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Walkability Measurement in Semarang Transit Oriented Development using Inclusive and Responsive Concept in Jalan Pandanaran, Semarang City

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Abstract: The concept of Transit Oriented Development (TOD) entails city planning for sustainable urban development, through a system, that aims to reduce the use of private vehicles and increase the interest in walking and transit areas utilization. Jalan Pandanaran is one of the supporting roads located in Simpang Lima area, which is crowded with offices, trade, and service centers. This area has the potential of becoming a regional center or Central Business District (CBD), which implies that it is capable of having a sustainable transportation system through the TOD concept depending on the Regional Center it is being applied to. Therefore, this study aims to identify, analyze and determine the concept of planning the Transit Oriented Development (TOD) system in the Pedestrian Path of Jalan Pandanaran. The method used was rationalistic quantitative with scoring analysis techniques and pedestrian analysis. The result showed a feasibility assessment on the pedestrian path on Pandanaran Street, through the application of the concept of TOD system planning based on the responsiveness of pedestrian users on the path.

Keywords: Transit Oriented Development (TOD); Pedestrian; Responsive.

1. Introduction

Transit Oriented Development (TOD) is a concept of a sustainable transportation system, which is a planning option that entails having a sustainable transportation system that does not leave future problems [1]. In addition, according to [2] Transit-Oriented Development (TOD) is a concept of urban development or construction that maximizes the use of mixed and integrated land, promoting the use of mass public transportation and healthy lifestyles, such as walking and cycling. According to Calthorpe in the book, The New American Metropolis in 1993, the concept of transportation based on Transit Oriented Development (TOD) is a multi-use community within walking distance with an average of 2,000 feet from transit stops and core commercial areas. Furthermore, according to [3], the initial form of modern TOD was marked by the development of small retail and commercial districts around transit stops to serve passengers and residents. There are two types of Transit Oriented Development (TOD) systems, namely Urban TOD and Neighborhood TOD [4]. The Urban TOD refers to a system in which public transportation infrastructure is strategically positioned at city bus stops, terminals, or high-density train stations that often evolve into commercial districts. Meanwhile, Neighborhood TOD has limitations in transit development having bus route locations in a residential area within 600-800 of the transit

point. The Reinaissance Planning Group in 2011 explained that there are three types of TOD namely, Regional Centers which are Central Business District or CBD, Community Centers being the transportation systems that cover local and sub-regional areas, and Neighborhood Centers know as small-scale residential centers [5]. The concept of Urban area TOD entails the prioritization of public transportation rather than personal vehicles [6], which has to the consideration of this concept as a perfect solution to urban area problems such as traffic congestion, especially in large cities [7]. This TOD structure is similar to nodes having commercial centers, municipalities and potential public transportation stations, space requirements retail outlets in stations, and other social needs or factors easily identifiable through community center judges in various jurisdictions [8]. Furthermore, it strives to achieve goals and create compact, versatile, pedestrian-friendly areas around the main public transportation station [9]. Also, It can be seen as having a conceptualized degree of personal characteristics (socio-demographic and socio-economic) and traveler's psychosocial variables. Such an environment may be detrimental to residents or commuters accessing their travel leisure, sports, or entertainment services, as well as those en-route to work in the transportation service area [10]. Therefore, the TOD area created should be one related to comfort and is pedestrian-oriented [11].

The development of Transit-Oriented Development (TOD) has established principles and key implementation strategies to meet the standard performance targets of TOD. [12] states that the principles and key implementation of standard TOD performance targets consist of walk, cycle, connect, transit, mix, densify, compact, and shift. The principle of walking can be properly implemented with the support of pedestrian infrastructure that is safe, complete, and accessible to various groups, including people with disabilities, equipped with road facilities such as lighting, shade trees, and road signs.

