# DESIGN PRINCIPLES OF PUBLIC OPEN SPACE IN THE TIDAL AREA (CASE : LIMBOTO LAKESIDE AREA IN GORONTALO CITY)

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**Abstract:** This study aims to formulate the design principles of public open space in the tidal area of Lake Limboto in Gorontalo city and create design simulation of lakefront public open space that can adapt to the tidal behavior of Lake Limboto. Formulation of the design principles is done by identifying aspects that need to consider (issues of concerns) and the components to be arranged (the scope of issues) obtained from literature review and analysis of the study area. From the analysis of tidal patterns, this study also identified an open space typology of the lakefront that is riparian open space, tidal open space, and littoral open space. These spaces can be used for public purposes by applying good design principles that are general or specific to each typology of space. Ecological approach which is also considered related to environmental issues through Eco-hidrology Engineering - Shoreline Development (RE-SLD) to increase biodiversity and carrying capacity of the lake, and Low Impact Design for the protection of wetlands and water quality. The aspects to be considered in addition to encompass the criteria that determines the success of public open space that refers to the physical, psychological and social community needs as users, also includes ecological-based criteria that refer to the hydrologic characteristics in Lake Limboto banks area including the ecological preservation, efficiency and mitigation. The formulation of the resulting design principles set the major component of public open space includes the circulation of vehicles and pedestrian paths, open space and parks, parking, commercial, recreational and residential facilities, and ecological components including the RE-SLD embankment, wetlands and drainage. The resulting design simulation gives an idea regarding the development that has an opportunity to enliven the Lake Limboto lakefront and also enriching the quality of its environment.

Keyword: design principles, eco-hidrology, public space, shoreline development, tidal.

## Introduction

Urban open space should be able to accommodate the needs, values and aspirations of the citizens as a public space. Public space can be defined as a space that can be used by all levels of society to carry out daily activities. It is as expressed by Carr, S., et al. [6 p.xi], that public open space is the stage where the drama of human life was held. A wide variety of both communal and personal functional activities and rituals happening here.

However, the growth that occurred in many cities, including in Indonesia, unfocused and ignoring the existence of a public space, which is very important for the life of city residents. Currently, many cities fail to accommodate the needs of citizens who should be served. Development of public open space should include activities: to meet the public needs, improving the visual quality, improving environmental quality, economic development, and image enhancement.

Gorontalo is an old city which is developed rapidly since it became the capital of the Gorontalo province (separated from North Sulawesi province since 2000). Issues identified in relation to open space is that Gorontalo City has not had a lot of representative public open space. The citizen of Gorontalo City still require open space that can accommodate events for socializing and accommodate certain activities. An example is the night event Tumbilotohe as the habit of welcoming Iedul Fitri by lit torches placed in many varied formations. This activity requires a fairly wide open space, and usually use the rice fields or other empty field.

Urban development cannot be separated from the influence of the surrounding natural environment. That's because the natural environment is a life support cities that are nearby. When this natural environment has decreased then the quality of life of the nearby city will also experience the same thing or even destroyed.

Another problem identified in Gorontalo City is environmental degradation in Lake Limboto that are nearby. Lake Limboto as the only large lake in Gorontalo province is currently experiencing severe environmental problems. As a result of the wrong forest management in the uplands in all watersheds which empties into the this lake is the process of silting remarkable that lasts from year to year, with erosion rate of 44.69 tonnes / ha / yr or 3.72 mm / yr (Legowo, [8 p.10] and Kusmawati, [7 p.VII-1])

Due to the continuation of superficiality, in 52 years the Limboto Lake size reduced to 4,304 hectares, or about 62.60%. Currently its size is only approximately 3,000 hectares. The depth of the lake which was originally 18 m, currently only 2 m. If no rescue effort, estimated at 2025 Lake Limboto will disappear (Akuba, [1 p.16]). Another direct consequence upon the inhabitants of Gorontalo city and surrounding areas are flooding that occurs during high rainfall. This is because the lake is no longer functioning as a barrier to increasing the volume of water entering through the inlet streams. In the dry season, the lake water volume decreased significantly resulting in a large size difference at high tide compare to low tide. The lake size during the rainy season is approximately 5,000 ha and during the dry season reduce to approximately 2,500 ha..

