Analysis of Slum Settlements on Livable Houses in Belawan Bahari Village, Medan

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Abstract. The rising demand for housing, in contrast to the limited availability of land, has resulted in the uncontrolled expansion of residential areas. This phenomenon contributes to the emergence of slum settlements, as observed in Belawan Bahari Village, Medan. Slum areas are typically characterized by deteriorating environmental quality, which is largely attributed to the prevalence of substandard housing and unsanitary living conditions. In light of these challenges, it is essential to conduct an evaluation of the residential environment's feasibility, with a particular focus on the adequacy of housing in Neighborhood VIII of Belawan Bahari Village, Medan. The assessment of housing suitability encompasses the structural integrity of buildings, construction quality, and spatial arrangements. Subsequently, the analysis is carried out using a qualitative descriptive approach, employing weighting and scoring methods to classify the results into three categories: very good, good, and poor.

Keywords: slum settlements; habitable housing; environmental quality

1. Introduction

The rapid increase in population has resulted in a growing demand for housing. The high level of residential demand, when coupled with the limited availability of settlement facilities and infrastructure, inevitably affects the quality of the residential environment within a given region. If left unmanaged, this situation may lead to the development of settlements that fail to comply with health, safety, and comfort standards, [1]. The quality of residential areas is largely determined by the condition of the inhabitants' dwellings. Inadequate and substandard settlement growth contributes to environmental degradation and a decline in residents' quality of life, ultimately leading to the emergence of slum areas.

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Rapid population growth has led to a significant increase in housing demand, [2]. The increasing demand for residential space, combined with the limited availability of infrastructure and settlement facilities, directly affects the quality of the residential environment. If left unaddressed, this condition may lead to the emergence of settlements that do not meet health, safety, and comfort standards. The quality of a settlement is greatly influenced by the condition of its housing units. Unplanned and inadequate housing development contributes to the decline of environmental quality and residents' quality of life, ultimately leading to the formation of slum settlements, [3].

Slum settlements may also arise as a result of natural degradation, such as tidal flooding, particularly in coastal areas. In addition, slum conditions can occur due to residents' behavior that neglects environmental care and healthy living practices, leading to poor and unmaintained surroundings that ultimately degrade the city's appearance, [4]. One of the slum settlement problems in Medan City is located in Belawan Bahari Subdistrict, Medan Belawan District.

Belawan Bahari Subdistrict is situated between the estuaries of the Belawan River and the Deli River. It is a densely populated residential area characterized by poor environmental quality and a low standard of living. The residents share similar backgrounds in terms of occupation, education, and socioeconomic conditions, marked by low educational attainment, limited skills, and weak environmental adaptability. These similarities form a community with a generally low quality of life. Most residents of Belawan Bahari work as small-scale fishermen or fishing laborers with limited economic capacity, [5].

The low economic condition has resulted in the community's limited ability to maintain and care for their housing, [6]. One of the key indicators of slum formation in an area is the high number of uninhabitable houses. Such conditions are prevalent in Belawan Bahari Subdistrict. The use of inappropriate and non-durable construction materials leads to the rapid deterioration of housing quality and eventual structural damage, reducing the physical strength of buildings. In addition, inadequate ventilation systems, poor sanitation, and limited access to clean water that meets health and safety standards further exacerbate the living conditions of residents, [7]. If all these factors persist over time, they can negatively affect environmental quality, eventually leading to a decline in the community's overall quality of life.

2. Research Methodology

The research was conducted in Belawan Bahari Subdistrict, focusing on Environment VIII, Medan Belawan District, Medan, as shown in **Figure 1**. The study employed a qualitative approach through assessment and ranking to evaluate the feasibility and suitability of habitable housing. The assessment of the feasibility and suitability of habitable houses can be based on the aspects of building structure and construction, as well as the spatial layout of the house. After obtaining the assessment results, the data are analyzed to determine the criteria for habitable housing, followed by the development of a housing planning concept tailored to the environmental conditions of the residential area.

