architectural approach in order to create an international-class basketball arena that is sustainable, inclusive, and possesses high urban value.

LOCATION DESCRIPTION

The site selection for the "Aethra Nexus" Basketball International Arena in Surabaya was conducted by considering urban planning principles and the demand for international-scale sports facilities. The selected location must align with the Surabaya Spatial Plan (RTRW), particularly within zones designated for the development of public facilities, sports districts, commercial-service areas, or strategic urban zones. This ensures that the arena's development does not conflict with land-use regulations and is able to support the strengthening of Surabaya's role as a regional activity center (Figure 1).

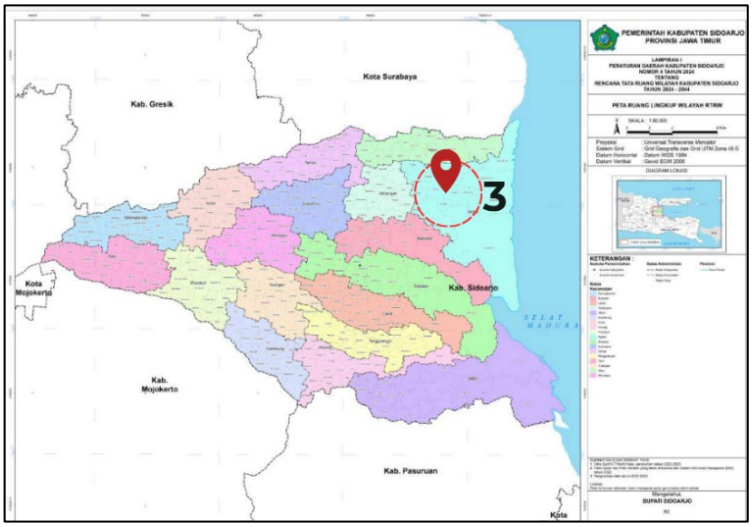

Figure 1. Siodarjo Regency Spatial Planning Map

The advantages of the Sedati area include comprehensive infrastructure and highly strategic accessibility, as its location is in close proximity to international scale fasilities such as Juanda

Airport. According to Regional Regulation No. 12 of 2014 concerning the Sidoarjo Regency RTRW, the Sedati District area is designated as a residential zone but still encompasses public facility functions. Sedati District is supported by the availability of highly adequate accommodation facilities, ranging from hotels and shopping centers to healthcare facilities such as RSAL dr. Soekantyo Jayja Puspenerbal and RS Sheila Medika. Based on these considerations of Sedati District's advantages, the area is highly ideal for the design location of Aquila Hoop Arena, supported by an established environment with complete transportation means and social facilities, ensuring comfort and ease of access for future arena visitors (Figures 2-4).

Figure 2. Siodarjo Regency Spatial Planning Map

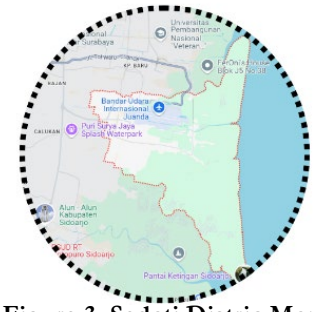

Figure 3. Sedati Distric Map

Figure 4. Site Location

THE SITE ANALYSIS

The design location is situated in a strategic area on Jl. Raya Bandara Juanda, Sedari District, Sidoarjo Regency. The site has an area of 258,000 m², which is administratively classified as a residential and public facilities zone. Geographically, the site exhibits relatively flat topographic characteristics with the lowest points ranging from 0 to 1 meter above sea level (masl) (Figure 5).

