Space Setting Process in Floating Houses (Rumah Lanting).

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Abstract. Rumah Lanting is a floating construction house that can be found in several areas of West Kalimantan. The dwellers in Rumah Lanting have a favorable ability to adapt to their environment. They have general roles in controlling and adjusting to the changes that occur in their environment. The relationship between behavior and environment determines the adaptation process of the occupants of the floating houses. This research was conducted in the Kapuas Riverside area in the Kapuas Hulu Regency by a descriptive qualitative method. The sample was taken through a Purposive Sampling with the Behavior Mapping technique by schematics and diagrams about an area where humans carry out various activities. This study's objective is to describe the behavior and the relationship pattern between human behavior to a specific design form. The study found a formulation of behavior and space form of the occupants in the floating houses of Kapuas Hulu Regency. First, the types of occupations affect the intensity of the duration of stay in Rumah Lanting. The duration of hours to do some activities inside the house will obliquely affect the behavior patterns, and those patterns are formulized in the formation as a space setting to the house. Second, the behavior patterns of the occupants create a centralized model of activities by making a space as a flexible and communalize.

1. Introduction
The history in the area of Borneo shows a close relationship between settlements and rivers. Rivers become an area in the formation and development of people and communities[1]. In several areas, riverside settlements are the precursors of urban growth. This growth is a result of the activities of migrants who use the waterway as access to support their activities. In the beginning, they established settlements on the riverside. Then the settlement shifted to the mainland, which eventually formed a city complete with its infrastructure. Some urban migrants select riverbanks as their settlements areas are of the feasibility of access to transportation of low-cost carriers. The settlement in riverbanks is also a strategic location to support the economic activities of traditional people. [2]. Settlements provide a spatial focus for most human activity and, therefore, strongly affect local land cover, water quality, and biodiversity. Consequently, human in the settlement acts as the most fundamental actors to linked the relationship between people and earth and it is reflected as people's interaction with the surrounding environment [3].

Most of the traditional settlement in Indonesia is established close to the river. The primary function of the river as the living orientation, transportation route, and settlement area. The development of the riverside area in Indonesia to be a city with the rapid growth of urban settlement along implies an impact on the city itself, such as un-planned growth inside a planned growth settlement [4]. The activities of the people living along the river course are very dependent on the potentials of the river.
Early economic activities (trade) made use of the river channel due to the lack of land access. The high intensity of activities through the river channel has an impact on the need for temporary residence. This residence is called *rumah lanting* (floating house). Floating houses appear because of trading activities by nomadic people who lived on ships. The need for a place to support their activities as sellers made them build floating house [5]. Occupants who occupy a house have a role to control and adjust to changes that occur in their environment. Similarly, it also occurs in floating house settlements. The role of the occupants is very strong to influence and adjust to the conditions in their environment. In the subsequent development, the existence of the settlements on the riverbank experienced dynamics conditions mainly related to environmental. Some rivers have been considered disrupting the community, such as floods during the rainy season. In addition, the flooding disruption, and climate change are the factors that also contribute to the environmental impacts on the settlements [6].

The size and number of space in a *rumah lanting* is very limited, so that the occupants utilize and manage spatial patterns effectively and efficiently. Limited space and the demands of living necessities indirectly force the occupants of a floating house to adapt to the environment both physically and socially. Adaptation and change are two sides of a coin that are inseparable for living creatures. Adaptation applies to every living creatures in living in an ever-changing environment [7].

The process of setting up space in a *rumah lanting* is a problem faced by every occupant in a floating house. The limitations that they have to do spatial setting are caused by, among other things, limited space and difficulty in facility access. This study aims to analyze the process of space setting in *rumah lanting* in terms of activity needs. Space territories are driven by a) a limitation of space that, in turn, triggers the need to acquire more space; b) the occupation of a dweller that necessitates different types of space; and c) the limitation of access to infrastructural life support that influences the extent of a living space’s dispersal [8]. This study aims to analyze the process of setting up space in a *rumah lanting* in terms of activity needs.

