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龜咯水上聚落適應海岸環境之空間模式發展研究

Spatial pattern development of Kukup water settlement in adapting coastal environment

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摘要

氣候變遷與海平面上升所帶來的潛在災害，使“與水共生”的議題日益受到都市研究領域的重視。沿海聚落必須因應氣候與其他物理或社經因素的變遷進行調適，以便盡可能降低破壞與發掘未來發展的機會。

對於應用在地的資源與方式促成有機生長的傳統聚落，瞭解當地居民的居住感受與執行調適政策的能力極為重要。然而，這方面的措施卻時常受到忽略，以致政策最終導向失敗。為了了解當地居民觀點與空間模式發展之間的相互關係，本研究將探討當地草根為因應海岸環境所做之調適措施，如何反映在空間模式的發展上。

水上聚落為馬來西亞一種傳統的生活方式。部分肇因於其在法律上定義為非法建築，針對水上聚落的空間與(或)環境調適上的相關研究極少。然而，這類聚落因其地理位置的關係，實際上為海平面上升(Md. Din & Mohd. Omar, 2009)及其他海岸潛在災害(Chan, 1995)的相對高風險暴露族群。

以馬來西亞柔佛州龜咯水上漁村（港腳漁村及鹹水港漁村）為例，本研究通過詳細的田野調查與訪問，探討生活在沿海環境的在地居住觀感點如何形塑聚落的空間模式。通過研究設計的兩個時期進行觀察，研究結果將呈現社區尺度與建築尺度的空間發展與其變遷原因。本研究發現，水上聚落的空間模式發生改變與空間調整，主要為因應環境的改變。長期的居住經驗形塑了居住觀點，而空間模式的發展則反映了居民與水共生的經驗。瞭解在地居住觀點對於落實任何的災害調適措施極為重要。本研究為補充傳統水上聚落研究之匱乏，對其空間模式進行詳盡的調查與分析，以提供未來相似自然與人文條件之水上聚落空間發展與調適策略之相關研究參考。

關鍵字:空間模式, 水上聚落, 在地觀點, 海岸環境, 龜咯

Spatial pattern development of Kukup water settlement in adapting coastal environment

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Abstract

The concern of "living with water" raises increasing attention due to potential disasters following by climate change and sea level rise. It is recognized that coastal community needs to adapt in order to moderate the harm or exploit beneficial opportunities resulting from changes in climate and other physical or socio-economic factors.

For organic-growth traditional settlement that was built by local resources and measure, it is important to consider people's perception and capacity to implement adaptation policy. However, it is usually be neglected and leads to failure of policy. To identify the interrelation between local perception and spatial pattern, this study discusses how grassroots' response to coastal environment reflects on spatial pattern development.

Water settlement is one of the traditional lifestyles in Malaysia. Partly due to illegal position in land use, the study of its space or/and adaptation to environment have received less attention and are limited in literature. And yet, these settlements are actually considered comparative high-risk exposed to sea level rise (Md. Din & Mohd. Omar, 2009) or other coastal potential disasters (Chan, 1995) based on their location.

Using case study of Kukup water settlement (Kukup Laut Fishing Village and Ayer Masin Fishing Village) in Johor State, Malaysia, this study conducts field research and interviews to identify local perception to coastal environment in shaping settlement's pattern. Applying to two designed phases, the result shows spatial pattern at community scale and building scale in order to identify the development and the causes. The study finds that spatial pattern has been facilitated to adapt to coastal environment. The everyday life experience, therefore, formed local perception; and the pattern represents the generation's experience to live with water. To understanding local perception to coastal environment and its changes is essential to practice of any adaptation policy. Through a detailed investigation and analysis to spatial pattern, it is to provide appropriate reference for further spatial and/or adaptation studies of traditional water centric community with similar natural and man-made conditions.

Keyword: spatial pattern, water settlement, local perception, coastal environment, Kukup

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Chapter 1 Introduction

1.1 Research Motive and Objective

1.1.1 Motive

It has been long history people living at the coast. The issue of "living with water", however, raises increasing attention of urban researchers due to the concern of potential disasters followed by climate change and sea level rise (Aerts, Botzen, Bowman, Ward, & Dircke, 2012; Olthuis & Keuning, 2010; Otto-Zimmermann, 2012).

There is over half of the world's population lives in vulnerable coastal cities, resulting in majority of people inhabiting in highly risk-exposed areas (Otto-Zimmermann, 2012). Coastal communities need to adapt in order to moderate the harm or deprive of the beneficial opportunities resulting from changes in climate and other physical or socio-economic factors. However, the vision and policy of climate change adaptation are usually developed from the viewpoint of globalization and apply top-down implementation. It may cause gaps to commitment and recognition between the authority and community as it neglects local worldview and perception towards natural environment and climate change. In response to the issue, various studies have been proposed to address the complexity and the inter-linkages of the challenges such as stakeholder involvement, policy-making and financial constraint confronting local governments while designing adaptation measures.

With interest to investigate local perception of coastal settlement, this study observes water settlement's local adapting efforts applied on spatial pattern. Water settlement, built on stilt and on shallow water of sea or river, is one of the traditional lifestyles in Malaysia. The natural settings of saline or fresh water, tidal cycle and surrounding ecosystem act as the fundamental role to form the settlement as well as to its continuous existence. Unique spatial pattern has been shaped by the generations' life experience on the sea, grassroots' knowledge to coastal environment, and continuing spatial experiment and measures in adapting environment changes.

Due to their location on water, these settlements are considered comparative high-risk exposed to sea level rise (Md. Din & Mohd. Omar, 2009) or other potential coastal disasters (Chan, 1995). However, the study to its pattern and/or adaptation to climate

change have not received attention in literature due to temporary occupied position defined by land use authority and isolation from land access. A few studies which mentioned water settlement classified it to Malay old port cities (Hassan, 2010) or Malay architecture (Nasir & Teh, 1996). Ambiguous definition to its legal and academic status leads to insufficient knowledge and concern to this type of settlement and exposes as vulnerable confronting risks and impacts of climate change.

Using case study of Kukup water settlement (Kukup Laut Fishing Village and Ayer Masin Fishing Village) in west coast of Peninsular Malaysia, this study focuses at community scale and building scale to identify grassroots, community-led response to the development of spatial pattern during physical or socio-economic change. Through a detailed investigation and analysis to its spatial pattern, this research aims to provide appropriate reference for further spatial study and/or adaptation policy of traditional water centric community with similar natural and man-made conditions.

1.1.2 Objective

This study discusses spatial pattern development of Kukup water settlement in adapting to coastal environment. The objectives of this study are:

1) Based on literature review, identify appropriate spatial components for water settlement's spatial pattern.

2) Based on field research and interviews, identify the development context of the settlement's spatial pattern.

3) Based on the basic data collection, analyze and evaluate how the spatial pattern reflects local perception and adaptation measures application in coastal environment.

1.2 Research Contents

This study identifies Kukup water settlement's spatial pattern in two designed phases. Through the analysis to spatial development and transformation, it traces the cause of change, records the characteristics of spatial pattern and community response in adapting to the change. The contents of this research are:

1) **Identify observed objects**

Literature review to spatial pattern, traditional water settlement, traditional Malay architecture and resilience to climate change, the research focuses on three essential structures of settlement: building, street, and public space to observe the development context of spatial pattern in adapting to coastal environment.

2) **Clarify the development context of spatial pattern**

Spatial pattern is a reflection of the consequent process of settlement development. To explore the interaction between coast and settlement, this research designs time scope into two phases based on data collection to historical background and natural environment, interviews and field observation. The development context provides a time sequence to track spatial changes and the causes that shaped the characteristic of spatial pattern. By observing and comparing the development during these phases, it aims to clarify the spatial pattern beneath buildings, street and public space.

3) **Explore local perception**

Based on the result of spatial pattern analysis, it presents local perception of the inhabitants beneath these grassroots spatial measures in adapting surrounding natural settings, environment changes and coastal impact. By involving local capacity into consideration, the study examines the condition and challenge to develop resiliency in water settlement.

1.3 Research Scope

1.3.1 Geographical scope

The study area is set at Kukup Laut Fishing Village and Ayer Masin Fishing Village in Kukup Town, Pontian District, Johor State, Malaysia. Kukup Laut and Ayer Masin Fishing Village are parallelly built on the shallow water of the Strait of Kukup, Peninsular Malaysia. It is geographically sheltered by an uninhabited mangrove island, *Pulau Kukup* the RAMSAR site and hence is protected from strong waves and winds. There is around one kilometer distance between the settlement and the island. Floating fish farms were built and operated by the villagers on the Strait of Kukup as one of their major economic activities.

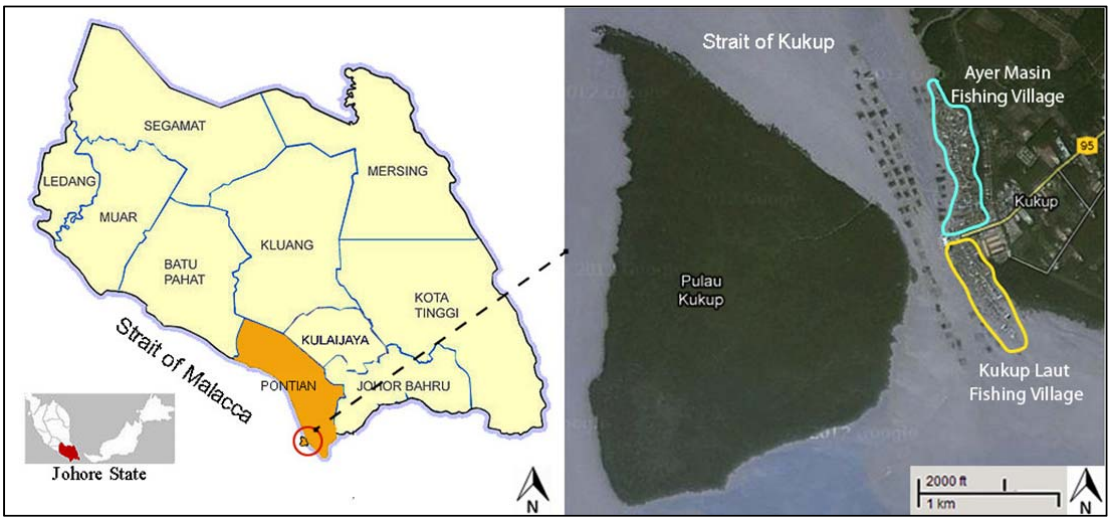

Figure 1.1 Pontian District and Location of Study Area

Source: Wikipedia (left); Google Maps (right)

According to inhabitants, the villages were formed by the foreign immigrants from China around 150 years ago. The inhabitants had been conducting fishery activities since the villages were formed and started to operate fish farming from 1970s and tourism from 1990s.

Kukup Laut Fishing Village built by immigrants from Kinmen County of Fujian Province, China (now is named Kinmen County of Fujian Province, R.O.C.) consists of around 170 units of buildings and 1000 inhabitants (around 120 families), 5 temples and 1 primary school. Ayer Masin inhabited by immigrants from Tong'an County of Fujian Province, China (now is named Tong'an District of Xiamen City, Fujian Province, P.R.C.) consists of around 120 units of buildings and 700 inhabitants (around 80 families), 6 temples and 1 primary school. There are over 90% of inhabitants in these villages remain as descendants of the immigrants[1] and speak Min Nan dialect. Both villages are included in the study because of their adjacent geographical location (which the villages are separated only by a town road), similar forming background and lifestyles. However, these two

[1] The villages were considered illegal and had been obtained Temporary Occupation License (TOL) from land use authority before they granted land ownership on year 2012. To limit the expansion of settlement, TOL application restricted the applicants of land use provide identity to prove as the descendants of original immigrants. It unintentionally led to the result of maintenance of villages' ethnic.

villages do not recognize each other as same living community due to their strong ethnic consciousness.

Figure 1.2 Photos of Kukup water villages

Source: photographed by the study

It has considered in several factors when setting these fishing villages as study case:

1) Relatively simple cultural factor control

As a result of strong identity consciousness, the villages remain to inhabit only descendants from original immigrants and the historical record has been generally inherited to existing generations. It assists the research to observe in depth the context of development under condition of a relatively simple culture structure.

2) Availability of data and figures

While most of the water settlements have not yet obtained legal position, these villages were the first that officially granted land ownership rights from the state government [2] and hence make official statistics available. Furthermore, the location adjacent to an international renowned national park provides comparatively diverse research perspectives to a less attention study object.

[2] The Chief Minister of Johor State Datuk Abdul Ghani Othman explained at the land grant ceremony, that the land on shore of the Straits of Kukup is owned by the state government and thus held the rights to grant the ownership. The Kukup traditional water villages' case is the first and only legal water settlement by now. The 99-years land ownership, which the local called "on-water ownership", was granted on March 2012. Previously, the residents, just as in other states, often faced difficulty in receiving land ownership and the risk of eviction. Most of the residents had been only given Temporary Occupation License (TOL) for the past decades.

1.3.2 Time scope

This research examines local perception reflected on spatial pattern development. Therefore, time scope is designed based on the stages when the spatial development was apparent and supported by available graphics and maps. Furthermore, a time sequence helps the study clarify the cause of spatial development by spotting the significant change at specific period. A summary of the village's development is produced according to interviews with inhabitants, news and written records.

Table 1.1 Summary to Kukup Laut and Ayer Masin Fishing Village's Development

Year		Event
Kukup Laut	**Ayer Masin**	
1860s		Kukup Laut Village was formed, followed by Ayer Masin. Fishing and pig farming were the main economic activities.
1878		A Singapore-Arab businessman Syed Muhammad bin Ahmad Alsagoff set up Constantinople Estate to plant cash crops at Southwest Coast of Johor. The estate had rapidly promoted the development of Kukub3 (now named Kukup). Kukub District was then formed.
1900		Road construction from Pontian to Johor Bahru.
1921		Road construction from Pontian to Kukup completed. The District administration office moved to Pontian. Kukup District was renamed to Pontian District.
-	1923	Primary School was established using a village's house
1926	-	Ken Boon Primary School was established.
1932	-	According to an immigrant arrived at the year, the jetty was a little stilt house with concrete structure.

[3] The authority and prosperity of the development project owned the rights to issue private currency (see appendix (3)), which clearly shown the name of "Kukub" and its function to make payment for coolies. "Coolies" was the word used in the early 1800s for Chinese laborers. The currency, hence, provides official document to support the oral history of settlement formation time.

Year		Event
Kukup Laut	**Ayer Masin**	
1936	-	According to an immigrant arrived at the year, the villages had no electric and running water service. There were only a few stilt houses with roof of sago palm's leaves (*attap* in Malay). Kukup road was paved with stone and red soil. Ayer Masin had no path connected to Kukup road and the villagers rode wooden boat (*sampan*) to land.
1938	-	Relocation of primary school to Kukup road.
-	1940	Construction of primary school.
-	1950s	Construction of wooden path (commonly apply as "*qiao-lu*" in Chinese) to connect the village with Kukup road under the pressure of post-War government.
-	1960	School decoration to concrete structure.
1970s		Infrastructure of lights, running water on Kukup road
1970s		On stilt fishing facility (Kelong) gradually be abandoned.
1970		Broaden Kukup road and asphalt paved.
-	1977	Part of village path was destroyed by waves.
1979		Sea pollution on the Straits of Malacca brought impact to fisheries. Developed floating fish farms.
1981	-	Houses collapsed due to mudslide.
1984	-	Set up Kukup fish farming trade union. 8 operating fish farms.
1990s	-	Landfills beside Kukup road. Construction to 55 units of 3-storey commercial shops and a bus terminal on land.
1990s		Village house decoration to concrete structure. Developed home stay tourism.
1990		Infrastructure of lights on the path and in-house electric.
1991	-	Houses collapsed due to mudslide.
-	1991	Decoration to school and expanded to 2-storey
1992	-	Village Fire, 4 houses were destroyed.
1993		Decoration to village path to concrete structure. New jetty with concrete structure be built.
-	2006	Village Fire.
2012		Received ownership of land.

Source: summarized by the study

It can be found that most of the infrastructure and facilities were completed by 1970s, although precise year of some constructions are hard to verify. After 1970s, there were structure improvement and alteration in an effort to deal with the impact of waves, pollution, fire disaster, that apparently caused changes to its spatial pattern. In addition, the earliest panoramic image in the settlement was at 1970. So the study period is designed to be two temporal phases[4]: a) Phase before 1970; and b) Phase after 1970.

1.4 Literature Review

This section stresses on reviewing related theories and research in four parts:

1) Study of spatial pattern development: water settlement is built on artificial space above water. Water, as the base of the settlement, led to unique consideration to building and community's spatial pattern. In order to design specific perspective for the study of water settlement's spatial pattern, it is important to review existing theories which interprets the formation of settlement occurred in natural settings and the spatial components used to observe and analyze spatial pattern. These basic knowledge is important references for this study to identify water and other physical or socio-economic factor to water settlement's spatial pattern.

2) Study of water settlement in local and foreign cases study: reviewing previous studies in water settlement offers diverse perspective of concern and methods used to deal with such issues. It helps expand the horizon of this study.

3) Study of traditional Malay architecture in aspects of spatial pattern and architectural forms: the study of Malaysia water settlement is minimal and some former studies classified water settlement into traditional Malay architecture. Hence, it is important to review spatial characteristic of traditional Malay architecture in order to identify the feasibility of water settlement.

[4] Nevertheless, this study understands that spatial development is a constant process; hence, the designed phases are only applicable in this specific study in consideration of available spatial and map data. Some of the development which could not be precisely traced or fit into the designed phases will be noted particularly in the description.

4) Study of resilience and adaptation of coastal or flood-prone area: The objective of this study is to discuss spatial pattern in adapting to coastal environment. Thus, the review of adaptation and resilience to climate change impact is important to examine the possibility of local resilience.

1.4.1 Study of spatial pattern development

Water settlement has gained little attention in former spatial research. Hence, this study refers general theory of spatial development to design specific interpretation that applicable to the study case.

Corresponding to the characteristic of water settlement, literature review focuses on the study of traditional and organic-growth (relative to planned) settlement. The structure to literature review is shown as Figure 1.3.

First, it reviews the form determinants of organic-growth settlement that are applicable to the case study. After identifying the formation of the settlement, the review focuses on spatial pattern. The pattern is observed through three essential spatial structures: building, street and public space.

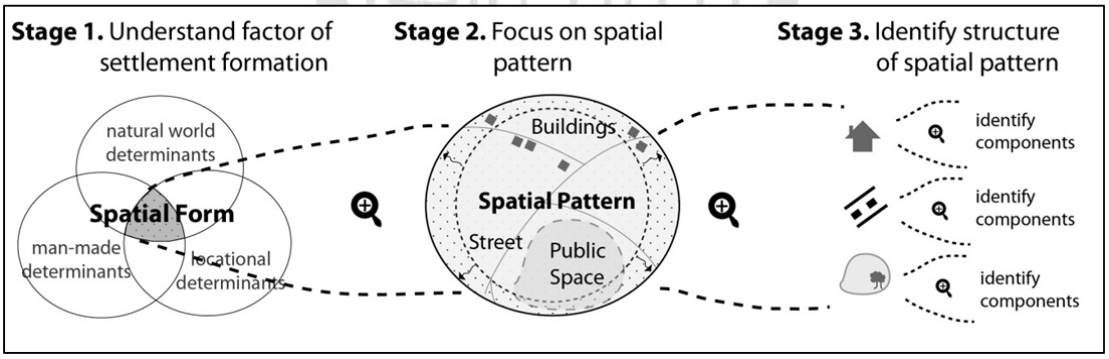

Figure 1.3 Diagram of spatial development's literature review

Source: illustrated by the study

It is found that, various studies in traditional and organic-growth settlement can be applied to this case study, which will be described in the following section. But, do note that, none of these studies develop from a water-base site. Hence, it can only provide reference to pattern components; the influence of water-base site (despite of ground-base) to pattern will be described in analytical results.

I. The form determinants of settlement

Settlement is a collective unit that human beings form for group living, that can be classified by spatial scales including village, rural town and city (R. C. Chen, 1993). By reviewing its spatial form, it provides clue to track the background and factor(s) of a settlement's formation. The factor then becomes an important object to be observed in the study under the hypothesis that the change of factor leads to the change of spatial characteristic.

According to Morris (1994), the form of settlement has been determined by factors and influences which shall call *urban form determinants*. The form of a settlement at any given period is the result of a number of locally effective determinants. The determinants can be classified into two different origins: a) natural world determinants and b) man-made determinants.

Besides these two origins of determinants, an introductory consideration is also required of underlying reasons for the existence on their sites of settlement, which are called locational determinants. It is a concept grounded on the natural-world and man-made determinants, which some of them must be the essential prerequisites for a settlement's existence, for example availability of permanent potable water supply and food.

Natural world determinants are those that originally exist in the natural environment of the geographical location of a settlement. The most significant determinants are topography, climate and available construction materials in surrounding environment.

Topography consists of natural constrains and advantages that may influence the geographical extent and direction of growth, make it a main part of a settlement's form. Local climate circumstances bring impact to the form of the shelter when it attempts to response. On the other hand, unexpected climatic or natural disaster can also lead to changes and adjustment of a settlement and its shelter form. Availability of local construction material plays a major role in traditional settlement's form due to accessibility. On the other hand, it also decides the form of the shelter depending on the performance

characteristic. These determinants will be discussed in the water settlement's forming background focusing on the natural environment that attributes to the settlement[5].

Man-made determinants are various, continuously increasing and much more complex in nature and the effect. However, they can be summarized into three primary motivating forces - trade, political and social power, and religion[6]. It provides a check-list for the study to analyze water settlement past and present spatial development.

II. The pattern of settlement

Spatial study can be conducted in various theoretical approaches such as typology, morphology, pattern and form. Due to the spatial study of water settlement very limited, the research resources is sufficient to support a comprehensive analysis or classification of a settlement's type or form. As one of the preliminary studies, this research aims to provide in-depth case analysis by exploring the underlying spatial pattern of the chosen site to identify the force that shaped the pattern and the unique characteristic of spatial structure. It is based on the assumption that an organic-growth settlement has a unique and distinct pattern that is shaped by grassroots' perception and their long-established practice on space. It is similar to the argument of Alexander, Ishikawa, and Silverstein (1977), that every town and buildings is made by people in the society who share a common language, and the elements of this language are entities called *pattern*. Hence, pattern can be defined as a kind of conscious arrangement of buildings into a predetermined form(Morris, 1994).

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[5] To be noted, the author suggested that the influence of natural-world determinants especially topography and local construction materials is reduced after new construction technology evolved. This explanation does not exactly fit with the current state of this case study where the intercourse between water settlement and nature environment is still frequent. However, as this study orientation focuses on spatial pattern, it refers to the impacts of natural-world determinants only for discussing of the origin of settlement formation. Thus, the argument, though not consistent with the current form, will not be discussed in this study.

[6] The author suggests that "not only have these forces had major determining effects on historic urban morphology, but also singly, or in combination, they have been mainly responsible for urban formation and growth…while it is urban history's exceptional results of trade, power, religion and other such determining influences that are conventionally highlighted, the great background mass of ordinary urban development has been shaped by mundane everyday requirements." (Morris, 1994: p12-13)

According to Alexander et al. (1977), a pattern language is considered a structure of network. The network is configured by both the scale (from larger pattern to the smaller) and the function (from the structure to the embellishment). The application of different sequence of pattern makes different language and can be considered as the "base-map" of a particular project[7].

A community scale pattern is organic growth and can be observed from its network connection and boundaries, local environment, growth of housing, and public land for human activities. Pattern at building scale defines the individual buildings and the space between buildings. The overall arrangement of a group of buildings shows its pattern at the height, number of these buildings, the entrances, parking areas and the lines of movement. These languages fix the position of individual buildings on the site while the components of indoor and outdoor space shape both the volume of the buildings and the volume of the space between the buildings. When the major parts of buildings and the outdoor areas have been given their rough shape, their internal gradients of space and movement define the most important area of a building. While the pattern above gives a scheme of spaces, the final part will be the structural details including construction and materials.

This study will produce a structure of pattern language network according to the study result as a reference of the water settlement's base-map that may contribute to further study to distinguish similar water settlement.

Refer to the literature of form and pattern, the study develop specific interpretation of the terms applicable in this case study. The relation between spatial form and pattern is interpreted as the diagram shown as Figure 1.4.

1) Form: a visible shape molded by form determinants.

2) Pattern: a kind of conscious arrangement that represents the uniqueness of a shape.

3) Structure: the essential elements to configure form and/or pattern particularly buildings, street, and public space in this study.

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[7] To be noted that, the book aims to standardize universal pattern in order to design a good project. But in this study, we only refer to the components it summarizes to support the observation of the site, and using the concept of "structure of network" to analyze Kukup water settlement's spatial pattern (without the intention to standardize general design rules of water settlement).

4) Component: used to describe object(s)' underlying structure to configure the characteristic of structure

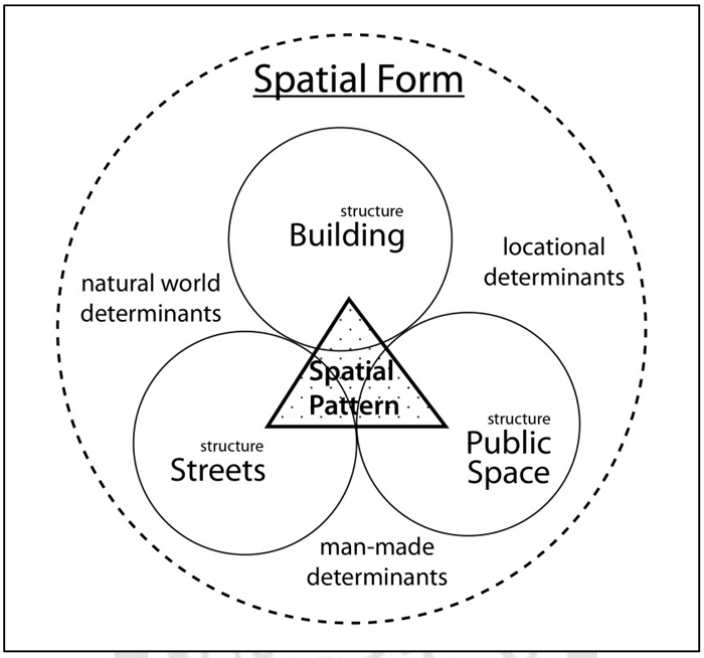

Figure 1.4 Diagram of spatial form and pattern

Source: illustrated by the study

Spatial pattern acts as an outcome of continuous history progress and ongoing daily life. The uniqueness of pattern is generated by interaction between buildings, street and public space in different combination under specific physical socio-economic conditions (Lin, 2006). It thus reflects the characteristic of these three structures in different phases (provided they have not been destroyed) as a record of the process of spatial development.

On the other hand, physical socio-economic conditions can be summarized into two major categories - "environment" and "human activities". Hence the interpretation of the spatial pattern development in this case study shown as Figure 1.5, implies spatial pattern is corresponding to "coastal environment" and "human activities". The continuous interaction between these two major factors shaped the uniqueness of water settlement's pattern.

The pattern can be recorded through the analysis of its structures: buildings, street and public space. By observing pattern, we are able to track and derive the social-environment relations and community relationship within a water settlement.

"Coastal environment" in this study is used to describe specific natural settings at Kukup water settlement - saline water coast with mangrove fringed and swampy mud ground in tropical climate.

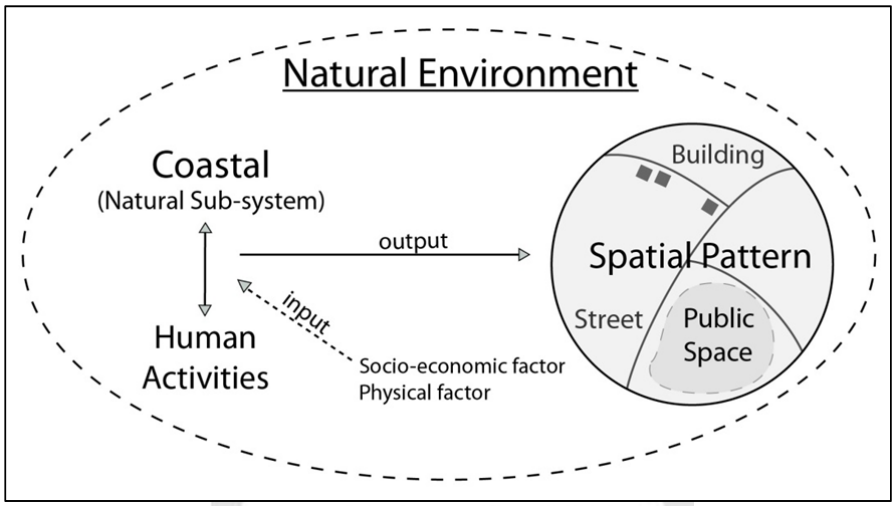

Figure 1.5 Shaping process of water settlement's spatial pattern

Source: illustrated by the study

Combined with the literature review, the study took reference from the "structure network" of Alexander et al. (1977) when conducting study at community scale and building scale to record spatial pattern by analyzing the characteristic of its three essential structures. Followed by the list of components, the uniqueness of the pattern at community scale can be observed through the combination of building, street and public space, while the pattern at building scale can be observed in its distribution and construction details.

III. The spatial structure of settlement

A settlement can be treated as an organic unit basically formed by buildings (Hillier & Hanson, 1984) or dwellings place (Sha, 1974). The major structural units of a settlement include housing, facilities, routes and road (F. H. Chen, 1984). They are not only the transformation of space through objects, but also "create and order the empty volumes of space resulting from the object into a pattern" (Alexander et al., 1977).

The process of space transformation through object into pattern can be observed apparently in water settlement where building, street and public space that are entirely built upon an artificial platform on stilt then transformed from a waterlogged space into a

settlement. The settlement pattern gradually forms during the interaction between these objects.

In the beginning, water stilt houses, the fundamental object in the settlement, were distributed randomly and isolated at riverbank and coast without road connection. It transformed natural territory into artificial. Gradually, other types of object including road and public space were constructed and bring transformation to the original pattern.

Hence, buildings are considered the fundamental structure in the study while its construction and layout has proactive influence to other spatial structure. Furthermore, street and public space bring diversity to the structure of settlement and through the interaction between these structures, the pattern is gradually shaped.

In an organic-growth traditional settlement, the function of street and public space can be varied. According to Yang (2009), traditional settlement without planning was usually built and expanded based on needs and utility preferences of the inhabitants. Due to the growth of the settlement, additional construction of buildings narrows the street. However, the clustered appearance generates sense of space closure that encourages physical and emotional interaction between inhabitants. Flexible interfaces of the streets become a shared space of daily life not only for accessibility but also for various neighborhood activities that may act as a people-oriented space and enhance activity within the community.

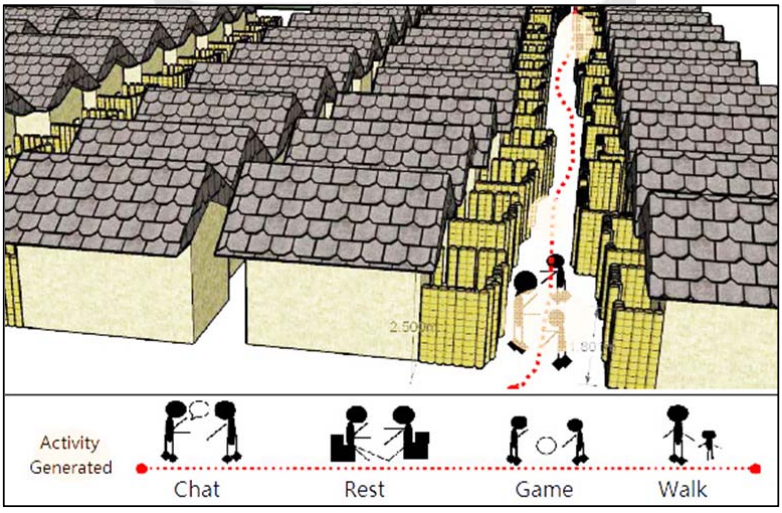

Figure 1.6 Flexible interfaces of streets in traditional settlement

Source: Yang, 2009: p. 57

The multifunction of a street which stimulated from space closure applies to Kukup water settlement. Street acts as a public space for activity and is applied to observe community interaction in the study.

"Public space" in this study is defined by the concept of social production referred from Hsia (1994) that including space for social life, consciousness, spiritual and physical activities. Public space consists of "representation of public space" (imagined space), "representational public space" (lived space), and "real public space" (real space) shown as Figure 1.7.

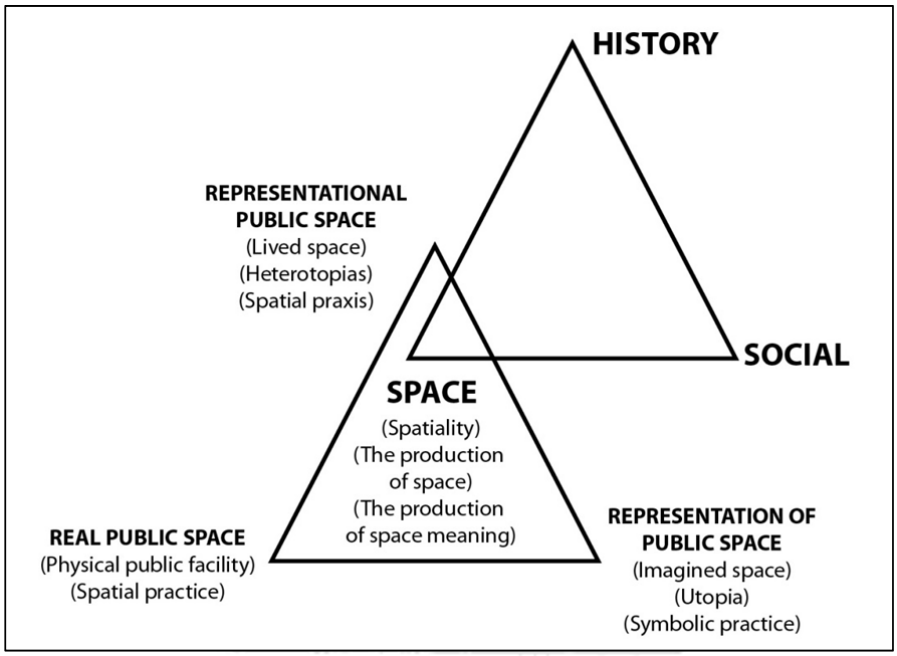

Figure 1.7 The social production of public space

Source: Hsia, 1994: p 15

"Representation of public space" is resulting from symbolic practice, discursive practice and ideological practice that produces an imagined space. "Representational public space" is consciously living space that physically exists and "real public space" is a configured by physical public facility and service.

The public space of Kukup water settlement fits into this concept and expands from these three dimensions. Initially, the sea and surrounding mangrove forest formed an imagined space that defined their collective identity. Afterwards, some physical space within the neighborhood gradually stimulated social interaction and activities without

planning and not necessary accompanied by public facilities. Finally, public facilities and services were produced in the process of urban planning and transformed into real public space in the community. As public facilities and services were not the primary public spaces in local villagers' perception, it was crucial to understand the layout of public space by utilizing the definition of public space mentioned above. The following study in public space will be conducted within these three dimensions in order to define specific perception and characteristic of public space in water settlement.

1.4.2 Study of traditional water settlement in local and foreign cases

Former studies in traditional water settlement in Malaysia are limited and mainly surfaced due to concern of heritage preservation of its community pattern. These studies, however, provide preliminary but important introduction of water settlement in Malaysia that helps identify the influences of environment and human activities to the pattern. A review of Hong Kong Tai-O village is applied in this study for its similar ethnics and lifestyle which was built by the Chinese with the original intention of fishery. Furthermore, the study of Netherlands water buildings provides basic knowledge to water building construction including the consideration of ground and water condition. This section is organized by the study scaling at community and building in order to fit into the designed structure of this study.

I. Community scale concern to spatial pattern and landscape

According to Hassan (2010), existing Malay village settlement can be classified into two types - traditional fishing (water) [8] and rural villages. One of the major differences between water and rural village in pattern is housing unit density per hectare. Water village has relative high density in low rise[9] housing than low rise housing in rural village.

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[8] The definition of "fishing village" in Hassan's study is equal to the term "water settlement/village" in this study. The following description uses "water settlement/village" despite of "fishing" in consideration of consistency.

[9] The author mentioned that "Low-rise means the houses with one story houses and low density… Low density means 4 or less housing units built in one acre, which typifies a typical traditional Malay houses in rural areas ranging from 1 to 4 house units per acre"

Water village has similar pattern to traditional old Malay port city based on historical records. It evolved highly related to local livelihood and natural settings and thus, preliminary survey to local geographical and topographical condition is essential to analyze spatial form of water settlement.

Figure 1.8 Port City during Johor Sultanate Kingdom in 16th Century

Source: Courtesy of Kota Johor Lama Museum

The research found that water village was usually built along coastal area to leverage the strategic location for fishery activities. Existing curvilinear topographical contour line plays a significant factor in influencing the development of the spatial pattern. For internal spatial pattern, he classified the distribution into several temporal layers and found that the first layer of settlement commonly included jetties, workshops and houses proved that livelihood is the essential element of a settlement's set up. According to the original locations and direction of expansion, he summarized in the settlement patterns into five types - inland water village, outward water village, parallel water village, water village and river mouth water village shown as Figure 1.9.

