The arrangement of Hamdan Sukaraja Slum Settlements in Medan Indonesia, through the concept of affordable vertical village

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Abstract. Initially, the city of Medan consisted of villages, often called urban villages, which evolved to form cities. Sukaraja and Hamdan villages are old villages that are part of the Sultanate of Deli and reflect the sociocultural character of the local people of Medan. Now, these villages have grown to the banks of the Deli River. The residents choose to live in riverbank areas that are not well-designed and create unhealthy slums that have social, economic, and cultural problems. These villages will be displaced soon by the discourse of the toll project in the city of Medan on the Deli River. This paper aims to analyze and provide solutions to the problems of the development of slums in the Deli River area. Both environmental, architectural, social, and economic issues of the population. Based on data analysis, the people of Hamdan and Sukaraja villages need livable housing at an affordable cost and can support the community's economy. This study recommends a vertical village design with an Ecological Architecture approach and integrated with sustainable economic systems. The vertical village design also accommodates the economic empowerment of Sukaraja and Hamdan villagers by developing and integrating businesses that have grown previously in this village.

1. Introduction

Settlements are formed through a continuous process in a functional place based on patterns of human activity, both those caused by the influence of physical and non-physical conditions [1]. A residential area is a part of the environment outside a protected area in the form of an urban or rural area, and it functions as a residential area or a place for activities to support life and livelihood [2]. Housing and settlements are basic human needs that cause problems for big cities in developing countries, including Medan City, Indonesia. The availability of affordable land in urban areas is decreasing and becoming more high-costed, while the number of population increases and the number of demands for housing needs increases. The financial condition of urban residents is a factor in the growth of urban housing. The low-income urban people prefer to live in areas near the city center and suburbs that are not well-designed. This problem creates many slum areas that are not healthy and have an impact on causing social, economic, and cultural issues. One of the slums that has developed in the city of Medan is Hamdan and Sukaraja Villages. They develop illegally along the Deli River. It is due to the decreasing amount of affordable land for low-economy urban communities. It Recorded in 2012, Medan City has several slums that spread in seven districts and 18 villages with an area of about 403 hectares [3]. Sukaraja is an ancient settlement during the Deli sultanate. Nowadays, the conversion of residential land
into a commercial function marginalizes the habitation to the banks of the Deli River. The government will evict the slums for the realization of a toll road project on the Deli River and the construction of a shop complex. This phenomenon will cause the number of urban settlements in Medan to decrease and even become extinct.

Previous studies have resulted in solving the problem of slum settlements in Medan by making a vertical village design. Vertical villages try to maintain existing activities, such as socializing between citizens and working together [4]. Indeed, building a vertical village can solve the problem of limited land and slum areas. Yet, whether the development of vertical villages is still able to solve these problems in the coming decades. Especially in cities in developing countries such as Medan City, slum settlements inhabited by the majority of the population with low economies. Building a vertical village with a large budget is not possible for low-income residents.

To solve these problems, several previous researchers recommended arranging slum into vertical villages by adding a focus on environmental aspects. However, social, cultural, and economic issues are still unresolved. This study will produce a recommendation of vertical village design that can solve the limited land, environmental damage, development costs, including sociocultural and economic problems. This research provides solutions in arranging slum residential areas on riverbank areas in Hamdan and Sukaraja through integrated architectural design with a system of sustainable economic.

2. Methods
This research has conducted in the slum area of Hamdan and Sukaraja Village, Medan Polonia District, Medan City, Indonesia. The researchers conducted a study of both physical and non-physical data on the population and the environment to find appropriate and acceptable design criteria at the research location. The research method used in Hamdan Sukaraja Vertical Village Design is descriptive research. This research has conducted by observing the research location and interviews. In the interview, it is necessary to select respondents who understood the physical conditions of the environment and the population, so it chooses the commune leader as the respondent. The observations are about the physics, environmental, and non-physical conditions of the research location, such as the type of activity, activity pattern, economy, social, and culture of the population. Through this observation, it can determine the data of the residents, space requirements, and the required architectural approaches. Then the results of these observations were studied with vertical village theory and ecological architectural theory to produce conceptual design findings to arrange the research area.

3. Results and discussion
Hamdan and Sukaraja villages are old settlements that were part of the Deli Sultanate society and reflect the sociocultural character of the local community in Medan. The residents of Hamdan and Sukaraja have different ethnic backgrounds but can live side by side in harmony, makes social life in this village very distinctive. The original inhabitants of Sukaraja are the Deli Malay ethnicity, but now many other inhabitants are migrants. Nowadays, they live in poverty in an unlivable environment. They use the river border area for building houses so that it damages the river environment. Many groups of people become marginalized in development just because of their gender, ethnic groups, age, sexual orientation, physical disabilities, and poverty [5].

Nowadays, this village has changed and has increasingly been shifted to the riverbank because residents are not able to compete financially. The land function of this residential area has converted into commercial facilities (shop house complexes), so the residents are marginalized and forced to live in riverbank areas. The government plans a toll road along the Deli River while the private developer plans a shophouse complex in the remaining settlement. The residents consider it is a disruptive development because it will replace the habitation and the river greening. This research is in opposition to provide access to livable and affordable urban housing for low-income people in this disruptive era. As shown in Figure 1, the total area of the Sukaraja settlement area has decreased from 1913 to 1925. As shown in Figure 2, the number of Hamdan and Sukaraja settlements has decreased and marginalized to the Deli Riverbank. In the next few years, these remaining settlements will be vanishing.
Conducted analyzes of the site, activity system, activity system, spatial organization, mass and shape, structure, and utility systems at the research location. Ninety-five residents are living in the research location. Based on interviews with the commune leader, known that 570 people are living in the research location. The residents of Hamdan and Sukaraja Villages have a unique activity pattern compared to the other, due to the potential of the Deli River at the residence. The residents use river water for non-consumption activities such as washing clothes, washing dishes, bathing, and others. The residents used dirty river water because of the financial constraints to use municipal waterworks (PDAM) services. The Deli River is very profitable to support the people's need for water, but its health condition is bad. The use of this unhygienic river water can cause disease for residents.