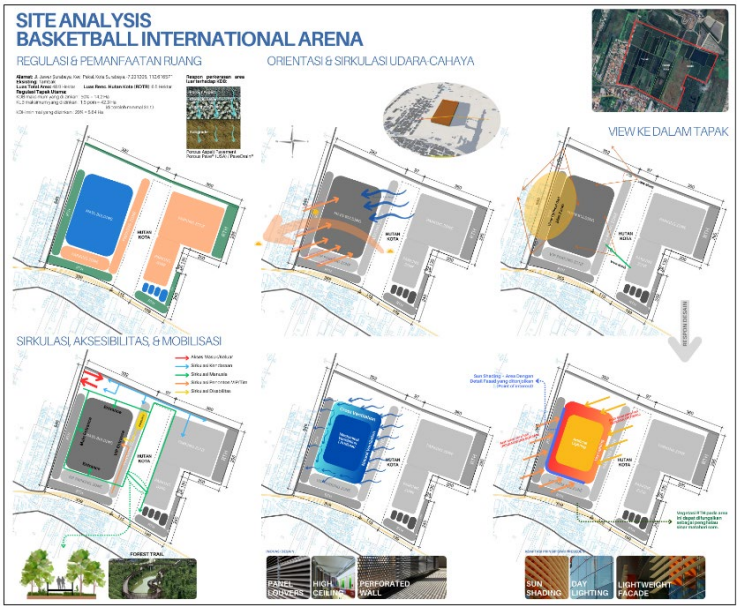

Figure 2. Measured Site Location (Source: Author)

Access to the site is supported by a primary arterial road connecting Juanda International Airport with the center of Surabaya City. Circulation analysis indicates high traffic activity on the southern side of the site. As a design response to this analysis, five entry and exit points are planned to function as a means to disperse vehicle volume density (Figure 6). There is additional circulation

within the site designed with a radial pattern that separates the paths for private vehicles, athlete buses, logistics vehicles, and pedestrian walkways to ensure smooth mass mobilization during international events.

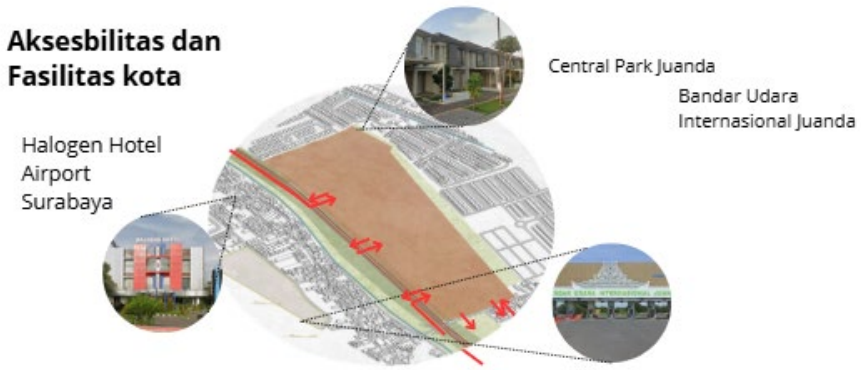

Figure 3. Accessibility Site Analysis (Source: Author)

The site is located in a humid tropical climate with high intensity solar exposure from the East and West. Building orientation analysis shows that to minimize the impact of heat gain, the main building mass is designed with its longest side facing South, featuring optimal openings on the North and South sides, and the implementation of sun shading on the West and East sides (Figure 7). This aims to maximize natural ventilation and natural lighting, which are capable of reducing energy consumption loads while simultaneously blocking heat exposure from the East and West.

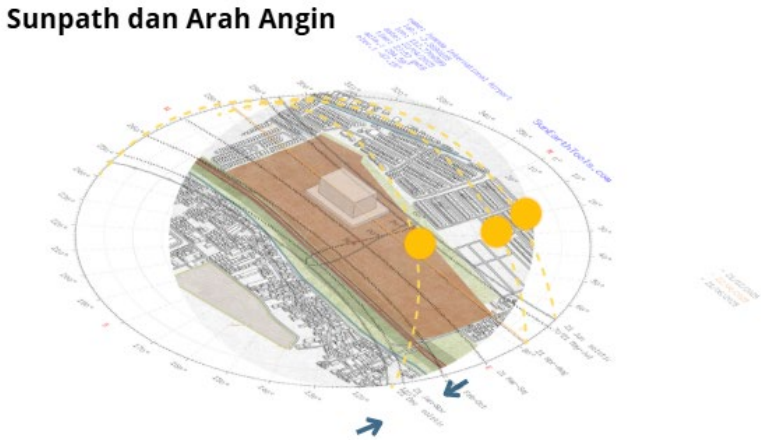

Figure 4. Climate Site Analysis (Source: Author)

