

Efforts to Develop Bicycle Transportation in Supporting the Internal Transportation System

Syarifah Nuzul Ahmad¹, Muhammad Yamin Jinca¹, Yashinta Kumala D.S¹

Corresponding Email: nuzulsyarifah2005@gmail.com

¹Department of Urban and Regional Planning, Hasanuddin University, Indonesia

Abstract

The Unhas Tamalanrea Campus has green open space which is one of the best urban forest areas in Makassar. This is supported by the implementation of Non-Motorized-Transport by re-developing bicycle transportation management. Campus Green Open Space is an attraction for the community to cycle, for this reason, attention to bicycle transportation facilities and connectivity with other transportation is needed so that vehicle access continues to run safely and comfortably, at the Unhas Tamalanrea Campus. This study aims to find out how the services of bicycle transportation facilities, the suitability of bicycle lanes, and development concepts can be applied at the Unhas Tamalanrea Campus. The analysis methods used are Importance Performance Analysis (IPA), Scoring Analysis, and Map interpretation. Data collection was carried out through observation, interviews, and questionnaires. The respondents taken were cyclists at the Unhas Tamalanrea Campus using accidental sampling techniques. The results showed that the condition of bicycle transportation facilities at the Unhas Tamalanrea Campus was quite good but still needed to be improved by the guidelines and concept of campus bicycle transportation.

Keywords: Bicycle Transportation, Internal Transportation, Unhas

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Introduction

Throughout 2020, Hasanuddin University built and developed many infrastructures and facilities to create a conducive learning atmosphere, as well as a comfortable place for activities for the entire academic community. One of the developments carried out at the Hasanuddin University Campus (Unhas) is the green open space of the Unhas Campus which has become one of the best urban forest areas in Makassar by optimizing four elements, namely maritime, connectivity, lakes and swamps and green open spaces.

In the aspect of connectivity, development and infrastructure development at the Unhas Campus, it is necessary to implement transportation that is both advanced and environmentally sound (Corazza et al., 2016). One of the alternative modes of non-motorized transport (NMT) is bicycles (Buliung et al., 2014) as a mode of transportation used in the Unhas Tamalanrea campus environment.

Since 2010, the Unhas Campus Bicycle program has been run to support the Green, Healthier, and Safer GHS program. Bicycle facilities can be used for free by students, but in 2014 there was a social problem around the Unhas Campus so that it had an impact on the provision of unhas bicycle facilities, which became less optimal. Currently, bicycle users in the Unhas Campus environment are still seen using private bicycles for sports activities and other activities. For this reason, the condition of bicycle facilities needs to be considered, such as

bicycle lanes that do not have markers but are in the same lane as other vehicles. This can endanger the safety of motorists and hinder traffic on campus (Yang et al., 2020). With the attraction of the Unhas campus to carry out cycling activities, bicycle transportation facilities need to be improved as a support for the Green and Clean Campus (GCC) program.

Literature Study

Bicycle Transport

According to Brand et al. (2018), walking and cycling are sustainable transportation that does not emit carbon emissions, the most minimal pollution of all modes, reduces traffic congestion, and supports more livable, inclusive, healthy, and affordable cities.

Based on article 45 of Law Number 22 of 2009 concerning Road Traffic and Transportation, it is regulated that supporting facilities for the implementation of traffic and road transportation include bicycle lanes, and the government must provide ease of traffic for cyclists. As for article 62, cyclists are in charge of supporting facilities for security, safety, order, and smoothness in traffic.

Bicycle Transportation Facilities

(Road and Bridge Field Guidelines No. 05/P/BM/2021 concerning Bicycle Facility Design)

Determination of the width of a lane or bike lane.

