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Research paper

Street space design for bendi in the urban area of a ternate city

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Abstract

Spatial planning is very important because it is a public space so whether or not a street space will affect all road users. Structuring street space is to increase user experience so that the best place of public space is achieved.
To get the best place, we need to accommodate and clearly define each user of the space. Bendi as a mode of transportation certainly uses street space as a means of motion space. And it requires a clear definition of the movement of the bendi in a physical order that can prevent violations of the rights of other street users both pedestrians and motorized vehicles.
The purpose of this study is how the standard of road spatial planning for bendi. The method used in this study is the collection of field data through qualitative descriptive analysis with several indicators, namely Characteristics and space for bendi, spatial planning standards, street space settings. The design concept of bendi lane is proposed in 2 types, namely a special lane with a straight line divider on the Hasan Esa street, the Pahlawan revolusi street, and the Djabar Syah street and integration on the Ahmad Yani street and the Nukila street.

Keywords: *Non-Motorized Transport; Bendi.*

1. Introduction

Ternate City is one of the waterfront cities in Indonesia which is the artery of the North Maluku province, the airport and the port as a supporter of traffic for migrants. This strategic position can be utilized as an opportunity to hook passersby to travel in Ternate City. Bendi is a non-motorized transportation that has advantages in line with the principle of sustainable city. In Ternate, public transportation that is as a paratransit is non-motorized vehicle that is bendi and is environmentally friendly transportation, and carrying passengers has several advantages such as relatively affordable prices, strong spatial penetration, pollution-free, tourism attractive, has cultural value and has a role not only limited to tourist transportation but also public transportation in general. Therefore Bendi needs to be strengthened in its role as an environmentally friendly mode of transportation in urban mobility and as a city tourism development.
Structuring street space to provide optimal space quality for its users will be carried out as a process towards a pedestrian street. Spatial planning requires a standard to achieve the quality of space appropriate to its users, but there is no standard for spatial planning for road bodies, it is necessary to formulate these standards. Aside from being a guide for street spatial planning, this standard serves as proof of the position of the bendi in irreplaceable urban mobility and that the bendi as a traditional mode can still be maintained.
The absence of a standard for spatial planning for a bendi street makes it difficult to make the design of a pathway for a bendi making this study function to formulate these standards so that questions arise about how to formulate spatial standards and make the design of spatial planning for the dam. The basis or guidelines as well as the process of formulating to produce a standard of spatial planning that can be used is important because there is no literature on standards for bendi.
And to include a bendi as a transportation with a tourist icon, it is necessary to arrange the space that is passed by the bendi. Outside its function as public transportation, the bendi has a function as a tourist transportation, but the existence of the bendi is becoming extinct. Its existence is a contribution from the regional government in 2008. In terms of service scale, the bendi has a higher spatial penetration so that the range of services is wider.
From the above background, it can be formulated how the standard of street spatial planning for the bendi and the application of lane design for urban areas of the city of Ternate and in accordance with the research problems that have been described, this study has the goal of reviewing the standards for spatial planning of the road in the urban area of Ternate City.

2. Literature review

2.1. Non-motorized transportation

Non-motorized transportation (NMT) can be interpreted as active transport or active transportation, namely transportation that uses human labour. According to the World Bank (1994) NMT is any form of transportation that does not use a combustion motor. NMT including

bicycle / rickshaw; human porterage; hand carts; carts pulled by animals; and other human-powered vehicles. Thus the bendi is classified as NMT because it does not use motor power and the positive characteristics of being environmentally clean, sustainable, affordable, and flexible. Bendi is a traditional transportation.

Traditional transportation as a form of initiative to form Sustainable Transportation The implementation of sustainable transportation for cities is conditioned in accordance with the principles of sustainable transportation adopted from various case studies. The principles of sustainable transportation include: (1) Policies that guide the implementation of sustainable transportation. The implementation of sustainable transportation is inseparable from the commitment of stakeholders to solve problems in the transportation sector. Government assertiveness is manifested in the form of social policies and technical policies governing the transportation system from national to regional levels. (2) Transportation systems that prioritize accessibility for all layers of society. Accessibility becomes a centre point in realizing sustainable transportation. It aims to create a transportation system that is accessible to all levels of society including the disabled, especially to support the movement of the disabled with the destination of the educational, social, trade and service areas.

