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Article

An Eco-Futuristic Approach to Boxing Community Center Design

Andrie Herdiansyah[1*], Gifranza[2,] Imbardi [3]

[1,2,3]Andrie Herdiansyah, Universitas Lancang Kuning

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*E-mail: andrie@unilak.ac.id

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The development of urban areas demands the existence of community sports facilities that not only function as physical activity spaces, but also as a medium for shaping environmental quality and the identity of sustainable public spaces. The Boxing Community Center is characterized by high-intensity activities that produce special demands on thermal comfort, air quality, and spatial flexibility. This study aims to examine how an eco-futuristic appropriate is applied in the formation of the Boxing Community Center building mass composition and its implications for environmental performance and architectural expression. The research method used is qualitative-descriptive through literature review, analysis of sports building precedents, and exploration of design concepts. The results of the study show of that the application of fragmented, layered, and climate-adaptive mass composition can improve natural ventilation, daylighting, and the quality of the transition space between the building and the outside environment. In addition to contributing to energy efficiency, this mass composition strategy also creates a dynamic and futuristic architectural image that is in harmony with the character of boxing. This study confirms that the processing of building mass with an eco-futuristic approach plays an important role as a passive strategy as a basis for designing community sports facilities that have optimal environmental performance and long-term flexibility.

1. Introduction

1. Introduction

Rapid urban growth is driving a growing need for public facilities that support physical health while addressing urban environmental and social issues. In this context, community sports facilities not only serve as venues for physical activity but also play a role in shaping the quality of urban space and strengthening social cohesion. However, sports facility design practices in many urban areas are still dominated by conventional approaches that emphasize solely technical and functional requirements. This approach often neglects long-term environmental performance, spatial adaptability, and the building's connection to the changing climate and urban dynamics. As a result, many sports buildings exhibit high energy consumption and suboptimal environmental response (John & Sheard, 2012).

The intense, dynamic, and performance-oriented nature of boxing makes the Boxing Community Center a building typology with specific environmental demands. Training and competition activities generate high levels of body heat, require good air circulation, and require lighting and acoustics that support concentration and social interaction among community members. Therefore, the design of these facilities cannot be treated as generic indoor sports spaces; they must be contextually designed, climate-adaptive, and oriented toward long-term sustainability. In this case, the composition of the building's mass becomes a key element because it determines how the building interacts with the site, climate, and the resulting architectural image (Ching, 2015).

The eco-futuristic appropriate in this study is positioned as an architectural strategy to address the limitations of sports facility design approaches, which have tended to be static and closed. Many sports buildings in urban contexts are designed as a single, compact mass, with limited integration of passive airflow strategies, adequate access to natural light, and flexible spatial configurations flexibility for future functional adaptation. The applied sustainability approach often stops at technical building solutions, failing to optimize the role of form and mass composition as passive environmental control strategies. In contrast, eco-futurism positions mass composition as the primary medium for responding to the climate and site context through the formation of fragmented, layered, and dynamic volumes, allowing for increased airflow, solar radiation control, and spatial openness (Jencks, 2011).

In response to the identified issues, this research aims to examine the application of an eco-futuristic approach to the mass composition concept of the Boxing Community Center as an effort to improve environmental performance and spatial quality. The study focuses on how mass management, building orientation, and the formation of voids and volume layers contribute to increased natural ventilation, reduced solar heat load, and optimized natural lighting. Furthermore, this research also examines the role of mass composition in shaping an architectural identity that represents the dynamic character of boxing. Therefore, this research is expected to provide a conceptual contribution in the form of a design framework for community sports facilities that integrates environmental sustainability and future-oriented architectural expression.

2. Literature Riview

2.1 Massing

Building massing is a design phase that focuses on developing the basic form of a building in response to functional requirements, site characteristics, climatic conditions, and the desired conceptual ideas. Building massing not only shapes spatial configuration but also determines the scale, proportion, and visual connection between the building and its surroundings. From a sustainable architecture perspective, massing is seen as a passive strategy that directly impacts a building's environmental performance. Appropriate massing can control solar radiation exposure, direct natural airflow, and maximize the use of daylight, thereby reducing the need for artificial energy from the initial design stage (Ching, 2015).

