

## Analysis of Parking Needs at Sakura Mart Amurang

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### ABSTRACT

Sakura Mart is the largest shopping center in Amurang City, North Sulawesi, Indonesia. At Sakura Mart Amurang the parking facilities cannot accommodate parking needs. This analytical research aims to calculate the parking space requirements that must be provided for visitors when in the Sakura Mart Amurang parking area. The steps taken include calculating parking volume, parking accumulation, parking duration, parking capacity, parking availability, parking index, parking turnover rate, analysis of parking space requirements, and vehicle waiting time. The total shortage of parking space for two-wheeled vehicles is 92 spaces, while for four-wheeled vehicles 23 spaces must be provided with a total area of 516 m<sup>2</sup>. For the time being, to reduce existing parking capacity, a maximum vehicle waiting time of 11 minutes 30.6 seconds for two-wheeled vehicles and 19 minutes 0.015 seconds for four-wheeled vehicles is used. Waiting time limits in parking areas must be emphasized so that they can accommodate all vehicles that come to park their vehicles, then by providing rates and multiples of rates after the specified waiting time has passed, it can encourage vehicle owners not to linger in the parking lot. area. parking area. parking area. The arrangement of the parking area must be considered with a good and correct parking management system for the convenience of parking users at Sakura Mart Amurang

## **INTRODUCTION**

Sakura Mart Amurang is the biggest shopping place in Amurang. Sakura Mart Amurang is located, Buyungon Amurang, South Minahasa Regency, North Sulawesi Province, Indonesia. Sakura Mart is located at 1°11'00" North Latitude and 124°34'18" South Latitude. The area of the Sakura Mart Amurang building is 27,744 m<sup>3</sup> which is divided into 4 parts.

Parking is an inseparable component or aspect of transportation needs because transportation continues to develop over time. The use of transportation can be seen from various community activities, namely economic benefits, social benefits, political benefits, regional benefits, but behind all the benefits above it has a negative impact, where with the development of transportation, the amount of transportation increases, with the increase in the amount of transportation the will give rise to parking violators (Saputra et al., 2024).

Sakura Mart Amurang has a parking area that has been built since it was first built, but in reality the parking area provided is not able to accommodate all the vehicles visiting Sakura Mart Amurang. This causes congestion on the Trans Sulawesi road because visitors park their vehicles outside the parking area that has been provided, so a review is needed to calculate the need for parking units at Sakura Mart Amurang by analyzing data and calculating parking space requirements (Rarung et al., 2023).

Parking characteristics are basic characteristics that provide an assessment of parking services and parking problems that occur at the study location. Based on parking characteristics, parking conditions will be known at the study location such as including parking volume, parking accumulation, parking time, parking turnover rate, parking capacity, parking space provision and parking index (Abrori et al., 2024).

## **LITERATURE**

In the technical guidelines for the implementation of parking facilities, the Directorate General of Land Transportation (1996) states that parking is a condition where vehicles are not moving which is not temporary. According to Indonesians, parking can be defined as a place where vehicles stop for a certain time (Kemenhub, 1996).

In the land transportation system, parking facilities are the most important part, parking facilities are also the main support for certain activities, such as; offices, trade, and education. Hobbs (1995) stated that "the increase in vehicle owners affects the need for parking space".

Parking Based on Vehicle Placement:

1. On-street parking, namely parking facilities using the side of the road as the parking area/space.
2. Off-street parking, namely land that is specifically designated as a parking space and has an entrance service or exit service as a place to hand over or collect parking cards so that you can know the number of vehicles and the duration of the parked vehicles.

**Parking Based on Land Ownership Status**

1. Special Parking: namely parking using land managed by a party.
2. Emergency Parking: namely parking in public places that use local government or private land that occurs due to sudden/incidental activities.
3. Public Parking: namely a parking area using land controlled or managed by the Regional Government.
4. Parking Area, namely a complete parking area or building with the necessary parking facilities and its management is carried out by the Regional Government
5. Parking Building: namely a building used as a parking area, the management of which is carried out by the regional government or a third party that has obtained permission from the Regional Government.