Non-Motorized Transport Sustainable transportation will be more perfect if it combines non-motorized transport with the integrity of multimode transportation. Non-motorized transport chosen by the community is traditional or bicycle transportation. The use of alternative traditional transportation has now been developed to support daily activities. Its role as a non-motorized transport is not the only choice for the community in carrying out the movement, but can function as a feeder to the public transportation mode.

The advantages and disadvantages of physical separation of non-motorized transport lines (NMT) can be seen in the following table:

Table 1: Advantages and Disadvantages of Physical Separation of Non-Motorized Transport (NMT) Lines

The profit	Loss
Providing higher security to NMT users	If the lane is too narrow, it will be difficult to pass, and three-wheeled vehicles can block the road
There is an element of self-coercion	easy to use by the rubble and bustle of street vendors on the road
Two-way NMT trips can be made even on one-way streets	Must be located on the outskirts of vehicle parking
Ensure that NMT users will not make sudden movements in the motorized vehicle lane or deter motorized motorists	Can make delivery trucks of major shops uncomfortable
Interference caused by double parked cars or illegal users for motorists and motorbike riders	three-wheeled vehicles need more space, at least 2.4 meters for two-way (minimum) and 4-meter safe traffic

Source: Andrea Broandus, Escborn-2009.

2.2. Effective width non-motorized transport

Effective width is the width of the space that can be used by users of vehicle facilities and how the space is limited. In addition, there are other factors such as the effective space of vehicle movement or dynamic envelope, namely the condition that the vehicle does not move statically but dynamically. For example, a bicycle or rickshaw when it moves will tend to experience wobble or sway, this happens when the vehicle starts to move from a stationary position and does not have enough momentum to be able to walk in balance.

2.3. Setting theory

In processing the road space setting is an interaction between the environment as a medium for activity with humans as users. Settings can see the relationship between physical elements of the environment with human activities (public) in a certain time frame. Setting road space, which is looking at the relationship between the physical space (walls and road space) as well as the installation of elements in the road space with the activity of its users

According to Amos Rapoport, (Amos Rapoport, Human Aspect of Human Form:
Towards a Man Environmental Approach to Urban Form and Design, Oxford, 1980, p. 46) setting is the layout of an interaction between humans and their environment, which is to find out the place and situation with what they are related, because different situations have different layouts also. There are two settings, namely: (a) Setting of street space which includes the dimensions of width and allocation functions that are owned by the public as street users. (b) Setting of building structure that covers road space by looking at the scale of the space that occurs, the function that dominates and the order of mass formed

3. Research methods

The method used in this research is field data collection through qualitative descriptive analysis. The study was conducted on street that are most frequently traversed by the bendi.

In determining the variables of this research based on previous understanding, a research component was formulated which can be described as follows: (1) Variable I appears as a way to understand the characteristics of the body both physically and in motion, taking this data based on observations, measurements, interviews, and literature. (2) Variable II emerged as the adoption of bicycle and pedicab standards which can be used at the bendi based on a literature review. (3) Variable III is the existing physical setting of the regional road space which is a service corridor by taking this data based on observations, measurements, interviews, and literature review. (4) Variable IV is the process of study and design applied to each service road section.

4. Results and discussion

4.1. Bendi characteristics and mobility

1) The characteristics of the bendi have 2 (two) wheels and are larger than a pedicab and can carry four passengers. There is a small door at the rear, which will be closed after all passengers have boarded. The driver is on the left at the front.