Furthermore, adaptive massing allows a building to dynamically respond to the climatic context. Volume fragmentation, void formation, and mass orientation toward the dominant sun and wind directions are design tools that determine the quality of a space's thermal and visual comfort. Thus, massing is understood not merely as an aesthetic issue, but as an architectural instrument that plays a strategic role in establishing relationships between the building, its users, and its environment.

2.2 Eco-Futuristic Architecture

Eco-futuristic architecture emerged from the intersection of sustainability thinking and futurism in architecture. This approach not only showcases innovative and visionary forms but also emphasizes the ability of buildings to

adapt to environmental challenges and changing future needs. Futurism in architecture is understood as an attempt to imagine the future through a dynamic and progressive form language, while the ecological dimension demands that buildings operate efficiently and in harmony with natural systems (Jencks, 2011).

Within an eco-futuristic framework, sustainability principles are translated into design strategies that integrate with the landscape, optimize energy performance, and utilize climate-responsive forms and technologies. This approach aligns with the notion of flexible and adaptive architecture, where buildings are designed to adapt to changing functions and environmental conditions without compromising their spatial quality (Kronenburg, 2015). Thus, eco-futurism is oriented not only toward futuristic appearance but also toward environmental performance and long-term sustainability.

This concept is closely related to the ecological architecture approach, which places climate as a primary factor in the design process. Ecological architecture emphasizes the use of bioclimatic strategies through passive design to reduce energy consumption and enhance user comfort. This approach considers the relationship between buildings, local ecology, and spatial and structural systems that can respond efficiently to climatic conditions (Yeang, 2006; Iriani & Subiyantoro, 2023). In an eco-futuristic context, these principles are then combined with the exploration of dynamic forms and mass compositions, resulting in architecture that is not only environmentally friendly but also reflects a future-oriented orientation.

Table 1. Ecological Principles According to Ken Yang.

Principle	Parameter
Blending in with the environment	Balance of local factors with natural conditions
Its environmental integration system	Utility systems in buildings
Unification of natural uses	Application of environmentally friendly materials and energy

Source : (Iriani & Subiyantoro, 2023)

In contemporary architectural studies, futurism is understood as a design approach that seeks to respond to future uncertainty and change through the progressive exploration of form, space, and technology. This future-oriented approach in architecture is manifested not only through innovative visual expression but also through the building's ability to adapt to ever-changing social, technological, and environmental developments (Nugrahaini, 2024). Thus, futuristic architecture places flexibility and transformability as core values in the design process.

The eco-futuristic concept expands on this concept by integrating ecological awareness into a futuristic orientation. This approach emphasizes that architectural innovation cannot be separated from responsibility for the natural environment. Eco-futuristic design focuses on mitigating long-term environmental impacts through an understanding of site conditions, climate, and resource availability, while utilizing sustainable materials and building systems. With this approach, architecture is projected as a solution capable of anticipating global challenges, such as climate change and resource constraints, through adaptive and ecological design strategies (Faridan & Utami, 2021).

3. Research Methodology

This research uses a qualitative, descriptive-analytical approach combined with a conceptual design study. This appropriate was chosen to deeply understand the relationship between mass composition theory, eco-futuristic architectural principles, and the spatial character of community sports facilities. Research data was obtained through a search of relevant literature, including theoretical studies on building mass composition, eco-futuristic concepts, and the design of sports facilities and community buildings. Furthermore, a precedent study of sports buildings and community centers demonstrated the application of sustainability principles and futuristic expression in the processing of form and space.

The research phase began with the formulation of eco-futuristic principles relevant to the context of community sports facilities. The next stage was an analysis of the activity characteristics of the Boxing Community Center, including the intensity of space use, environmental comfort needs, and user social interaction patterns. Based on this analysis, alternative building mass compositions were explored that were responsive to climate and site conditions. The analysis process linked spatial functions, solar orientation, dominant wind direction, and the building's relationship to the surrounding environment to produce an

adaptive and environmentally conscious mass scheme.