Noise pollution is the primary environmental constraint on this site due to its proximity to Juanda Airport, which results in the site being affected by high-frequency noise from airport activities. The strategy to address this condition is through the application of soundproof facade materials and the addition of vegetation around the site perimeter as a sound barrier (Figure 8). Visually, the building is designed as an iconic landmark using a basketball hoop metaphor capable of attracting the attention of road users as well as aerial observers, while outward views from the site are optimized toward green areas and residential settlements.

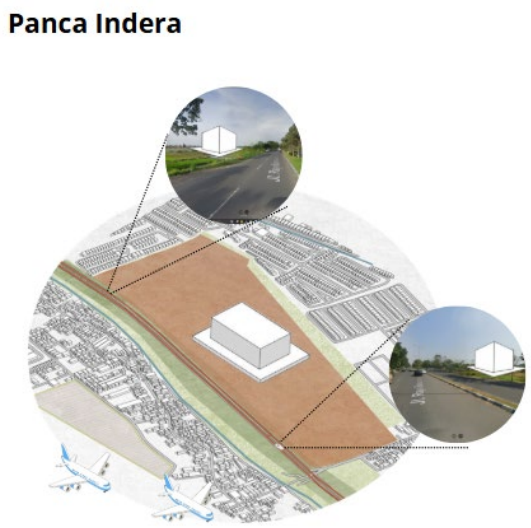

Figure 5. Sensory Site Analysis (Source: Author)

CONCEPTUAL APPROACH AND WARFARE THEME

The design of Aquila Hoop Arena at the construction process is carried out to meet current needs without compromising the needs of the future (Widyawati, R, nd). Thus, this design employs a primary strategy of adopting the morphology of Pangolin scales, which is transformed into a climate-responsive building envelope system (Figure 9). The biomimicry approach on the building facade has proven effective in reducing energy consumption in hot-humid climates through the regulation of heat absorption and passive ventilation (Fecheyr-Lippens, D., & Bhiwapurkar, P 2017; Hays, N., et all. 2024). This integration is not merely an aesthetic ornament but functions as ecological infrastructure that regulates solar heat gain through a secondary skin mechanism (Salah, T., et all. 2018). The segmented surface texture design on the secondary envelope can reduce thermal radiation by 15-20% compared to conventional facades (Chen Austin, M. A., et all. 2022).

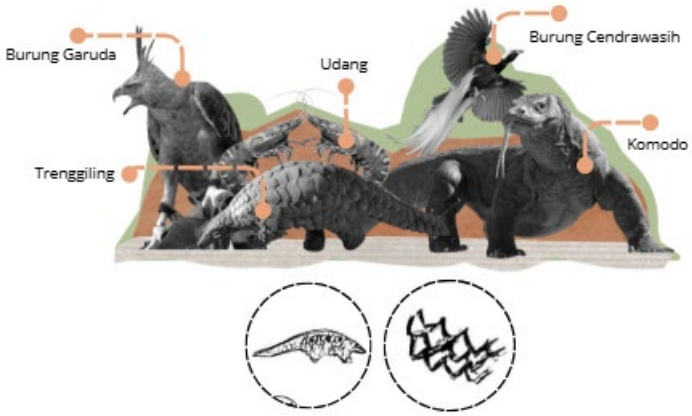

Figure 9. Pangolin-Inspired Façade Concept (Source: Author)

