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REDEVELOPMENT OF BOAT TERMINAL AT KUALA TAHAN, PAHANG

Hazwan Zubir, *Srazali Aripin & Asiah Abdul Rahim
Kulliyyah of Architecture and Environmental Design
International Islamic University Malaysia

ABSTRACT

Perahu is used significantly by the rural people living on the riverbanks of Malaysia as the main water transport, such as moving from one location to another, transferring foods and agricultural products, fishing and renting it for tourism purposes. However, the usage of *perahu* as a method of transportation is slowly diminishing. Nonetheless, water transportation service is still dominant for the villagers of Tembeling River, Pahang. The Tembeling River is necessary for the locals and tourists as the route to the remote villages at Hulu Tembeling and National Park, Kuala Tahan. However, deforestation causes damage to the river, which leads to three issues. They are environmental damage, unsustainable economy and loss of culture. Thus, this research aims to redevelop the existing boat terminal at Kuala Tahan, Pahang and enhance the potential ecotourism along the Tembeling River to help prevent excessive deforestation by showing the importance of preserving the nature of Tembeling River. The research aims to improve the existing facilities of the boat services, educate and create awareness of environmental preservation through ecotourism, and preserve the local culture through an architectural approach. The research applied qualitative methods, which consisted of observation and interviews. The secondary data consists of case studies and literature reviews. The findings from the research formulate a design brief to redevelop the existing boat terminal at Kuala Tahan. The proposed design will represent the place as a *Gateway to Nature*.

Keywords: *Redevelopment, Boat Terminal, Ecotourism, Tembeling River, Kuala Tahan*

*Corresponding author: srazali@iium.edu.my

INTRODUCTION

The traditional Malay boat or *perahu* is one of the heritage arts that is disappearing and somehow being forgotten by the Malays (Mohd and Zuliskandar, 2018). Ismail (1989) said *perahu* is significantly used as the primary means of water transport by locals who live at the riverbanks in Malaysia to move from one location to another, transferring foods and agricultural products, fishing and renting it for tourism purposes. Water-based public transportation (*perahu penambang*) still operates in some areas of Malaysia. According to Mazdi et al. (2016), the dominant areas that still use water transport services are the rural areas of Sabah and Sarawak. While in Peninsular Malaysia, the same scenario still exists in Hulu Tembeling, Pahang, where the water transport is known as *Perahu Tembeling*.



Figure 1: Usage of Perahu Penambang around Malaysia

JERANTUT

The state of Pahang consists of 11 districts, and Jerantut is the largest district. Jerantut district is located in the middle of Pahang at the coordinate of 3°56'N 102°22'E. Jerantut consists of 10 subdistricts, and Kuala Tahan is located in the district of Tembeling, close to the border of Hulu Tembeling. Figure 2 shows the project's Key Plan, Location Plan and Proposed Site.

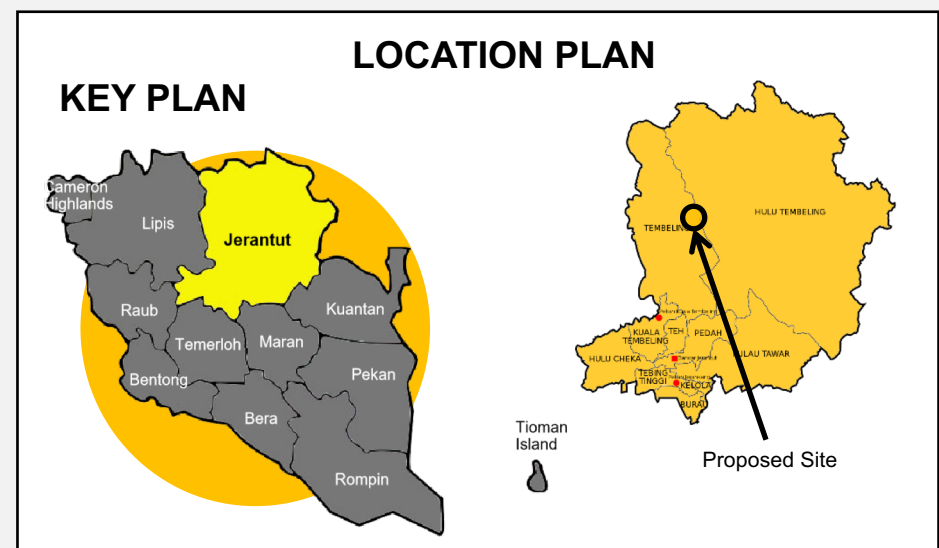


Figure 2: Key Plan and Location Plan of Jerantut and Proposed Site

HULU TEMBELING

Hulu Tembeling is located in a Jerantut subdistrict, geographically connected by the Tembeling River. Tembeling River is one of the main tributaries of the Pahang River. Six (6) remote villages are located at Hulu Tembeling, where the river is their primary transportation route. The significance of *the perahu* and Tembeling River are as follows:

- Transportation system for villagers of Hulu Tembeling.
- Connectivity of six villages at Hulu Tembeling (Kg. Kuala Tahan, Kg. Pagi, Kg. Kuala Sat, Kg. Kuala Bantal, Kg. Mat Daling and Kg. Gusai)
- Source of income (fishing at Tembeling River, Kenyam River, Pengau River, Sepia River)
- Tourists' transportation method and route to the National Park.

RESEARCH ISSUES

The usage of *Perahu Tembeling* at Tembeling River is diminishing due to excessive deforestation that damages the river ecosystem (Tan, 2016). Thus, it affects the natural environment of the Tembeling River, as well as the daily life of the local villages at Mat Daling Village. Mazdi et al. (2016) reported that excessive deforestation at Hulu Tembeling causes soil erosion and sediment, which increases the time the boat or perahu takes to reach the desired destination, especially during drought and rainy seasons. Observation had recorded the presence of a low booking counter for the boat services and the need for more facilities at the jetty to support the needs of both locals and tourists. Figure 3 shows the average score of the quality service of Perahu Tembeling.

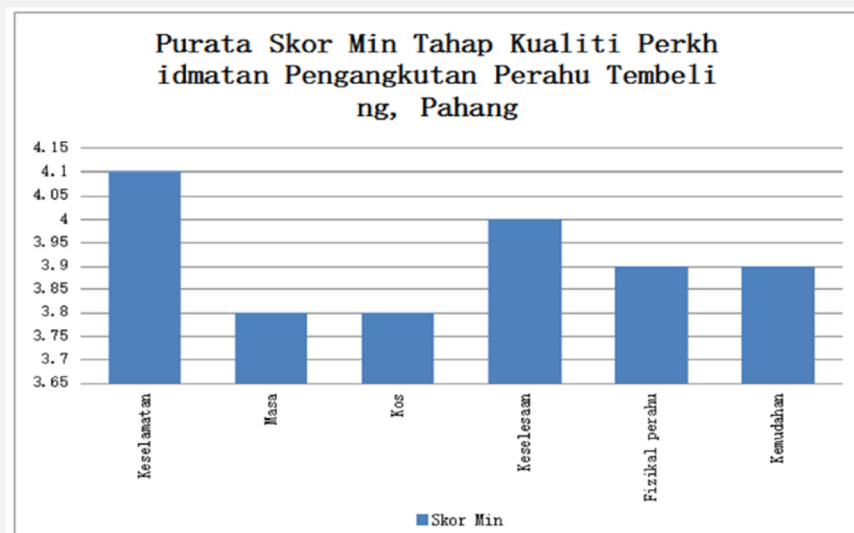


Figure 3: Average scoring statistics of quality service of Perahu Tembeling (Source: Mazdi et al., 2016)

The excessive deforestation at Hulu Tembeling causes damage to the Tembeling River, which leads to three (3) core issues. The first issue is **environmental damage** at Tembeling River; second, **the unsustainable economy** for the local villages; and third is, **the loss of culture**. Figure 4 shows the correlation between the three core issues caused by the excessive deforestation at Hulu Tembeling.

