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(Research/Review) Article

Design of Public Space at Roundout Old City Pulo Brayan, Medan with Sustainable Architecture Approach

Robby Pratama [1], Melly Andriana [2,*], and Dara Wisdianti [3]

[1] Student, Department of Architecture, Faculty of Sains and Technology, Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia 1; e-mail : robbypratama330@gmail.com
[2] Lecturer, Department of Architecture, Faculty of Sains and Technology, Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia 2; e-mail : mellyandriana@dosen.pancabudi.ac.id
[3] Lecturer, Department of Architecture, Faculty of Sains and Technology, Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia 3; e-mail : darawisdianti@dosen.pancabudi.ac.id
* Corresponding Author : Melly Andriana

Abstract: The development of major cities in Indonesia, including Medan, is inseparable from complex social, economic, and political dynamics. This transformation often leads to a mismatch between the city's image and its local identity, reduced access to adequate housing, and the decline of public open spaces, particularly in urban fringe areas such as Pulo Brayan. In fact, public spaces play a crucial role in supporting social interaction and ecological functions within a city. This study focuses on the importance of redesigning public space in the Pulo Brayan area using a sustainable architectural approach. The main objective is to create a public space that can address social, economic, and environmental challenges in an integrated manner. The proposed design emphasizes the integration of historical values, active community participation, and ecological functionality to support the realization of sustainable cities, in line with the principles of Sustainable Cities and Communities. Thus, this design is expected to serve as a contextual, inclusive, and sustainable model for public space regeneration.

Keywords: Community; Public Space; Sustainable City; Urban History

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1. Introduction

The development of major cities in Indonesia, including Medan, is significantly influenced by complex social, economic, and political dynamics. Historically, the early transformation of Medan was driven by Dutch colonial policies, particularly the expansion of plantation lands, which had a profound impact on the city's structure and residential patterns. One of the most affected areas was Pulo Brayan, now a vital part of Medan's historical and cultural heritage (Widya et al., 2022). Massive urban transformation often leads to a city image that no longer aligns with its local identity. In peripheral areas such as Pulo Brayan, these changes present serious challenges, including social and economic disparities as well as declining environmental quality. Many affected residents have resorted to informal settlements along railway corridors due to limited access to education and decent employment opportunities (Sosial et al., 2015; Nuraini,). In addition to socio-economic changes, shifts in urban structure have also influenced the quality and function of public spaces in the area. Public space plays a crucial role not only as a platform for social interaction but also as an ecological element supporting urban environmental sustainability (Krier, 1979; Hakim, 2003; Nuraini, 2019; Nuraini, 2020). The degradation of public space functions tends to exacerbate social inequality, a common issue in large cities like Medan (Hantono et al., 2018). Several previous studies have proposed sustainable approaches to public space design, such as the integration of historical tourism in Bandung (Muwarih et al., 2023), educational parks in Karanganyar (Almira

et al., 2020), and urban acupuncture strategies in Denpasar (Ballinan & Supatra, 2023). However, these designs are often limited to micro-scale sustainability and have yet to fully integrate the concept of *Sustainable Cities and Communities*. Therefore, it is crucial to propose a new design approach that not only considers physical and environmental sustainability but also integrates local historical values and community roles as active agents in area regeneration. (Andriana & Tharo, 2018; Wisdianti, 2022; Wisdianti et al, 2023; Andriana et al, 2023). The design of public space in the Pulo Brayan area aims to establish a sustainable relationship between history, community, and public space as a unified cycle of a living and inclusive city. Sassi (2006) identifies six core principles of sustainability based on a comprehensive analysis of architectural case studies that apply sustainable design concepts. These six principles include: 1) Site and Land Use, This principle encompasses the planning of compact cities to support spatial efficiency and quality of life. Reducing transportation impact is achieved through the integration of public transit systems, pedestrian pathways, and bicycle lanes. Site development should be in harmony with nature, avoiding habitat destruction and supporting local food production to reduce emissions and strengthen the local economy, 2) Community, Community participation is a fundamental aspect of creating inclusive environments. The provision of sustainable housing must consider comfort, accessibility, and adaptability. Development should also aim to generate employment and training opportunities, improve quality of life, and foster awareness of social and environmental sustainability, 3) Health and Well-Being, Thermal comfort, air quality, and environmental control are central concerns. The use of building materials and technologies should prioritize health impacts. Design must support identity, autonomy, and create restorative spaces that enhance users' physical and psychological well-being, 4) Materials, The sustainable materials approach emphasizes design longevity, reuse of building components, and the use of recycled materials. Material selection must account for the environmental impacts of extraction, manufacturing processes, and embodied energy. Waste management through efficient design and construction practices is integral to achieving a closed-loop material cycle, 5) Energy, Energy efficiency is achieved through optimal building orientation, natural ventilation and lighting, and the use of passive technologies. Energy use must be minimized and its efficiency maximized through low-energy building systems and the adoption of renewable sources such as solar and wind power, 6) Water, Water management focuses on reducing consumption, increasing efficiency, and utilizing alternative sources such as greywater and rainwater. On-site treatment and reuse systems help reduce pressure on municipal drainage infrastructure and lower the risk of environmental pollution.

