

Assessment of Public Transport Footway Facilities Bogor District

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ABSTRACT

Along with the increasing need for travel and the high dependence on motorized vehicles, the growth of existing transportation facilities and infrastructure is ultimately unable to accommodate these needs and leads to traffic jams, such as pollution, a decrease in the quality of life of the community and the level of road safety. Studies conducted at stations and Cibinong Terminal to analyze pedestrian characteristics and facilities. The research method used is direct observation and data collection in the field. From the results of the analysis in the direction of Jl. Raya Bogor to Pabuaran with a vehicle volume of 2,160 per / hour on Monday afternoons at LOS B, the direction of Bogor to Jakarta with a vehicle volume of 13,390 on Tuesday and Saturday with peak hours in the afternoon, there is LOS E, and in the direction of Ciriung to Cikaret there is LOS B from morning to evening. The number of pedestrians is based on age with the direction of entering and exiting stations, stops and terminals, such as Cibinong Terminal with adult male pedestrians 16-40 years old, with the volume of pedestrians from and to the station. The density occurs on Monday afternoons, Tuesday morning, noon and evening, and Terminal on Wednesday morning. with the results of interviews of respondents who are at the productive age of 18-45 years, with high school / vocational school graduation with an income of 3-6 million and an expense of 1-2 million, the traveling characteristics of most respondents use station facilities, respondents are willing to walk 501-600 m, the level of facility in the respondent's station is quite satisfied, in the terminal the respondent is not satisfied, especially with the safety of pedestrians. Special satisfaction of Taxi / Ojek / delivery users and parking lots, respondents are quite satisfied, especially in the ease of finding a vehicle, the satisfaction of users of public transportation of respondents is quite satisfied, especially in the ease of finding a vehicle. The results of this study are the construction of pedestrian facilities and zebra crossing facilities.

Keywords: pedestrian facilities; means of transportation infrastructure; zebra crossing; satisfaction.

INTRODUCTION

The development of transportation problems in urban areas in developing countries is generally caused by transportation development policies that favor private vehicles and encourage people to travel by motorized vehicle. Along with the increasing need for travel and the high dependence on motorized vehicles, the growth of existing transportation facilities and infrastructure is ultimately unable to accommodate these needs and causes traffic jams with all its implications, such as pollution, decreased quality of life of people and levels of road safety, waste of fuel. and wasted productive time on the road. Walking is a relatively easy and inexpensive means of reaching a destination that cannot be served by other modes of transportation, (Amos Rapoport, 1977) says that walking has advantages, namely low speed so it is profitable, because it can understand the surrounding environment and observe objects in detail and easily aware of the surrounding environment. Meanwhile (Gideon Geovani, 1977) states that walking is a means of transportation that connects the functions of trade areas, cultural areas and residential areas.

Everyone's transportation journey is different. This journey creates the basic concept of a person's initial transportation when traveling. Every trip always experiences changes. Travel changes are caused by planned activities not receiving a positive response from the environment (Ganda CF et.al, 2019; Karimah H, Akbardin J, 2019; Syaiful S et.al, 2022). The environment plays an important role in changing a person's journey. If heavy rain occurs in the area, the journey will

stop. People using public transportation will feel burdened by this travel behavior (Syaiful S et.al, 2022; Syaiful S, Rusfana H, 2022; Syaiful S, Pratama Y, 2019; Syaiful S, Hariyadi D, 2019).

The journey undertaken should follow a clear and measurable pattern. This pattern is followed up with planning conditions that match the steps people take when traveling. Go somewhere with careful planning. This trip affects the travel time used. The faster the travel time used, the faster you will reach your destination (Syaiful S et.al, 2020; Syaiful Fadly A, 2020; Syaiful et.al, 2021; Syaiful S et.al, 2023; Syaiful S et.al, 2023).

Footwalk Characteristics

The characteristic of pedestrians is one of the main factors in the design, planning and operation of pedestrian facilities. Some of the characteristics of pedestrians are as follows (Artawan, Medagama and Mataram, 2013).

Flow is the number of pedestrians crossing a point on the sidewalk and is measured in units of pedestrians per meter per minute. To determine the current, a formula is used which includes:

Equation 1

Where:

- Q = pedestrian flow (people/m/min)
- N = number of pedestrians passing (people/m)
- T = observation time (minutes)

Speed is the distance that can be covered by pedestrians on a certain time association sidewalk. Speed is formulated as follows:

Equation 2

$$V = L / t$$

Where:

- V = pedestrian speed (m / min)
- L = length of observation piece (m)
- T = travel time for pedestrians passing the observation segment (minutes)

Pedestrian speed is also calculated based on:

The pedestrian speed can also be calculated based on the past population plotted on the prepared graph paper.

Time average speed (time line speed)

Equation 3

$$V_t = 1/n \sum_{i=1}^n V_i$$

Where:

- V_t = time average velocity (m / min)
- n = number of observed velocity data
- V_i = observed speed of each pedestrian (m / min)

Space mean speed

Equation 4

$$V_s = (1 / (1/n \sum_{i=1}^n (1/V_i)))$$

Where:

- V_s = average velocity of space (m / min)
- n = amount of data
- V_i = the speed of each observed pedestrian (m / min)

Density is the number of pedestrians in a certain sidewalk area. The formula to use:

Equation 5

$$D = Q / V_s$$

Where:

- D = density (people / m²)
- Q = current (people / m / min)
- V_s = Average velocity of space (m / min)

Pedestrian space is the average area of area available for each pedestrian on a sidewalk which is formulated in units of m² / person:

Equation 6

$$S = (V_s / Q = (1/D))$$

Where:

S = pedestrian space (people / m²)

Q = current (people / m / min)

V_s = Average velocity of space (m / min)

RESEARCH METHODS

The location of this research was conducted in Pabuaran Village, Kec. Cibinong Kab. Bogor. The destination for research is Cibinong Station and Terminal.



