Journal of Architectural Research and Education

Journal homepage: https://ejournal.upi.edu/index.php/JARE/index

Oceanarium Design Development: Integrating Biomorphic and Narrative Architecture for Marine Educational Tourism Center

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ABSTRACT

Indonesia is recognized as a maritime nation with an exceptionally rich marine biodiversity, as it is an archipelagic nation including around 17,504 islands and a 5,800,000 km² ocean region. But marine pollution, which disturbs marine and coastal ecosystems including seagrass beds, mangrove forests, and coral reefs, poses a threat to this potential. In order to address this issue, it is crucial to create an oceanarium as a means of promoting environmental education and protection. The three primary phases of programming, design preparation, and design execution are covered in this article regarding the design development of the oceanarium at Parangtritis Beach, Bantul Regency, Daerah Istimewa Yogyakarta. Based on suitable design requirements and environmental potential, this study designates Parangtritis Beach as a strategic location. The Oceanarium, which was intended to be Yogyakarta's first structure, would showcase 135 species of Indonesian marine biota and follows to the idea of a black box museum. With the application of a narrative method and a biomorphic architectural motif, this oceanarium design creates a structure that consists of three interconnected circular buildings that are combined into a single, enormous, two-story building. To create an immersive educational experience for visitors, the design process involves analyzing the local setting, developing biomorphic concepts, and integrating the narrative. The final design attempts to serve as a symbol of innovation in Indonesian marine ecosystem management and conservation, in addition to being a center for marine life education and conservation.

ARTICLE INFO

Article History:
Submitted/Received 11 Dec 2023
First Revised 15 March 2024
Accepted 8 July 2024
First Available online 1 Nov 2024
Publication Date 1 Nov 2024

Keyword:
Design Development,
Biomorphic Architecture,
Oceanarium,
Narrative Architecture

1. INTRODUCTION

Indonesia, with over 17,500 islands and a coastline of 81,290 km, is a major maritime nation boasting extensive marine biodiversity, including coral reefs, mangroves, and seagrass beds (Ishomuddin, 2014; Arifin et al., 2019). However, the potential of its marine resources, valued at IDR 1,772 trillion (P2O LIPI), is threatened by significant pollution and overfishing, compounded by inadequate conservation efforts (Darza, 2020; Permana & Azizah, 2022).

To address these issues, the development of an oceanarium at Parangtritis Beach, Yogyakarta, is proposed. The project unfolds in three phases: programming, design preparation, and design execution. The programming phase sets the criteria for the location and objectives, while the design preparation incorporates biomorphic architecture to mirror organic forms and a narrative approach to create an immersive educational experience (Asyifa et al., 2020; McLeod, 2005). The final design aims to serve as both a conservation and educational center, highlighting Indonesia's marine life and fostering public awareness and environmental stewardship.

1.1 Oceanarium

An oceanarium represents a specialized type of aquarium designed to facilitate public engagement with marine life while serving as a center for research, conservation, and marine development (Sanjaya, 2015). Oceanarium functions as both a breeding ground for marine biota and a recreational facility that integrates educational and informational aspects. It is characterized by its role as an animal park that offers recreational, informational, and educational value (Bagasta, Harani, & Murtomo, 2018).

In the context of architectural typology, an oceanarium aligns with the category of science museums, as outlined in the book Public Space Design in Museums. This classification necessitates employing a museum-based design approach. Modern science museums are often conceptualized as *black box* environments. The term *black box* denotes a space designed without natural light to enhance the sensory experience and provide a profound educational engagement with scientific concepts (McLeod, 2005).

Table 1. Categories Of Museums

Categories of Museums	
Art	***Park Museums and Visitor Centers***
Children's and Junior Museums	***College and University Museums***
Company Museums	***Exhibit Areas***
General Museums	***History Museums***
Libraries Having Collection Other Than Book	***National and State Agencies***
Nature Centers	***Specialized***
Science Museums	
Aeronautics and Space Museum	*Anthropology, Ethology and Indian Museums*
Aquariums, Marine Museums	*Arboretums*
Archeology Museums	*Aviaries and Aquatic Gardens*
Entomology Museums and Insect Collections	*Geology, Mineralogy and Paleontology Museums*
Herbariums	*Herpetology Museums*
Medical, Dental, Health, Pharmacology, Apothecary and Psychiatry Museums.	*Natural History and Science Museums*
Planetariums, Observatories and Astronomy	*Wildlife Refuges and Bird Sanctuaries*
Zoology Museums	*Zoos, Children's Zoos*

(Source : Public Space Design in Museums, 1982)

DOI: https://doi.org/10.17509/jare.v6i2.77332
p- ISSN 2776-9909 e- ISSN 2580-1279

The definition of a museum, as established by the International Council of Museums (ICOM) during its 22nd General Assembly in 2007, encompasses a place or institution dedicated to the acquisition, preservation, research, and exhibition of objects related to human culture and the natural environment. This definition highlights the museum's role in supporting cultural heritage preservation while offering educational opportunities (Herlly, 2020). Museums are built upon three core pillars: enhancing societal intelligence, shaping national identity, and reinforcing national resilience and understanding (Munandar et al., 2011, as cited in Kavin & Elviana, 2022). According to ICOM's 2004 definition, museums are described as non-profit, permanent institutions that serve society and its development, are open to the public, and engage in the acquisition, conservation, research, communication, and exhibition of material evidence for educational and recreational purposes (ICOM, 2004).

