



Architectural Design Concepts for Waterfront Areas Using a Waterfront Development Approach: A Case Study of the Sipin Lake Area

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Abstract. The Sipin Lake area in the center of Jambi City, in Legok Sub-district, Danau Sipin District, is a waterfront area experiencing spatial-quality degradation toward a slum settlement with purely functional activities. The slum area in Legok Sub-district covers 147.34 hectares. This study aims to formulate an architectural design concept for the Sipin Lake waterfront area through a waterfront development approach, supporting its development into an ecotourism destination while addressing existing environmental and slum-settlement problems, in line with the Jambi City Spatial Plan 2013-2033. The method used is a qualitative method with a rationalistic approach, emphasizing interpretation of empirical data and holistic conceptual-theoretical construction. The analysis shows that the 45.01-hectare study area, spread across eight neighborhood units in Legok, holds physical potential in a natural lake, floating-net fish farming, and land and water transport access, while also facing poor basic infrastructure, absence of building regulation, limited public space, and inadequate waste management. The resulting design concept applies ecological architecture principles and a waterfront development approach covering building configuration, landscape, and facade design suited to the site's character. This study is expected to serve as an initial reference for local government in formulating spatial policy for the Sipin Lake waterfront area.

Kata kunci: ecological architecture; Lake Sipin; waterfront area; slum settlements; waterfront development.

1. BACKGROUND

Construction project management has an important role in determining the level of profitability of a project, as the successful management of resources, time, and costs will determine whether the project is financially profitable. This is in line with the findings of Febrianita et al. (2024), which show that the evaluation of profitability in road rehabilitation projects can be carried out through the Return on Investment (ROI), Internal Rate of Return (IRR), and Benefit Cost Ratio (BCR) approaches, where the results of the analysis on the project show an ROI level of 29% and an IRR of 10.42% per year, higher than the prevailing benchmark interest rate. These findings reinforce the importance of profitability analysis as a basis for investment decision-making in road infrastructure projects, especially in Banjaragung Pulosari Jombang.

The increase in development activities and the number of urban residents have also encouraged the use of land in waterfront areas for various activities, such as industry, tourism, commercial, agribusiness, settlements, and transportation (Algusrinof, 2023). This phenomenon is in line with the United Nations projection that the proportion of the world's population living in urban areas is estimated to increase from 55% in 2018 to 68% by 2050 (United Nations Department of Economic and Social Affairs [UN DESA], 2018). This rapid growth of the urban population requires control over the development of waterfront areas to

suit the physical character of the area, the impact of its development, and the problems inherent in it (Nobele, 2023).

The Lake Sipin area is one of the waterfront areas in the center of Jambi City that is affected by this growth dynamic. Administratively, this area is located in Legok Village, Danau Sipin District, Jambi Province. Based on the Jambi City Regional Regulation Number 09 of 2013 concerning the Regional Spatial Plan (RTRW) of Jambi City for 2013-2033, the Lake Sipin area is designated as a tourism development area supported by fishery activities in river and lake waters in a controlled manner (Jambi City Government, 2013). However, the existing condition of the area shows a gap with the designation. Based on the Decree of the Mayor of Jambi Number 166 of 2016 concerning the Determination of the Location of Slum Housing and Slum Settlements, the area of slum areas in Legok Village was recorded at 147.34 Ha, with 14.11 Ha of which was included in the RPJMN handling program which includes 40 RTs (Jambi Mayor Decree No. 166 of 2016).

Environmental problems in the research area are generally caused by poor quality of drainage networks, inundation and seasonal flooding due to lowland conditions, lack of fire protection infrastructure, inadequate environmental road access, irregularities in residential buildings, and waste management that is not in accordance with technical requirements (Pratiwi et al., 2026). This condition has the potential to expand pockets of urban poverty if it is not immediately addressed through targeted structuring (Algusrinof, 2023), in line with the mandate of Jambi City Regional Regulation Number 11 of 2016 concerning the Implementation of Residential Areas and the Improvement of the Quality of Slum Settlements (Jambi City Government, 2016).

Conceptually, the arrangement of waterfront areas can be carried out through *the waterfront development approach*, which is a comprehensive rejuvenation effort that includes changes in land use, building designation, circulation and parking, development intensity, and arrangement of green open spaces in waterfront areas (Wrenn et al., 1983). This approach has been applied in a number of cities around the world and has been proven to play a role in increasing the attractiveness of the area as well as the resilience of the waterfront environment, as shown in the study of the revitalization of waterfront areas in Istanbul (Butuner, 2006). Based on this description, this study aims to formulate the architectural design concept of the waterfront area of Lake Sipin through an approach to improving functional quality, visual quality, and environmental quality.