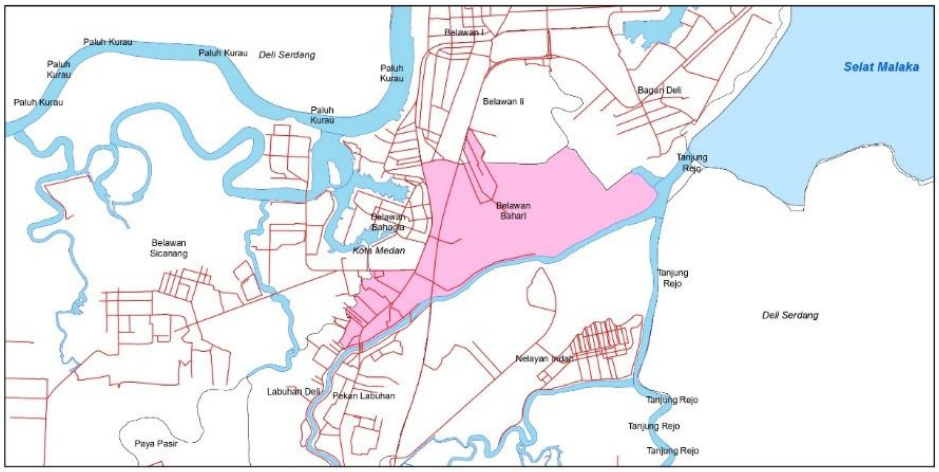

Fig 1. Study Location Belawan Bahari Sub-district, Medan, Indonesia

Data were collected through observation and interviews with 45 respondents and homeowners. The data were then analyzed based on the Building Structure and Construction (SKB) aspect with variables including foundation (Pd), floor (Lt), walls (Dd), and roof (At). For the House Spatial Layout (TRR) aspect, variables included house area (Lr), spatial pattern (Tr), access to the building (An), lighting (Pc), ventilation (Ph), clean water (Ab), and sanitation (Sn). Each variable was assessed using weights and scores to measure the feasibility and suitability of the houses, classified as very good, good, or not good. Below are the calculations for the building structure and construction (SKB) and the house spatial layout (TRR).

$$SKB = (\Sigma\ Pd \times 30) + (\Sigma\ Lt \times 20) + (\Sigma\ Dd \times 25) + (\Sigma\ Ap \times 25) \quad (1)$$

Ket:

Pd	:	Foundation
Lt	:	Floor
Dd	:	Walls
Ap	:	Roof
Σ	:	Locations 1 to 6

$$TRR = (\Sigma Lr \times 10) + (\Sigma Tr \times 15) + (\Sigma An \times 10) + (\Sigma Pc \times 15) + (\Sigma Ph \times 20) + (\Sigma Ab \times 15) + (\Sigma Sn \times 15) \quad (2)$$

Ket:

Lr	:	House area
Tr	:	Spatial pattern
An	:	access to the building
Pc	:	lighting
Ph	:	ventilation
Ab	:	clean water
Sn	:	Sanitation
Σ	:	Locations 1 to 6

3. Analysis and Discussion

This section discusses the situation and condition of the slum settlement in the observation area. The location is in a flood-prone area, causing frequent waterlogging. The community's typical occupations include fishermen, fishing laborers, and salted fish artisans or workers who dry salted fish. The feasibility of habitable houses can be analyzed by assessing the house's structural and construction system as well as the spatial layout system.

3.1 Aspects of Structure and Construction in Houses

The criteria for habitable houses based on the assessment of structural and construction conditions refer to the evaluation of the foundation, floor, walls, and roof through visual and functional inspection. The objective is to determine the feasibility, safety, and comfort of the house. The assessment focuses on the sturdiness and stability of the building structure by examining whether it remains solid, not tilted, not porous, not decayed, and free from cracks. Additionally, the evaluation considers the materials used in construction.

The results of observation and inspection of the physical condition of the building from the aspects of structure and construction do not meet healthy housing standards. The building’s strength is assessed based on variables such as the strength and solidity of the foundation, floor surface condition, wall condition, and roof condition. The analysis results indicate a low feasibility and suitability rating for habitable houses, categorizing the houses as poor or uninhabitable, (Table 1).