Based on the previously described background, the main design problem can be formulated as follows:

How can a public space at the Kota Tua Pulo Brayan Roundabout be designed to integrate the principles of sustainable architecture, the historical values of the area, and the active role of the local community in order to support the realization of an inclusive and sustainable city?

The main objectives of this design can be outlined as follows: 1) To preserve local cultural and historical heritage, by designing a public space that protects, showcases, and honors the historical values and architectural elements of the Kota Tua Pulo Brayan area, thereby strengthening local identity and community awareness of cultural heritage, 2) To enhance social interaction and community activities, by creating spaces that encourage public participation through inclusive and adaptive facilities such as recreational areas, open spaces, and safe, comfortable social interaction zones, 3) To integrate principles of sustainable architecture, by applying designs that are resource-efficient, environmentally friendly, and that support the ecological functions of urban spaces through water management, vegetation integration, and green energy systems, 4) To promote economic growth and tourism appeal, by transforming the roundabout area into a hub for local economic activity and a cultural tourism destination through strategic, functional, and attractive spatial planning for both visitors and investors, 5) To improve quality of life and public awareness, by designing public spaces that are inclusive, accessible, safe, and comfortable, aiming to enhance community well-being and foster a sense of ownership toward the surrounding environment.

2. Proposed Method

Design Process

The design of the public space began with the collection of primary data through field observations and community interviews, as well as secondary data from literature, regulations, and technical guidelines. These data were used to understand existing site conditions, user

needs, and the theoretical foundations of the design. The subsequent design process followed a systematic architectural design methodology, starting from needs analysis to the development of concepts and final design. This method facilitates critical and creative thinking in generating design solutions that are functional, aesthetic, contextual, and sustainable. The integration of data and design methodology results in a public space design that is responsive to social needs, environmentally friendly, and technically and visually appropriate. The stages and design process of the Public Space at the Kota Tua Pulo Brayan Roundout, Medan with a Sustainable Architecture Approach are illustrated in Figure 1.

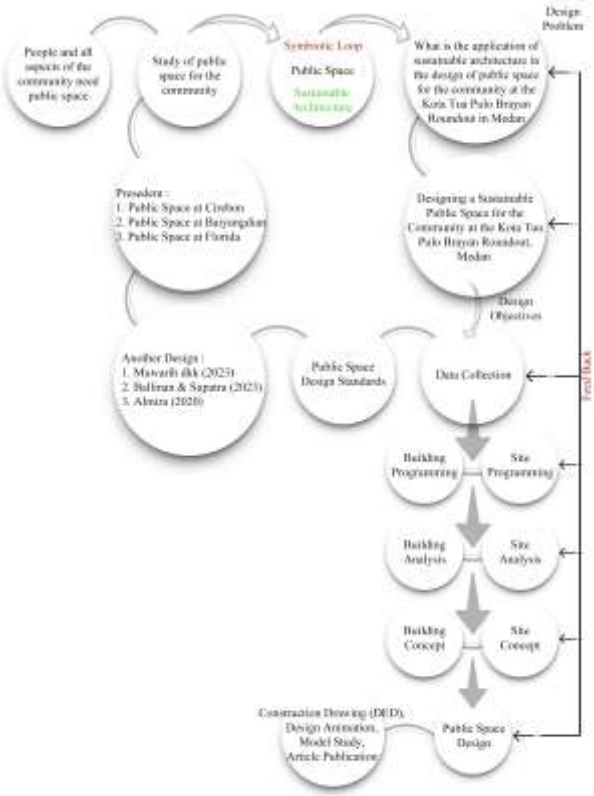

Figure 1. Design Process
(Source : Author's Construction, 2025)