Based on this definition, museums, including oceanariums, can be classified as educational tourism venues. Educational tourism, or edu-tourism, involves programs designed to provide participants with direct learning experiences through guided tours and interactive activities (Munir, 2010, as cited in Juwita et al., 2020). Thus, modern science museums and oceanariums are not only venues for recreation but also pivotal educational tools that facilitate an immersive learning experience through their design and programming.

The oceanarium is designed to exhibit a comprehensive array of marine biota and their respective ecosystems, providing a platform to support and enhance the understanding of marine life. Given the extensive diversity of marine biota, which can lead to potential confusion and inadequate educational outcomes, a systematic classification based on habitat is employed to facilitate effective visitor education.

Marine biota are categorized according to their habitat within the pelagic environment, which encompasses the entire water column from the surface to the seabed (Rangkuti, 2017). The pelagic environment is divided into two primary zones:

1) Neritic Zone
   The neritic zone comprises shallow sea areas where sunlight can penetrate to the seabed. This zone extends to a depth of approximately 200 meters, allowing for optimal energy absorption by primary producers. Due to the high availability of light and nutrients, this zone supports a rich diversity of marine life (Rangkuti, 2017).
2) Oceanic Zone
   The oceanic zone, which constitutes the high seas, extends from regions where light penetrates to those where light is absent. This zone is further subdivided into five distinct layers:
   a. Epipelagic Zone, can be called as sunlight zone, extends to a depth of around 200 meters where sunlight penetrates effectively. This zone supports a diverse range of marine organisms due to its well-lit environment (Lalli & Parsons, 1993).
   b. Mesopelagic Zone
      The twilight zone, spans from 200 to 1000 meters in depth. This zone experiences significant temperature gradients and is characterized by the presence of the thermocline, where temperature changes markedly with depth (Lalli & Parsons, 1993).
   c. Bathypelagic Zone
      This zone extending from 1000 to 4000 meters, is characterized by a persistent absence of natural light and lower temperatures compared to the mesopelagic zone. It predominantly hosts secondary consumers such as deep-sea fish (Lalli & Parsons, 1993).

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d. Abyssalpelagic Zone
Abyssalpelagic Zone which reaches depths between 4000 and 6000 meters, is perpetually dark and hosts organisms adapted to extreme conditions, including low temperatures and high pressure. Species in this zone have evolved unique adaptations to survive in such an environment (Wulandari, 2020).

e. Hadalpelagic Zone
This zone located at depths ranging from 6000 to 10,000 meters, represents the deepest part of the ocean. This zone is characterized by complete darkness and extreme pressure, resulting in a distinct and isolated ecosystem (Lalli & Parsons, 1993).

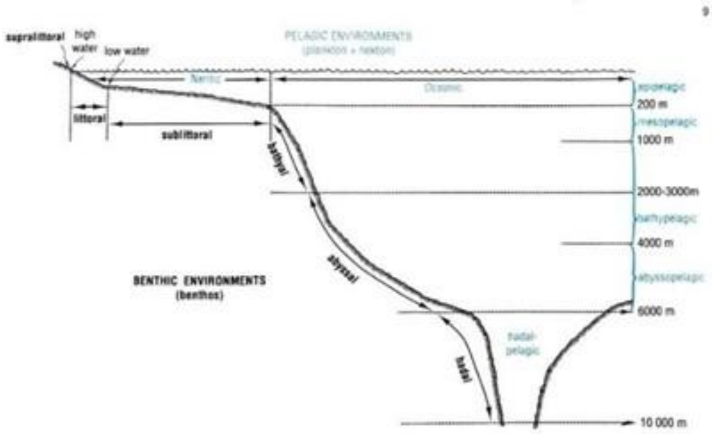

Figure 1. Pelagic Environment
(Source : *Biological Oceanography: An Introduction, 1993*)

By categorizing marine biota according to these pelagic zones, the oceanarium aims to provide an organized and educational framework that enhances visitor understanding of marine ecosystems and their complexities.

1.2 Biomorphic Architecture

Biomorphic architecture derives its nomenclature from Greek, combining the terms bios, which signifies organic life, and morphe, meaning form. Thus, biomorphic architecture can be comprehensively understood as the architecture that emulates or draws inspiration from organic forms or life processes (Tawakali et al., 2014). This architectural theme integrates natural elements with design processes, using these elements as sources of inspiration for shaping architectural forms (Mandias et al., 2021). The application of biomorphic design adheres to several core principles, which are articulated as follows:

1. Principle of Form
The fundamental forms within biomorphic architecture are derived from natural shapes and ecological patterns, as well as metaphorical representations. This principle emphasizes the translation of natural forms and processes into architectural design, reflecting an organic and ecological basis for form generation (Ishomuddin, 2014).
2. Principle of Structure and Materials
Structures and materials in biomorphic architecture are intrinsically linked to concepts of natural life. The design of building structures is informed primarily by natural forms, serving as the principal source of inspiration. This approach advocates for the use of locally sourced natural materials where feasible. Additionally, it employs lightweight materials, such as membranes and other flexible materials, to facilitate the creation of curvilinear forms and structures (Mahardika et al., 2023). This principle underscores the alignment of structural and material choices with natural aesthetics and functional

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p- ISSN 2776-9909 e- ISSN 2580-1279

requirements.

3. Principle of Sustainability

   Biomorphic architecture necessitates a design approach that considers environmental impact, aiming to create structures that are environmentally sustainable. This principle ensures that architectural forms not only express themselves through their shapes but also embody principles of sustainability, as observed in natural systems (Asyifa et al., 2020). The design approach seeks to harmonize with the natural environment, promoting eco-friendly practices and contributing to sustainable development.