**Parking Space Unit (SRP)**

The length and width of the parking lot at the activity center is determined based on the results of a study by the Directorate General of Land Transportation, permanent parking activities at supermarkets are as follows

Table 1. Permanent Parking Activities Supermarkets

Total Area (100 m <sup>2</sup> )	50	75	100	150	200	300	400	500	1000
Parking Space Unit Requirements (SRP)	225	250	270	310	350	440	520	600	1050

Source: Directorate General of Land Transportation, 1996

Table 2. Determination of Parking Space Units (SRP)

	Transportation type	Parking Space Unit (m <sup>2</sup> )
1	a. Class passenger car I	2,30 x 5,00
	b. Class passenger car II	2,50 x 5,00
	c. Class passenger car III	3,00 x 5,00
2	Bus/Truck	3,40 x 12,50
3	Motorcycle	0,75 x 2,00

Source: Directorate General of Land Transportation, 1996

a. Unit Size of Passenger Car Parking Space in Centimeters (cm)

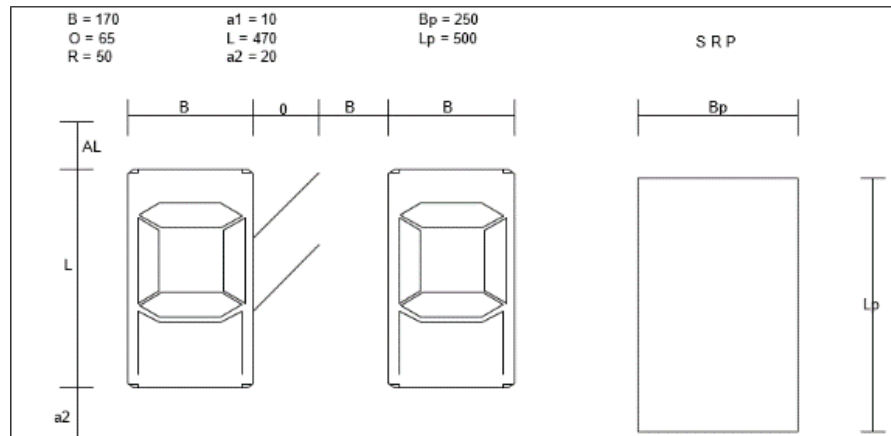


Figure 1. Unit size of Passenger Car Parking Space in centimeters (cm)  
 Source: Directorate General of Land Transportation, 1996

Information:

- $B$  = Total vehicle width
- $O$  = Open the door wide
- $L$  = Total length of vehicle
- $a1, a2$  = Longitudinal clearance
- $R$  = Lateral clearance

b. The size of the motorbike parking space (SRP)

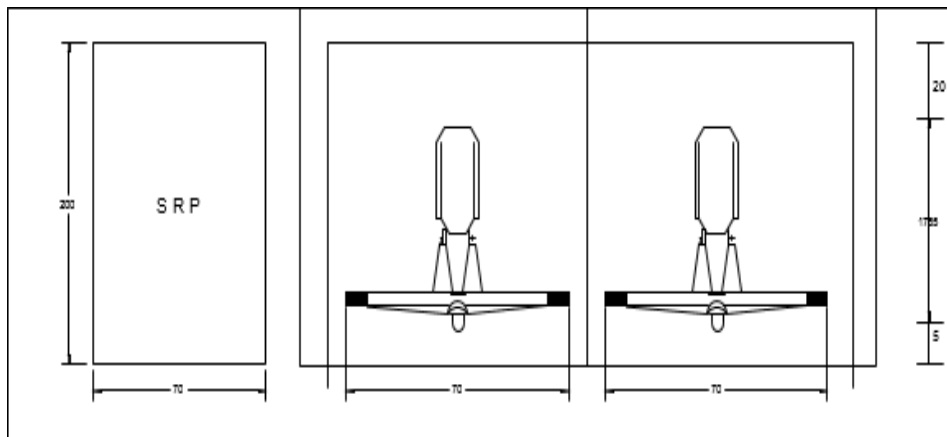


Figure 2. Motorcycle Parking Units in Centimeters (cm)  
 Source: Directorate General of Land Transportation, 1994

**METHOD**

The research method used is field observation. Take the required data, conduct surveys/calculate daily traffic at Sakura Mart, carry out data processing, analyze the data obtained. This data collection was carried out directly (quantitatively) with an observation period of 7 days from 09.00 to 21.00 or 12 hours. Similar research also collected this data (Irawan et al., 2021). The data collection location was at Sakura Mart Amurang. This research design uses a

method of analyzing parking space requirements by calculating all components of Volume, Accumulation, Duration, Capacity, Availability, Index, Turnover Rate, and finally obtaining Parking Space Requirements, from these results you can see and provide suggestions and input to the parties involved. need. management of Sakura Mart Amurang to be used as evaluation material for the existing parking area. The data required in the secondary data collection stage is data on the parking area of the Sakura Mart shopping center, a map of existing parking locations and the condition of the existing road network and then calculating the parking index, parking demand factor and level of parking space usage (Wahyudin, 2020).