Belawan Bahari Subdistrict is located on the coastline and is highly prone to tidal flooding. The phenomenon of tidal flooding, which is the rise of sea water onto land, has a significant damaging impact on residents' houses, [8]. In addition to tidal flooding that leaves waterlogged areas, residents also experience waterlogging due to sea water rising through the estuaries of the Belawan and Deli Rivers. This condition exacerbates the waterlogging, causing the ground surface to remain wet. Stilt houses are a solution for residents' comfort and convenience. Most people use stilt houses with concrete or wooden foundations, many of which are now beginning to become porous and decayed. Observations show that the foundation conditions do not yet meet the structural durability criteria, **Figure 2a**.

Table 1. Assessment of Structural and Construction Aspects of Housing

Location	Foundation	Floor	Wall	Roof	Compliance of Decent Livable Housing	
	N	N	N	N	N	K
Corridor 1	36	25	30	30	121	R
Corridor 2	45	30	40	30	145	R
Corridor 3	40	23	30	35	128	R
Corridor 4	40	23	30	25	118	R
Corridor 5	45	20	30	30	125	R
Corridor 6	45	20	30	25	120	R

Source: Processed field data, (2025
Explanation: N : value, K : the category, with T : high, S : medium, and R : low.

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Fig 2. House Structure and Construction (a. Stilt house with concrete pile foundation; b. Wooden board wall structure; c. Access to the interior of the house)

The stilt house design with a wooden plank floor extending the column posts is characteristic of coastal stilt houses. The flooring materials consist of wooden planks and plywood. The wooden boards are laid flat and supported by beams underneath. The wood material, according to analysis, shows signs of deterioration in the floor structure of some houses due to inadequate maintenance. The damage to the floor poses a threat to the safety of the residents.

This issue also occurs in the wall structure. The wall materials used are wooden boards arranged vertically and horizontally, along with plywood used as partitions between rooms inside the house. Some houses even use plywood as exterior wall covering, as shown in **Figure 2b**. The choice of inappropriate materials leads to easy damage to the building. Based on the

assessment results, the wall structure does not meet the comfort and safety standards for the occupants within the house (**Figure 2c**).

The roof structure uses zinc and corrugated asbestos materials. About 90% of the roofs are gable-type and generally do not have ceilings. This roof design is easy and inexpensive to maintain. Field conditions indicate that some houses experience rotting and corrosion on the zinc roofs, caused by relatively high salinity levels, **Figure 3.**

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Fig 3. Roof structure model (gable roof shape, and interior condition of houses without ceilings)

From the aspect of building structure and construction, it can be concluded that the suitability of habitable houses remains low. This issue is influenced by the lack of maintenance and management of individual homes. This is affected by the community's low income levels, leading residents to use second-hand materials in house development, which impacts the physical durability of the buildings. According to Yuzni (2025), the use of second-hand materials such as wood and zinc results in semi-permanent building structures that often lack longevity, [9]. Fragile and poorly maintained walls indicate building vulnerability, which, if not repaired, will endanger the occupants.

3.2 Aspects of House Spatial Layout

The spatial layout assessment of houses was conducted to determine their suitability as residences for the community. The evaluation involved observation and interviews to examine and understand the condition of houses at the research site. The following are the results of the suitability assessment of habitable houses based on the house spatial layout aspect, as shown in, **Table 2**.

Based on observational data, 10% of residents have houses with an area between 70 m^2 and 100 m^2, 20% have houses between 45 m^2 and 70 m^2, 40% have houses between 21 m^2 and 45 m^2, and 30% have houses smaller than 21 m^2. The number of occupants per house generally ranges from 4 to 8 people. Houses are generally owned by residents through inheritance with land ownership status (SHM), rental, or usage rights. A livable house must be able to accommodate many of its occupants' activities. The standard room area per person is approximately 7.2 square meters per individual. Meanwhile, the room height should be at least 2.8 meters, [10].