3. Results and Discussion

Site Analysis

The site for the sustainable public space design is located on Jalan Bengkel, Pulo Brayan Bengkel Baru Subdistrict, Medan Timur District, Medan City, North Sumatra. The area is a vacant lot designated as a Green Open Space – Tourism Zone (RTH-4) according to the Spatial Pattern and Zoning Plan of Medan Timur District. The site analysis includes aspects of location selection and accessibility to identify the site's potential in supporting its function in accordance with the *Detailed Spatial Plan (RDTR)* and *Zoning Regulations of Medan City for 2015–2035*. The analysis is illustrated in Figure 2.

Figure 2. Site Analysis
(Source: Personal Analysis, 2025)

Site Selection

The location is situated within an area designated for public service facilities, commercial services, and trade. This zone holds significant potential for development into a public space, and the site selection was based on several considerations, namely:

a. The site is located near major toll gates such as Krakatau Toll Gate and Haji Anif Toll Gate.
b. It lies within an area designated for public services, commercial activities, and trade.
c. The site offers a large area suitable for public space development, with a total of approximately ±5.05 hectares.
d. It is in close proximity to public transportation facilities and community amenities, including Pulo Brayan Railway Station, Pulo Brayan Flyover, toll access, Baiturrahman Mosque, YWKA Private School, and Brayan Bengkel Morning Market.

Site Accessibility Analysis

The site is accessible by both private vehicles and public transportation, including commuter trains and city minibuses (*angkot*). The primary access routes to the site are from Krakatau Toll Gate and Haji Anif Toll Gate, followed by Jalan Cemara, and then through Jalan Bengkel or Jalan Lampu. These conditions indicate that the site has strategic accessibility, which supports its function as a public space. The analysis is illustrated in Figure 3.

Figure 3. Site Accessibility Analysis
(Source: Personal Analysis, 2025)

Site Boundary Analysis

This analysis illustrates the surrounding environment of the site, which has both direct and indirect influences on the design of the public space. The boundaries are described as follows:

a. North Side: Jalan Bengkel, adjacent to residential areas and Baiturrahman Mosque.
b. South Side: Jalan Pertahanan, adjacent to the Pulo Brayan Flyover.
c. East Side: Jalan Lampu, adjacent to residential areas and vacant land.
d. West Side: Jalan Bengkel, adjacent to residential areas and the railway tracks.

Site Regulation

According to Regional Regulation of Medan City No. 2 of 2015 concerning the *Detailed Spatial Plan (RDTR)* and *Zoning Regulation* of Medan City for the years 2015–2035, the zoning regulation includes zone types, zone/subzone classifications, and conditions for restricted and conditional land use. These regulations cover:

a. Nature of land use
b. Maximum of 3 permitted activity groups
c. Floor Area Ratio (FAR)
d. Building Coverage Ratio (BCR)
e. Green Coverage Ratio (GCR)
f. Building height
g. Spatial use requirements
h. Incentive provisions
i. Disincentive provisions
j. Sanction provisions (incentives and disincentives)

Zoning Details for the Site:

a. Nature of land use : Museum, outbound/recreation area, and restaurant
b. Permitted activity groups : Maximum of 3

c. Floor Area Ratio (FAR) : Maximum 0.2
d. Building Coverage Ratio (BCR): Maximum 10%
e. Green Coverage Ratio (GCR) : Maximum 80%
f. Building height : Maximum 3 floors / 13 meters
g. Building setback line (BSL) : 3 meters

Site Description:
a. Land area : Approximately ±5.05 hectares
b. Coordinates : 3.631696 S / 98.671772 E
c. Topography : Relatively flat

Figure 4. Site Size Analysis
(*Source: Personal Analysis, 2025*)

Zoning Analysis

This analysis serves to determine the appropriate and context-sensitive placement of buildings based on the site's existing conditions. Zoning is carried out by grouping activities according to site conditions and zoning criteria. The zoning plan is divided into the following categories:

a. Public Zone, areas directly accessible and used by visitors.
b. Semi-Public Zone, transitional areas between visitors and management staff.
c. Private Zone, areas designated for internal use by the management or staff.
d. Service Zone, general utility areas designated for supporting or auxiliary activities.

