Sustainable Streetscape Design Based on Functional Aspects
Case Study: Medan City, Indonesia

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Abstract. Streets are an important part of a city. Streets provide city views and experiences for their users. Streetscape as a visual depiction of the urban environment can reflect the aesthetics of the urban area and improve urban visual quality. Streetscapes must be planned to provide spatial and visual comfort for pedestrians. Sustainable streetscapes can improve the quality of the environment by providing suitable paths for pedestrians and thus encouraging people to walk. Sustainable streetscape design is one of the determining factors for a city's success. This research aims to analyze and produce sustainable streetscape designs based on functional aspects. This research uses qualitative methods with observational data collection. The functional aspects of the streetscape studied include pedestrian paths, building façades, street furniture, greenery, crossing paths, bicycle lanes, drainage, distance between buildings, and signage. The analysis was carried out descriptively. The research results show that sustainable streetscape design must be equipped with sidewalks, street furniture, greenery, lighting, bicycle lanes, interconnected sidewalks, a good drainage system, and signage arrangements.

1 Introduction

The lack of a pedestrian-friendly environment, uncontrolled development patterns, traffic and parking problems make street life vulnerable and unattractive for users, and affect the use of mass transportation [1]. Poor road conditions and road spaces shared by pedestrians and cyclists cause pedestrians to feel unsafe. Parking facilities, crossings, greening of roads and sidewalks are not well designed, making it difficult to reach stations or bus stops. Increasing density without sustainable urban design and streetscape will reduce people's quality of life [1].

Streetscape as a visual depiction of the urban environment not only reflects the aesthetics of the area, but is also a space for social interaction, mobility, and community welfare. Streetscapes must be planned to provide spatial and visual comfort for pedestrians. Spatial planning and visual comfort are two aspects that influence each other [2]. This research aims to analyze and produce sustainable streetscape designs based on functional aspects to improve the quality of urban life. Sustainable streetscape design is one of the determining factors for a city's success. Sustainable streetscapes can improve environmental quality, provide suitable roads for pedestrians, maintain economic vitality, conserve limited natural resources, provide visual quality, and contribute to public health by encouraging people to walk [3].

2 Sustainable Streetscape

Streetscape is defined as a part of urban space that displays the quality of street design and its visual effects [3]. Streetscape includes buildings, road surfaces, bus stops, signs, signage, street furniture, and so on. A comfortable and safe street view can increase the number of pedestrians and urban visual quality [4, 5]. There are five principles of streetscape: improving air quality, reducing heat island effects, improving water quality (including flood management) or efficiency, increasing energy efficiency, and reducing light pollution [3].

Streetscape elements can have a positive influence on road users and make an area more lively [6]. Quality urban space will become more active where it is necessary to provide adequate seating, covered paths and seating areas, lighting devices throughout the streets, and paved areas that can be passed and accessed by pedestrians and people with disabilities. The visual quality of a city can be influenced by the streetscape. A city that has good visual quality will produce a positive image for society. Community participation is needed in streetscape planning to produce a good visual quality of urban space [2].

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Several aspects of a sustainable streetscape are functional, ecological, social, and economic [7]. When designing a streetscape, it is important to consider functional aspects so that the street is not only visually attractive but also provides benefits for its users. The functional aspect of streetscape includes planning and implementing elements aimed at increasing comfort, safety, and environmental sustainability. Every functional element, including pedestrian-friendly sidewalks and efficient use of lighting, plays an important role in shaping the character of every city street. The functional aspect of streetscape is not only the key to addressing urban space design but also to creating an urban environment that is efficient, comfortable, and balances people's needs and expectations for sustainable urban space.

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The functional aspects of streetscape refer to the elements that form the characteristics and function of pedestrian paths that provide friendliness and usefulness for pedestrians and other road users [8]. In a streetscape, indicators are needed that can form the streetscape. The following are streetscape elements, namely pedestrian paths, building façades, street furniture, greenery, crossing paths, bicycle facilities, distance between buildings, and signage.

2.1 Sidewalk

Pedestrian paths are an important part of every streetscape; they must be designed to provide a safe, attractive and comfortable space for road users, with appropriate arrangements for tree planting, lighting, and street furniture. Street sidewalks exist to allow local interactions and create a more complex order [9].