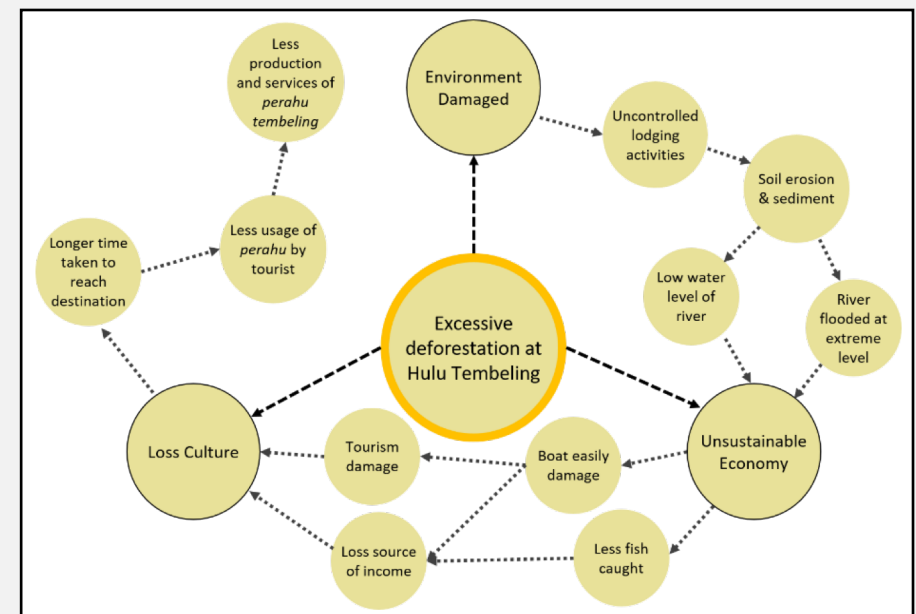


Figure 4: Co-relation of the research issues

RESEARCH OBJECTIVES

The objectives of the research are as follows:

1. To educate and create awareness of environmental preservation through ecotourism.
2. To improve the existing facilities of the boat service of Perahu Tembeling.
3. To preserve the local culture through architectural approach.

RESEARCH METHODOLOGY

This research seeks to understand the issues at Tembeling River. The research aims to assist in the redevelopment of the existing boat terminal at Kuala Tahan, Pahang, by enhancing the potential of ecotourism along the Tembeling River. The redevelopment helps prevent deforestation and showcases the importance of preserving the nature of the Tembeling River. A qualitative research method is used for this research with primary data and secondary data as follows:

1. Observation: Observation of the existing facilities of the boat services at Kuala Tahan and the natural context of Tembeling River.
2. Interview: The local villagers and tourists were interviewed to understand the issues at Tembeling River and the boat services.
3. Secondary Data: Literature reviews were sourced from written documentation such as news articles.
4. Case Study.

THEORETICAL FRAMEWORK

The research focuses on design that can : (a) preserve the Tembeling River, (b) enhance economic sustainability by improving the existing facilities and infrastructure of water transport services, and (c) preservation of culture, i.e., perahu as the method of transportation, and the production of Perahu Tembeling. Table 1 shows the combined research details, and Figure 5 shows the correlation between research objectives and research outcomes.

Table 1: Combined research detail

Research Question	Research Objectives	Research Methodology	Research Outcomes
How to educate and create awareness of environmental preservation through ecotourism?	To educate and create awareness of environmental preservation through ecotourism.	Observation Interview Literature Review	Locate the ecotourism spots along Tembeling River and provide educational spaces at the Boat Terminal.
How to improve the existing facilities of boat service?	To improve the existing facilities of boat service of Perahu Tembeling.	Observation Interview Case Study	Formulation of design brief and redesign of the existing boat terminal.
How to preserve the local culture through architectural approach?	To preserve the local culture through architectural approach.	Interview Case Study Literature Review	Provide workshop spaces and improve the existing commercial spaces.

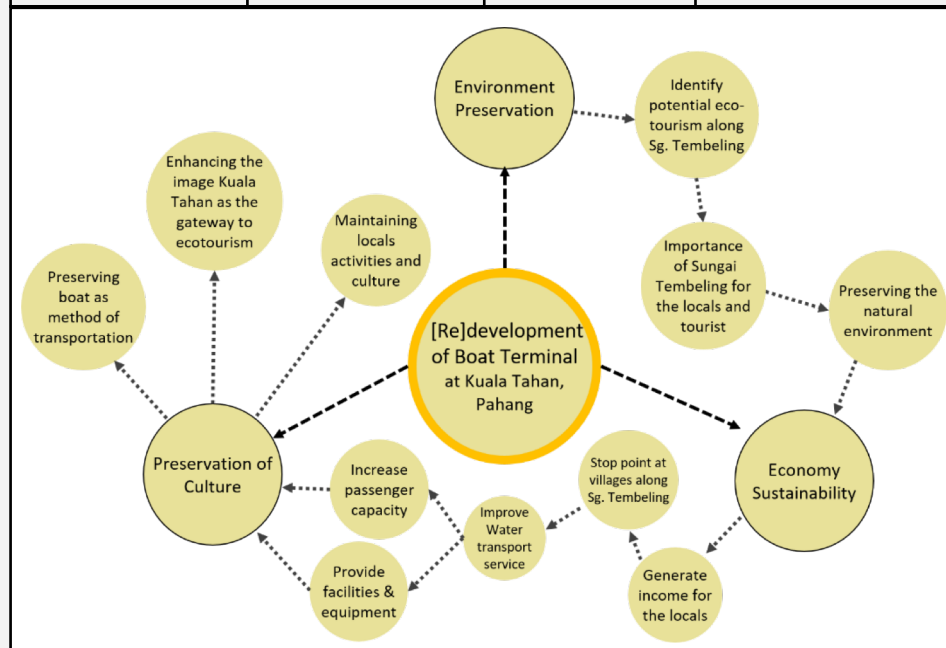


Figure 5: Overall research framework, research objectives and research outcomes.

RESEARCH LIMITATION

This research was conducted during the Covid-19 pandemic. The data collected was a combination of desktop research, an on-site survey and interviews during the Recovery Movement Control Order (RMCO). As such, there are limitations in terms of time constraints, the collection of data from local people and tourists, and accessibility to the villages at Hulu Tembeling.

RESEARCH FINDINGS

The research findings are based on the data collected from the observations, interviews, literature review and case study.

According to TIES (2015), ecotourism is defined as responsible travel to natural areas that conserves the environment and sustains the well-being of the local people. It also involves the interpretation of place and education. Based on the observation, interview and secondary data, there are several ecotourism spots along Tembeling River. Figure 6 shows the eco-tourism spots along the river.