Figure 1. Research location (Source: Google Earth)

The stages of this research are shown in the form of a flow chart as follows:

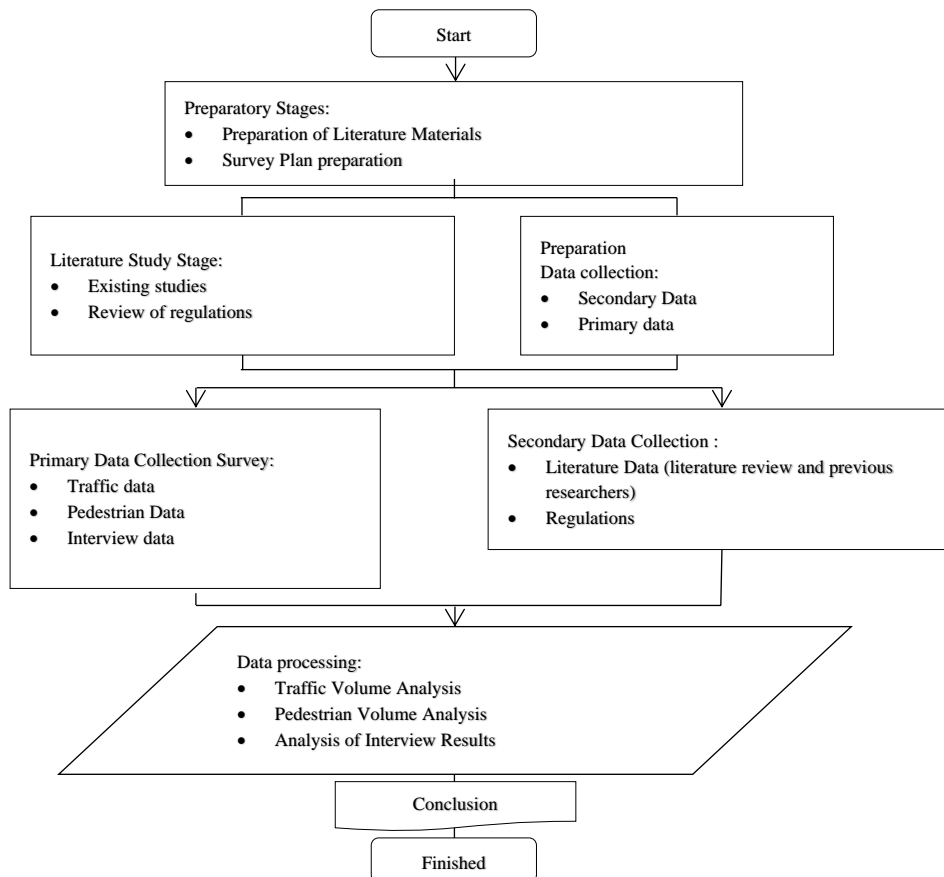


Figure 2. Research flow diagram

RESULTS AND DISCUSSION

Survey Results

Data from observations of the amount of traffic in the field for 3 days, which is carried out on Monday, Tuesday and Saturday by assuming peak hours, namely morning at 06.00-08.00, noon at 11.00-13.00 and evening at 16.00-18.00, vehicle survey data as shown in the following table:

Calculation of Vehicle Volume and Road Service Level

The calculation of vehicle volume and road service levels on roads around the Cibinong Station area and Cibinong Terminal is shown in the following table:

Road traffic data on Jl. Raya Bogor towards Jl. Pabuaran and the opposite direction

Table 1. Vehicle Volume on Monday

Busy time	From the direction of Jl. Raya Bogor to Jl. Pabuaran				From the direction of Jl. Pabuaran to Jl. Raya Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	293	20	0	A	462	2370	0,19	A
07.00-08.00	301	28	4	A	424	2370	0,18	A
11.00-12.00	309	51	13	A	265	2370	0,11	A
12.00-13.00	316	53	26	A	299	2370	0,13	A
16.00-17.00	462	85	20	A	346	2370	0,15	A
17.00-18.00	480	87	8	B	332	2370	0,14	A
Amount	2.160				2.127			

(Source: Analysis results)

Table 2. Vehicle Volume on Tuesday

Busy time	From the direction of Jl. Raya Bogor to Jl. Pabuaran				From the direction of Jl. Pabuaran to Jl. Raya Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	94	2370	0,04	A	121	2370	0,05	A
07.00-08.00	132	2370	0,06	A	156	2370	0,07	A
11.00-12.00	284	2370	0,12	A	246	2370	0,10	A
12.00-13.00	228	2370	0,10	A	258	2370	0,11	A
16.00-17.00	304	2370	0,13	A	412	2370	0,17	A
17.00-18.00	285	2370	0,12	A	399	2370	0,17	A
Amount	1.327				1.591			

(Source: Analysis results)

Table 3. Vehicle Volume on Saturday

Busy time	From the direction of Jl. Raya Bogor to Jl. Pabuaran				From the direction of Jl. Pabuaran to Jl. Raya Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	230	2370	0,10	A	294	2370	0,12	A
07.00-08.00	253	2370	0,11	A	336	2370	0,14	A
11.00-12.00	266	2370	0,11	A	291	2370	0,12	A
12.00-13.00	356	2370	0,15	A	282	2370	0,12	A
16.00-17.00	407	2370	0,17	A	384	2370	0,16	A
17.00-18.00	384	2370	0,16	A	366	2370	0,15	A
Amount	1.896				1.952			

(Source: Analysis results)

From tables 1, 2 and 3. Shows the volume of vehicles from the direction of Jl. Raya Bogor towards Jl. Jl. Pabuaran and the opposite direction, this is based on the maximum VCR value of the direction of the road section of 8 (LOS B) which means Stable Flow, on Tuesday afternoon from 17.00-18.00. The minimum VCR value from the direction of the road section is 0 (LOS A), which means Free Flow on Monday 06.00-07.00.

Road traffic data in the direction of Bogor towards Jakarta and the opposite direction on Jalan Bogor Raya

Table 4. Vehicle Volume on Monday

Busy time	From Bogor to Jakarta				From Jakarta to Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	2.244	3344	0,67	C	1.593	3344	0,48	C
07.00-08.00	2.677	3344	0,80	D	1.760	3344	0,53	C
11.00-12.00	2.289	3344	0,68	C	1.715	3344	0,51	C
12.00-13.00	2.147	3344	0,64	C	1.822	3344	0,54	C
16.00-17.00	2.072	3344	0,62	C	2.216	3344	0,66	C
17.00-18.00	2.337	3344	0,70	C	2.273	3344	0,68	C
Amount	13.765				11.378			

(Source: Analysis results)