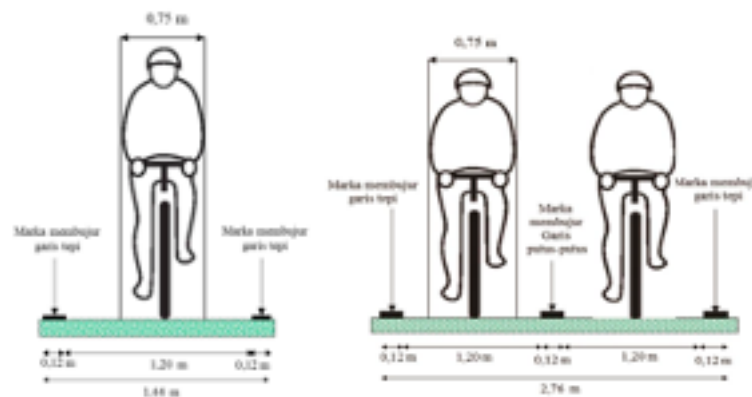


Figure 1. A minimum of one bike lane and a maximum of two bike lanes

Provision of existing road width conditions for lane placement or bicycle lanes

The placement of the bicycle lane or lane is to the left of the road body and does not reduce the minimum lane width required for motor vehicles

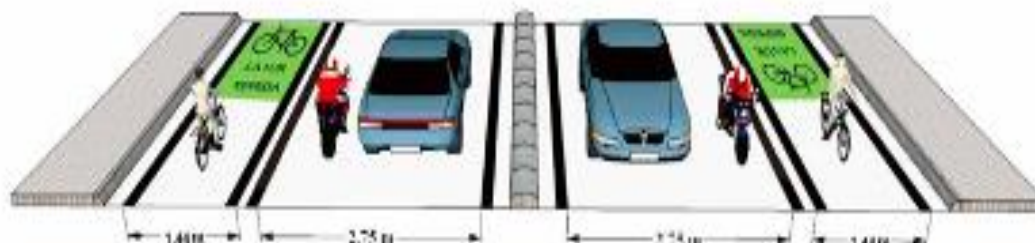


Figure 2. Lane width conditions for small roads

Provisions of sidewalk conditions for the placement of bicycle lanes

The placement of bike lanes or lanes on the sidewalk should not interfere with the minimum lane width for pedestrians. the sidewalk to be used for the bike lane must be continuous, flat and safe.

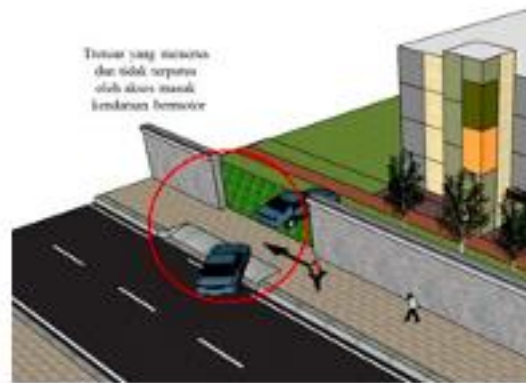


Figure 3. Continuous sidewalks

Slanderous Provisions

The placement of lanes or bike lanes placed on slumps should not exceed 5%. If a lane or bike lane is built on a road with a slump of more than 5%, it is necessary to provide a flat foundation as a resting place for cyclists with a minimum length of 25 m.

Bicycle Lanes on the Road

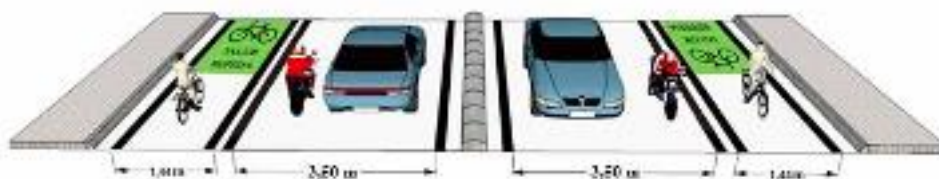
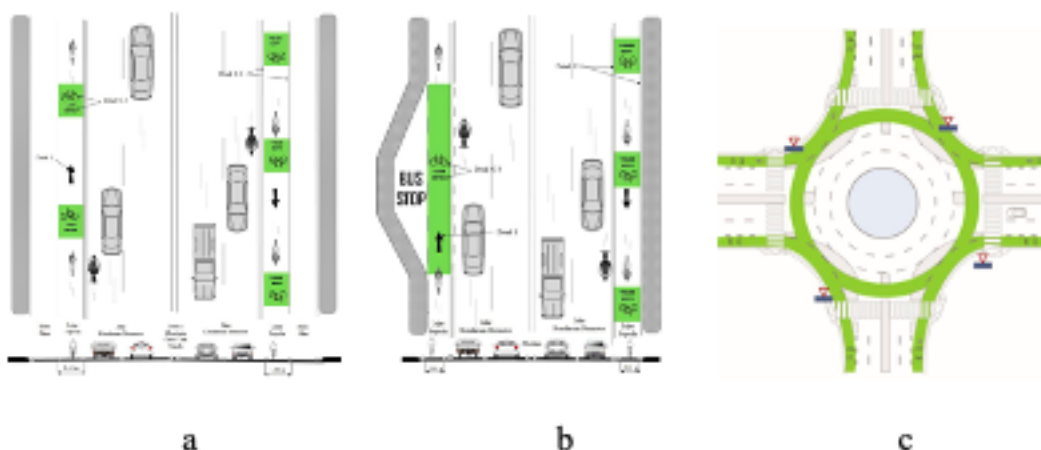