   By following these principles, biomorphic architecture aims to combine creative design, strong structures, and environmental care, showing how natural forms can influence architectural style.

1.3 Narrative Architecture

Narrative architecture is an approach predicated on the concept that architectural forms possess the capacity to convey stories to their users. This approach seeks to embed a narrative into the design of a building, thereby creating a storyline that informs and enriches the user's experience (Aufa & Marlina, 2023). The integration of narrative within architecture involves a dynamic interplay between story and spatial experience, which can be understood through two principal methods: the "Maps" (seeing) and "Tours" (experiencing) approaches. The "Maps" approach emphasizes the interpretation of visual elements within a space, focusing on how these elements convey meaning and contribute to the narrative. Conversely, the "Tours" approach is centered on the direct sensory experience of the space, allowing individuals to engage with and become part of the narrative through physical interaction (de Certeau, 1984).

There are three types of narrative that can be integrated into architectural forms, namely binary, sequence, and biotope. This type of narrative is discussed in detail in the book Narrative Architecture: Architectural Design Primers (Coates, 2012).

1. Binary Narrative

   The binary narrative represents a straightforward narrative structure wherein the architectural form facilitates the articulation of context, function, and story. This type of narrative creates a direct illusion or mood, aiming to elicit specific perceptions or responses from the users through the design's immediate impact.

2. Sequence Narrative

   Sequence narrative involves conveying a story through a series of linear segments or sequences. This narrative type typically utilizes the circulation and spatial layout of the building as a means of guiding users through a sequential journey, thereby narrating the story through the progression of space and movement.

3. Biotopic Narrative (Biotope Narrative)

   The biotopic narrative, derived from 'bio' (life) and 'topos' (place), pertains to the creation of a cohesive, uniform environment shaped by the interrelationships among living entities. In a narrative context, a biotopic narrative reflects the interactions, conditions, and dynamics within a given environment. An architectural realm becomes a narrative biotope when the components of the narrative are seamlessly integrated with the functional elements of the building, thereby transforming the physical reality of the space and allowing for diverse interpretative possibilities.

   Each of these narrative types affects the building's capacity to engage users and enrich their experience. By inviting users to actively participate in the imaginative process, these narratives enhance the resonance and impact of the architectural form.

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p- ISSN 2776-9909 e- ISSN 2580-1279

2. METHOD

Design is a basic proposal that changes something that is available into something better. This change is carried out through three processes, namely, identifying problems, identifying methods as problem solving efforts, and implementing problem solving. Therefore, the design process is divided into three categories, namely programming, design preparation, and design execution (Wade, 1997). These categories are then made into stages which are described as follows:

1. Programming
   Programming represents the initial phase of the design process, focusing on the comprehensive understanding and definition of the project's requirements and constraints. This stage employs a variety of research methodologies, including literature reviews, surveys, precedent studies, and comparative analyses. These methods are utilized to gather essential data, establish a contextual framework, and formulate a clear problem statement. Programming aims to identify the project's goals, user needs, and site conditions, providing a foundation for the subsequent design phases.
2. Design Preparation
   The design preparation phase builds upon the insights gained during programming, transitioning from conceptualization to detailed design development. This stage involves the thorough analysis of collected data and preliminary design ideas to refine and specify the project's design parameters. Key activities include the development of design briefs, spatial planning, and the formulation of design concepts. The preparation phase ensures that the design solution is well-integrated with the project's objectives, addressing functional requirements, aesthetic considerations, and technical constraints. This stage also involves iterative design reviews and refinements to align the evolving design with stakeholder expectations and project requirements.
3. Design Excecution
   Design implementation encompasses the translation of detailed design concepts into executable architectural plans. This phase involves the preparation of detailed drawings. The implementation process ensures that the design is translated accurately into a built form, addressing all technical, structural, and regulatory aspects.
   In summary, the design development process is a methodical approach to transforming conceptual ideas into tangible solutions. It involves a structured sequence of stages that collectively ensure the design's functionality, feasibility, and alignment with project objectives. Each stage is integral to refining and realizing the architectural vision, ultimately resulting in a cohesive and effective design solution.

3. RESULT AND DISCUSSION

3.1 Programming

During the programming phase, literature reviews, surveys, and comparative studies of SeaWorld Ancol, Jakarta Aquarium and Safari, and Monterey Bay Aquarium were conducted. Key observations included zoning, building mass, circulation, exterior design, and interior layout. These aquariums typically feature public, service, and private zones, with Monterey Bay also including a semi-public zone. The Oceanarium will adopt a similar zoning approach to distinguish public and staff areas.

Building mass varies, with Jakarta Aquarium and Safari integrated into a mall, while SeaWorld Ancol and Monterey Bay are standalone. Circulation strategies emphasize separating vehicle and pedestrian traffic, with Jakarta Aquarium and Safari featuring mall pathways and others using internal strategies. The Oceanarium must ensure efficient

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circulation aligned with exhibit placement. Exterior design should blend with the surroundings and provide visitor amenities. Space organization will cater to visitors, staff, and marine life, supporting educational goals and enhancing the visitor experience. Interior design will align with thematic concepts, and climate control and lighting will cater to both visitor comfort and marine needs. Effective water management and safety features are critical, as are attractions and sociocultural spaces for community engagement.