Bendi has dimensions with an effective width of 120 cm with a length of 120 cm and height of 180 cm, length of 330 cm. Based on observations and interviews, it was found that the bendi has a dynamic space of 60 cm with 30 cm for each side for gestures and other movements such as giving a signal. Based on the effective width of the bendi which is added to the dynamic space of the bendi given at both sides of the bendi which is 120cm + (30cm x 2), it is concluded that the dynamic envelope of the object requires space to move at least 180cm wide see figure 1 and 2.

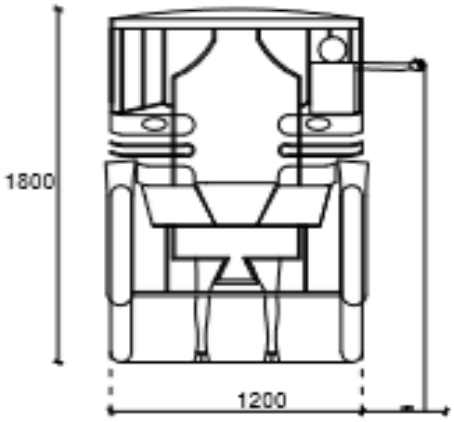

Fig. 1: Effective Width of the Bendi.

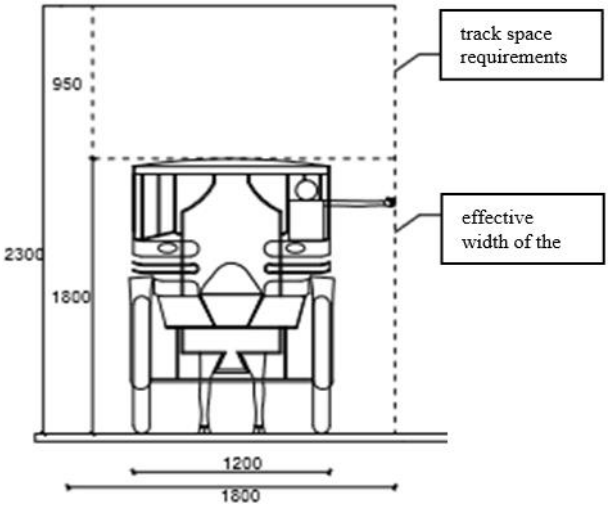

Fig. 2: Dynamic Envelope Bendi.

2) In addition to space requirements, a study of the mobility capability of the object such as speed, distance needed to stop, turning radius can be seen in Figure 3, the ability to see the street, the ability to climb, and the range of distance the ability of the service. This mobility ability is a representation of the ability of pedicabs to move in urban or regional spaces.

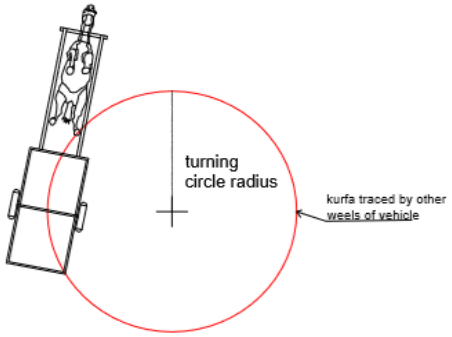

Fig. 3: Bendi Turning Radius.

Table 2: Mobility Abilities of the Bendi

Mobility Ability	value
No load speed	12 km/hour
Plan speed	12 km/hour
Speed with a Maximum Load	10,6 km/hour
Stop Distance	9,375m
Rotating Radius	420 cm
Service Distance Range	0,5-7 km
Range of services with the highest frequency	1-4 km
Bendi Service Distance with the highest frequency	2 km

Table 3: Comparison of Achievements Distance and Non-Motorized Transport Services

Non-Motorized Transport	Distance
Achievement on foot	0-600 m
Bicycle Achievement (Europe Communities, 1999)	6 km
Pedicab Distance Services (Bayu Aristo, UGM, 2016)	0,5-3,6 km
Bendi Distance Services (discussion result)	0,5-7km

4.2. Bendi road spatial standard arrangement

After reviewing the characteristics of the bendi and knowing the mobility of the movement, adoption standards can be carried out. Adoption Adjustment: Based on the study of the characteristics of the bendi which can be communicated with the adoption of the pedicab and bicycle lane standards, the standard is adjusted. From table 3, the differentiators that become the main focus in the standards for the arrangement of the bendi road are the dimensions of space, the characteristics of the movement, the bicycle lane that can be accommodated in the bendi lane, signage attributes, user type, nature and characteristics of parking activities. The dimensions of the bendi chamber are larger than the standard of the pedicab and bicycle because the basic size of the bendi mode is larger so it requires a larger space. The signage attribute in the form of a bendi symbol is different from the pedicab or bicycle symbol because the symbol describes the mode using graphics.