Table 5. Vehicle Volume on Tuesday

Busy time	From Bogor to Jakarta				From Jakarta to Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	1.414	3344	0,42	B	2.090	3344	0,62	C
07.00-08.00	1.484	3344	0,44	B	2.355	3344	0,70	C
11.00-12.00	2.046	3344	0,61	C	2.271	3344	0,68	C
12.00-13.00	2.394	3344	0,72	C	1.953	3344	0,58	C
16.00-17.00	3.128	3344	0,94	E	2.253	3344	0,67	C
17.00-18.00	2.924	3344	0,87	E	1.839	3344	0,55	C
Amount	13.390				12.760			

(Source: Analysis results)

Table 6. Vehicle Volume on Saturday

Busy time	From Bogor to Jakarta				From Jakarta to Bogor			
	Smp/hours	Capacity	VCR	LOS	Smp/hours	Capacity	VCR	LOS
06.00-07.00	2.318	3344	0,69	C	1.767	3344	0,53	C
07.00-08.00	2.669	3344	0,80	D	1.862	3344	0,56	C
11.00-12.00	2.847	3344	0,85	E	1.970	3344	0,59	C
12.00-13.00	3.209	3344	0,96	E	2.044	3344	0,61	C
16.00-17.00	2.937	3344	0,88	E	2.086	3344	0,62	C
17.00-18.00	2.576	3344	0,77	D	2.436	3344	0,73	C
Amount	16.556				12.164			

(Source: Analysis results)

From tables 4, 5 and 6. Shows that the level of road service from the road from Bogor to Jakarta and vice versa is still quite high, seen from the maximum LOS value of E at 12.00-17.00. in the opposite direction at LOS C at 06.00-18.00 with a VCR of 0.73.

Road traffic data in the direction of Ciriung towards Cikaret on Jl. H.R Lukman

Table 7. Vehicle Volume on Monday

Busy time	From the direction of Ciriung towards Cikaret			
	Smp/Hours	Capacity	VCR	LOS
06.00-07.00	553	3344	0,17	A
07.00-08.00	884	3344	0,26	B
11.00-12.00	894	3344	0,27	B
12.00-13.00	738	3344	0,22	B
16.00-17.00	1.018	3344	0,30	B
17.00-18.00	874	3344	0,26	B
Amount	4.961			

(Source: Analysis results)

Table 8. Vehicle Volume on Tuesday

Busy time	From the direction of Ciriung towards Cikaret			
	Smp/Hours	Capacity	VCR	LOS
06.00-07.00	612	3344	0,18	A
07.00-08.00	846	3344	0,25	B
11.00-12.00	938	3344	0,28	B
12.00-13.00	760	3344	0,23	B
16.00-17.00	947	3344	0,28	B
17.00-18.00	788	3344	0,24	B
Amount	4.890			

(Source: Analysis results)

Table 9. Vehicle Volume on Tuesday

Busy time	From the direction of Ciriung towards Cikaret			
	Smp/Hours	Capacity	VCR	LOS
06.00-07.00	466	3344	0,14	A
07.00-08.00	725	3344	0,22	B
11.00-12.00	797	3344	0,24	B
12.00-13.00	709	3344	0,21	B
16.00-17.00	998	3344	0,30	B
17.00-18.00	763	3344	0,23	B
Amount	4.459			

(Source: Analysis results)

From tables 7, 8 and 9. Shows that the level of road service from the road from Ciriung to Cikaret is still quite high, seen from the maximum LOS B value at 07.00-18.00. with a minimum LOS value of A at 06.00-07.00 with a VCR of 0.18

Table 10. Sidewalk Needs Analysis

Location	Childre n 6-15 Years	Adults 16-40 Years	Parents >40 Years	Total Walkers per week (2020)	Total Pedestrian s per day (2020)	Per hour (2020)	Per minute (2020)	Minimum sidewalk width (2020) (metre)
	(person)	(person)	(person)	(person)	(person)	(hour)	(minute)	
	1	2	3	4(1+2+3)	5(5/6hari)	6	7(6/60)	8
Jl. Pabuaran	462	1318	1499	3279	547	200	3	1,6
Bus stop	147	872	497	1516	253	103	2	1,5
Jl. Raya Bogor	413	4306	2052	6771	1129	605	10	1,8

(Source: Analysis results)

From the results of the analysis of the three sections, an analysis of the minimum sidewalk width on Jalan Pabuaran 1.6 m, Jl. H.R Lukman 1,5m, and Jl. Raya Bogor 1.8 m.

Pedestrian analysis of the direction of entry and exit from terminals, stops and stations

From the observations of pedestrians from the direction of entering and exiting the terminal, bus stop, and station based on the age category, the least age category is child pedestrians aged 6-15 years entering and exiting bus stops and the most are adult males aged 16 -40 years is 2,314 for the direction of entering and exiting the Terminal. Meanwhile, for stations of all pedestrians based on age are dominated by older women > 40 years of 800 pedestrians.

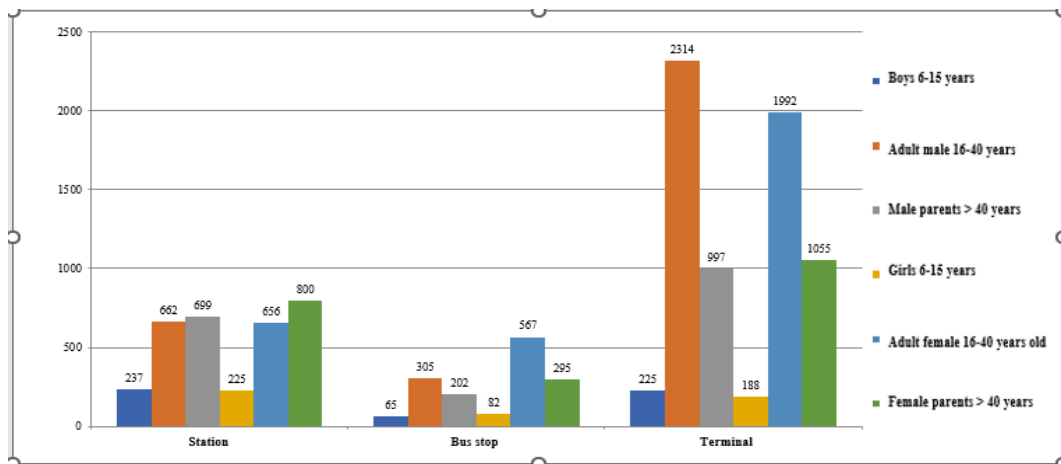


Figure 3. Characteristics of Number of Pedestrians by Age (Source: Analysis results)