1. Taman Negara (Canopy Walk, Jungle Trekking, Fishing, Boat Cruise, Orang Asli village, etc.)
2. Bateq Negerito Village (Orang Asli Village)
3. Sat Expedition (Fish Sanctuary, Canoe, Hiking, Camping)
4. Jeram Perahu – Sg. Sepia, Sg. Tembeling (Boat Riding, Fishing, Camping)
5. The villages at Hulu Tembeling.

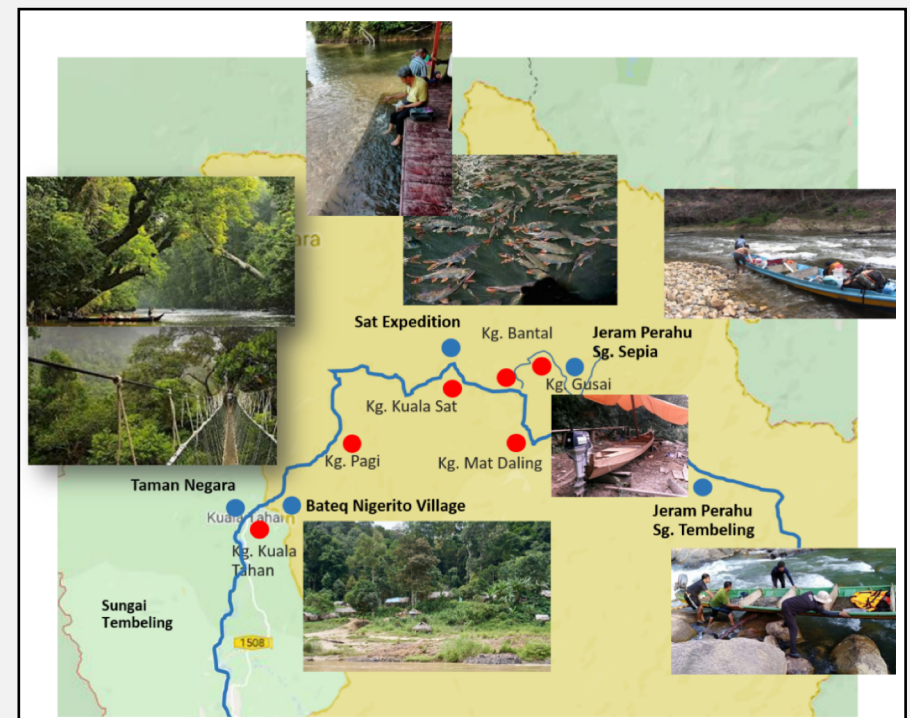


Figure 6: Potential ecotourism spots along Tembeling River

SITE INFORMATION

The proposed site is located at the existing Jetty Kuala Tahan, Pahang. The location of the site is chosen based on several criteria, which are:

1. Strategic Location
 - The site is located at the riverbank of Tembeling River.
 - Kg. Kuala Tahan is the nearest local village.
 - Taman Negara is the nearest tourist spot.

2. Accessible from land

- Jalan Jerantut-Kuala Tahan is the main access road to Kuala Tahan.
- The metalled road access is only available until Kg. Kuala Tahan.

3. Site Terrain

- Geographically, the site is located higher than the river.

The proposed site area is approximately 3.76 acres, equivalent to 15236m². Figure 7 shows the location of the proposed site.



Figure 7: The location of the proposed site at the existing Jetty Kuala Tahan

ACCESSIBILITY

Kuala Tahan is a transfer point for visitors to visit their respective locations. The six villages at Hulu Tembeling are connected by the Tembeling River, as shown in Figure 8. The main transportation route to Kuala Tahan used to be from Jetty Kuala Tembeling via Tembeling River. Currently, there is only one land route to access Kuala Tahan, which is through Jalan Jerantut - Kuala Tahan.



Figure 8: Access route to Kuala Tahan via river and land (Source: Author)

ZONING

The economy of Kuala Tahan builds from tourism, i.e., providing accommodation and facilities: chalets, resorts, homestays, floating restaurants, and campsites, serving as Taman Negara's base camp. Agriculture is also another leading contributor to its economy, especially rubber (rubber estate managed by RISDA). Figure 9 shows the zoning of the land at Kuala Tahan.

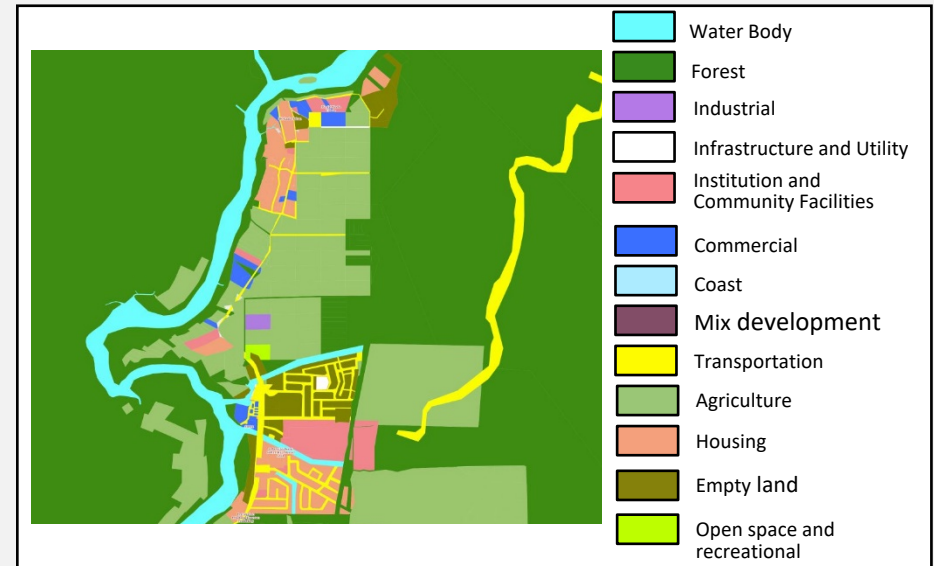


Figure 9: Land zoning at Jerantut Town, Kuala Tembeling and Kuala Tahan at macro level (Source: Iplan)

PROPOSED LAND USE

According to the interview with Jerantut local authority, the municipality has produced a proposed area plan or *Rancangan Kawasan Khas (RKK) Kuala Tahan 2020*, to rejuvenate the development of Kuala Tahan as the main gateway to the area that is economically advanced, fun to visit and comfortable to live. There are several development proposals for the Kuala Tahan area, as suggested in the RKK Kuala Tahan 2020. Figure 10 shows the various development proposals for Kuala Tahan.