The potential possessed by Lake Limboto actually quite large, such beautiful scenery into the tourism potential, the existence of the lake biota such as fish into the fishery potential, presence of marginal land into fertile agricultural potential, as well as its function as a retarding basin potential for flood control.

The problem of flooding that always happens in the city of Gorontalo related to Lake Limboto bring the idea to create a design principle of public open space development that can adapt to the hydrological behavior of the lake in the form of tidal patterns. Design principles is one component of the draft policy in addition to the design objectives and design guidelines (Punter, [13 p.28]). Ecological approach undertaken in formulating design principles using Eco-hidrology Engineering - Shoreline Development (RE-SLD) to increase of biodiversity and carrying capacity of the lake, and Low Impact Design for the protection of wetlands and water quality.

**Methodology**

The study used a descriptive method, in analyzing the facts revealed in the study and describe it in a form that is easy to understand. Here are described the research methods used in several stages.

a. Identifying typology and norms of designing public spaces for formulating aspects to consider (issues of concerns) and components that must be regulated (scope of issues) and standards which must be met in designing public spaces. Secondary data collection techniques performed through review of the literature concerning aspects of public space, and open space standards.

b. Identifying typology of open space that can be applied at the lakeside through the study of literature on open space and waterfront development, particularly related to the lake, as well as aspects of wetlands, and low-impact urban design (LIUD).

c. Identify alternative open space utilization function lakeside according typology. Data processing techniques performed by the method of synthesis by considering the characteristics of open space that will be developed into a public space, public expectations regarding the facilities that can be developed in an open space as well as the analysis of the results of similar design in other countries (case study). In connection with this survey to identify the preferences of local community facilities open space which is the object of study include public expectations of the physical condition of open space, as well as the type of desired activity in the open space. This preference survey aimed to obtain a general description only, is not a statistical representation of public opinion. For the purposes of the survey determined the total sample of 100 respondents and then divided into several segments which consist of various groups, namely government, scientists, non-governmental organizations (NGOs) and community.

d. Identify existing condition to reveal the potential of the region, especially the problems and opportunities associated with open space both within the region, as well as in the Gorontalo City. Analyses were performed using secondary data on spatial policy Gorontalo city related to the planned area. Data was collected through primary data from direct observation and field interviews and secondary data from previous studies.

e. Identify the behavior of Lake Limboto tidal, including the delineation of local tide and low tide areas. Techniques of data collection will be carried through the exploration of secondary data from the studies that have been done before in the area of Lake Limboto.

f. Formulate lakeside open space utilization at high tide and at low tide based on the identification of an alternative open space utilization function lakeside synthesized with the identification of patterns of tidal lake.

g. Formulate criteria and design principles of open space in the lakeside area as a public space that is adaptive to the behavior of the tidal lake. The formulation of design principles to consider the main issues facing the open space and surrounding environment, adapted to the potential of the region, as well as the limitations possessed tread. Design principles are divided into two, namely the general principles applicable to all conditions of the open space and the type of utilization, and specific principles that apply to the type of open space and utilization.

h. Creating the design concept of public open space in the banks of Lake Limboto by applying the criteria and principles of design that has been determined as well as the design simulation.

**Results And Discussion**

**Typology of Space**

Assessment in this study indicates there are three types of space shores of Lake Limboto as follows:

a. Riparian Zone: The area above the elevation of 4.5 m to a maximum limit as far as 100 m from the point of highest tide, can be used for agricultural, residential and recreational

b. Tidal Zone: The area is located between the elevation of 2 up to 4.5 m, can be used for agriculture and recreation

c. Littoral Zone: The area is under 2 m elevation above sea level with a maximum depth of 2 m, where sunlight can still reach the bottom, can be used for fishing and recreation.

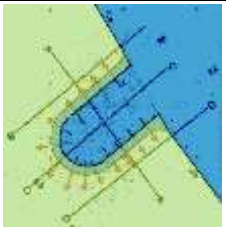
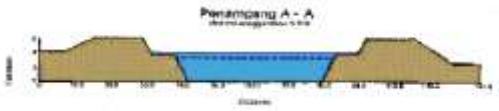
**Design Principles and Standards Prescriptive of Components**

Design principles that are described in this section is a specific arrangement of the components contained within each typology of space on the edge of Lake Limboto region. The elements of open space can be categorized as a component in the design of public spaces (Shirvani, [14 p.28]). Components such as vegetation and pedestrian pathways regulated by many criteria. This is logical considering that the public space designed is natural open space.