Additionally, a site survey of the location on Jl. Samas – Parangtritis revealed a varied topography with significant depth variation of approximately 13 meters, benefiting from its accessibility and proximity to notable tourist destinations like Gumuk Pasir and Parangtritis Geomaritime Science Park.

Figure 2. Topographical Contours Cross-sectional Line
(Sumber : Google Earth, 2024)

Figure 3. A-A Site Contours
(Sumber : Google Earth, 2024)

Figure 4. B-B Site Contours
(Sumber : Google Earth, 2024)

The site is accessible via two main routes: Jl. Samas - Parangtritis to the north, an 8-meter wide major road supporting two vehicles, and a 6-meter wide secondary unpaved road on the eastern and northern sides, accommodating one vehicle and one motorcycle simultaneously. Located in a prominent tourist area, the site is close to diverse attractions such as Gumuk Pasir, beaches, and pine forests, with ample nearby accommodations. As per Regional Regulation No. 5 of 2019, the site's designation for natural, educational, special interest, and aerospace tourism supports its development as an educational facility.

In summary, the Oceanarium's design integrates insights from comparative studies and site surveys, ensuring effective zoning, circulation, and design. The site's strategic location on Jl. Samas – Parangtritis and adherence to local tourism regulations enhance its potential for educational and visitor engagement, aligning with regional goals and thematic requirements.

3.2 Design Preparation

In the design preparation phase, a thorough analysis was conducted utilizing previously gathered data. This data, collected through surveys and literature reviews, was integrated to

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form a comprehensive site analysis and thematic elaboration. The combination of these data sources provided a detailed understanding of the site's characteristics and contextual factors, laying the groundwork for informed and effective design decisions.

1. Site Analysis

A. Topography

The existing site is primarily farmland, with some areas featuring sandy beach and varied vegetation. It has a sloping terrain that primarily directs towards irrigation needs. The highest elevation is in the southern part of the site, at 13 meters, while the lowest points are in the northern regions. According to Regional Regulation No. 5 of 2019, any construction in this area must preserve the natural landscape due to its designation as a Tsunami Prone Area.

Figure 5. Site Topography

The topography significantly influences water flow patterns, with rainfall runoff descending from higher elevations to lower ones, following the site's contours. This runoff creates two retention points in the northern area. Given the site's varied topography, an organic design response would be unsuitable for the Oceanarium, which requires relatively flat areas.

Figure 6. Cut And Fill Area

Therefore, a cut and fill system is proposed to manage the diverse contours without completely removing them. The central area of the site is the most feasible for these operations. The identified retention points can be utilized as detention ponds, strategically placed in the lowest parts of the site to maintain natural water flow patterns and facilitate stormwater management.

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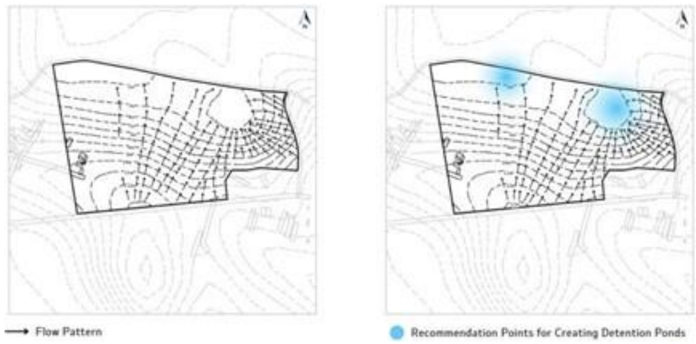

Figure 7. Flow Pattern and Detention Ponds Point

B. Environmental Linkages

The Oceanarium's location is strategically positioned near various buildings and tourist attractions. Key nearby sites include Gumuk Pasir Parangkusumo directly across from the site and Parangtritis Geomaritime Science Park, located 1.1 km away, approximately a 2-minute drive. Accommodation options, from homestays to resorts, are also conveniently close, with Losmen Alden just 2 km away, accessible in 3 minutes by car. However, healthcare facilities are limited; the nearest clinic, Klinik Rawat Inap Darma Husada, is 2.8 km from the site, a 5-minute drive. To address these factors, the Oceanarium will be designed to stand out as a unique and attractive destination, with a focus on connectivity to nearby attractions and residential areas. Additionally, the design will incorporate basic emergency medical facilities to ensure quick responses to health-related incidents.

C. Utilities

Water for Pantai Parangtritis Area is sourced from PDAM Seloharjo and groundwater from Gumuk Pasir. The area faces challenges in securing sufficient fresh water due to rising demand and decreasing availability, making groundwater use essential for meeting household needs. Electricity is provided by PLN Kretek, covering the entire region, including tourism sites, though details on wastewater management are limited. Consequently, wastewater management must be carefully integrated into the Oceanarium’s design. To tackle water supply issues, detention ponds will be incorporated for rainwater harvesting, with collected rainwater used to meet the Oceanarium’s needs. A generator will be installed to supplement the limited electricity supply, ensuring reliable power for lighting and HVAC systems. Wastewater management will involve separate channels for stormwater and sewage, with sewage undergoing filtration to prevent marine pollution.

D. Noise

The southern part of the site experiences high noise levels, exceeding 70 dB, due to vehicular traffic. In contrast, the northern and eastern areas have moderate noise levels, around 60-70 dB, while the western area is quieter, below 60 dB, due to its forested and sparsely populated nature. To mitigate the high noise levels from the southern traffic, vegetation will be used as a natural sound barrier, providing both aesthetic and acoustic benefits. Additionally, the building massing strategy will be designed to minimize noise intrusion, ensuring a tranquil environment for visitors.