Characteristics of pedestrian age in the direction of entry and exit from terminals, bus stops, and Cibinong stations. based on the age category, the least children were pedestrians 6-15 years of age in and out of bus stops and the most were adult males of 16-40 years who entered and left the Terminal. Whereas for stations of all ages of pedestrians are dominated by older women > 40 years, when compared between the direction of entry and exit of stations, stops, and terminals, the most pedestrian is the direction of entering and exiting the terminal, especially the age of male pedestrians. adults 16-40 years. The age characteristics of the pedestrians are shown in the following Figure:

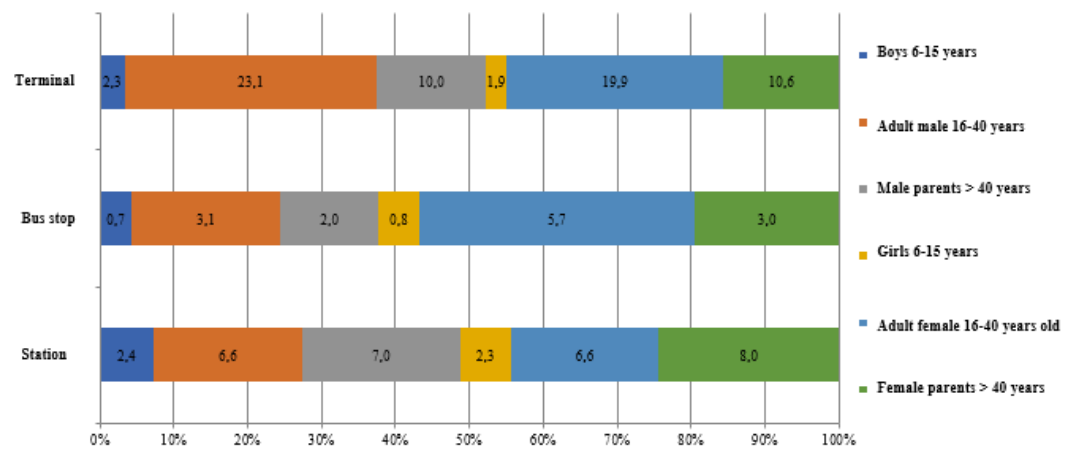


Figure 4. Age Characteristics of Pedestrians Age (Source: Analysis results)

The volume of pedestrians in and out of the station, there is the highest volume of pedestrians on Tuesday in the afternoon on the exit direction of the station. Of the total volume of pedestrians, the highest is Tuesday and Saturday in the afternoon, pedestrians travel out of the station. The volume of pedestrians to and from the station is shown in the following Figure:

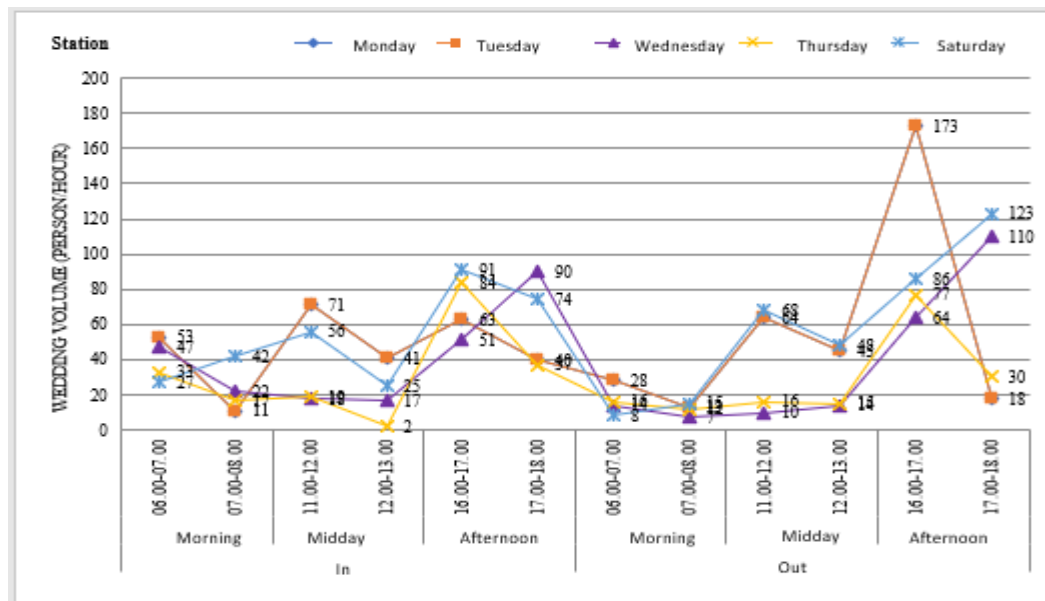


Figure 5. The Volume of Pedestrians to and from Age Station (Source: Analysis results)

The volume of pedestrians in and out of the stop. most volume is on Tuesday in the morning, afternoon and evening. Meanwhile, the minimum volume of pedestrians is Saturdays. Especially in the afternoon and evening, the volume of pedestrians is almost zero. The volume of pedestrians to and from the bus stop is shown in the following figure:

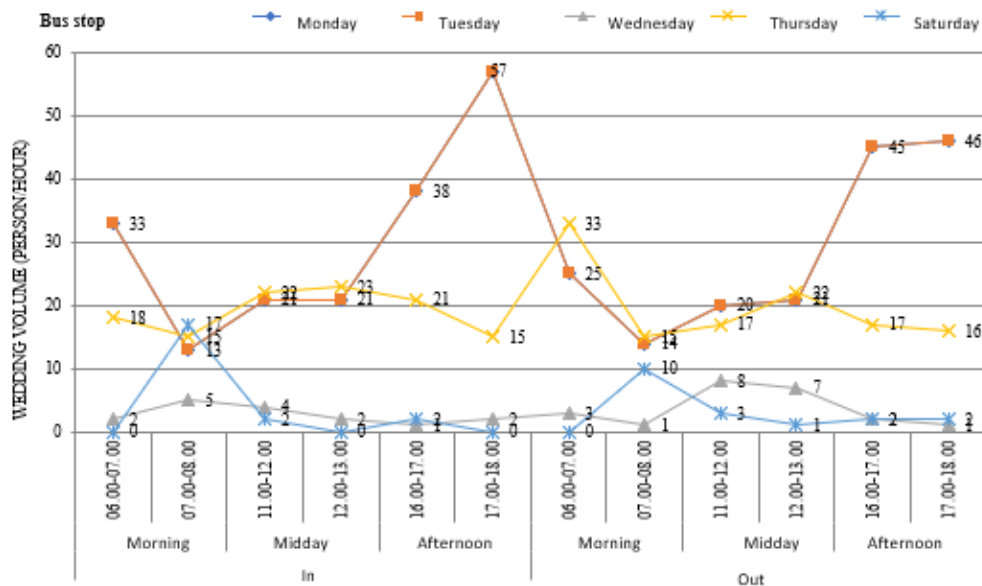


Figure 6. The volume of pedestrians to and from the bus stop (Source: Analysis results)