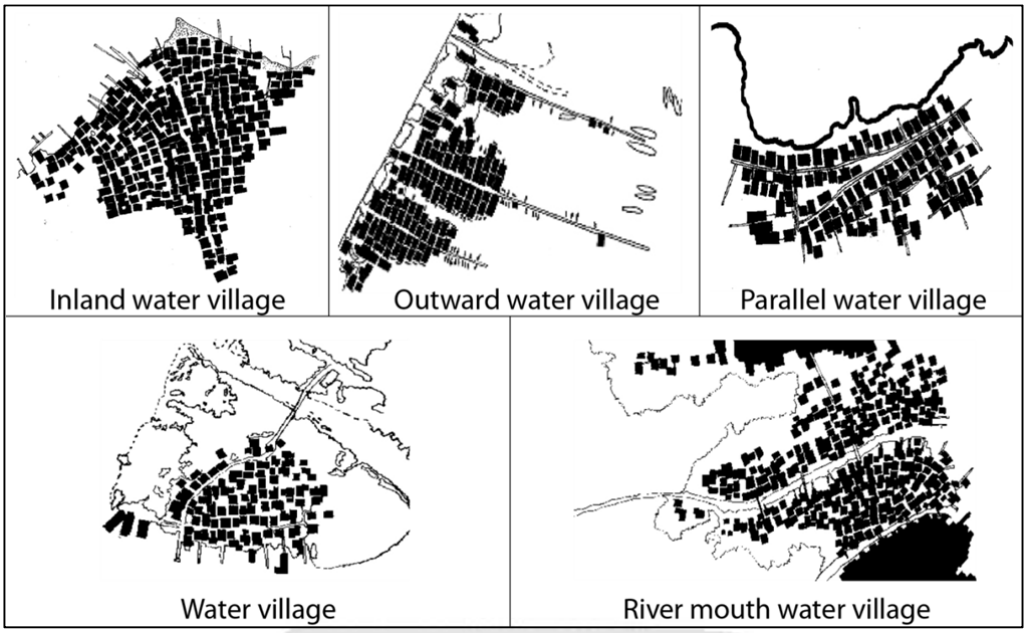

Figure 1.9 Patterns of water village

Source: Hassan, 2010

Original location and topographical condition mentioned in the study can be considered as nature world determinant mentioned in spatial form review. This study, hence, supports the perspective that the form of water village is highly related to the nature settings. Kukup Laut water village and Ayer Masin water village fit into the pattern category of parallel water village and river mouth water village.

Another case study of water settlement in Chew Jetty, Penang provided reference to local sense of place (Ng, 2013). The study found that, water village's patterns, proximity and scale of the built environment were apparently different from outside the neighborhood and contributed to a sense of community. This sense of place[10] of water village derives from the pattern of road and routes (which is the major structural object the study discusses), its interaction with human activities and the way this space being used. The wooden path is not only for accessibility but also promotes interaction between inhabitants,

[10] The author summarized the common grounds of definition of "sense of place": (1) it comprises of a combination of characteristics (physical and socio-cultural elements) that collectively constructs a particular sense of place, and differentiates it from others; (2) sense of place is temporal; and, (3) sense of place is experienced.

and between inhabitants and visitors. It invites more visitors to the village and has become a space to experience "local sense of place". The patio became the buffer space between public and private territories, while the size of path also led to different "sense of place". It appears that smaller path expanded from the main path led to comparative private space that is usually used only by inhabitants. Furthermore, the overall view consisting of temples, boat, children, inhabitant's activity on the patio and temples also offers a non-static place identity and sense of place. Although the sense of place is not a major focus in this study, it provides an in-depth reference to the activities and functions of road and routes of the water village that constituted the representation of public space.

From the socio-economic aspect, Leung (2002) analyzed the impact of urban development to water village's natural, cultural and social environment using case study of Hong Kong Tai-O water village. In the case study, the layout development of building and community was described in detail which assists to observe local perception of living on water. This study adopted this approach to observe community pattern's development. Furthermore, Current urban issues such as environmental pollution, tourism industry, inadequate infrastructure and change of surrounding landscape also caused large impact to preservation of the original layout of the village. Hence, the effort to encourage communal participation and culture connotation in pattern preservation is necessary to enhance proactive action.

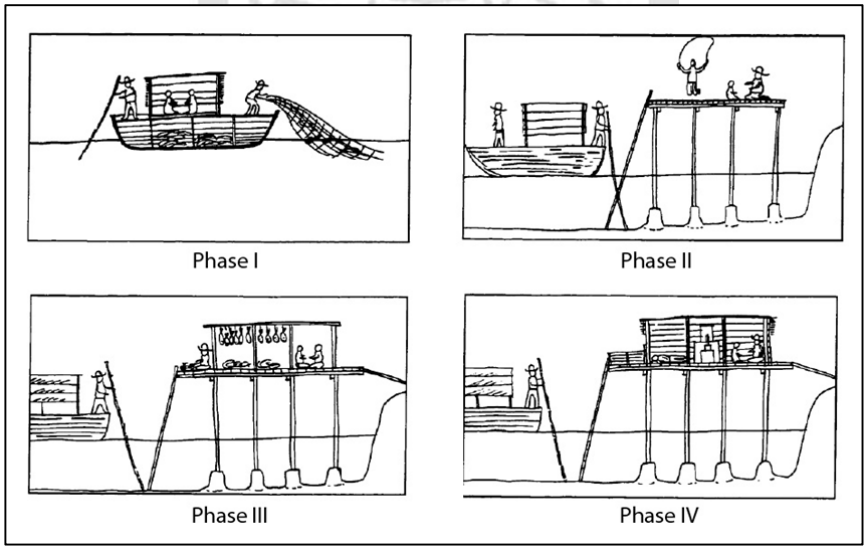

Figure 1.10 Spatial development layout of Hong Kong Tai-O water village

Source: Leung, 2002

Similar to Tai-O, Clan jetties in Penang in the study of Chan (2011) is facing high pressure from urban development that may destroy its original pattern and lifestyle if the development plan does not heed local opinion. The issues being discussed included the disturbance to the locals' private life caused by mass tourism, lack of funding for regular repairs and maintenance of wooden structure, poor environmental conditions and natural hazards, poverty and migration of young generation. It can be found that the village pattern that was originally shaped to service the inhabitants has increased conflict from the visitors' demand in the midst of urban development and the challenge facing Kukup villages' pattern.

II. Building scale concern to construction and materials

The review to the Netherlands water architecture provides perspectives to individual building structure. According to Olthuis and Keuning (2010) in the study of the Netherlands water architecture, the first forms of living on water were rafts with huts on them, followed by wooden houseboats and barges. Later version had a steel understructure but retained the disadvantage of maintenance. Wooden and steel houseboats and barges have to pay regular visits to the boatyard for maintenance usually every five years. The development of floating foundation is then be proposed following on the invention of reinforced concrete. Reinforced concrete is a combination of concrete and steel bars and requires far less maintenance to the foundations.

It claims that, the only essential difference between a house on water and a house on land is related to the foundation but not the structure.

Different sorts of water have differing characteristics that influence the building type. In another hand, different kinds of water, for instance, fresh, brackish, salt and acidic water are considered with different effect on building materials. There are two main types of foundation in use in the Netherlands which are dry regions consist of sandy ground and wet-boggy ground. And different foundations are used according to the ground conditions:

1) Spread foundation

That is a method of foundation used in dry region and requires a good ground base. The walls have a broadened foot that rests on the bearing substratum.

2) Pile foundation

It includes wooden-pile and friction-pile foundation. It is suitable for the marshy ground but the ground has to be consolidated when start construction or else the buildings subside. Wooden pile-foundation had been used in many old buildings and currently be harmed by the fluctuating groundwater levels. Climate change causes more severe rainfall to the city and water levels can be expected to fluctuate more. Pile rot is a main threat to this wooden-pile foundation now.

Friction pile foundations have been used widely too. The building does not rest on the piles. The friction between the piles and the base layer keeps the building down; otherwise start to rise due to the upwards pressure of the groundwater. The basements lie partly in the groundwater in these cases.

3) Floating foundation

Floating foundation works on the similar principle with friction pile. Buoyant objects experience an even upward force from the water they displace. The house goes up and down in unison with fluctuating water. The disadvantage of floating foundations is that the stability of small house is a point of attention.

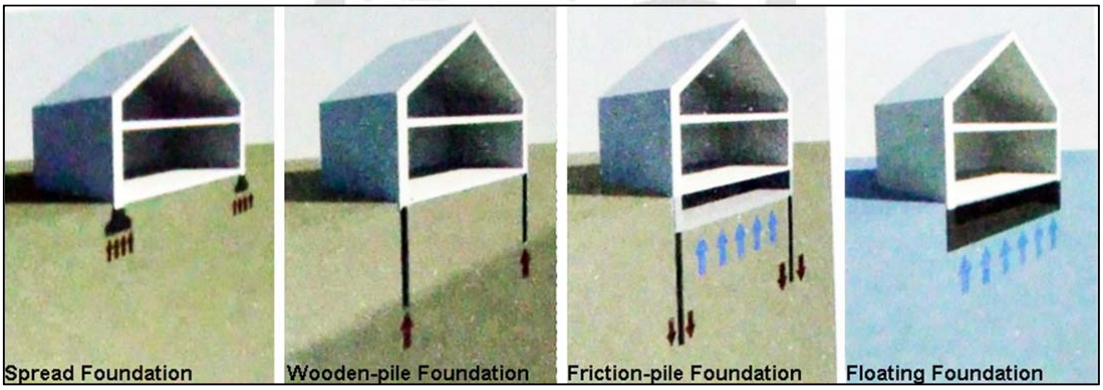

Figure 1.11 Diagrams of spread, wooden-pile, friction-pile, and floating foundation

Source: Olthuis & Keuning, 2010: p. 51

Water architecture emphasizes on the security and selects construction technique and material according to natural conditions. The ground base, water properties, and also, the maintenance of material need to be considered to ensure the building sustainability. It will be applied in the research to examine the construction and environment function of traditional water stilt house.

1.4.3 Study of traditional Malay architecture

As water stilt house and traditional Malay house have similarities to their building structure and materials, while the literature of local water stilt house is rare, it is particularly important to review Malay house's structure, spatial characteristic, and construction way as reference of water stilt house's spatial component.

I. Community scale concern on spatial pattern

The *Kampong* is Malay rural settlement which generally sustained by agricultural activities for example fishing and rice-growing. According to Lim (1987), some common features of its spatial characteristic including:

1) Random layout

The layout of a *kampong* is not apparently observed. Traditional Malay houses were randomly distributed and therefore appeared free-standing. The sites of house are traditionally selected by owner's observation and religious rituals. The space between houses is far to ensure further expansion of living area, privacy and planting.

2) Private and public space

The boundary between private and public spaces is hard to define as house compounds are usually open and unfenced and merging with public spaces. Another semi-private space is the open bottom of the raised floor acts as place for work, chat, and also storage.

3) Free-flowing path

The connection of houses is by free-flowing paths. The paths are not "designed" and "built" with particular intention but gradually generated due to the needs of accessibility. The shape of paths is not apparent to observe as many of them merge into open compounds of houses. Main roads are occasionally built for accessing from and to town.

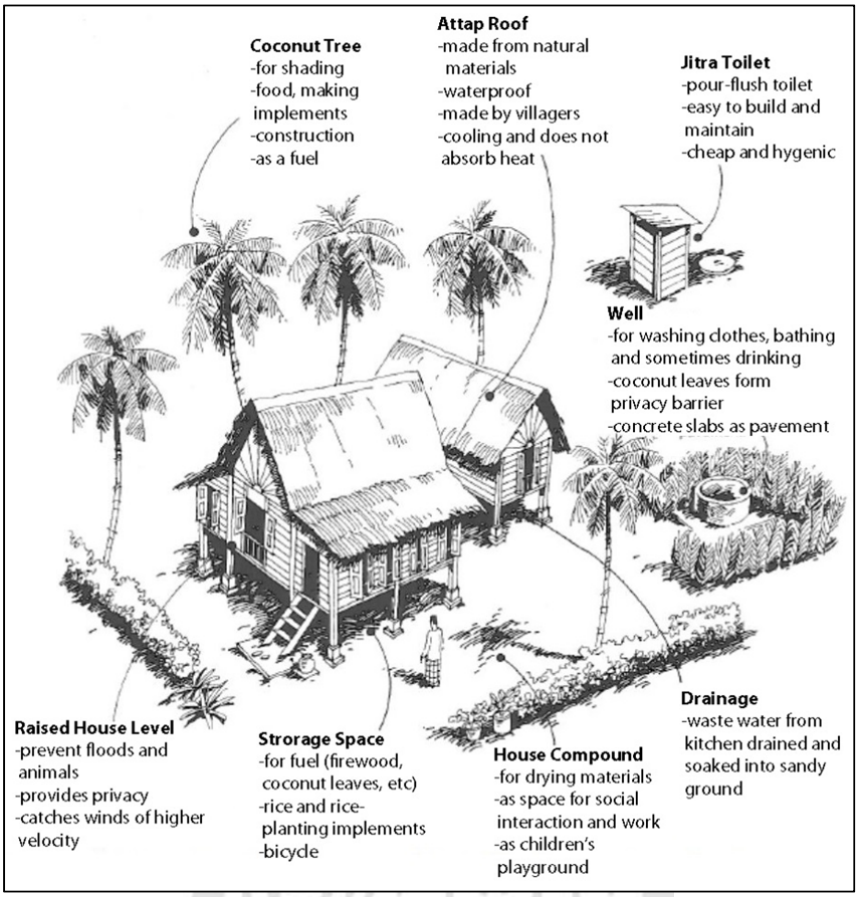

Figure 1.12 External environment of the Malay house

Source: Yuan, 1987

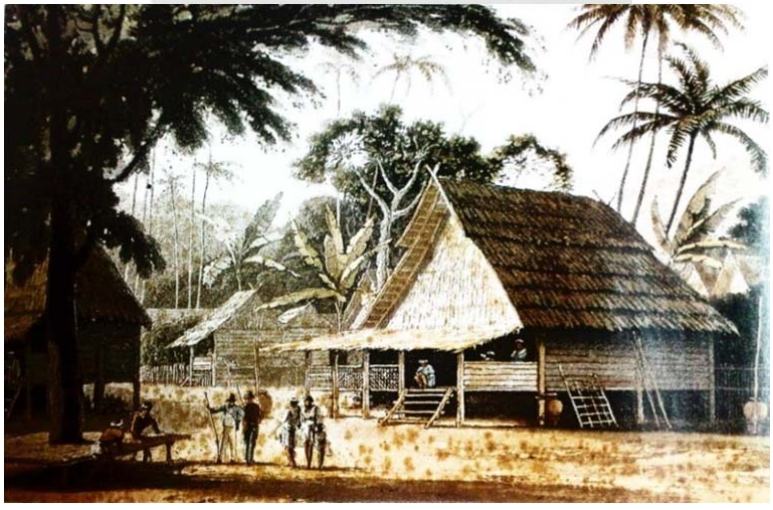

Figure 1.13 'A Malaye Village', drawn and engraved by T. & W. Daniell, 1810

Source: Moore, 2004: p. 27

II. Building scale concern on construction and materials

Traditional Malay houses are mainly classified by their roof shapes (Abidin, 1981; Lim, 1987; Nasir & Teh, 1996). There are *bumbung panjang* or gabled roof, *bumbung limas* or hipped roof, *bumbung potong perak* or gabled hip roof, and *bumbung meru 2-Tingkat* or 2-tiered pyramidal roof (Ismail, 2005) shown as Figure 1.14.

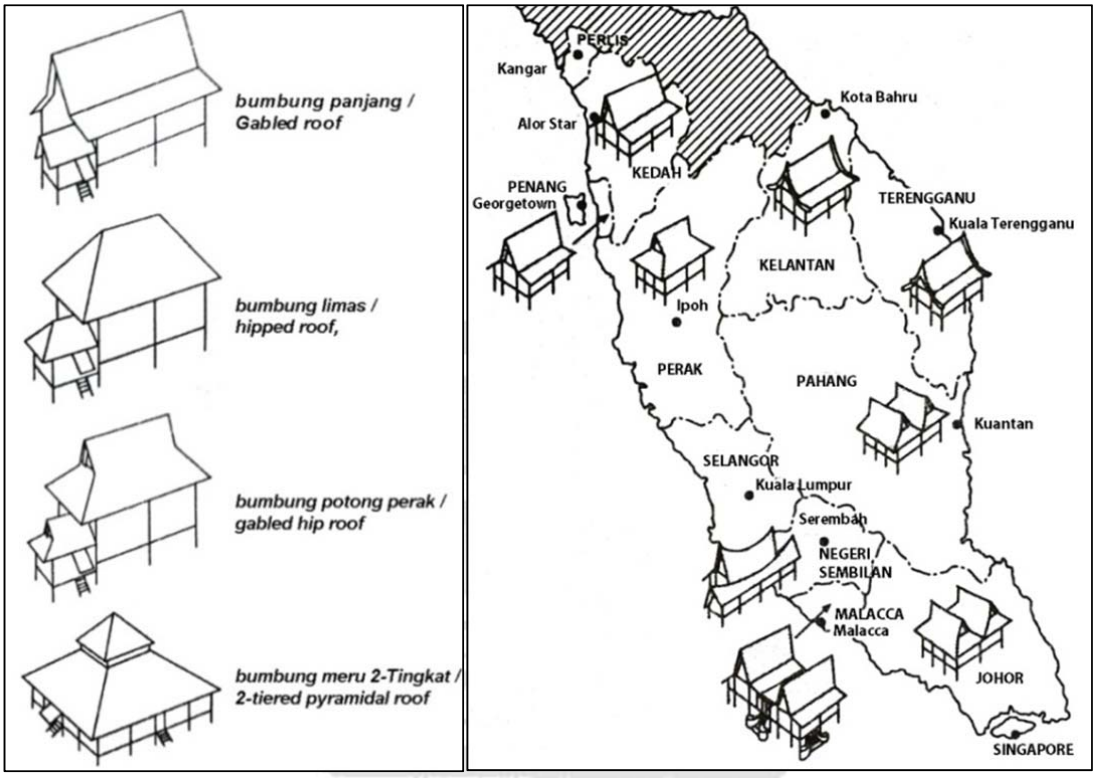

Figure 1.14 Type of Malay house and the distribution in Peninsular Malaysia

Source: Ismail, 2005: p.15&16

Typically, a traditional Malay house can be divided into several important components shown as Figure 1.15 and Table 1.2.

According to Nasir and Teh (1996), pillars, walls and roof are three main parts in traditional Malay house. The construction components are first made on the workshop and later assembled on the site. Various mortis and tenon, lap and dovetail joints are used in the construction. Wooden dowels were used and then replaced by nails. A pattern of additional construction shows the extension sequence and growing needs of the users (Figure 1.16).

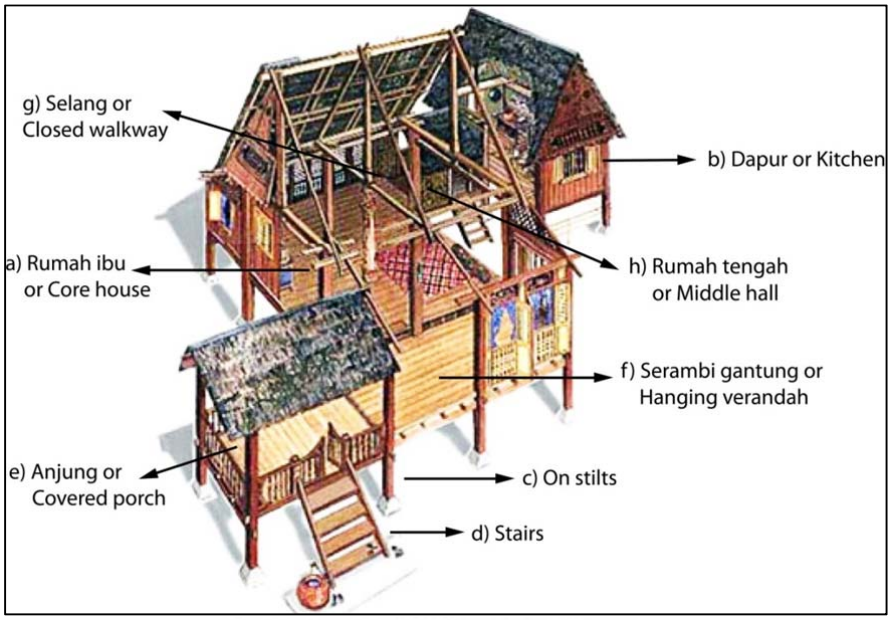

Figure 1.15 Diagram of basic components of traditional Malay house

Source: Chen, 1998: p. 20

Table 1.2 Basic components of traditional Malay house

Components	Description
a) *Rumah ibu* or Core house	▪ The largest area in the house where most activities are conducted. ▪ The importance of the *rumuh ibu* is expressed by its floor level being the highest in the house.
b) *Dapur* or Kitchen	▪ It is always situated at the back of the house, and is on the lowest floor level.
c) On stilts	▪ Raised floors to prevent floods and animals. ▪ Space under the house as a storage area for rearing animals or as a working area.
d) Stairs	▪ Located at entrance to lead up to a covered porch.
e) *Anjung* or Covered porch	▪ Acts as an important focal point for the entrance. ▪ Acts as a transition space between the public and the private domains. ▪ Unfamiliar visitors and guests are entertained here.
f) *Serambi gantung* or Hanging verandah	▪ The place where most guests are entertained. ▪ Low windows here allow for good ventilation and views to the exterior.

Components	Description
g) *Selang* or Closed walkway	▪ Use to link the kitchen and the *rumuh ibu*, which leaves an open space between these two portions, allowing good ventilation and lighting for the house. ▪ Used by the womenfolk as a space to chat and socialize.
h) *Rumah tengah* or Middle hall	▪ Intimate, private interior open space ▪ The wet core of the house where washing, drying and toilet areas ▪ Resting place, informal guests especially ladies, are entertained here.

Source: Lim, 1981: p. 76&77

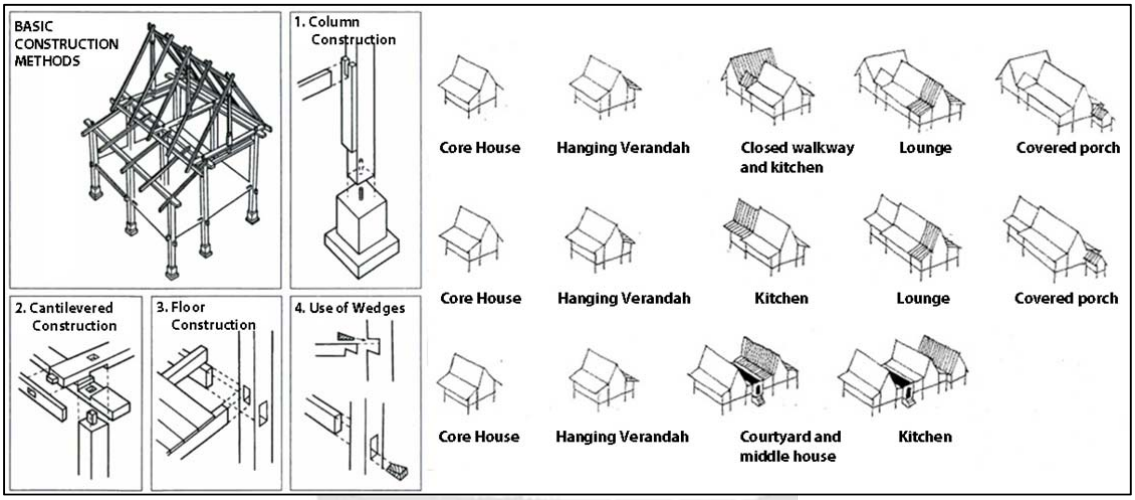

Figure 1.16 Basic construction methods and additional sequence of Malay house

Source: Ismail, 2005: p. 17

The materials used to build the houses are basically those found locally in the jungles. Timbers were used commonly for the pillars and basic structure, timber or bamboo for the wall and thatched roof.

1) Pillars: extremely good wood is used to support the weight of the house. The base of pillars was buried in the ground in early period. After then the pillars were given a foundation which usually made of wood or concrete.

2) Crossbeam: it served to secure the structural framework and made by wood.

3) Floor: made of wood from the *Ficus* plant species or from strips of the trunk of areca tree *(pinang*), or hollow bamboo about 5-6cm wide.

4) Open platform: made of *nibong* tree trunks split into halves and laid with slits in-between to allow water to drain.

5) Stairs: made of wooden poles. Dovetailed planning was done at the joints between the rungs and the banisters to prevent from slipping.

6) Walls: leaves were used normally from the *eugeissona trisis* tree (*bertam*), the *Baeckea frutescens* bush (*cucur attap*), the sago palm, *Metroxylon* (*rumbia*), and the *nipah* palm. There were also wattlework walls from bamboo strips or wickerwork walls from bamboo. Beside, walls made from the bark of trees and planks were also found.

7) Doors and windows: the door consists of two boards that usually open inwards. The window opening is usually latticed. Doors and windows have wooden frames.

8) Roof: it consists of a wooden framework and cover by variety materials: leaves from *Baeckia frutescens* (*attap cucuh*, a jungle palm), the sago palm (*attap rumbia*), and the *nipah* palm.

Literature review of traditional Malay architecture offers reference of pattern components that suitable to the observation of water settlement. Despite of the similarities between Malay house and water stilt house, the study concerns to the difference of their pattern too. It intends to verify the statement of former literature that water stilt house is in the category of traditional Malay architecture and will be discussed in details in chapter three.

1.4.4 Study of resilience and adaptation on coastal area

The challenge of coastal settlement is not only to face potential risk of climate change but also continuous impact generated from tidal cycle and coastal erosion. Hence, policy to reduce vulnerability should not only focus on climate change adaptation but to design comprehensive plan towards resilient community. In this section, the review to adaptation and resilience intends to understand the complexity of policy making and the factors to be considered confronting risks. Besides, risks occur on Kukup settlement is also the primary concern of the review.

I. Significant of local measures to resilience and adaptation

Concern to climate change adaptation is usually a global perspective. The focus on the implementation on community scope only entered the local government agenda in the past 10 years. During the United Nations Johannesburg Summit in 2002—the World Summit on Sustainable Development (WSSD)—the international community came to realize that a sustainable city must be a resilient city.

Resilience is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2009). Crisis and disasters impose significant threats to sustainability and have the power to affect society, the environment, and economy. The capacity of a city to respond 'creatively, preventively and proactively to change or extreme events, thus mitigating crisis or disaster', is to be resilient (ICLEI-Local Governments for Sustainability, 2002).

Hence, resilience goes beyond addressing only climate impacts and overcomes the only risk-oriented approach of disaster risk reduction which is more than successful climate change adaptation. It emphasizes the preparedness to extreme events, reduced vulnerability, and enhanced adaptive capacity. The concept of resilience, as a development approach, is able to address the complexity and the inter-linkages of challenges confronting local governments in cities of both developed and developing countries.

In effect, ICLEI's Resilient Communities and Cities Initiative was launched at the Local Government Session of the WSSD in 2002 to help local actors develop and implement local resilience agendas.

The initial definition of resilience was applied most frequently to the literature on disasters, whereby local governments and disaster management communities recognized that building resilience to disasters was a crucial element in creating sustainable cities. Recent attempts to define and apply resilience have occurred against a build-up of ongoing debate on the readiness of our cities to effectively cope with the impacts of climate change. As such, there grew a common understanding among experts that cities need to improve their resilience to climate change impacts (e.g. ICLEI's Climate Resilience Communities

Program[11]). In turn, local governments are currently searching for tools to help protect their communities from the impacts and costs associated with climate change. This essential capacity can be described as *'local resilience'* (ICLEI, 2004).

The occurrence of climate change and natural disasters and the responses necessary for its management are inherently local. While policies for climate change mitigation and adaptation and for disaster prevention require national attention, effective action towards more resilient cities must be local and responsive to specific local conditions (Otto-Zimmermann, 2012). There is a strong need for greater attention to locally based efforts to reduce vulnerability and increase the resilience of local systems and institutions to climate change, crisis and possible disasters. Furthermore, as the risks and impacts of climate change disproportionally affect the most vulnerable in our society (e.g. elderly, urban poor, children, and women), social and economic concerns must be at the forefront of resilience thinking.

Although city officials are increasingly more aware of this, the majority are still implementing measures aimed at coping with the impacts of climate change with a reactive rather than preventative approach due to constrain when trying to implement adaptation measures. These include insufficient funding, lack of coordination at different levels of governance, difficulty in building and conducting effective participatory processes with stakeholders, limited availability of knowledge and its limited exchange between actors and between cities, insufficient vertical and horizontal integration of instruments (Bucx, 2010), and lack of linkage between adaptation measures and local knowledge potentials(Otto-Zimmermann, 2012). In response to it, this study advocates to explore a grassroots, community-led response to climate change.

[11] ICLEI is an organization that facilitates local government input to United Nations (UN), processes such as the UN Framework Conventions on Climate Change, and Biodiversity. In partnership with the UN and other organizations, as well as national governments, ICLEI puts in the groundwork for more ambitious and more responsible international commitments - and seeks global recognition and support for local action (ICLEI, 2004).

II. Local perception in adapting coastal environment

Adaptation to coastal environment is a continuous progress to water settlement. It is just the great concern towards climate change that highlights the vulnerability and risks of coastal settlement. The environment accompanying by regular tidal impact and changing quality of ground has shaped local perception to live on water far beyond climate change concern. It should not be neglected in policy making of resilience and adaptation especially when the settlement is generally built by grass roots' efforts and measures without much intervention of the authority.

Local perception is developed highly depend on the life experience in the specific environment and its measures adopted. According to Newell et al.(2005), one of the principal challenges in urban study of human–environment systems is to understand the interactions between phenomena that occur at different temporal and spatial scales. For this the Layer model developed by Bucx (2010) is suited since it combines the spatial scale of each of the layer with the vertical differentiation in temporal dynamics. Each of the layers can be represented in map form, or as overlays in a GIS, enabling spatial analyses. Applied on spatial pattern development, it helps the study notice the influence of human-environment interaction at different spatial scales presented in temporal dynamics.

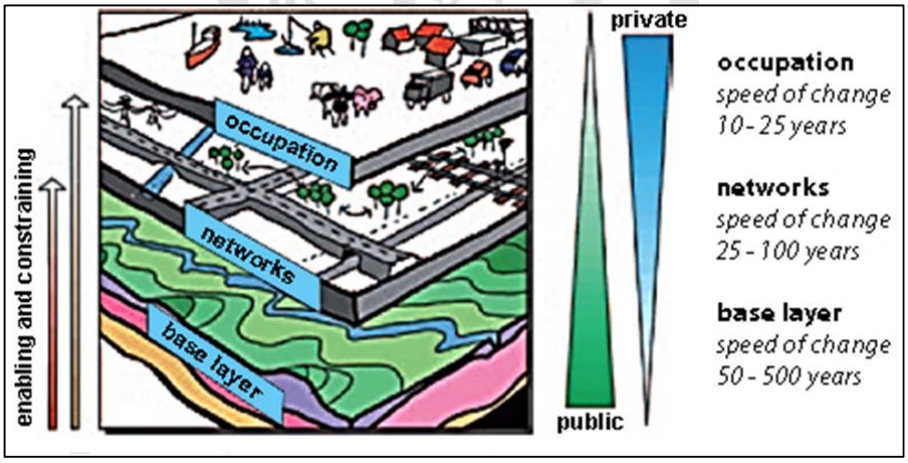

Figure 1.17 Layer model combines spatial scale with vertical differentiation in temporal dynamics

Source: Bucx, 2010

To approach more resilience and sustainable development, a clear vision has to be developed on how to respond to the various drivers of change as well as on how to play along with the trends in society. Using the Layer model as a starting point, it becomes clear that there are three main response themes on which coastal management could focus, i.e. the development and adaptation of land and water use (occupation layer), the extension and revitalization of infrastructure (network layer) and the management and restoration of natural systems (base layer). Regarding the base layer, it should be noted that in the case study of water settlement especially the sediment dynamics (balance) between sea, river and hinterland is important.

III. Vulnerability of Malaysia to coastal impact

Malaysia covers an area of 329,750 square kilometers with a coastline of 4809 kilometers and inhabitants over 60% of the population. Most of the coastline is beaches or mangrove fringed. According to Ong (2000), there is approximately 30% of the coastline subject to varying degrees of erosion that may contribute to variation of a few millimeters per annum to coastal sedimentations rates (in protected areas). Confronting the erosion, large area of coast, especially mangroves covered, have been pumped in sand to reach above sea level to prevent saline or tidal intrusion.

From MOSTE (2000) and DID (2007), Malaysia sea level has risen at an average rate of 1.25 mm/year over 1986 to 2006. The findings are signals to show that Malaysia coastal system might be vulnerable to sea level rise. Meanwhile, the sedimentation rate which appears to be playing a critical role in relative sea level change in Malaysia is in the region of a few millimeters per year.

Sea level rise is partly a natural phenomenon. The impacts of sea level rise would be expected particularly on Malaysia coastal systems. Greater strength and intensity of waves is a threat to beaches' existence at the same time increase coastal erosion and inundation. Flooding risk, defined as the probability of flooding multiplied by the potential consequences, such as economic damage or loss of lives (Smith, 1994), accompanied by land subsidence and erosion makes the condition worse especially to human community where the western low plains of muddy sediment, about 12 percent of Peninsular Malaysia's flood prone area, are home to 2.5 million people (Ong, 2000).

Using altimeter data from year 1993 to 2008, it revealed that the mean sea level in Malaysian Seas has been rising at a rate of between 1.42 to 4.08 mm/year (Md. Din & Mohd. Omar, 2009). Taking the average of the west coast peninsular group of 6 tide gauge stations, it shows that the relative sea level trend in this group is about 2.02 mm/year and the highest rising trend of 3.02 mm/year is at Kukup.

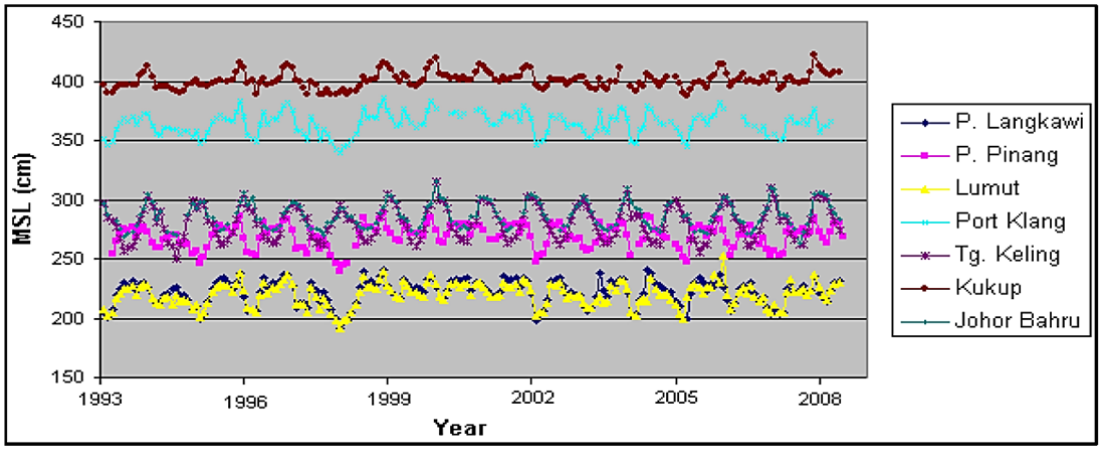

Figure 1.18 Monthly mean sea levels for tide gauge stations in West Coast PM

Source: Md. Din & Mohd. Omar, 2009

Table 1.3 Sea Level Rise of Malaysia at Tide Gauges

Location of Tide Gauge		Linear Trend (mm/yr)	Data Used
West Coast Peninsular	P. Langkawi	1.21	1993 - 2008
	P. Pinang	1.78	
	Lumut	2.34	
	Port Klang	2.25	
	Tg. Keling	1.37	
	Kukup	3.02	
	Johor Bahru	2.17	
East Coast Peninsular	Tg. Sedili	1.83	
	P. Tioman	2.36	
	Tg. Gelang	2.64	
	Chendering	3.20	
	Geting	1.73	

Source: Department of Survey and Mapping Malaysia (JUPEM), 2008

Using down-scaled regional climate and hydro-climate models, projections of future climate are made as shown in

Table **1.4**:

Table 1.4 Observed and projected climate change in Malaysia

	Observed	**Projected (by 2050)**
Temperature	0.6-1.2˚C per 50 years (1969-2009)	1.5-2˚C increase
Rainfall	No appreciable difference	• (-) 5% to (+) 9% change in region within Peninsular Malaysia • (-) 6% to (+) 11% change in region within Sabah and Sarawak
Rainfall Intensity	Increased by 17% for 1 hour duration and 29% for 3 hours duration (2000-2007 compared to 1971-1980)	• Increase in extremes within wet cycles • Increase in frequency of extreme weather
Sea Level Rise (SLR)	1.3 mm/yr (1986-2006, Tanjung Piai, Johor)	0.5 m (global high worst case at 10 mm/yr)

Source: NRE, 2011: page xxi

Effective coastal hazard management relies on concrete action of inhabitants. Therefore research in tidal hazards should also include the study of people's perceptions and assessments of their adaptive and proactive capacities (Muh et al., 2008). However, the policy making and implementation is usually difficult to involve local actors.

While examining high vulnerability of Kukup coast, the settlement granted land ownership from the state government on 2012 for the reason of economic value. It reveals the truth that climate change adaptation on local community is usually a conflict between different benefit groups including not only public and private actors, but also different levels of governmental sector. Hence, it is crucial to identify local perception of coastal adaptation and hazard risk in order to effectively implement the policy without sacrifice the essential living safety of the residents.