The visual concept of Aquila Hoop Arena originates from a Basketball Hoop metaphor translated through a circular-radial mass composition. This form not only represents the building's functional identity as an international basketball arena but also facilitates efficient user circulation and optimal mass distribution (Twardowski, M. 2018). This radial pattern allows for a centralized mass distribution in the competition area, while the surrounding transition zones are designed using perforated wall coverings to maximize natural ventilation (Mutlu Avinç, G., 2024). Perforated facades with biomimetic patterns increase natural airflow by up to 30% and reduce surface temperatures by 3-5°C in tropical climates (Hays, N., et all. 2024 ; Chen Austin, M. A., 2023). This strategy aligns with modern stadium design principles that integrate circulation efficiency with passive thermal performance (Twardowski, M. 2018). This adaptive envelope system creates thermal comfort without high dependence on mechanical cooling (Fecheyr-Lippens, D., & Bhiwapurkar, P. 2017); Badarnah, L., & Knaack, U. 2018).

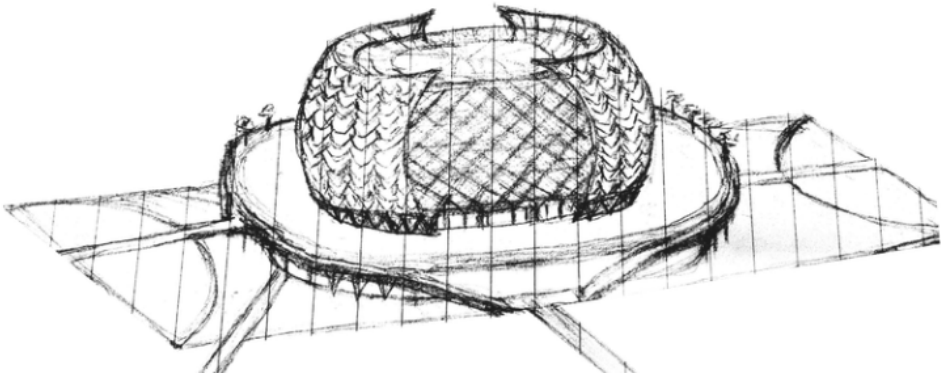

Figure 6. Massing Sketches (Source: Author)

In response to the site location (Figure 10), which is situated within the Juanda Airport air transport corridor, this design employs an urban forest strategy as acoustic and thermal protection. The landscape arrangement, using high-density shade vegetation, is designed to reduce aircraft noise pollution while creating cool and high-quality air around the arena (Skärbäck, E. 2007; Lugten, M., et all 2018). Urban forests with layered vegetation structures can reduce air traffic noise by (Skärbäck, E. (2007; Aletta, F.,2018) dB and enhance the soundscape quality of public spaces (Hong, X., Liu, J., & Wang, G. 2022; Yildirim, Y., 2022). The integration of public space on the second-floor open area provides a new realm for user social interaction, where architecture functions to create social communities and environmental preservation (Korol, E., Shushunova, N., & Passmore, D. 2018). The combination of vegetation with water elements in the landscape is proven to improve the perception of acoustic comfort by up to 40% in areas exposed to airport noise (Lugten, M., et all, 2018; Aletta, F., 2018).

DESIGN THEME

The visuals of the Aquila Hoop Arena building are based on a basketball hoop metaphor, representing the primary function of the arena, which is applied to the building's mass composition. The monumental expression of the building is strengthened through the metaphor of the Garuda bird's wings, visualized by adopting the silhouette of the Garuda's wings (Figure 11) that serve as the support for the spherical structure above it, creating a symbol of the strength of sportsmanship and national spirit. According to (Agnes et al., 2019) metaphorical architecture allows observers to have their own individual perceptions based on the impressions that arise when they first see the building. In this building, it is expected that the observer's visualization will be defined by their respective perceptions. The theme of this design also emphasizes

ecological principles through the implementation of a building envelope inspired by Pangolin scales, a characteristic fauna of the Sidoarjo region. The application of this building envelope does not only function as aesthetics for the facade of the Aquila Hoop Arena but also plays a significant role in enhancing thermal comfort and reducing the building's energy load.

