European Journal of Social Sciences
ISSN 1450-2267 Vol. 55 No 4 December, 2017, pp.462-474
http://www.europeanjournalofsocialsciences.com/

Study of Unplanned Settlement Structures in Coastal Belawan Medan Fishermen Village

B. O. Y. Marpaung
Architecture Department, Faculty of Engineering
Universitas Sumatera Utara, Medan, North Sumatra, Indonesia
E-mail: beny.marpaung@usu.ac.id

Nadia Winny Silaban
Architecture Department, Faculty of Engineering
Universitas Sumatera Utara, Medan, North Sumatra, Indonesia
E-mail: nadiawinnys@gmail.com

Abstract

Informal settlements are formed without the planning of the government and the settler community itself and are often built as a result of the massive urbanization of local people to the city. The urbanization process leads to an increase of the housing needs of the urban population, while the number of settlers who moved to cities is often un proportional to the amount of housing the community can afford. The purpose of this study is to find the structure of the settlement space and the relationship between each physical element that forming the built environment with the spatial pattern of settlements in Belawan Medan Fishermen Village. In the process of collecting the data, the researchers made a map of the observation area, space structure, and the relationship between one function room with other space functions. Also, researchers identified one spatial element to another spatial element. This study found the structure of settlement space in Belawan Medan Fishermen Village and the tendencies of the community of Belawan Medan Fishermen Village in building the built environment.

Keywords: spatial, structure, settlement, informal.

1. Introduction

One of the forming patterns factors in a settlement is the needs of the settlers. The spatial functions associated with spatial forms affect the spatial pattern of settlements (Darjosanjoto, E. T., 2005, Hurskainen, P., & Pellikka, P., 2004, Muriuki, G., et al., 2011, Vaz, E., 2014). Each settler has a space requirement tailored to their ability to shape the built environment. These formed spaces will then form a spatial pattern of settlements. In the process of forming the space, there are differences in boundaries in informal settlements and formal settlements, while spatially refers to physical elements such as structural systems, utility systems, road networks, and open spaces (Trujillo, T. A., 2012, Hao, J., et al., 2015). In unplanned settlements, the boundaries are in the social and economic conditions of the settler community whereas in the planned settlement the main constraint lies in the government regulation. One of the causes of the increasingly widespread growth of houses in informal settlements is the need for houses in cities that are not reached by the poor. Thus, the choice leads people to build on the land that is not their own. Informal settlements are a response to the failure of the market to produce adequate shelter in quantity at an affordable price for the poor (Tsenkova, 2010). Also, one of the

causes of informal settlement is the massive urbanization of people from remote areas to urban centers. This occurs in an area called Chengbiancun in China (Lang, et al., 2015). Informal settlements are formed as a result of urbanization of local communities to cities, communities moving from densely populated urban areas, and natural population growth (Oelofse and Dodson, 1997). Informal settlements are defined by the lack of a secure housing system, lack of adequate mobility, access to clean water or inadequate sanitation, and the absence of secure tenure (UN-Habitat, 2003). Issues that exist in informal settlements around the world include poverty, self-built homes, and lack of basic facilities. This limitation also causes people to have the ability to manage and control their public area, negotiate prices or buy land, share and build their own infrastructure and housing (Archer, et al., 2012).

The number of problems in unplanned settlements and the difficulty of identification of spatial patterns in the settlement cause settlers often get a one-party policy by the government. Knowing the spatial pattern of a settlement and its geographical aspects is important because it can help understand land use and land cover change. Understanding the spatial patterns of settlements, on the one hand, can also help to understand the relationship between ecological and environmental processes and culture and lifestyle on the other (Zhang, et al., 2014). Zhang, et al. (2014) conducted a study of the spatial pattern of settlements in the Wen-Tai region, the coastal section of southeast China. According to Zhang, et al. (2014), understand the size, pattern, and spatial distribution of a settlement into something fundamental to know the process of resource distribution, settlement management, and socio-economic development. According to Zhang, et al. (2014), the dissemination or distribution of informal settlements by humans around coastal ridges may disrupt ecosystem production capabilities and environmental problems, such as polluted soil and rivers, disturbed water cycles, declining biodiversity, and increasing public health risks. In Indonesia itself, Fishing Village settlements can cause sea water pollution (Pratama, et al., 2013). Often the results of the absence of an integrated garbage system, communities dump garbage into the sea and cause disruption of environmental health and reduce aesthetic value of the region. Pratama, et al., (2013) researched on Tambak Lorok Fishermen Village on the coast of Semarang City. This garbage problem is also added with sanitation problems such as sewerage and inadequate water supply. The another examples of natural destruction due to coastal settlements also degrade the useable natural resource base, decrease the soil capacity to produce biomass, undermine ecosystem functions, and others (Fasona et al., 2010). By knowing the spatial pattern of settlements, the planner can then find out the point of settlement problems not only through the designer's point of view, but also from the settlers who build their settlements according to their socio-economic needs and conditions.