2.2 Building facade

Building façades are part of the urban elements that influence the visual quality of the city [10]. Building facades can be viewed from building style, color, texture, materials and lighting [11]. Buildings should adopt green building principles, apply green walls and green roofs to support the concept of sustainable cities [12]. Several building indicators that influence sustainable streetscape design include color (contrast, bright), facade (attractive fence, attractive height, articulation, roof line details, balconies, verandas, materials), furniture. roads (seating, lights, gardens) and pavement (attractive textures, colors, materials, patterns and edges) [13].

2.3 Street furniture

Street furniture such as benches, trash cans, street lights and others are included in street furniture, which can be used by the public on pedestrian routes. Street furniture is provided to complement pedestrian needs. Street furniture should be well designed so that it can meet the needs of city residents [14]. Street furniture elements include banners, benches and seating, bicycle racks, bollards, community kiosks, parklets, toilets, transit shelters and trash cans [15].

2.4 Greenery

Greenery on the roads is needed to reduce heat and improve air quality. Planting trees along pedestrian paths can provide comfort for users and increase walking opportunities [16]. Vegetation planted along roads is able to withstand wind and handle rainwater runoff [17]. Roads with little vegetation can result in increased air pollution, a lack of shade and the desire to walk [12].

2.5 Crossing Route

Crossings are an important part of the pedestrian network. By emphasizing the pavement at road crossings, vehicle drivers can be alert to pedestrians. Street streetscapes should focus on design through special paving in crossing areas to ensure safe pedestrian traffic. Wide sidewalks, crossing lanes, traffic lights, and roads lined with vegetation are part of the street-level pedestrian environment [18].

2.6 Drainage

Providing good drainage on green roads can handle rainwater runoff and prevent flooding [12].

2.7 Bicycle lane

When designing roads, needs must be identified, and bicycle accommodations must be considered in the traffic mix just like other vehicles. The basic needs of cyclists are traffic safety and having a comfortable and safe parking space. Micro-scale attributes of the built environment include pedestrian facilities and bicycle paths [19].

2.8 Distance between buildings

Distance between streetscape buildings refers to the space provided between buildings and other facilities, such as roads, to meet user needs and sustainability.

2.9 Signage

Signage is important in the future commercial streetscape and shows that increased visual communication between pedestrians and the streetscape can create an attractive streetscape [20]. Signs or signage play an important role in creating a comfortable
urban environment by creating visual guides and navigation aids for road users. Sign boards are placed at social interaction points and at strategic places such as road intersections, parking areas and other public facilities.

3 Method

This study used qualitative methods with observational data collection techniques to analyze the functional aspect of streetscape in Medan city, Indonesia. The study focused on the visual deception of the urban environment and its impact on street users. Direct data collection in the field provides a realistic picture of the urban environment. On these three roads, there are buildings with commercial functions with quite high activity.

![Fig 1. Map of Research Location](image)

The research location is in Medan City, namely Ahmad Yani Street, Pemuda Street and Perniagaan Street which are commercial areas (Fig. 1).

![Fig 2. Research Framework](image)

The variables used in this research are pedestrian paths (dimensions, materials), street furniture, crossing paths, bicycle paths, distance between buildings, and sign boards. The analysis was carried out descriptively to determine what variables would be applied to sustainable streetscape design (Fig. 2).

4 Analysis

The study found that sustainable streetscape design is crucial for improving the quality of urban life. The design of streetscape must be equipped with sidewalks, street furniture, greenery, lighting, bicycle lanes, interconnected sidewalks, a good drainage system, and signage arrangements. The study also found that the lack of pedestrian-friendly environments, uncontrolled development patterns, and inadequate street design have made street life vulnerable and unattractive for users. (Table 1).

**Table 1. Function aspects on Ahmad Yani, Pemuda and Perniagaan Street**

<table>
<thead>
<tr>
<th>Element</th>
<th>Ahmad Yani Street</th>
<th>Pemuda Street</th>
<th>Perniagaan Street</th>
</tr>
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<tbody>
<tr>
<td>Sidewalk</td>
<td></td>
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<tr>
<td>- The width of the pedestrian on Jendral Ahmad Yani Street is 5 meters, which is divided into:</td>
<td></td>
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<tr>
<td>- Shopping arcade width 1.5 meters,</td>
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<tr>
<td>- Sidewalk width 3.5 meters</td>
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<tr>
<td>Building facade</td>
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<td>- Street lights</td>
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<td>- Traffic lights</td>
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<td>- Trash can</td>
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<td>- Roadblock</td>
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<td>- Power pole</td>
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<td>Street furniture</td>
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<td>- Street lights</td>
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<td>- Power pole</td>
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<td>Paving block material</td>
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<tr>
<td>Ramp</td>
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</tbody>
</table>
Based on Table 1, the elements in the three locations have several similarities. The pedestrian paths at all three locations have dimensions of more than 3 meters. On the sidewalk, there is a path for the disabled, which is colored yellow and has textured material. The sidewalk material uses non-slip material so that it provides a feeling of safety and comfort for pedestrians. Apart from that, the sidewalks are also equipped with street furniture consisting of street lights, trash cans, and road dividers. Sidewalks that are comfortable for pedestrians can enable interaction between pedestrians [9].