Tabel 1: Design Principles and Standards Prescriptive of Components at each zone

| No. | Components | Criteria | Design Principles and Standards Prescriptive |
|---|---|---|---|
| **Riparian Zone** | | | |
| 1. | Vegetation | Comfort | • Trees are placed at certain distances (within a maximum interval of 6 m)<br>• Heading lush trees and has a sufficient diameter to calm (minimum 4 m)<br>• Placed to form intimate spaces but still visible |
| | | Safety | • Placed between the pedestrian path to reinforce the separation of vehicle lanes<br>• Avoid the use of thorny or poisonous vegetation types, especially at pedestrian paths |
| | | Clarity | Using directional tree types, i.e single trunked plants such as palm species (king palm, cashew nut, palm), Plant branched trees> 2 m (Khaya anthotheca, Lagerstroemia, Mimusops elengi) |
| | | Beauty | • The use of decorative vegetation types, for example: Ixora stricata, Lantana camara, Duranta sp<br>• Placement of vegetation that does not obstruct the view of the good (herbaceous plant height <0.8 m) |
| | | Health | The use of vegetation types that can effectively capture dust on the path of the vehicle |
| | | Ecological preservation | • The use of vegetation types that can reduce soil erosion by water<br>• The use of vegetation types that can filter out various forms of |

| No. | Components | Criteria | Design Principles and Standards Prescriptive |
|---|---|---|---|
| | | | pollutants (sediment and nutrient) |
| | | Mitigation | Use of vegetation types that can withstand and absorb rainwater (the ability to absorb water approximately 80% closure.) |
| 2. | Pedestrian way | Security | Pedestrian paths are connected directly to the main street or the center of activity |
| | | Comfort | • Pedestrian path has many paths that connect directly to the choice of the main street or the center of activity (is permeable)<br>• The width of the walkway is needed for pedestrians (including difable) do not intersect (minimum 1.8 m)<br>• It has a flat surface.<br>• Using a ramp with a slope that is adequate when there are differences in height (accommodate difable). Comparison of the maximum ramp slope is 1: 8 and at the maximum distance of 900 cm each are required flat part at least 120 cm |
| | | Safety | • Pedestrian path separate from the path of the vehicle and made a higher level<br>• Marking part crossings (crossing) at the path of the vehicle with special signs (painting and material distinction)<br>• It has a textured surface and not slippery. |
| | | Clarity | Pedestrian path has a clear hierarchy |
| | | Beauty | • Pedestrian path using materials prepared with varied patterns are adapted to local character.<br>• Using a selection of attractive color scheme |
| | | Mitigation | Pedestrian paths are connected directly to the high building or high place |
| 3. | Lighting feature | Security | • Lighting feature placed at certain distances and at active activity location (distance intervals every 10 m, with a maximum height of 4 m)<br>• The intensity of the lighting should be sufficient to illuminate the public space (ranges from 50-150 lux depending on the intensity of use, hazard and safety requirements) |
| 4. | Street furniture | Comfort | Placement and size of street furniture is not blocking pedestrian paths |
| | | Safety | Avoiding forms of furniture pointed / sharp, especially on human height position |
| | | Beauty | • Street furniture using forms that have good aesthetic value adapted to local character.<br>• Using a selection of attractive color scheme<br>• Street furniture using materials that are not easily damaged / corroded |
| 5. | Bench | Comfort | • Placed at certain distances along the walkway and in the garden / activity center<br>• Created following the principles of anthropometry |
| 6. | Signage | Safety | Altitude signs high enough so as not to run over pedestrians |
| | | Clarity | • Placed in locations that require direction<br>• Have a clear color |
| 7. | Sculpture, water feature | Clarity | Has a form that is easily recognized and remembered as a place marker |
| | | Activity | Water feature design / sculpture that can attract visitors to perform activities in the surrounding |
| 8. | Gate/ entrace | Clarity | • Gate / entrance given as a clear form that can be passed to enter the public space site<br>• Gate / entrance given the features that can attract visitors such as food stalls / souvenirs |