Table 1.5 Summary of Literature Review

	Year	Author	Topic	Review Content
Settlement Spatial Development	1977	Christopher Alexander et al.	A Pattern Language	The interpretation of "pattern" and the spatial components to be observed at different spatial scales
	1994	A.E.J. Morris	History of Urban Form	The determinants of forming space.
	1994	Hsia, Chu-Joe	Public Space [in Chinese]	The analysis and description to the interaction between space, culture and community.
	2006	Lin, Ying-Hua	A Study of Street Fabrics of the Traditional Towns in Taiwan [in Chinese]	Describe various type of traditional spatial texture and support this paper to verify the concept of spatial and architectural form.
	2009	Yang, Wen-Yun	A research on the trans-formation of spatial texture and architectural form of military dependents' village: a case study of Lyufong East Village, Tainan city [in Chinese]	Analysis model to traditional settlement's spatial and architectural form in case of lacking basic map data. Interpretation of spatial texture, community space and street function in aspects of community interactive activities.
Study of water settlement	2002	David C. F. Leung	Rebuilding Community Spirit: Developing a Communal Reconstruction Strategy in the Village of Tai-O, Hong Kong	Through analyzing village's religious, community values and needs, it proposed a phased reconstruction strategy fit to different needs and flexible expansions sequence in hope to strengthen community spirit through re-enacting traditional building rituals.
	2010	Ahmad Sanusi Hassan	Review on Old City Landscape with Reference to Traditional Fishing Village Settlements in Western Coastal Region, Peninsular Malaysia	Literature review to traditional old port cities and fishing villages in Malaysia; Analyze and compare water settlements' zoning systems. Determine five types of settlement patterns of fishing villages in Malaysia, which are inland water village, outward water village, parallel water village, water village and river mouth water village.
	2010	Koen & David	Float! : Building on water to combat urban congestion and climate change	Introduction to the trend and necessity to water architecture development due to climate change. Summarize technical knowledge about structure and material to build on water.
	2011	Chan, Ngai-Weng	Challenges in developing clan jetties as heritage attractions for conservation and tourism in Penang, Malaysia	Discuss the uniqueness of spatial pattern and the issues of water village that may destroy the pattern during urban development.
	2013	Ng, Veronica	Toward a holistic understanding of sense of place: a phenomenological reading of Chew Jetty, Penang	Identify water village's sense of space derives from the pattern of road and routes, intercourse with human activity and the way this space be used

	Year	Author	Topic	Review Content
Study of traditional Malay architecture	1981	Wan B. B. Wan Abidin	The Malay House: Rationale and Change	Analyze Malay house physical, spatial and functional elements and the variations that these elements exhibit. Make up underlying principles or rules for reconstruction of the house.
	1981	Lim Jee Yuan	The Malay House: Rediscovering Malaysia's Indigenous Shelter System	Investigate the components of Malay house from the building structure, interior and exterior environment, culture and customs beneath the architecture.
	1984	Wan Burhanuddin	The Malay House: Learning from its elements, rules and changes	Definition of Malay house from summary to former interpretation. Analyze Malay house structure components with case study of Pontian district where the settlement was adjacent to this research case.
	1996	Nasir & Teh	The Traditional Malay house	In effort to preserve the heritage, it introduced the concept, structure and function of traditional Malay house and classified the house-types by the roof shape.
	2005	Wan Hashimah Wan Ismail	Houses in Malaysia: fusion of the East and the West	Introduction how Malay house suit to local history, geography and climate. Analysis house's design concept, spatial organization, building forms, materials and climatic control.
	2005	Mohamad Tajuddin Haji Mohamad Rasdi	The Architectural Heritage of the Malay World: The Traditional Houses	Classification and preservation of traditional Malay house. Description to various types of Malay house using case study in Peninsula Malaysia.
Adaptation and local resilience	2004	ICLEI	Resilient Communities and Cities Partnership Program proposal	Definition of resilience and significant accompanying by climate change adaptation.
	2008	Muh, A. M. et al	The impact of tidal flooding on a coastal community in Semarang, Indonesia	The examination of local perception to tidal flooding and the local adaptive measures development. The problem occurring while the government neglecting local participatory in climate change adaptation
	2009	Md. Din and Mohd. Omar	Sea level change in the Malaysian seas from multi-satellite altimeter data	Provide multi-satellite data of sea level rise trend in Malaysia including the tide gauge station of Kukup.
	2010	Bucx, T.	Comparative Assessment of the Vulnerability and Resilience of 10 Deltas: Synthesis Report	Introduce the Layar model which combines the spatial scale of each of the layer with the vertical differentiation in temporal dynamics.
	2012	Aerts, J. C. J. H.	Climate Adaptation and Flood Risk in Coastal Cities	Introduce the current measures and experiment to coastal cities' adaptation while stressing on local implementation.
	2012	Otto-Zimmermann, K.	Resilient Cities 2: Cities and Adaptation to Climate Change - Proceedings of the Global Forum 2011	Declaring the assessment of climate change impact has to include the social and economic aspect which especially important to the adaptive capacity of social minority.

Source: summarized by the study

1.5 Research Design

1.5.1 Hypothesis

1) An organic-growth settlement has unique and distinct pattern that shaped by grassroots' perception and their long-established practice on space.

2) Environment and human activities are two essential factors to shape spatial pattern and the change of factor itself direct to the change of spatial pattern.

3) The interaction between natural environment and spatial pattern is a continuous process.

1.5.2 Restrains

1) Lack of related research to Kukup villages and traditional water settlement

Wide fields of literature have been reviewed but failed to build up diverse research perspectives to Kukup villages and traditional water settlement' spatial development and resilience topics. Hence, the study refers to some similar spatial structure and focuses on first hand data collection to understand the spatial pattern using the general structure of spatial units.

2) Disappearing building types and building material

Most of the earliest buildings and man-made space have been replaced by modern building material and technique in result of modernization and difficulty to obtain original material. So the restoration of the building types will be demonstrated by graphic model with guidance of the villagers and ancient graphics to ensure as accurate as possible the final display.

3) Difficulty to accurately define geographical scope

Exact location of some reconstruction and alterations in earliest times is hard to verify due to unavailable maps data. However, the highly enclosure of settlement and the topographic constrain of natural environment made the spatial development less complicated. And so the study sets the time scope in consideration of available maps data

in attempt to ensure the maximum accuracy and restore the condition with the supplement of historical photos and interviews.

4) Less diversity of interviewees

The interviewees were basically the leaders and elders, who are mostly males, and better speakers of Han dialect among the villages. It may cause the analytical result unable to present comprehensive perspective of the settlement's ethnic and different benefit groups. Also, it can be found that due to the intimate relationship and careless accuracy concern, they do not usually point out the errors or misunderstanding of each other during group interviews. Thus, the field research highly refers to observation, official data, historical records and photos to compare the interview content to possible error. By comparing interview content occurred in different groups, the interviews to some reliable individuals is conducted accompanied by 3D demonstration and photos to clarify contradictory statements.

1.5.3 Method

This research uses case study of Kukup villages to identify spatial pattern of traditional water settlement in adapting coastal environment. According to Muir (2008), case studies are used widely in urban studies as the benefit of the spatial focus, the emphasis on real-life context, the experience of multiple perspectives on the case, and the depth and richness of data that can be obtained. Nevertheless, case studies have arguably the potential disadvantages of generalizability which aims to fix into theoretical prepositions (Yin, 2003) and affects case study selection(Schofield, 1990).

Case study is considered suitable for this research mainly because of the emphasis on real-life context. Real-life context is important aspect to examine comprehensive status of water settlement, where the village is built by the locals with little intervention of state authority and policy. Using case study, it can be studied and examined in depth the similarity and difference through comparison of two water settlements to improve the validity of research application.

Literature review is insufficient to support analytical base of this work due to the lack of relevant research to Malaysia or Kukup water settlement. Hence, as many and detailed the primary data collect as possible in this study field is important to contribute to

the future research resource. In consideration to build up comprehensive background information, this research emphasizes on first-hand data collection through field research and interviews to villagers. The research design is shown as Figure 1.19 which includes:

1) Historical records and map data collect

Data collection includes graphics and written record of old buildings and important living space to trace the village's development. According to the data obtained, time scope is designed into two significant phases to observe pattern development. The first available accurate map obtained from Department of Survey and Mapping Malaysia (JUPEM) was by 1990. The distribution of villages before and after 1970 will be traced back according to the map of 1990 accompanied by some panoramic graphics and the guidance of the locals. It sets temples and road sequence to trace the distribution because they are the important activity places for the villagers and have accurate establishment year in record. The significant construction and activity space will be marked on the map to present the spatial development in different time phases. It will be applied to build up basic understanding to the site's background as well as observe the correlation between the villages' distribution and water environment.

2) Literature review

Review to literature of spatial development including spatial form and pattern which suitable to the condition of Kukup water villages. The review supports this research by providing reference of components to observe spatial pattern. The study to traditional water stilt house is inadequate. Corresponding to this situation, the study reviews foreign case study of water stilt house and traditional Malay house in spatial structure. The concern of resilience and adaptation on Malaysia coastal area are also be reviewed.

3) Field observation

Field observation is to identify and record activity in the village, the frequency and where it takes place. It takes note to real-life intercourse between inhabitant, between inhabitants and environment, and between inhabitants and visitor/outsider/authority. Besides, the characteristics of building, street and public space are major object to observe. As the villages' exclusiveness is high, field observation is conducted not only in consideration of recording in-depth data but also creates chance that under informal

circumstance for initial intercourse between researcher and inhabitants to introduce her intention and increase familiarity.

4) Interviews

Unstructured interviews, group interviews and individual interviews are conducted. As the villages' exclusiveness is high, unstructured interviews create chance that under informal circumstance for initial intercourse between researcher and inhabitants to introduce her intention and increase familiarity. Besides, it helps researcher collect basic information of the interviewees including their background, characteristic, relationship with other inhabitants, culture and language, etc. in order to select appropriate candidates in presenting diverse position for further interviews. Group interviews are then conducted with designed topics included village forming history, spatial development, construction method, village activities, hazards and risk, etc. It helps collect large amount of information through open answer discussion and also to discover some helpful and reliable individual who then become important support to examine the accuracy of data. The data obtained from field observation and interviews is then combined and compared. At the time, individual interview is conducted with reliable interviewees accompanied by graphic model to revise vague and error part. The examination steps of revising and displaying graphics model are iterated until confirm for rigorous approach.

5) Model draw and analysis

Final results evaluate how the geographical location and surrounding natural condition affects the development. It will be displayed by 3D model drawing to describe the transformation and characteristic of spatial pattern and how it reflects local perception of adapting environment change.

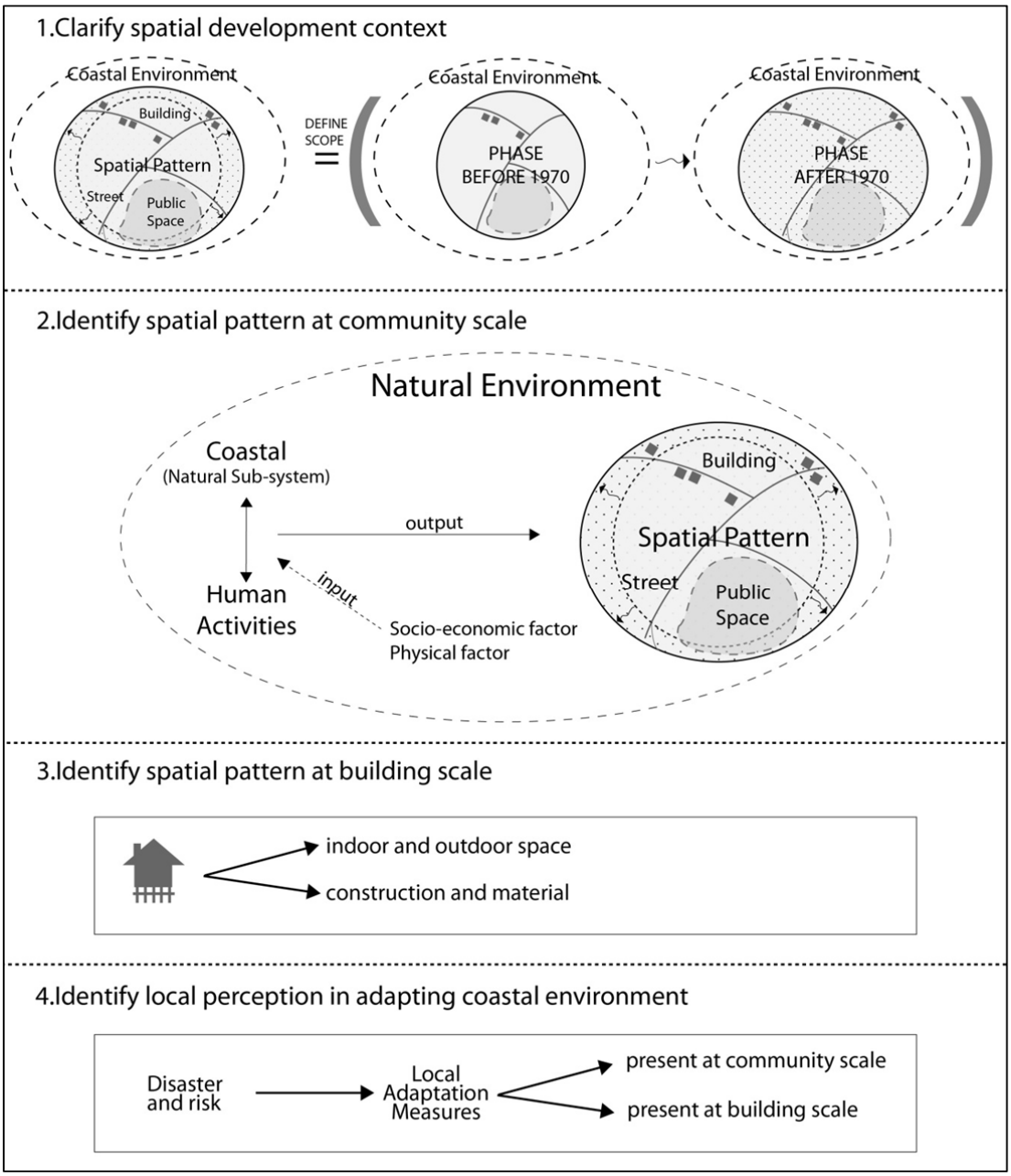

Figure 1.19 Diagram of Research Design

Source: illustrated by the study

1.6 Research Process

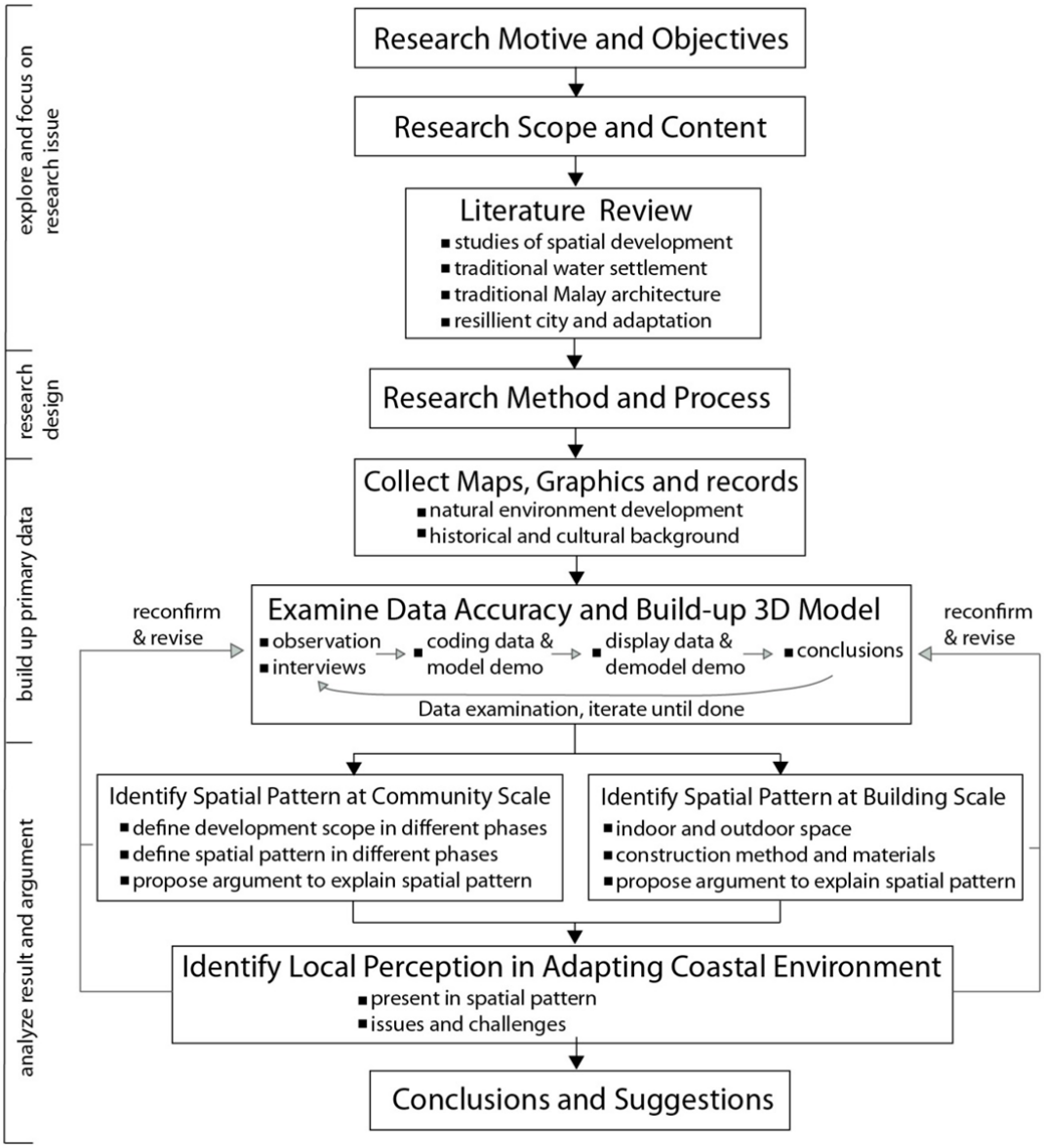

Figure 1.20 Research Process

Chapter 2 Spatial Pattern at Community Scale

Water settlement in Malaysia is common. However, due to illegal or unofficial position and the difficulty to access from the land, they were generally neglected in the study of urban planning. Using the case study of Kukup water settlement, this research explores spatial pattern development in hope to build reference for further spatial study to water settlement.

This chapter is organized into four parts. The first part introduces the forming determinants of Kukup water villages. The second part, applying to the designed phases before and after 1970, introduces the overall community layout to identify the development and transformation of spatial pattern, which helps identify general characteristic and the components of spatial pattern. The third part is to introduce the characteristic of spatial structures including building, street and public space within the pattern. Finally, the fourth part records community's perception in adapting coastal environment that applied on spatial pattern.

2.1 Introduction to Kukup water settlement

2.1.1 The forming background

Kukup water settlement includes two villages: Kukup Laut water village and Ayer Masin water village. It is surrounded by mangrove wetlands from inland and island (Figure 2.1) and exists as low-lying land (Figure 2.2 and Figure 2.3). The island of Kukup national park is 1 kilometer offshore from Kukup settlement. It is one of the largest uninhabited mangroves in the world and is entirely covered by mangroves and mudflats. The area of the island is 6.472 square kilometers and is surrounded by 8 square kilometers of mudflats.

As for Kukup transportation, it is located in the district of Pontian, state of Johor and is situated approximately 16 kilometers in the south of Pontian city center. It is linked by Kukup Road (Jalan Kukup), the south of main traffic route 95 junction heading to Kukup from Pontian.

The land use regulation of Pontian (Figure 2.4) shows that the zoning of Kukup settlement is in commercial zone where the important supply source of fishery and its

leisure facilities supporting the 1kilometers away natural reserve land Kukup Island National Park.

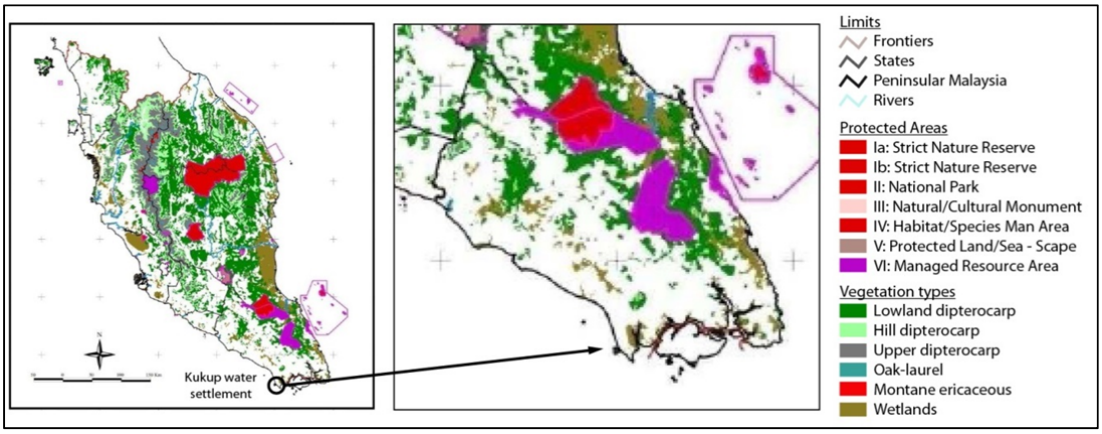

Figure 2.1 Protected area system in Peninsular Malaysia

Source: Ministry of Natural Resources and Environment, 2007

Figure 2.2 Terrain of Pontian district

Source: Google maps, 2014

Figure 2.3 Terrain of Kukup water settlement

Source: Google maps, 2014

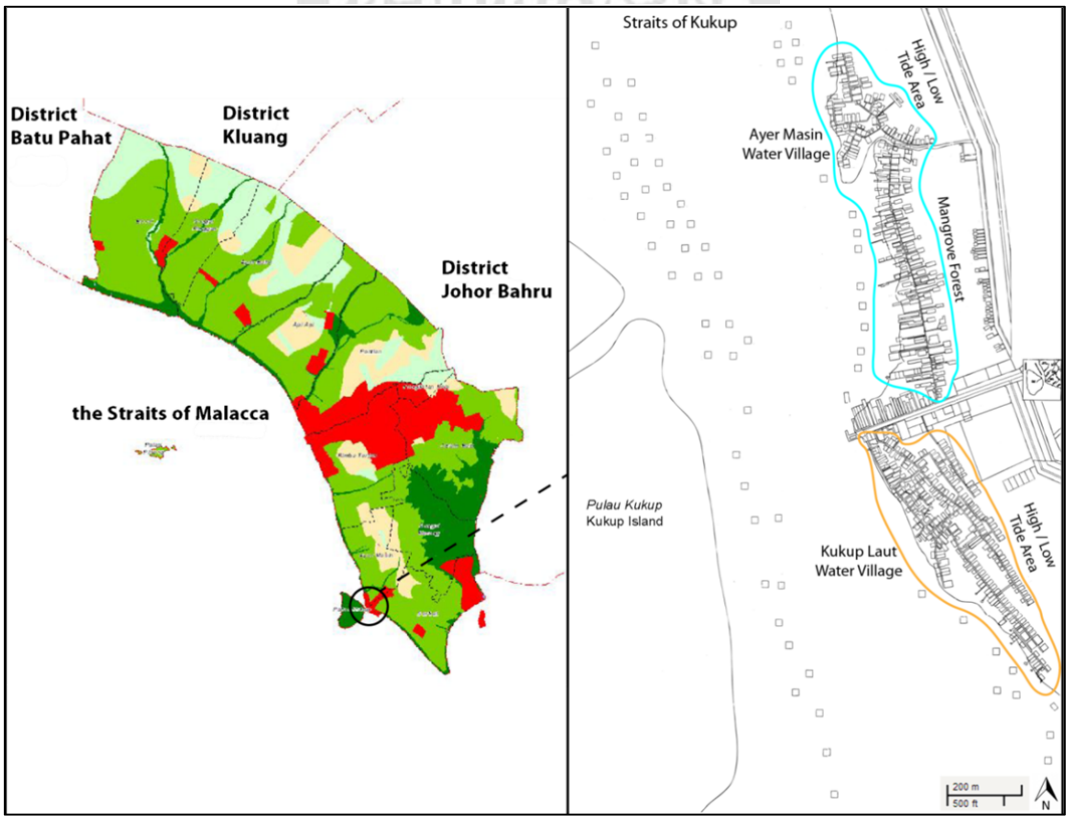

Figure 2.4 Land use of Pontian and location of case study

Source: Pontian District Council (left); JUPEM

According to oral history, the settlement was set up on 1860s. Kukup Laut was formed first and later Ayer Masin. A wide-accepted explanation to its forming background is came from Kadir (1955). The topographic advantage of the Straits of Kukup to be naturally sheltered by Kukup Island had largely weakened waves and winds from the Strait of Malacca. Based on the strategic location and naturally formed haven, the Straits of Kukup attracted sea pirates and travelers especially from Malacca and Temasek (former name of Singapore). However, the travelers who encountered storms and seek shelter usually faced pirates' threat of robbery and kidnap. Hence, people called the place *Telukup* (*telungkup*, means overturn), to express the fear of boat capsizing in the risk of encountering pirates[12]. The name *Telukup* was later evolved to *Kukub* and then the current name *Kukup.*

The position of Kukup was increasingly important since an Tamasek Arab Syed Muhammad bin Ahmad Alsagoff (known also as Nong Chik) had obtained the approval of the Sultan of Johor to develop the Southwest Coast of Johor on 1878 (Said, 1977). Harbor and jetties were gradually built and also the administration office. Kukup became more and more prosperous and attracted the Chinese immigrants travelled by the sea to settle down.

The district was originally centered by Kukup and named Kukup District until road system from Pontian to state capital Johor Bahru constructed by 1900, followed by the construction from Pontian to Kukup by 1910s. The completion of regional road system raised the importance of Pontian's location and the district administration office then moved to Pontian. Kukup District was renamed to Pontian District by 1921 (MDP, 2013).

Despite the social-economic contribution of Kukup settlement, it had had treated as illegal settlement due to its location on sea. The situation was just recently solved when official land grant on 2012 (NST, 2012). The settlement has always been self-governed by the villagers without intervention of government or legislation power and thus shaped a unique spatial pattern by grass roots' measures while attempts to adapt environment change.

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[12] There were other two versions about the name of Kukup. One stated that it came from the Malacca people who attempted to use sea route to escape from the ruling of Dutch from 1819 to 1824. They called the Strait "telutup" due to fear. Another statement claimed that the name came from "kukub", which means "stars" in Arabic and related to the Islam religion.

2.1.2 The form determinants

A settlement is the result of locally effective determinants. From this viewpoint, the research analyzes the determinants of two different origins:

1) Natural world determinants which derive from geographical 'natural-world' attributes of the location of a settlement:

a. Topography: The terrain on which a settlement became established or over which it expanded, could have an underlying effect not only on geographical extent, but also on direction of growth. The settlement was built along the coast which surrounding by swampy mangrove forest and mudflats. It was built in the shadow of Kukup Island that acts as the shelter of tidal waves and winds and become the critical factor to forming settlement. Meanwhile, the drinking water source was accessible at nearby locations brought another advantage to form settlement. In the case of Kukup Laut, the village generated parallel to the contour of the coast. In the case of Ayer Masin, the village origin occurred at both sides of the river banks and then gradually heading to the center of the sheltered shadow.

b. Climate: Shelter has been a fundamental human need, of varying significance and taking different forms depending on local climatic circumstances. Natural-climate-response shelter plays fundamental role due to its effect on the formation and arrangement of houses. The location in between the sea and mangrove forest makes the place an ideal site for the settlement due to well ventilation and rainfall. On the other hand, climatic and natural disaster adjustment towards land erosion and subsidence has facilitated direction of settlement growth. It will be described in next section. The roof shape, stilt structure and windows are also concrete response to the climate and will be discussed in details in Chapter 3.

c. Available construction materials: In history, there was no alternative for settlement but to use local materials due to the constraint of transportation and construction technology. Thus, the availability to construction materials is essential to formation of settlement. In the case of Kukup settlement, the materials were from the surroundings mangrove forests. Mangrove timber has the advantage to adapt saline water, meanwhile it is not conducive to apply when exposed to air. It provided the chance to the settlement be built on the sea, and only on the sea.

Figure 2.5 Kukup settlements in 1940s

Source: unattributed online

(2) Man-made determinants: The man-made determinants are various comparative to natural world determinants. The amount of man-made determinants has continued to increase followed the evolvement of urban societies and technologies. Major determinants that brought formative influence to Kukup settlement were:

a. Economic: Kukup was previously one of the most important agricultural and commercial area in late of eighteenth century. The economic advantage contributed the place with better infrastructure and attracted people to settle down. Furthermore, the concern to occupy strategic location in order to access to sea is far more important to fishery rather than inland access. It was considered more attractive to build settlement on sea.

b. Mobility: Sea route was the major transportation in earlier centuries. The strategic location between Temasek and Malacca as well as the calm waters originally made it as rest stop of travelers and gradually the settlers.

c. Ethnic of settler: The immigrants were originally from Tong'an and Kinmen, where are located along the sea. The location of Kukup is similar to their native land and allowed them to conduct familiar livelihoods that made the place ideal for them to settle down.

2.2 The development of spatial pattern

Spatial pattern of Kukup water settlement is described in two designed phases to identify the development: (a) the phase before 1970; (b) the phase after 1970. Through the investigation of two phases' spatial pattern, the study analyzes the cause of spatial pattern development and transformation. The development is identified at community scale, combines spatial structure of each of the layer: buildings, street and public space, with the vertical differentiation in temporal dynamics.

1) The phase before 1970

a. Kukup Laut Fishing Village: it was originally built nearby the port and also the center of sheltered shadow of Kukup Island. It can be found that the topographic contour of coast is major factor to shape the pattern. It had gradually developed from the center towards direction of south. The house are built as outwards to sea as possible for boat access. After the village path constructed to connect Kukup Road, the development tended to gather in clustered pattern and shaped current state of dense and random distribution.

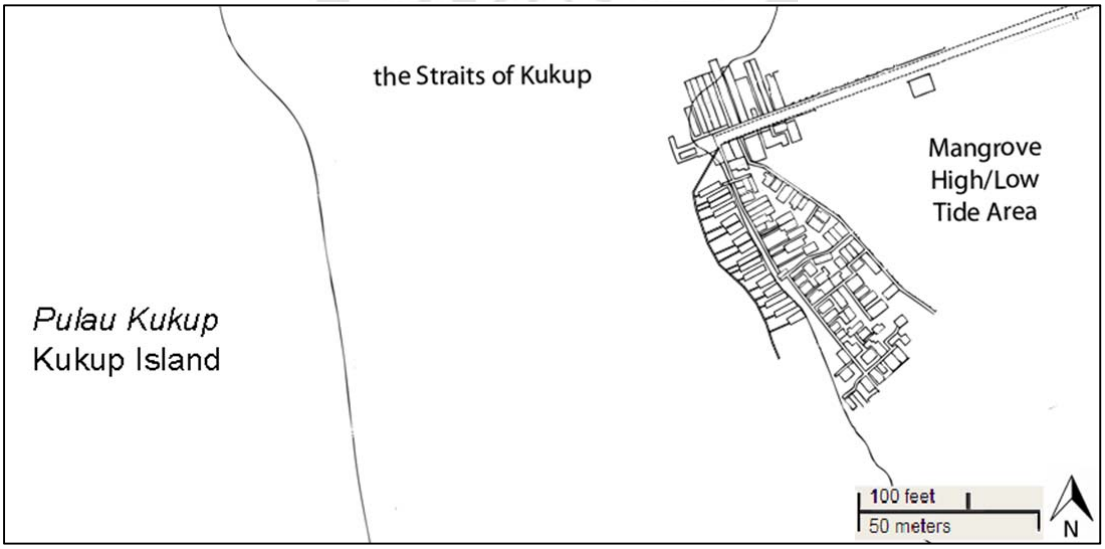


Figure 2.6 Layout of Kukup Laut fishing village before 1970

Source: JUPEM

Figure 2.7 Paranomic image of Kukup Laut fishing village in 1970

Source: personal communication, 2012

b. Ayer Masin Fishing Village: it was originally built along both sides of the estuary of Permas River (Sungai Permas) from west to east. It tended to gather along river mouth for sea access and boat parking. The pattern is in clustered random distribution. The riverbank contour shaped the original pattern of the village growth until the construction of village path on the 1950s to connect Kukup Road under the pressure of post-War government for the reason of territory control. The construction brought adjustment to the spatial pattern by starting to grow along the path and towards south to Kukup Road.

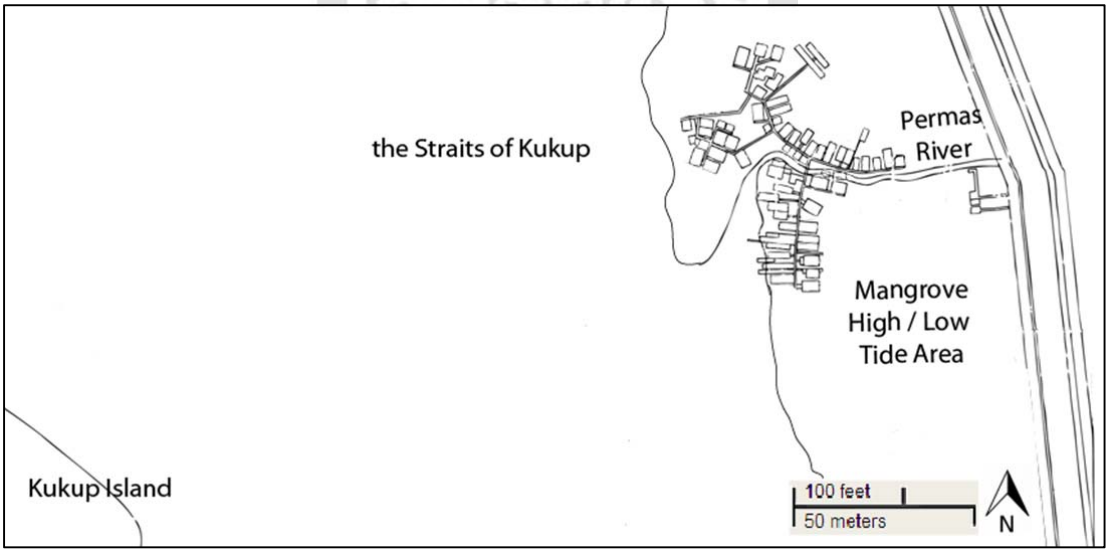


Figure 2.8 Layout of Ayer Masin fishing village before 1970

Source: JUPEM

Figure 2.9 Houses built along riverbank

Source: photographed by the study

2) The phase after 1970

a. Kukup Laut Fishing Village: the outward orientation of village development had facilitated after 1970. The major reason was the mudslide happened on 1981 which caused the houses located at the first row facing the island collapsed. The reconstruction site was tended inwards and restricted by the existed path direction. The reconstruction way to build along path shaped the distribution after 1970. Hence, it presented comparatively neat arranged as the planned result.

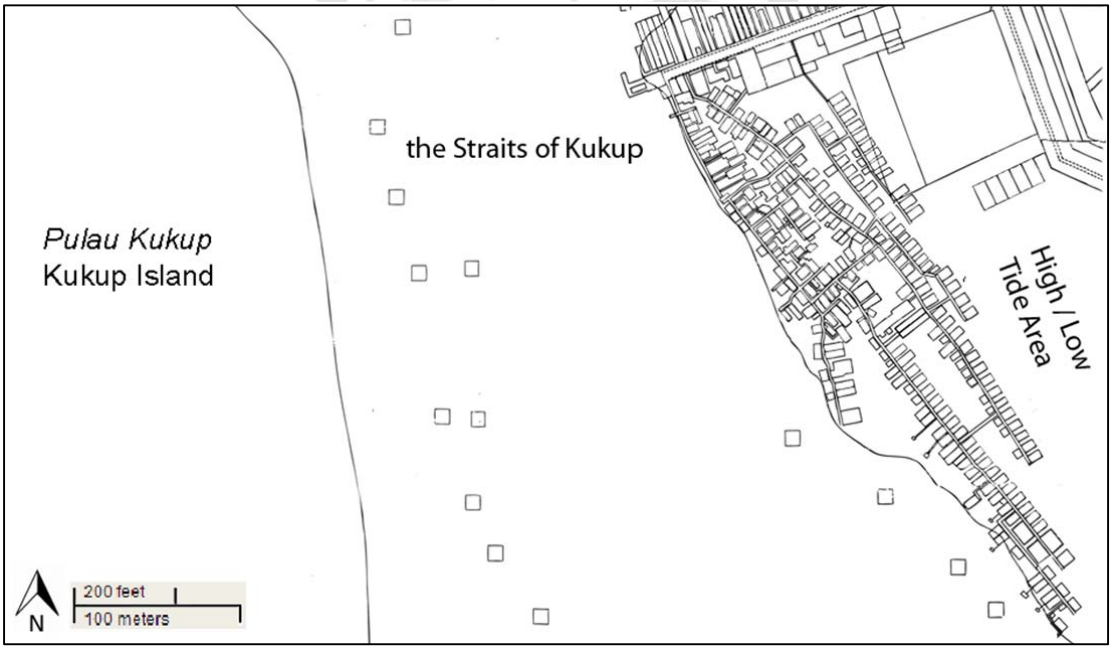


Figure 2.10 Layout of Kukup Laut fishing village after 1970

Source: JUPEM

b. Ayer Masin Fishing Village: the path became major reference line for the settlement pattern towards Kukup Road. Due to the concern of relative open to tide, where Kukup Laut is protected by port and weakens the tide, and also the collapse in Kukup Laut, the houses at the earlier period in this phase is restricted to gather along the inward side of path. Hence, the distribution is denser. Although the worry was overcome by the new construction technology and materials, the pattern is remained to develop along the original path without developing other parallel path such as Kukup Laut.