1) Bendi lane: Space for movement where the free space for moving vehicles on the lane that has been provided where the width is at least 1.8 meters with a safe distance with a motorized vehicle of at least 1 meter. The ideal width of road space is less than 3.7m and more than 4.4m. In a bendway scenario there are 2 (two) system strategies in designing lanes for non-motorized vehicles namely segregation and integration. (a) Segregation is a technique of separating spaces between pedestrian spaces (NMT) and vehicles, which allows pedestrians and non-motorized vehicles to use spaces that are different from motorized vehicles. By defining the pathway, we will know that the pathway segregation that is suitable for the capacity and function of the road provides an opportunity for the segregation of the bend lane to support safety and comfort aspects. Application of segregation if the road width is more than 4.5m according to the street capacity. (b) Integration, NMT or walkers and drivers of vehicles divided in space. Traffic signs and traffic management can reduce vehicle speed. And if the width of the road body is less than 4 meters or less, the bendin line is defined by the bendi symbol in the middle of the bendin road.
2) Intersections prioritize safety and security. Typology of crossings, intersections, and roundabouts. Regulatory techniques in the typology are: (a) Crossings; surface marking, namely providing road signs and traffic calming is an effort made to slow down traffic and regulate the speed of road space in order to improve the safety of NMT road users. (b) Intersection with lights; by providing an ASL (Advance Stop Line) or Special Stop Room (RHK) box to assist the bendi in crossing the intersection by placing a break room in front so that it can move ahead of other road users. The ASL box must be able to accommodate space requirements according to the dimensions of the material. (c) Intersections without traffic lights; note that the corner radius of the bend is less than 400 cm, the line of sight is free of distractions and traffic calming. (d) Roundabout or island road: width of 1 (one) lane to enter and surround and pass roundabout / island road and deflection when entering.
3) Bendi Lane street design includes lighting and protection systems. (a) Lighting system Placement of street lights must be planned in such a way so as to provide good evenness of light, safety and security for street users. The lighting system used is a continuous system where the system is continuous along the way. (b) Perindang system, trees in the street network system in the city can be planted at the boundary of the street, median, or in the dividing lane. Street benefits space includes street body, roadside channel, and safety threshold. At the road median only shrubs / shrubs and flowering plants can be planted at the median. This plant height must not obstruct vehicle lights. For a median of less than 1.5 meters plants can be planted with a height of less than 1.00 meters, provided that no part of the branch of the plant is blocking the road body.
4) Bendage signatures include street signs and markings as signs or directions of street users. The ideal sign is at the driver's eye level of + 1.8 meters. Road markings are signs or symbols that are on the surface of the street, in this case instructions in the bendi lane.
5) Parking Needs, the parking space unit (SRP) is a measure of the effective area to place passenger vehicles (cars, buses / trucks, motorcycles, NMT) including the required free space and the width of the door opening. It can also be said that Parking Space Unit is a measure of space requirements for safe and comfortable vehicle parking with the most efficient amount of space possible.

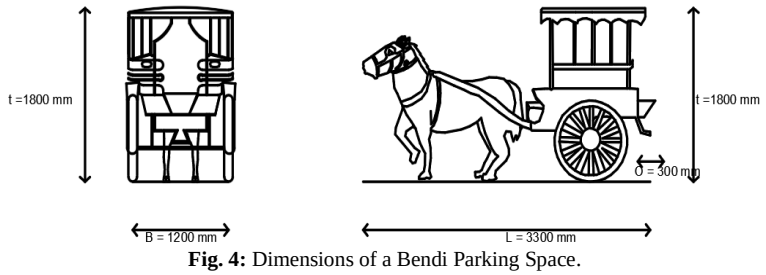

Fig. 4: Dimensions of a Bendi Parking Space.