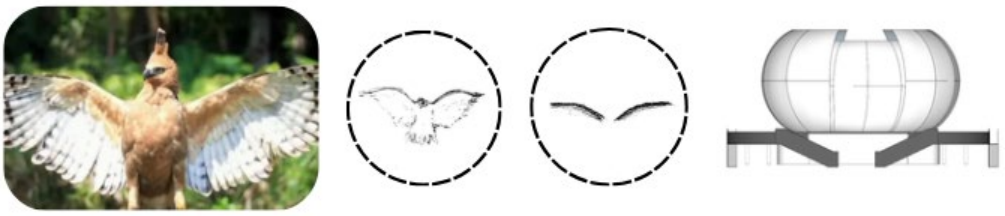

Figure 7. Garuda Bird Metaphoricaal Concept (Source: Author)

The design theme of Aquila Hoop Arena does not only function as an international-scale sports building but also builds a dialogue between function, national symbolism, ecological context, and local character. The fusion of dynamic formal expression and sustainable architectural strategies produces an arena that is both iconic and adaptive to the tropical environment, contributing to the strengthening of Sidoarjo Regency's identity as a center for global-scale activities.

IMPLEMENTATION OF CONCEPT IN DESIGN

The site plan design, featuring an urban forest concept that acts as a barrier to high-frequency noise pollution originating from road vehicle activity and airport aviation, is implemented through the planting of high-density vegetation surrounding the main building.

Figure 8. Outdoor Basketball Court (Source: Author)

Figure 9. Landscape Area (Source: Author)

The site plan design does not only focus on vegetation arrangement but also on the circulation within the site, which includes both pedestrian and vehicle circulation in a radial pattern. This effort aims to address the issue of vehicle congestion during matches (Figures 12-13). The site design is not created merely for aesthetic interests, but the design also strives for visitor safety by providing assembly areas in anticipation of hazards.

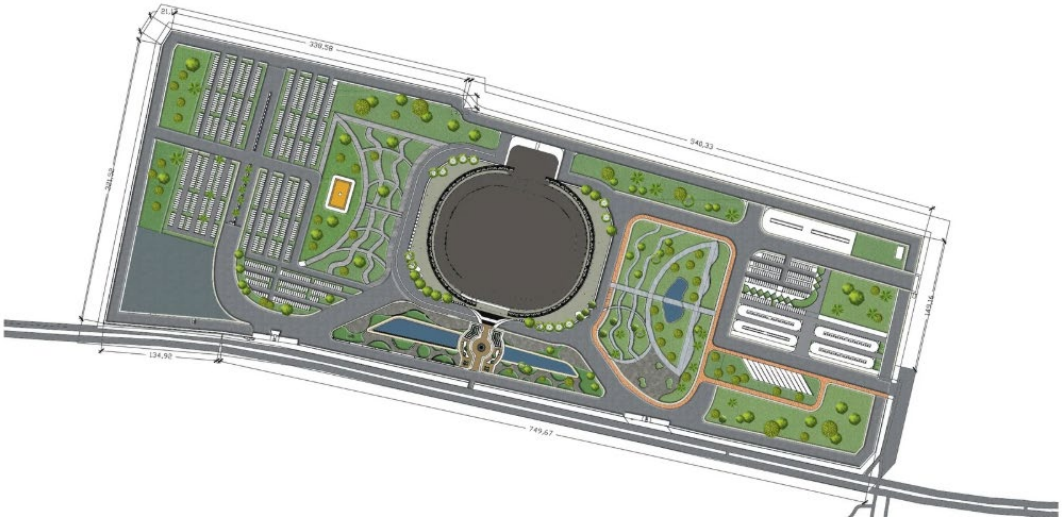

Figure 10. Site Plan (Source: Author)

The silhouette of the Garuda bird's wings is applied to the open area system on the second floor, which can be connected via an outdoor staircase on the first floor. This visualization is visible from the building's facade, which is not only aesthetic but also provides an impression of strength in supporting the structure above it (Figure 13).