The volume of the pedestrian in and out of the terminal. the largest volume is on Wednesday in the morning. Overall, on Wednesday is the highest volume of pedestrians, and on Monday and Saturday is the lowest volume of pedestrians. The volume of pedestrians to and from the terminal is shown in the following figure:

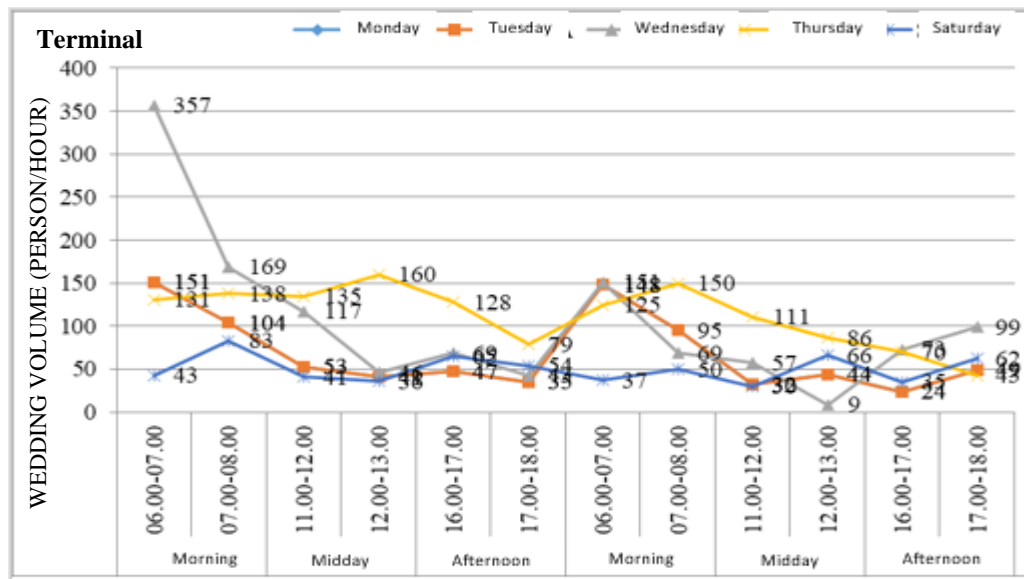


Figure 7. The Volume of Pedestrians to and from the Terminal (Source: Analysis results)

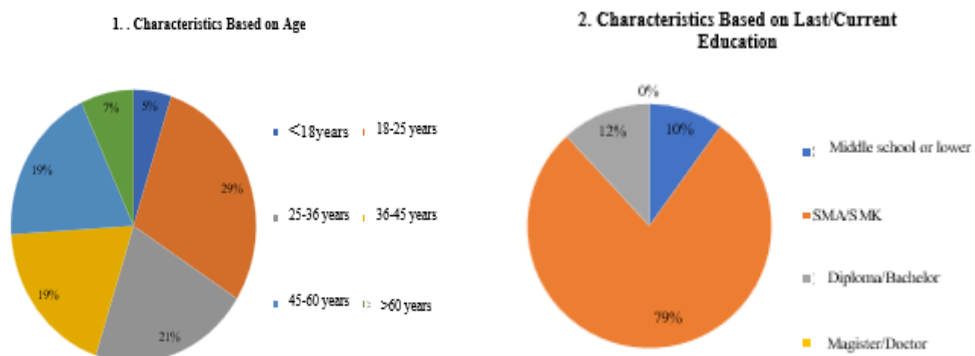
Table 11. Pedestrian Capacity by Volume and Average Speed TAHUN 2020

Location	Pedestrian street (m2/person)	Average Speed (meter/minute)	Flow Volume (person/meter/Minute)	Volume/ Capacity Ratio	Los
Jl. Pabuaran	25,5	85	3	0,04	A
Halte	48,3	83	2	0,02	A
Jl. Raya Bogor	7,6	77	10	0,13	B

(Source: Analysis results)

Interview Data Analysis

Based on the main mode used by the respondent from the place of origin to the Cibinong station / terminal. It is known that most of them are in the productive age, namely 18-45 years of 69%, last education SMA/SMK is 79%, monthly income is 55% of Rp. 3-6 million, 39% monthly expenditure of Rp. 1-2 million, ownership of private vehicles such as private cars, private motorbikes and other vehicles, almost 95% of respondents do not own private vehicles. Shown in the following image:



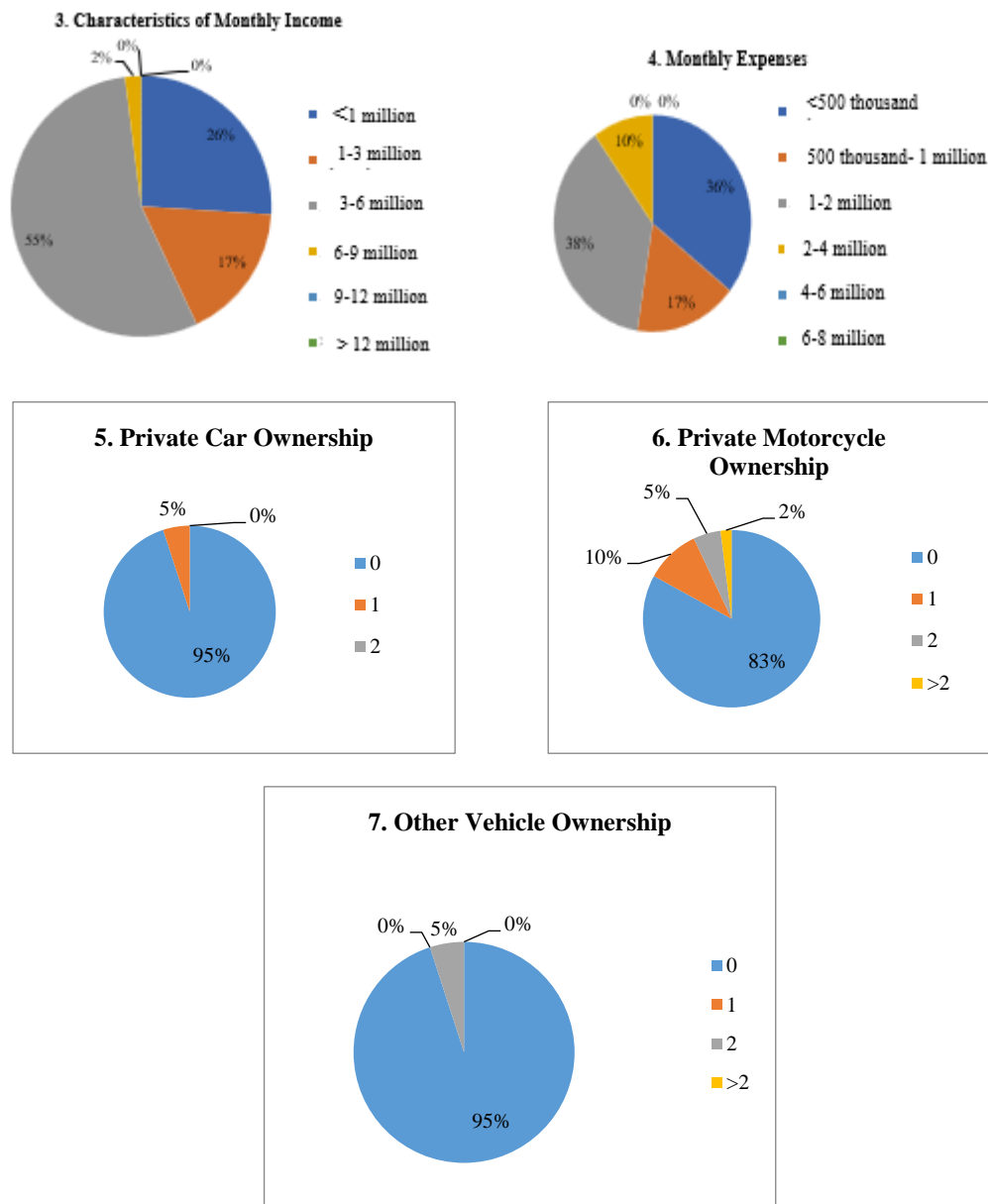
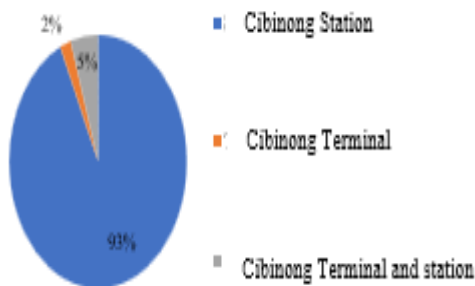


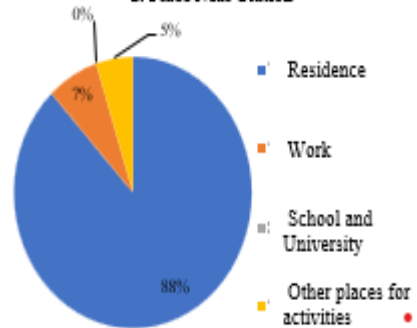
Figure 8. Characteristics of Respondents (Source: Analysis results)

The travel characteristics of the respondents, the facilities used by 93% are Cibinong Station facilities, 88% of the places near the station, the location of activities / living near the station, 81% live in Pabuaran and 12% live in Cibinong. / activity from Cibinong Station / terminal is less than 4 km or 100%, the total duration of the trip to the station / terminal is 88% less than 15 minutes, the average total cost of one trip to the station / terminal is 100% less than Rp. . 4000, with a walking distance from the vehicle drop off / parking lot to the station / terminal as far as 101-201 m from the station or 31%. Shown in the following image:

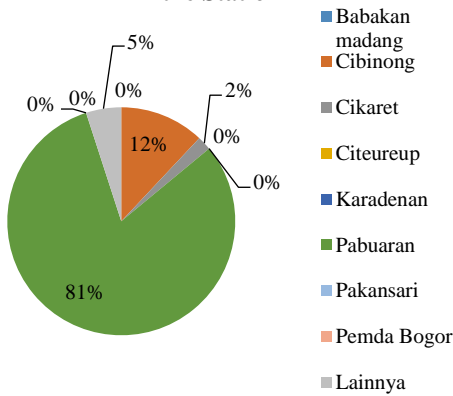
1. Facilities used



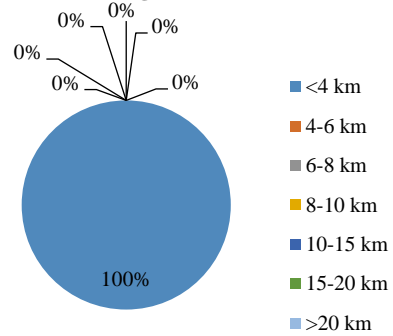
2. Place Near Station



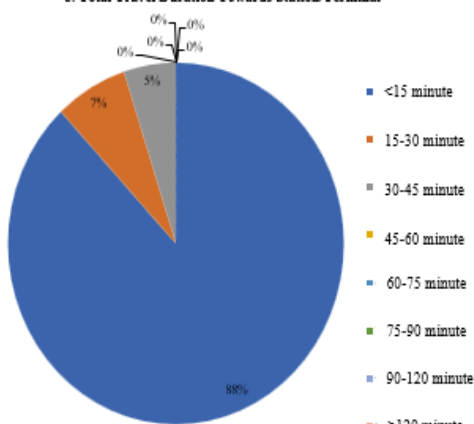
3. Activities/Living Locations Near the Station