The unit of analysis in this study is the concept of the Boxing Community Center building mass composition as a representation of a community sports facility. The selection of precedents was conducted purposively, with the criteria being buildings that implement sustainable design strategies and futuristic approaches in an urban context. Data collection techniques included documentation studies, visual analysis, and conceptual mapping, supported by diagrams, sketches, and conceptual models as analytical instruments. The collected data were then analyzed qualitatively through a process of interpretation and comparison to identify patterns of relationships between mass composition, environmental performance, and architectural expression. The results of this analysis became the basis for developing a design concept that emphasizes the integration of environmental sustainability and future orientation.

4. Results and Discussion

4.1. Location Site

The site was chosen for its ease of access and proximity to the center of Pekanbaru. The surrounding buildings are residential.

Figure 1. Location Site

The site is located on Jl. Nelayan, Pekanbaru City. It covers an area of 15,200 m² (1.52 hectares) and is adjacent to the Siak River and Siak Bridge 1.

4.2. Konsep Zoning

The zoning concept planning is as follows:

Figure 2. Zoning of the 1st Floor Site

The arena zone is located on the north side of the site, directly facing Nelayan Street, which serves as the main access corridor to the planning area. This positioning is utilized to orient the building's main facade, making it easily recognizable from the street and strengthening the visual connection between the building and the urban space. The arena's placement on this side also supports the building's legibility as a public sports facility with a high level of activity.

The community center zone, management area, and lobby are designed arranged close to the site access area to optimize user and vehicle circulation. This area serves as the main meeting point for visitors and athletes during daily activities, so proximity to the entrance facilitates movement and increases efficient use of space. The arrangement of this zone adheres to riverbank regulations, maintaining building distances in accordance with applicable regulations.

The remaining land is utilized as a green zone located on the side of the site directly bordering the Siak River. This area is designed to follow the riverbank line with a width of 30 meters, thus functioning not only as a green open space but also as an ecological buffer zone. The presence of a large green area allows for the development of outdoor spaces for light exercise, physical recovery, and community social interaction, while contributing to improving the environmental quality and microclimate of the area.

Figure 3. Zoning Site 2nd Floor

The second floor is allocated for entertainment and cafeteria-related activities as part of a spatial planning strategy that integrates recreational activities with green open space. The cafeteria is designed with a stepped approach that blends with the landscape through terraced terraces, a green roof, and wide openings that allow for visual and physical connectivity between indoor and outdoor spaces. This configuration not only enhances the user's spatial experience but also maximizes views of the surrounding greenery.

On the same floor, a fitness room and additional exercise areas are designed adjacent to the cafeteria and entertainment zones to create an efficient and understandable circulation flow. The proximity of these functions allows for seamless user movement while maintaining a consistent zoning. This area is categorized as a semi-public space, thus providing ample access for visitors while remaining controlled to meet the needs of sports and recreational activities.

Figure 4. Zoning Site 3rd Floor

The third floor is designated for athlete dormitory functions, reflecting its private and restricted nature.

4.3. Eco Futuristic

The outcomes of this research indicate that the Boxing Community Center's mass composition concept, using an eco-futuristic approach, was developed through a transformation phase, transforming the building's basic form into a more adaptive mass configuration. This process involved a strategy of volume fragmentation and the formation of mass layers to avoid the impression of a rigid and closed building. This approach allows the building to appear visually lighter while also improving its response to the site's climatic conditions.

Mass fragmentation has proven to play a crucial role in improving the quality of the spatial environment. The separation of building volumes creates gaps between the masses that function as voids and interstitial spaces, allowing for optimal natural airflow. These transitional spaces act as air corridors, helping to reduce heat buildup within the building, particularly in areas with intense physical activity. Furthermore, the uncompacted mass configuration allows natural light to penetrate deeper into interior areas, enhancing visual comfort and reducing reliance on artificial lighting.

Furthermore, the utilization of inter-mass spaces as open communal areas reinforces the building's social function as a community activity center. These spaces serve not only as passive environmental elements but also as a medium for social interaction, supporting the Boxing Community Center's character as a community-based sports facility. Thus, the composition of the masses in an eco-futuristic approach not only contributes to improving environmental performance, but also shapes the quality of space and user experience holistically.