Figure 5. Zoning Analysis Response
(Source: Personal Analysis, 2025)

As a response to land-use incompatibility, the residential zone was relocated to the opposite side of the site, where existing housing already exists. The church zone was expanded to provide parking access without disrupting traffic flow on Jalan Bengkel, supported by a service zone accommodating toilets and storage to ensure a conducive environment for worship activities. The green zone functions as a vegetated infiltration area and serves as a noise buffer from Jalan Pertahanan and the Cemara Flyover. The private zone is allocated for administrative and management purposes, while the rear service zone functions as a support facility. Semi-public zones are distributed in three locations as parking and waiting areas,

whereas the public zone includes the museum building, outbound/recreation area, and restaurant.

Circulation Analysis

Circulation analysis is divided into several categories, namely:

a. Pedestrian Circulation

Pedestrian circulation is focused on the central activity areas for both visitors and site management, by optimizing the existing pathways within the site. Additional circulation routes are also provided outside the site area to support access from public transportation modes such as city minibuses (*angkot*), online motorcycle taxis, and the train station located across from the site. These efforts aim to enhance connectivity and pedestrian comfort.

Figure 6. Pedestrian Circulation Analysis Response
(Source: Personal Analysis, 2025)

b. Transportation Circulation

Vehicular circulation is designed by utilizing existing roadways to prevent traffic congestion. The primary access is from Jalan Bengkel on the west side of the site, implementing a one-way system with separated lanes for two-wheeled and four-wheeled vehicles to reduce queuing during peak visitor capacity. Jalan Lampu, located on the north and east sides, functions as an alternative exit route from the site.

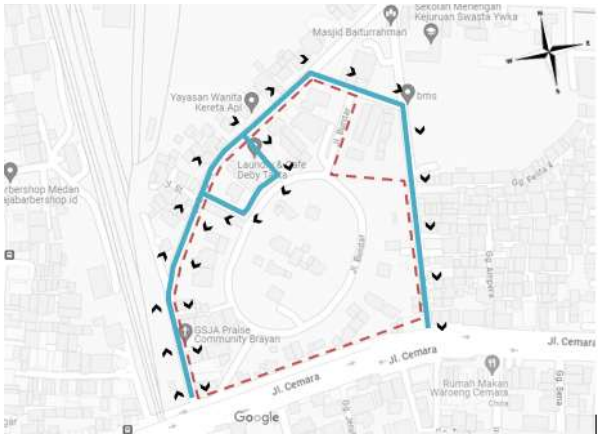

Figure 7. Transportation Circulation Analysis Response
(Source: Personal Analysis, 2025)

c. Parking Circulation

The parking area is located in the northwest part of the site, utilizing a one-way circulation system to ensure internal traffic efficiency. Parking lanes are separated based on vehicle type, with designated zones for motorcycles/bicycles and separate zones for cars, minibuses, and tourist buses.

Figure 8. Parking Circulation Analysis Response
(Source: Personal Analysis, 2025)

Sun Path Analysis

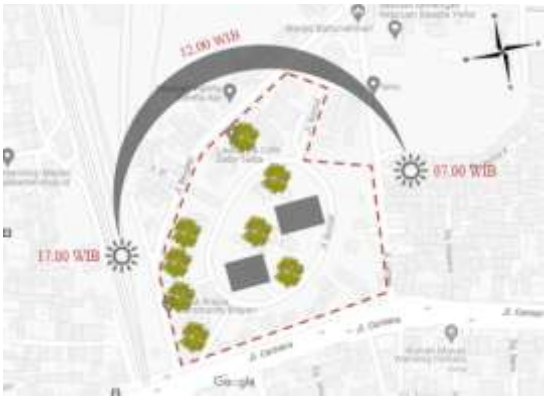

Figure 9. Sun Path Analysis Response
(Source: Personal Analysis, 2025)

To reduce sun exposure in the western area of the site—where solar intensity is highest—a vegetative buffer in the form of rows of shade trees is applied. A similar strategy is also implemented in areas with moderate solar intensity by utilizing existing vegetation. In addition, buildings are designed with orientations that minimize direct sunlight exposure and are equipped with solar panel roofing to optimize solar energy as an electricity source for public space facilities.