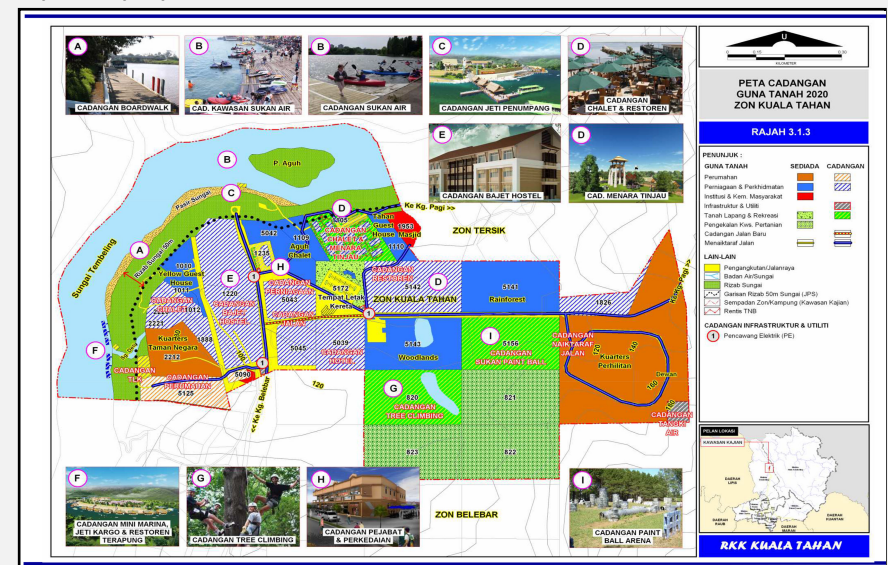


Figure 10: Proposed Development plans of Kuala Tahan Zone in the RKK Kuala Tahan 2020 (Source: Majlis Daerah Jerantut)

SENSORY

Based on observation data, the site consists of four (4) different platform levels descending towards the river. The ground level is the arrival area for visitors to Kuala Tahan. There are ticketing counter, souvenir shops and offices. Lower Ground 1 has a rest area with a gazebo and sittings for visitors while they enjoy the natural scenery of the Tembeling River. Lower Ground 2 is covered with grass and acts as a buffer area before the departure level at Lower Ground 3. Lower ground 3 is where the boat service area is located. There is also a floating restaurant that allows visitors to dine in and watch the boat service the villagers provide to take visitors to their desired destinations. Figure 11 shows the view of the site at different platform levels.

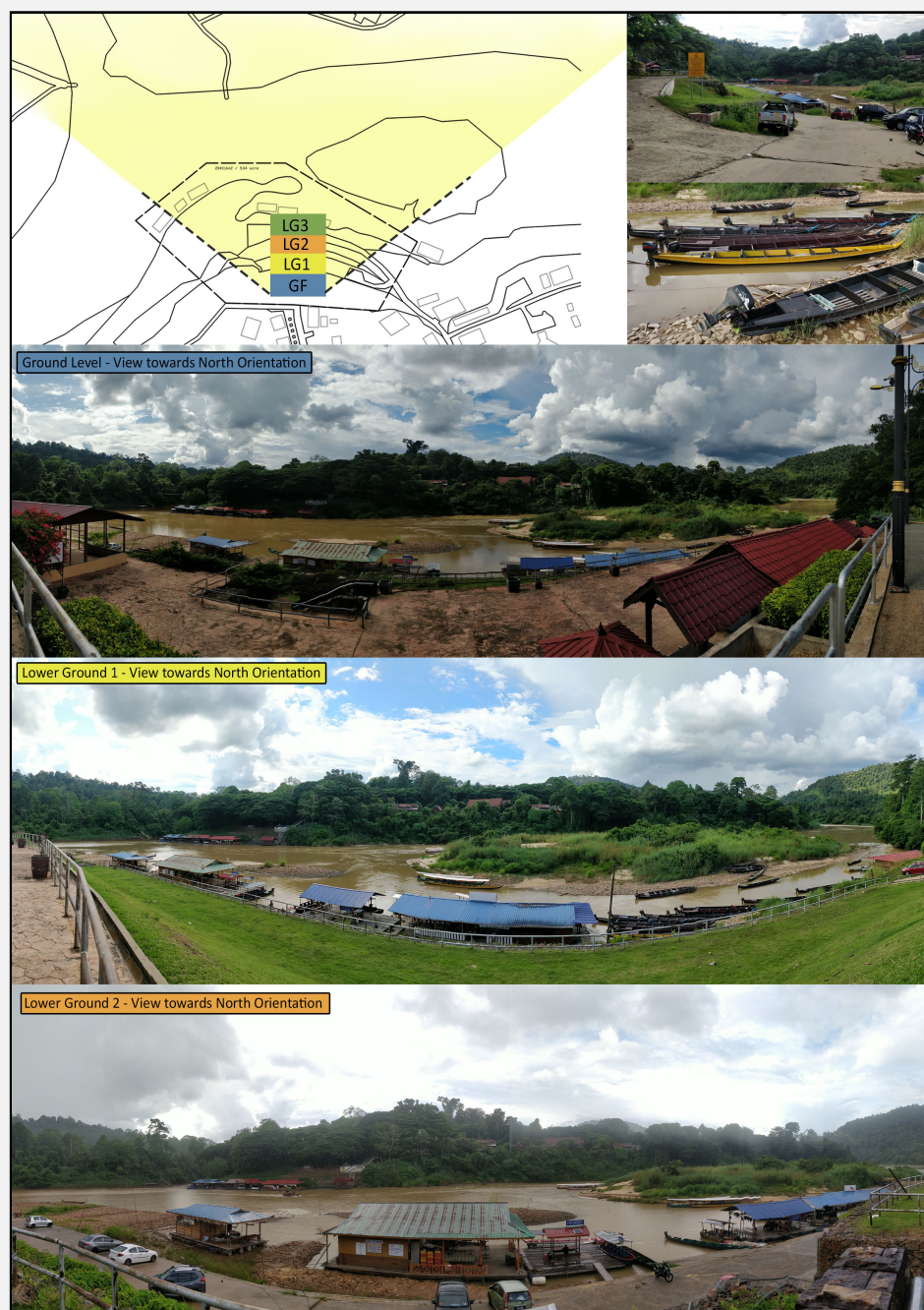


Figure 11: The view of the site from the different platform levels facing the river

NEIGHBOURHOOD CONTEXT

Kuala Tahan settlement comprises accommodations and facilities such as chalets, resorts, homestays, floating restaurants, campsites and parking as Taman Negara's base camp. Basic public facilities, such as schools, mosques, local shops and restaurants, as shown in Figure 12 (a) and (b), are also available.