### 2. Literature review

#### 2.1. Floating Architecture

Floating architecture can be defined as a floating structure system of building for living or working space that floats on the water in a permanent location. The structures do not include a watercraft designed or intended for navigation, and it has a premises services system (electricity, water/sewage, gas), it served through connection by permanent supply/return system between a floating building, and a service station on land or has self-supporting service facilities for itself [9].

Floating architecture could be a promising future design structure to current problems in many districts, cities, and landscapes. Such problems can be seen in some countries in Europe and Asia, especially in need of some new housing areas and construction grounds. The need for housing and ground area is the common impact of the growing population and/or the slowly rising sea level in the context of worldwide climate change [10]. The global history of floating houses is very complicated. The technique and architecture of the floating structures all over the world depend on many aspects. The climate boundary conditions, the culture, and the raw materials, which were available at the different local areas, are the aspect to consider in establishing it [11].

A floating house is not a vessel to transport humans or things. The floating house is an architectural product of design and structures in principle associated with its location. The location context is essential to consider in tropical climates such as Indonesia. The location context considers the spatial arrangement on the house orientation concerning the comfortability of the residents by the design of the indoor and outdoor space of the houses [12]. Floating houses on the riverside are the precursors of settlements that have existed since a long time ago in large rivers in Sumatra, Kalimantan and Papua. The communities who utilize the potential of rivers will choose to live by building a floating house on the water [13]. *Lanting* (floating house) is a kind of wooden house that is built on the water or a river that is widely spread in the Kalimantan regions, including West Kalimantan [14]. A raft house or floating house is a house made from a spatial arrangement built on a series of wooden / bamboo sticks as a medium to float on the river waters [15].
2.2. Adaptation
The definition of adaptation in climate science is the adjustment in response to actual or expected climatic stimuli or their effects in an environment or human systems, which have consequences to harming or opportunities to engage in mutual [16]. A more comprehensive definition of adaptation is the transforming action to increasing the ability of individuals, groups, or organizations to adapt to changes and implementing adaptation decisions by involve[s] on both building adaptive capacity [17]. Adaptations relate to changing needs and to necessary modifications. It is important to consider possible adaptations already in the planning process to reduce costs. The earlier change is being considered, the better you can react to altering conditions during the construction and operation of a building [18]. An adaptable layout is one that affords different times standing patterns of behaviour at different times without requiring physical changes. Flexible layout are those in which the structure is easy to change to accommodate different needs. This is more than is generally implied by semifixed feature space [19].

2.3. Behaviour Setting
Setting is used in the study of environmental (physical) architecture and behavior, which refers to the integration relationship between space (spatially physical environment) with all the activities of individuals/groups of individuals within a certain period of time [20]. Human behavior study in architecture consists of some analysis to find the relation between humans and the environment and its implementation in the design. It means that human behavior will strongly influence the design of space where they do their action. Space itself has a ‘social logic’ as much as these relational patterns affect everyday behavior, contributes to structuring social relationships, and how society and culture become intelligible through their spatial forms [21].

Behavior Setting is described in two terms, namely system of setting and system of activity, where the relationship between the two forms a specific behavior setting. The system of setting or system of place or space is defined as a series of physical and spatial elements that have a specific and related relationship so that it can be used for a particular activity. Meanwhile, the system of activity is defined as a series of behavior that is intentionally done. Behavior has some characteristics such as [22]:

- Behavior is actually tangible, but the cause of behavior cannot be seen directly.
- There are many kinds of behavior, e.g. simple and stereotype like amoeba, complex like human social, and there is also biology mental process.
- Behavior is various, with classification, e.g. cognition and affective, which shows rational, emotional, and physical movement.
- Behavior can be realized and unrealized.

The guidance of the schemata driven by needs as the information about the environment is obtained through perceptual processes. These schemata are partially learned and innate, then forming the linkage between perception and cognition. The schemata's guidance is not only on the perceptual processes but also on emotional responses (affect) and actions (spatial behavior). The outcomes of behavior discerned, in turn, affect the schemata [19].