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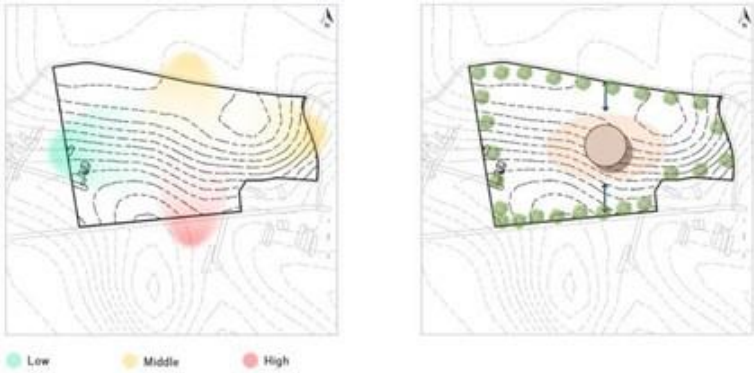

Figure 8. Noise Analysis and Design Response

E. Climate

The site receives sunlight from 05:43, with approximately 12 hours and 7 minutes of daily exposure. The sun reaches its peak at 11:45, marking the hottest part of the day. Wind patterns average 4 knots from the southeast, with waves of 1.27 meters heading north. The site experiences moderate rainfall, ranging from 150-200 mm, with a normal precipitation rate of 85%-115%.

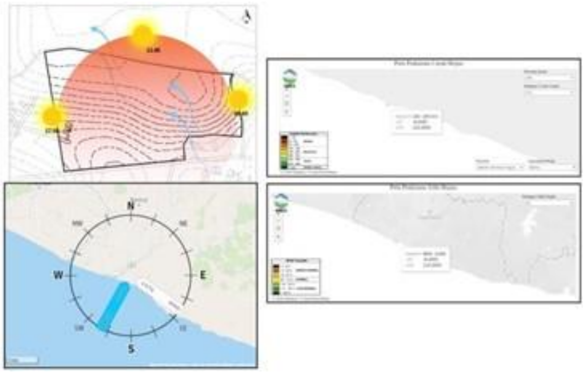

Figure 9. Climate Analysis

To address these climate considerations, the design will be approached in five phases. First, the building orientation will avoid direct west or east-facing facades to minimize excessive heat gain. Second, the building mass will be divided into sections to enhance airflow and reduce bulkiness. Third, these sections will be dispersed to avoid obstructing natural airflow. Fourth, detention ponds will be incorporated to manage rainwater efficiently. Finally, cross-ventilation will be integrated into non-black box museum areas to improve natural cooling.

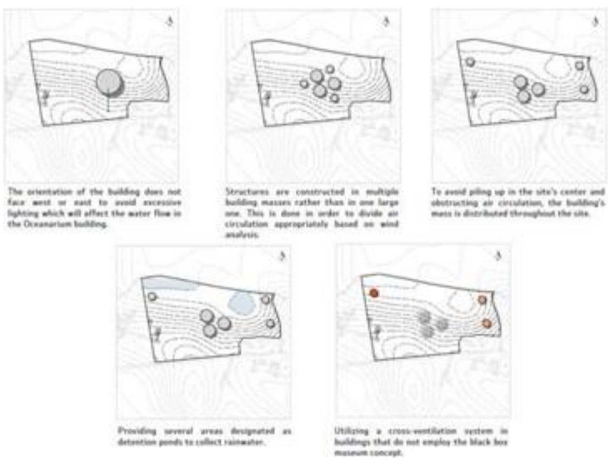

Figure 10. Climate Design Response

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F. Views

The best views from the site are to the north and west, where the northern view offers picturesque rice fields and mountains, while the western view includes expansive fields and orchards. In contrast, the southern and eastern views are less attractive, featuring only farmland and roads.

To optimize the visitor experience, the design will focus on the northern and western views by orienting key spaces to highlight these scenic vistas. Although the building's primary attraction does not depend on these views, enhancing the visual appeal of external areas will contribute to a more enjoyable overall experience for visitors.

Figure 11. Views Analysis

G. Circulation

Vehicular circulation around the site is concentrated on the northern, southern, and western edges. The southern route, Jl. Samas – Parangtritis, is a major road 8 meters wide, allowing bidirectional traffic. The western and northern roads are 6 meters wide, supporting two vehicles simultaneously. Currently, pedestrian circulation is mixed with vehicular traffic due to the lack of dedicated walkways, although access from the west, north, and south is feasible despite the steep gradient on the western side.

To improve circulation, access points will be located on the southern edge, using Jl. Samas - Parangtritis for primary ingress and egress. The northern and western routes will be designated for service access to minimize interference with visitor traffic. Pedestrian pathways will be designed to separate foot traffic from vehicles, enhancing safety and accessibility.