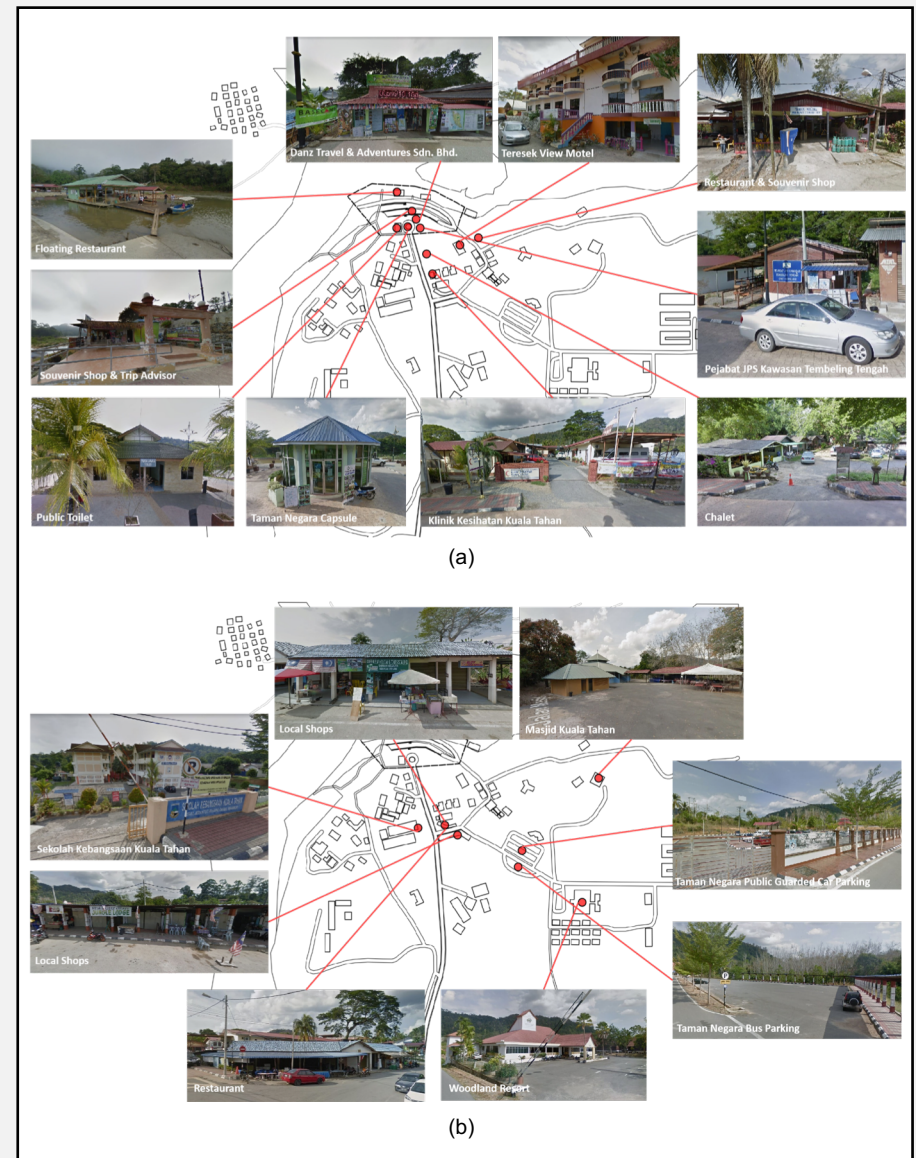


Figure 12 (a) & (b): Facilities and infrastructures at Kuala Tahan

FLOOD ISSUES

Kuala Tahan experience increasing rainfall from October to December due to Northeast Monsoon season (October – March). The proposed site experiences flood, especially during the monsoon season. There are four (4) different flood levels that have been indicated at the site. Figure 13 shows the diagram of the site according to the flood level.

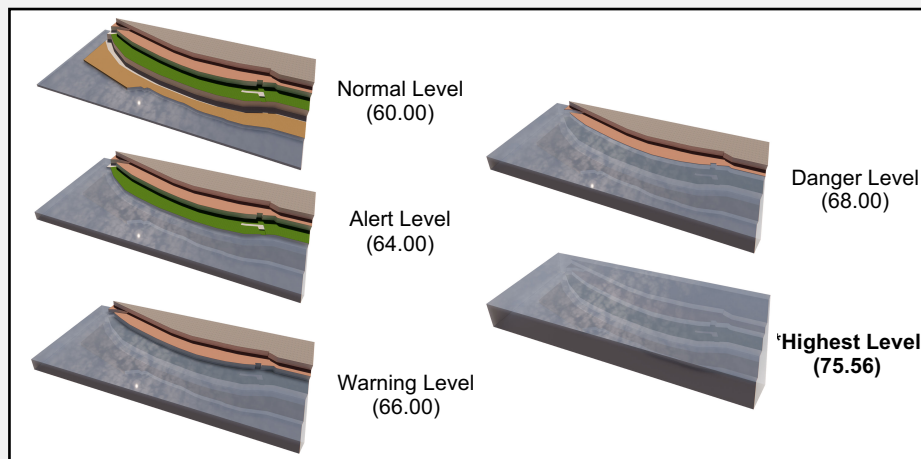


Figure 13: Diagram of the flood levels at the site

Department of Irrigation and Drainage (DID) Malaysia charted the water level of the Tembeling River for each year. The reading of the maximum, mean and minimum water level of Tembeling River from year 1971 to 2019 is shown in Figure 14. In 2014, the site experienced the highest flood level, with a reading of 75.56m.

Year	Max (m)	Mean (m)	Min (m)	Year	Max (m)	Mean (m)	Min (m)
1971	74			2002	62.29	60.38	58.85
1973	70.69	62.1	59.31	2003	68.26	61.95	58.84
1974	62.93	60.28	58.92	2004	68.76	61.13	58.85
1975	69.38	61.61	58.29	2005	65.09	60.75	58.62
1976	59.51	59.35	58.5	2006	70.27	61.06	58.85
1977	60.83	59.63	58.13	2007	67.99	63.71	16.54
1978	66.22	60.39	58.37	2008	65.44	60.68	59.16
1979	69.95	61.43	58.07	2009	65.8	61.01	58.82
1980	61.89	60.8	58.97	2010	62.8	60.02	56.67
1994	64.25	62.06	58.88	2011	66.33	60.74	58.83
1995	67.42	60.72	58.61	2012	68.57	61.15	59.02
1996	63.1	60.77	58.6	2013	71.75	65.71	59.25
1997	64.64	60.28	58.55	2014	75.56	65.71	59.58
1998	67.23	60.62	58.64	2016	62.56	60.07	59.58
1999	67.26	63.58	58.8	2017	69.76	61.57	59.72
2000	62.96	60.19	58.92	2018	67.79	62.1	59.61
2001	72.59	61.61	58.88	2019	64.5	61.11	59.58

Figure 14: The data of maximum, mean and minimum flood level from year 1971 to 2019 (Source: Department of Irrigation and Drainage Ampang)

CASE STUDY

In the redevelopment of the boat terminal at Kuala Tahan, the concept of floating architecture should be taken into consideration to ensure the sustainability of the building for all seasons. According to Kumar (2015), a floating architecture is a structure that is capable of floating in the water and maintaining a functional floor height above the water surface when exposed to high tides or floods. Moon (2015) stated that resilience in the built environment is the ability to respond to changing environments and to preserve or restore usability and productivity in the face of tension or disruption. Three case studies were selected on the types of material for the floating structure and their floating mechanism in order to be flood resilient; 1) Brisbane Ferry Terminal; 2) Amphibious House; 3) Makoko Floating School. Figure 15 shows the analysis of the selected case studies for floating structures.

Case Study	Material of Floating Structure
Case Study 1 Brisbane Ferry Terminal	Concrete Pontoon
	Mechanism/Components
	<p>Three mechanism of flood resilience:</p> <ol style="list-style-type: none"> 1. Single tall defensive pier in place of multiple piers 2. Gangway incorporating floatation tanks 3. Dynamic shape of pontoon <p>Normal Operation: Pontoon stabilised by single pile with flexible anchor at far end</p> <p>Rising River: Gangway lifts off clasp and rotates on floating tanks</p> <p>Flood Mode: Gangway parallel to pontoon allows debris through. As the flood recedes, the gangway rotates back into position</p>
Case Study 2 Three-Storey Amphibious House	Concrete Pontoon
	Mechanism/Components
	<p>Four components of flood resilience:</p> <ol style="list-style-type: none"> 1. Wetdock and debris control 2. Can-float base and dwelling 3. Guide posts and running gear 4. Flexibility utility connections <p>Previous House, Resting Position, Flood Event</p>
Case Study 3 Makoko Floating School	Plastic Barrel
	Mechanism/Components
	<p>Three components of flood resilience:</p> <ol style="list-style-type: none"> 1. Lightweight Wooden structure 2. A-frame structure 3. Plastic barrel base <p>LOCAL MAKOKO TECHNOLOGY + GLOBAL FLOTATION TECHNOLOGY = DERIVED SOLUTION</p>

Figure 15: Analysis of the case studies on floating structures

RESEARCH OUTCOMES/RECOMMENDATION

This project proposes to redevelop the existing boat terminal to solve the issue of excessive deforestation at Hulu Tembeling by improving the service quality of public water transport for the rural villages of Hulu Tembeling. It will boost their economy by enhancing potential ecotourism at Hulu Tembeling, promoting the significance of the Tembeling River. Figure 16 shows the brief design formulation of required spaces.