Spatial extensively can be defined as space. While in the built environment, spatial refers to the physical elements of the building such as structural system, utility system, road network, and open space. Spatial refers to the physical elements of a built environment (Trujillo, 2012). Spatial or spatial planning is a major part of regional and urban planning that includes space-use layouts, road systems, open spaces, and others (Hao, et al., 2015). In addition to being defined as part of the spatial structure system, spatial patterns can also be used to detect land use and land cover changes. Spatial pattern changes or spatial analyzes are used to detect changes in mangrove forest land use on the coastline of Kien Giang, Vietnam (Nguyen, et al., 2013); changes in land use use in Chyulu Hill, Kenya (Muriuki, et al., 2010); changes in the spread and use of informal settlements around Izmir Beach, Turkey (Hepcan, et al., 2012) and others. The spatial state of a settlement can be affected by several factors. One influencing factor is the geographical factor of the settlement (Zhang, et al., 2014). On the other hand, the spatial pattern can also be influenced by the needs of the settler community in building the built environment. Although there is no measurable space structure, unplanned settlements are part of the urban spatial structure that develops deviate from the patterns and regulations set by the government or city space planners (Sobreira and Gomes, 2001).

According to Yang, et al. (2015), each settlement has an interrelated morphological and functional dimension. Literally, morphology means the knowledge of form. The form of space is interconnected with the function of the space. Space shape and function are often inseparable because

they affect each other. Space structure system was formed as a result of the functions attached to each part of the system. Informal settlements, one of which includes the slums are one of the urban settlement structures that grow outside of the boundary framework with little or no public interference. Informal structures are usually manifested in irregular distribution of settlement, consequently, they are usually regarded as unformed, illogical, and therefore difficult to model. Based on the space perspective, the relationship between morphology and function has two main aspects. The first relates to spatial or geographical distribution patterns of socio-economic activities. The second one is identifies the physical form and morphological mechanisms based on functional transformation, although morphological features can be interpreted as block size, building density, spatial shape, line of sight, building facade patterns, physical connections, or even topological relationships (Yang, et al., 2015).

Belawan Medan Fisherman Village consists of formal settlements and unplanned settlements. Unplanned settlements are defined by the lack of a secure housing system, lack of adequate mobility, access to clean water or inadequate sanitation, and the absence of secure tenure status (Tsenkova, S., 2010). Also, unplanned settlements also formed as a result of the urbanization process of local communities to the city; the community moved from the densely populated urban areas, and the naturally increasing of the population (Doan, P., & Oduro, C. Y., 2012).

This study will analyze the spatial structure system that was formed at the Belawan Medan Fisherman Village and connect each physical element in the settlement that formed to produce a trend pattern that was built in this settlement. With this research, the government and researchers can take a better step to address informal settlement issues. Also, this research is expected to add more knowledge about the system structure and spatial patterns of informal settlements.

2. Method

This research was conducted by observing and identifying directly the mass of building-mass of buildings, road network, and open space in Belawan Medan Fishermen Village. After conducting the survey and getting observation data, the results of the research will be reviewed with the theories that have been interpreted. Spatial patterns of settlements will be identified based on the built-in physical elements. After that, based on observation results will be found some tendencies of settlers in building the built environment in Belawan Medan Fishermen Village.