According to research by Wibawa and Sutaji 2016 in [13] identifies obstacles on several pedestrian paths in the city of Semarang, particularly for people with disabilities, including at bus stops, vehicle parking lots, and bollard locations. Typical problems that arise in the provision of pedestrian paths in cities, according to [14] and [15], are that the provision of pedestrian facilities is not yet entirely in line with the needs of pedestrians, the environment, and climatic conditions, especially when temperatures are high and during the day.

In the planning document of the city of Semarang, the Simpang Lima area is a central area for the development and improvement of shopping recreation objects that are supported by pedestrian paths connecting the surrounding buildings, which are the Strategic Economic Growth Areas in Semarang City. This region becomes the Central Business District (CBD) in the center of Semarang City and earns the title Simpang Lima Center (SLCC). Furthermore, characteristics enabling these areas to have the potential of becoming a Transit Oriented Development (TOD) area include high density development, mixed land use, having a comfortable pedestrian environment and finally, having high quality public transportation services. It is known that the pedestrian path on Jalan Pandanaran is one of the routes in the Simpang Lima area.

The concept of pedestrian paths in the TOD area recommends the development of the walkability concept in urban areas by glorifying pedestrians seen in city spaces with a comfortable, safe, and humane concept [16]. Pedestrian glorification according to Danang Priatmodjo in 2018 is aimed at low-sighted road users through properly managing textured (tactile) or guidance tiles. According to [4] the success of public transport (the streetcar suburbs) depends on pedestrian access to transit connections, downtown jobs, and environmental services. Subsequently, many TOD sites (squares on the left) reflect environments with poor walking ability. Conversely, some have a more walkable environment as indicated by stations with multiple squares on the right [17]. Early transit environments included transit depots located in the city center, public spaces, small cottage type houses, patterns, and road scales that allow convenient walking distances for transit. Also, the shape of a road can be analyzed in terms of the many qualities such as straight or wavy, wide or narrow, closed or open, and formal or informal [18].

The pedestrian lane on Jalan Pandanaran supports this center of trade and service activities through the existence of transit stops and integrated pedestrian paths. The characteristics of a community's walkability potential include having sidewalk system coherence with clear roads and land use, continuity with design and usage of patterns that unite the pedestrian system, balance between modes of transportation to accommodate and encourage pedestrian participation, safety in the form of pedestrian protection from cars and bicycles, the convenience of safe paving through sidewalks and crossings, sociability by providing friendliness and suitability for individual and community interactions, accessibility shown through the utilization of opportunities in the pedestrian environment, efficiency in the form of simplicity and cost effectiveness in design, function, and attractiveness by providing a clean, effective, as well as a well-maintained environment [19]. This study aims to determine the concept of planning the Transit Oriented Development (TOD) system in the Pedestrian Path of Jalan Pandanaran, using its objectives to identify and analyze the TOD concept.

2. Methods

The "Transit Oriented Development (TOD) Concept for the Responsiveness of Pedestrian in Jalan Pandanaran, Semarang City" employed the rationalistic quantitative methods through a rationalistic deductive approach explained descriptively, using scoring and path user test analysis techniques on pedestrians from 1st to 14th, November 2023