2. THEORETICAL STUDIES

Waterfront Concept

The term *waterfront* basically refers to the meeting point between land and water bodies that are dynamic, where urban activities and aquatic life interact with each other (Breen & Rigby, 1994). In a more technical context, this area is also understood as the banks of rivers, lakes, or seas that are part of the city and are usually equipped with dock or port facilities (Salim, 1993). From these two senses, it can be seen that the waterfront area is not just a physical boundary between land and water, but a space formed from human interaction with the surrounding water elements so that its development ideally does not stop at visual arrangement alone, but also considers how the public space and ecological value of the area are maintained.

The determination of the boundaries of a waterfront area is not always single; several criteria can be used simultaneously, ranging from the peculiarities of physical conditions, administrative and political limits, to functional limits drawn based on a certain distance from water bodies (Chua Thia-Eng & Scura, 1992). The selection of these criteria is important because it will determine the scope of analysis and design intervention of an area that is administratively delineated (such as urban village boundaries) can result in different coverage from areas that are delineated based solely on physical conditions.

Typology and Function of Waterfront Areas

In general, waterfronts can be distinguished based on the type of meeting with riverside water bodies, sea banks, or lakes, each of which carries a different character of development; lakeside waterfronts, for example, tend to develop for more limited special functions than waterfronts that are more influenced by port activities (Breen, 1994, as cited in Algusrinof, 2023). In addition to the type of water body, the typology of the waterfront can also be seen from the activities it contains, including cultural, environmental, historical, *mixed-use*, recreational, settlement, and productive functions such as fisheries (Breen, 1994,). This classification is relevant for the Lake Sipin area, because this area in practice shows a combined characteristic of recreational functions (boat tourism), productive functions (fish cages), and residential functions so that the concept of development needs to accommodate more than one typology at once, rather than imposing a single category.

Waterfront Development Concept

Waterfront development is understood as an effort to organize the waterfront area, which can include changes in land and building designation, rearrangement of circulation and parking, adjustment of development intensity, and provision of green open space (Wrenn et al.,

1983). What distinguishes this approach from mere "area renovation" is that it is the nature of the whole that changes to one element (e.g. circulation) are treated as part of a system that is interconnected with other elements (buildings, open spaces, land use), rather than a stand-alone intervention.

Slums: Definition and Causative Factors

Slums in an area are generally triggered by two groups of factors: direct factors that are reflected in the physical condition of housing and sanitation, and indirect factors that come from the economic, social, and cultural conditions of the local community (Cahyana et al., 2025). On a more specific level, the emergence of slums in many cities is often associated with a surge in population growth that is not balanced by the government's readiness to provide basic infrastructure, so that people build housing independently without adequate site planning (Atika & Ikaputra, 2023). Rindrojono (2013) expands this explanation by attributing slums to five interrelated factors: urbanization pressures that encourage village-urban migration, limited urban land, lack of basic infrastructure and facilities, low economic capacity of residents, and weak urban spatial enforcement.

This framework is relevant to read the problems in Legok Village, because the problems identified in the field of poor basic infrastructure, the absence of building regulations, and the low economic level of some of the population are in line with the patterns described in these factors, not just a symptom of slums that stand alone without a theoretically explainable root cause.

Ecological Architecture as a Design Approach

Ecological architecture places the reciprocal relationship between buildings and the environment as the basis of design, with an emphasis on the utilization of the natural potential of the site, adaptation to the tropical climate, and energy and material efficiency (Frick & Suskiyanto, 2009; Frick & Mulyani, 2012). This approach differs from conventional design that treats environmental considerations as an addition at the end of the process in ecological architecture, with the character of the site (topography, vegetation, microclimate) being the starting point that shapes the design decision from the beginning, rather than a later adjustment.

Public Spaces in Waterfront Areas

Public space is understood as a shared space that allows city residents to interact, gather, and carry out social activities outside the private realm (Carr et al., 1992). In waterfront areas, public spaces have added value because of their proximity to water elements that naturally attract social activities, but this value is only realized if the accessibility and quality of the public space are adequate (Carr et al., 1992). This principle is important as a framework for

evaluating existing public spaces in Legok Village, such as piers and cage areas, which have the potential to be developed into a space for citizen interaction if arranged according to these principles.