3. Results and Discussion

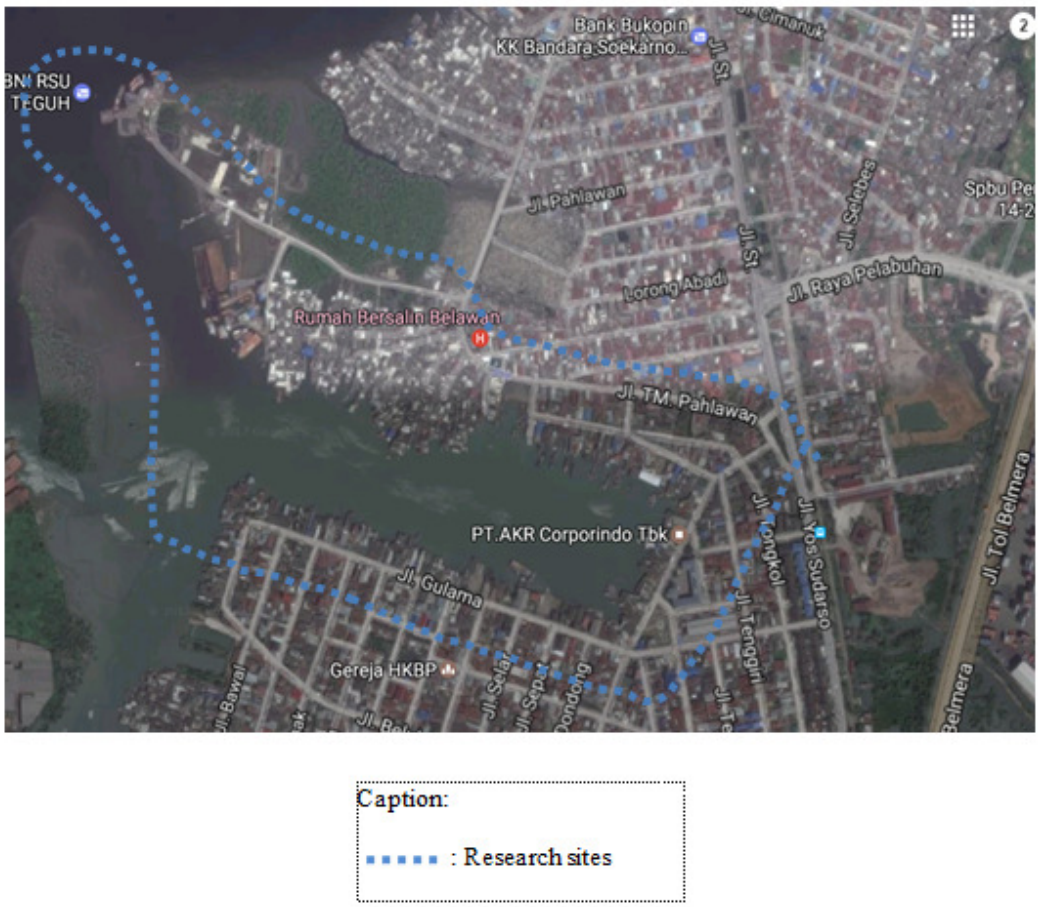
Fisherman's Village is located in the coastal area of Medan Belawan, one of the districts in Medan, Indonesia. Medan Belawan District is located in the northernmost part of Medan City and directly adjacent to the sea. Medan Belawan District has six sub-districts. The location of this research is in Belawan Bahagia Sub-Districts. According to Wikipedia, in 2001 the population of Medan Belawan district reached 91,881 inhabitants with the area of 26.25 km^2.

The diversity of the settlements location in Belawan Medan Fishermen Village can cause a different form of pattern. The state of an area and the specific geographic factors of a settlement may affect settlement patterns (Zhang, Z., et al., 2014). Unplanned settlement locations in Belawan Medan Fishermen Village spread into several points of location where the majority built directly above the sea. Many of the settlers choose to stay in lower places land because it was more profitable (Zhang, Z., et al., 2014).

The study area is located in the seafront area from Gulama Street to the end of T. M. Pahlawan Street (Figure 1). This area is directly adjacent to the sea. The northern area is adjacent to T. M. Pahlawan Street, the east area is bordered by Tongkol Street, Tenggiri Street, and Temenung Street. South is bordered by Dondong Street, Sepat Street, and others, while the western area is directly

adjacent to the sea. The Belawan Medan Fishermen's Village is one of the built environments made by humans and located in coastal areas.