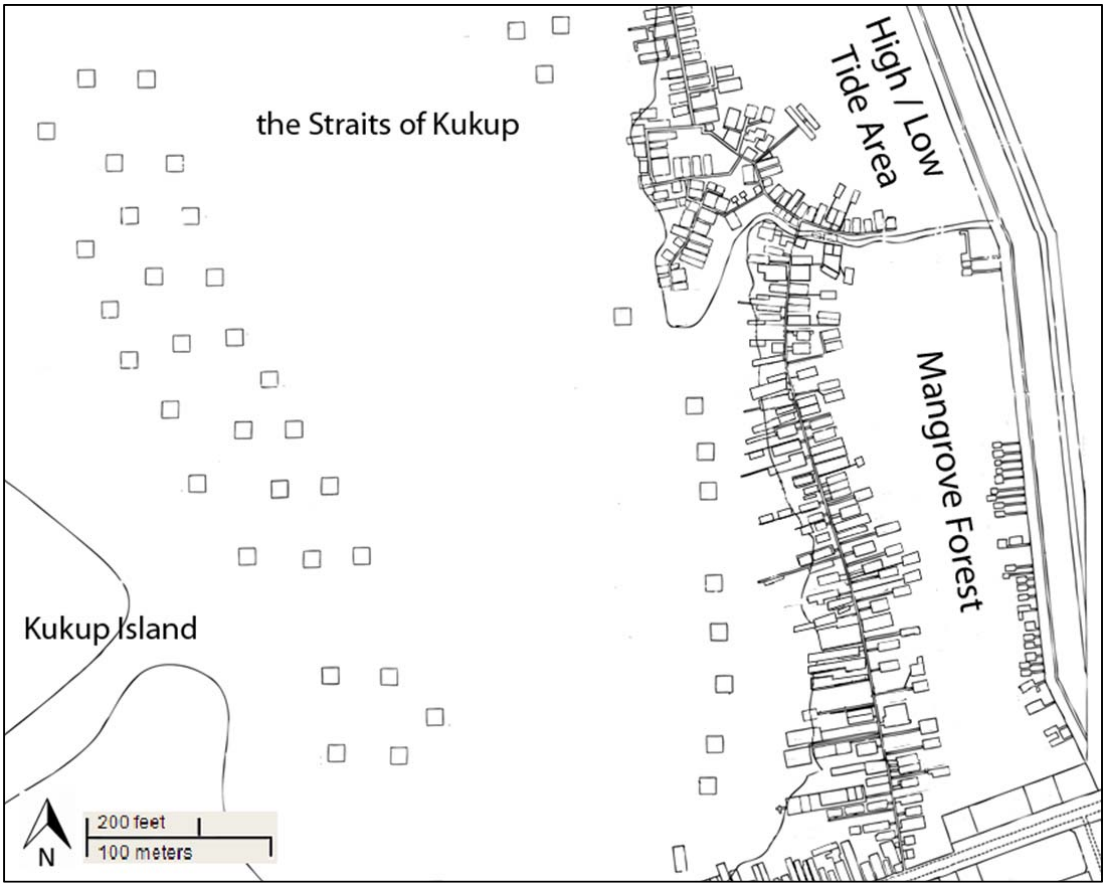


Figure 2.11 Layout of Ayer Masin fishing village after 1970

Source: JUPEM

Apart from existing space within the villages, offshore fishing platforms *kelong* were built on the straits and isolated from the settlement for fishing purpose. It increased artificial space for settlement and influenced spatial pattern after 1970. It was then replaced by floating fish farms in 1970s due to the sea pollution and decreasing fish amount. The

facilities were built within the area where sheltered by the mangrove island and appeared as random distribution.

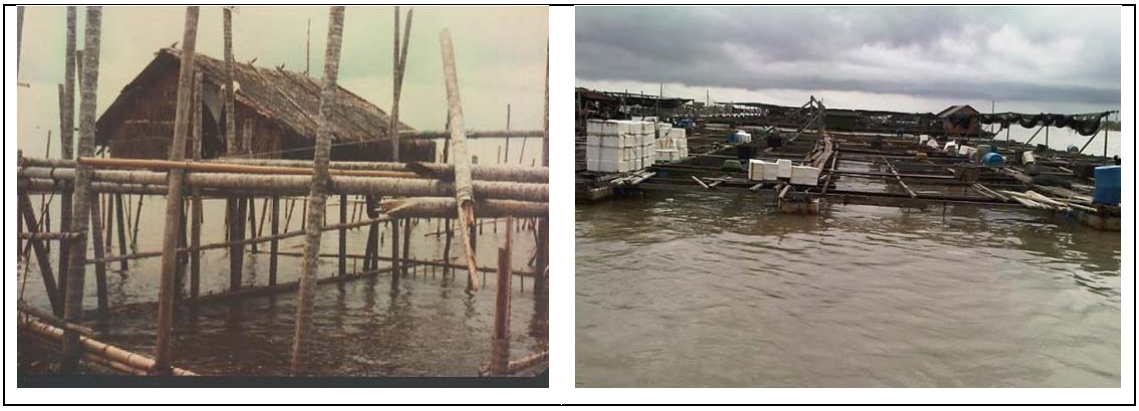


Figure 2.12 Kelong and floating fish farm

Source: personal communication, 2012 (left); photographed by the study (right)

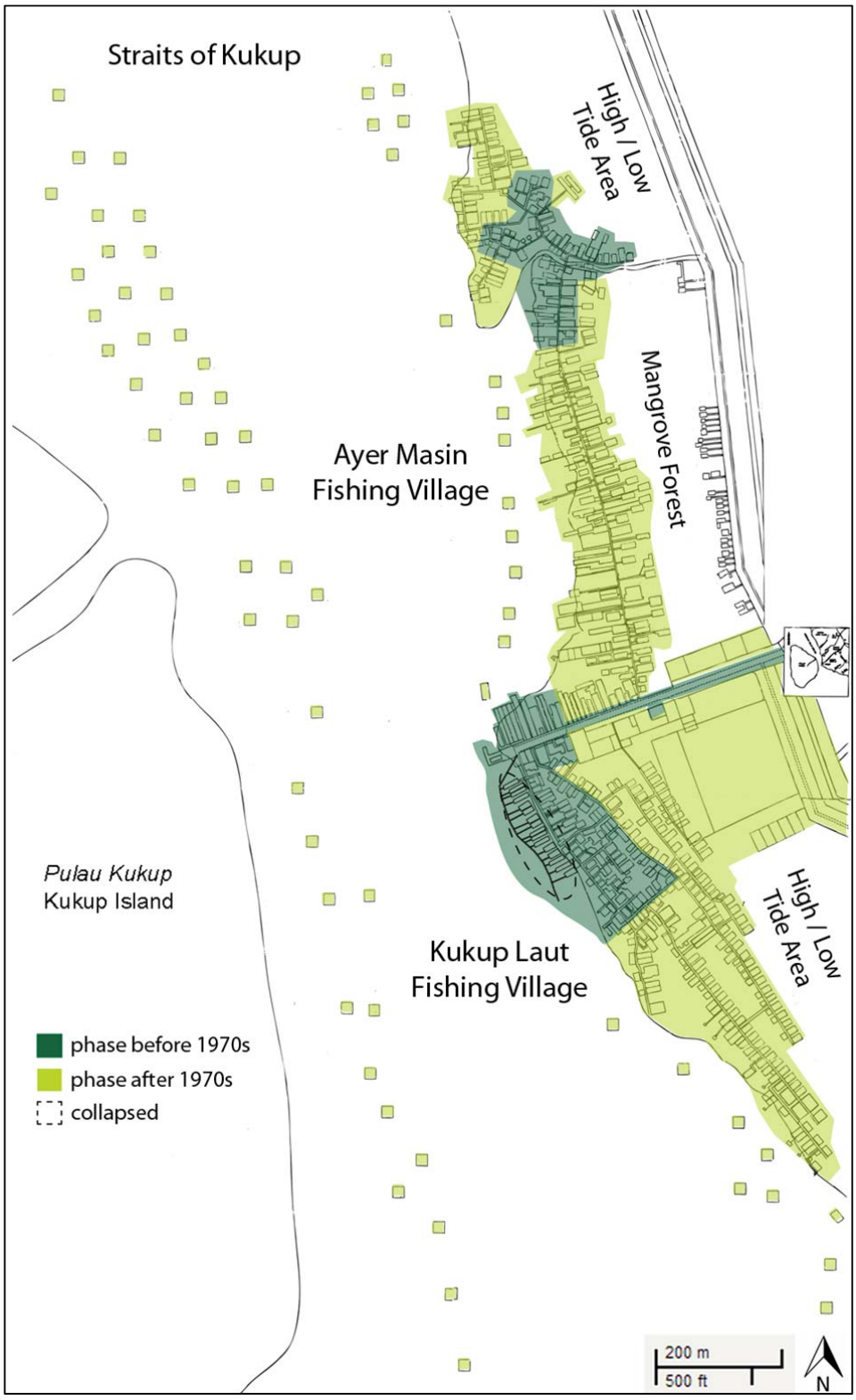


Figure 2.13 Distribution of Kukup settlement in two phases

Source: JUPEM

2.3 The characteristic of spatial pattern

2.3.1 Building

1) The phase before 1970: building characteristic can be observed from the land use and story height. The land use in the villages contained houses, temples, workshops and jetties. Most of the buildings maintained as open area or one story. The houses were narrow and long in order to access both to the path and to sea. It created as well high enclosure to the private space. All the commercial shops, public facilities such as school and administration offices were built along Kukup Road except the school in Ayer Masin due to the buildings was built before the construction of path.

2) The phase after 1970: land use became diverse. In Kukup Laut, the resorts were concentrated at the south where the open water provided better landscape. From Figure 2.14, it apparently showed that the area for tourist is separated from the houses which fit the resistance to outsider even at the current time. Besides, it can be found that the resorts are partly over one story which was rarely in previous phase. Furthermore, some of the houses were evolved to mix-use which operates small business on the front porch of house. This kind of mix-use house was found gather along the main entrance of village and also the path nodes. Also, temples are usually set at the path nodes as well.

Figure 2.14 Resort and mix-use of house

Source: photographed by the study

In the case of Ayer Masin, it appeared different situation both the tourism and religious area. The resorts are usually altered houses and the later built buildings which can be identified by their location close to Kukup Road. Due to the houses built along the

single path, the temples were not built on the nodes where people usually gathered but depend on spacing apart. It can be found that the distance to approach each temple is similar to coordinate with the settlement's linear pattern.

In both cases, the resorts are located at the later layer of village and the earliest pattern of settlement remained similar land use to houses and workshops.

Figure 2.15 Earliest layer of Kukup Laut and Ayer Masin remained similar function

Source: photographed by the study

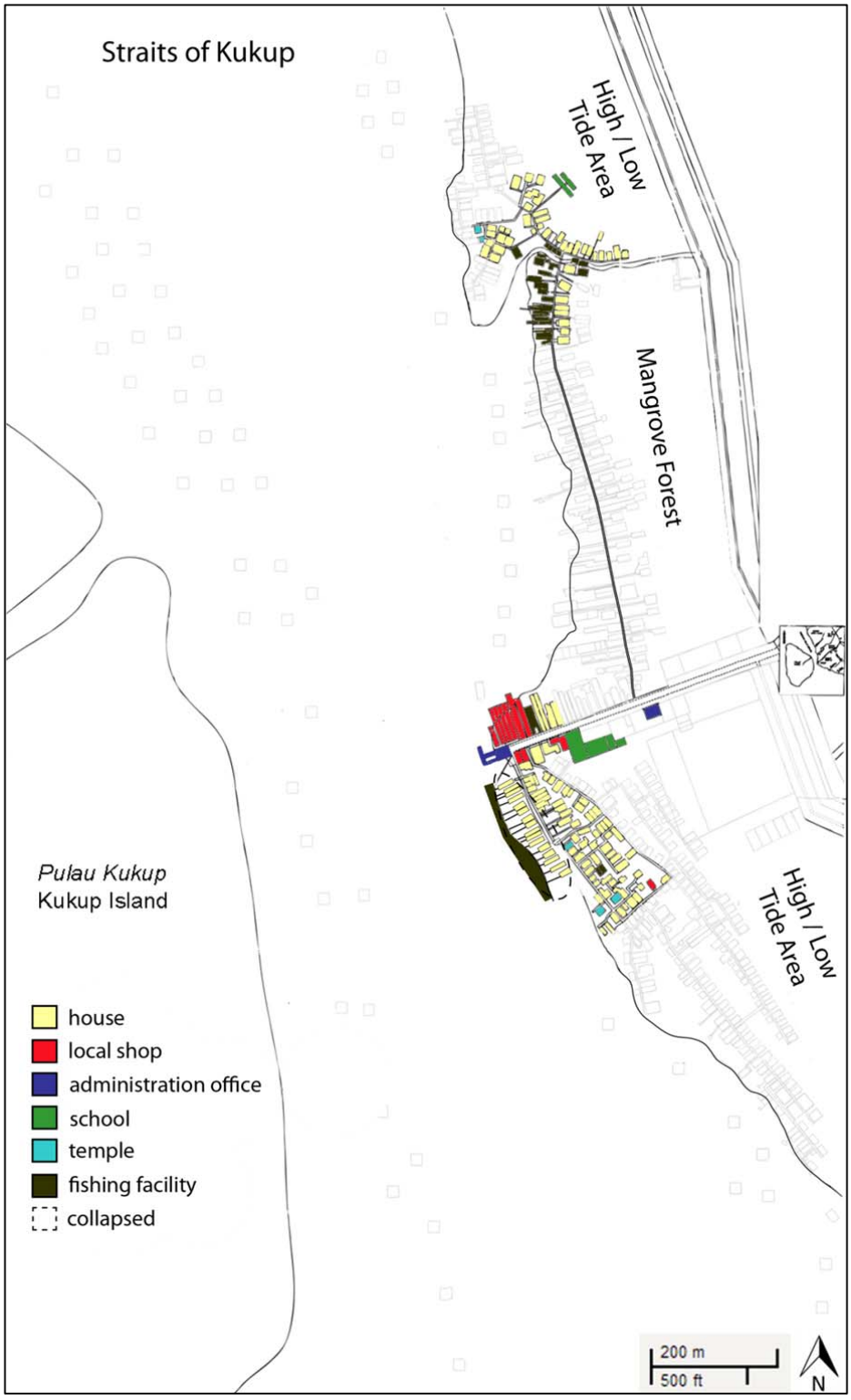


Figure 2.16 Land use before 1970

Source: Base map from JUPEM

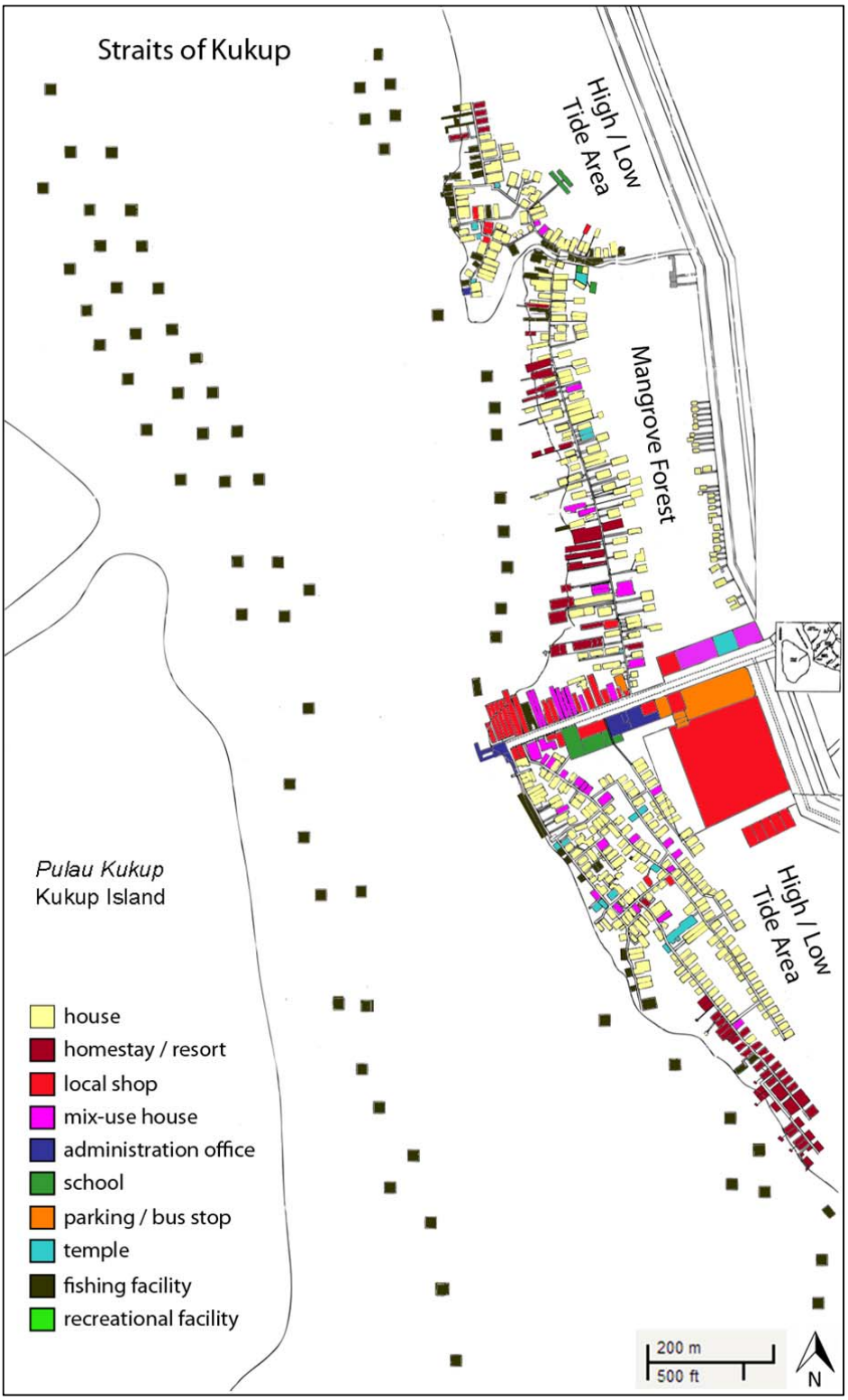


Figure 2.17 Land use after 1970

Source: Base map from JUPEM

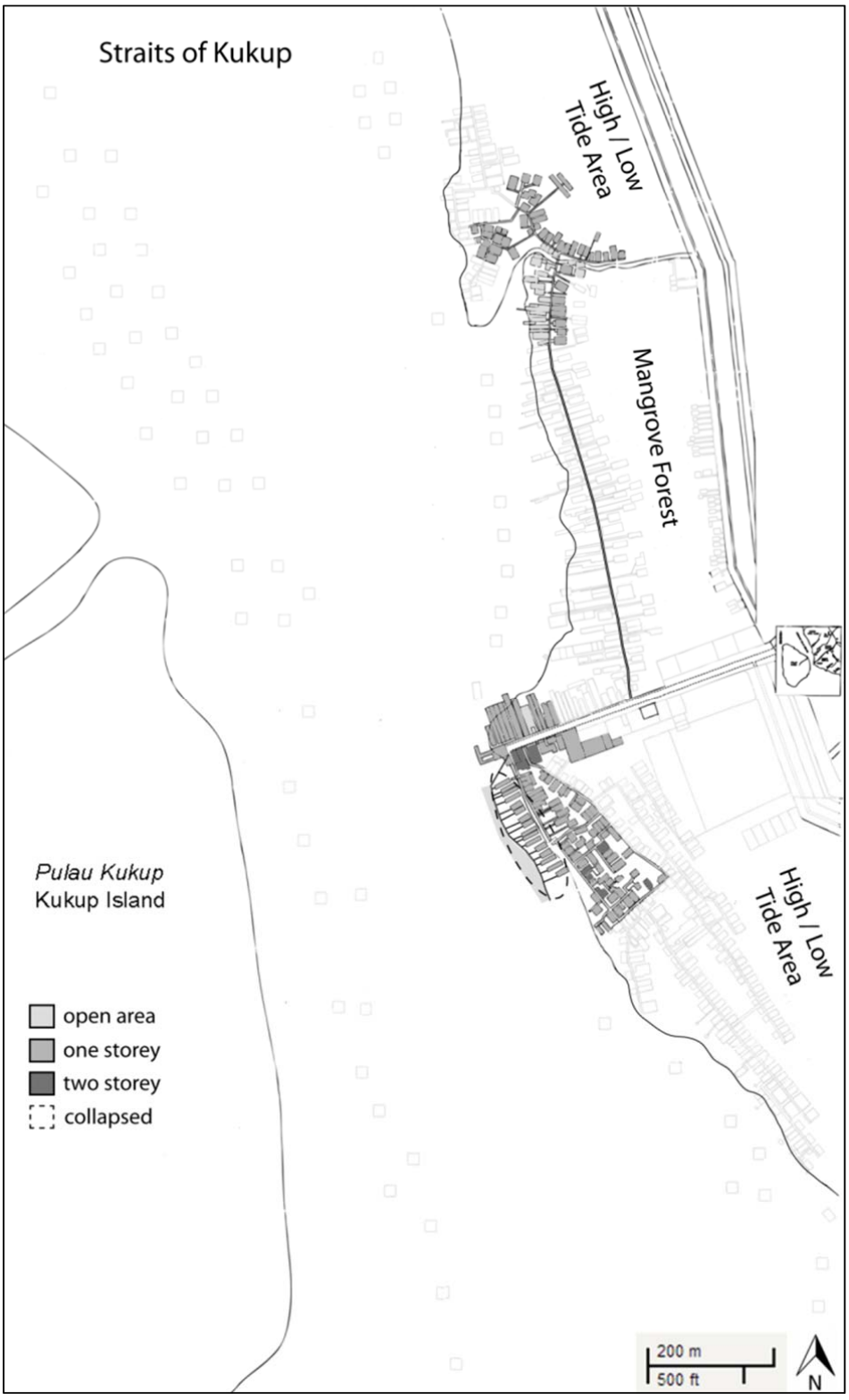


Figure 2.18 Story height before 1970

Source: Base map from JUPEM

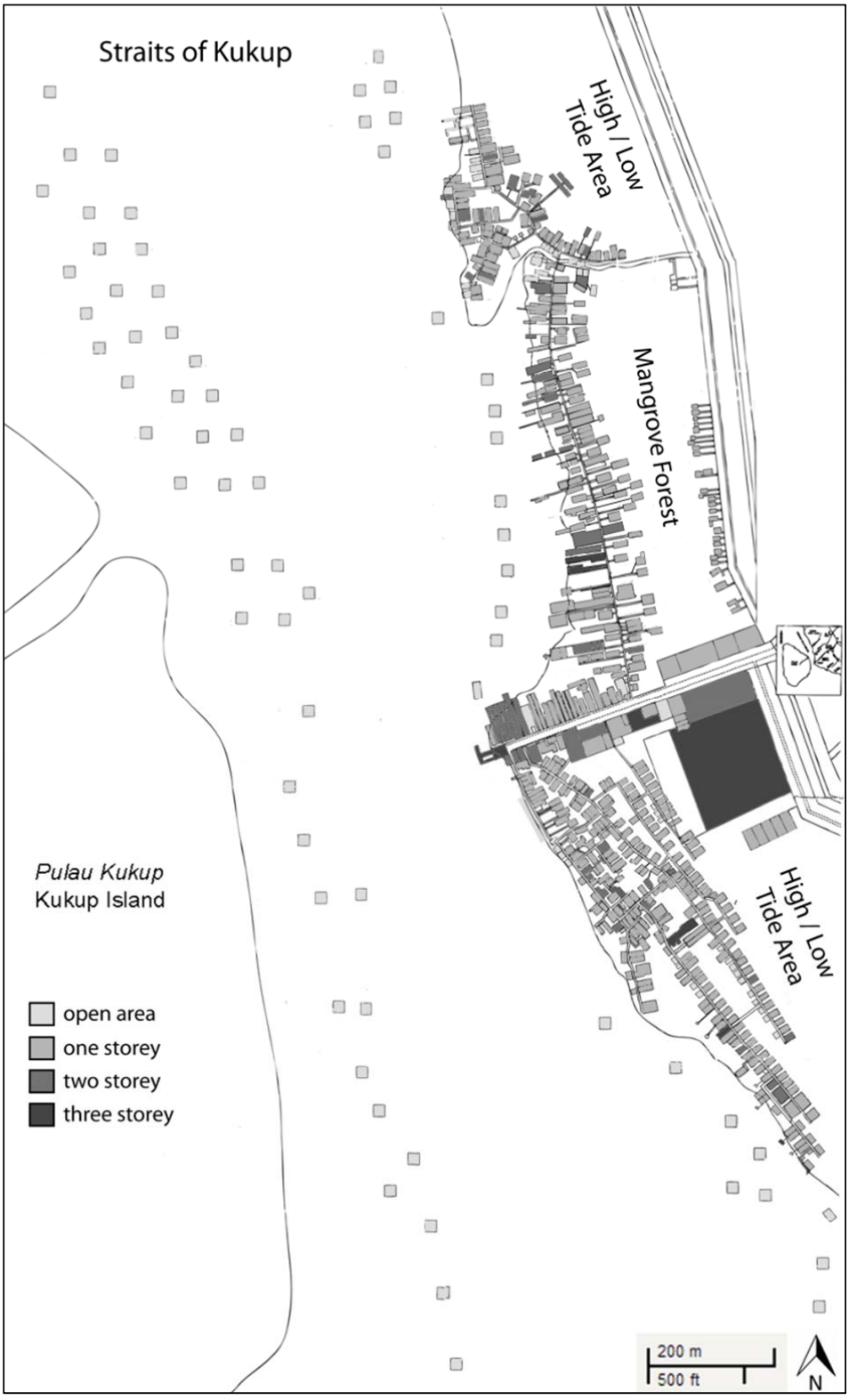


Figure 2.19 Story height after 1970

Source: Base map from JUPEM

2.3.2 Street and village path

The settlement had totally isolated by mangrove forest from inland before Kukup Road built in 1920s. The construction of Kukup Road acted as the connection to the district, boundary between district and local, as well as between Kukup Laut and Ayer Masin. Separated by Kukup Road, two villages' living area tends to develop inwards the village. Kukup Road plays the role majorly for passing through. The function and facilities of Kukup Road mostly set to serve tourists and foreigners arriving from harbor, such as restaurant, souvenir shop, information center, immigration office, etc.

The road was installed infrastructure of lights, running water on 1970s when was also the period of sightseeing tourism bloomed. More shops were opened and gradually covered along entire road.

Figure 2.20 Kukup Road as boundary between district and local, and between villages

Source: photographed by the study

The main gate way of both villages is hidden in the alley entrance from Kukup Road. In Ayer Masin, there is only one gate way which has two signboards. The signboard of temple entrance is more gorgeous than the village signboard. And in the case of Kukup Laut, the main signboard is more undisclosed. Kukup Laut has three gate ways to connect Kukup Road and only the main gate way has signboard. The other gate ways are almost hidden at the back alley of shops and usually used only by villagers. The signboards were set around 1990s while the resort tourism started to bloom in order to serve tourists as distinction between two villages, which prove the strong identity consciousness of the villages.

Figure 2.21 Main gate way of Kukup Laut and Ayer Masin

Source: photographed by the study

Figure 2.22 Other entrances of Kukup Laut that mainly used by villagers

Source: photographed by the study

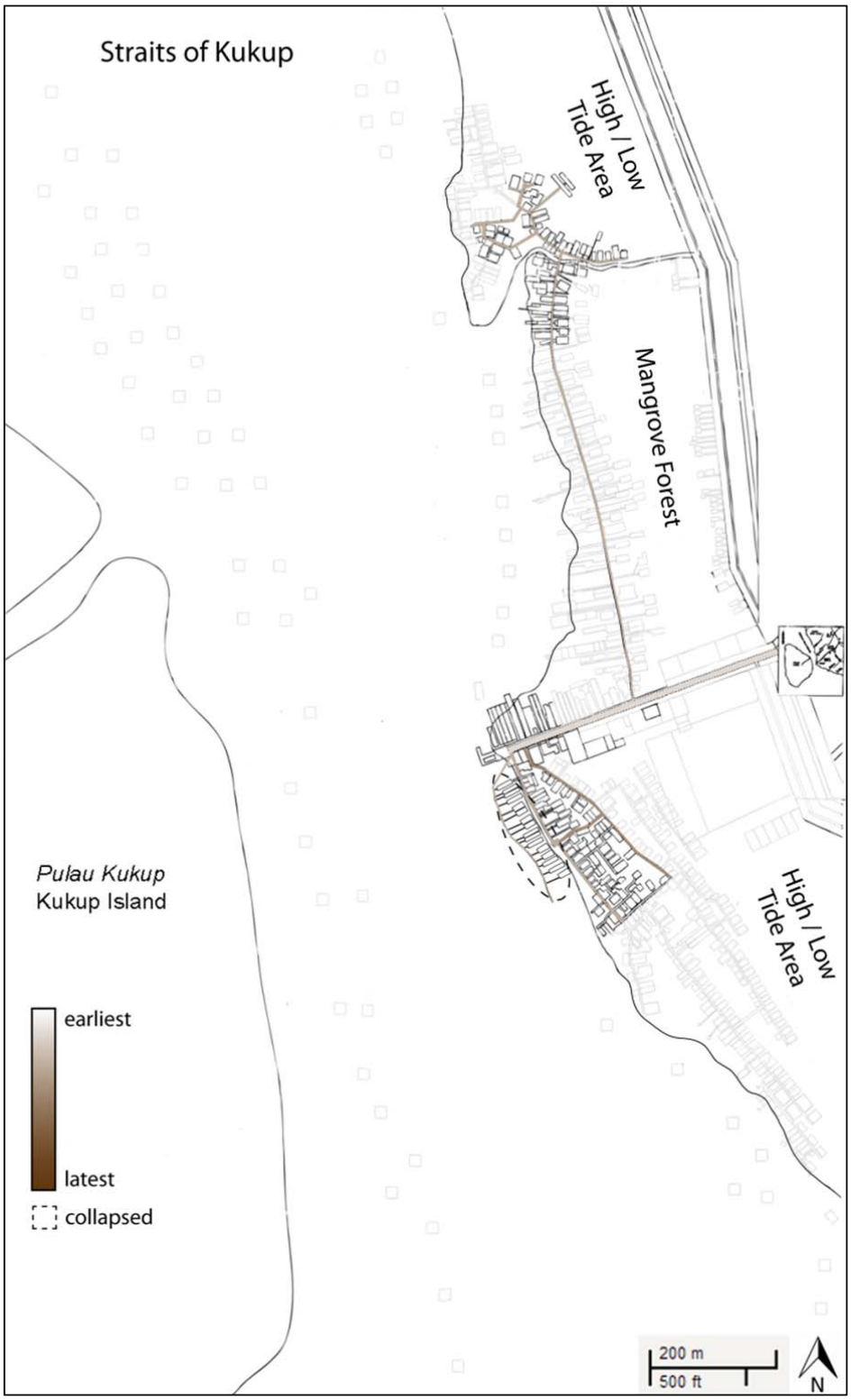


Figure 2.23 Road sequence before 1970

Source: Base map from JUPEM

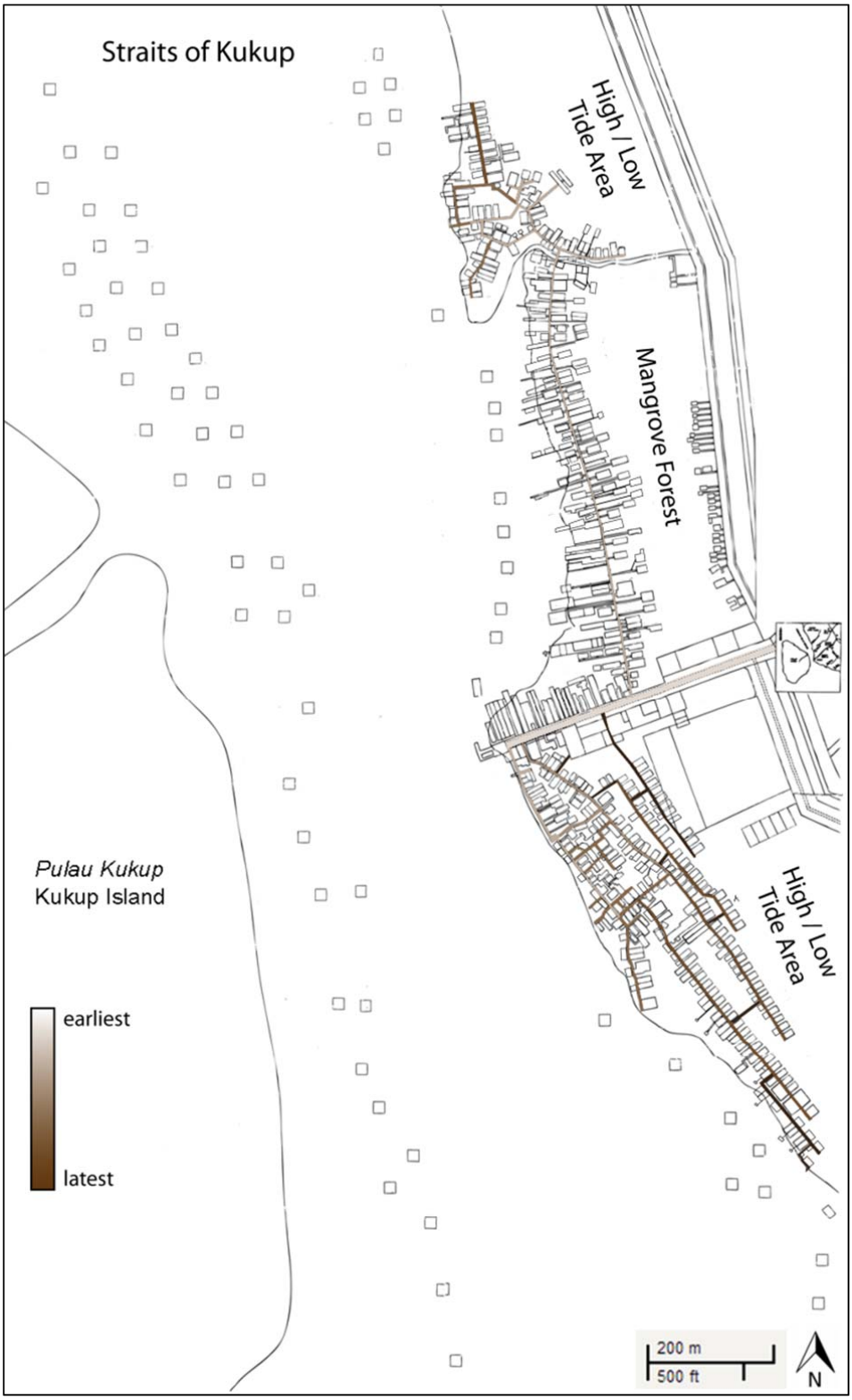


Figure 2.24 Road sequence after 1970

Source: Base map from JUPEM

Before 1940s, the paths in the villages were rarely organized and built by individual household to link workshop and house. The demand of path construction was from the government due to chaos of newly independent country after World War II. The paths acted as important element to observe pattern of water village. In history, the settlement on open water had hardly generated recognition and common pattern language. The paths offered opportunity to build settlement identity and gradually became the reference line to building construction and at thus way brought impact to settlement pattern. Also, the nodes of path became the spot where people meet and gather, where to generate community activities, and some of them evolved to public space after then.

The paths was constructed by wood at the first and only be replaced by concrete in 1990s. There was the period when infrastructure of lights and in-house electric, running water be installed in the house. Concrete path is usually 8 feet width which allowed only pedestrian, trolley, motorcycle and bicycle to pass through. Besides, motorcycle is restricted to pass through the paths after midnight. The width and local effort help maintain living quality of village even in current state of comparative high density.

Figure 2.25 Paths in 1980s and 2010s

Source: personal communication, 2013

According to Figure 2.23, it can be found that the paths before 1970 were spreading like network in organic growth pattern. After that, the path only expanded from the original paths in Ayer Masin which allowed remaining almost same pattern in current time. In the case of Kukup Laut, the paths built after 1970 are very obvious to identify due to the planned result. The path is expanded accompanying by additional building construction. While the path is too long in length, a cross path will be built to connect two parallel paths

for easy access and evacuation consideration after the disaster like mudslide and fire happened.

2.3.3 Public space and facilities

Public space is one of the essential elements of spatial pattern. In the case of Kukup settlement, public space can be classified according to the definition of Hsia (1994). Public space consists of imagined space, lived space and real space. Real public space includes physical public facilities and services. Imagined space and lived area where tend to a symbolic or conceptual living space that community activities are conducted and not necessary accompanied by public facilities.

Real public space in the site contained school, temples, recreational facilities, parking area, bus terminal, administration offices, harbors and fishing port. Recreational facilities, bus terminal and parking area were constructed in 1990s.

The public fishing port along Kukup Road used to be lived space where villagers, especially fishermen, gathered. However, fishing port nowadays is more crowded for catches loading, tourist sightseeing and heavy loaded automobiles. The port is no longer the preferred meeting place for villagers. Gathering place replaced by private jetty or workshop in the village's quiet back.