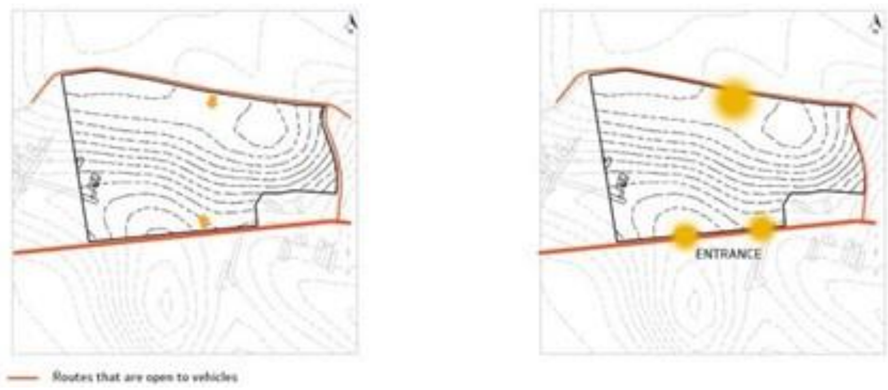

Figure 12. Circulation Analysis and Design Response

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2. Thematic Elaboration

The themematic elaboration for the Oceanarium focuses on integrating biomorphic architecture with a narrative approach. Biomorphic design, inspired by natural forms, aligns with the building's role as an educational tourism facility. The narrative approach adds depth, creating a compelling visitor experience. This integration, grounded in a thorough analysis of issues, needs, and concepts, ensures the design is both functional and thematically cohesive, enhancing the Oceanarium's educational and recreational objectives.

Table 2. Thematic Elaboration

	Oceanarium	**Biomorphic Architecture**	**Narrative Architecture**
What	A giant container housing fish and other marine life for public viewing or scientific observation (Oxford Learner's Dictionary, 2023).	Biomorphic architecture is a design theme that incorporates organic life ideas, including forms, systems, and movements (Asyifa et al., 2020).	Narrative architecture is an approach based on the understanding that architectural forms can convey stories to their users. This approach aims to create a narrative through the building's design (Aufa & Marlina, 2023).
Problem	Designing the Oceanarium as a facility for marine conservation aims to provide education and raise awareness about marine ecosystem preservation, while also being an enjoyable destination for both domestic and international tourists.	Applying organic life concepts to the building's form, system, and movement.	Applying a narrative of marine life from the surface to the depths, creating an interactive spatial experience that enhances visitors' imagination.
Fact	Conservation and education facilities for marine life are unevenly distributed, resulting in insufficient public education.	Biomorphic design, with its natural forms and elements, aligns well with the Oceanarium's concept.	Incorporating a narrative flow in the design creates an educational tourist facility that tells a story and engages visitors interactively.
Needs	The Oceanarium building serves as a conservation facility for marine life, providing education and raising awareness about the preservation of marine ecosystems.	Applying biomorphic elements and characteristics into the building to integrate it with the surrounding environment.	Consider visitor circulation to ensure that the educational narrative about marine life, from the surface to the deep, is effectively conveyed through a cohesive storyline.
Goals	Create a building that serves as a platform for education, conservation, and research on marine life.	Creating buildings that integrate harmoniously with the surrounding environment and positively impact both the local ecosystem and visitors.	Designing buildings that facilitate education about marine life by incorporating narrative elements into the design process, thereby making theeducational experience unique and effective.
Concept	Designing an oceanarium that serves as a marine life conservation facility, aimed at educating and raising awareness about the preservation of marine ecosystems, while also being enjoyable for both domestic and international tourists in Parangtritis, Yogyakarta. This will be achieved through the application of biomorphic architecture combined with a narrative architectural approach.		

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3.3 Design Execution

Design execution is the final stage in the design development of the oceanarium. This phase involves the implementation of the design, starting from the creation of the concept, through the preparation of detailed design documents (DED), and culminating in the final outcome of the oceanarium's design.

1. **Concept**

A. Mass Design Concept

The design concept for the oceanarium responds to site analysis by integrating biomorphic architecture inspired by octopuses. This approach shapes the building mass to be both functional and aesthetically pleasing. Biomorphic elements are applied to the facade and form, creating a visually harmonious structure. The octopus inspiration is reflected in the building's shape and patterns, giving it a unique character. The facade incorporates secondary skin resembling octopus tentacles with gradient colors to enhance aesthetic appeal. The biomorphic concept not only enhances visual beauty but also optimizes air circulation, lighting, and environmental integration. This design aims to create a landmark in Parangtritis, Yogyakarta.

Figure 13. Mass Design Concept

B. Thematic Concept

The oceanarium's design employs biomorphic architecture inspired by octopuses, featuring a facade with secondary skin resembling octopus tentacles, giving the building an underwater appearance. The structure includes a spiral layout mimicking tentacle movement, creating a winding path for visitors. Tentacle motifs are used in the landscaping, and the "Octopus Brain" exhibition zone highlights marine intelligence. Organic-shaped tunnels simulate the experience of moving through an octopus, while an adaptive lighting system replicates underwater light variations. Complementing this, the narrative architecture unfolds as a journey of an adventurer in search of legendary treasure across five thematic stages: Coastal Beach, Shallow Ocean, Medium Ocean, Deep Ocean, and Epilogue, providing an engaging and educational experience on marine life and conservation.

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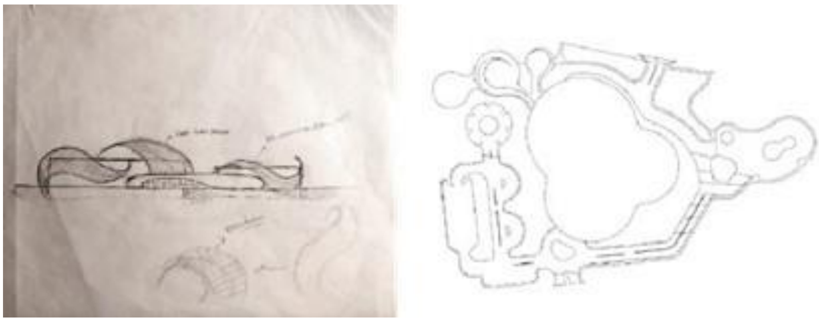

Figure 14. Thematic Concept

C. Zoning Concept

The oceanarium is divided into public, semi-public, private, and service areas. The public zone includes the parking area, the semi-public includes the main oceanarium and supporting facilities, the private zone encompasses management offices and laboratories, and the service areas are designated for operational needs.