Figure 1. Research sites

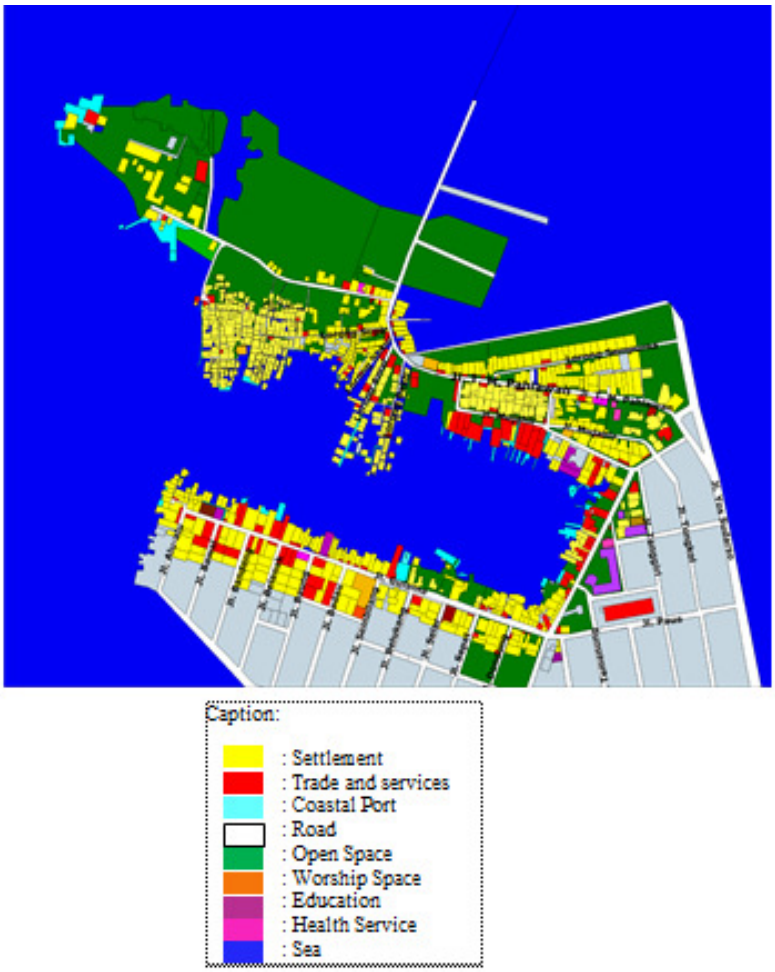


In highway areas such as Gulama Street, Hiu Street, and T. M. Pahlawan Street there are many residential and economic functions; While in the seafront area there are many buildings that function as residential and made of board that is designed using wooden foundation or PVC pipe (Figure 2). For highway areas, built houses are brick, permanent, and have legally valid ownership rights. Formerly, the area around the highway was just an empty field. However, the land was later built to accommodate evicted societies in the 1960s. Now, the houses that are built already have legal ownership rights. As a result of the development of population and the needs of the people will be occupancy, the area of the settlement is growing and began to grow around the seaside area. The seafront area is built without the interference of government regulations so that it has no legal ownership rights.

Based on observations, there are several types of land use built into these unplanned settlements. The functions are differentiated on the function of shelter, economic function, educational function, worship function, toilet function, and others (Figure 2). There is no health facility in these informal settlements (Table 1). The location of the educational function is also only on one area which is Gulama Street. The open space area has the largest area. The area of open space was wider than the area of the settlement. However, the mass of settlements or the point of location of the settlement more than the point of open space. There are 498 settlements point in Belawan Medan Fishermen Village. After homes or settlements, the function with the most location point is the coastal port. This may be caused by the location of settlements that are on the coast so that many residents who work as

fishermen. This profession causes settlers to own boats or rent their boats and tether them in front of their homes.

Figure 2. Land Use Map in Fisherman's Village area



Tabel 1: Accumulation of spatial function formed in informal settlement at Belawan Medan Fishermen Village

Function	Size	Number of Locations
Settlements	34122,76 m^2	498
Trade and Service	4676,25 m^2	54
Coastal Port	5583,63 m^2	107
Worship Area	189,61 m^2	2
Education and Sport Area	389,07 m^2	1
Health Service	0	0
Open Space	35006,67 m^2	23
TOTAL	**79967,99 m^2**	**685**

In addition to the functions that accompany it, the structure of space in the settlement of Belawan Fishermen Village Medan is also formed by the road network system. The roads to these settlements can be divided into two categories. The classification is the division of roads based on the builder of the road based on the type of vehicle that can pass the road.

Based on the party building the road to the settlement, there are two types of roads formed, namely the formal road built by the government and the road formed by settlers. Roads built by the government have their own rules and systems by applicable laws while the roads built by settlers are

tailored to the needs of the settlers themselves. The roads built by the settlers themselves are often found in unplanned settlements and formed by empty spaces that lie in front of or beside the settler's house. Although this road was formed without government regulations, at some point locations, there was a road that was given pavement by the government to help the unplanned settlement space structure.

The road network built by the government has a larger area than the road built by settlers (Table 2). The state of the road network built by the government has also been given pavement for the use of both four-wheeled vehicles and footwear (Figure 4). Government-built roads are spread out of Gulama Road which is integrated with other roads in the north of the area such as Alu-alu Street, Bawal Street, Bandeng Street, and others. Hiu Street and T. M. Pahlawan Street also built by the government while the road from Bakti Aisle to Supir Aisle was built by the settlers. This road has a smaller area due to the width and length of the road that is not too broad. This is due to limited land in unplanned settlements. Also, the density of occupancy or mass of buildings cause the road network is built in accordance with mass conditions. Thus, the roads to unplanned settlements are many that can only be passed by pedestrians only.