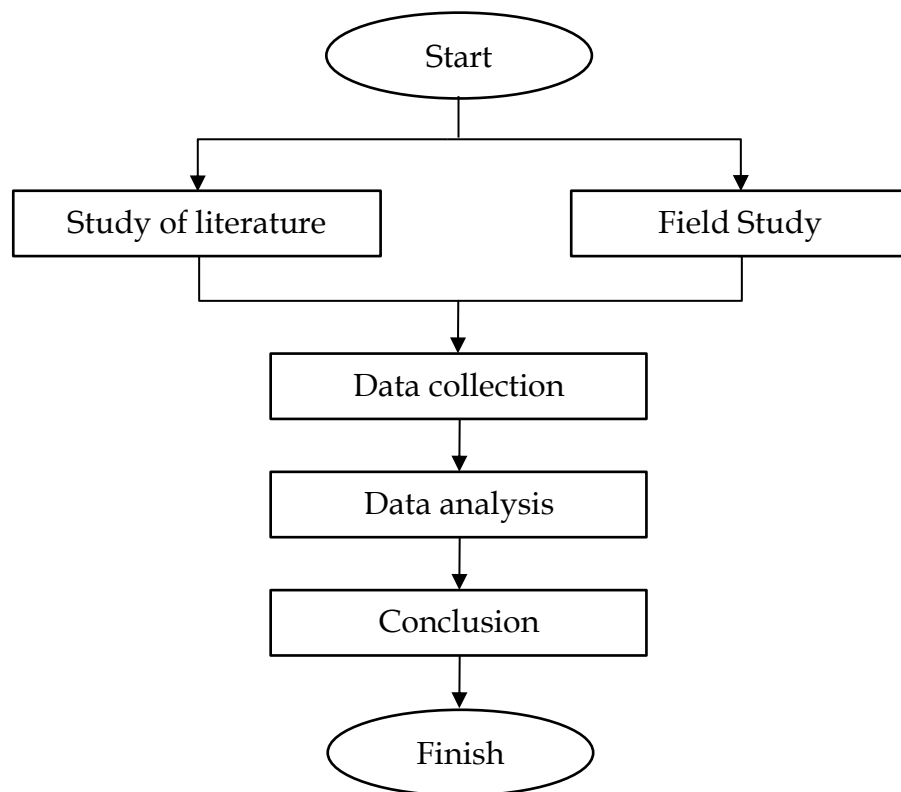


Figure 3. Research Flow Chart

## RESULT AND DISCUSSION

The data from subsequent observations at the study location were processed and analyzed according to the research problem formulation, which focused on the parking characteristics of vehicles at Sakura Mart Amurang. These characteristics include parking volume, parking accumulation, parking duration, parking capacity, parking index, and parking turnover rate (Hobbs, 1995). Here are the findings based on the field research:

1. Available Parking Area: The total available parking area at Sakura Mart Amurang is 645.835 square meters. This space is divided into 32 Parking Space Units for 2-wheeled vehicles and 11 Parking Space Units for 4-wheeled vehicles.

2. Vehicle Types: Only private vehicles of specific makes/models are allowed in the parking area. These include brands like Avanza, Xenia, Grandmax, and smaller vehicle types such as Ayla and Agya, which do not exceed a vehicle length of 5 meters.

### Parking Volume

Table 3. Maximum Volume of 2 Wheeled Vehicles

Day	Time (hour)			Maximum Volume (Vehicle)
Monday	09.00	-	21.00	1098
Tuesday	09.00	-	21.00	882
Wednesday	09.00	-	21.00	1064
Thursday	09.00	-	21.00	1125
Friday	09.00	-	21.00	1749
Saturday	09.00	-	21.00	2122
Sunday	09.00	-	21.00	314

Based on the table, the maximum parking volume for 2-wheeled vehicles occurs on Saturdays with a total of 2122 vehicles, while the minimum parking volume for 2-wheeled vehicles occurs on Sundays with a total of 314 vehicles.