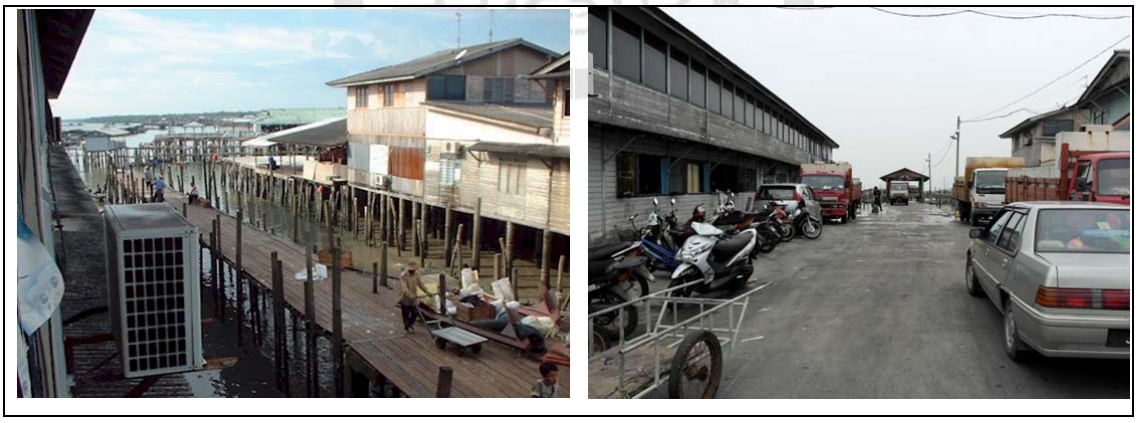


Figure 2.26 Fishing port in 1990s and current state

Source: personal communication, 2013

Figure 2.27 Private jetty and workshop become semi-private area to gather

Source: photographed by the study

Figure 2.28 Public facilities in the villages

Source: photographed by the study

As real public space was not as common as current under villagers' perception, there are some other shared spaces where generate activities in observation. In previous time, riverside and mudflats were major open area for villagers. The area displays different landscape following to tidal cycle that stimulated activities to enjoy public space. However, the village's density is getting higher and reduces open area. In addition, water pollution and domestic garbage threw to the sea made the area unsuitable for leisure use. The contact between people and water is getting estranged. It loaded in elder's childhood memory but is no longer to be seen in current time.

Another shared space is the area extended from every house's front porch. A narrower passage (comparative to village path) to connect buildings and village path is considered as boundary between private and public space. However, buildings are getting clustered and the passages of every building become denser and later link together to create an artificial space which is neither belonged to any private individual nor public. These semi-private spaces gradually become stop by spot of pedestrians.

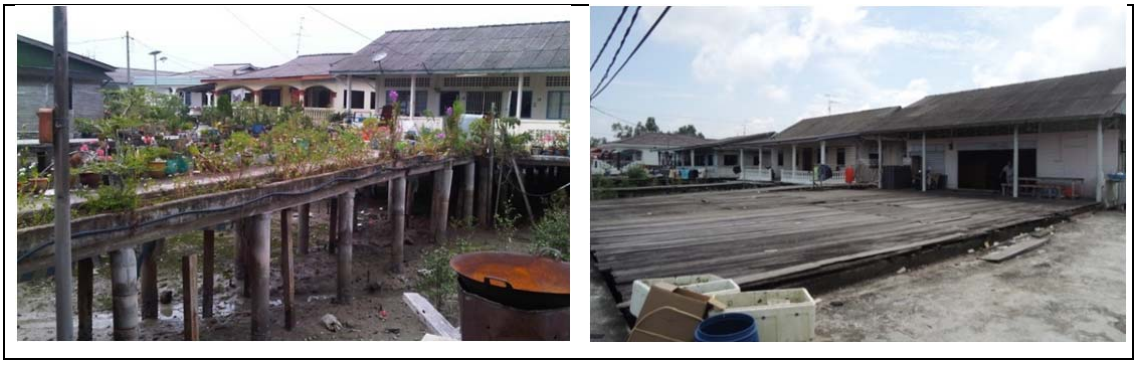


Figure 2.29 Cross passage gradually become semi-private space

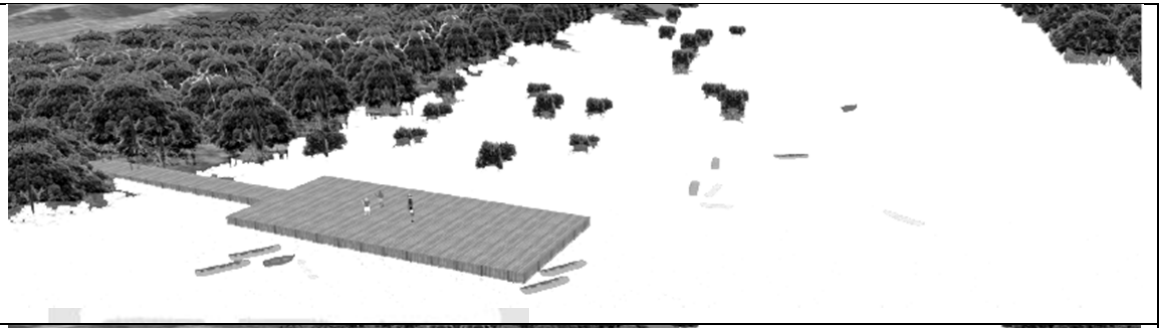
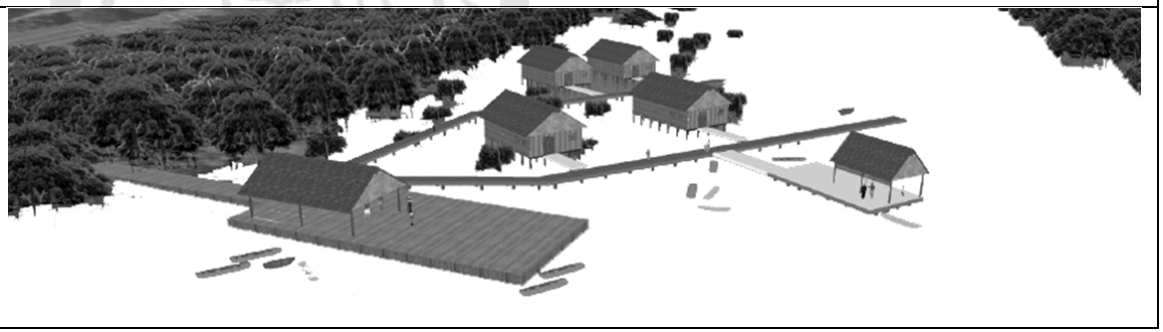
Source: photographed by the study

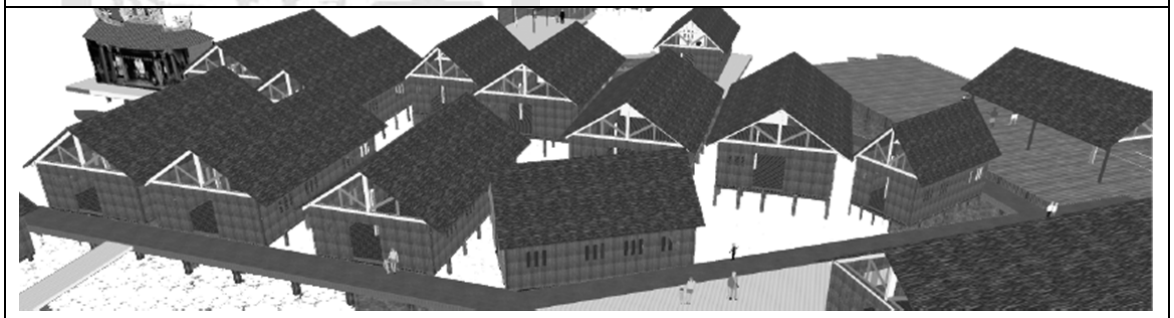
2.3.4 Additional sequence of development

Additional sequence helps identify the process of pattern development at community scale, the influence of each pattern to another, and the essential patterns existing at community scale. It is to describe spatial pattern in dynamic temporal scale and to understand the perception of inhabitants to manage the community and gradually shaped a unique pattern.

It is found that additional sequence of development is similar to both villages. From partial simulation of 3D model and description shown as Table 2.1, the first layer of settlement contains houses, jetties and workshop (or working platform). It shows that the settlement was originally built up with the intention of livelihood advantage. The paths were built in the second layer of pattern. The convenient accessibility stimulated higher frequency of contact, and gradually raised demand of public facilities. Temples, school and shops were built and that created the third layer of settlement. The fourth layer was added due to the construction of fishing facilities included *kelong* and floating fish farm. The most current layer increased tourist facilities such as resort, bus terminal and information center, etc.

Table 2.1 Additional sequence of development

1. Introductory consideration of an accessible port, where sheltered by the mangrove island, was of underlying reasons for the existence on the site of settlement.	
2. While the settlement was formed, the first layer contained houses, jetties and workshop surrounded by mangrove. All the artificial spaces were isolated from each other and contacted only by sea route.	
3. In the second layer, the paths were added. In 1950s, wooden paths were constructed in the settlement and increased the contact frequency between villagers.	

4. The closer link led to the demand of public space, which was the third layer of the settlement, and temple as the religious and gathering center was first built.	
5. The later houses and workshop take village path as reference line to construction and built as closer as possible to the path. It became a way to distinguish the houses built in first or second layer. Besides, the consideration to build along the existing path also made the distribution of settlement more cluster and the direction of houses became random. Natural habitat vegetation is replaced by high density artificial space.	 

6. School-age population increased, primary school was built that provides public facility and public space to villagers.	
7. Increased population and also the travelers came across the sea led to the construction of commercial shops and more public space on shopping street.	 

8. The fourth layer brought in fishing facilities *kelong*, a traditional fish trap on the sea and isolated from the settlement path.	
9. Due to sea pollution and encouragement policy to fish farming launched by local government, it was replaced by floating fish farm.	
10. The latest layer was tourist facilities especially resort. This layer is not only adding artificial space to the settlement, but also alters original space. Resorts have demand of sightseeing and seek to extend from village to open area. Workshops and houses where originally facing the mangrove island was altered to resorts due to high economic value. Some resorts were built to two or three story which was rarely seen in the previous layers.	

Source: illustrated by the study

2.4 Community's response to coastal environment

Living on sea is inevitably having impact from nature tidal cycle and accompanied by potential hazards such as land erosion, subsidence, mudslide, etc. The situation may be more severe in the century of climate change. Extreme climate reflected on sea level rise, unpredictable weathers and increasing frequency of natural hazards, while undeniably, the coastal community is one of the most vulnerable living groups in climate change.

In this study, the adaptation measure is observed by local practice of space pattern. From former sections, it can be found that the spatial pattern is majorly influenced by the natural environment. The impact from environment is one of the major factors to spatial pattern adjustment to adapt coastal environment. The adaptation measures to be taken by inhabitants in spatial practice will be discussed in this section accompanied by investigation to local perception towards environment change. The primary data have been collected from informal interviews and field observation. It includes socio-economic condition of water settlement, coastal impacts and potential disasters to live on water, and grass roots and government's response to climate change.

Table 2.2 Spatial pattern adjustment in adapting coastal environment

Year	Event	Spatial pattern adjustment
1860s	Kukup Laut and Ayer Masin were formed.	Tended to gather to sheltered shadow of Kukup Island to seek protect from strong waves and winds on the Straits of Malacca.
1970s	A significant reduction of fish catch due to sea pollution	On stilt fish trap (*Kelong*) gradually be abandoned.
1970	Land subsidence	Kukup road had been bunded and broaden to prevent flood and tidal intrusion.
1977	A part of Ayer Masin's path was destroyed by waves.	Houses tended to gather to center of sheltered shadow of Kukup Island. No new path has built from the time.
1979	A significant reduction of fish catch due to sea pollution	Developed floating fish farms.
1981	15 to 16 units of houses located at the first row facing the straits collapsed due to mudslide (Kukup Laut).	Houses were parallel reconstructed inwards and near the shore. It became the pattern be referred until now.

Year	Event	Spatial pattern adjustment
1990s	Several times of mudslide happened but without consistent rhetoric to exact year. One of them caused collapse of port, and another caused collapse of an administration office.	New concrete port and office be built.

Source: summarized by the study

To be noted that, the impact of tide is not the one-time hazard but continue to occur in daily life. The hazard is the accumulated result of constant intrusion and erosion. Tidal cycle is accompanied by issues such as erosion, mudslide, subsidence, and flooding.

The erosion is happening quietly in Kukup everyday life that can only be perceived by the residents. It is found in the interviews to elders that, at least 50 years ago since now, the ground was actually approachable during low tide period in a distance of 3 to 4 feet height. Till now, the distance from house's floor to ground during low tide may reach 8 feet height and is being elevated slightly every year. It also destroyed public space. Mudslide happened several times in the settlement and destroyed the outward buildings facing the sea. The intrusion of tide accompany by land subsidence. Local measures to adapt to coastal environment include elevating houses; locate houses away from open water without shelter.

Figure 2.30 Collapsed office and replaced by 3 story building along Kukup Road

Source: personal communication, 2012

The speed of land subsidence is mainly observed on Kukup Road. The road was originally swampy mangrove mudflats and paved by stones and sand to make accessible. It

was decorated to asphalts on 1970s. Land subsidence has continued to occur accompanied by, both natural and man-made factor, tidal force and increasing load of buildings. Flooding happened frequently during monsoon season every year September to January. And yet, landfills work to construct 55 units of 3 story commercial shops and a bus terminal on land was done by 1990s. The subsidence is so significant that road elevating has to be operated every few years to ensure road functioning.

Figure 2.31 Flood commonly happens during monsoon period

Source: personal communication, 2012

It is also found that the frequency of events increases. Destructive power is getting stronger and more obvious in daily life. The adaptation measures have been done by villagers, allowing people to continue to live in coastal area. However, the study to coastal land erosion and subsidence (Ong, 2000) and sea level rise (JUPEM, 2008) also show the vulnerability of Kukup to climate change. It is extremely important to examine local resilience to adapt climate change with local measures.

2.5 Conclusions

In the case study, the settlement's pattern is highly referred to natural contour line either riverbank or coast. The pattern appeared as parallel to contour line and also expanded towards the center of sheltered shadow of Kukup Island. From the layout of additional sequence of settlement, it can be found that the development of spatial pattern

can be classified into the layers of buildings, followed by road and path, and finally public space.

Houses, workshop and jetty are the essential components at its origins pattern, which also the proof to the motive of livelihood in the forming of settlement. During the development, sea pollution, erosion and mudslide bring significant impact to the settlement's pattern including the direction and distribution of settlement growth, alteration and addition of space components.

By observing its spatial structure, it is found that demand of high enclosure and distinction from external the settlement is obvious. It can be observed from the building that house shape of narrow facing the street and developed to the back. Also, street system without clear gate way highlighted boundaries between villages and between residents and tourists. Public space in the village are mostly be used by local while the facilities on Kukup Road serve mostly outsiders also reflects living area of villages tends inward the center of settlement.

In other hand, people live on sea also feedback to nature environment by measures in response to its characteristic. The contact between nature and people is constantly ongoing and form local perception to the surrounding environment and adaptation. Hence, understanding people's perception to tidal hazards and environment change is essential to design effective implementation policy in local community's resilience.

Chapter 3 Spatial Pattern at Building Scale

Building is the fundamental structure of water settlement's pattern. All other structure and embellishment development (indicated street and public space in this study) is grounded on building pattern. Hence, understanding to building is important to support basic components of all structures. This chapter introduces its pattern development, layout and construction details. It plays the role to link a pattern structure of network from community scale to building scale. Besides, it is the preliminary introduction to understand local perception.

3.1 Overall pattern of building

The overall arrangement of the buildings shows its pattern at its foundation, detached house with one story height, front and back porch, passage, wooden jetty and workshop.

The foundation is the identity of water building's pattern. All buildings in the settlement are built in pile structure. It elevated the buildings around eight feet high above ground that allow seawater flows and wetland vegetation grows. The flow changes village landscape due to regular tidal cycle. Floating foundation is evolved to adapt tide flow. It creates artificial space detached from the village and contributes to building pattern.

Front porch and back porch act as entrances to enter the building. Front porch entrance is major entrance that connects to village path. Both porches are built in similar design and volume of space, however, back porch entrance is usually used by owner and familiar visitors. Passage is the boundary between private and public space. It is usually narrower in width and decors according to owner's preference. It makes the pattern distinct from village path and creates unique identity.

Wooden jetty and workshop are essential to building pattern. It contributes not only to fishery operation but also a sense of place that presents the lifestyle and livelihood of settlement. It creates a quite back for villagers and gradually become meeting place with neighbors and familiar visitors.

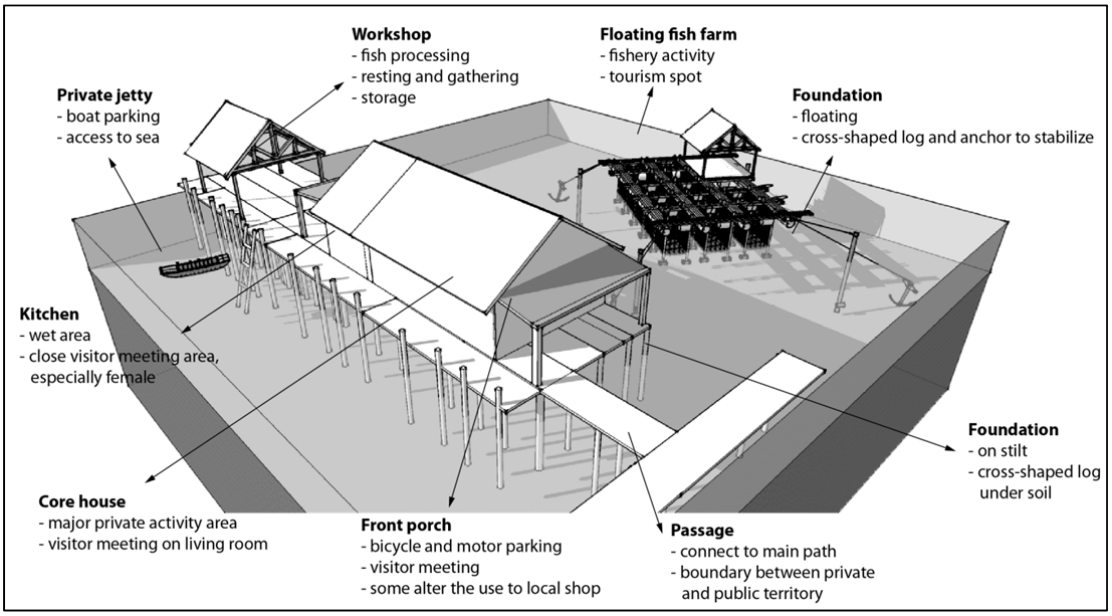


Figure 3.1 Overall pattern of Kukup water building

Source: photographed by the study

3.2 Internal layout and pattern development

When the major parts of buildings and the outdoor areas have been given their rough shape, their internal gradients of space and movement define the most important area of a house. The internal layout of house is slightly different but commonly contains similar space function. The house is designed with many windows on both sides for ventilation. Apart from living room that uses to entertain visitors, all other space is for private use. A long and narrow house shape contributes to high enclosure and provides privacy for user.

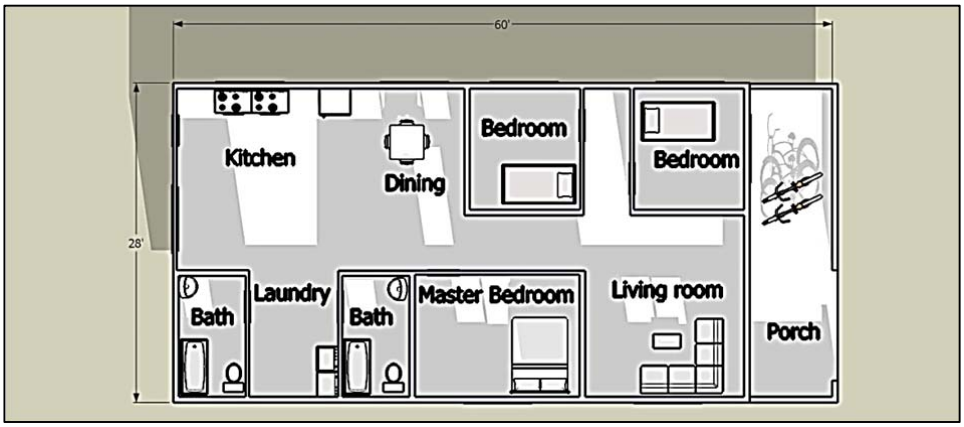


Figure 3.2 Internal layout of common house

Source: illustrated by the study

The development of building identifies the demand of expansion. Usually a standard house contains passage to boat parking. It is then expanded to workshop. Kitchen is commonly the next to be added and then front porch. After the additional of back porch, another independent space is usually be constructed either alters from workshop or expand from the back. It is commonly seen when the family is growing and also for the resort demand. Besides, fishing industry is shrinking due to sea pollution and lead to the abandon of workshop.

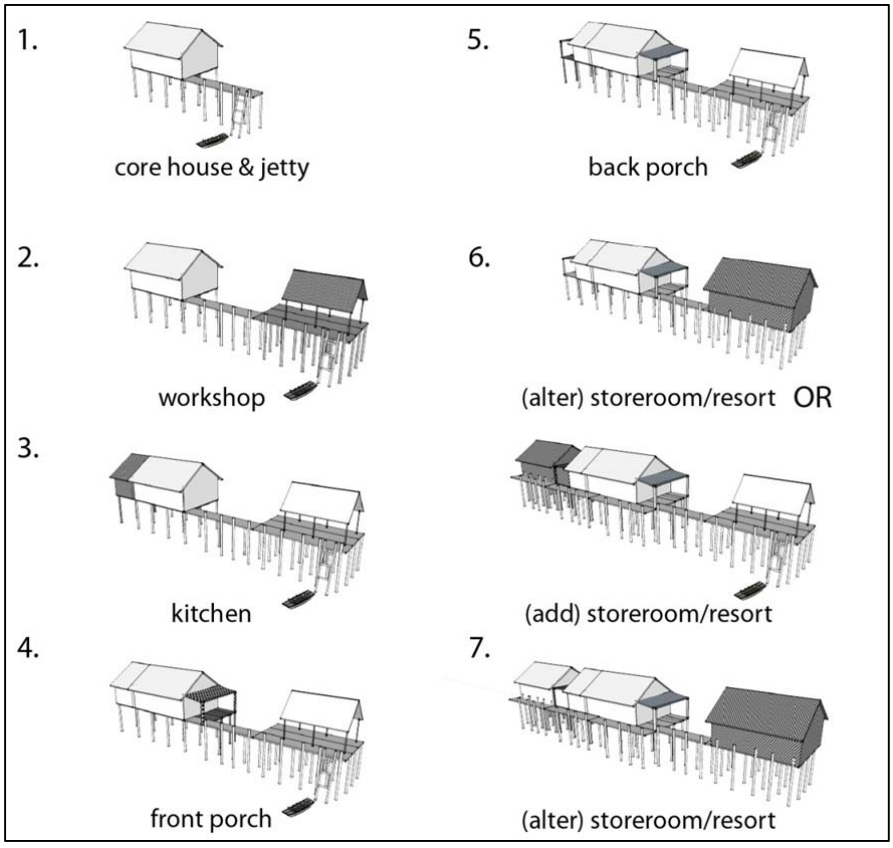


Figure 3.3 Pattern development of house (Type I - front workshop)

Source: illustrated by the study

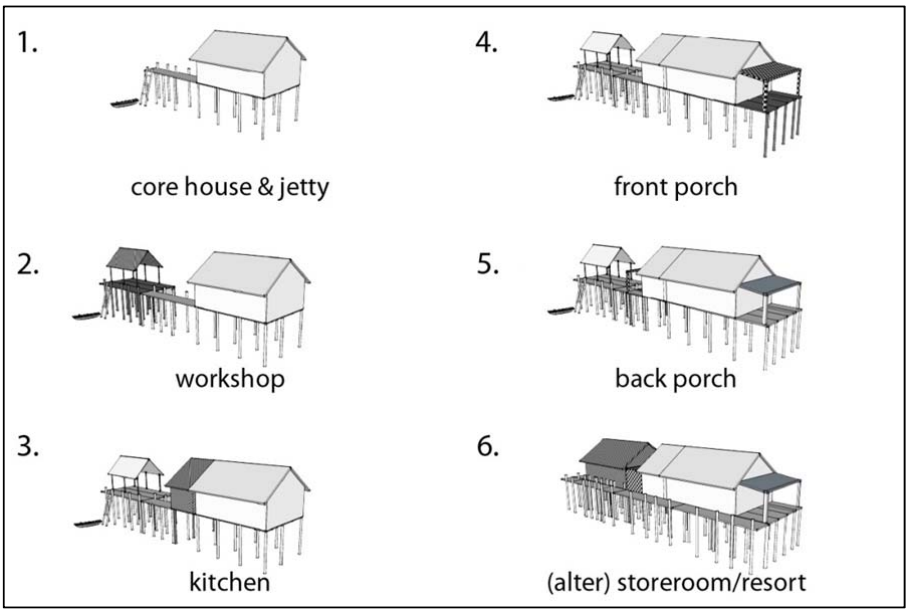


Figure 3.4 Pattern development of house (Type II - back workshop)

Source: illustrated by the study

3.3 The construction method and material

The buildings pattern can be categorized by its function to human activity that including the living and working building. The construction of buildings was conducted on temporary platform on the sea as Figure 3.5. The construction was usually conducted by experienced contractor who is familiar to the building method.

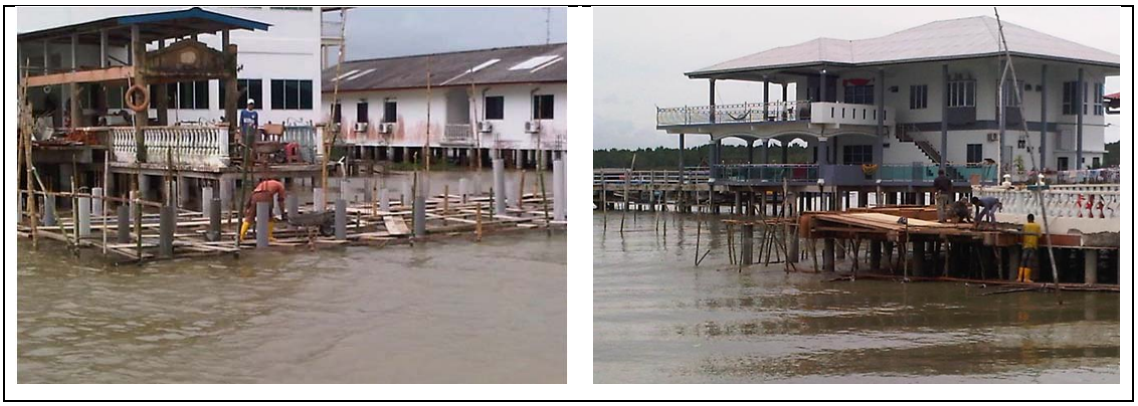


Figure 3.5 Temporary construction working platform on the sea

Source: photographed by the study

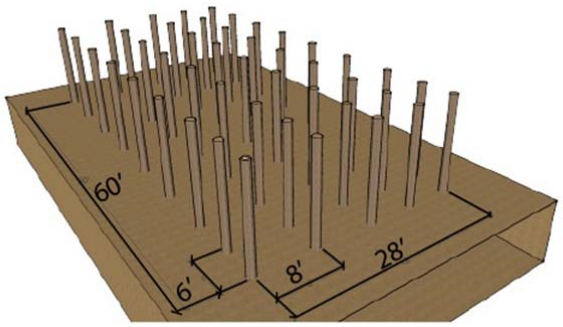
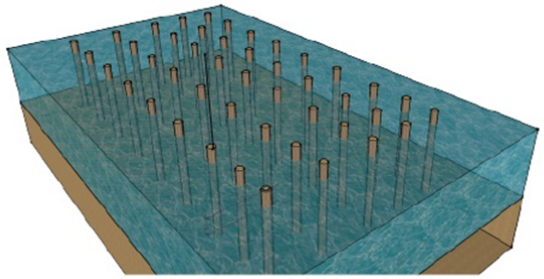
3.3.1 Construction details of living house

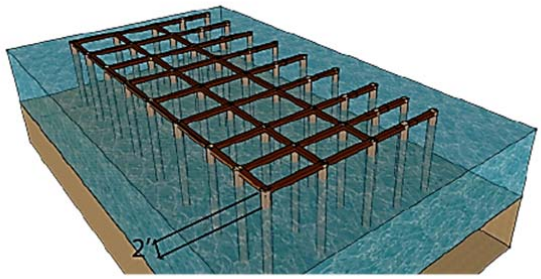
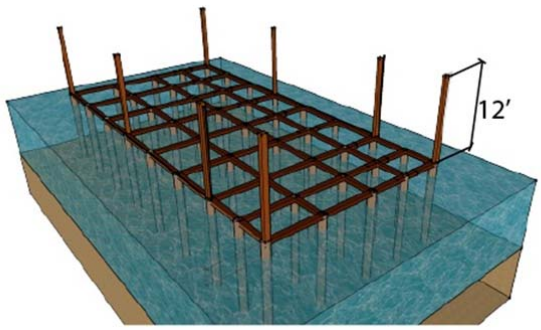
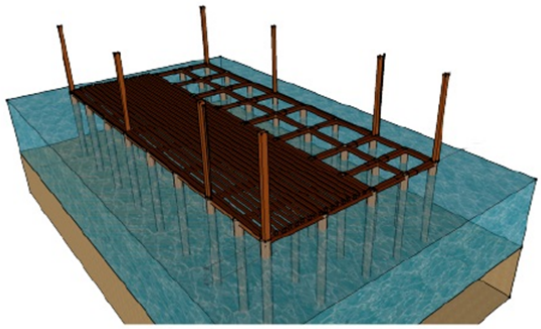
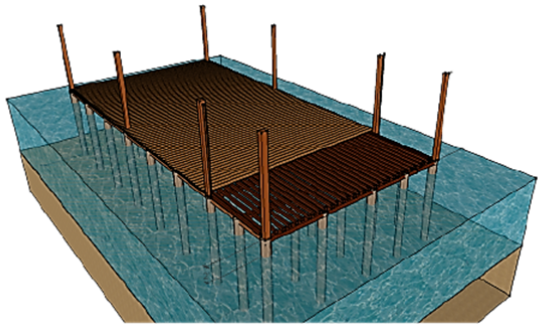
The construction of living house is majorly classified by two types that are wooden house and concrete house. The main difference of pattern can be identified from the foundation construction method and the material.

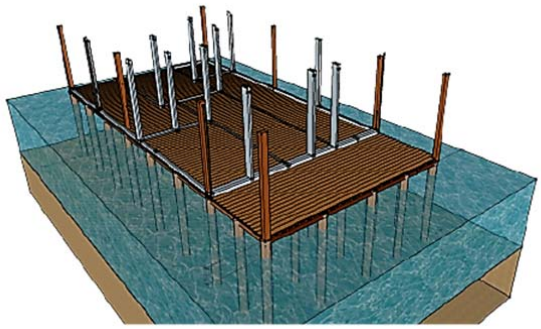
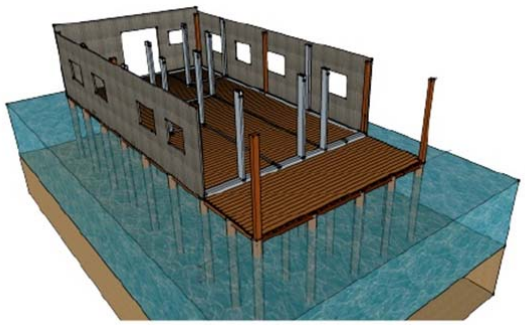
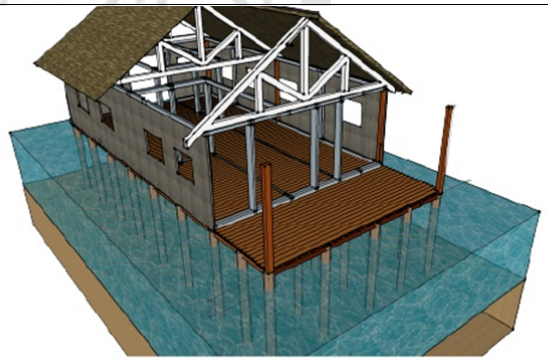
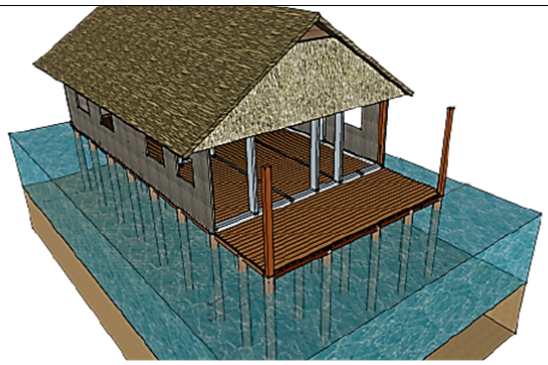
1) Wooden house

The foundation of wooden house is comparatively weak in confronting tidal movement and weight of building. Hence, it is constructed one story height and the material is usually light in weight, for example timber and palm leaves.

Table 3.1 Construction process of wooden house

1. The foundation is built by the mangrove woods. The logs are manually piled into the mudflat in a distance of 6 to 8 feet in between.	
2. The piling progress is only being conducted within the low tide period approximately 4 hours per day and took few months to be done.	

3. After it is done, 6 x 8 inches cross beams are joined to create an artificial space on sea for building. The platform is usually 1-2 feet higher than the highest tide level. The stilt height varies depends on the experience of artisan while observing the tide height during construction.	
4. Wood column are then being connected with the beam below. The height of pillar is approximately 12 feet but highly depends on the material be found.	
5. 4 x 5 inches floor joist is then be placed onwards the beam.	
6. 1x8 inches boards are placed and form the floor.	

7. Other columns which mainly supporting wall loads are built.	
8. Wall is built	
9. Roof beam and roof be built	
10. Sill and partitions be built.	

Source: illustrated by the study

Figure 3.6 Wooden house in earlier period

Source: unattributed online (left); photographed by the study (right)

The log is cross-joist and piled into 5 feet underneath mudflats. According to the villagers, the method is developed by the experiment and improvement. Single log was previously piled vertically into the mudflat but due to the adsorption characteristic of marsh mud, the log sink or pushed upwards the ground and make the construction of foundation not applicable. The cross-joist log provide an intersect surface and turn the adsorption energy into stabilizing force of foundation.

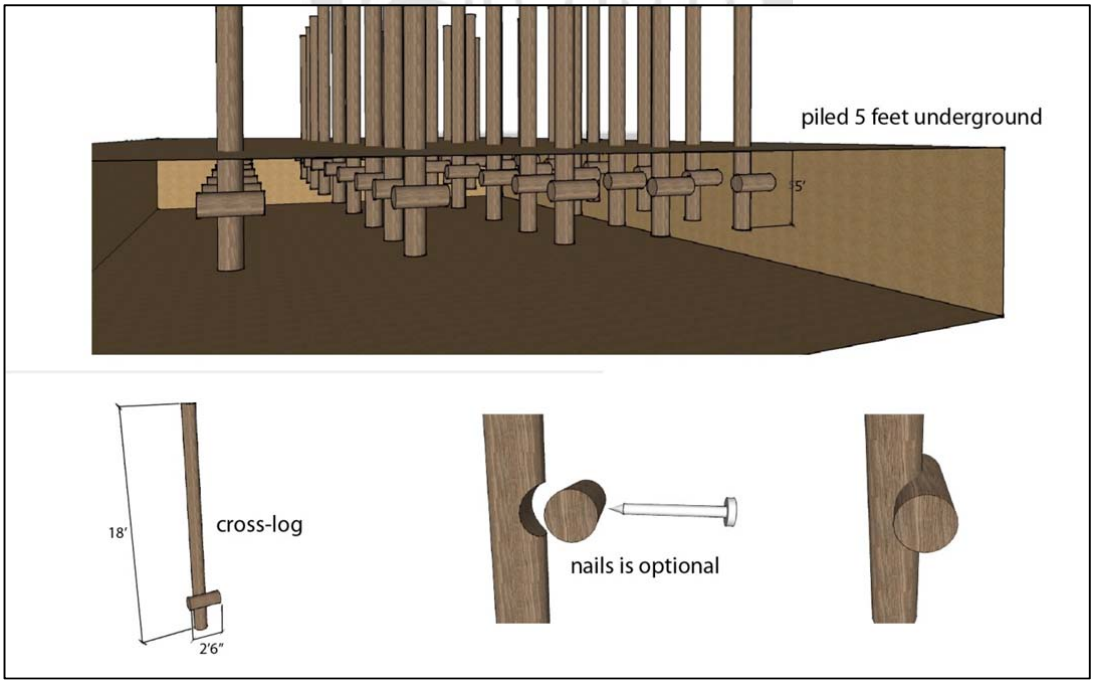


Figure 3.7 Construction detail of pile log

Source: illustrated by the study

The fixation of cross beam has evolved in several methods (Figure 3.8). The earliest known way is to join the log and beam together and then place another beam above. The second method is to join the cross beam with a ribbon-shaped joist and place on the log. The final evolvement is to cut part of the log surface to place cross beam while the joist type remained.

The constructions detail in Figure 3.9 to Figure 3.11 shows that, the woods were commonly joined together without nails. The nails used are optional.