Wind Direction Analysis

Figure 10. Wind Direction Analysis Response
(Source: Personal Analysis, 2025)

The building layout is designed in a zigzag pattern to maximize wind flow throughout the entire area, thereby creating effective natural ventilation. In addition, low-lying shrubs that obstruct air circulation are reduced to enhance thermal comfort within and around the buildings.

Noise Analysis

Figure 11. Noise Analysis Response
(Source: Personal Analysis, 2025)

To mitigate traffic noise, vegetative buffers are applied along the west and northwest edges of the site. A similar strategy is implemented on the eastern side and further reinforced on the southern area—where noise levels are highest—through the addition of dense vegetation, green spaces, and infiltration zones. These measures aim to enhance environmental comfort within the site.

Spatial Program Overview

Based on the spatial program, several facilities are provided within the public space, including:

a. Main Facilities

Table 1. Main Facilities

No	Facilities	Quantity m²
1	Office Management	1.270,8
2	Museum	2.448
	Total	3.718,8

(Source: Personal Document, 2025)

b. Supporting Facilities

Table 2. Supporting Facilities

No	Facilities	Quantity m²
1	Restaurant	1.963,8
2	Sport & Playground	2.553
3	Parking Area	3.240
	Total	7.756,8

(Source: Personal Document, 2025)

c. Total Area

Table 3. Total Area

No	Facilities	Quantity m²
1	Main Facilities	3.718,8
2	Supporting Facilities	7.756,8
	Total	11.475,6

(Source: Personal Document, 2025)

Basic Concept

In the conceptual stage, the design approach applies a programmatic concept. A programmatic concept is a design methodology that focuses on problem-solving and systematically fulfilling user needs. This approach integrates functions, activities, and user interactions into spatial forms that are effective, functional, and contextually appropriate. The main stages include:

a. Identification of problems and user needs,
b. Functional analysis,
c. Spatial zoning based on functional relationships,
d. Efficient circulation planning, and
e. Final design formulation that considers technical, aesthetic, and sustainability aspects.

In the context of public space, this concept is used to design zones for social, cultural, economic, and ecological activities that are interconnected. As a result, the design produced is not only aesthetically pleasing but also responsive and relevant to the needs of the community.

Massing Concept

The massing design process is divided into four visual stages that represent the architectural transformation as follows:

- Stage 01: Basic Module Arrangement
  Three to four basic building blocks are arranged based on the requirements of primary functions: interaction spaces, service areas, and main circulation paths. This massing illustrates a systematic and efficient spatial program interpretation.
- Stage 02: Fragmentation and Orientation
  The masses are then split and rotated to create more dynamic spatial relationships. These adjustments are informed by user accessibility and movement direction, generating negative spaces with the potential to function as open public areas.
- Stage 03: Vertical Volume Addition
  Additional structures (in red) are placed atop the base masses to establish vertical functional hierarchies. These areas may include semi-private spaces such as viewing decks, galleries, or coworking areas. The vertical volumes also serve as visual markers for key functions within the site.
- Stage 04: Open Space Activation
  The addition of blue elements at the base indicates the formation of public open spaces, such as plazas, pedestrian pathways, or small urban parks. These elements enhance the connectivity between buildings and bridge the interaction between indoor and outdoor spaces.

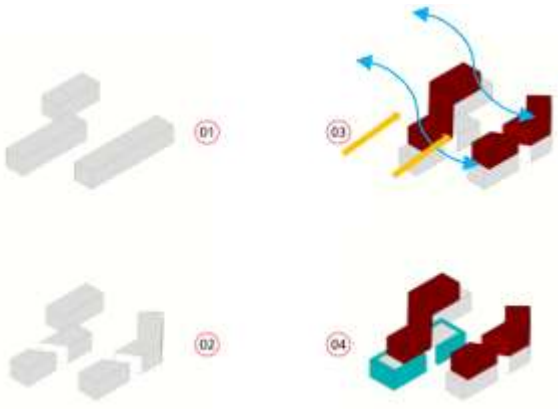

Figure 12. Massing Process
(Source: Personal Document, 2025)

The Health and Well-Being aspect is implemented through massing strategies that respond to site conditions, air circulation, and natural lighting. The building masses are elongated along the prevailing wind direction to maximize natural ventilation, while

minimizing direct solar exposure by reducing the surface area exposed to sunlight. Several volumes are strategically cut along the wind path to maintain visual continuity and create open spaces between building blocks, ensuring optimal and balanced thermal conditions and indoor lighting.