Figure 4. Perceptions of type C bicycle lanes on the road



Top view of the type C

Top view of type C bike lanes on roads that have bus bays.

Top view of type C bike lanes on roads that have bus bays.

Road Markings

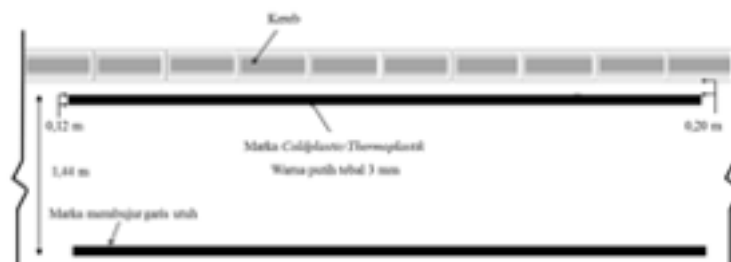
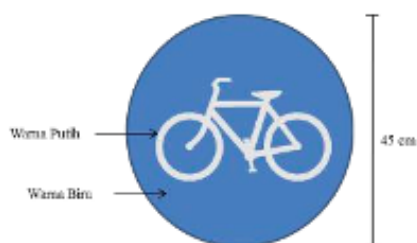


Figure 5. Bicycle lane markings in road

longitudinal markings of the bicycle lane edge on the road, including whole line longitudinal markings on the left and longitudinal markings of the dotted line on the right.

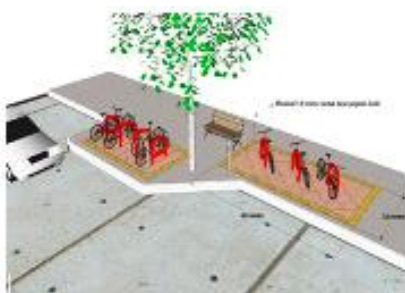
Traffic Signs



This sign is a notification sign for motorists that the lane is a bicycle lane.

Figure 6. Bike Lane Signs

Bicycle Parking Lot



There are four types of parking spaces for bicycles, namely n-type parklets (installation distance between shelves of 1 m), wave-type parking lots, rack-type parking spaces, and fence-type parking spaces.

Figure 7. Placement of bicycle parking on the sidewalk

Bike rental and general bike and bike sharing

A network of bike stations that can be used by the general public where bicycles can be picked up and returned in two different places with low rental rates to encourage users to take short trips.

Bicycle repair/repair shop

There needs to be an affordable bicycle repair/repair shop located nearby.

The rules support cycling

Urban transportation arrangements and bike lanes are equipped with separate signal/traffic light systems and markings at intersections, as well as special traffic regulations for bicycles and non-motorized vehicles to improve their safety.

Bicycle Mode

The type of bicycle used in the planning of the bike lane is a type of bicycle that is stranded with an average steering size of 0.6 meters, a length of 1.9 meters, and a height of 1 meter.

Methods

Data Collection Techniques

This research is a type of descriptive research using qualitative and quantitative approaches in the process of researching data or information. The types of data needed are primary data and secondary data. Primary data was obtained through field observations (observations and measurements), interviews, and questionnaires. Meanwhile, secondary data is obtained through literature studies from reference books, data from related agencies, and other libraries.