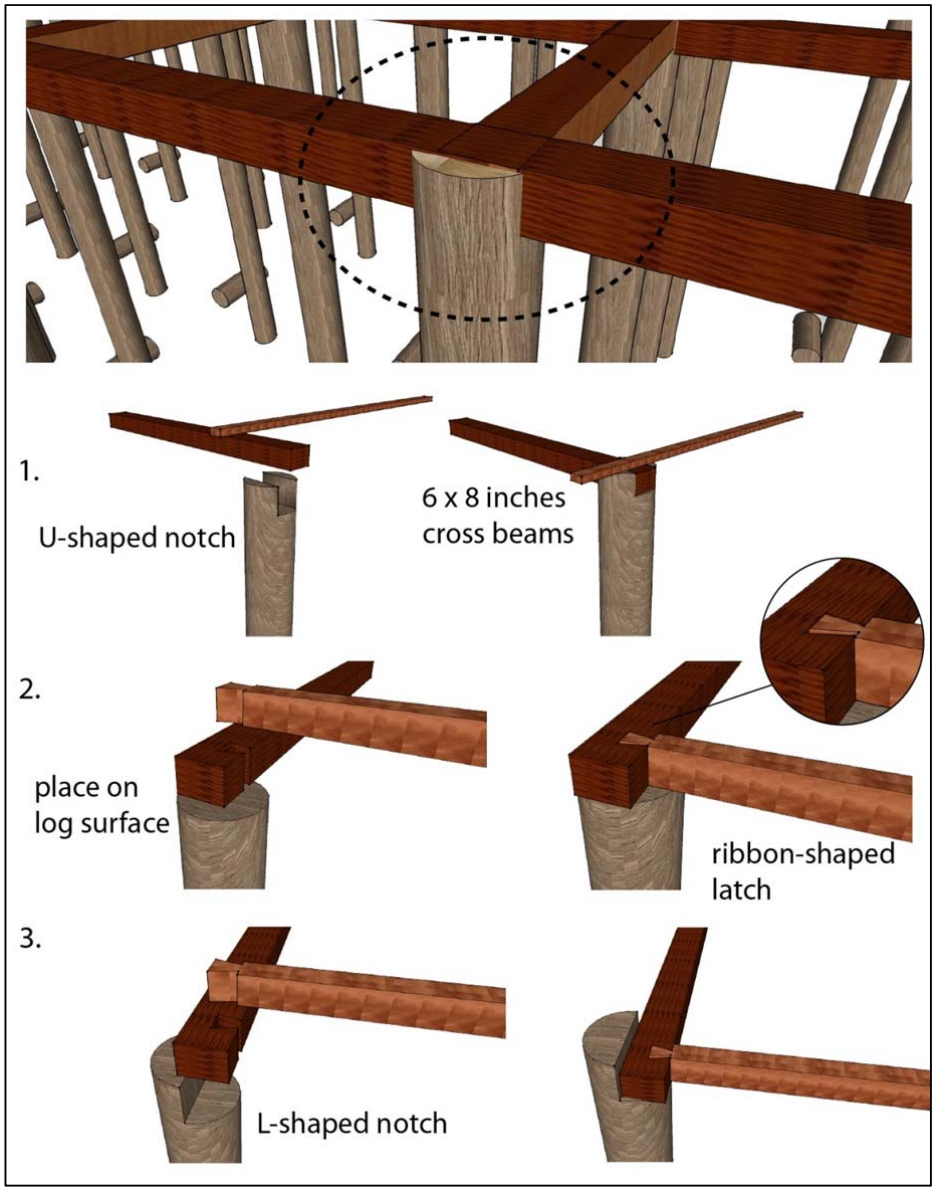


Figure 3.8 Construction detail to connect pile log and cross beam

Source: illustrated by the study

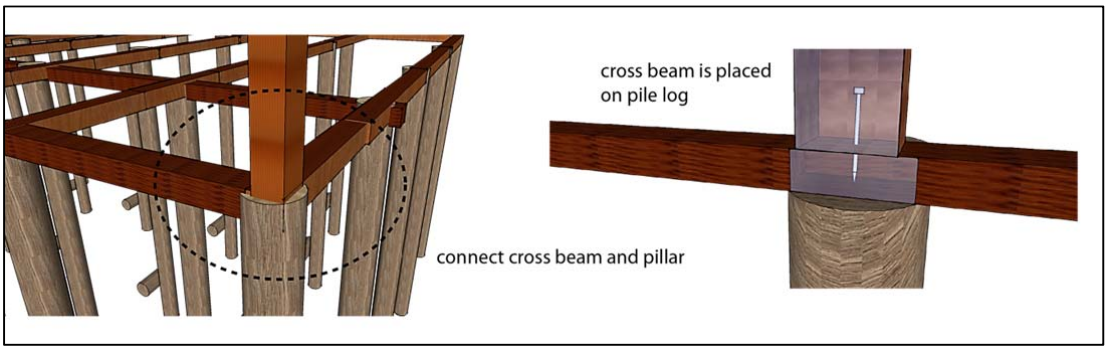


Figure 3.9 Construction detail to connect cross beam and pillar

Source: illustrated by the study

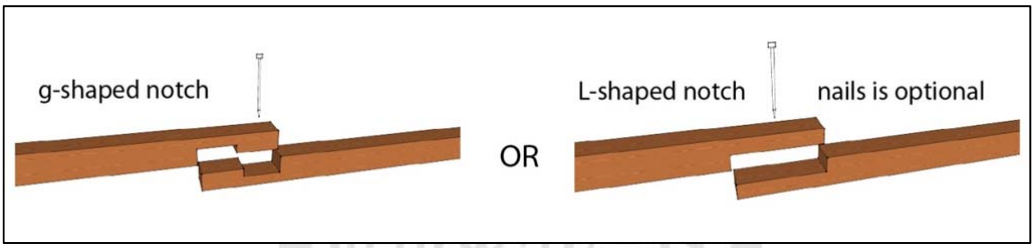


Figure 3.10 Construction detail of crossbar

Source: illustrated by the study

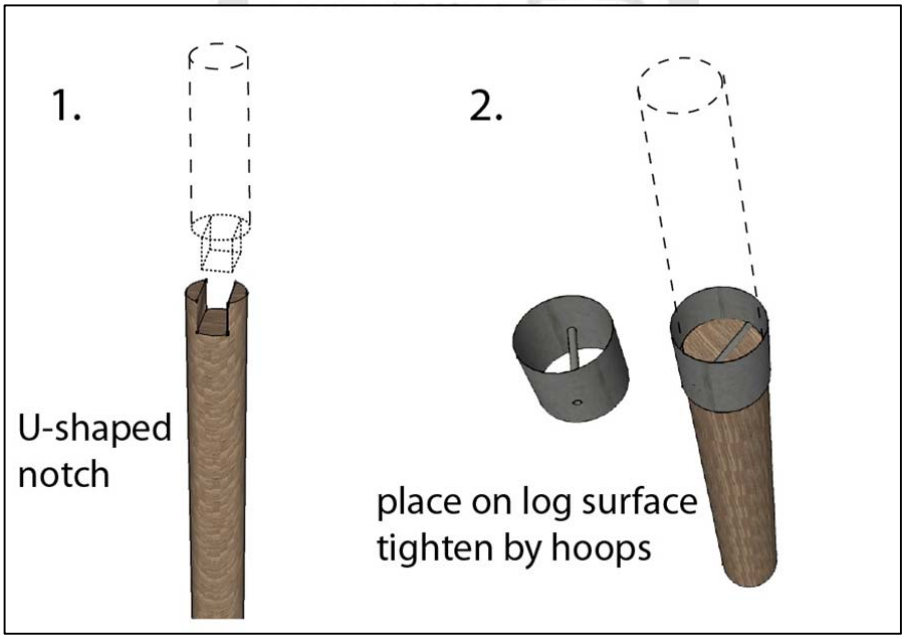


Figure 3.11 Construction detail of vertical bar

Source: illustrated by the study

Figure 3.12 Some of the wooden construction details found in the settlement

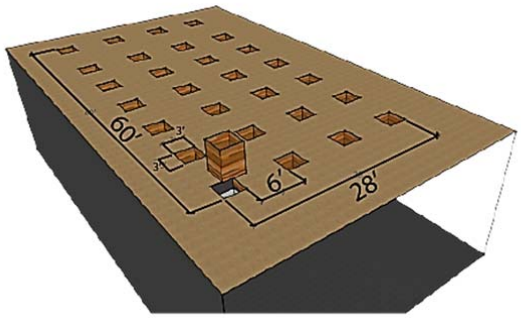
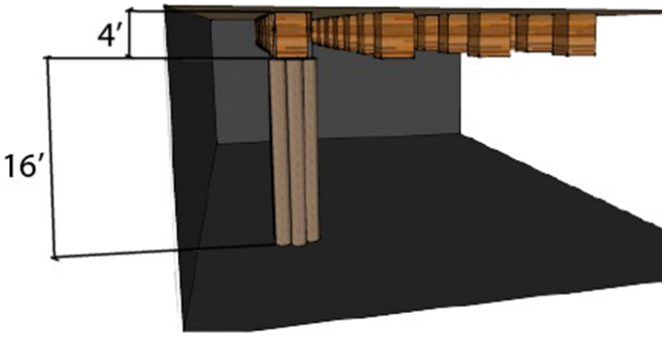
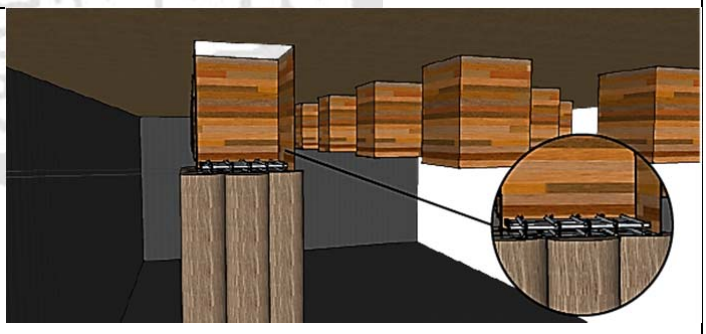
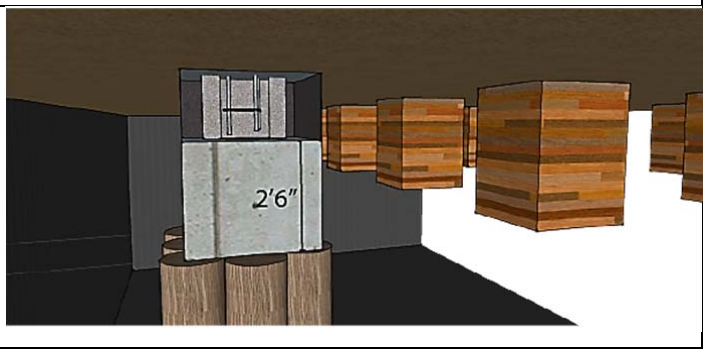
Source: photographed by the study

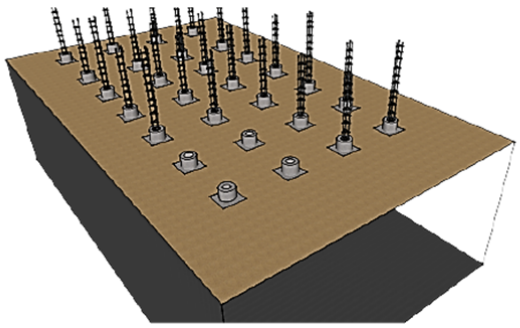
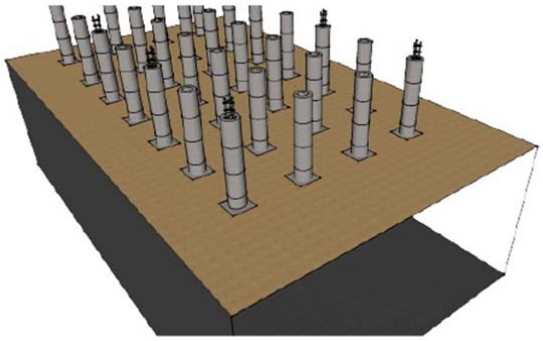
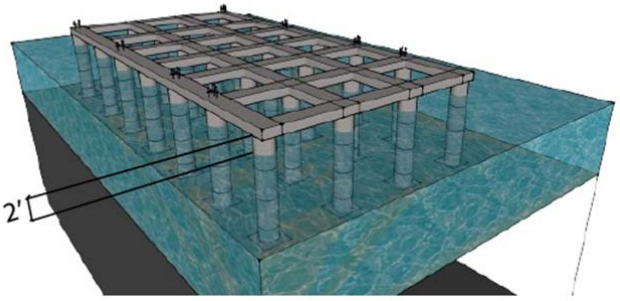
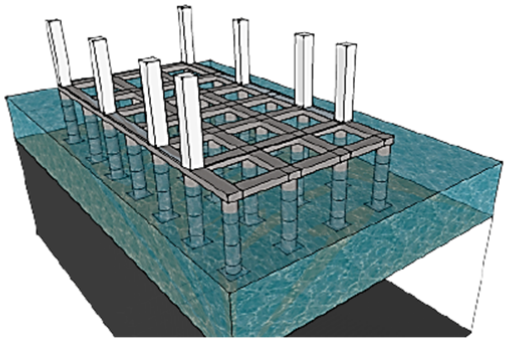
b) Concrete house

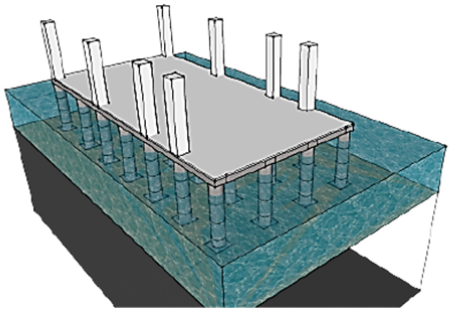
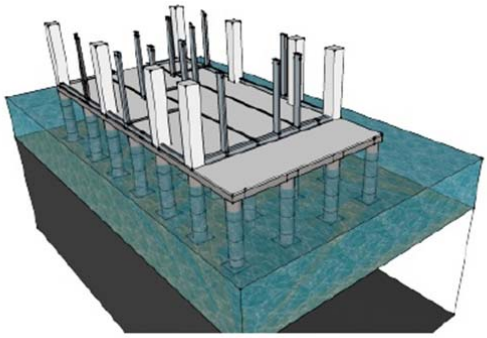
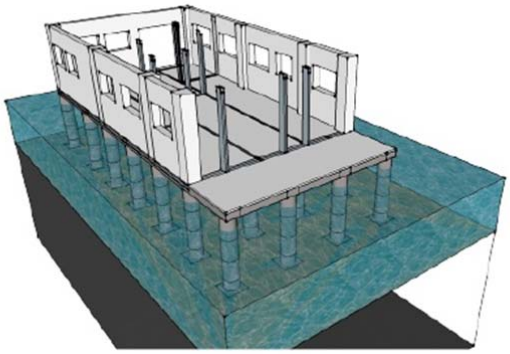
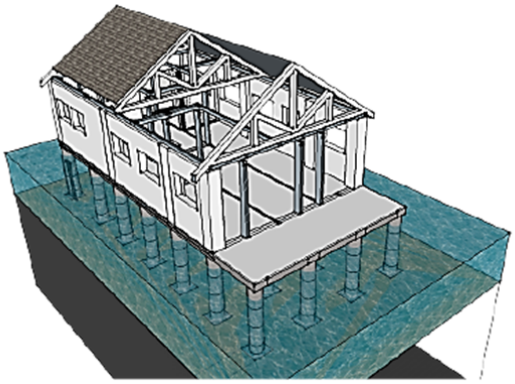
The foundation of concrete house is evolved combining nature resilient character of mangrove wood to saline water and heavy load-bearing capacity of concrete. The concrete material and new building technology overcome the constraint of wooden house. It supports heavy weight, higher story, and allows various materials to be used on the design of building.

However, the characteristic of salt water is still the biggest consideration to the construction. The application of mangrove log as foundation is still important. The foundation of concrete house has been evolved by piling the entire log underground. Based on the experience of villagers, they found that the part buried under the ground remained undamaged for the over-100 years' houses but the part exposed to air damage around every 3 to 4 years. The construction of concrete house improved the way to apply mangrove log to enhance its advantage.

Table 3.2 Construction process of concrete house

1. Wooden box which formed by 4 pieces of board will be piled into mudslide as the moldboard of later concrete foundation. The distance between boxes is around 6 to 8 feet depending on the weight of building.	
2. After the mud in the boxes is emptied, 12 to 15 units of mangrove log are manually piled to the bottom of boxes.	
3. Iron plate is put above the logs and optionally placed surrounded internal of box.	
4. Cement is poured into the box and while reach around 2.5 feet, the cement column and iron bar are put in to the center of column and continue to fill the box.	

5. The bottom part of logs is not able to be seen even during the low tide period.	
6. Cement columns are continued to be stacked.	
7. The platform usually takes one month to complete and around 2 feet higher than the highest tide.	
8. The columns are built.	

9. The floor is built.	
10. Other columns which mainly supporting wall loads are built.	
11. Wall is built	
12. Roof beam and roof be built, and finally the sill and partitions.	

Source: illustrated by the study

Figure 3.13 Construction site of concrete house

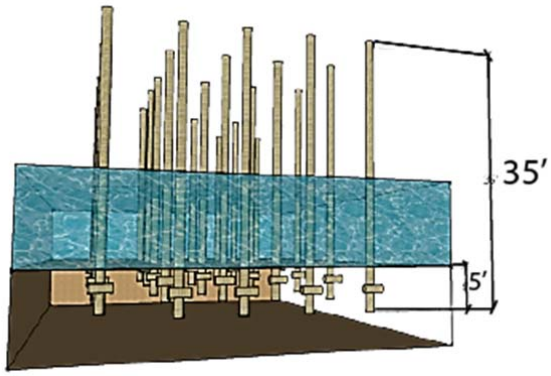
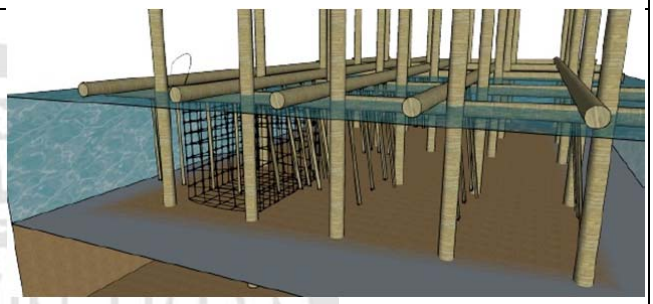
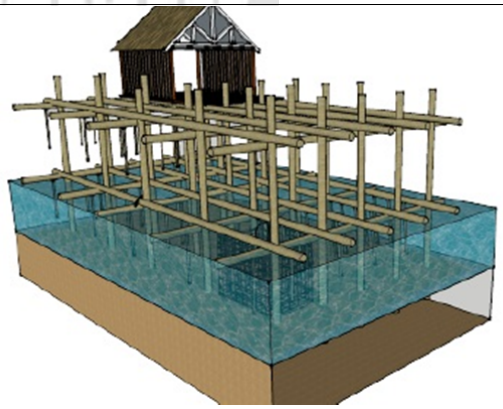
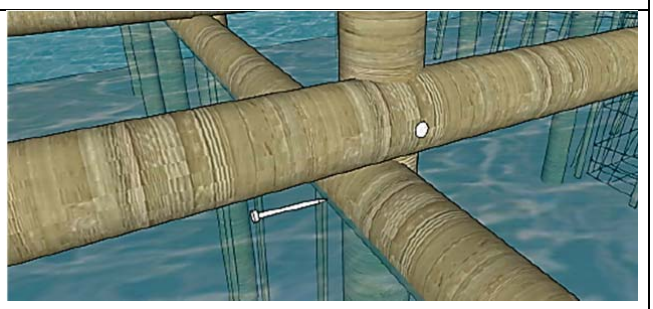
Source: photographed by the study

The construction sequence of building can be separated to three parts: foundation and floor, wall, and then roof. It reflects local perception to building's pattern. It is the construction method developed by villagers in order to overcome the restriction of the water base.

3.3.2 Construction details of working facility

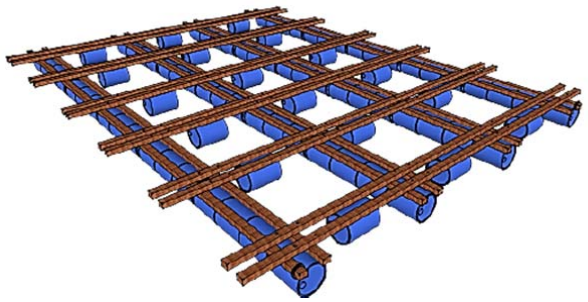
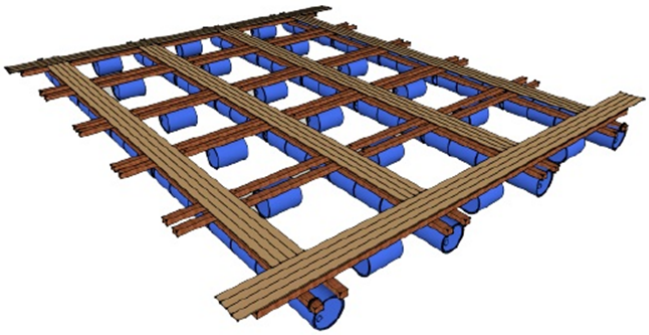
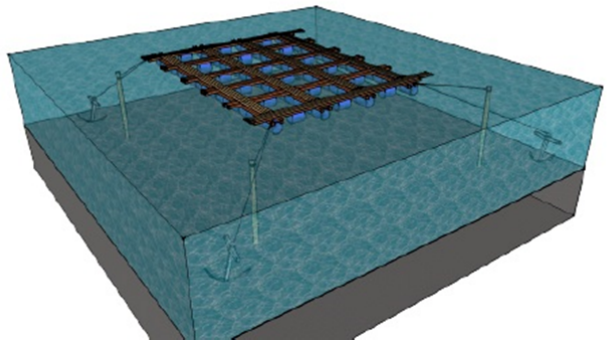
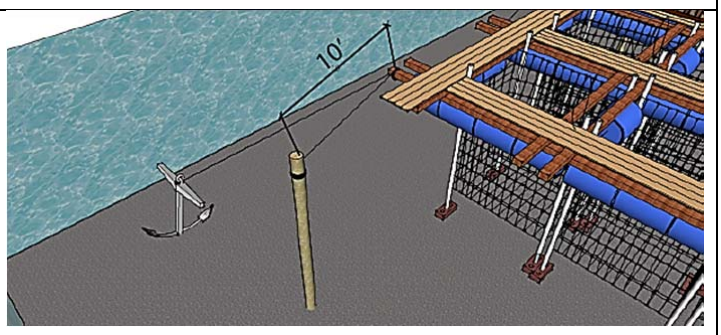
Despite workshop and working platform developed on the first layer of settlement, there are other two types of working facilities built that isolated from the settlement. *Kelong* was built for fish catching. Exact time of its origin is not found in the study. It was replaced by floating fish farm in 1970s due to the impact of sea pollution and decreasing catching.

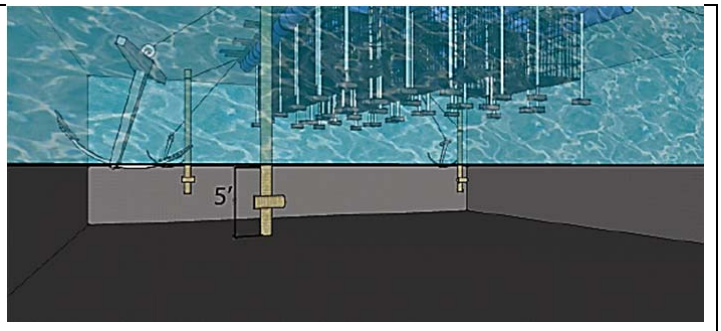
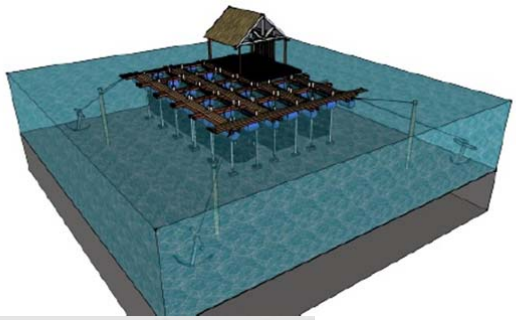
Table 3.3 Construction process of Kelong

1. Differs from living house, *kelong* is built on sea. It is firstly built a working platform on the sea. Two workers on the platform and two workers dive into sea to manually pile the areca logs into the ground for 5 feet. The distance between logs depends on the tide force. The stronger the tide, denser the logs are piled.	
2. The first level is always under sea level. The direction of fish trap has to follow the flow of tide and design trap entrance from north to south to lure fishes into the trap.	
3. The second level is for the operation of fishing.	
4. Logs are joined by nails. Areca log is high and straight that suitable to the construction on sea. However, it is easy to be damaged and has to be replaced every 2 to 3 years.	

Source: illustrated by the study

Table 3.4 Construction process of floating fish farm

1. The framework of floating fish farm is constructed on land. Woods are placed above plastic buckets and nailed together. A fish farm commonly contains around 100 grids.	
2. Passage is nailed above the woods.	
3. Fish farm is then dragged to open water and fix the position by anchor and mangrove log at four corners to prevent from being swept away by wave.	
4. The way to pile mangrove under the ground is same with *kelong*. Distance between fish farm and log is around 10 feet. The anchor will then be placed slightly farer than the log.	

6. Cross-shaped mangrove log takes same practice with wooden house.	
7. Fish nets are then put into the grids.	

Source: illustrated by the study

As the fish farms are set on the sea and meet stronger tide, the stabilization of net is considered. The net is string together through iron tube and brick. The tubes at four corners are to ensure the square-shaped of net, while the bricks add weight to net to fix the position.

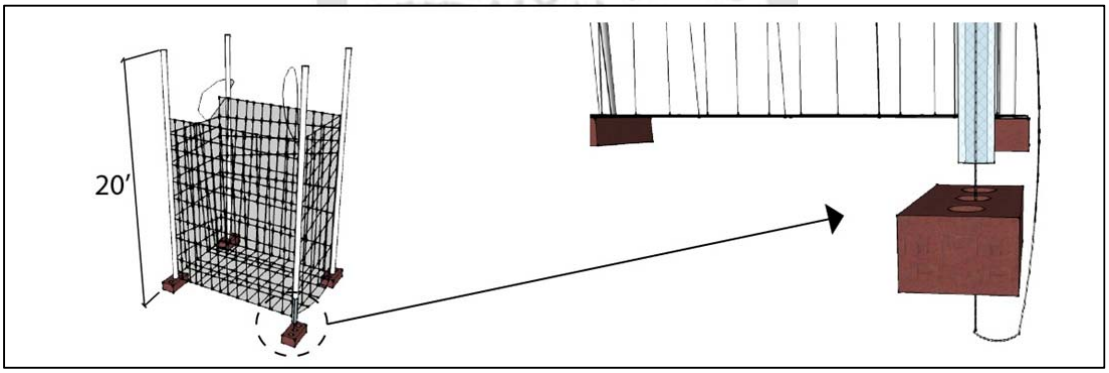


Figure 3.14 Construction details of fish net

Source: illustrated by the study

3.3.3 Construction materials

In history, the materials are basically found locally in the jungles. Mangrove woods were applied for pile foundation. Timbers were used commonly for the column and basic

structure, wall and thatched roof. Timber structure was then be replaced by modern construction materials and technology such as cement, brick and iron, etc.

1) Pile: mangrove log is used to support the weight of house and need to be replaced every 7 to 8 years regularly. It is then evolved to be buried under the ground to support concrete foundation.

2) Column: extremely good wood is used to support the high portion of weight of the house. After then it was replaced by concrete.

3) Crossbeam: it served to secure the structural framework and made by timber. After then it was replaced by concrete.

4) Floor: made of wood. After then it was replaced by concrete and ceramic tile.

5) Walls: leaves were used normally from palm tree. After then it was replaced by concrete and brick.

6) Roof: it consists of wooden framework and cover by leaves from palm tree. After then it was replaced by tile while the framework remained as wooden.

7) *Kelong*: trunk of palm tree is used to make entire framework. Timber is used to make passage.

8) Floating fish farm: plastic bucket or Styrofoam is used to make floating devices. Timber is use to made passage. Iron and brick to fix net's position.

3.4 Comparison with traditional Malay architecture

As mentioned in literature review, Hassan (2010) considered water village as one of the Malay architecture that similar to traditional Malay old port in eighteenth century. Besides, there is also statement in literature classified water village as Malay village that is located along water banks (Nasir & Teh, 1996). However, these studies' major concern to general structure of Malay architecture but not to water village. It neglects some fundamental difference between water building and Malay building.

To be noted that, there is also similarity between these two pattern particularly on roof shape and construction material. The comparison here intends to identify the distinction of pattern in its structure and function according to the designed interpretation of pattern (see page 13).

Table 3.5 Comparison of water building and Malay building

	Water building	Malay building
1) Foundation	▪ Cross-joint log piled into ground and raise above high tide level to create artificial space for building. ▪ Mangrove wood is used to adapt saline water.	▪ Timber piled into ground, decoration on interface between ground and air. ▪ Raised floors to prevent floods and animals, storage and working area.
2) Core house	▪ Most activities are conducted. ▪ Visitor entertainment.	▪ Most activities are conducted. ▪ Floor level is the highest in the house.
3) Front porch	▪ Bicycle and motor parking ▪ Visitor entertaining, usually neighbor and familiar visitor. ▪ Some alter front porch into local coffee shop, grocery or family handworks stall.	▪ Transition space between public and private domains. ▪ Unfamiliar visitors are entertained here. ▪ A hanging verandah is built between porch and core house as the place where most guest are entertained.
4) Fishing facility	▪ Fish farm is floating on water and adopt cross-joint log and anchor on four corners for stabilization. ▪ Mangrove wood is used to adapt saline water.	-
5) Workshop	▪ At the most strategic location to access to sea. ▪ Fish processing is operated here. ▪ Fisherman resting and gathering. ▪ Storage area.	▪ In raised floor under the house mentioned above.
6) Private jetty	▪ Pairing with workshop. ▪ Boat parking. ▪ Gateway to access to water.	-
7) Passage	▪ Connects to main path. ▪ Boundary between private and public territory.	▪ Paths are unclear as merge into open compounds of houses.

Source: summarized by the study

By identifying the difference especially on the structure, the comparison between water house and Malay house intends to raise concern to the spatial research of water house. It is particularly important to water settlement located on coastal area and flood-prone area. The vulnerability and adaptation research to water settlement is not adequate to design effective policy and measure towards resilient community.

3.5 Building response to coastal environment

Building is the most basic structure of settlement that provides space to conduct daily activity. Adaptation to climate and coastal environment is essential to water settlement in order to maintain the function of building. The pattern of building clearly displays this consideration.

Water building is generally divided into three parts (Figure 3.15). The foundation is built of pile structure to prevent tide intrusion. The pile is made by mangrove wood to adapt saline water. The middle part of building body constructs many windows for ventilation in tropical maritime climate. The upper part of roof is constructed by inverted V-shaped and high slope. It is to ensure rainfall shed rapidly to prevent leaking from heavy and frequent rainfall. The roof is usually hollow for ventilation. Ventilation is not only for comfort temperature but also necessary to create passage for strong winds on the sea.

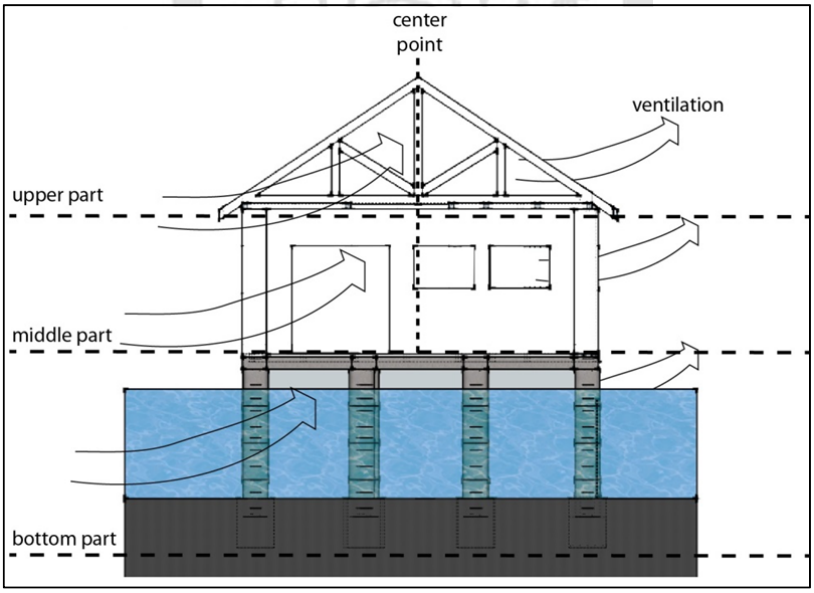


Figure 3.15 Adaptation consideration of building

Source: illustrated by the study

Some interviewees mentioned that generally the mangrove wood and wooden board applied in wet area of house such as kitchen and washroom lasted only 3 to 8 years because of sea wind erosion. Also several fires occurred in the settlement brought damage to property as well. To protect their belonging, new materials, for example tiles, bricks and concrete, are applied.

The experience of fire disaster has raised inhabitants' awareness of crisis too. For evacuation consideration, the village made regulation to design a back entrance and also built cross path to effectively connect the village.

The construction of fishing facilities also reflects the adaptation of environment change. *Kelong* is abandoned because of sea pollution and be replaced by floating fish farm. Fish farm has structure that drift with tide cycle up-and-down without rely on the force of ground. It also increases safety to activity above.

3.6 Conclusion

Seawater, tidal cycle and wetlands vegetation are the patterns to compose the base of building pattern. A water base site influences all other patterns and embellishments among the foundation, indoor and outdoor space and its volume, construction method and materials.

The development of pattern is majorly classified by the foundation of building. It contains pile structure and floating structure. The evolvement of foundation shows local perception and adaptive efforts to coastal environment. Building layout shows high enclosure of private space. From the development of building pattern, it is found that the development generally follows the demand of livelihood. Sea pollution decreases yield of catch and leads to floating fish farming. Industrial restructuring from fishery to tourism has facilitated the volume of indoor and outdoor space, also the pattern of indoor layout.

The construction of water buildings is highly applied on local materials and resources. Application of mangrove timber is the essential pattern attached on pile structure pattern. The pattern remains even when cutting of local mangrove log is forbidden nowadays.

Local perception to "live on water" considers coastal impact as natural cycle. The villagers show high tolerance to periodic floods and damage of artifacts. Spatial pattern has been facilitated to adapt to coastal environment.

Chapter 4 Conclusion and Suggestion

4.1 Conclusion

4.1.1 Summary of analytical result

This research discusses spatial pattern development of Kukup water villages in adapting environment change. It observes community scale and building scale pattern. Water settlement, which is shaped by local experience and measures, demonstrates a unique pattern that fits to local perception towards coastal environment. The pattern has been facilitated to adjustment according to local perception when facing any physical or socio-economic change. At the same time, the experience of several generations' practice have internalized into local perception in adapting physical and socio-economic change. Hence, the observation of local perception is conducted based on the analytical result of community scale and building scale pattern shown as Figure 4.1.

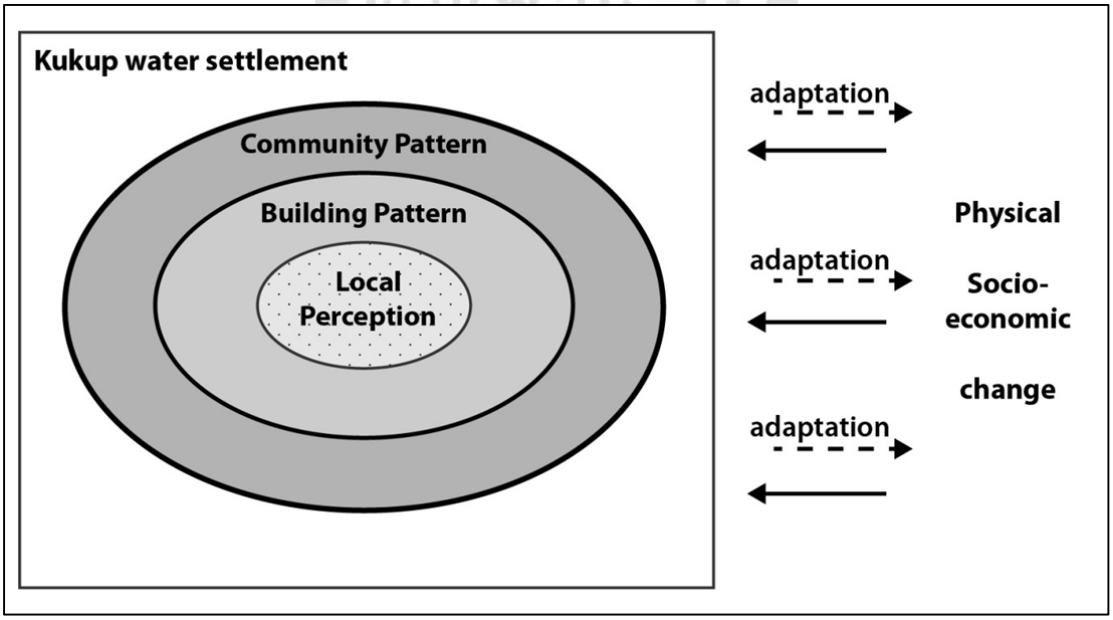


Figure 4.1 Interrelation between local perception, pattern and environment change

Source: illustrated by the study

It identifies spatial pattern of community scale in two designed phases. The spatial pattern is highly influenced by nature environment and the impact of tidal force. The pattern of water settlement can be identified by 5 development layers which show the

components of pattern including houses, workshop, jetty, path, public facility and public space, fishing facility and tourist facility. The pattern shows high enclosure and strong consciousness to community identity which can be found in the public-private space settings, local-outsider territory, clear boundary.

Spatial pattern of building scale can be classified by functions. A living house has pattern with pile foundation evolved with new material and technology. The development of spatial pattern basically follows the livelihood demand of residents which are jetty, workshop, and resort. Working building is fishing facility. The pattern development evolved from pile structure to floating structure with similar construction method referred to wooden living house.

Based on the pattern analysis and interviews, it identifies how spatial pattern reflected local perceptions and adaptive measures to live on water. The core issue is the difference recognition to “disaster” or “hazard”. Local villagers take natural occasional occurrence as part of natural cycle according to their living experience while policy maker and authority takes it as “risk”. The implementation of any top-down measure hence can be difficult due to neglect of local perception.