Information: B: Total width of the vehicle, O: width of the door opening, L: total length of the vehicle, a1, a2: clearance, parking space dimensions 1 (one) unit of parking space is 1.2 x 3.30 m and free space 1 (one) meters.

4.3. Element for setting the bendi road space

In assessing the arrangement of road space it is necessary to know how to set up existing spaces. Elements of a road space setting, which is to see the relationship between the physical space (walls and road space) as well as the installation of elements in the road space with the user's activity. that need to be known based on an understanding of the standards for the arrangement of street space for hans are summarized in table 5.

Table 5: Physical Setting Elements in Road Spaces in Ternate Urban Area to be Reviewed

Variables	indicator
	Street function
	The width of the street
Bendi lane	Path direction
	Lane amount
	Pieces of road space to see the composition of street space
	Junction type
	Visual impairment
	Asl Box
intercection	Traffic calming
	Geometric intersection
	Intersection angle radius
	Asl box dimensions
	Location of host
	Longing
Street Design	Location of signage points
	Signage type
	Placement of signage
	Location of signage points
Signage	Signage type
	Placement of signage
	Parking point location
	Parking type
Bendi Parking	Parking space facilities
	Parking point location
	Parking space facilities

4.4. Arrangement of the bendi road space

From the study of the physical settings on the street space, suggestions and recommendations on how to fit the hatchery are appropriate.

1) Proposed Alternative design of Bendi Path; Giving recommendations on how the bendi paths that fit the urban context with the review area then made the following guidelines as a direction for spatial planning for the bendi.

The following guidelines have been prepared by connecting typology of street spaces with rickshaw pathways. This relationship is distinguished based on several things namely the location of street space, road space users and the type of street space. This relationship serves as a guide in determining the appropriate type of bendway applied to a particular street space context. Bendi, pedestrian, and motor vehicle users; consists of 3 lanes namely: (a) Special lanes; Transparent dividing separators, such as bollards or potted plants, sign attributes and bendi symbols and the colour of the line if needed. Minimum width of 1.8 m. (b) Separator with different levels. attribute signs and bendi symbols and track colours if needed. Minimum width of 1.8 m. (c) Separator with continuous lines, sign attributes and bendi symbols and the colour of the line if necessary. Minimum width of 1.8 m Path. (a) Full Segregation Pathway; (a) Separator with green space, attribute signs and bendi symbols and the colour of the path if necessary. Minimum width (x) of 2.3-2.8. (b) Separator with floating parking. Attributes of signs and pedicab symbols and the colour of the bendi lane if necessary. Minimum width (x) of 3.8-4.8m. Car parking is placed between the motor vehicle lane and the special bendi lane as a barrier to protect from conflicts that arise due to speed differences. (b) Integration path. The sign attribute and the bendi symbol merge with other vehicles because the maximum width of the 1-way lane is 3.7 m, the maximum width of the 2-way lane is 7.4 m

2) Design directives in defining bendi and action paths can be seen in the following description:

a) Hasan Esa street: Street space width: 9,60 m (1 lane + 4,8)

Bendi lane: the remaining street space is more than 4.4 meters so that the lane is defined as segregation in the form of a special lane with a boundary in the form of a line. The legal system on the road of Hasan Esa already exists even though it is not neatly arranged and part of the point merges with the sidewalk. The condition of the road space does not allow for additional measures. Look figure 5