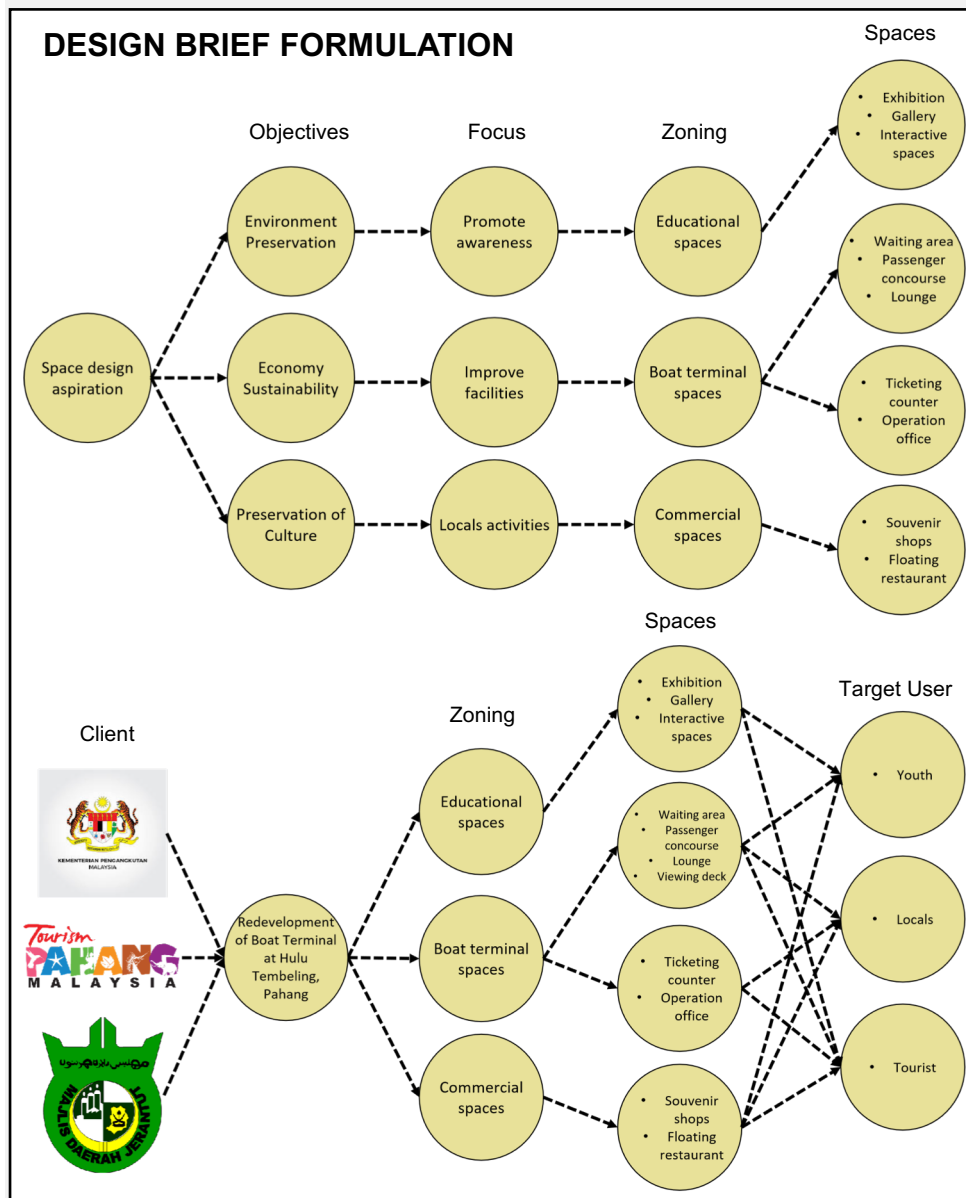


Figure 16: Brief formulation of the required spaces

Design Concept: **Complementary Architecture**

Complementary Architecture intends to understand the local conditions and context holistically. It aims to contribute to the environment in a way that **improves or emphasises its pre-existing qualities**. It **emphasises environmental experience over demonstrative design bravado** (Speck, 1982).

DESIGN APPROACH

Based on the data collected, the design approach to the building is synthesised into zoning of structures into 3 types: permanent structure, flexible structure and floating structure. The zoning of the types of structures is an act to overcome the flooding issues at the site in order to maintain the functioning of the proposed boat terminal. Figure 17 shows the zoning and the selected design approach by types of structures.

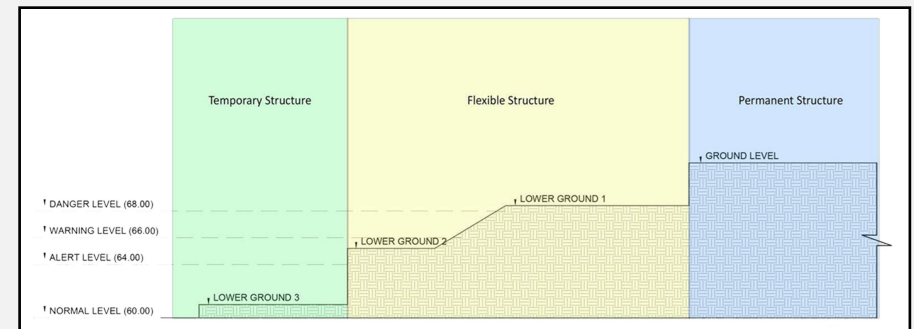


Figure 17: Site zoning by types of structures design approach

FLOOR PLAN

The overall image of the Boat Terminal as shown in Figure 18 is designed based on the concept of Complimentary Architecture, in which the form, orientation of the building and spatial planning respond to the site issues and embrace the existing facilities and natural surroundings of the site.



Figure 18: Overall image of the Redevelopment Boat Terminal Kuala Tahan

GROUND FLOOR PLAN

Most of the facilities of the boat terminal are designed at the Ground Floor level. The three main parts of the buildings, which are the lobby, exhibition space and multi-purpose space/education space, are designed with a floating structure. The design is an act of countermeasure in the case of floods reaching the ground floor. The spaces located on the ground floor are mostly public spaces as well as educational and commercial spaces. These spaces include the drop-off area - information area, commercial area, souvenir shop, exhibition area, seminar room, management office, lobby, viewing deck, watch tower, *musolla* and toilet. Figure 19 shows the layout plan of the Ground Floor.