Parking Area Concept

The parking area is located on the northwest side of the site, adjacent to the main vehicular access point, serving as a buffer between the transportation zone and the main public space. A one-way circulation system is applied to ensure efficient and conflict-free traffic flow.

The parking zone is divided into two sections:

a. Two-wheeled vehicle parking (bicycles and motorcycles), placed near pedestrian pathways.
b. Four-wheeled or larger vehicle parking (cars, minibuses, tour buses), with ample maneuvering space.

Each zone is equipped with safe pedestrian access, bordered by protective vegetation and differentiated paving materials, clearly separating vehicle lanes from pedestrian routes.

Utility Concept

The utility system design for the public space at Bundaran Kota Tua Pulo Brayan refers to the existing site conditions and principles of sustainability. The system is divided into two main components—clean water and wastewater—which are designed to be integrated with the city's infrastructure and responsive to the local context.

a. Clean Water System

The site consists of vacant land, active residential areas, and old buildings. Most residents rely on the municipal water supply (PDAM), which also serves as the primary source for public facilities. The distribution system is centrally designed with branches leading to functional units such as toilets, prayer rooms (*mushola*), and the food court. It is equipped with storage tanks and pressure control systems. Pipe networks are aligned with the building zoning for efficiency and ease of maintenance.

b. Wastewater System

Liquid waste is channeled into the municipal sewer system and the surrounding open drainage channels. Before discharge, the waste is treated through grease traps (for kitchen waste) and modular septic tanks or wastewater treatment units (IPAL) for domestic use to meet environmental quality standards. The piping system follows the site's contours and includes inspection chambers and manholes to facilitate maintenance.

Figure 13. Utility Simulation on Building
(Source: Personal Document, 2025)

The implementation of water efficiency in public space buildings is realized through an integrated water management system that includes rainwater harvesting, greywater recycling, and the optimization of non-consumptive water use. Rainwater is collected and filtered for landscape irrigation, while greywater from domestic activities is treated and reused for toilet flushing. This system not only reduces clean water consumption and the burden on urban drainage infrastructure but also minimizes environmental pollution risks. The strategy reflects sustainable principles by promoting resource efficiency and reinforcing natural cycles within the built environment.

Design Visualization

a. Site Plan

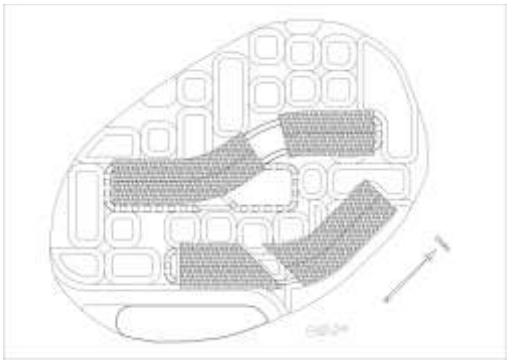

Figure 14. Building Site Plan
(Source: Personal Document, 2025)

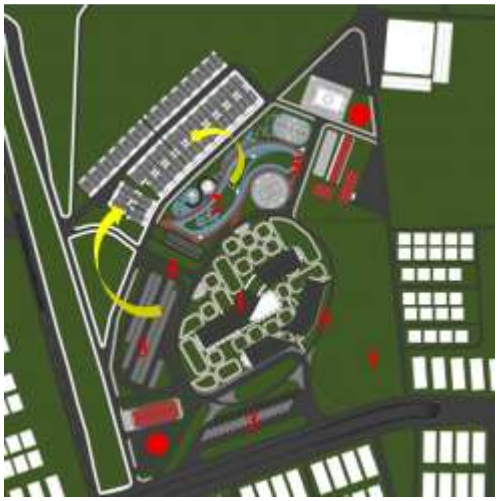

Figure 15. Design Site Plan
(Source: Personal Document, 2025)

The implementation of sustainable architecture from the site and land use aspect is reflected through the functional arrangement of the site layout. Zone (1) functions as the main building, (2) as supporting facilities, (3) as the parking area, (4) as an infiltration and natural ecological zone utilizing existing vegetation, and (5) as optimized pedestrian and bicycle pathways leading to the public space core. Existing buildings marked on-site are retained and integrated within the area with designated privacy zones, while residential structures deemed incompatible with the land use plan are relocated across the site to restore spatial function in a sustainable manner.