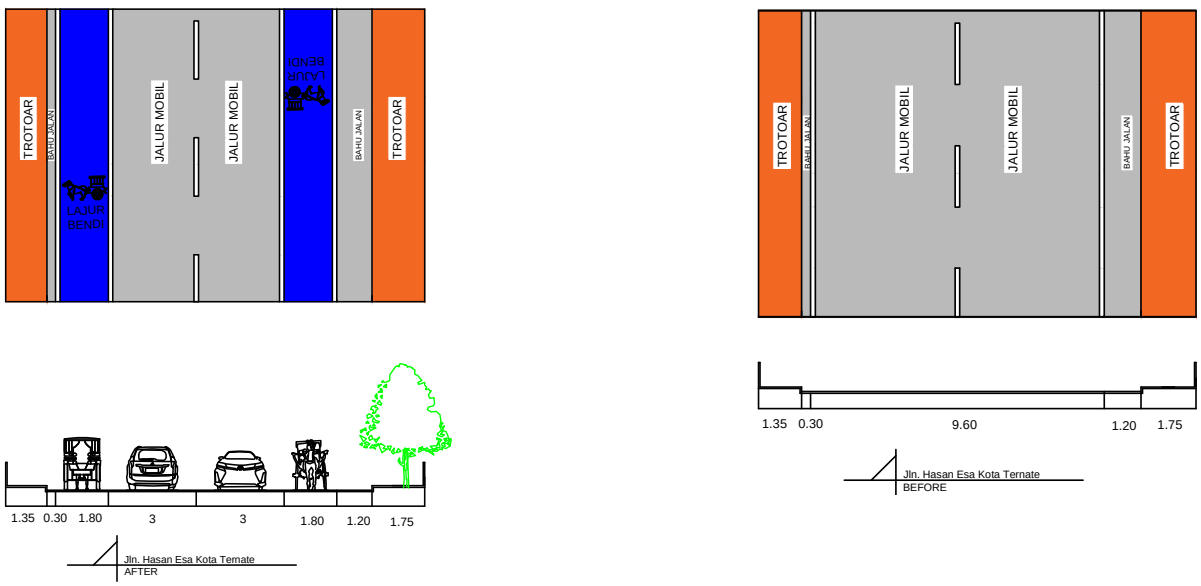

Fig. 5: Directions for Hasan Esa Roadway.

b) Ahmad Yani Street; Street space width: 6.5 m (1 lane + 3.25)

Bendi path: the remaining street space is less than 3.7 meters so that the bendi lane is defined as an integration path with a pedicab symbol. With a room size setting like the one above where the pedestrian room is 1.8m wide and 1.7 meter wide it is possible to provide space for the space. Look at Figure 6