The sample population for the bicycle user questionnaire used accidental sampling, i.e., sampling was based on what they happened to appear at the time of observation. According to Wibisono et al. (2016), the Nawawi formula (1995) in calculating samples in unknown populations is by using the Lemeshow formula (1997) as follows

$$n = \left(\frac{Z \alpha / 2 \sigma}{e} \right)^2 = \left(\frac{(1,96)(0,25)}{0,07} \right)^2 = 49$$

Description =

n = The number of samples

Z α = standard normal distribution value (1.96)

σ = population variance value.

e = error rate

That way, researchers are confident of a 93% level of confidence that a random sample of size 49 will give a difference in the estimate of x with a μ of less than 0.07. So, the sample rounded up to 50 people.

Data Analysis Techniques

The analysis method used is Importance Performance Analysis (IPA) to examine the relationship between bicycle users and the priority of improving bicycle transportation facilities, using an analysis of performance levels and interests, and then the value will be interpreted into a diagram consisting of four quadrants. The X-axis represents the level of performance, while the y-axis represents the level of importance.

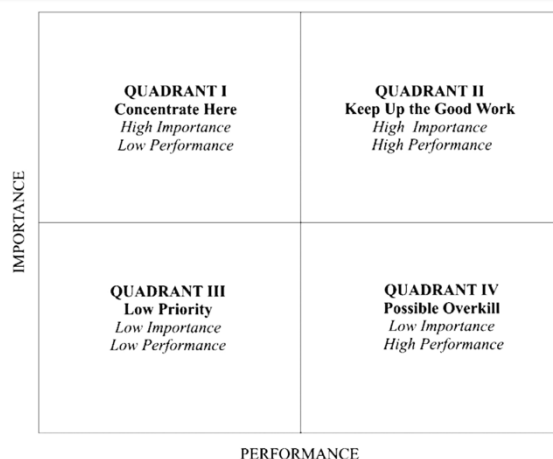


Figure 8. Cartesian Quadrant Performance Level and Importance

Description:

A: It shows aspects that are considered to affect the satisfaction of bicycle users, including aspects that are considered very important, but the performance is not in accordance with the wishes of bicycle users, so that it is disappointing or dissatisfied.

B: This shows aspects that have been successfully implemented. For that, it must be maintained. considered very important and very satisfactory.

C: shows some less important aspects of the effect on the user, but the performance is mediocre. considered less important and unsatisfactory.

D: Showing aspects that affect bicycle users is less important, but the implementation is excessive. considered less important but very satisfactory.

Results and Discussion

Importance Performance Analysis (IPA) results

Based on the results of the survey obtained from 50 respondents, the average value was obtained from the results of the calculation of the performance level and importance scores in Table 1. The scale value for performance of at least "1", which states that the performance of the facility is very poor according to the respondent, while the maximum value of "5" states that the performance of the facility is very good according to the respondent. The minimum importance scale value is "1", which states that the performance of the facility is very unimportant according to the respondent, while the maximum value of "5" states that the performance of the facility is very important according to the respondent. The average results of performance values and importance are interpreted in the form of cartesian diagrams to show development priorities in figure 9.

Table 1. The average value of the respondent's level of performance and level of importance

No.	Attribute	Performance Level Weights	Importance Level Weight	X	Y
1	The condition of the unhas campus road section as a bicycle lane (free of obstacles for other vehicles, side obstacles, and pedestrians).	193	215	3.86	4.30

2	The topographical condition of campus roads used as bike lanes	207	194	4.14	3.88
3	road markings as bike lane markers.	156	209	3.44	4.12
4	signs that provide instructions for cycling.	157	214	3.14	4.28
5	The condition of the bicycle parking lot	167	195	3.44	4.10
6	Bike rental places	152	199	3.04	3.98
7	Bicycle Workshop	140	188	2.80	3.76
8	The condition of the bicycles found at the Unhas Tamalanrea Campus	136	202	2.72	4.04
9	A shade path (example: tree) along the road section of the Unhas Campus	209	209	4.18	4.18
10	The rules support bicycles.	149	198	2.98	3.96
		X Average	Y Average	3.03	3.68