Figure 15. Front Perspective Rendering (Source: Author)

The structure of the Aquila Hoop Arena utilizes a combination of several structural systems: a truss system for the long-span roof, while the building columns use concrete material to maintain the stability of the building structure (Figure 14). Furthermore, the walls utilize a space frame structure adapting the pattern of a basketball net, symbolizing the functional core of the building as a basketball competition arena. The walls from the second to the fourth floors use perforated material as massive walls that play a role in allowing air to enter and exit more freely, ensuring the ventilation system functions well in the corridors outside the competition area (Figure 15).

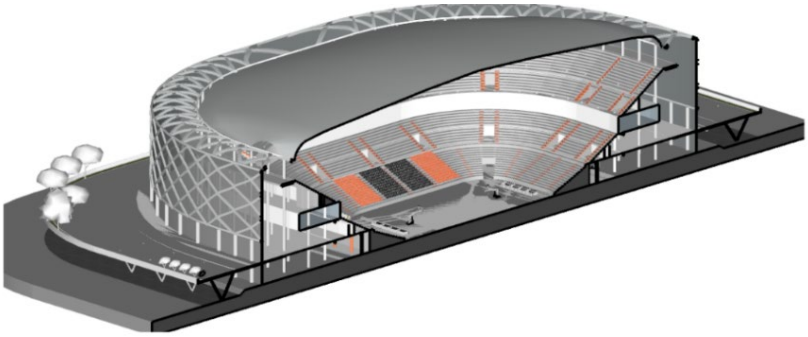

Figure 16. Isometric Building Section (Source: Author)

The building facade, resulting from the adaptation of Pangolin scales—which is one of the characteristic fauna of Sidoarjo Regency—is positioned as the building envelope. In terms of aesthetics, the repetition of the pangolin scale forms provides a dynamic visual and a dominant textural impression. Functionally, the facade plays a role in protecting the building from driving rain during the wet season and reducing excessive solar heat radiation during the dry season. The implementation of this system acts as a light filter that diffuses sunlight into the rooms. By reducing the heat entering the building, the load on air conditioning (AC) usage can be minimized, impacting the improvement of the building's energy efficiency in the long term.

The implementation of passive design strategies at Aquila Hoop Arena is focused on creating thermal comfort without full dependence on artificial energy. The use of perforated walls as the building's skin functions as an element to generate air circulation (Figure 16). By utilizing air pressure differences, the openings in the walls allow airflow to enter the corridor areas and transition zones.

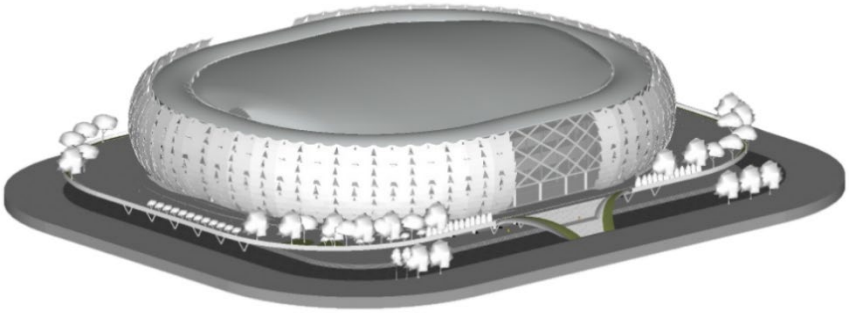

Figure 11. Building Isometric (Source: Author)

In response to the stadium's large energy requirements, this design utilizes a solar panel system as a renewable energy source. The solar panels are placed on the roof of the building, which receives maximum solar exposure throughout the day. The utilization of this technology aims to convert solar radiation into electrical power to support lighting operations, mechanical systems, and other supporting facilities. This response is in accordance with the opinion of (Hidayatulloh, 2021) stating that addressing negative environmental impacts requires the implementation of sustainable concepts, namely by using as few non-renewable resources as possible to improve the quality of life for future generations.

The provision of Green Open Space (RTH) on the second floor of the building acts as a vegetative element capable of serving as a coolant that lowers the micro-temperature around the stadium. Plants help absorb carbon dioxide and release oxygen and water vapor, which cools the air temperature surrounding the arena. Furthermore, these green open spaces create comfortable

social interaction areas for users, reconnecting humans with nature despite being within a massive sports building structure(Figures17-19).