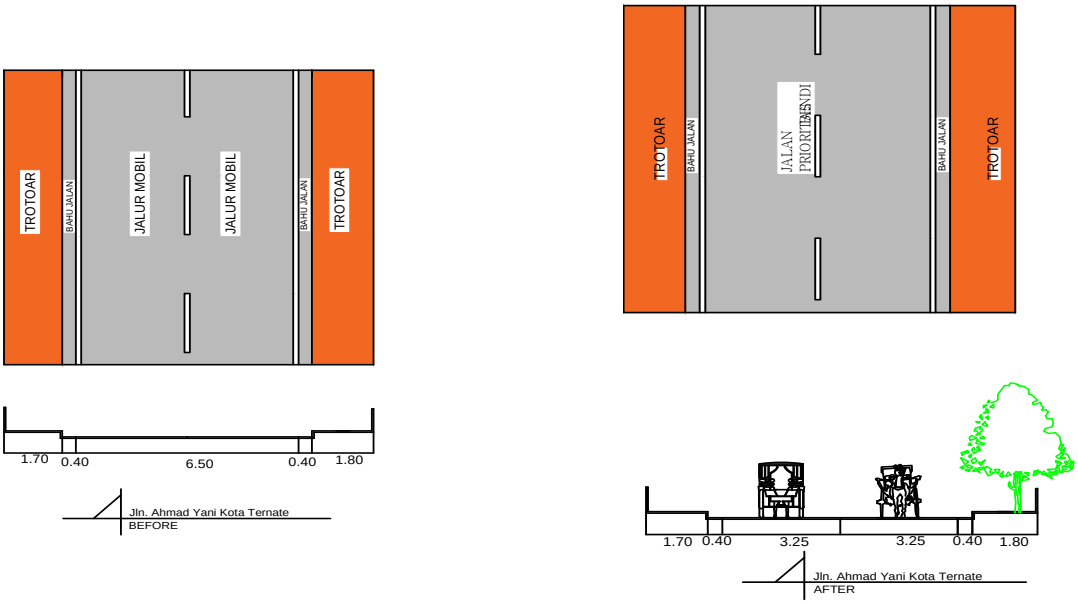

Fig. 6: Directions for Bendi Lane Design Jl. Ahmad Yani.

c) Pahlawan Revolusi street 1: The width of the street space is 8 meters using 1.8 m of street parking

Bendi lane: the rest of the lane is more than 4.4 meters so that the lane is defined by segregation in the form of a special lane with a boundary in the form of a line. the size of the area of green space 2 meters so that there is an opportunity to provide space for the space.

At the street median, plants with less than 1.5 meters with a height of less than 1.00 meters, provided that no part of the plant branch is blocking the road body (Permen PU No.5). while on this road section using trees with a height of more than one meter, these plant species are edge plants as a function of the road director.

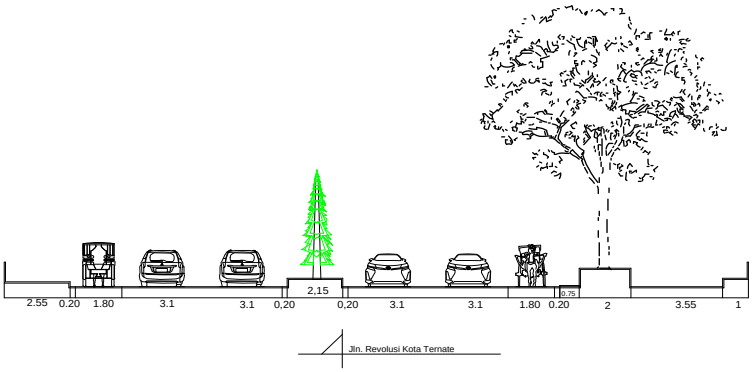

Fig. 6: Directions for Bendi Lane Design Pahlawan Revolusi Street.

d) Pahlawan Revolusi street 2: The width of the street space is 15.5 m (1 lane + 7.75), street parking users 1.8 m

Bendi lane: the rest of the lane is more than 4.4 meters so that the lane is defined by segregation in the form of a special lane with a boundary in the form of a line. There is no green space because the existing conditions are directly located in commercial areas.

e) Djabarsyah street 1: The width of the street space of 8.85 m, 1.8 meters of street parking users

Bendi lane: the rest of the lane is more than 4.4 meters so that the lane is defined by segregation in the form of a special lane with a boundary in the form of a line. pedestrian space 2.5-3.5 m wide so that there is an opportunity to provide a barrier to the edge and median of the street.

f) Djabir syah street 2: street space width of 7.50 meters

Bendi lane: the road lane is more than 4.4 meters so that the lane is defined as segregation in the form of a special lane with a boundary in the form of a line.

g) Nukila Street: 4.60-meter-wide street street parking motorcycle users 1 meter

Bore lane: the lane is less than 3.7 meters so that the lane is defined as an integration lane with a pedicab symbol. for a barrier there is no need for a barrier, but there is an opportunity to provide a barrier to the median of the street.

5. Conclusion

Space for movement where the free space for moving vehicles on the lane that has been provided where a width of at least 1.8 meters with a safe distance with motor vehicles at least 1 meter. The ideal width of road space is less than 3.7 m and more than 4.4 m. In a bendway scenario there are 2 (two) system strategies in designing lanes for non-motorized vehicles namely segregation and integration.

Bendi route is proposed in 2 types, namely a special lane with segregation in the form of a special line dividing the straight line on the Hasan Esa street, Pahlawan Revolusi street, and the Djabir Syah street and integration on Ahmad Yani street and Nukila street.

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