Source: Survey 2022

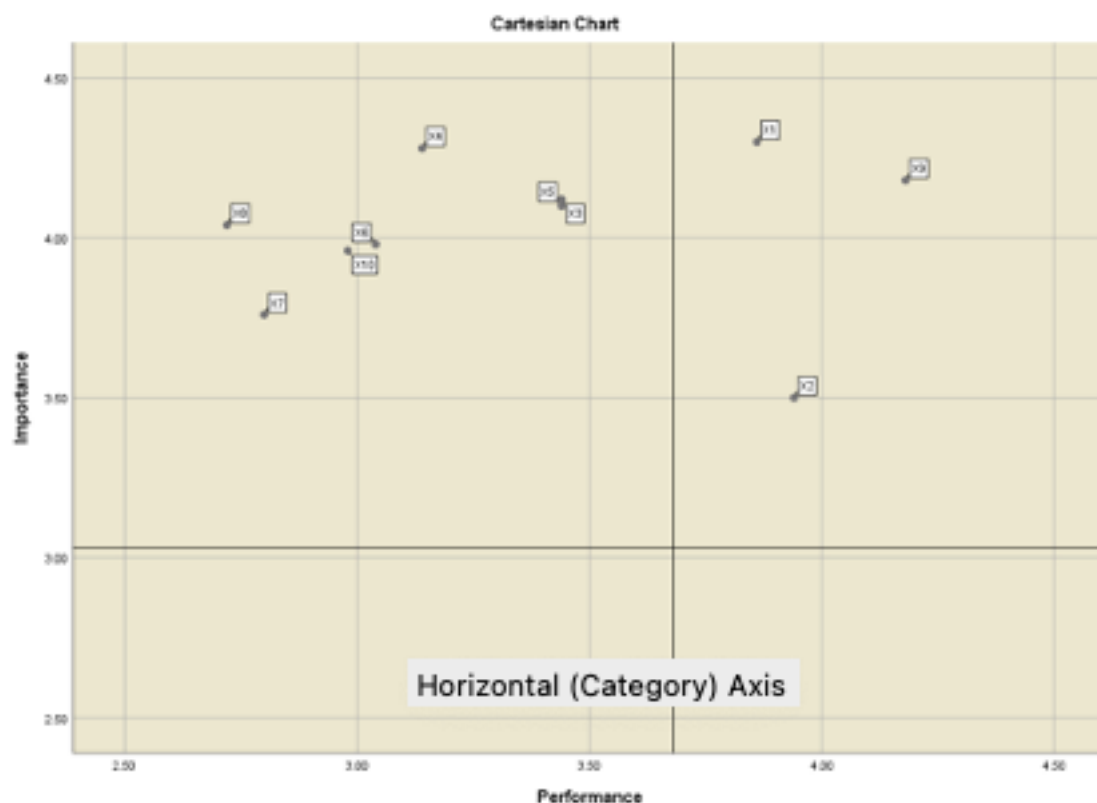


Figure 9. Importance Performance Analysis (IPA) Diagram

The Cartesian diagram shows the relationship between the level of service of the facility and the level of importance based on the average value of each attribute obtained from the results of a survey of 50 respondents. The results of the calculation of the average values are grouped into a priority scale that is in quadrant I and quadrant II.

Quadrant I (Top Priority)

There are 7 attributes included in quadrant I. This shows that transportation facilities are very important for respondents, but the condition of the facilities is still considered lacking. The facilities contained in this quadrant are a top priority to improve.

X3. Road markings as bike lane markers.

There are road markings as a barrier between the road body and the sidewalk, but there are no markings that indicate bicycle lanes are not yet available. This makes bike lanes less protected. For this reason, this facility is included in the top priority to be developed because it is considered very important by bicycle users and has less performance. For bicycle lane area markings that will be placed on mixed traffic, namely road opening lane area markings and bicycle markings at intersections, Bicycle lane area markings have a distance of every 6 meters with a width of 3 meters.

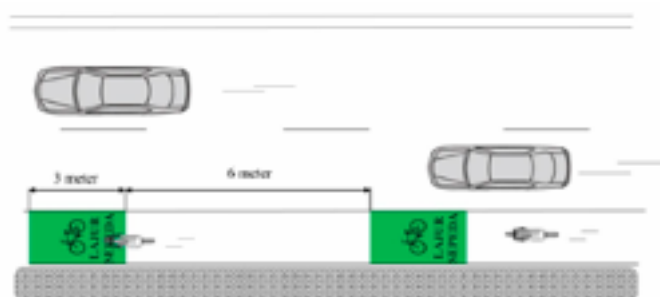


Figure 10. Placement of type C lane area markings

X4. Signs that provide instructions for cycling.