Figure 3. Map of the state of the road network in the settlement of Belawan Fishermen Village Medan

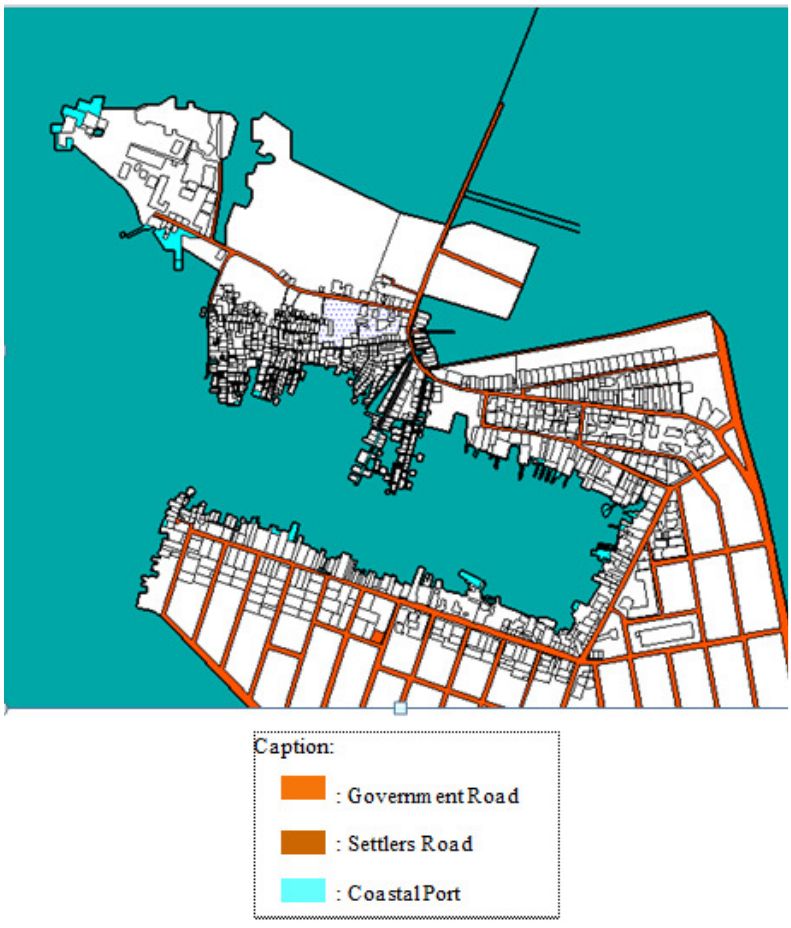


Table 2: The area of the road network in the settlement of Belawan Medan Fishermen Village is based on the type of road

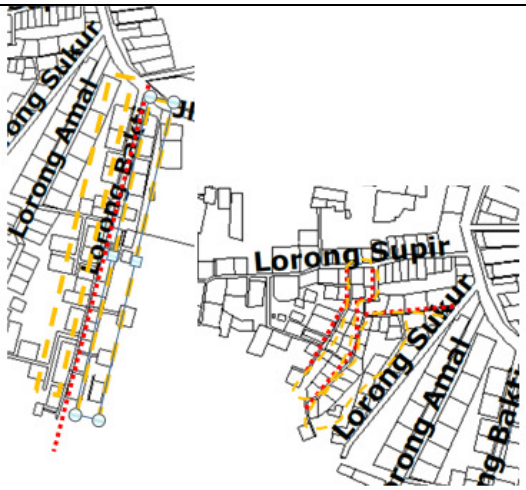
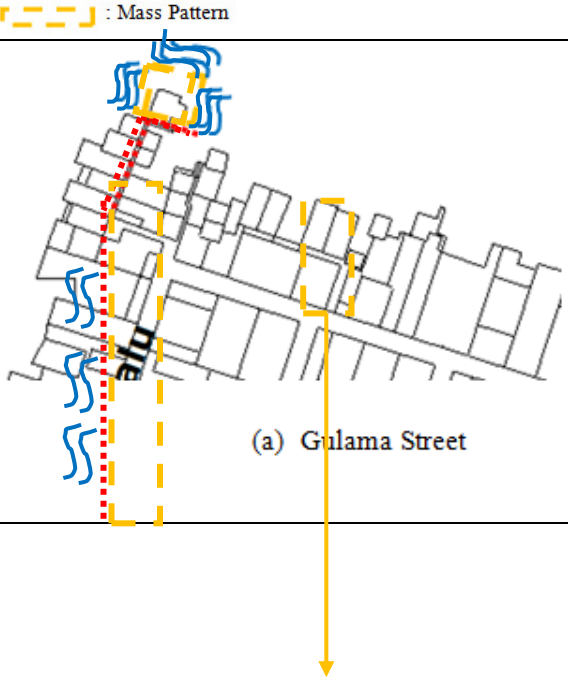
Road Type	Size
Government road	42133,19 m²
Settler's Road	3572,13 m²
Total	45705,32 m^2