Figure 12. Second Floor Green Open Space (Source: Author)

Figure 13. Building Perspective Rendering (Source: Author)

Figure 14. Pedestrian Path (Source: Author)

The interior of Aquila Hoop Arena is designed with a primary focus on optimizing functionality and user comfort. All interior design elements, from court dimensions and clearance zones to the technical specifications of the wood parquet flooring, fully comply with FIBA standardization requirements. The tribune area is designed with a circular-radial system that guarantees maximum viewing angles from all sides, ensuring every spectator receives a clear visual experience without obstruction.

Figure 15. Main Arena Interior (Source: Author)

The locker rooms are designed to professional standards that prioritize privacy, comfort, and efficient circulation flows in accordance with FIBA regulations. These rooms serve not only as changing areas but also as zones for technical preparation and athlete recovery, equipped with ergonomic individual lockers, showering areas, and sanitation facilities. The furniture arrangement supports team coordination activities before entering a match. The flooring utilitizes anti slip materials, an optimal air conditioning system, and even lighting that provides the visual focus athletes need to prepare for their maximum performance on the court.

Figure 16. Locker Room Interior (Source: Author)

The fitness room is designed as a physical conditioning facility that integrates modern aesthetics with FIBA functionality standards for professional athletes. This room adopts an open-plan concept with a systematic equipment zone arrangement. The flooring material uses a special rubber coating with high impact absorption to protect athletes' joints and minimize noise from weight equipment. Mirrors on the wall surfaces provide a spacious impression while functioning as a tool for athletes to monitor their body posture during training.

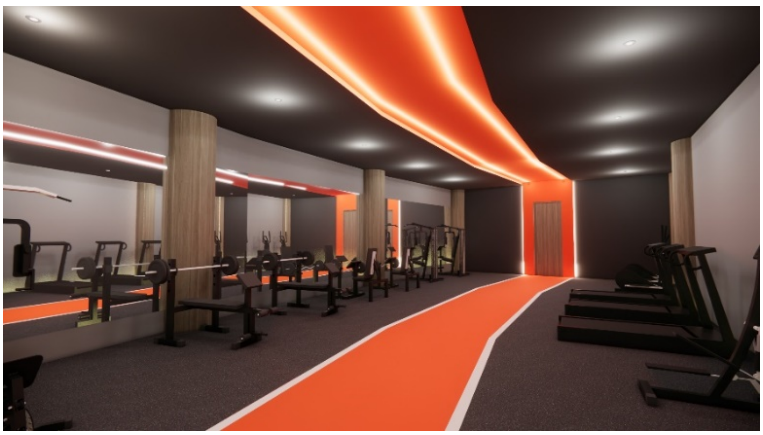

Figure 17. Fitness Center Interior (Source: Author)

CONCLUSION AND SUGGESTIONS

The design of Aquila Hoop Arena integrates local identity with sustainable architectural principles capable of addressing the environmental challenges in Sidoarjo Regency. Through the use of the basketball hoop metaphor and the silhouette of the Garuda's wings, this building creates a monumental impression that represents both sportsmanship and national identity. The implementation of passive design strategies enables the corridor and transition spaces to be free

from artificial energy during the day. Furthermore, the urban forest concept and green open spaces serve as supporting elements to produce more oxygen and improve the air quality around the arena.

For future development, this design emphasizes the importance of optimizing technology to support the massive operational needs of the stadium. It is recommended to strengthen the more integrated radial circulation system to guarantee safety and smooth mass mobilization during international events. Additionally, the collaboration between the sports building's functions and the supporting facilities in the surrounding area must be enhanced so that the arena does not only become a physical icon but also plays a vital role in driving the economy and serving as a global-scale activity center that is adaptive to the characteristics of a tropical region.

REFERENCES

Agnes, R., Hutabarat, G., Warouw, F., Punuh, C. S., Cermin, K. P., Cermin, P., Pengajar, S., Universitas, A., Ratulangi, S., Pengajar, S., Universitas, A., & Ratulangi, S. (2019). *No Title*. 189–198.