Traffic signs are found on every road section of the Unhas Tamalanrea Campus so that vehicle users can pass by paying attention to the appropriate road rules. While signs for cycling are not yet on campus roads, this affects the facilities of signs and is a top priority to be improved. Bicycle lane signs that will be placed on the bicycle lanes of the Unhas Tamalanrea Campus as a notification sign for motorists that the lane is a bicycle lane.

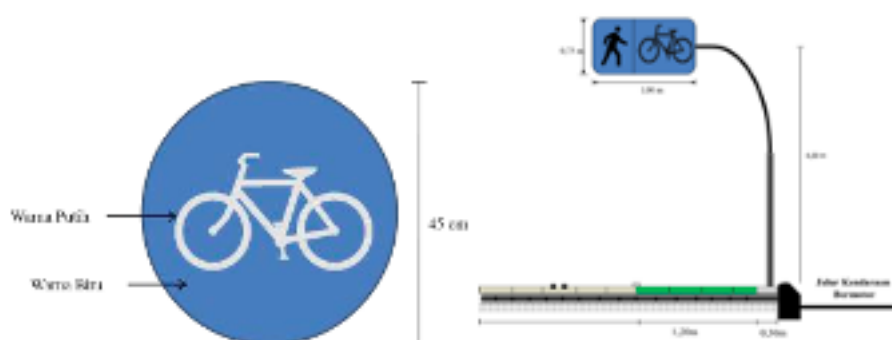


Figure 11. Bike lane signs and bike lane notification signs on sidewalks

X5. The condition of the bicycle parking lot.

Bicycle parking facilities are at two points, bicycle parking 1 is after the entrance gate of the JL.door 1 Campus; and bicycle parking 2 is near the sports area of the Unhas Tamalanrea Campus. The bike parking location is on the sidewalk and is only located in the western part

of the campus. Based on the survey results, this facility is included in important attributes but its performance is still lacking, so it needs to be improved by adding bicycle parking facilities at several points. Bicycle parking can also be placed near the entrance or exit of buildings that have a high movement pull. The placement of bicycle parking on the sidewalk should not interfere with pedestrian activity. Bicycle parking spaces must meet safety, usability, and aesthetic aspects. Bicycle parking facilities must be located outside the circulation space of pedestrians or other vehicles and within a radius of 100 meters from the entrance of the public transport station (Widodo et al., 2020).

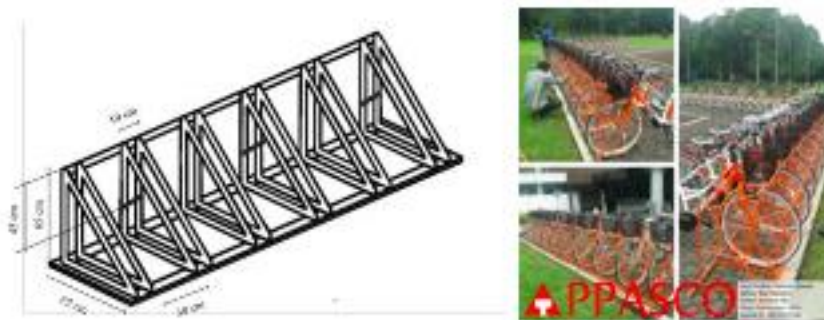


Figure 12. Bicycle Parking Illustration and Examples of Campus Bicycle Parking Facilities in IPB

X6. Bike rental places

The Unhas Campus bicycle program has been running since 2010 and has a free bicycle rental place that can be used by students, lecturers, and employees by leaving an ID card and student card. Currently, bicycle rentals have not been implemented again. This facility is an expectation for respondents because it is included in the top priority. For the re-procurement of bicycle rental places, the location that becomes the place of borrowing is in the door lane of one Unhas Campus as the starting point. with the lending mechanism as follows; (1) Students, lecturers, and employees, as evidenced by membership cards (KTM, KTP, and so on) to the nearest shelter (starting point); (2) Completing the loan registration form; (3) Conduct bicycle selection and condition checks in the presence of the duty officer; (4) Using campus bikes to get to your destination; (5) Return the bike to the nearest shelter.