b. Layout Plan

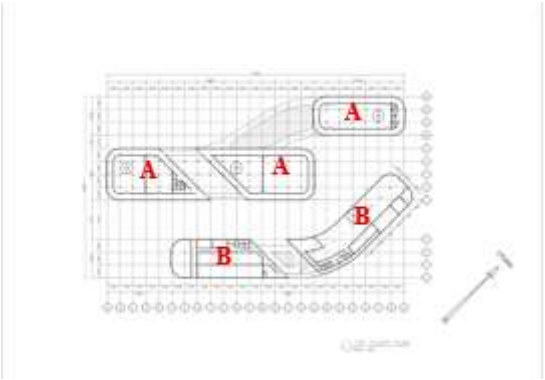

Figure 16. Layout Plan 01
(Source: Personal Document, 2025)

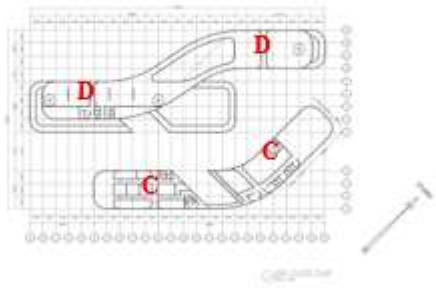

Figure 17. Layout Plan 02
(Source: Personal Document, 2025)

The application of sustainable architecture from the community aspect is reflected in the building functions and their supporting facilities. Zone (A) serves as a center for human resource training and exhibitions, (B) as a food court and logistics warehouse, (C) as a public space management and culinary area, and (D) as a museum of Pulo Brayan's Old Town history. This functional distribution creates job opportunities, stimulates local economic circulation, and improves the quality of life for surrounding communities. Additionally, the provision of sports and playground facilities further strengthens the social dimension and long-term sustainability of the area.

c. Elevation

Figure 18. Front Elevation
(Source: Personal Document, 2025

Figure 19. Rear Elevation
(Source: Personal Document, 2025)

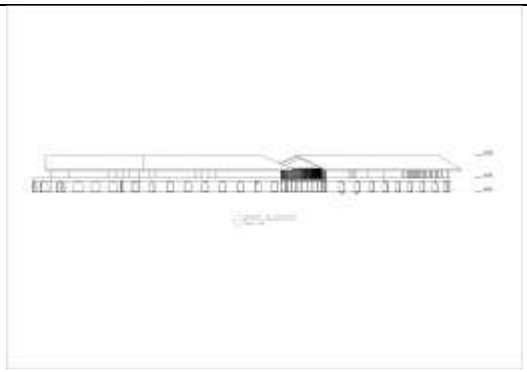

Figure 20. Right Side Elevation
(Source: Personal Document, 2025)

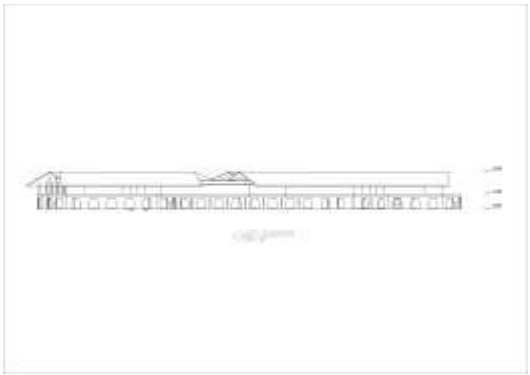

Figure 21. Left Side Elevation
(Source: Personal Document, 2025)

Figure 22. Building Materials
(Source: Personal Document, 2025)

The implementation of sustainable architecture from the material aspect is realized through the use of environmentally friendly and biodegradable materials. The building walls utilize FSC-certified wood with low carbon emissions, as well as recycled bricks made from a mixture of fly ash, sand, and cement, offering greater efficiency and improved thermal insulation. In pedestrian areas, permeable paving is applied to support rainwater infiltration and reduce runoff, complemented by a subsurface drainage system to prevent flooding and maintain the site's hydrological balance.

d. Section

Figure 23. Section A - A
(Source: Personal Document, 2025)