3. RESEARCH METHODS

This research is designed as a qualitative research with a rationalistic approach. This choice is based on the nature of the study object that requires a comprehensive understanding of the conditions of the area, not just the measurement of variables separately so that the process of interpreting field data needs to be supported by a conceptual framework built from the beginning, and the findings are then returned again to test and enrich the framework. It should be noted that this methodological reference is cited as listed in the original thesis source; The full bibliographic details of its primary sources are not fully available for independent re-verification.

Data collection is carried out flexibly through the study of verbal and visual data, including primary data from field observation and purposive sampling, as well as secondary data in the form of policy documents and official statistics, namely Jambi City Regional Regulation Number 09 of 2013 concerning RTRW, Jambi Mayor Decree Number 166 of 2016, data on Danau Sipin District in 2021 (Central Statistics Agency, 2021), and Legok Village Profile 2021.

The analysis was carried out on three site scales, namely macro (the suitability of the area to urban spatial policies), meso (the relationship of the area with the surrounding area), and micro (the condition of the boundaries, contours, and physical character of the site), which was then combined with ecological architecture principles to produce a design concept. The principles of ecological architecture that are referred to include the utilization of environmental potential, control of environmental constraints, adaptation to the local climate, energy efficiency and conservation, and wise technology selection (Frick & Suskiyanto, 2009; Frick & Mulyani, 2012).

4. RESULTS AND DISCUSSION

Overview of Lake Sipin Area

Danau Sipin District is located in the center of the government of Jambi Province, with an area of 7.88 Km² which is divided into five villages, namely Selamat, Sungai Putri, Legok, Murni, and Solok Sipin (Central Statistics Agency, 2021) Legok Village is the largest village

(3.41 Km² or 43.27% of the sub-district area), but has the lowest population density among the five villages, namely 2.8 thousand people/Km² (BPS, 2021). Full data details are presented in Table 1.

Table 1 Overview of Lake Sipin Area

Village	Area (km ²)	Total Population (Soul)	Density (Soul/km ²)
Congratulations	1,40	8.072	5,7
Putri River	1,59	8.109	5,1
Legok	3,4	9.676	2,8
Pure	0,36	5.105	14,1
Snoop Dogg	1,12	12.413	11,1
Quantity	7,88	43.375	5,5

Based on livelihood, the population of Legok Village is dominated by the trade and service sectors (teachers, health workers, hotels, and the like) by 84.09%, while the industrial/factory and mining/quarrying sectors only contribute 0.38% and 0.46%, respectively (Profile of Legok Village, 2021, as quoted in Algusrinof, 2023). This area also has a number of public spaces as spaces for residents to interact, such as places of worship, weaving houses and batik houses as a forum for cultural preservation, boat moorings (piers), and freshwater floating cage management (Algusrinof, 2023). The existence of these spaces is in line with the concept of public space as a shared space that supports the social interaction of urban residents (Carr et al., 1992).

Condition of Slums in the Legok Area

Based on the Decree of the Mayor of Jambi Number 166 of 2016 concerning the Determination of the Location of Slum Housing and Slum Settlements, the Legok area has a slum area of 147.34 Ha spread across 41 RTs, with 14.11 Ha of which (covering 40 RTs) has been included in the RPJMN handling program (Algusrinof, 2023). The condition of residential buildings in this area generally does not meet the provisions of the building and environmental quality management as stipulated in the RTBL, with construction quality that does not meet technical requirements (Algusrinof, 2023). Of the 512 building units identified in the research area, only 10 units have Building Permits (IMB), while the other 520 units do not have permits.

Other infrastructure problems identified include the condition of environmental roads that are damaged and do not meet technical standards due to the condition of the basin soil that is prone to flooding, environmental drainage channels that are not connected to the channels in

the hierarchy above them, causing inundation, and the unavailability of infrastructure and waste facilities that meet technical requirements, including garbage cans with a sorting system on a household scale.

Table 2 Condition of Slums in the Legok Area

Occupation/Profession	Amount (Household)	Percentage (%)
Agriculture, plantations, forestry, livestock	30	1,26
Fishery / Fishermen	32	1,34
Mining / Mining C	11	0,46
Industry / Factory	9	0,38
Building Construction / Builder	121	5,06
Trade & services (teachers, healthcare workers, hotels, etc.)	2.009	84,09
Government employees	177	7,41

Delineation and Site Analysis of Research Areas

The research area is administratively included in the Legok Village area, including RT 21, 22, 23, 24, 25, 32, 39, and 40. Details of the area of delineation of research areas per RT are presented in Table 3.