4.1.2 Pattern structure of network

According to Alexander et al. (1977), current settlement embodies a higher level of complexity than a tree structure. He proposes a three dimensional “semilattic” network which allows for multiple overlapping to occur, as well as provides nonhierarchical means of connectivity. The uniqueness of spatial pattern is shaped by the interconnection of various patterns from the larger scale to smaller and from the structural function to the embellishment.

The study adopts the viewpoint and summarizes pattern structure of network of Kukup water settlement shown as Figure 4.2. It is composed by overlapping pattern layers that shows internal connectivity of water settlement pattern.

A structural pattern of coastal environment set the tone for the network structure. Within coastal environment pattern, buildings, street and public spaces pattern have been shaped according to the settings of coast, as well as their function of human activity. These languages fix the position of individual buildings on the site while the components of

indoor and outdoor space shape both the volume of the buildings and the volume of the space between the buildings. While the pattern above gives a scheme of spaces, the final part will be the structural details including construction and materials.

The application of this particular sequence of pattern makes pattern language of Kukup water settlement. Pattern varies by application of different sequence or component. Using this conceptual network structure, it contributes to further study to water settlement pattern.

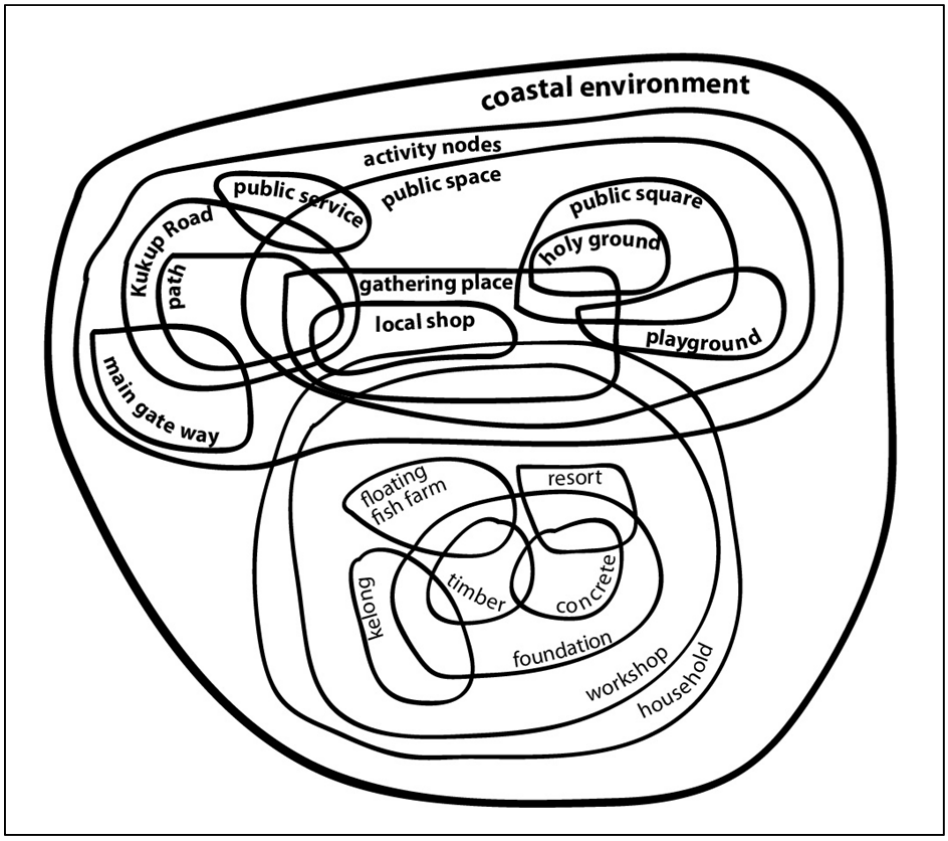


Figure 4.2 Pattern structure of network of Kukup water villages

Source: illustrated by the study

4.1.3 Local perception in adapting coastal environment

The coastal impact almost constantly happens with various depths of seawater tidal inundation and erosion. However people's perception of hazards may vary depending on their living experience. Study to the behavior of inundation and erosion, for example water depth, duration and factors, is critical to design and implement resilience policy.

Perception of flood depth is commonly ranged from one to two feet during high tide in monsoon period. The acceptance of flood is wide to see under the perception of residents. Most of the people treat it as natural tidal cycle and some of them especially elders and children welcome flood as time for leisure.

Various statements on the cause of flooding are recorded, such as lack of drainage system, inadequate maintenance to road, natural cycle, and land subsidence. It can be found that people in the settlement does not linked the cause of flood to sea level rise or climate change. Tidal flooding impact does not bother the residents, not to mention the business operators on the road. The only concern to flood is to protect their property and they can simply move them to higher place.

For climate change, the villagers especially fishermen are generally aware of unpredictable climate, season and monsoon that had never happened in their fishing career. It brought impact to their fishing operation and they have to rely on meteorology to decide whether to sail. Though there was situation such as houses damaged due to monsoon and collapsed due to waves, most of the interviewees feel acceptable in both frequency and degree of force.

Compare to natural disaster, however, the impact of man-made disaster is obviously perceived by the inhabitants. There were several times a large number of fish died collectively due to sea pollution. Black oil dumped into sea carried by monsoon from the ships on the Straits of Malacca, it brought twice of fish death. The impact is ongoing to the Straits of Kukup while it is comparatively calm to flow. The acidity remains high by current while the fish farm continues to generate fish waste and rubbish. Also, pesticides residues generated by agricultural activity on river downstream area is carried to the Straits of Kukup and worsen water quality.

The study found that the way the residents regard “impact” or “disaster” is usually linked to man-made hazards. While the residents are aware to the deterioration of natural environment, it is found that, they usually explain the phenomena based on their living experience, including sea pollution and domestic garbage pollution. To understanding local perception towards environment change is important for local resilience capacity measure.

While the policy making and implementation are from top-down system, the perception of local users may be neglected. In the case of Kukup settlement, their

generation's experience has shaped their perception to "impact" and "disaster". While local majority is not taking natural disaster as "disaster" but regular cycle of nature environment, the mitigation or prevention measures issued by government is not possible to be stressed by local users. Hence, it is critical to understand local perception to effectively design measure to enhance the resiliency of community.

The implementation of environment adaptation without considering local perception may lead to conflicts and difficulty, even worsen the situation. In this case, the recognition of sea level rise and climate change does not actually exist in people's perception, and thus the authority is considered as working on a problem that does not exist in people's eyes. Hence, the study of local perception is important to local resilience proactive measure.

4.2 Suggestion

Water settlement is a traditional lifestyle of Malaysia. It has intimate contact to water and surrounding natural settings. However, the study to its spatial pattern and climate change adaptation is limited. Further research is suggested including:

1) **Various oriented researches to its spatial characteristic**

The basic data to water settlement is inadequate to conduct any in-depth research. Various oriented researches to its spatial characteristic from regional scale to building scale are suggested to collect comprehensive knowledge to water settlement. Besides, the variants underlying spatial characteristic including various socio-economic and physical factors is suggested to be studied in order to identify their influence to water settlement.

2) **Evaluation to water building's structural capacity confronting tidal hazards**

This study finds that, previous studies to water settlement surfaced due to concern of tourism value and heritage preservation. However, despite of its social value, water buildings' structural capacity confronting coastal hazards and climate change impact is unknown. The research to water settlement's vulnerability is suggested in order to ensure living safety of the inhabitants.

Reference

Abidin, W. B. B. W. (1981). *The Malay House: Rationale and Change*: Massachusetts Institute of Technology Department of Architecture.

Aerts, J., Botzen, W., Bowman, M. J., Ward, P. J., & Dircke, P. (2012). *Climate Adaptation and Flood Risk in Coastal Cities*: Earthscan Canada.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language : towns, buildings, construction*. New York: Oxford University Press.

Bucx, T. (2010). *Comparative Assessment of the Vulnerability and Resilience of 10 Deltas: Synthesis Report*: Deltares.

Chan, N. W. (1995). Flood Disaster Management in Malaysia: An Evaluation of the Effectiveness of Government Resettlement Schemes. *Disaster prevention and management, 4*(4), 22-29.

Chan, N. W. (2011). Challenges in developing Clan Jetties as heritage attractions for conservation and tourism in Penang, Malaysia. *Malaysian Journal of Environmental Management, 12*(1), 117-127.

Chen, F. H. (1984). *Cun luo di li xue [in Chinese]*. Taipei: Wunan.

Chen, R. C. (1993). *The study of coastal settlement development in Taiwan [in Chinese]*. Taipei: Hu shi.

Hassan, A. S. (2010). Review on old city landscape with reference to traditional fishing village settlements in western coastal region, Peninsular Malaysia. *Jurnal of Human Settlements, 2*(1), 1-10.

Hillier, B., & Hanson, J. (1984). *The Social Logic of Space*. Cambridge: Cambridge University Press,.

Hsia, C. J. (1994). *Public Space* Taipei: Council for cultural affairs, MOC.

ICLEI. (2004). *Resilient Communities and Cities Partnership Program proposal*. ICLEI.

Ismail, H. W. (2005). *Houses in Malaysia: Fusion of the East and the West*: Penerbit Universiti Teknologi Malaysia.

Kadir, A. B. A. (1955). *Hikayat Abdullah*: Oxford University Press.

Leung, D. C. F. (2002). *Rebuilding Community Spirit: Developing a Communal Reconstruction Strategy in the Village of Tai O, Hong Kong.* (Master thesis), Dalhousie University. Retrieved from http://books.google.com.tw/books?id=ABY-OAAACAAJ

Lim, J. Y. (1987). *The Malay house : rediscovering Malaysia's indigenous shelter system*. Pulau Pinang, Malaysia: Institut Masyarakat.

Lin, Y. H. (2006). *A Study of Street Fabrics of the Traditional Towns in Taiwan [in Chinese]*. (Master thesis), NCKU, Tainan.

Md. Din, A. H., & Mohd. Omar, K. (2009). *Sea level change in the Malaysian seas from multi-satellite altimeter data*. Paper presented at the Postgraduate Seminar Faculty of Geoinformation Science & Engineering, Institut Ibnu Sina UTM.

MDP. (2013, 26 November). Background of Pontian. Retrieved 26 November, 2013, from http://www.mdpontian.gov.my/en/latar_blkg_pontian

Morris, A. E. J. (1994). *History of urban form : before the industrial revolutions* (3rd ed.). Harlow, Essex, England: Longman Scientific & Technical: Wiley.

MOSTE. (2000). *Malaysia 'Initial National Communication' submitted to the United Nations Framework Convention on climate change*. Ministry of Science, Technology & the Environment, Malaysia.

Muh, A. M., Lorenz, K., Junun, S., Sudrajat, S., Sri Rahayu, B., & Fajar, Y. (2008). The impact of tidal flooding on a coastal community in Semarang, Indonesia. *Environmentalist, 28*, 237-248. doi: DOI 10.1007/s10669-007-9134-4

Nasir, A. H., & Teh, H. H. W. (1996). *The traditional Malay house*. Shah Alam: Fajar Bakti.

Ng, V. (2013). Toward a holistic understanding of sense of place: a phenomenological reading of Chew Jetty, Penang. *International Journal of Humanities and Social Science, 3*(20), 75-83.

NST. (2012). A century's wait for land title ends [Press release]. Retrieved from http://www.nst.com.my/a-century-s-wait-for-land-title-ends-1.64587

Olthuis, K., & Keuning, D. (2010). *Float! : building on water to combat urban congestion and climate change*. Amsterdam: Frame.

Ong, J. E. (2000, 14-16th November). *Vulnerability of Malaysia to sea level change.* Paper presented at the Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia - Pacific Region, Kobe, Japan.

Otto-Zimmermann, K. (2012). *Resilient Cities 2: Cities and Adaptation to Climate Change - Proceedings of the Global Forum 2011*: Springer.

Said, S. (1977). Kegiatan keluarga Alsagoff dalam ekonomi negeri Johor 1878-1906 [in malay]. *Malaysian Journal of History, Politics and Strategic Studies, 07*(08), 52-67.

Schofield, J. W. (1990). Increasing the generalizability of qualitative research *Qualitative inquiry in education: the continuing debate*. New York: Teachers College Press.

Sha, X. (1974). *Cheng shi yu si cheng ju luo [in Chinese]*. Taipei: Zheng zhong.

Smith, D. (1994). Flood damage estimation - A review of urban stage-damage curves and loss functions. *Water SA, 20*, 231-238.

UNISDR. (2009, 2009). Terminology on disaster risk reduction. Retrieved Feb 04, 2014, from http://www.unisdr.org/we/inform/terminology

Yang, W. Y. (2009). *A research on the transformation of spatial texture and architectural form of military dependents'village : a case study of Lyufong East Village, Tainan city.* (Master thesis), NCKU, Tainan.

Yin, R. K. (2003). *Design and methods (3rd ed.)*. Thousand Oaks: Sage.

Glossary

English	Malay	Chinese (local used term)
Johore	Johor	柔佛
-	Kukup Laut	龜咯港腳(漁村)
-	Ayer Masin	咸水港(漁村)
Floating fish farm	-	漁場
Kukup Island	Pulau Kukup	龜咯島
Nipa palm	Attap	亞答(葉)
On stilt fish trap	Kelong	牵籠
Wooden boat	Sampan	舢舨
Path	-	橋路
Wooden jetty	-	搭頭
Malacca	Melaka	馬六甲
Tai-o village	-	大澳漁村
Old Johor Fort	Kota Johor Lama	柔佛舊城
Malay village	Kampong (kampung)	馬來村落
Gabled roof	Bumbung panjang	人字形屋頂
Hipped roof	Bumbung limas	四角屋頂
Gabled hip roof	Bumbung potong perak	人字形四角屋頂
2-tiered pyramidal roof	Bumbung mera 2-tingkat	雙層金字塔形屋頂
Core house	Rumah ibu	主屋
Kitchen	Dapur	廚房
Covered porch	Anjung	(覆蓋式)門廊
Hanging verandah	Serambi gantung	吊掛式陽台
Closed walkway	Selang	(屋內)走廊
Middle hall	Rumah tengah	中廳
Lounge	Lepau	休息區
Areca	Pinang	檳榔樹
Oncosperma tigillaria	Nibong	-
Eugeissona trisis palm	Bertam	婆羅洲西米
Baeckea frutescens	Cucur attap	岡松
Metroxylon	Rumbia	西米椰子/沙谷
Nypa fruticans	Nipah	水椰
Kukup Road	Jalan Kukup	龜咯路
Facedown	Telukup (telungkup)	翻覆
Permas River	Sungai Permas	-

Appendix

1) Partial contents from *Town and Country Planning Act 1976* that relevant to the study extracted for review:

Act 172 TOWN AND COUNTRY PLANNING ACT 1976

Incorporating all amendments up to 1 January 2006

PART I PRELIMINARY

Interpretation

2. (1) In this Act, unless the context otherwise requires—

"building" includes any house, hut, shed, or roofed enclosure, whether or not used as a human habitation, and any wall, fence, platform, staging, gate, post, pillar, paling, frame, hoarding, slip, dock, wharf, pier, jetty, landing-stage, or bridge, and any structure, support, or foundation connected to or with any of those structures;

"building operation" means the demolition, erection, re-erection, or extension of a building or part thereof and includes—

(a) any increasing of the height or floor area of a building;

(b) the roofing or re-roofing of a building or part thereof;

(c) any addition to or alteration of a building that affects or is likely to affect its drainage or sanitary arrangements or its soundness;

(d) any addition to or alteration of a building, whether done before or after completion of the building, that departs in any manner from any plan or specification in respect of the building approved at any time by any authority empowered under any written law to approve the plan or specification;

(e) any addition to or alteration of a building that materially affects or is likely to materially affect the building in any manner; and

(f) any other operation normally undertaken by a person carrying on the business of building construction;

"land" includes—

(a) the surface, and all substances forming the surface, of the earth;

(b) all substances below the surface of the earth;

(c) all vegetation and other natural products, whether or not requiring periodical application of labour to their production, and whether on or below the surface of the earth;

(d) all things, whether on or below the surface of the earth, that are attached to the earth or permanently fastened to any thing attached to the earth;

(e) land covered by water; and

(f) any estate or interest in, or right over, land;

"local authority" means any city council, municipal council, municipality, district council, town council, town board, local council, rural board, or other similar authority established by or under any written law;

"local plan", in relation to an area, means the local plan for the area, and any alteration of the plan, for the time being having effect in the area by virtue of subsection 15(1); and, in relation to any land or building, means the local plan, as so defined, for the area in which the land or building is situated; and "draft local plan" shall be construed as the context requires;

"local planning authority", in relation to an area, shall be construed as provided in section 5 and, in relation to any land or building, means the local planning authority, as so construed, for the area in which the land or building is situated;

"occupier", in relation to any land or building, includes—

(a) a tenant of the land or building;

(b) an owner of the land or building occupying or otherwise using the land or building;

(c) a person in actual occupation of the land or building or having the charge, management, or control thereof, whether on his own account or as an agent of another person, but does not include a lodger;

"open space" means any land whether enclosed or not which is laid out or reserved for laying out wholly or partly as a public garden, park, sports and recreation ground, pleasure ground, walk or as a public place;

"owner", in relation to any land or building, means—

(a) the registered proprietor of the land;

(b) if, in the opinion of the local planning authority, the registered proprietor of the land cannot be traced, his agent or trustee;

(c) if the registered proprietor of the land is dead, his legal personal representative;

(d) if none of the persons mentioned in paragraphs *(a)*, *(b)*, and *(c)* exists, the person who for the time being is receiving the rent of the land or building, whether on his own account or as an agent or trustee of another person or as a receiver, or who would be receiving the rent if the land or building were let;

"road" means any public or private road, and includes any street, square, court, alley, lane, bridge, footway, track, bridle-path, passage, or highway, whether a thoroughfare or not, over which the public have a right of way;

"use", in relation to any land, means any use of the land other than merely for the keeping or storage of materials and equipment intended to be employed in the construction or erection of a building on the land, or as a site for temporary buildings for the accommodation of workers involved in the construction or erection of the building;

PART II POLICY AND ADMINISTRATION

Local planning authorities

***5.** (1) Every local authority shall be the local planning authority for the area of the local authority.

**(2) For any area in the State that does not form part of the area of any local authority, the State Director shall be the local planning authority, and references to the "local planning authority" in this Act shall be deemed to include the State Director whenever he performs the functions of the local planning authority in relation to that area.

(3) (*Deleted by Act A1129*).

(4) A local planning authority shall furnish the Committee with such returns and information relating to its activities as the Committee may from time to time require.

Functions of local planning authorities

6. (1) The functions of a local planning authority shall be—

(a) to regulate, control and plan the development and use of all lands and buildings within its area;

(b) to undertake, assist in, and encourage the collection, maintenance, and publication of statistics, bulletins, and monographs, and other publications relating to town and country planning and its methodology; and

(c) to perform such other functions as the State Authority or the Committee may from time to time assign to it.

(2) A local planning authority may perform any other functions that are supplemental, incidental, or consequential to any of the functions specified in subsection (1) and do all such things as may be necessary or expedient for carrying out its functions under this Act.

PART IV PLANNING CONTROL

Use of land and buildings

18. (1) No person shall use or permit to be used any land or building otherwise than in conformity with the local plan.

(2) Subsection (1) shall not apply to the use of any land or building for the purposes described in paragraph 19(2)*(d)*.

(3) Subsection (1) shall not affect the continuance of the use of any land or building for the purposes for which and to the extent to which it was lawfully being used prior to the date when a local plan first came into effect in the area concerned or, where there has been a change of local plans or in a local plan, the date when the change became effective.

Prohibition of development without planning permission

19. (1) No person, other than a local authority, shall commence, undertake, or carry out any development unless planning permission in respect of the development has been granted to him under section 22 or extended under subsection 24(3).

(2) Notwithstanding subsection (1), no planning permission shall be necessary—

(*a)* for the carrying out of such works as are necessary for the maintenance, improvement, or other alteration of a building, being works that affect only the interior of the building and do not—

(i) involve any change in the use of the building or the land to which it is attached;

(ii) materially affect the external appearance of the building;

(iii) involve any increase in the height or floor area of the building;

(iv) involve any addition to or alteration of a building that affects or is likely to affect its drainage, sanitary arrangements, or its soundness; or (v) contravene or involve or result in any inconsistency with any provision in the local plan;

(*b)* for the carrying out by any authority established by law to provide utilities of any works for the purpose of laying, inspecting, repairing, or renewing any drains, sewers, mains, pipes, cables, or other apparatus, or for the purpose of maintaining or repairing roads, including the breaking open of any road or ground for those purposes;

(*c)* for any excavation, including excavation of or for wells, made in the ordinary course of agricultural operations in areas zoned for agriculture;

(*d)* for the use of any land or building for a period not exceeding one month or such further period as the local planning authority may allow for purposes of—

(i) a temporary or mobile cinema, theatre, or show;

(ii) a temporary amusement park, fair, or exhibition; or

(iii) a temporary ceremony or festivity of a religious, social, or other character, and for any development necessary to give effect to such use;

(*e)* for the construction or erection on any land of temporary buildings for the accommodation of workers involved in the construction or erection of a building on the land, for which planning permission has been granted;

(*f)* for the use of any land or building within the curtilage of a dwelling-house for any purpose incidental to the enjoyment of the dwelling-house as such; or

(*g)* for the making of such material change in the use of land or building as the State Authority may prescribe to be a material change for which no planning permission is necessary.

Source: www.agc.gov.my/Akta/Vol.%204/**Act**%20172.pdf

2) Partial contents from *Street, Drainage and Building Act 1974* that relevant to the study extracted for review:

Act 133 STREET, DRAINAGE AND BUILDING ACT 1974

Incorporating all amendments up to 1 January 2006

PART I PRELIMINARY

Interpretation

3. In this Act, unless the context otherwise requires—

"arcade" includes verandah;

"dwelling house" includes a building or tenement wholly or principally used, constructed or adapted for use for human habitation;

"footway" includes footpaths and verandah-ways at the sides of streets;

"frontager" means the owner of premises fronting on, adjoining, abutting on, or (though not actually so fronting, adjoining or abutting) adjacent or accessible to a street or back-lane or where—

(a) the owner of the premises by himself or his tenant has the right to use or commonly does use the street or backlane as a means of access to or drainage from the premises; and

(b) in the opinion of the local authority, the use or the right to use is for the advantage or benefit of the land;

"house" includes dwelling-house, warehouse, office, countinghouse, shop, school, and any other building in which persons are employed;

*"private connection pipe" has the same meaning assigned to it under the Sewerage Services Act 1993 [*Act 508*];

"private street" means any street not being a public street;

"public street" means any street over which the public has a right of way which was usually repaired or maintained by the local authority before the coming into operation of this Act or which has been transferred to or has become vested in the local authority under this Act or in any other manner;

*"sewer" has the same meaning assigned to it under the Sewerage Services Act 1993;

*"sewerage system" has the same meaning assigned to it under the Sewerage Services Act 1993;

"street" includes any road, square, footway or passage, service road, whether a thoroughfare or not, over which the public have a right of way, and also the way over any bridge, and also includes any road, footway or passage, open court or open alley, used or intended to be used as a means of access to two or more holdings, whether the public have a right of way over it or not; and all channels, drains, ditches and reserves at the side of any street shall be deemed to be part of such street;

"street works" includes work of sewering, levelling, paving, metalling, flagging, kerbing, channelling, draining, lighting, laying of water, gas or electricity services and otherwise the making good a street or part of a street;

"structural elements" means those parts or elements of a building which resist forces and moments and includes foundations, beams, columns, shear cores, slabs, roof trusses, staircases, load bearing walls and all other elements designed to resist forces and moments but excludes doors, windows and non-load bearing walls;

"structural plan" means a plan relating to structural elements;

"sullage" includes any household waste liquids discharged from any bath, shower, lavatory, basin, floor gully, laundries or sink (not being a slop sink) but excludes faecal water and urine.

PART II STREETS

Maintenance and repair of public streets

4. (1) The local authority shall, so far as the funds at its disposal will admit, cause all public streets together with the footways thereof, whether covered by arcades or not, to be maintained and repaired and may—

(a) cause the same to be paved, metalled, flagged, channelled, drained, kerbed, lighted or otherwise improved, and the surface thereof to be raised, lowered or altered as it thinks fit;

(b) make and keep in repair any footways for the use of foot passengers in any such street;

(c) place on the sides of such footways or otherwise such fences and posts as are needed for the protection of foot passengers;

(d) provide street lighting.

Power to make and improve streets

5. The local authority may, with the consent of the State Authority—

(a) lay out and make new streets and back-lanes;

(b) build and construct bridges and tunnels;

(c) turn, divert, discontinue or stop up any public street; and

(d) widen, open, enlarge or otherwise improve any public street.

Private persons making new streets

9. (1) No person shall make any new street without the prior written permission of the local authority.

(2) Any person who intends to make any new street shall apply to the local authority, accompanied by a plan in duplicate, showing the intended level and construction of such street and the level of the houses to be built on the land abutting upon it and the proposed manner of draining it and by a statement specifying the use for which such street is intended:

Provided that the local authority shall not approve the detailed plans of any new street unless the use of the land for this purpose has been approved by the competent authority under any law relating to town and country planning.

(3) The local authority may give written directions to the person submitting a plan for a new street with regard to any of the following particulars:

(a) compliance with this Act and any by-laws made thereunder;

(b) the line of the new street, so as to ensure that it forms a continuous street with any existing or proposed new street;

(c) the level, material and construction of the new street;

(d) the provision of footpaths and the size, specification and gradient of such footpaths;

(e) the provision along the length of the new street of intersecting streets or back-lanes;

(f) the width of the new street;

(g) the width of any intersecting street or back-lane, which shall be of such width as the local authority requires;

(h) the gradients, levels and mode of drainage of the new street and of any intersecting streets or back-lanes;

(i) the rounding of the corners of new streets;

(j) the provision of culverts and the sizes, specifications and gradients of such culverts; and

(k) the provision of street lighting, and the person to whom any such written directions are given shall amend the plan accordingly.

(4) The person whose plan has been approved by the local authority and each successor in title of such person, in so far as the street lies in the land acquired by him, shall lay out the new street and demarcate its boundaries by such boundary stones or other marks as may be specified by the local authority to denote the length, width and alignment of the street.

(5) If the new street has not been laid out and demarcated within the period of six months from the date when the plan was first approved or within such further period as may be approved by the local authority, the local authority may enter upon the land and lay out the new street and demarcate its boundaries at the expense of the person whose plan has been approved or of his successor in title.

(6) The person whose plan has been approved by the local authority or his successor in title in so far as the street lies in the land acquired by him shall, if he constructs the new street, construct the new street in accordance with the plan approved by the local authority within such period as may be specified in such approval:

Provided that the local authority may renew such approval for such period as it considers necessary.

(7) Any person who—

(a) constructs any new street otherwise than in accordance with a plan approved by the local authority under this section;

(b) without the permission in writing of the local authority plants any hedge in such manner that any part thereon is in any direction less than twenty feet from the centre of the carriageway of any street, not being a public street, or less than forty feet from the opposite

side of any road or path which is used or intended to be used as the means of access to two or more houses exclusive of the width of any footway which the local authority requires; or

(c) constructs any culvert or bridge on the line of the new street drainage otherwise than in accordance with the plans and specifications approved by the local authority, shall be liable on conviction to a fine not exceeding two thousand ringgit, and a Magistrate's Court shall, on the application of the local authority, make a mandatory order against the offender requiring him to execute any one or more of the following works:

(i) to alter the street;

(ii) to remove any hedge so planted;

(iii) to alter or remove any culvert or bridge so constructed; or

(iv) to comply with the plan approved by the local authority.

(8) Where any new street is stated to be intended for pedestrians, the local authority may impose such conditions for ensuring that the same shall not be used by vehicles or classes of vehicles as may be specified by it.

(9) Any person who keeps open or uses such street in breach of the conditions imposed under subsection (8) shall be liable on conviction to a fine not exceeding one thousand ringgit and shall also be liable to a further fine not exceeding one hundred ringgit for every day during which the offence is continued after service of a notice to cease the breach.

(10) No person shall erect or maintain or permit to be erected or maintained any obstruction in any street, and the local authority may, where any such obstruction exists, take down and remove the same and cost and expenses of so doing may be recovered from the person who erects, maintains or permits the erection or maintenance of such obstruction and shall be recoverable in the manner hereinafter provided.

(11) For the purposes of this section the continuation of an existing street or the widening or alteration of any existing street or the adapting for carriage traffic of a street made for other traffic shall be deemed to be making a new street in respect of the whole thereof.

(12) If the person applying under subsection (2) is dissatisfied with any requisition or disapproval by the local authority, he may, within seven days from the receipt of such requisition or disapproval, appeal to the State Authority whose decision shall be final.

(13) If the local authority does not, within two months of receipt of the application and plan under this section approve, disapprove or make written requisition with regard thereto the applicant may then apply to the State Authority, and the powers vested in the local authority under this section shall then be vested in the State Authority.

Projecting verandahs, *etc*., may be made in streets not less than 40 feet wide

34. (1) The local authority may give permission in writing to owners of houses or buildings fronting, adjoining or abutting on public street of not less than forty feet in width to project open verandahs, balconies, sun shades, weather frames and signboards and may, in granting such permission, impose any condition it thinks fit.

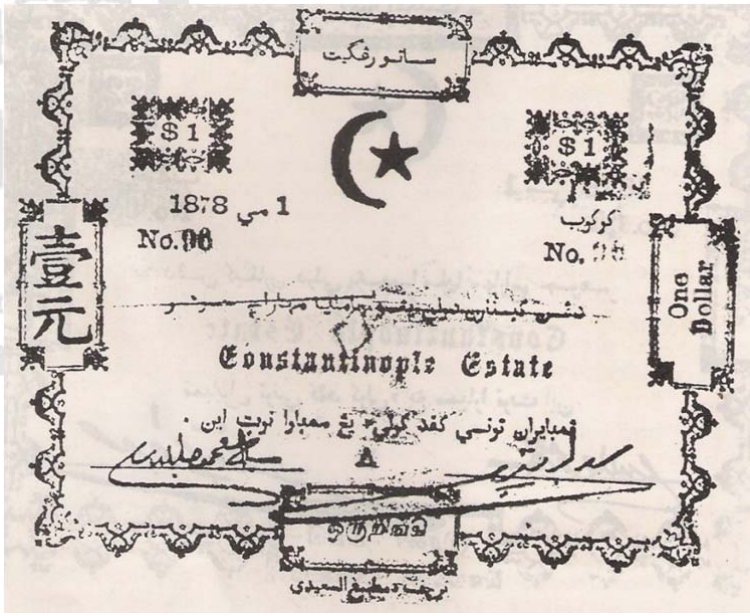
(2) On breach of any such condition the local authority may give the owner or occupier notice to comply with such condition and, if such condition is not complied with within thirty days, a

Magistrate's Court shall, on the application of the local authority, make a mandatory order for the removal of such projection.

Source: www.agc.gov.my/Akta/Vol.../Act%20133%20Teks%201%20(1-50).pdf

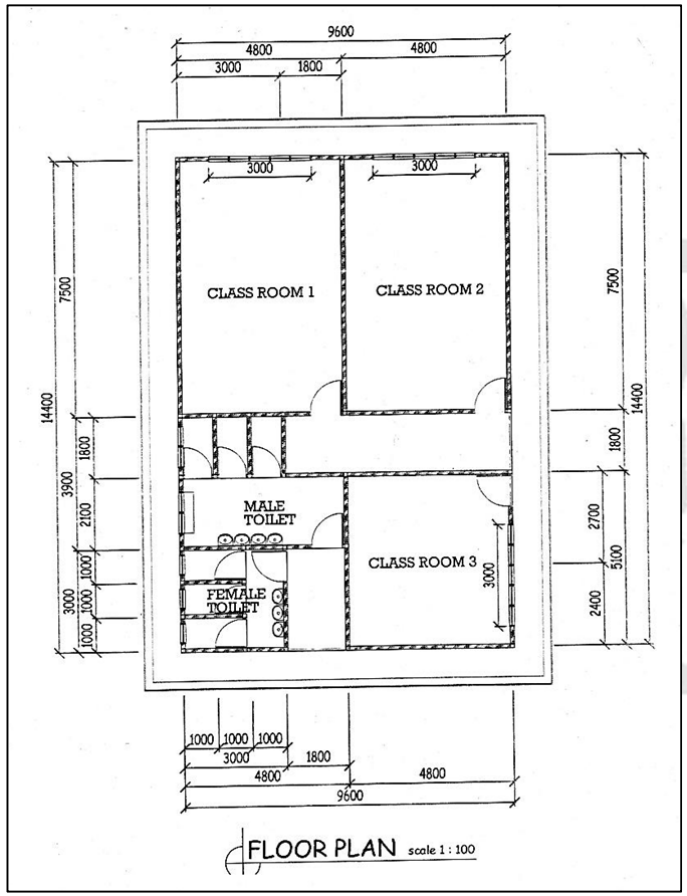
3) Ancient notes issued by Constantinople Estate provided by villager:

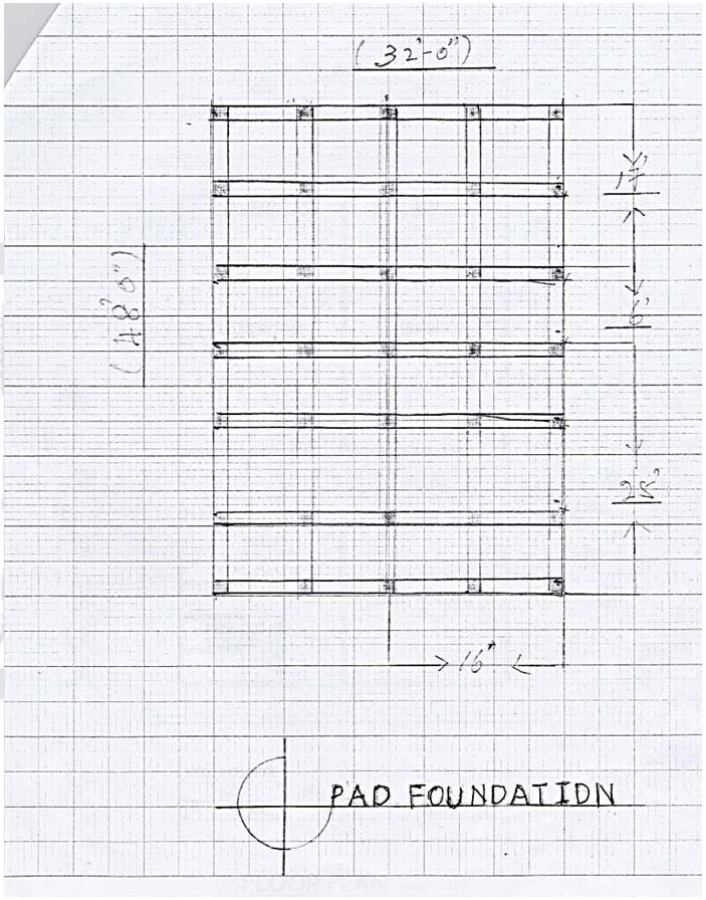
Description of note on the left: A frame printed currency value in English (left), Jawi (top), Chinese (right) and Tamil (bottom). An icon contains a crescent and five-sized star on the top center represented Johor Sultanate with the value "$2" in a square to either side of it. Below was the date printed 1st May 1878 and a serial number rubber stamped when issued. The first line of sentence on the right center was written by Jawi in meanings of “Kukup” and “With permission of His Highness the Maharajah of Johor”. Below it was in English "Constantinople Estate" and the bottom line in Jawi script "For payment in cash on production by coolies" followed by the handwritten signatures and the sealed chop.