X7. Bicycle Workshop

There is no bicycle workshop at the Unhas Tamalanrea Campus. Bicycle transport equipment needs to be maintained, and if the bicycle is damaged while cycling, it can be moved directly to this workshop and repaired. For this reason, bicycle facilities need to be equipped with a bicycle workshop that can be reached easily.

X8. The condition of the bicycles found at the Unhas Tamalanrea Campus

At the time of the Unhas bicycle program in 2010, there were more than 100 bicycles, which were the result of university cooperation. However, in 2014 there was a social problem around the Unhas Campus so that it had an impact on the provision of unhas bicycle facilities, which became not optimal. Based on observations in the field, there are currently no more unhas bicycle units that can be used. This makes bicycle facilities a top priority to upgrade. It is hoped that the re-procurement of campus bicycles will support the Green and Clean Campus (GCC), realize environmentally friendly transportation services, improve campus services, and become

an attraction to reduce the use of motorized vehicles. Bicycles are not only used for exercise but can also be used as transportation for daily activities (Heinen et al., 2010).

X10. Rules in favor of cycling

In supporting the Green Open Space of the Unhas Campus as the best urban forest area in Makassar, there are four elements that will be optimized, namely maritime, connectivity, lakes and swamps, and green open space. It is hoped that in the element of connectivity, there will be campus bicycle rules that will support the re-program of the unhas campus bicycle program. A campus bike master plan typically includes the following key elements; (1) Vision, objectives, and goals; (2) Assessment of existing conditions; (3) Opportunities and constraints; (4) Proposed bike lane network; (5) Bicycle program proposed; (6) Funding and implementation strategy.

One of the implementations of the campus bicycle program is the four "E" program of bicycle planning: encouragement, education, enforcement, and evaluation (Wilson et al., 2018). The following is a brief explanation of the purpose of focusing attention on each of those "4 E":

Education: Increasing community understanding and appreciation of cyclists' and other transportation users' roles and responsibilities, such as pedestrians and motorists. Encouragement: improving cyclists' skills and encouraging the creation of a strong cycling advocacy community and bicycle culture. Enforcement: advocacy for a more secure environment for cyclists and other non-motorized modes of transportation. Evaluation and Planning: institutional collaboration and support to track cycling rates and drive additional growth.

Quadrant II (Achievement Priority)

X1. The unhas campus road section's condition as a bicycle lane (free of obstacles for other vehicles, side obstacles, and pedestrians).