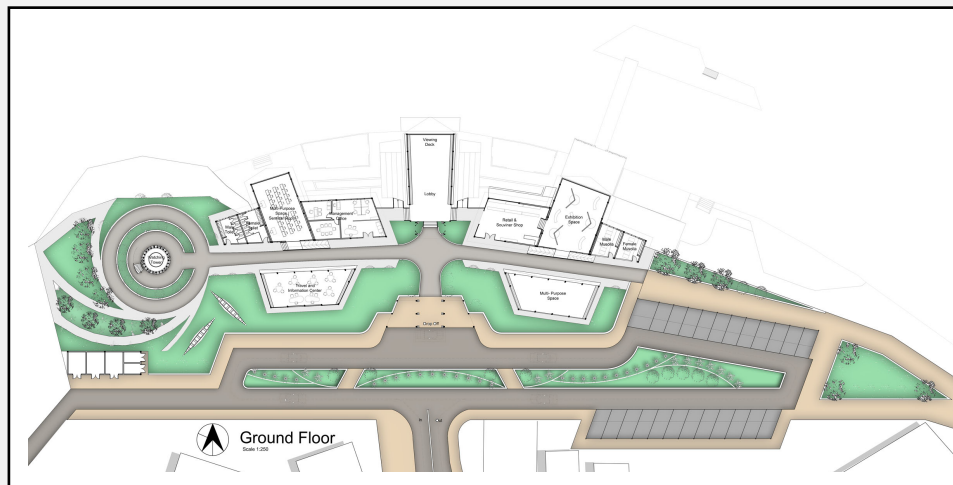


Figure 19: Ground Floor Plan
(Source: Author)

LOWER GROUND 1 FLOOR PLAN

The facilities at the Lower Ground 1 floor plan act as the waiting area for visitors who will ride the boat for their respective destinations. The spaces available are the waiting area, workshop, gallery, cafe and dining area, as well as the viewing deck. Figure 20 shows the layout floor plan of Lower Ground 1.

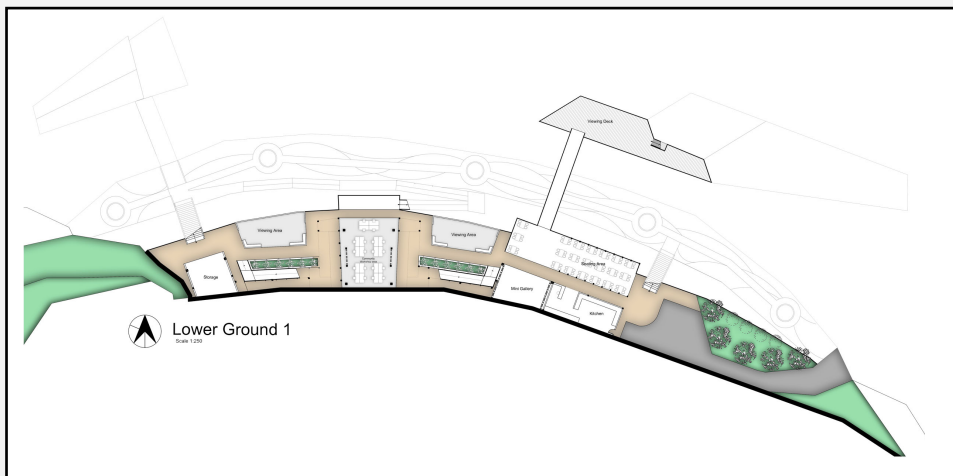


Figure 20: Lower Ground 1 Floor Plan
(Source: Author)

LOWER GROUND 2 FLOOR PLAN

Lower Ground 2 level is reserved for landscape and vegetation. It is also to respond to the RKK Kuala Tahan, which is to provide a bird-watching area and maintain the existing greenery in the area. The proposed landscape area attracts migratory birds that fly across the site. This event creates an alternative attraction area for visitors. Figure 21 shows the floor plan of Lower Ground 2.

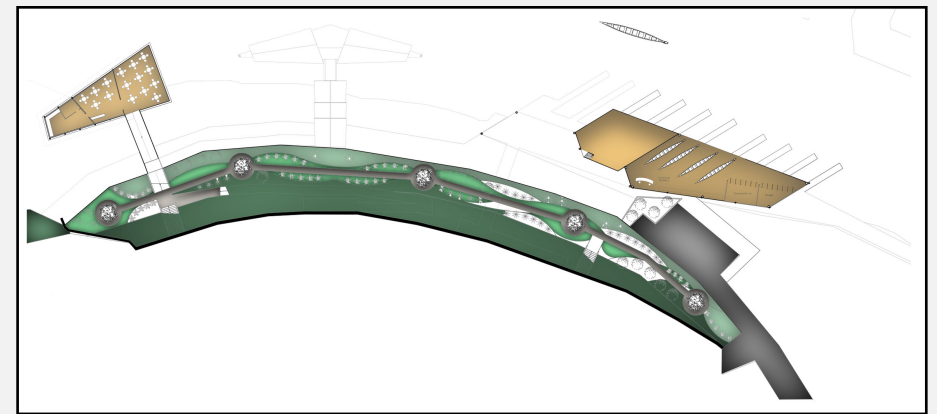


Figure 21: Lower Ground 2 Floor Plan
(Source: Author)

LOWER GROUND 3 FLOOR PLAN

Lower Ground 3 level is the departure area for visitors to depart to their respective destinations. At this level, the architectural elements are constructed with a floating structure to mitigate the area as a frequent flood-prone area. The pontoon and floating restaurants are flexible to float according to the water level. This is to reduce the loss and damage to the infrastructure during the flood season. Figure 22 shows the layout floor plan of Lower Ground 3.

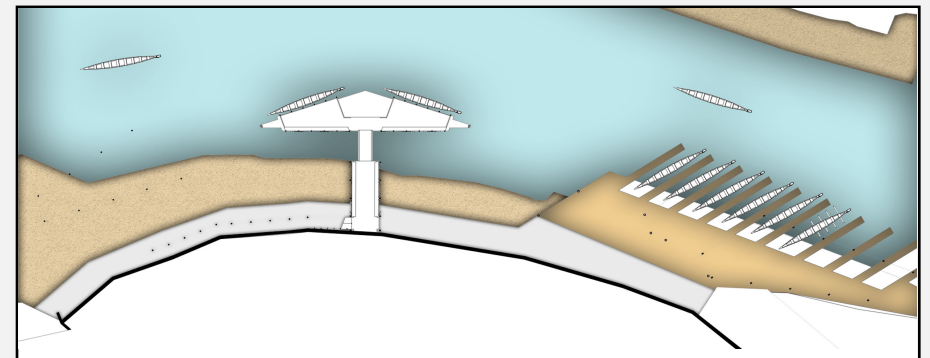


Figure 22: Lower Ground 3 Floor Plan
(Source: Author)

SECTION

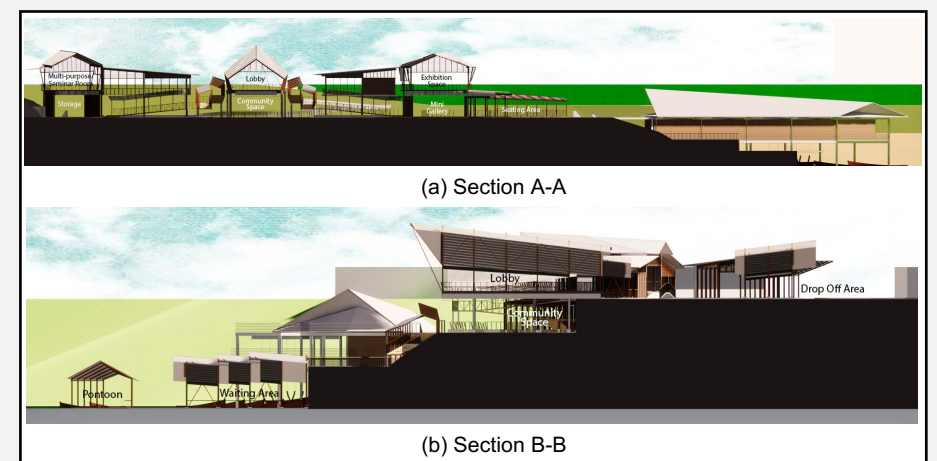


Figure 23 (a) and (b): Section A-A and Section B-B
(Source: Author)

ELEVATIONS



Figure 24 (a), (b), (c), (d): Elevations of the Boat Terminal
(Source: Author)

PERSPECTIVE



Figure 25: Perspective images of the Redevelopment of Boat Terminal Kuala Tahan
(Source: Author)

FLOATING STRUCTURE

The three main buildings at the ground level that use the same floating mechanism are the main lobby, exhibition space and multi-purpose space. The building has four (4) main building components, which are: Lightweight Structure (Portal Frame), Floating Base (Expanded Polystyrene, EPS), Guiding Post and Fixed Post, as shown in Figure 26.