Source: Provided by villager, 2012

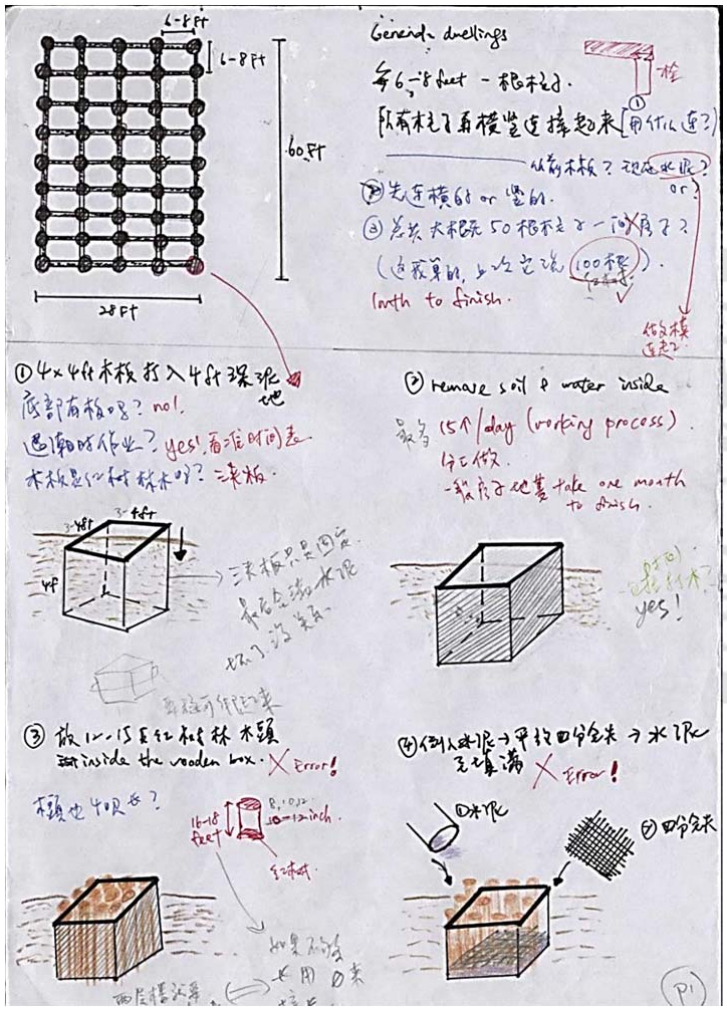
4) Construction Floor plan of Ken Boon Primary School provided by villager:

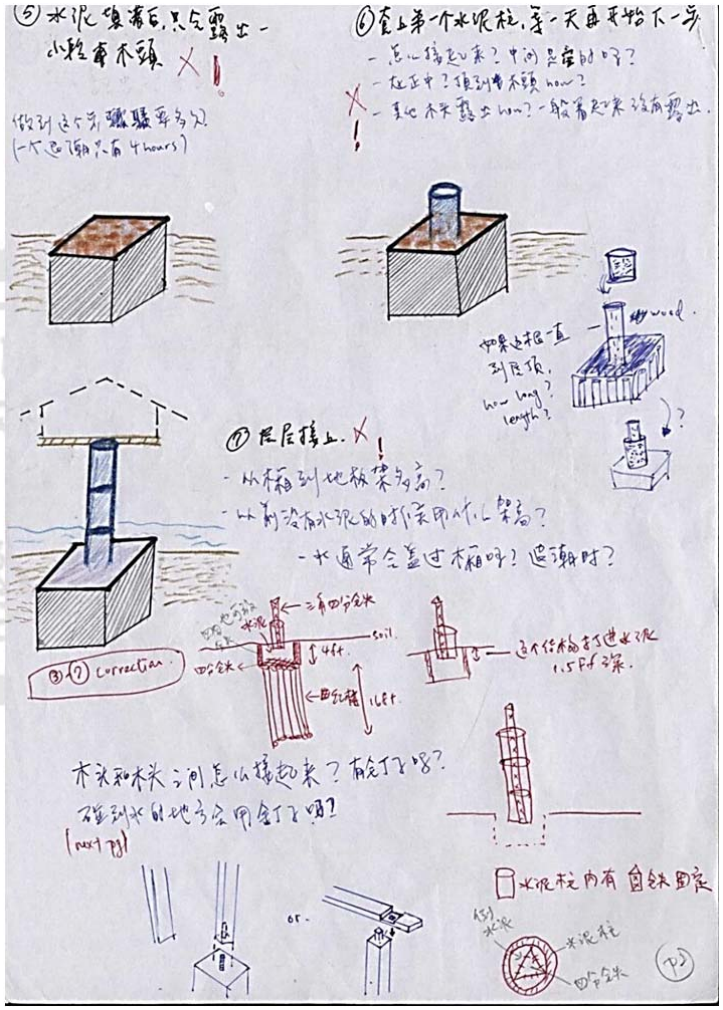


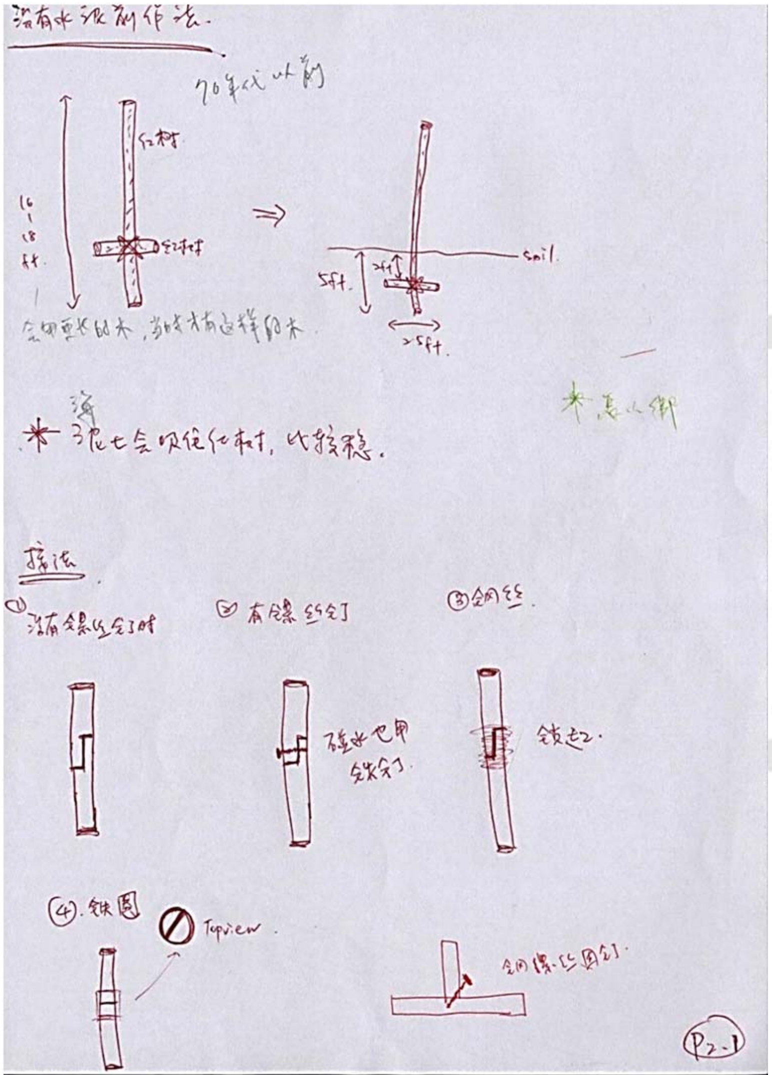


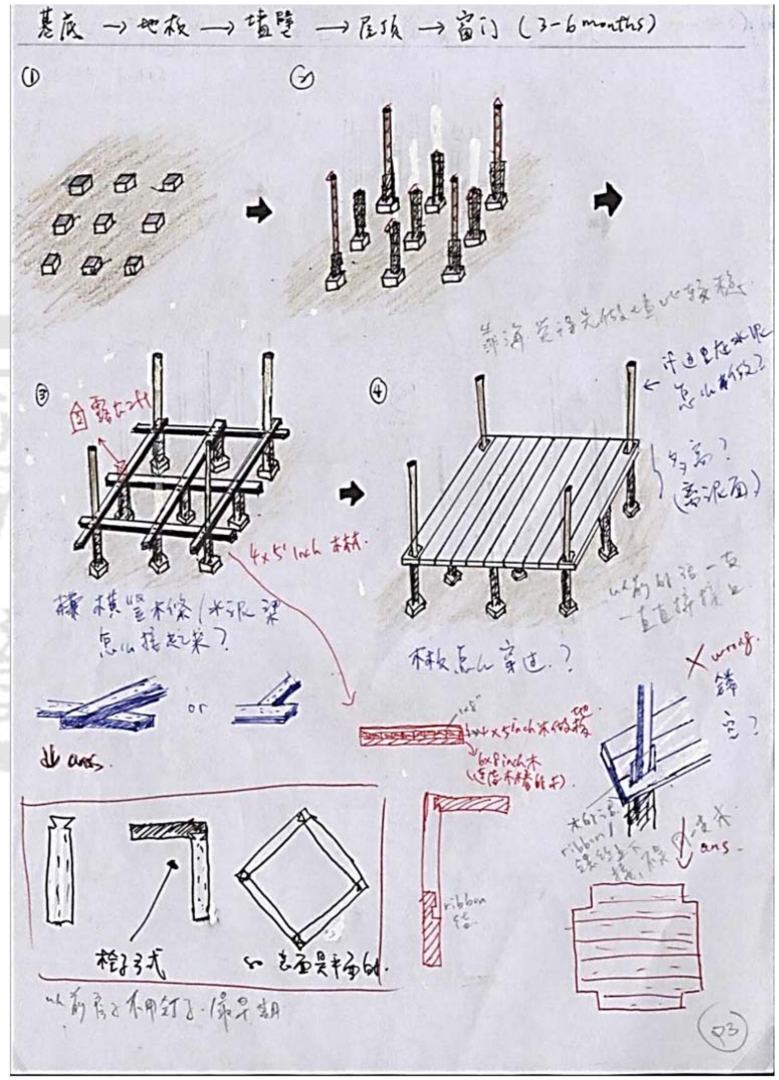
Source: Provided by villager, 2013

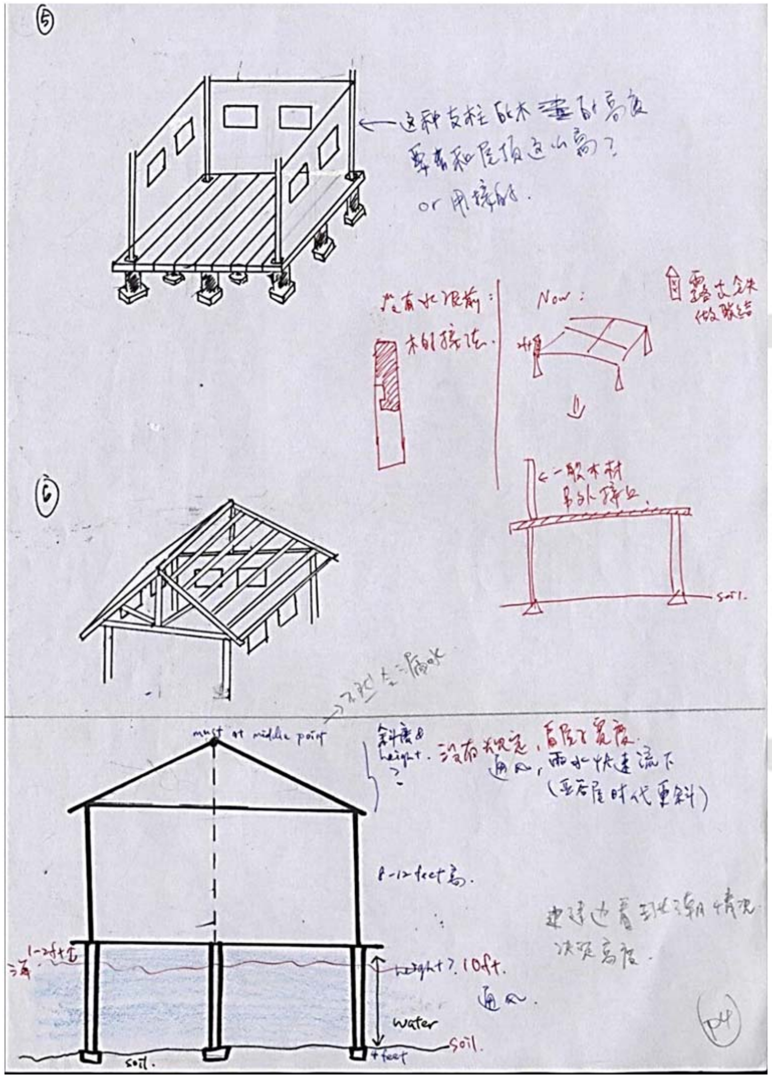
5) Some manuscripts during field research:



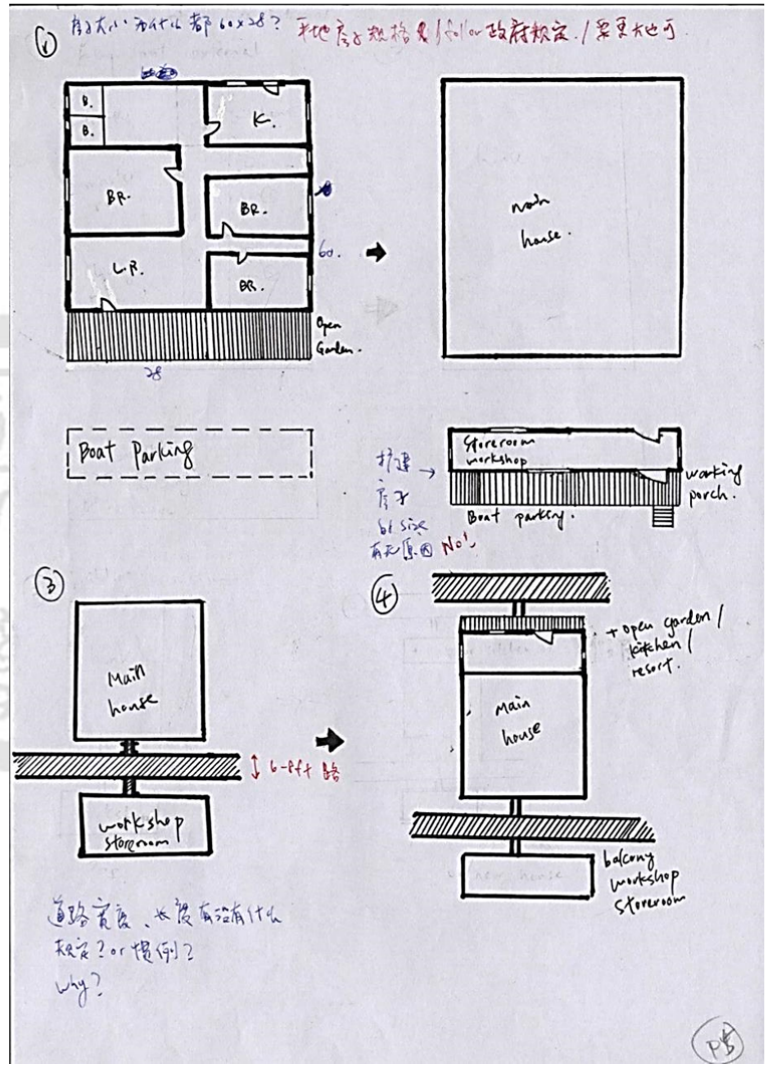



70年代以前
soil
5ft.
>5ft.
Top view
P2-1


(3-6 months)
4x5 inch
or
ans.
ribbon
ans.
wrong.
P3

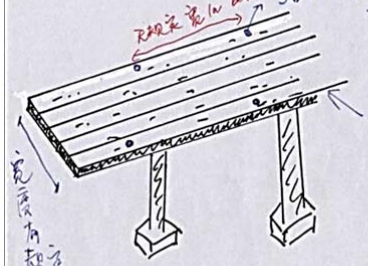


Now:
must at middle point
8-12 feet 高.
height? 10ft.
water
Soil.
soil.



K.
BR.
BR.
BR.
L.R.
Open Garden.
28
Boat Parking
main house.
Storeroom workshop
working porch.
Boat parking.
Main house
workshop storeroom
Main house
balcony workshop storeroom
Why?

road.



开始是木板？什么木？
台架水泥的构造是？架在木板上 or 直接？
水泥+钢筋 or 还会加木板？

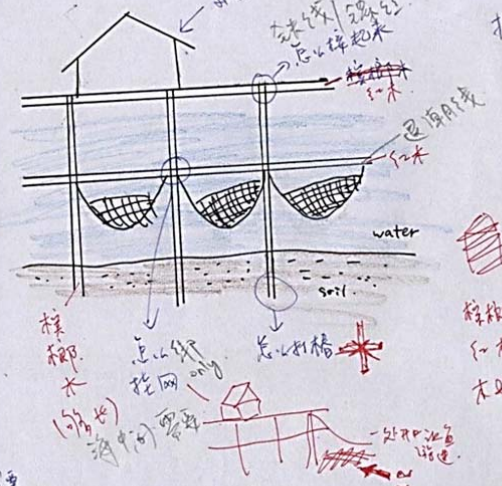
再拆重建

→房子最容易坏的地方（要维修的地方）是哪里？
怎么坏法？多久要修一次？怎么修
轻森 5-6年
海水不怕潮湿
全拆再建
整个区域
原来的地方 Toilet, Kitchen
但有些没关系
（改钢筋水泥 now）

红树 在水中易坏 1-2年
埋在土中没有空气，可耐百年以上

P6

Kelong (1970以前)



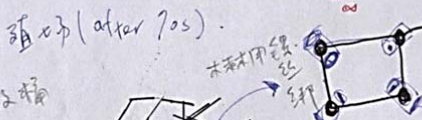
建材？一般材料 竹木

怎么绑起来

Kelong是养殖还是捕鱼？
捕鱼的话？鱼怎么引到网里面

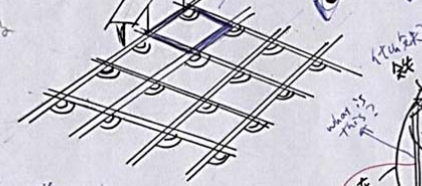
一个渔场多少渔格？
没有规定

轻轻敲木 2-3年换一次
红木 8年
木头 木与木之间用金属丝绑

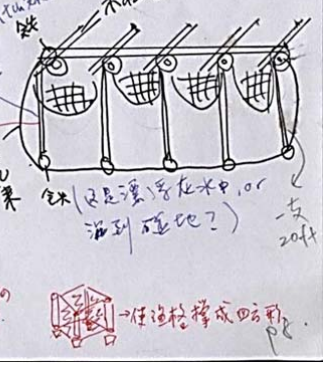


漂浮养殖场 (after 70s)

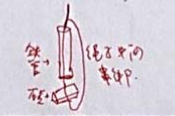
怎么绑
再说



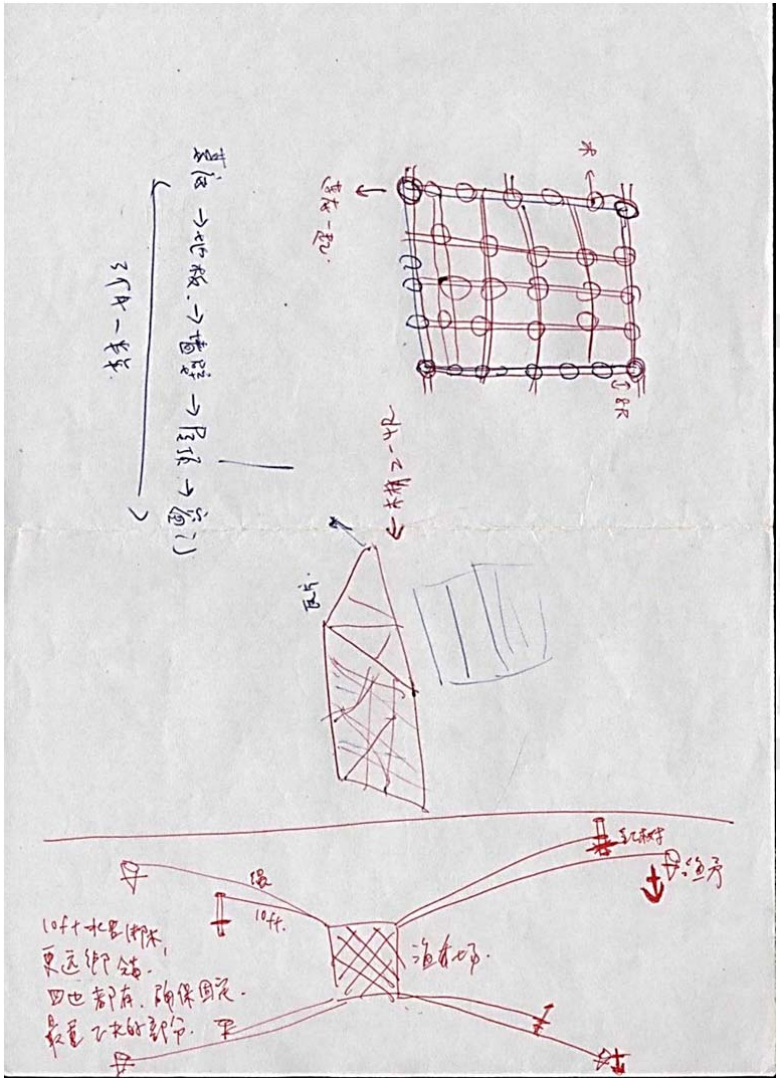
怎么样的构造
请他们说明

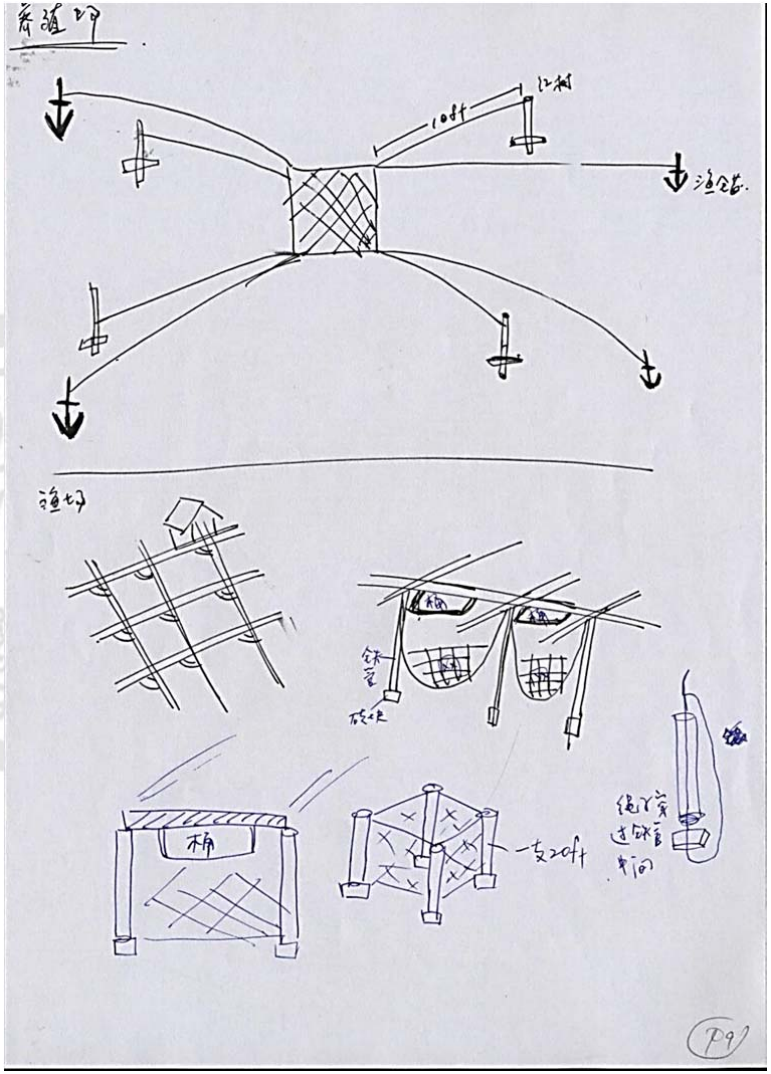


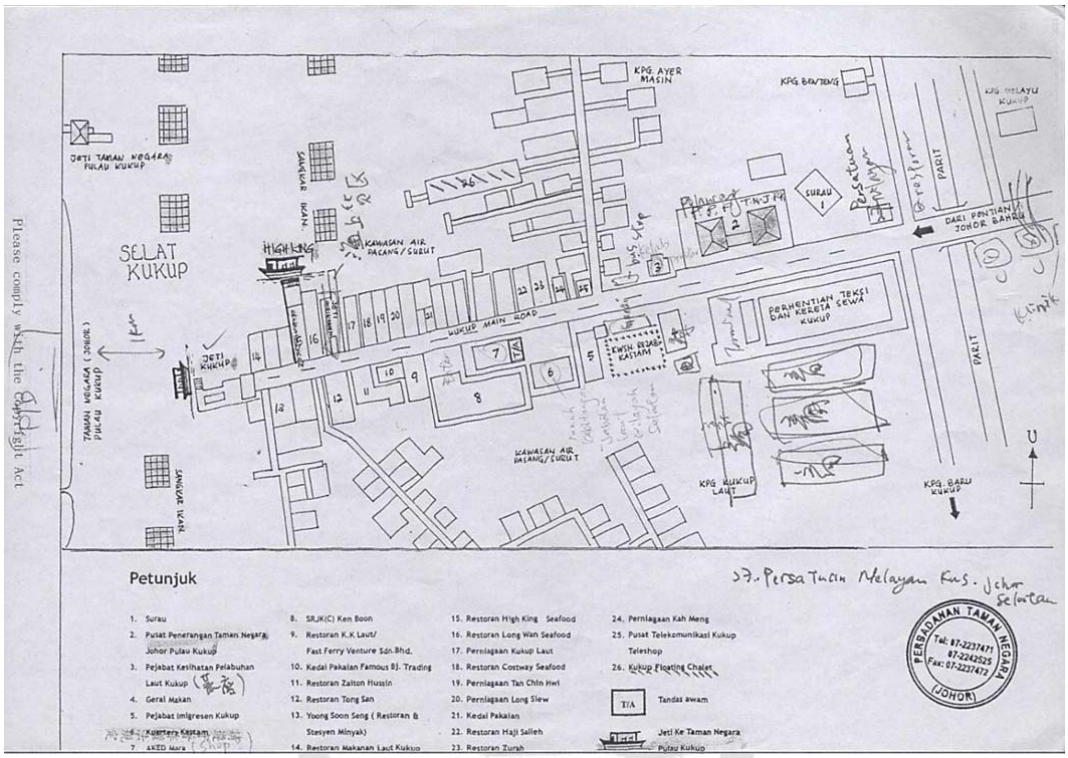
一个渔场多少渔格 100

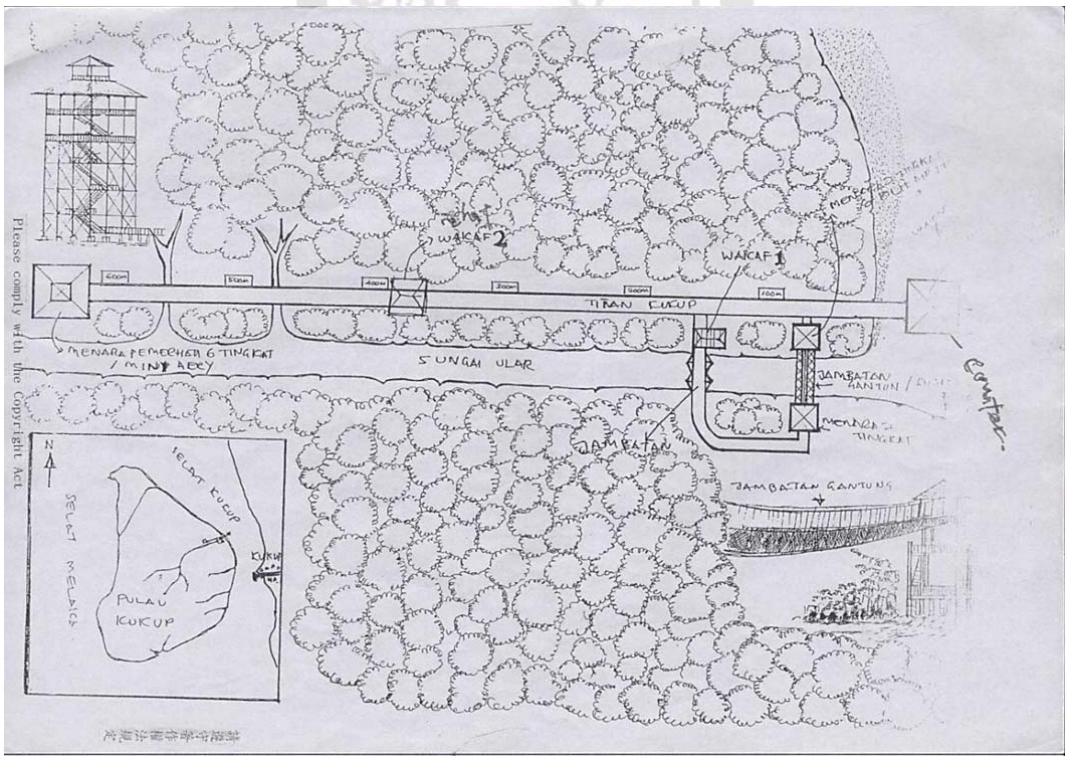


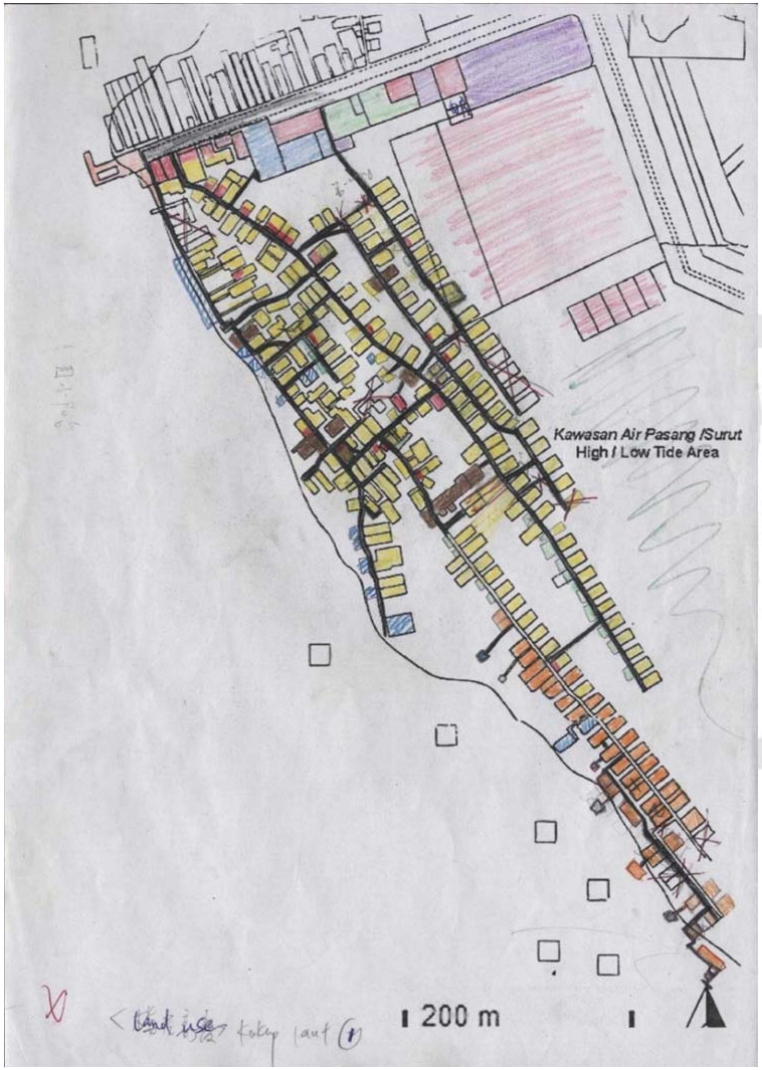
→使渔格摆成四方形

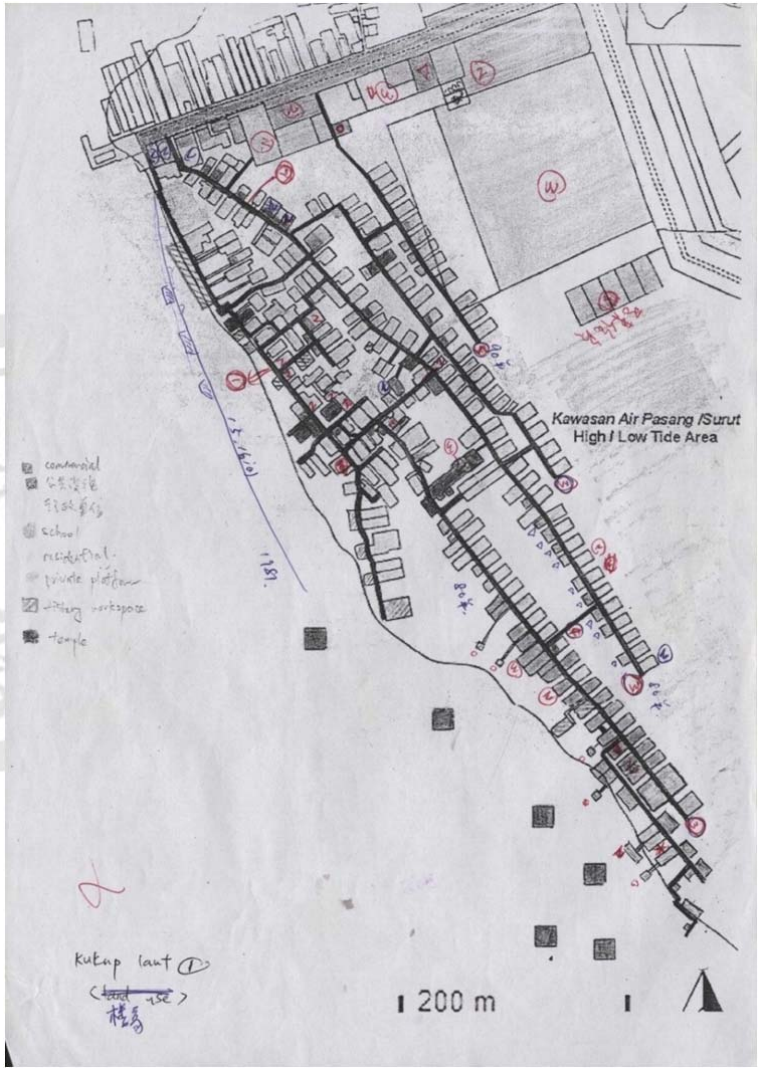

10ft
10ft
漁師

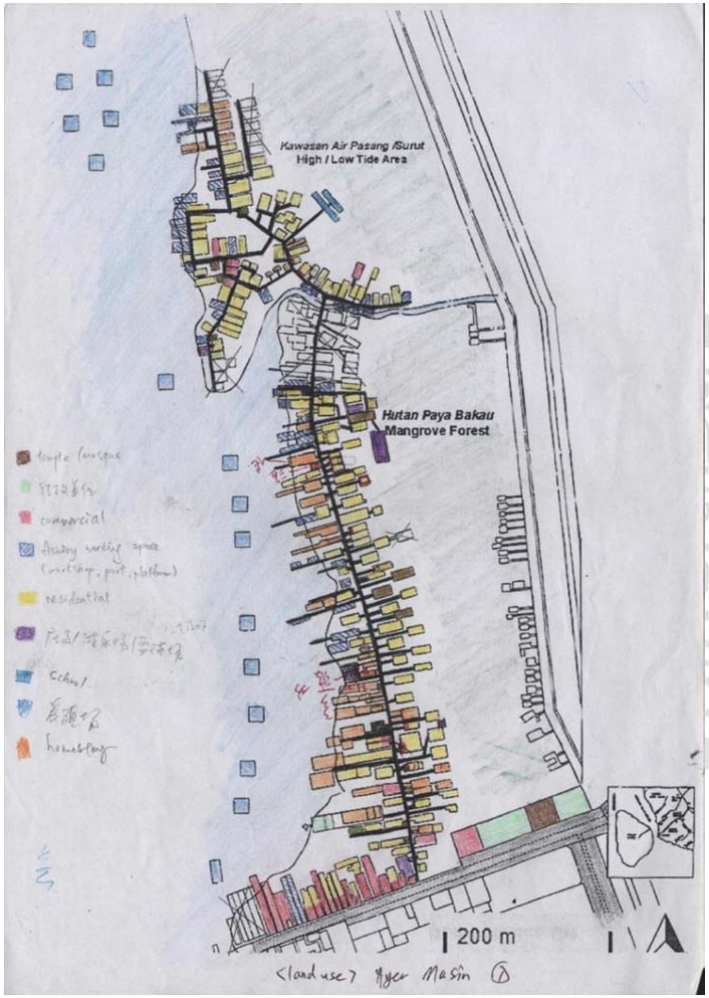

漁師
10ft
漁師
柿
柿
一支10ft
P9

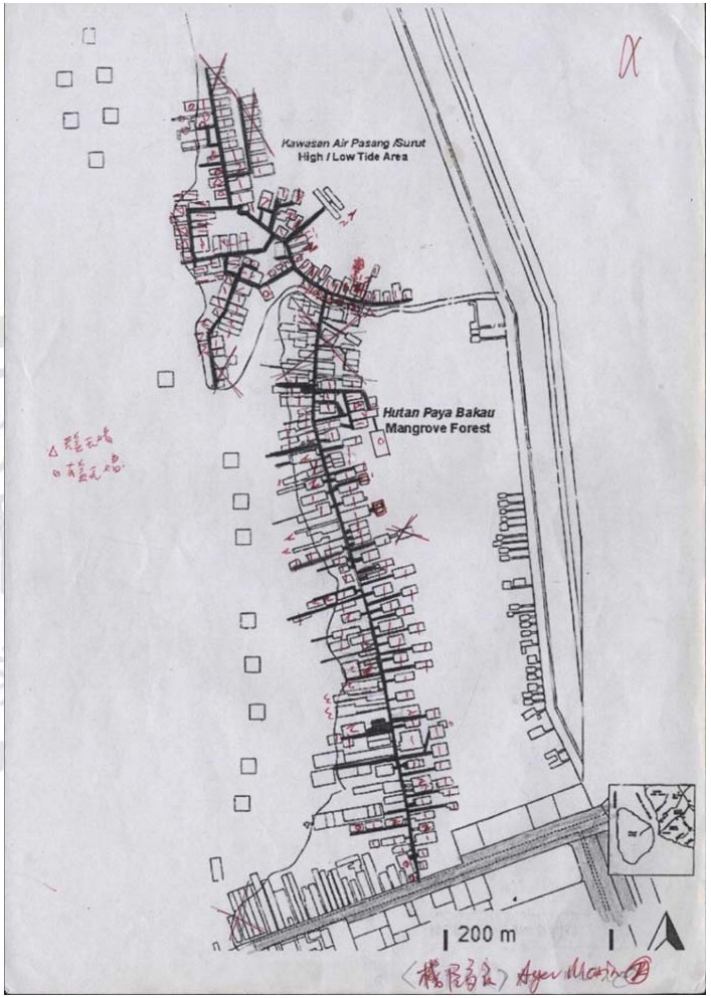





Kawasan Air Pasang /Surut
High / Low Tide Area
200 m


Kawasan Air Pasang /Surut
High / Low Tide Area
commercial
school
residential
200 m


Kawasan Air Pasang /Surut
High / Low Tide Area
Hutan Paya Bakau
Mangrove Forest
commercial
residential
200 m
<land use> Ayer Masin


Kawasan Air Pasang /Surut
High / Low Tide Area
Hutan Paya Bakau
Mangrove Forest
200 m