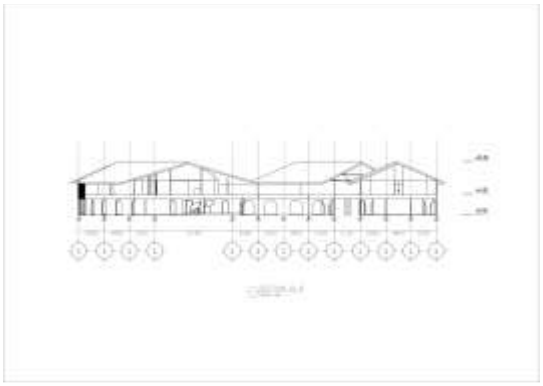

Figure 24. B – B
(Source: Personal Document, 2025)

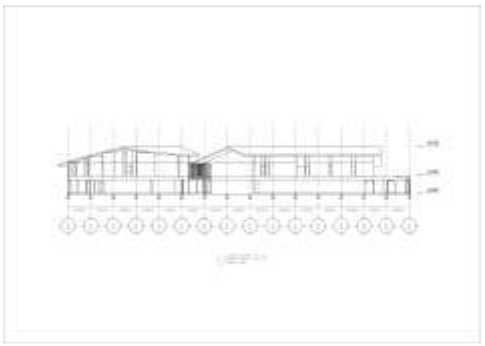

Figure 25. Section C – C
(Source: Personal Document, 2025)

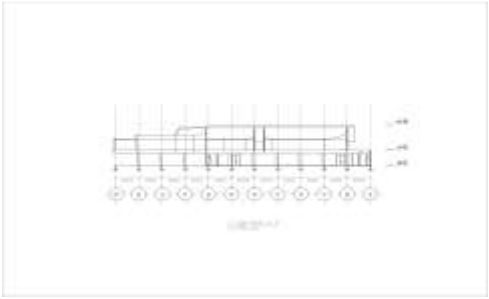

Figure 26. Section D – D
(Source: Personal Document, 2025)

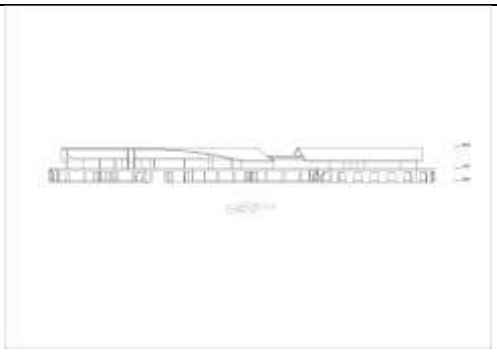

Figure 27. Section E – E
(Source: Personal Document, 2025)

Figure 28. Light and Air Illustration on Building
(Source: Personal Document, 2025)

The energy aspect is applied through the building orientation, which optimizes natural lighting and ventilation, thereby minimizing the need for artificial lighting and mechanical cooling. The integration of solar panels on the building's roof further supports self-sufficient energy supply, making the energy system more efficient and sustainable in accordance with the site's potential.

e. Perspective

Figure 29. Bird's-Eye Perspective
(Source: Personal Document, 2025)

Figure 30. Bird's-Eye Perspective
(Source: Personal Document, 2025)

Figure 31. Food Court Building
(Source: Personal Document, 2025)

Figure 32. Museum Building
(Source: Personal Document, 2025)

Figure 33. Human-Eye Perspective
(Source: Personal Document, 2025)

Figure 34. Sport & Playground
(Source: Personal Document, 2025)

4. Conclusions

The rapid development of major cities in Indonesia, including Medan, highlights the urgent need for adaptive, inclusive, and sustainable public spaces. As part of the urban periphery, the Pulo Brayan area has experienced significant degradation in public space quality

due to complex social, economic, and environmental pressures. The redesign of this public space using a sustainable architectural approach offers a strategic solution to address these challenges. By integrating the area's historical values, involving active participation from the local community, and applying the principles of sustainable architecture, the design aims not only to create a socially inclusive and ecologically responsible public space but also to foster a strong and contextual place identity. Through this approach, the public space in Pulo Brayan is expected to function as a catalyst for area regeneration—strengthening social connectivity, enhancing environmental quality, and supporting the vision of sustainable urban development as outlined in the Sustainable Cities and Communities principle. This design serves as a reference for developing public space models that respond to the needs of today's urban communities while addressing city dynamics with a holistic and forward-looking perspective.

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