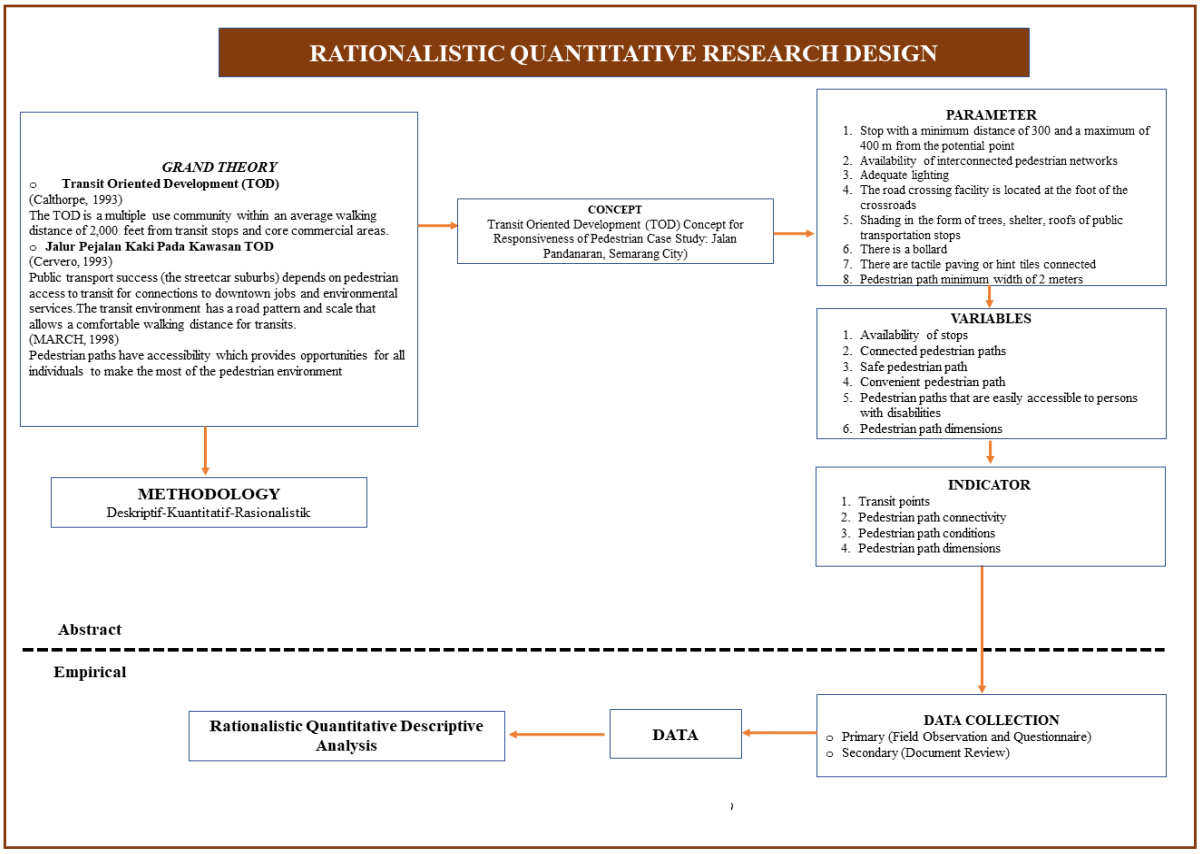

Fig. 1. Study Design (Source: author analysis, 2024)

3. Pedestrian Path Identification on Jalan Pandanaran

This study entails a discussion on the responsive TOD concept for pedestrian lane users on Jalan Pandanaran, Semarang City. The selection of this location was because, it is one of the supporting routes for activities in the Strategic Economic Zone of Semarang City, namely the Simpang Lima Area in the Semarang City Spatial Planning 2011-2031. In addition, the location is part of the

golden triangle area of trade and services which connects Simpang Lima and Tugu Muda [20]. The importance of the Jalan Pandanaran is especially seen when considering a center for office activities as well as trade and services. In addition, homogeneous commercial area characteristics was an important factor during the selection of this location [21], resulting in the need for the application of a responsive TOD concept as a form of a sustainable transportation planning system on Jalan Pandanaran, especially on pedestrian paths that support walking activities at that location. The explanation can be seen in Fig. 2. below:

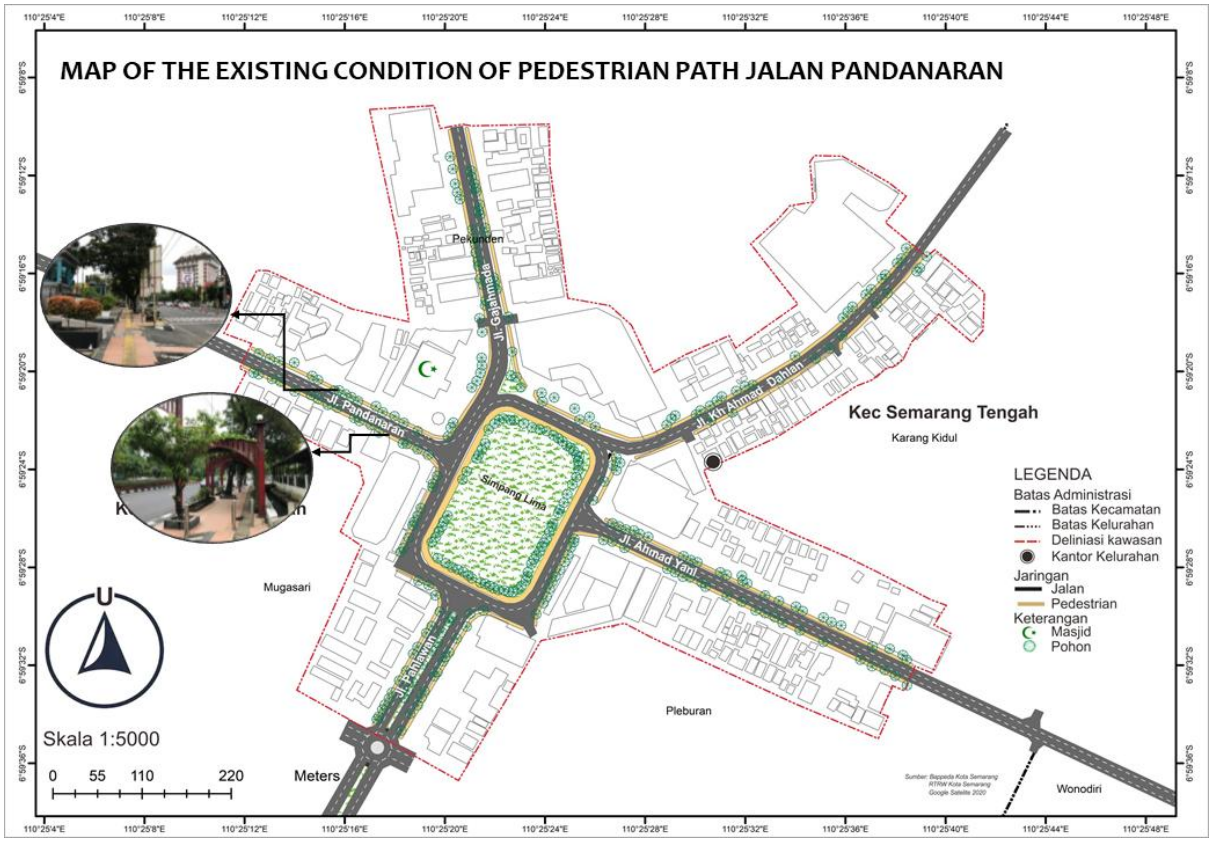

Fig. 2. Map of The Existing Condition of Pedestrian Ways Jalan Pandanaran

The pedestrian path on Jalan Pandanaran is one of the lanes in the Simpang Lima area being supported by tactile paving pedestrian lanes and safety poles. This is due to the need to enable pedestrian path users to feel safe and comfortable when using the route, which also connects office buildings and trade services around it.

This pedestrian path has conditions that are accessible to road users and wheelchair users. Furthermore, it is integrated with the BRT Stop and other pedestrian path networks, therefore supporting mobility facilities for pedestrian users on the pedestrian path.

Therefore, the pedestrian shopping center has supported this area to becoming a sustainable transportation area with adequate infrastructure which supports access to office and community activities, as well as trade services.