Table 4. Maximum Volume of 4 Wheeled Vehicles

Day	Time (hour)			Maximum Volume (Vehicle)
Monday	09.00	-	21.00	146
Tuesday	09.00	-	21.00	192
Wednesday	09.00	-	21.00	166
Thursday	09.00	-	21.00	189
Friday	09.00	-	21.00	390
Saturday	09.00	-	21.00	573
Sunday	09.00	-	21.00	67

Based on the table, the maximum parking volume for 4-wheeled vehicles occurs on Saturdays with a total of 573 vehicles, while the minimum volume for 4-wheeled vehicles occurs on Sundays with 67 vehicles.

### Parking Accumulation

Table 5. Maximum Accumulation of 2 Wheeled Vehicles

Day	Time (hour)		Maximum Volume (Vehicle)
Monday	12.00	- 13.00	43
Tuesday	15.00	- 16.00	48
Wednesday	14.00	- 00.00	75
Thursday	17.00	- 18.00	71
Friday	18.00	- 19.00	47
Saturday	17.00	- 18.00	55
Sunday	17.00	- 18.00	40

The accumulation table data shows that the largest number of vehicles entering the parking lot occurred on Wednesday at 14.00-15.00 with 75 vehicles.

Table 6. Maximum Accumulation of 4 Wheeled Vehicles

Day	Time (hour)		Maximum Volume (Vehicle)
Monday	13.00	- 14.00	9
Tuesday	10.00	- 11.00	13
Wednesday	19.00	- 20.00	16
Thursday	13.00	- 14.00	18
Friday	15.00	- 16.00	18
Saturday	13.00	- 14.00	16
Sunday	13.00	- 14.00	7

The largest accumulation table for 4-wheeled vehicles entering the parking lot occurs on Thursdays and Fridays at 13.00 - 14.00 and 15.00 - 16.00 as many as 18 vehicles. Based on the calculation analysis of seven days of observation, the maximum accumulation for 2-wheeled vehicles occurred on Wednesday with 75 vehicles and 4-wheeled vehicles occurred on Thursday and Friday with 18 vehicles.

## Parking Duration

Table 7. 2-Wheeled Vehicle Parking Duration

Day	Number of vehicles	Length of Parking Time (Minute)	Average Parking Duration (Minute)
Monday	1069	309532.5	289.6
Tuesday	859	262057.5	305.1
Wednesday	1036	336705	325.0
Thursday	1097	375127.5	342.0
Friday	1721	555862.5	323.0
Saturday	2097	623722.5	297.4
Sunday	294	129540	440.6
<b>Average</b>	<b>1167.6</b>		<b>331.8</b>

Table 8. 4-Wheeled Vehicle Parking Duration

Day	Number of vehicles	Length of Parking Time (Minute)	Average Parking Duration (Minute)
Monday	140	43785	312.75
Tuesday	189	47887.5	253.37
Wednesday	161	57127.5	354.83
Thursday	184	57420	312.07
Friday	384	116175	302.54
Saturday	569	180727.5	317.62
Sunday	67	31252.5	466.46

The average parking duration for 2-wheeled vehicles and 4-wheeled vehicles is more than 5 hours. This shows that the majority of visitors to Sakura Mart Amurang have long-term needs. In field observations, visitor activities were dominated by workers selling at Sakura Mart stalls and shopping. These parking users occupy parking spaces for more than 5 hours.

## Parking Capacity

Table 9. 2-Wheeled Vehicle Parking Capacity at Sakura Mart Amurang

Day	Number of Plots (SRP)	Average Duration (Hours)	Capacity (Vehicle/Hours)
Monday	32	4.83	6.63
Tuesday	32	5.08	6.29
Wednesday	32	5.42	5.91
Thursday	32	5.70	5.61
Friday	32	5.38	5.94
Saturday	32	4.96	6.46
Sunday	32	7.34	4.36

From the table data for 2-wheeled vehicle parking plots at Sakura Mart Amurang, it can be seen that the existing parking availability is 32 plots, the average parking has an hourly capacity of 5.89 vehicles/hour or 6 vehicles/hour.

Table 10. 4-Wheeled Vehicle Parking Capacity at Sakura Mart Amurang

Day	Number of Plots (SRP)	Average Duration (Hours)	Capacity (Vehicle/Hours)
Monday	11	5.21	2.11
Tuesday	11	4.22	2.60
Wednesday	11	5.91	1.86
Thursday	11	5.20	2.11
Friday	11	5.04	2.18
Saturday	11	5.29	2.08
Sunday	11	7.77	1.41
<b>Average</b>		<b>05.52</b>	<b>2.05</b>

From the table it can be seen that at Sakura Mart Amurang there are 11 plots, the average parking capacity is 2.05 vehicles/hour or 3 vehicles/hour.