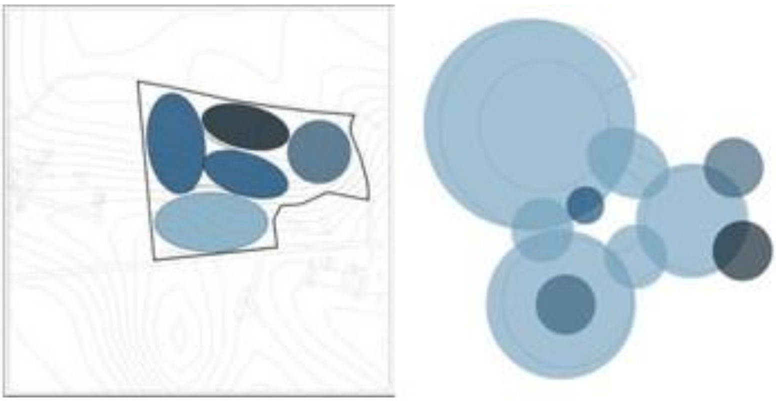

Figure 15. Zoning Concept

D. Circulation Concept

The internal circulation adopts a biomorphic theme inspired by octopuses, with a central atrium serving as the main circulation hub. The external circulation incorporates tentacle-like paths to guide visitors while separating pedestrian and vehicular traffic.

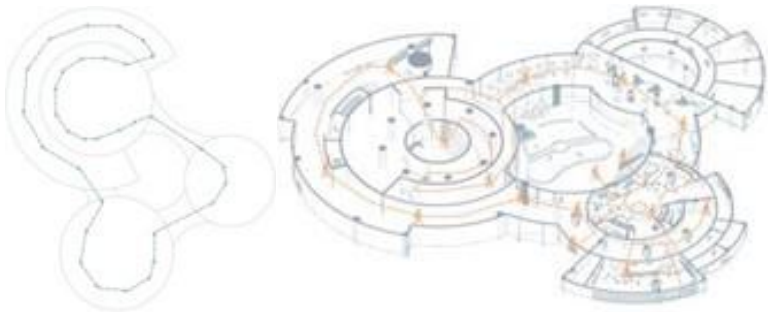

Figure 16. Circulation Concept

E. Structural Concept

The building employs wide-span biomorphic structures to avoid column interference in the aquarium areas. Acrylic glass, resistant to sea water corrosion, is used for aquariums, supported by reinforced concrete foundations. The structure adapts to the natural forms and forces of octopuses. The façade of the building has been selected with a focus on material durability in coastal weather conditions. Enamel steel panels were chosen for the primary façade, providing robust protection against

DOI: https://doi.org/10.17509/jare.v6i2.77332
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the elements. In contrast, the undulating façades of the other sections use a membrane material with relatively low transparency. This membrane is supported by a façade structure made of galvanized steel pipes, with diameters ranging from 3 to 10 cm, ensuring stability and resilience.

Figure 17. Structure Concept

F. Utilites Concept

- Clean Water: Utilizes rainwater and municipal water, with storage and pumping systems for recycling.

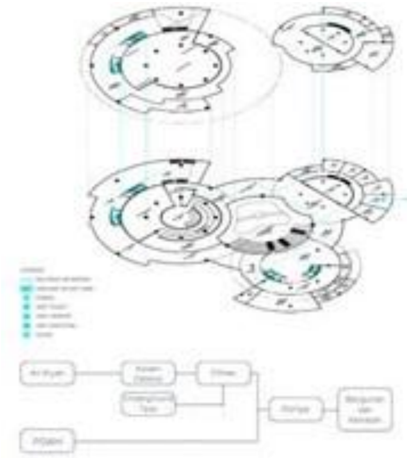

Figure 18. Clean Water Utilites Concept

- Wastewater and Waste: Separate systems for sewage and marine waste, with filtration and recycling processes.

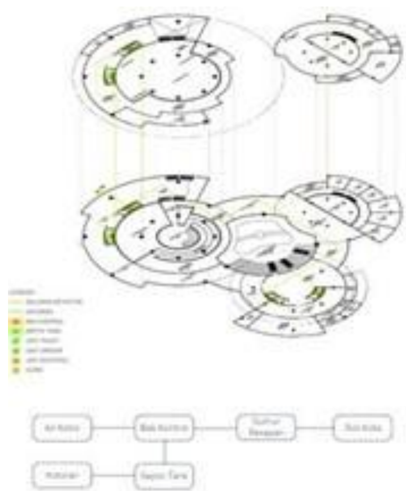

Figure 19. Wastewater and Waste Utilites Concept

- Seawater: Sourced from Pantai Parangtritis, filtered, and used in the aquariums.

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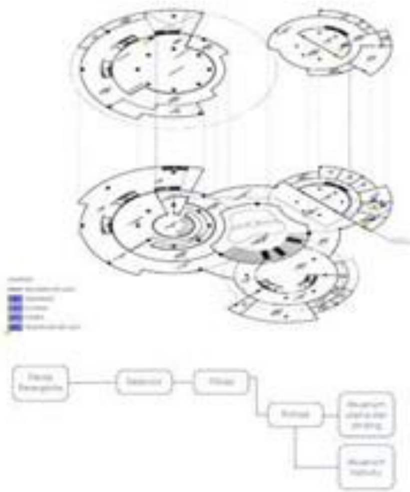

Figure 20. Seawater Utilites Concept

- Electricity: Powered by both grid and generator, with centralized control.