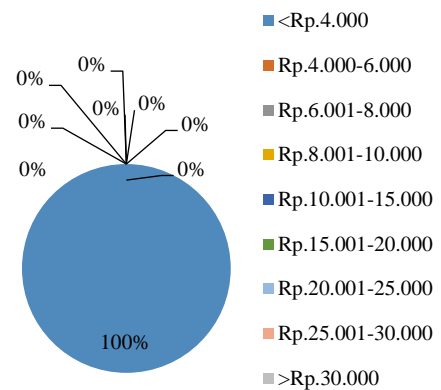
4. Travel distance of Residence/Activity from Cibinong Station/terminal



5. Total Travel Duration Towards Station/Terminal



6. Average Total Cost of One Trip to Station/Terminal



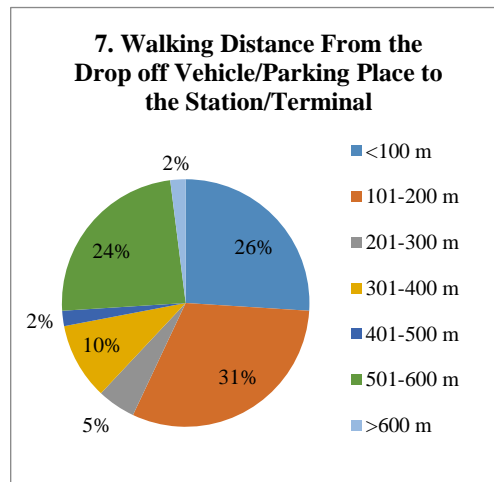


Figure 9. Characteristics of Respondents' Trips (Source: Analysis results)

Level of Willingness, Satisfaction and Interest at Cibinong Station and Terminal

Willingness Level, most of them are willing to walk because they have an average value of 80%. respondents are willing to walk 501-600 m. When compared, this figure is higher than the routine distance that the respondent usually walks from the vehicle / parking lot to the station / terminal is shown in the following table:

WILLING

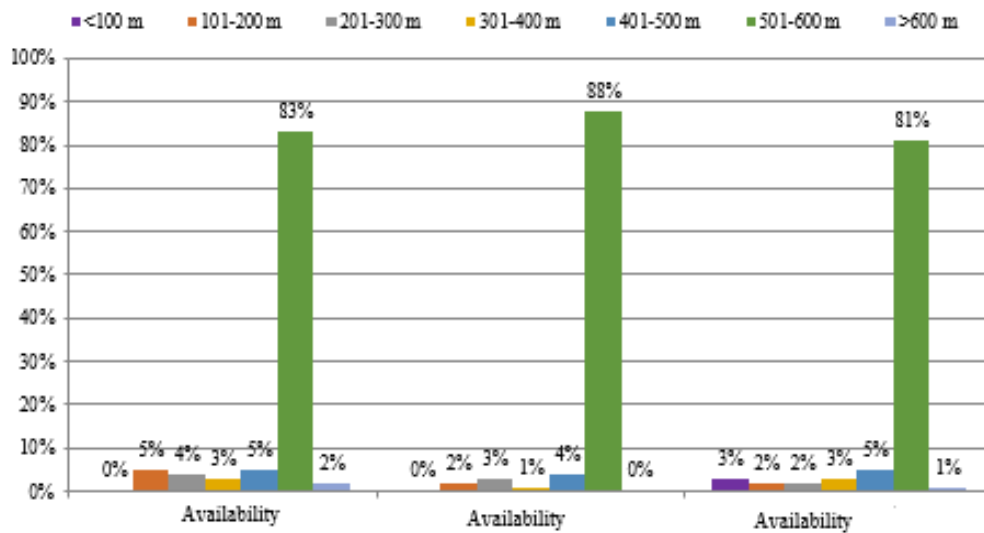


Figure 10. Willingness to walk from the vehicle / parking lot to the station / terminal (Source: Analysis results)

The level of satisfaction and importance of facilities in and around the Cibinong Station

In the comfort category, the respondents are quite satisfied with the satisfaction score of 3.27% but the important value is 3.21%. Respondent's safety category is not satisfied, with a satisfaction score of 3.21% but the important value is 3.34% such as lighting and security officers, the

respondent's safety category is less satisfied, with a satisfaction score of 2.97%, such as emergency response to health conditions suddenly, the disaster emergency response at the facilities inside the station is still unsatisfactory, the importance value is 3.39%, and the category of supporting facilities for respondents is not satisfied, with a satisfaction score of 3.01%, such as public toilets, less seats in the station. satisfactory, the importance value of 3.40%.

The level of satisfaction and importance of facilities in the terminal and around the Cibinong Terminal

In the comfort category, the respondents were not satisfied, with a satisfaction score of 2.91% such as being clean from rubbish, dirt and dust, while those in the importance value were 3.37% where there were trees or plants for shelter. Respondent's security category is less satisfied, with a satisfaction score of 3.00%, especially in lighting and security from criminal acts, while those with important values such as security officers, the presence of CCTV with an interest value of 3.49%. The safety category of respondents is less satisfied, with a satisfaction score of 2.98%, such as emergency response to sudden health conditions, disaster emergency response and protection from traffic flow around the terminal, an importance value of 3.48%. Especially in the protection of the flow from traffic and the category of supporting facilities, the respondents were not satisfied, with a value of 2.79%, such as pedestrian crossings (zebra crossing) around the terminal, the value of importance was 3.64%. Due to the absence of trash bins and public toilets.

Satisfaction level and special interest of taxi/ojek/delivery users

Comfort category, from the comfort category, the respondents are quite satisfied with the convenience and comfort when getting on / off the vehicle with a satisfaction value of 3.47%, with an importance value of 3.37%. shown in the following Figure:

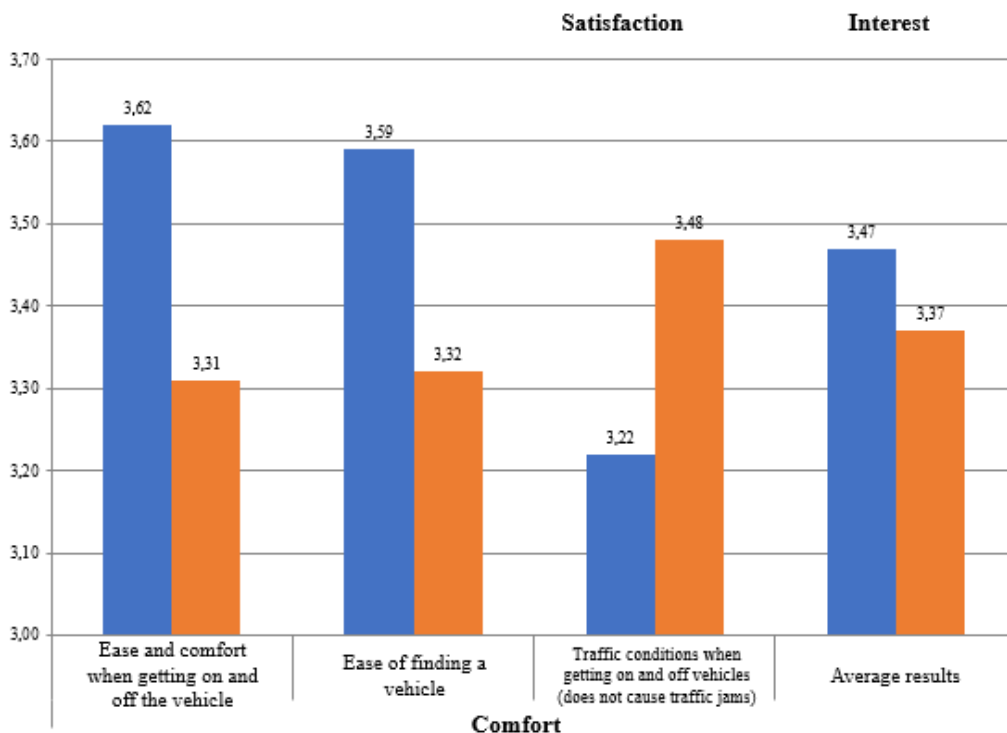


Figure 11. Level of satisfaction and special interests of taxi / ojek / delivery users (Source: Analysis of results)

Satisfaction levels and special interests of users of parking lots for motorized vehicles

Comfort category, respondents are not satisfied, on the aspect of the ease of finding a parking space or with a satisfaction value of 3.50%, while those in the importance value of 3.21% are on parking facilities. The safety category of respondents was less satisfied, with a satisfaction score of 3.17%, especially in vehicle safety from crime, while the importance value of 3.49%, from vehicle safety from crime and from the risk of vehicle damage. Respondents' connectivity category is less satisfied, with a satisfaction score of 3.06%, due to lack of information on access to the Station / Terminal, with an interest value of 3.33%.

Satisfaction level and special interest of public transport users

Comfort category, respondents are not satisfied, on the aspect of the ease of finding a parking space or with a satisfaction value of 3.50%, while those in the importance value of 3.21% are on parking facilities. The safety category of respondents was less satisfied, with a satisfaction score of 3.17%, especially in vehicle safety from crime, while the importance value of 3.49%, from vehicle safety from crime and from the risk of vehicle damage. Respondents' connectivity category is less satisfied, with a satisfaction score of 3.06%, due to lack of information on access to the Station / Terminal, with an interest value of 3.33%. shown in the following Figure:

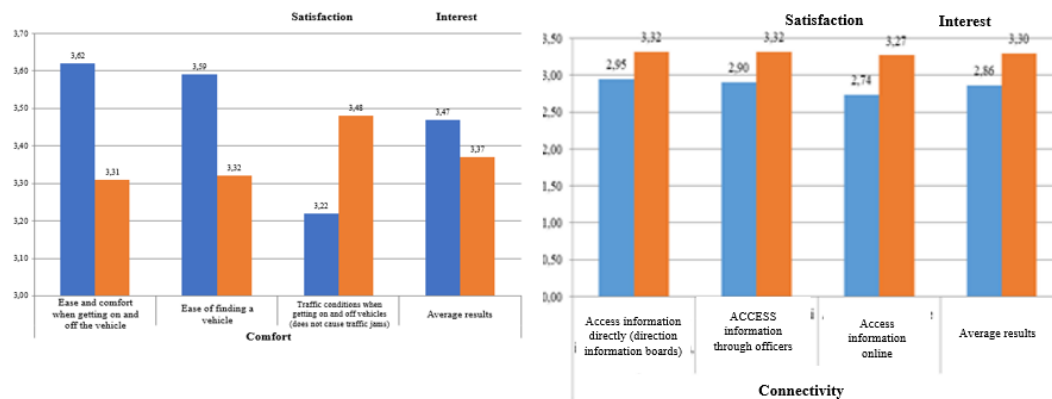


Figure 12. Satisfaction levels and special interests of public transport users (Source: Analysis results)

CONCLUSION

The level of satisfaction and importance, for facilities around Cibinong Terminal, are scored from the following categories: Comfort category, respondents are not satisfied, because there is no incline / descent (elevation in walking) to the station / terminal. And the interests of respondents assessed the lack of awareness of trees / plants to take shelter. Security categories, with the security of respondents being less satisfied such as the lack of security officers and security from criminal acts (theft and harassment) and what is important for security is the presence of CCTV, security duties and lack of lighting . Safety category, respondents are not satisfied with the lack of protection from traffic flow and emergency response to sudden health conditions (dizziness and injury) and the important thing is that there is a need for protection from traffic flow. In the category of supporting facilities, respondents are not satisfied with supporting facilities because of the lack of seating / reclining facilities, trash cans and crossing facilities such as zebra crossing, and the important ones need trash bins, public toilets, seats / reclines. Satisfaction Level and Special Interests of Taxi / Ojek / Delivered Users, which are assessed from the following categories: Comfort category, respondents are quite satisfied with the ease of getting on and off the vehicle, and what is important is the traffic condition when getting on / off the vehicle (does not cause traffic jams)). Satisfaction Level and Special Interest of Parking Area Users for motorized vehicles, which are assessed from the following categories: Comfort category, respondents are quite satisfied with the cleanliness of the parking area and the ease of finding a parking space, and what is important is the need for parking facilities (e.g.protected from the rain). Security category, respondents are not satisfied with the lack of information on access to stations/terminals (information boards), with the importance of increasing security from the risk of vehicle damage

and from criminal acts (theft). Connectivity category, respondents are not satisfied with the lack of information on access to stations / terminals (information board) with an important value there must be access information to the Station / Terminal (information board). Satisfaction Level and Special Interests of Public Transportation Users, which are scored from the following categories: Comfort category, respondents are quite satisfied with the ease of finding a vehicle and the value that is considered important is in traffic conditions when getting on and off the vehicle (does not cause traffic jams). In the connectivity category, respondents are not satisfied with direct access to information (information boards and directions) and what is important is that there must be access to information directly or through officers.

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