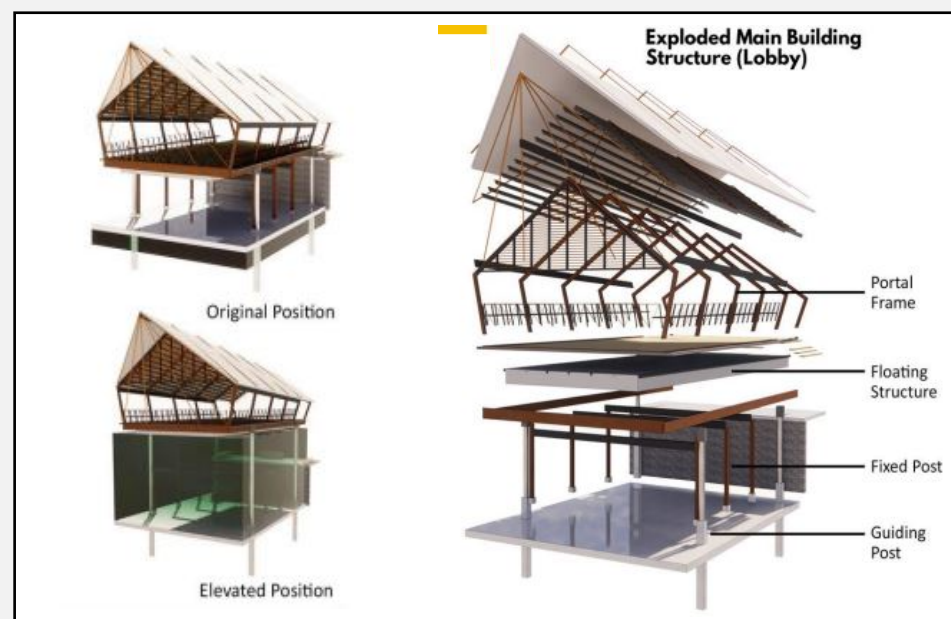


Figure 26: Lobby structure and components
(Source: Author)

The pontoon structure form is taken from the concept of *perahu*, resembling its dynamic form. The floating structure of the pontoon integrates Expanded Polystyrene (EPS) and a mooring system. The EPS is used as the base of the pontoon, while the mooring system is anchored to both ends of the pontoon. The strategy is used for station keeping of the pontoon in all water depths. The pontoon consists of three (3) main structural components, which are: Lightweight Structure (Portal Frame), Floating Base (Expanded Polystyrene, EPS) and Mooring System, as shown in Figure 27.

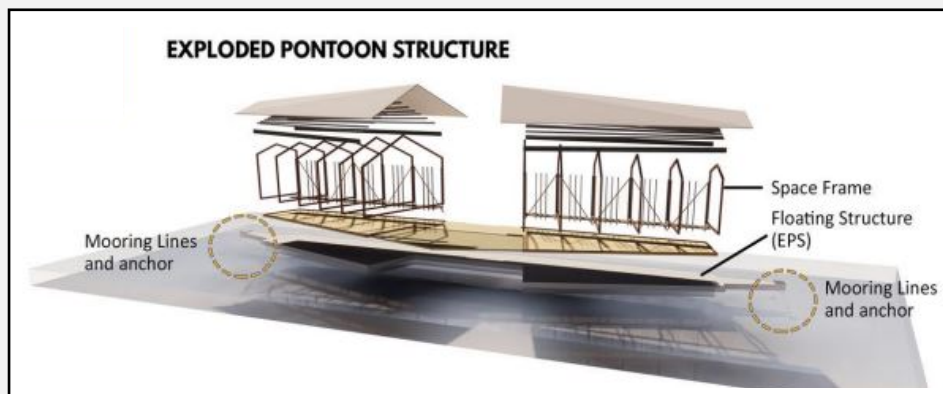


Figure 27: Pontoon structure and components
(Source: Author)

FLOOD LEVEL DIAGRAM

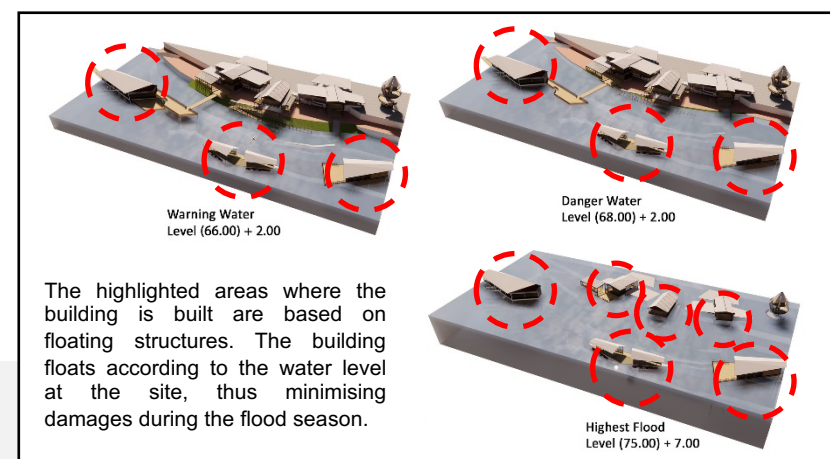
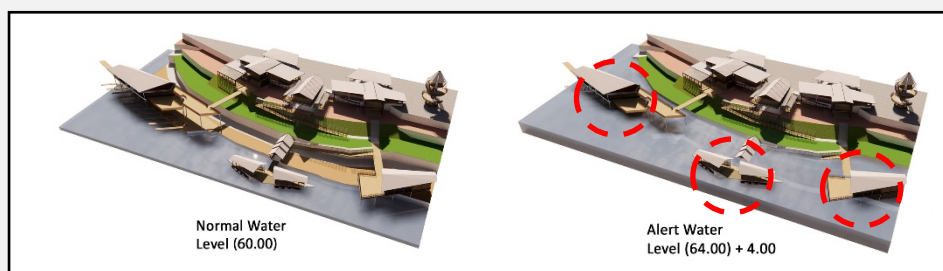


Figure 28: Structure of the Boat Terminal responding to the flood level
(Source: Author)

CONCLUSION

The design produces a Boat Terminal that complements the existing facilities and infrastructure and responds to the site issues. The research outcomes formulate a design brief for a Boat Terminal at Kuala Tahan, responding to the local authority's development plan. It creates a Gateway to Nature for Kuala Tahan with an integrated boat terminal redevelopment proposal using floating structures to overcome the flood issue, improves the facilities of the boat terminal and creates awareness of the importance of preserving Tembeling River and its natural surrounding.

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