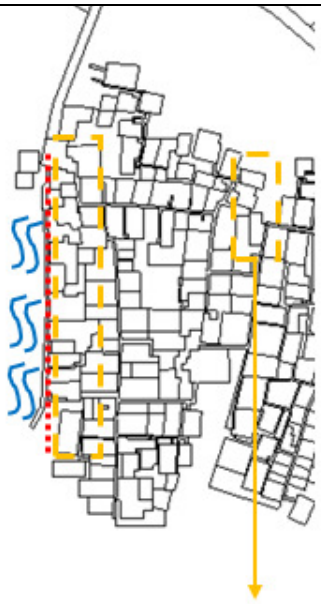
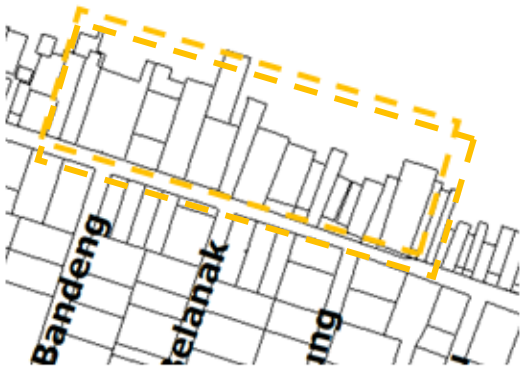
The system of the structure of the settlement space is related to the spatial pattern formed in the settlement. According to Yang, et al. (2015) the relationship between morphology and function has two main aspects. The first aspect examines the relationship between spatial or geographic distribution patterns of socioeconomic activities. The second aspect examines the relationship between physical form and morphological mechanisms that are based on functional transformation. Morphological features can be interpreted as block size, building density, spatial shape, the line of sight, building facade patterns, physical connections, or even topological relationships. Through the theory of Yang, et al. (2015), the spatial form is one of the morphological aspects that have relationship to the function of space. This relationship is based on the change of function that occurs in the spatial formed environment.

Studying patterns is to look at the order that shows how relationships between these elements occur or how and how they are laid. Studying the physical pattern is to study its physical design (Alexander, C., 1977). To study the spatial pattern is to see the correlation or connection between each physical element of the built environment, how the order is formed or lasted and where the element is located. The location of the elements of each physical element affects the correlation that occurs. Informal settlements in Belawan Medan Fishermen Village spread into several locations, ranging from Gulama Street to the end of T. M. Pahlawan Street. The orientation of the buildings at each location is mostly facing the road body. In the areas that close to the sea, most of the buildings are road-oriented, although there are also some sea-oriented homes, especially if the community has fishing vessels and breeding grounds. In each area, every standing buildings have their respective functions. These functions include residential, trade and services, education function, and places of worship. The most functions are residential, then trade and services. Few locations have places of worship and only one location has educational facilities. The minimum public facilities in these informal settlements may result from a narrow and non-strategic road network, then the economically incapable local community to establish the facility, or the absence of a government role in the formation of settlements so that other basic facilities such as health and Open space not provided. Table 4 describes the underlying factors of shelter function, how the orientation of the building on the road network, and how the spatial shape that occurs in the settlement. As for building settlements and designing the built environment, there is a tendency that occurred in seven informal settlement areas in this Belawan Medan Fishermen Village (Table 4). This tendency occurs as a result of the influence of the mass of buildings and road network. The priority of society needs so as to influence the type of function of space formed, and the social conditions that cause people tend to follow the mass circumstances surrounding buildings. The tendency that arise in unplanned settlement area is seen based on the observation and analysis of space conditions that occurred in Belawan Medan Fishermen Village.

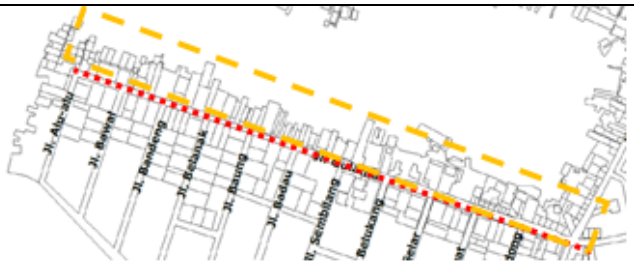
Settlement structures are formed as a result of an integrated relationship between building mass, road network and open space. The structure system is related to the function that is formed. In the absence of a function that is formed there is no structure of the settlement space. In addition, there is a relationship between elements of settlement structures. As there is a relationship between the function of the mass of the building with the network of roads formed in front of it. Or there is a relationship between open space with the surrounding road system. The structure of residential space can also be identified through the extent or magnitude of the functions that are formed.