3. Methods
The method used in this research is the descriptive qualitative method. Qualitative research is a research method based on post-positivistic philosophy, which is used to examine the natural conditions of objects. In this study, the researcher is a key instrument. The sampling of data sources is done through purposive and snowball sampling, and the data collection technique is performed through triangulation. Data analyzed in the inductive/qualitative approach and research results established a qualitative aspect to emphasize meaning rather than generalization [23].
Sampling is done by purposive sampling that is taking samples from the population-based on a specific criterion. The technique used is Behavior mapping. The principles of behavioral mapping were used to document the patient family’s activities and their movements in time and space [24]. Mapping in the Behavioral aspect is a research tool used to observe and record behaviors in a particular setting at a particular time. Behavioral mapping can be either place-based or individual-based, depending on whether the focus of observation is to identify locational or temporal patterns of behaviors [25].

Behavior mapping is a design technique that accurately records the actions of people at a place at a time on a map. This behavior mapping can be used to help predict how people use new buildings or facilities. This mapping is a sketch or diagram of an area where there are people doing their activities. This map provides information about human behavior and interactions [26].

Behavioral mapping is done using the Person-centered mapping method. Person-centered mapping is a mode of observation that implies following the person observed in order to record their behavior, location and time. A person’s pathway is represented graphically. More complex versions can include the recording of length of stay, detailed description of behaviors and detailed description of environments. According to the authors, this method is recommended for the study of groups, their social life, and of how and where they spend their time [27].

The research location was in Kapuas Hulu Regency of West Kalimantan Province. The objects of research in this study were eight floating houses with a duration of settlement between 10-30 years. The objects of this study were selected in three sub-districts, namely North Putussibau Sub-District (2 units), Bika Sub-District (4 units), and Emboloh Hilir Sub-District (2 Units). All research sites are on the bank of the Kapuas River.
4. Discussion

4.1. Occupant Characteristics

The segmentation communities based on their settlement preference based on riverbank residents and associated with socio-demographic characteristics gives more detailed information in making more appropriate designs that will suit the unique characteristics of the residents[28]. The characteristics of the occupants were reviewed based on the number of occupants who lived in rumah lanting and the average duration of stay in a floating house is 24 hours. The number of occupants of rumah latings at the research location was 34 people with a total of 8 families. There were 18 adults and 16 children. More details can be seen in the following table:

| Case | Number of householder | Number of people | Total | Total |
|------|-----------------------|------------------|-------|-------|
|      |                       |                  | Men   | Women |
| C1   | 1                     | 6                | 4     | 2     |
| C2   | 1                     | 3                | 2     | 1     |
| C3   | 1                     | 3                | 1     | 2     |
| C4   | 1                     | 4                | 2     | 2     |
| C5   | 1                     | 3                | 2     | 1     |
| C6   | 1                     | 4                | 3     | 1     |
| C7   | 1                     | 5                | 3     | 2     |
| C8   | 1                     | 6                | 2     | 4     |
| Total| 8                     | 34               | 19    | 15    |

The occupations of rumah lanting occupants are very diverse. Most of them are occupants who are unemployed amounting to 10 individuals (29%). These occupants consist of children who have not attended school. The second largest number of occupants is those who work as housewives with a total of 8 individuals (23%). The third highest number is those who work as a private worker with a total of
7 individuals (21%). Next is the occupants who are students with a total of 6 individuals (18%). The smallest number is the occupants who work as farmers with a total of 3 individuals (9%).

![Diagram of Workers Number in Rumah Lanting](image)

**Figure 4.** Diagram of Workers Number in *Rumah Lanting*.

Activity space analysis can be used as a tool to explore the relationship between daily activity and urban form through analyzing the spatial distribution of activities [29]. Two factors play an important role in activity space measurement: (1) individual characteristics or preferences, and (2) surrounding environments, which can provide opportunities to perform activities [30]. The type of occupation affects the amount of space utilization in *rumah ranting*. Based on the analysis, occupants who are farmers, students, and private workers have relatively few hours of utilization compared to housewives and non-working occupants. This is because they do activities mostly outside the house. Occupants who work as farmers have the least space utilization time, which is an average of 16 hours a day (66.67%). They usually go to work early in the morning and come home from work in the afternoon so they only use the space from the afternoon until the next morning. It also applies to those who work as private workers and students, where most of their activities are carried out outside the room / house. Occupants who work as private workers have an average space utilization time of 17.2 hours a day (72.02%) while students have an average of 17 hours a day (70.83%).