Table 3. the area of delineation

RT	Area (Ha)
21	7,7
22	3,08
23	4,06
24	5,72
25	5,47
32	6,85
39	6,82
40	5,31
Quantity	45,01*

On a macro scale, the suitability of the area to the city's spatial planning policy refers to the Jambi City RTRW 2013–2033, which stipulates the areas of Lake Sipin and Teluk Kenali in Telanaipura District, as well as Teluk Lake in Teluk District, as tourism development areas supported by river and lake fisheries activities in a controlled manner (Jambi City Government,

2013). On the meso scale, the analysis of the area link shows that the distance between the site location and the reference points of the surrounding area is between 0.9 Km and 1.7 Km.

Accessibility to the site location can be reached through two modes of transportation, namely land transportation through the DR. Siwabessy – KH Street section. A. Majid as the primary arterial road, and the Sipin Lake Road section as the only local road to the site location but with narrow and potholes; and water transportation through the Pangkalan Ketek Wisata Danau Sipin pier which is 0.9 km from the site location, with a traditional ketek motorcycle transportation fare of IDR 10,000 per passenger and a rowing boat of IDR 30,000 per boat.

On a micro scale, the site is bordered by the Batanghari River on the north side, residential areas on the south and east sides, and the waters of Lake Sipin on the west side. The condition of the tread is relatively flat and watery with a shallow pavement layer (about 50 cm), and is prone to flooding due to high rainfall. Climate data for Jambi City in 2020 shows that the average air temperature ranges from 26.5°C (February) to 27.2°C (November), with an average air humidity of between 82% and 85% (Algusrinof, 2023).

Design Concept: Waterfront Development and Ecological Architecture Approach

The garbage pollution and flooding that occurred in the Lake Sipin tourist area shows that environmental problems in this area cannot be solved only through physical repairs, but require an architectural perspective that places environmental balance as the basis for design, not just additional considerations. In the framework of ecological architecture, this means that every natural potential of the site ranging from water, vegetation, to local climate patterns is treated as design capital that needs to be optimized, while existing environmental constraints need to be managed in a controlled manner; energy efficiency and technology selection are determined based on their suitability to the local context, not on the basis of trends alone (Frick & Suskiyanto, 2009; Frick & Mulyani, 2012). Starting from this perspective, the results of the site review are translated into four interrelated aspects of the design: the layout and configuration of the building mass, the arrangement of the landscape and vegetation, the preparation of the façade that is responsive to the climate, and the structural and utility systems that support the overall concept (Algusrinof, 2023). This approach is consistent with the concept of *waterfront development* as an effort to organize the waterfront area as a comprehensive arrangement (Wrenn et al., 1983), and is in line with the principles of architectural and urban planning in Indonesia that emphasize the harmony between physical development and the character of the local environment (Budihardjo, 1991).

The criteria for selecting the design site consider accessibility, environmental conditions, site potential, and existing site conditions, with the selected location being in the Lake Sipin tourist area because of its potential to support the development of a waterfront concept tourist area. The technical guidelines for the arrangement of waterfront areas also refer to the Guidelines for the Utilization of Beachfront Space in Urban Areas published by the Directorate General of Spatial Planning, Ministry of Public Works (2014), as a normative reference in controlling the use of waterfront space in urban areas.

5. CONCLUSIONS AND SUGGESTIONS

The Lake Sipin area is a strategic waterfront area in the center of Jambi City that has the potential for development as an ecotourism area, but currently still faces the problem of slums with an area of 147.34 hectares, inadequate basic infrastructure, and a lack of public space connected to the surrounding area. The architectural design concept of waterfront areas formulated through the waterfront development approach, combined with ecological architectural principles, includes the arrangement of building configurations, landscaping, facades, and building structures and utilities that are in harmony with the physical characteristics of the site.

The successful implementation of this concept requires the policy support of local governments and the active participation of local communities, considering that the arrangement of waterfront areas involves regulatory, technical, and socio-economic aspects simultaneously. Further research is suggested to expand the scope of study to the south of the Lake Sipin area as well as to the main road corridor that functions as a commercial area, considering that the two areas are still part of the unity of the waterfront area of Lake Sipin Jambi City.

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