Table 3: Spatial Patterns Built and Their Relation to Infrastructure Conditions in Belawan Medan Fishermen Village

Location	Spatially Built Tendencies
 (a) Bakti Aisle (b) Sukur Aisle Caption: : Road Integrity : Mass Pattern	1. Buildings tend to form following the pattern of roads that have been built. If the road is built linear, then the patterns of buildings that are formed also tend to be straight with the rectangular plane. If the road is built branched and twisted, the building's pattern also tends to meander along the path and looks asymmetric.
 (a) Gulama Street	2. As a result of the need for shelter, settlers can build their own access to their settlements or road networks around their homes. These streets are usually 2-3 meters in size and can only be passed by pedestrians and two-wheeled vehicles. The streets can be built using cement or wood.

Location	Spatially Built Tendencies
 (a) Supir Aisle Caption: : Road : Building Mass Pattern : Sea	
 	3. The mass of buildings formed in unplanned settlements also tends to follow the mass of buildings around them. If the mass of the building is built on formal roads or roads built by the government, then the dwelling tends to follow the facade of buildings that are on the formal road even though the buildings are included in the category of informal buildings. Also in unplanned settlement areas, buildings tend to follow the physical form of the houses around them. This can be due to human tendency to imitate or find patterns in pre-formed environments.

Location	Spatially Built Tendencies
 (a) Gulama Road (b) Supir Aisle Caption: : Building Mass Location	
	4. There is priority on the formation of space adapted to the needs of the community. Communities tend to prioritize buildings and roads then the front porch for yard and captivity for those living close to the sea. Therefore, terraces and yard or garden are rarely seen in these informal settlement areas because of the limitations of communities in building their environment and other factors such as seafront areas that are not suitable for gardening.

Location	Spatially Built Tendencies
   (a) Supir Aisle Caption: : Building Mass Location	
 (a) Gulama Street is close to the market center and primary arterial road / Jl. Yos Sudarso that has a road length of 500 meters. Building masses built solid and more built than Jalan T. M. Pahlawan. Caption: : Road : Bulding Mass	5. Accessibility formed through the road network affects the number of buildings. The longer the road then the building will be more and more. The closer the road to the primary arterial road (Yos Sudarso Street) then the building mass that is built more than the area far from the market center. Areas that are close to formal roads or roads built by the government have a large mass of building blocks. Buildings on government road bodies tend to be adjacent or attached to each other than buildings built on informal roads or settler-built roads.

4. Conclusions

Belawan Medan Fisherman Village is a settlement located in Belawan Bahagia and Belawan District. The settlement is located on the edge of the sea or coast and is on land owned by PT. Pelindo. As time goes by and the increasing needs of the residential homes, the building then grew more and more and formed a complex structure of residential space. This building then forms a network of roads, open spaces, utility systems, and others.

In the structure of space there are areas of formal and informal settlements in the area of Kampung Fisherman Medan Belawan this. The formal area is in an area directly facing the road

formed by the government such as the Gulama Street area, part of Hiu Street, and T. M. Pahlawan Street. While unplanned areas are directly faced with coastal areas such as Bakti Aisle area, Sukur Aisle, Amal Aisle, and Supir Aisle.

The structure of informal settlement space in this region is formed by several functions. These functions include mass block function and road network function. The structure of informal settlement space in this region is formed by several functions. These functions include mass block function and road network function. In the mass of building functions that are formed include residential function, function of trade and services, educational function, function of worship, and open space.

Residential that formed in this region stands on the land that is not their private property. Also, the structure of the building is not adequate because it uses a wooden foundation and stands on the sea. After that, there are no health facilities in the region. Educational facilities are also minimal.

The function of trade and services in this area is dominated by grocery stores that are established directly in front of the dwelling or along with residential dwellings. There is also a restaurant.

There are also two functions of worship area which is in the form of mushola in this unplanned area. There are a lot of open areas but usually the ground is muddy and inundated or become a garbage dump. On the other hand, the utility system in the Belawan Medan Fishermen Village can be divided into two categories. The one is the integrated system with the government and the other is the system that is not integrated with the government. Utilities can be divided into clean water systems and dirty water systems. In governmentally licensed settlements, the water system uses a direct source of PDAMs while the sewage system has a direct disposal to the ditch in front of the house. In unplanned settlements, clean water sources are not obtained from the PDAM but purchased directly using jerry cans and dirty water systems discharged directly into the sea.

Then, based on observations and observations between the mass relationship of buildings and networks there are several tendencies that are formed in the informal settlement of Belawan Medan Fishermen Village. The tendency is related between the mass of the building and the road network and the shape of the building. The tendency among other buildings tend to be formed following the pattern of roads that have been built. If the road is built linear, then the pattern of buildings that are formed also tend to be straight with the rectangular plane. If the road is built branched and twisted, the building's pattern also tends to meander along the road and looks asymmetric.