Table 1. Pedestrian Path Identification on Jalan Pandanaran

Observation Variable	Parameter	Caption	Analysis
Availability of Stops	Stop with a minimum distance of 300 and a maximum of 400 m from the potential point		 The bus stop is 300 meters from a potential point around the eastern part of the pedestrian path at Jalan Pandanaran, Simpang Lima Area
Connected Pedestrian Paths	Availability of interconnected pedestrian networks		 The pedestrian path on Jalan Pandanaran has pathways linking one another
Safe Pedestrian Path	Adequate lighting The road crossing facility is located at the foot of the crossroads		It has adequate lighting and has crossing facilities located at the foot of the intersection, therefore it is following the study parameter
Convenient Pedestrian Path	Shading in the form of trees, shelter, roofs of public transportation stop		Availability of shade in the form of trees and canopies, which make pedestrians feel comfortable, following the study parameter

Observation Variable	Parameter	Caption	Analysis
Pedestrian Paths That are Easily Accessible to Persons with Disabilities	There is a bollard There are tactile paving or hint tiles connected		Presence of a bollard blocks motorized vehicles from passing through the path, making it easier for people with disabilities to access. However, on this path, there are tactile paving that is not connected, which is not following the study parameter
Pedestrian Path Dimensions	Pedestrian path minimum width of 2 meters	 Dimension 4 meter	It has a dimension of 4 meters wide, therefore this measurement meets the standards of the study theory parameter

Source: Researcher Analysis Results, 2024

4. Result and Discussion

In this study, "Responsive TOD Concept for Pedestrians on Jalan Pandanaran, Semarang City" the feasibility of pedestrian paths based on the feasibility scoring analysis of each variable and pedestrian pathway users were explained as follows:

4.1. Pedestrian Feasibility on Jalan Pandanaran Based on Scoring Analysis

Using the scoring analysis technique, the feasibility of each variable was obtained by comparing the variables from the existing conditions of each pedestrian path using parameters that are the benchmarks for the path variable based on the TOD concept. Furthermore, this analysis uses the Guttman Scale grading system, which entails the analysis of the appropriate variables that will get a value of 1 (one) and inappropriate variables that will get a value of 0 (zero) described in Table 2. Scoring of Study Variables located in the study method section.

Table 2. Study Variable Scoring

No	Indicator	Variable	Parameter	Score	Classification		Source
					Feasible	Unfeasible	
1	Transit Points	Availability of Stops	Stop with a minimum distance of 300 and a maximum of 400 m from the potential point	1	1	0	Pedoman Perencanaan, Penyediaan, dan Pamanfaatan Prasarana dan Sarana Jaringan Pejalan Kaki di Kawasan, 2014

No	Indicator	Variable	Parameter	Score	Classification		Source
					Feasible	Unfeasible	
2	Pedestrian Path Connectivity	Connected Pedestrian Paths	Availability of interconnected pedestrian networks	1	1	0	Cervero, 1993 ; MARCH, 1998; Muzzaky, 2016
3	Pedestrian Path Conditions	Safe Pedestrian Path	Adequate lighting	0.5	1-0.6	0-0.5	MARCH, 1998; Refaat & Kafafy, 2014; Muzzaky, 2016; ITDP, 2017
			The road crossing facility is located at the foot of the crossroads	0.5			
		Convenient pedestrian path	Shading in the form of trees, shelter, roofs of public transportation stops	1	1	0	Cervero, 1993; Muzzaky, 2016; Danang Priadmojo, 2018
		Pedestrian paths that are easily accessible to persons with disabilities	There is a bollard	0.5	1-0.6	0-0.5	Muzzaky, 2016; ITDP, 2017; Danang Priadmojo, 2018
			There are tactile paving or hint tiles connected.	0.5			
4	Pedestrian path dimensions	Pedestrian path dimensions	Pedestrian path minimum width of 2 meters	1	1	0	Pedoman Perencanaan, Penyediaan, dan Pemanfaatan Prasarana dan Sarana Jaringan Pejalan Kaki di Kawasan Perkotaan., 2014; Muzzaky, 2016
			Total Score	**6**			

Source: Researcher Analysis Results, 2024

The following are the results of the feasibility scoring for each variable that has been carried out on the pedestrian path of Jalan Pandanaran:

Table 3. Scoring Variables on Jalan Pandanaran

Variable	Score	Classification
Availability of stops	1	Feasible
Connected pedestrian paths	1	Feasible
Safe pedestrian path	1	Feasible
Convenient pedestrian path	1	Feasible
Pedestrian paths that are easily accessible to people with disabilities	0.5	Unfeasible
Pedestrian path dimensions	1	Feasible
Total Score	5.5	

Source: Researcher Analysis Results, 2024

Based on the results of the feasibility scoring analysis of each variable on the pedestrian pathway in the Simpang Lima area that has been carried out, the percentage score results are obtained for each pedestrian path. Therefore, the explanation of the percentage of the score and the classification of its feasibility is as follows.