**Table 2.** The Intensity of Use of *Rumah Lanting*

| No | Type of Work   | Cases | Intensity of Space Utilization | Number of Hours | Percentage |
|----|----------------|-------|--------------------------------|----------------|------------|
| 1  | Housewives     |       | C1                             | 23             | 96%        |
|    |                |       | C2                             | 21             | 88%        |
|    |                |       | C3                             | 23             | 96%        |
|    |                |       | C4                             | 22             | 92%        |
|    |                |       | C5                             | 21             | 88%        |
|    |                |       | C6                             | 23             | 96%        |
|    |                |       | C7                             | 22             | 92%        |
|    |                |       | C8                             | 22             | 92%        |
|    | **Average**    |       | 22.13                          |                | 92.19%     |
| 2  | Students       |       | C1                             | 17             | 71%        |
|    |                |       | C2                             | 17             | 71%        |
|    |                |       | C3                             | 17             | 71%        |
|    |                |       | C4                             | 17             | 71%        |
|    |                |       | C8                             | 17             | 71%        |
|    | **Average**    |       | 17.00                          |                | 70.83%     |
| 3  | Farmers        |       | C4                             | 17             | 71%        |
|    |                |       | C5                             | 15             | 63%        |
|    |                |       | C6                             | 16             | 67%        |
|    | **Average**    |       | 16.00                          |                | 66.67%     |
| 4  | Private Worker |       | C1                             | 16             | 67%        |
### Intensity of Space Utilization

| No | Type of Work | Cases | Number of Hours | Percentage |
|----|--------------|-------|----------------|------------|
|    |              | C1    | 16             | 67%        |
|    |              | C2    | 20             | 83%        |
|    |              | C3    | 15             | 63%        |
|    |              | C7    | 14             | 58%        |
|    |              | C7    | 20             | 83%        |
|    |              | C8    | 20             | 83%        |
|    |              | **Average** | **17.29** | **72.02%** |

#### Unemployment

| No | Type of Work | Cases | Number of Hours | Percentage |
|----|--------------|-------|----------------|------------|
|    |              | C1    | 24             | 100%       |
|    |              | C3    | 23             | 96%        |
|    |              | C4    | 23             | 96%        |
|    |              | C5    | 23             | 96%        |
|    |              | C6    | 23             | 96%        |
|    |              | C7    | 23             | 96%        |
|    |              | C7    | 23             | 96%        |
|    |              | C8    | 22             | 92%        |
|    |              | C8    | 22             | 92%        |
|    |              | **Average** | **22.90** | **95.42%** |

### 4.2. Behavior Patterns

#### 4.2.1. Case 1

![Figure 5. Existing Conditions of Rumah Lanting Case 1](image)

![Figure 6. Behavior Patterns of Rumah Lanting Occupants Case 1](image)

Based on the occupants’ behavior pattern activities in rumah lanting Case 1, there are two starting points of activities, namely from bedroom 1 and 2. The duration of the longest activity is carried out in the living room and sitting room. This space is a shared space that serves to accommodate a variety of activities such as discussion, eating and resting.
4.2.2. Case 2

Based on the occupants’ behavior pattern activities in rumah lanting Case 2, there are two starting points of activities, namely, from bedroom 1 and 2. The duration of the longest activity is carried out in the living room, kitchen and dining room.

4.2.3. Case 3
Based on the occupants’ behavior pattern activities in rumah lanting Case 3, there is an initial activity starting from the bedroom. All the space in this *rumah lanting* is used when the occupants are at home except the storeroom. The storeroom becomes a semi-private space that is only used by some occupants. The activity patterns of all occupants are relatively the same because each space is always used by all. The duration of utilization of the main space (terrace, living room, sitting room and bedroom) is relatively the same because this space is the center of the occupants’ activities in this *rumah lanting*.