This residential area was also affected by the flood by the Deli River due to the unavailability of flooded land and the use of river greening land to become residents' houses. Based on interviews with residents, the Deli River at the site causes flooding at least twice a year, reaching a height of 2 meters in residents' houses during floods. Figure 3 shows the flood-affected areas based on contour observations of the site and the results of interviews with residents.

**Figure 1.** Sukaraja settlements on the Medan Maimun map in 1913 and 1925 [6].

**Figure 2.** Hamdan and Sukaraja settlements on the Medan city map in 2020.
Based on these problems and analysis results, a vertical village design will be formulated with the concept of vertical housing at affordable costs, using an ecological architectural approach in the Hamdan and Sukaraja areas, which integrates with a sustainable economic system. A vertical village is a residential area with buildings arranged vertically to maximize the amount of occupancy on limited land with the function as housing for low-income groups, and it has a system of supporting the population's economy to increase the standard of living of the communities. Concerning the situation of slums, the space created after the overcrowded building replaced with vertical housing can utilize as a green or open space [7]. There are several consequences associated with the implementation of verticalized housing approaches, such as changes in the behavior or habits of occupants, the impact on the surrounding environment, changes in the value of land, and others [7]. This vertical village design using an ecological architectural approach to solve the problem of environmental destruction. Ecology architecture is an ecologic dimension in architecture that is concerned with the natural environment and limited natural resources [8]. Ecological design is bioclimatic design, design with the climate of the locality, and low energy design [9]. In conclusion, ecology architecture emphasizes the integration of local ecological conditions, macro-climate, micro-climate, site conditions, development programs, climate responsive design concepts and systems, low energy use, through passive design taking into account the shape, configuration, facade, building orientation, vegetation, natural ventilation, color elements, and others.

The basic concepts applied to the design of Hamdan Sukaraja Vertical Village.

- Environmentally responsible building. Building designed that can be responsive to the environment. This concept will affect the building designs of the mass arrangement, circulation, and others.
- Passive design technology. Passive building design strategy by taking direct advantage of nature to achieve thermal comfort in buildings through design elements. The passive design divides into building site context and building design context. Thermal comfort in architectural design is a necessity because humans are involved in it as residents. Humans tend to carry out some efforts to fulfill comfortable thermal needs, such as using a fan or AC [10].
- Waterfront. The mass of the building's direction will be indirectly facing the Deli River.
- Use of renewable energy. The use of renewable energy to produce electrical energy utilizes sunlight with a solar harvesting system and the Deli River flow with a power generator turbine system. A hydropower plant is one renewable source of electrical energy that utilizes water as a source of electricity [11].
- Urban vertical farming. The application of the vertical urban plantation system in the area along the Deli River to be a green area with a modular grid system and developable in limited land.
- Rainwater harvesting. The rainwater harvesting locally collects and stores rainfall through different technologies, for future use, to meet the demands of human consumption or human activities [12]. Rain harvesting is applied to collect rainwater and reuse it for toilet needs.
- The use of ecological and affordable building materials. The use of ecologic materials by using environmentally friendly materials and recycled materials to solve environmental problems and reduce waste.

![Figure 4. Conceptual design of building mass.](image)

The orientation of the building mass is towards the south and north. The shortest side of the building is the part that is exposed to direct sunlight in the east and west. With this orientation, the building openings are focused on the south and north to maximize natural ventilation in buildings with cross ventilation systems. As shown in Figure 4, the building masses are spaced and not attached to maximize the wind flow on the site into the building. The building mass raised to the top in anticipation of flooding. This concept makes the building shaped like a stilt building.

![Figure 5. Concept of building development construction.](image)

There are two types of residential designs in this vertical village (type 45 and type 70). In the early days, each building has three floors. However, it can be expanded to the 5th floor to anticipate housing needs for the next decade. Design of residential buildings using 6x7 m modules for the house type 45 and 12x7 m for the house type 70. The building structure using a rigid frame structure system (steel-reinforced concrete). The building design able to expand up to the fifth floor by adding columns and beams to the top of the building's structure, as shown in Figure 5.
Conclusion

Hamdan and Sukaraja Villages are the living spaces of local communities that reflect the social life of the people of Medan. But nowadays, they turning becomes a slum area on the banks of the Deli river due to the inability of the community to compete economically. However, its existence will soon disappear, replaced by a complex of shophouses and toll roads, which is considered a disruptive development for the community and the environment. It is necessary to maintain the existence of this urban village so that the city will not lose its identity. Hamdan Sukaraja Vertical Village will protect the urban village's existence and solve architectural, social, cultural, and even economic problems for the community. The vertical village design with paying attention to values in the community's social life.

The building design uses the ecological approach to solve environmental problems. The house buildings design is a vertical configuration to save the budget in urban land use to provide livable and affordable housing. They also use waste material as building materials to save the building cost. Hamdan Sukaraja's vertical village building integrated with a sustainable economic system with the concept of empowering human resources through creative economic activities. This research produces a vertical village concept that provides access to affordable and livable urban housing. It can be a pilot project to organize slum settlements in urban areas, especially in riverbank areas.

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This research is presented as a pilot project to organize slum settlements in riverbank areas for middle to low-income economies. We gratefully acknowledge the support of the Department of Architecture, Faculty of Engineering, Universitas Sumatera Utara, Indonesia.

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