As a result of the need for shelter, settlers can build their own access to their settlements or road networks around their homes. These streets are usually 2-3 meters in size and can only be passed by pedestrians and two-wheeled vehicles. The streets can be built using cement or wood. The mass of buildings formed in unplanned settlements also tends to follow the mass of buildings around them. If the mass of the building is built on formal roads or roads built by the government, then the dwelling tends to follow the facade of buildings that are on the formal road even though the buildings are included in the category of informal buildings. Also in unplanned settlement areas, buildings tend to follow the physical form of the surrounding houses. This can be due to human tendency to imitate or find patterns in pre-formed environments.

There is a priority on the formation of space tailored to the needs of the community. Communities tend to prioritize buildings and roads then the front porch for yard and captivity for those living close to the sea. Therefore, terraces and yard or garden are rarely seen in these informal settlement areas because of the limitations of society in building their environment and other factors such as seafront areas that are not suitable for gardening.

Accessibility formed through the road network affects the number of buildings. The longer the road then the building will be more and more. The closer the road to the primary arterial road (Yos Sudarso Street) then the building mass that is built more than the area far from the market center. Areas that are close to formal roads or roads built by the government have a large mass of building blocks. Buildings on government road bodies tend to be adjacent or attached to each other than buildings built on informal roads or settler-built roads.

Acknowledgement

This research is funded by Ministry of Research and Community Service Directorate General of Research, Technology, and Higher Education Republic of Indonesia in accordance with Applied Product Research Contract of 2017 Number: 73 / UN5.2.3.1 / PPM / KP-DRPM / 2017

References

[1] Archer, D., Luansang, C., & Boonmahathanakorn, S. (2012). Facilitating community mapping and planning for citywide upgrading: the role of community architects. *Environment and Urbanization*, *24*(1), 115-129.

[2] Darjosanjoto, E. T. (2005, June). Spatial growth and function in a Javanese coastal city. In *The 5th International Space Syntax Symposium Proceeding (ISSN 90-8594-002-8), TUDelft* (pp. 13-17).

[3] Doan, P., & Oduro, C. Y. (2012). Patterns of population growth in peri-urban Accra, Ghana. *International Journal of Urban and Regional Research*, *36*(6), 1306-1325.

[4] Hao, J., Zhu, J., & Zhong, R. (2015). The rise of big data on urban studies and planning practices in China: Review and open research issues. *Journal of Urban Management*, *4*(2), 92-124.

[5] Hepcan, S., Hepcan, C. C., Kilicaslan, C., Ozkan, M. B., & Kocan, N. (2012). Analyzing landscape change and urban sprawl in a Mediterranean coastal landscape: a case study from Izmir, Turkey. *Journal of Coastal Research*, *29*(2), 301-310.

[6] Hurskainen, P., & Pellikka, P. (2004, October). Change detection of informal settlements using multi-temporal aerial photographs–the case of Voi, SE-Kenya. In *Proceedings of the 5th African Association of Remote Sensing of the Environment conference, Nairobi, Kenya, unpaginated CD-ROM*.

[7] Lang, W., Chen, T., & Li, X. (2016). A new style of urbanization in China: Transformation of urban rural communities. *Habitat International*, *55*, 1-9.

[8] Muriuki, G., Seabrook, L., McAlpine, C., Jacobson, C., Price, B., & Baxter, G. (2011). Land cover change under unplanned human settlements: A study of the Chyulu Hills squatters, Kenya. *Landscape and Urban Planning*, *99*(2), 154-165.

[9] Nguyen, H. H., McAlpine, C., Pullar, D., Johansen, K., & Duke, N. C. (2013). The relationship of spatial–temporal changes in fringe mangrove extent and adjacent land-use: Case study of Kien Giang coast, Vietnam. *Ocean & coastal management*, *76*, 12-22.

[10] Oelofse, C., & Dodson, B. (1997). Community, place and transformation: a perceptual analysis of residents' responses to an informal settlement in Hout Bay, South Africa. *Geoforum*, *28*(1), 91-101.

[11] Sobreira, F., & Gomes, M. (2001). The Geometry of Slums: boundaries, packing and diversity.

[12] Trujillo, T. A. (2012). *Spatial and process strategies toward the formalization and integration of the informal settlement, Villa 31, in Buenos Aires, Argentina* (Doctoral dissertation, University of Washington).

[13] Tsenkova, S. (2010). Informal settlements in post-communist cities: Diversity factors and patterns. Urbani izziv, (21 (2)), 73-84.

[14] Vaz, E. (2014). Managing urban coastal areas through landscape metrics: An assessment of Mumbai's mangrove system. *Ocean & Coastal Management*, *98*, 27-37.

[15] Zhang, Z., Xiao, R., Shortridge, A., & Wu, J. (2014). Spatial point pattern analysis of human settlements and geographical associations in eastern coastal China—A case study. *International journal of environmental research and public health*, *11*(3), 2818-2833.