Aletta, F., Oberman, T., & Kang, J. (2018). Associations between positive health-related effects and perceptual constructs of soundscapes: A systematic review. International Journal of Environmental Research and Public Health, 15(11), 2392. https://doi.org/10.3390/ijerph15112392/

Arlianto, A., Arch, M. A., Arsitektur, P. S., Petra, U. K., & Siwalankerto, J. (2019). *Gambar. 1. Perspektif Bangunan (. VII*(2), 9–16.

Badarnah, L., & Knaack, U. (2018). Biologically-inspired double skin facades for hot climates: A parametric approach for performative design. Energy Procedia, 145, 142-147.

Chen Austin, M. A., Soto, M. G., Pinto, P. A., & Adames, A. (2022). Numerical assessment of zebra-stripes-based strategies in buildings energy performance: A case study under tropical climate. Biomimetics, 7(1), 14. https://doi.org/10.3390/biomimetics7010014

Revista Fecheyr-Lippens, D., & Bhiwapurkar, P. (2017). Applying biomimicry to design building envelopes that lower energy consumption in a hot-humid climate. Architectural Science Review, 60(6), 478-489. https://doi.org/10.1080/00038628.2017.1359145

Hays, N., Badarnah, L., & Jain, A. (2024). Biomimetic design of building facades: An evolutionary-based computational approach inspired by elephant skin for cooling in hot and humid climates. Frontiers in Built Environment, 10, 1309621. https://doi.org/10.3389/fbuil.2024.1309621

Hidayatulloh, S. (2021). *Kajian Prinsip Arsitektur Berkelanjutan Pada Bangunan Perkantoran (Studi Kasus : Menara Bca Jakarta). 18*(1), 89–97.

Hong, X., Liu, J., & Wang, G. (2022). Soundscape in urban forests. Forests, 13(12), 2056. https://doi.org/10.3390/f13122056

Korol, E., Shushunova, N., & Passmore, D. (2018). Technical and economical factors in green roof using to reduce the aircraft noise. MATEC Web of Conferences, 170, 01081. https://doi.org/10.1051/matecconf/201817001081

Lugten, M., Karacaoglu, M., Kang, J., & Steemers, K. (2018). Improving the soundscape quality of urban areas exposed to aircraft noise by adding moving water and vegetation. The Journal of the Acoustical Society of America, 144(4), 2906-2917. https://doi.org/10.1121/1.5079310

Mutlu Avinç, G., Koç, S. N., & Arslan Selçuk, S. (2024). Biomimetic facade design proposal to improving thermal comfort in hot climate region. International Journal of Built Environment and Sustainability, 11(2), 117-128. https://doi.org/10.11113/ijbes.v11.n2.1226

Salah, T., Mohamed, O., & Azmy, A. (2018). The elements of natural concept in sustainable building skins. ISEC Research Proceedings, 56. https://doi.org/10.14455/ISEC.RES.2018.56

Skärbäck, E. (2007). Urban forests as compensation measures for infrastructure development. Urban Forestry & Urban Greening, 6(4), 279-285. https://doi.org/10.1016/j.ufug.2007.05.006

Twardowski, M. (2018). Football stadiums – Icons of sports architecture. Czasopismo Techniczne, 10, 153-166. https://doi.org/10.4467/2353737XCT.18.162.9418

Widyawati, R. L. (n.d.). *Green Building Dalam Pembangunan Berkelanjutan*. Widyawati, R. (n.d.). Prinsip arsitektur berkelanjutan dalam pembangunan masa depan. Jurnal Arsitektur Indonesia.

Yildirim, Y., Arefi, M., & Şensöz, E. (2022). Soundscape assessment of green and blue infrastructures. Urban Science, 6(1), 22. https://doi.org/10.3390/urbansci6010022

REGULATION:

FIBA Venue Guide, 2023

Peraturan Daerah No. 12 Tahun 2014 tentang RTRW Kabupaten Sidoarjo