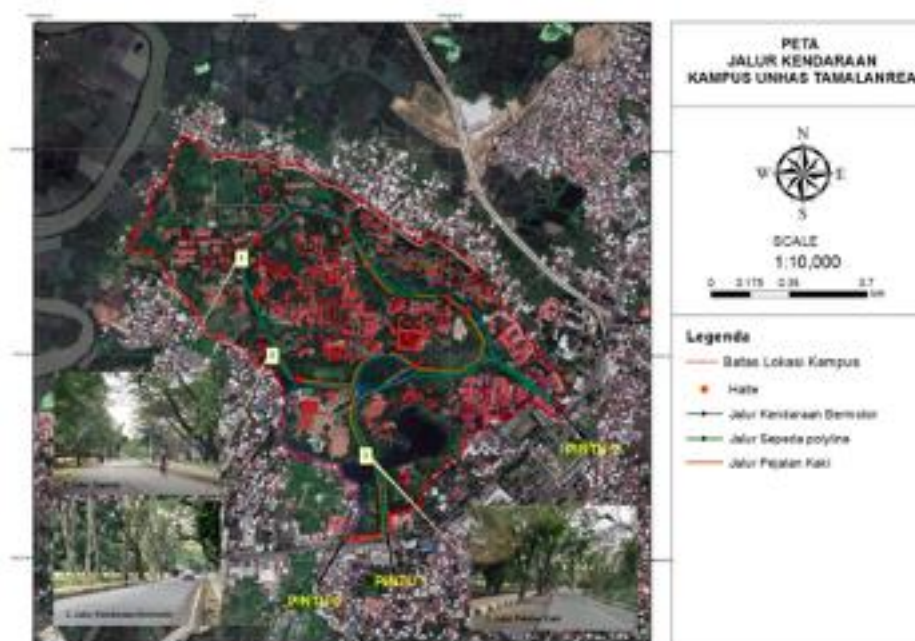


Figure 13. Vehicle Path Map of Unhas Tamalanrea Campus

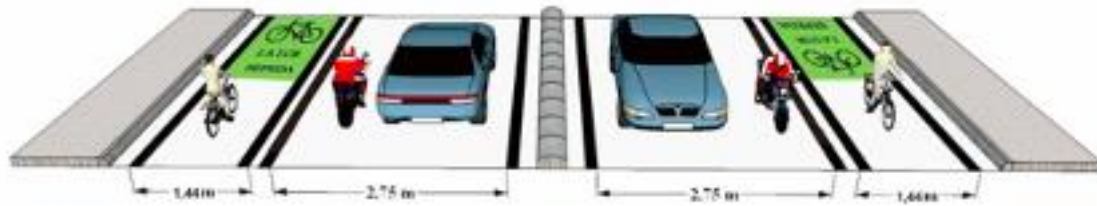


Figure 14. Lane width conditions for small roads

Bicycle lanes are located on roads for pedestrians and cyclists. On the map, it can be seen that bicycle users are in the same lane as motor vehicle lanes, so the comfort and safety of motorists must be considered so that there are no obstacles. Cyclists who are on the left side of the road body are not the minimum lane width required for motor vehicles, which is 2.75 meters in accordance with PP No.34 of 2006 concerning roads. The pedestrian path located on Jl.Pintu I Unhas has a width of 10 meters. This shows that cyclists and pedestrians get comfortable and safe access on the pedestrian path.

The aspect of the road section in quadrant II has good performance and is considered important by respondents. Therefore, the road section at the Unhas Tamalanrea Campus, which is used as a bicycle lane, is expected to be able to nourish its performance. Campus and pedestrian roads are directed to provide bicycle access lane markers in order to improve the effectiveness of the road (Zegeer, 2002). In addition, maintenance should be carried out on the road if there is damage and there is inundation.



Figure 15. Bicycle lanes on the road body (Jl. Sudirman, Central Jakarta)

Source: Kompas News



Figure 16. Bike lanes in pedestrian lanes (Siam Riep City, Cambodia)

X2. Topographical condition of campus roads used as bike lanes.

The bicycle path at the Unhas Tamalanrea Campus is quite stable and comfortable to walk on when cycling. This section of the road is easy for cycling paths to pass, and there are no other roots or barriers. At the Unhas Tamalanrea Campus, there are no climbs or descents that will be dangerous when cycling. This facility is good at maintaining its performance because it is a fairly important facility.



Figure 17. Unhas Tamalanrea Campus Ramp Path

Source: Survey 2022

X9. Shade Path (for example, a tree) along the Unhas Campus's road section

One of the attractions for cycling at the Unhas Campus is the comfortable green path, which runs along the Unhas Campus road section. The Green Open Space Area of the Unhas Campus has an area of 2.4 hectares, which makes it one of the best urban forest areas in Makassar City. Based on this, this facility is considered to have been successfully implemented according to the respondents. This aspect can be maintained by maintaining trees and plants, monitoring and pruning plants periodically so as not to hinder cyclists, and is considered very important and very good performance.

Conclusion

The bicycle transportation facilities of the Unhas Tamalanrea Campus are quite supportive of cycling but still need to be developed. Based on the results of the survey and the calculation of the average value of performance and importance, in general, transportation facilities are the top priority for improvement. Efforts can be made with the campus bicycle program by implementing the arrangement of bicycle facilities in accordance with bicycle transportation guidelines, making them protected, comfortable, and attractive for cycling so that bicycles are not only used for sports but can also be used for other activities such as going to work and college. In addition, implementing a bicycle program can reduce environmental pollution and support the Green and Clean Campus (GCC) program again. Road lane facilities, topographic conditions, and shade paths located at the Unhas Tamalanrea Campus include facilities that are considered important and have performance that needs to be maintained. Shady road paths will make bicycle users comfortable when cycling. For this reason, maintenance of plants and trees is needed.

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