Table 2. House Spatial Layout Assessment

Location	Lr	Pr	Ab	Pc	Ph	Ab	Sn	Compliance of Decent Livable Housing	
	N	N	N	N	N	N	N	N	K
Corridor 1	20	30	15	22,5	22,5	30	20	160	R
Corridor 2	15	22,5	15	15	18,75	25	18,75	130	R
Corridor 3	10	20	10	15	15	20	15	105	R
Corridor 4	15	20	10	15	20	30	15	125	R
Corridor 5	15	20	10	15	15	20	15	110	R
Corridor 6	12,5	15	12,5	22,5	22,5	20	15	120	R

Source: Processed field data,, (2025)
Explanation : Lr: house area, Pr: spatial pattern, Ab: access to the building, Pc: lighting, Ph: ventilation, Ab: clean water, Sn: sanitation
N : value, K : the category, with T : high, S : medium, and R : low.

Each house has a common room, which can be used collectively for various occupant activities. Based on spatial pattern data, 70% of the houses have one bedroom, one common room, and one kitchen adjacent to a very small bathroom. For fishermen, the house is an essential facility supporting their maritime activities. Their home serves as shelter, protection, and a place to carry out social, religious, and fishing-related activities, [11]. The low standard of living and limited available land require a structured approach in designing building spatial layouts. The constantly wet site conditions cause the road surface to be higher than the land. In addition, residents raise their buildings, so accessibility for entering and exiting the houses needs to be addressed..

Lighting system consists of natural and artificial lighting. Lighting is needed inside the house to see and analyze objects visually. The involvement of light intensity will affect our vision of an object, [12]. The allowed standard for openings on wall surfaces according to Greenship is a minimum of 30% of the room's floor area, [13]. The lighting analysis shows that the condition of openings on the house wall surfaces does not meet the established standard. This is caused by the very narrow distance between houses, which ranges from 1 m to 0.5 m, **Figure 4**.

Fig 4. Building appearance dynamics

Natural ventilation is the exchange of indoor air through open building elements such as vents, windows, and doors that can be opened or closed as needed, [14]. The analysis indicates a low

level of compliance within the buildings. This results in wall openings being restricted solely to the front facade, failing to conform to the Indonesian National Standard (SNI) established by the Ministry of Public Works and Housing (PUPR). According to PUPR regulations, the minimum requirements for natural ventilation comfort in residential buildings mandate that ventilation openings cover no less than 5%, and windows at least 20%, of the floor area of the room.

A habitable house must have access to adequate drinking water services. A safe drinking water source is defined as one originating from a municipal clean water network or a pump well that is protected from rainwater contamination. Data analysis shows that the community's clean water needs are met primarily by privately managed pump wells. Residents purchase water on a monthly basis from the owners of these pump wells. The water is distributed to households through pipes or hoses.

The existing sanitation system does not comply with environmental health standards. This is primarily due to the lack of adequate drainage facilities, resulting in wastewater being directly discharged onto waterlogged ground. The wastewater is channeled into septic tanks constructed from concrete pipes with a diameter of 1 meter. Furthermore, the waste management system in the area is poorly coordinated, leading to scattered waste that contributes to environmental pollution.

The assessment of adequate housing suitability based on structural and construction aspects, as well as spatial layout, indicates a low level of adequacy. The deterioration is evidenced by compromised foundations, floors, walls, and roofs exhibiting rot, decay, and corrosion. Similarly, the spatial layout quality is also poor. The evaluation, which included variables such as building area, spatial configuration, access to the building, lighting, ventilation, clean water quality, and sanitation systems, found all these factors to be of low quality.

References

[1] A. S. Wimardana, "Faktor Prioritas Penyebab Kumuh Kawasan Permukiman Kumuh Di Kelurahan Belitung Selatan Kota Banjarmasin," *J. Tek. ITS*, vol. 5, no. 2, pp. 3–8, 2016, doi: 10.12962/j23373539.v5i2.18386.

[2] E. Zuraidi, I. Caisarina, and M. Agustina, "A Bibliometric Study of Global Trends in Community Resilience and Spatial Planning Research (2000-2021)," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 881, no. 1, 2021, doi: 10.1088/1755-1315/881/1/012067.

[3] UN HABITAT, "A Short Guide to Human Settlements Indicators Goal 11: Sustanable Cities and Communities," in *Sustainable Development Goals: Monitoring Human Settlements Indicators*, 2020, pp. 26–28.