4.2.4. Case 4

Based on the occupants’ behavior pattern activities in *rumah lanting* Case 4, the activity starts from the bedroom that also serves as a sitting room. This room is a multifunctional space because almost all activities start and are carried out in this area. The only separate space is the lavatory which can only be accessed from the terrace.

4.2.5. Case 5
Based on the occupants’ behavior pattern activities in *rumah lanting* Case 5, the initial activity starts from the bedroom then to the sitting room then to the living room, kitchen and dining room. Finally, the activities are carried out in the laundry room and the terrace. The duration of the longest activity is carried out in the living room, kitchen and dining room. Due to the limited space, these rooms serve as a multifunctional and flexible space accessed by each occupant.

4.2.6. Case 6

Based on the occupants’ behavior pattern activities in *rumah lanting* Case 6, there are two rooms which are the starting point of the occupants’ activities. The first is the bedroom and the second the living room and the sitting room. The longest activity duration takes place in the living room and the sitting room because this space is a communal area for the occupants. Many activities are done in this room such as discussion, eating, resting, etc.
4.2.7. Case 7

Based on the occupants’ behavior pattern activities in rumah lanting case 7, there are two starting points to begin the activities. First the activity starts from the bedroom by the father and mother. And the second starts from the living room and the sitting room by the children because they sleep in the room. The pattern and flow of occupants’ activities are relatively the same after the starting point. Only mothers are a little different because there are activities that require going into the kitchen to cook and prepare food.

4.2.8. Case 8
Based on the occupants’ behavior pattern activities in rumah lanting Case 8, there are two starting points to begin the activities. The first is the bedroom which is the starting point for the activities of the father and the mother. Both activities start from the living room and the sitting room which are the starting point for children. The longest duration of activities and, in fact, most of activities are carried out in the living room and the sitting room. These rooms are one area due to limited space so that this space becomes flexible to be utilized for various activities. The space that is least accessed by other occupants of this rumah lanting is the business space. It is only accessed by the parents to conduct their business activities.

4.3. Findings
Space setting in rumah lanting affects the pattern of movement of each occupant. The movement of each occupant becomes a pattern of repetitive activities at all times. Routine activities carried out in rumah lanting occur monotonously due to limited space. The kinds of physical activities of occupants are associated with houses and their sites. It is proposed that the shape of houses and sites affect physical activity at several spatial scales. The selection and design of sites concerning a building’s location on its site and its immediate community, and the provision and layout of site amenities. Furthermore, concerns also to building design such as the programming, layout, and form of the building; and building element design such as the design and layout of elements such as stairs or exercise rooms [31].

Figure 20. Behavior Patterns of Rumah Lanting Occupants Case 8

Figure 21. Flexible Hybrid Space of Rumah Lanting
The limited space in *rumah lanting* creates a flexible hybrid space that can be accessed and utilized to do activities together. The space is in response to the activity needs of each occupant. Occupants of a floating house make the space a public one in the house even though the initial function of it is a private, semi-private or semi-public space. Incremental shifts can be seen between public and private spaces. The visibly manifest inbuilt, personal, and technical signs. These processes generate ‘spaces of a hybrid character,’ which have various mixtures of public and private structures, different degrees of accessibility, and varying extents of usability [32].

5. Conclusion
Based on the analysis and findings, several conclusions are obtained which include:

- The types of occupations affect the intensity of the duration of stay in *rumah lanting*. The intensity of activity time at home will indirectly affect the behavior pattern in the formation of space setting.
- Behavior pattern of the occupants of *rumah lanting* form a centralistic pattern. The activity center is formed from hybrid space created by the need for shared space. This space is flexible so that it allows a variety of activities to be carried out in this place. Most of the existing functions of this space are for the sitting room and the living room.
- The mother is the dominant actor who influences the setting of *rumah lanting* space because most of her activities are carried out almost in all rooms. In contrast, the non-dominant actor is the father because most activities are carried out outside the house.
- The starting point of the activities starts from the private area (bedroom). This process occurs hierarchically from private to public areas so that in the sitting room there has been less privacy among the occupants.

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