The first thing to do is to calculate the total score on each pedestrian path and convert it into a percentage using the following formula:

The results of the percentage score for the area are further classified into the Guttman scale range [22] as follows. Based on the concept of the pedestrian path and TOD, when the pedestrian path integration score is in the:

a. 0-49% scale range, the pedestrian path integration in the area is declared "not feasible".
b. 50% scale range, the pedestrian path integration in the area is stated as "approaching unfit and feasible".
c. 51-100%, the pedestrian path integration in the area is declared "feasible".

The calculation result of the feasibility of the pedestrian path on Jalan Pandanaran is 92%, which means it is included in the Appropriate category through the application of the TOD concept.

4.2. The Feasibility of the Pedestrian Path on Jalan Pandanaran Based on the Test of the Pedestrian Path

A feasibility analysis based on the pedestrian user test was conducted to support the assessment of pedestrian path integration on Jalan Pandanaran. The results were classified into four feasibility categories, which were used to interpret the calculated values, as described as follow.

Table 4. Feasibility Assessment Category on Pedestrian Paths

Feasibility Assessment Categories	Classification
>25%	Very Unfeasible
25%-50%	Unfeasible
51%-75%	Feasible
76%-100%	Very Feasible

Source: Researcher Analysis Results, 2024

The results of the calculation of the pedestrian feasibility assessment analysis based on road users on the pedestrian path in Jalan Pandanaran are 79%, which is considered very feasible using the TOD concept. The following is a comparison table for the TOD theory and the classification of the feasibility analysis on the pedestrian path in Jalan Pandanaran:

Table 5. Comparison of Theory and Classification Analysis of the Feasibility of Integrating Pedestrian Paths on the Jalan Pandanaran

Theory of Pedestrian Based on the Concept of Transit Oriented Development (TOD)	Jalan Pandanaran	
	Scoring Analysis	User Test Feasibility Assessment Analysis
Bus Stop Availability	Feasible	
Connected Pedestrian Path	Feasible	Very Feasible
Safe Pedestrian Path	Feasible	Very Feasible
Convenient Walking Path	Feasible	Very Feasible
Accessible Pedestrian Paths for Persons with Disabilities	Unfeasible	Unfeasible
Pedestrian Path Dimensions	Feasible	

Source: Researcher Analysis Results, 2024

Based on the comparison of the TOD concept theory variables with scoring analysis and user test feasibility assessment analysis in Jalan Pandanaran, the walking theory is that it is easily

accessible by people with disabilities. During the scoring and assessment analysis of the feasibility in each user test, it was discovered that the pedestrian path of the Simpang Lima area was declared inadequate. This is because the paving block tactile pathway facilities used as a supporting pedestrian path for blind people were cut off and do not comply with the standards or conditions for laying paving, which enables accessibility of persons with disabilities. This is following the theory of the TOD concept which is oriented towards the walking path.

5. Conclusion

Based on the study results of the "Transit Oriented Development (TOD) Concept for Pedestrian Responsiveness (Case Study: Jalan Pandanaran, Semarang City)", it was concluded that the concept of Transit Oriented Development (TOD) system planning is dependent on the responsiveness of pedestrian users. Subsequently, pedestrian path on Jalan Pandanaran can be applied, since the feasibility assessment is based on the consideration of the results of the feasibility scoring analysis, classified as “feasible” using pedestrian pathway TOD concept. Furthermore, there is an average calculation from the pedestrian path test stating that the path is classified as very feasible.

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