[4] R. Nursyahbani and P. Bitta, "KAJIAN KARAKTERISTIK KAWASAN PEMUKIMAN KUMUH DI KAMPUNG KOTA (Studi Kasus : Kampung Gandekan Semarang) PENDAHULUAN Perkembangan suatu kota tidak terlepas dari pertumbuhan penduduk . Berkaitan dengan hal tersebut terdapat berbagai macam sebab yang mendor," *J. Tek. PWK*, vol. 4, no. 2, pp. 267–281, 2015, [Online]. Available: http://ejournal-s1.undip.ac.id/index.php/pwk

[5] T. Harahap, "Komparasi Indikator Rumah Layak Huni dan Permukiman Kumuh Indonesia," *J. Sci.*

Appl. Technol., vol. 5, no. 1, p. 163, 2021, doi: 10.35472/jsat.v5i1.426.

[6] A. Ardiyanto, M.T., "Perubahan Struktur Rumah Terdampak Rob di Dusun Morosari, Desa Bedono, Kecamatan Sayung, Demak," *Prax. J. Sains, Teknol. Masy. dan Jejaring*, vol. 6, no. 2, pp. 99–108, 2024, doi: 10.24167/praxis.v6i2.11921.

[7] D. Fitri, "Faktor-Faktor Penyebab Munculnya Permukiman Kumuh Daerah Perkotaan Di Indonesia," *J. Unesa*, pp. 1–9, 2021, [Online]. Available: https://ejournal.unesa.ac.id/index.php/swara-bhumi/article/view/38202/33713

[8] S. Bagus Pribadi, Indriastjario, A. Ratna Wulandari, Y. Tri Wibowo, B. Janatin, and M. Muzamil, "Sistem Konstruksi Bangunan Sederhana pada Perbaikan Rumah Warga di Daerah Rob (Studi Kasus : Kelurahan Kemijen, Semarang Timur)," *Modul*, vol. 11, no. 2, pp. 81–88, 2011, [Online]. Available: http://buildingindonesia.biz/

[9] S. Z. Yuzni and E. Zuraidi, "Agile Urban Dynamics: Examining Housing Characteristics in the Slums of Belawan Bahari, Medan-Indonesia," *Plan. Malaysia*, vol. 23, no. 2, pp. 56–70, 2025, doi: 10.21837/pm.v23i36.1702.

[10] M. S. Suryo and P. KemenPUPR, "Analisa Kebutuhan Luas Minimal Pada Rumah Sederhana Tapak di Indonesia Analysis of Minimum Space for Low Cost Landed House in indonesia," *J. Permukim.*, vol. 12, no. 2, pp. 116–123, 2017, [Online]. Available: http://jurnalpermukiman.pu.go.id/index.php/JP/article/viewFile/62/pdf_1

[11] T. Santri, "Analisis Karakteristik Visual Arsitektur Pemukiman Nelayan," *J. Tiarsie*, vol. 15, no. 2, 2018, doi: 10.32816/tiarsie.v15i2.37.

[12] D. K. R. Dumillah, A. Setiawan, and N. Suryanti, "Evaluasi Sistem Pencahayaan Alami Pada Hunian Kontrakan Amanah Mahasiswa," *Semin. Karya Pameran Arsit. Indones. 2023 Sustain. Resil. Futur. Urban Rural Living*, vol. 6, no. 2, pp. 36–42, 2023.

[13] G. B. C. Indonesia, "Rumah Greenship Versi 1.0," *Direktorat Pengemb. Perangkat Penilai. GBCI*, pp. 1–22, 2014, [Online]. Available: https://gbcindonesia.org/files/resource/9b552832-b500-4b73-8c0e-acfaa1434731/Summary GREENSHIP New Building V1.2.pdf

[14] D. W. Lestari, "Penghawaan Alami Pada Rumah Tinggal Di Kawasan Permukiman Waduk Pluit Dengan Pendekatan Konsep Rumah Sehat," *Mintakat J. Arsit.*, vol. 23, no. 2, pp. 85–97, 2022, doi: 10.26905/jam.v23i2.7731.