| No. | Components | Criteria | Design Principles and Standards Prescriptive |
|---|---|---|---|
| 9. | Plaza | Activity | Plaza size is broad enough to be used by a variety of activities |
| 10. | Trash can | Health | • Placement of trash cans at certain distances<br>• Separation of bins based on the type of organic and non-organic |
| 11. | Sewer | Ecological preservation | Sewer directed to the location of waste treatment both natural (wetlands) or artificial (septic tank) |
| 12. | Guttering, drainage and bioswale | Efficiency | • Integrate all discharge lines rainwater from the roof to shelter / reservoir both locally and centrally<br>• Using low areas with vegetation filter, directing and store rainwater<br>• Reduce the manufacture of drainage infrastructure |
| | | Mitigation | Drainage should be able to drain the rain water disposal properly |
| 13. | Floorscape | Mitigation | The use of floorscape that can absorb water (permeable) |
| 14. | Water catchment | Mitigation | Water catchment must be able to act as a trap and temporary rainwater storage |
| **Tidal Zone** | | | |
| 1. | Vegetation | Ecological preservation | • The use of vegetation types that can reduce soil erosion by water<br>• The use of vegetation types that can filter out various forms of pollutants (sediment and nutrient) |
| 2. | Pedestrian ways | Security | Pedestrian paths are connected directly to the main street or the center of activity |
| | | Mitigation | Pedestrian paths are connected directly to the high building or high place |
| 3. | Wetlands | Ecological preservation | The shape is maintained or wetlands restored in its original condition after construction |
| 4. | RE-SLD Embank-ment | Efficiency | • Using natural structure with a combination of the composition of rocks, soil and vegetation.<br>• Embankment soil material is obtained by means of cut and fill of the bay RE-SLD bay thus saving the cost of construction |
| | | Mitigation | Embankment surface is at a safe elevation of tidal / flood (minimum 5 m above lake level) |
| **Littoral Zone** | | | |
| 1. | Vegetation | Ecological preservation | • The use of aquatic vegetation types that can be a fish habitat<br>• Maintaining the existing vegetation, especially that have important functions in the ecosystem of the lake banks |
| 2. | Teluk RE-SLD | Ecological preservation | • Has sufficient depth in order to be a place of refuge for aquatic biota during the receding lake (maximum 2.5 m)<br>• Not too deep so that sunlight can still be close to the bottom of waters that submerged plants can still grow<br>• Size is not too large so that the level of water clarity can be maintained (maximum of 5,000 m2)<br>  <br>  <br>Reference: Center for Sulawesi River Region II, Department of Public Works [2] |
| 3. | Wetlands | Ecological preservation | The shape of wetlands is maintained or restored in its original condition after construction |
| 4. | Dock | Safety | • Using a strong and stable structure (quality of the concrete used must meet a minimum characteristic compressive |

| No. | Components | Criteria | Design Principles and Standards Prescriptive |
|---|---|---|---|
| | | | strength (fc) = 20 Mpa<br>• Able to bear the burden of the nominal life of 5 kPa.)<br>• It has a non-slip surface |

**Design Simulation**

The design principles are applied in a design simulation at Limboto lakeside and provide direction to: (1) The creation of the character of the area as an area of "natural and cultural heritage" which also can support Gorontalo city image as a waterfront city; (2) The presence of new economic zones in order to improve the welfare of local communities; (3) Increasing the quality of the natural environment and increase biodiversity on the shores of Lake Limboto.

Figure 1:Masterplan of Limboto Lakeside as design simulation

**Conclusion**

Meeting the needs of the physical, psychological and social for users of public open space is the key to the success of public open space. So that the user needs can be met by public open space, the components of public open space that will be used must be set in order to work as design indicators. The indicators are derived from the variable is an element of the design criteria. Environmental approaches such as Eco-hydrology Engineering - Shore Line Development (RE-SLD) and low-impact urban design (LIUD) can contribute to the design principles of public space on the Lake Limboto banks.

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