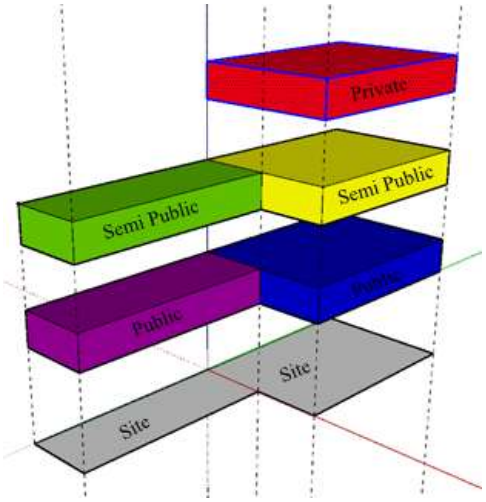

Figure 5. Basic Mass through Layering process
Legend :
Private : Athlete Dormitory Area
Semi Public : Cafetaria, Entertaiment Area and Trainning area dan Fitness Area
Public : Community Area and Arena

4.4. Massing

The building's massing is designed with an asymmetrical composition and bold line articulation as a visual representation of the dynamics, strength, and rhythm of movement inherent in boxing. The futuristic expression is realized through unconventional and layered forms, yet remains guided by contextual considerations for the tropical climate. This approach positions the building's form not merely as a symbolic element, but as a result of environmental and performative logic.

The massing orientation is strategically arranged to reduce direct solar radiation exposure on the main facade, particularly on the side receiving the highest heat intensity. At the same time, the massing configuration opens up natural airflow through the creation of gaps and openings aligned with the dominant wind direction. This strategy allows for effective cross-ventilation, allowing for passive heat release within the space. Thus, the massing design contributes directly to reducing reliance on mechanical ventilation systems while increasing the building's overall energy

efficiency.

Figure 6. Mass composition sketch

4.5. Landscape

Landscape integration is a key element of the eco-futuristic massing. The building is designed to blend with the green open space through terraced terraces, green roofs, and large openings that strengthen the connection between the interior and exterior. Thus, the massing not only serves as a visual image builder but also as an ecological strategy that enhances the building's thermal comfort and environmental quality.

Figure 7. Perspektive view

4.6. Analisa Hubungan Konsep Desain dan Dampak Lingkungan

The application of an eco-futuristic approach to the design of the Boxing Community Center's mass composition demonstrates that the configuration of the building's form plays a direct role in its environmental performance. Unlike design practices that primarily focus sustainability on material selection or the use of mechanical systems, the latest sustainable architecture approach emphasizes the importance of mass processing as a primary passive strategy in responding to climate change. Through the arrangement of volume, orientation, and the formation of spaces between masses, buildings are able to more effectively regulate airflow, the distribution of natural light, and thermal comfort conditions from the conceptual design stage (Olgyay, 2015; Ching, 2015). Within this framework, the mass composition is understood as an actively functioning functional element, not simply a visual or symbolic representation.

The interaction between the mass composition and the landscape also has a significant impact on shaping the site's microclimate. The breakdown of the building's mass creates interstices that function as thermal transition zones, where the presence of vegetation and open spaces helps lower ambient temperatures through natural shading and evapotranspiration, while also facilitating air movement around the building (Gehl, 2010; Santamouris, 2016). These spaces not only contribute to improved thermal comfort but also strengthen the site's ecological connectivity and provide a platform for social interaction for the user community.

Thus, this research enriches the discourse on sustainable architecture by confirming that the processing of form and massing composition can serve as an effective ecological solution without sacrificing the quality of architectural expression. The applied eco-futuristic approach demonstrates that the building massing strategy is capable of integrating environmental performance and establishing an adaptive and future-oriented architectural identity for a community sports facility.

Conclusion

This research demonstrates that the eco-futuristic approach provides a coherent and effective conceptual basis for shaping the massing of the Boxing Community Center. The application of an environmentally responsive and dynamic massing configuration allows the building to meet boxing-related functional requirements while optimizing spatial quality and passive environmental performance. This strategy demonstrates that architectural form decisions can play a direct role in supporting thermal comfort, natural lighting, and a building's energy efficiency.

Moreover, within the eco-futuristic framework, massing is perceived not only as a formal expression but also as a sustainability-driven strategy that reflects the forward-looking character of community sports architecture. This integration of environmental performance and architectural expression opens up opportunities for the eco-futuristic approach to provide a conceptual basis for design of urban sports facilities that are adaptive, sustainable, and responsive to future social dynamics and environmental challenges.

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