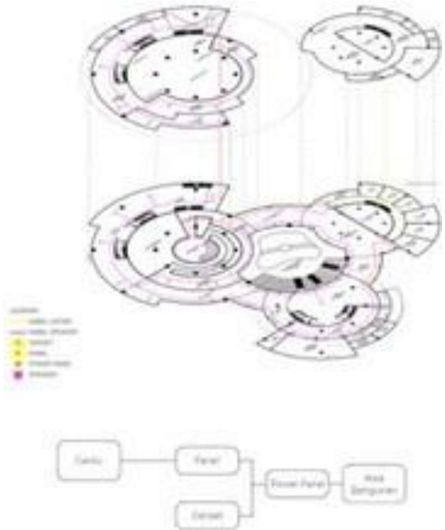

Figure 21. Electricity Utilites Concept

- Fire Protection: Integrated with clean water supply, equipped with hydrants, extinguishers, and smoke detectors.

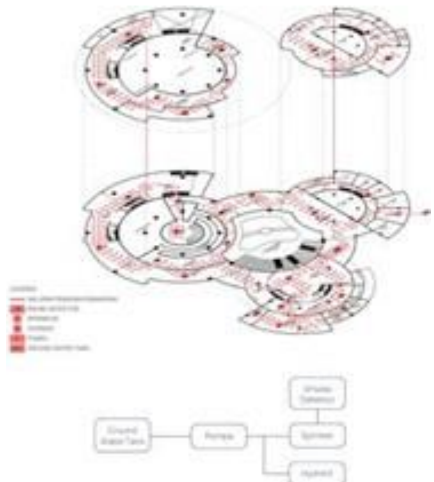

Figure 22. Fire Protection Utilites Concept

- HVAC: Centralized system with cassette units, suitable for large buildings and maintaining suitable conditions for marine life.

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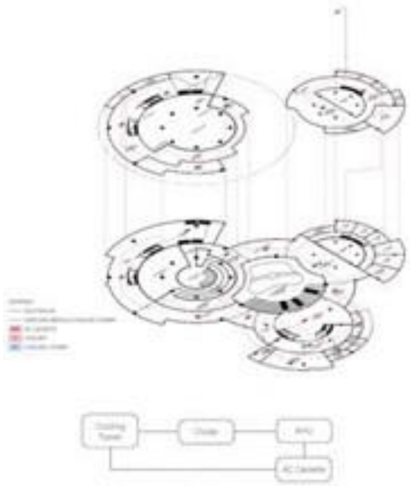

Figure 23. HVAC Utilites Concept

This concise overview captures the essential aspects of the design and planning for the oceanarium.

2. Final Design

The final design is the culminating product achieved through three stages of design development: programming, design preparation, and design execution. As a component of the design execution phase, the final design is realized as a 3D rendering, providing a clear and detailed visualization of the design outcomes. This rendering allows for an accurate depiction of the architectural and spatial elements, ensuring that the design intentions are effectively communicated and comprehended.

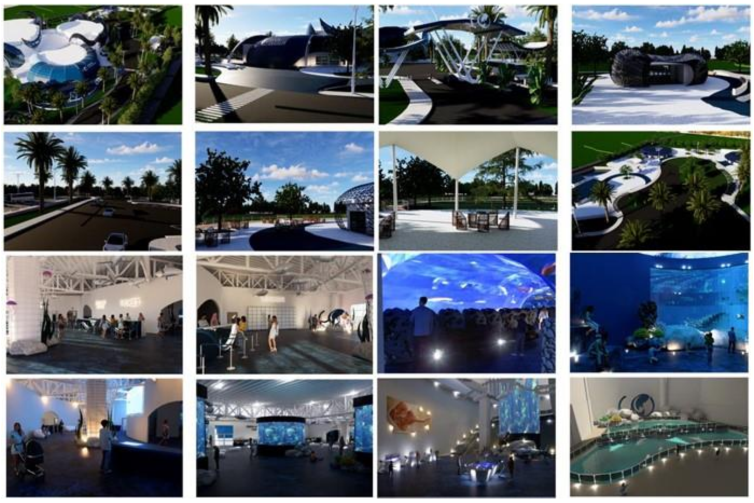

Figure 24. Final Design Product

4. CONCLUSIONS

The Oceanarium Design Development project aims to tackle critical marine conservation, preservation, and education needs in Indonesia, responding to challenges like pollution and overexploitation. The site at Pantai Parangtritis in Bantul, Yogyakarta, was selected for its alignment with project goals and proximity to the Parangtritis Geomaritime Science Park, adhering to Regional Regulation No. 5 of 2019.

The oceanarium design features biomorphic architecture inspired by the octopus, influencing its form and circulation to reflect sustainability and environmental harmony. A narrative design strategy enhances visitor engagement through a structured storytelling approach. The facility, envisioned as Yogyakarta’s first, will feature a black box museum

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concept housing 135 Indonesian marine species. It comprises three interconnected circular structures, adapting to the site's topography and separating exhibition areas from ancillary facilities. This design fosters immersive educational experiences and ensures the welfare of marine species, positioning the oceanarium as a key player in marine ecosystem education and conservation.

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