The building facades on Ahmad Yani Street are dominated by colonial building styles, bright colors and varied articulations. Meanwhile, on Pemuda Street and Perniagaan Street, there are buildings with modern styles and contrasting colors. The function of the buildings in these three locations is for trade and services. Building facades in urban areas can provide the visual quality of the city [7] and support sustainable concepts [11,12].

Street furniture available at the research location includes trash cans, street lights, traffic lights and bollards. It is recommended that benches be provided in commercial areas so that pedestrians can rest and interact and meet the needs of city residents [14]. Signage in this area is dominated by signage on buildings and traffic. Greenery on Ahmad Yani Street and Perniagaan Street is on the sidewalk. Meanwhile, on Pemuda Street, greenery is on the island side of the road. Sustainable streetscapes can be designed with greenery. Vegetation can reduce pollution and heat thereby providing a sense of comfort for pedestrians [16]. The crossing route available in the research allocation is a zebra crossing to support connectivity in the area. At all three locations there are no bicycle lanes. A drainage network is provided to drain water and retain rainwater runoff.

The study's findings are consistent with previous research that sustainable streetscapes can improve environmental quality, provide suitable roads for pedestrians, maintain economic vitality, conserve limited natural resources, and promote public health by encouraging people to walk. Based on the results of observations of functional aspect elements in the streetscape, recommendations for sustainable streetscape design based on functional aspects were
prepared. In commercial areas that have high activity, it should be supported by a sustainable streetscape so that it provides a feeling of comfort to pedestrians and traders.

Fig 3. Sustainable Streetscape Design

In addition, sustainable streetscapes can provide better environmental quality. Sustainable streetscape design should fulfill functional aspects such as greenery, sidewalks with comfortable dimensions and materials, bicycle lanes, street furniture, signage, bus stops and good drainage (Fig 3).

Fig 4. Sidewalk Design

Fig 5. Greenery and Bicycle Lane

In sustainable streetscape design, pedestrian paths are provided with non-slip material and dimensions of 3-4 meters, there are paths for the disabled, street furniture is available such as park benches, street lights, trash cans and bus stops, bicycle lanes on the side next to the sidewalk and greenery directly adjacent to the road as a buffer for air and noise pollution (Figure 4 and 5).

Fig 6. Building Façade and Signage

Signage on buildings should be arranged neatly and not cover the building facade (Figure 6). Building facades can provide city visual quality.

Sustainable streetscapes in commercial areas provide good visual effects and quality for users. Commercial areas have high activity so comfort, good air quality, reduction of island heat effects and good water management are needed [3]. Functional aspects such as sidewalks, greenery, and street furniture need to be provided so that commercial areas become more livable and comfortable for pedestrians [6]. A good sustainable streetscape is able to provide good visual quality to the city and form a positive image for the community [2].

5 Conclusion

Sustainable streetscape design is essential for improving the quality of urban life. The study's findings highlight the importance of considering the functional aspects of streetscape in designing sustainable streets. Sustainable streetscapes depict the visuals of cities, provide comfort for pedestrians, and improve the quality of the urban environment. Sustainable streetscape designs in commercial areas should provide comfortable sidewalks so that they attract visitors to walk and carry out their activities. The sidewalks are designed with dimensions and materials that allow pedestrians to walk comfortably and are equipped with street furniture and greenery along the road. Building facades play an important role in supporting the streetscape, namely by setting the distance and height of buildings in accordance with building codes. Signage needs to be arranged so that it does not cover the facade and does not interfere with surrounding activities. Bicycle lanes are provided as an effort to promote the use of environmentally friendly vehicles. Handling rainwater runoff is supported by a good drainage system. City planning and design should consider providing sustainable streetscapes, not only in commercial areas, but throughout the city. Sustainable streetscapes can
support efforts to create a quality urban environment that is free of emissions and provide urban visual quality.

The study's results have implications for urban planners, policymakers, and developers who seek to create sustainable and livable cities. Future research should focus on implementing sustainable streetscape designs in different urban contexts and evaluating their impact on urban life.

References


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