### Parking Supply

Parking supply is a situation where the number of SRP plots will be provided by the owner. From the research results, the results of parking availability from Sakura Mart Amurang are as follows:

Table 11. 2-Wheeler Parking Supply

Day	Number of Plots (SRP)	Average Duration (Hours)	Factor Insufficiency	Survey Time (Hours)	Parking Supply (Vehicle)
Monday	32	4.83	0.9	12	72
Tuesday	32	5.08	0.9	12	68
Wednesday	32	5.42	0.9	12	64
Thursday	32	5.70	0.9	12	61
Friday	32	5.38	0.9	12	64
Saturday	32	4.96	0.9	12	70
Sunday	32	7.34	0.9	12	47
<b>Average</b>		<b>5.53</b>			<b>64</b>

Table 12. 4-Wheeler Parking Supply

Day	Number of Plots (SRP)	Average Duration (Hours)	Factor Insufficiency	Survey Time (Hours)	Parking Supply (Vehicle)
Monday	11	5.21	0.9	12	23
Tuesday	11	4.22	0.9	12	28
Wednesday	11	5.91	0.9	12	20
Thursday	11	5.20	0.9	12	23
Friday	11	5.04	0.9	12	24
Saturday	11	5.29	0.9	12	22
Sunday	11	7.77	0.9	12	15
<b>Average</b>		<b>5.2</b>			<b>22</b>

Based on the above, in accordance with the results of data processing characteristics, it can be said that 2-wheelers with an average parking duration of 5.53 hours/car and the number of available parking lots is 32, so the average parking availability is 64 vehicles for 12 hours of observation. Meanwhile, for 4-wheeled vehicles, the average parking duration is 5.52 hours/vehicle and the number of parking lots available is 11, so the average parking availability is 22 vehicles during the 12 hours of observation. This shows that in these conditions the parking accumulation exceeds the existing vehicle parking capacity.

### Parking Index (IP)

Table 13. 2-Wheel Parking Index

Day	Maximum Accumulation	Number of Plots (SRP)	IP (%)
Monday	1098	32	3431.25
Tuesday	882	32	2756.25
Wednesday	1064	32	3325.00
Thursday	1125	32	3515.63
Friday	1749	32	5465.63
Saturday	2122	32	6631.25
Sunday	314	32	981.25

Table 14. 4-Wheel Parking Index

Day	Maximum Accumulation	Number of Plots (SRP)	IP (%)
Monday	9	11	81.82
Tuesday	13	11	118.18
Wednesday	16	11	145.45
Thursday	18	11	163.64
Friday	18	11	163.64
Saturday	16	11	145.45
Sunday	7	11	63.64

Based on the results of the calculation table, it was found that the highest parking index for 2-wheeled vehicles occurred on Saturdays at 6631.25% and for 4-wheeled vehicles occurred on Thursdays and Fridays at 163.64%. This is because parking at Sakura Mart Amurang is problematic, namely the parking index for 2 and 4-wheeled vehicles exceeds the capacity.

Table 15. 2-Wheel Parking Turnover Rate

Day	Number of vehicles	Number of Plots	Length of Parking Time (Hours)	Parking Turnover Rate
Monday	1069	32	12	2.78
Tuesday	859	32	12	2.24
Wednesday	1036	32	12	2.70
Thursday	1097	32	12	2.86
Friday	1721	32	12	4.48
Saturday	2097	32	12	5.46
Sunday	294	32	12	0.77

Table 16. 4-Wheel Parking Turnover Rate

Day	Number of vehicles	Number of Plots	Length of Parking Time (Hours)	Parking Turnover Rate
Monday	140	11	12	1.06
Tuesday	189	11	12	1.43
Wednesday	161	11	12	1.22
Thursday	184	11	12	1.39
Friday	384	11	12	2.91
Saturday	569	11	12	4.31
Sunday	67	11	12	0.51

From the two tables above, the parking turnover rate during the 7 days of observation was 3.04 vehicles/lot/hour for 2-wheeled vehicles and 1.83 vehicles/lot/hour for 4-wheeled vehicles. And the parking turnover rate for 2-wheeled vehicles occurs on Saturdays, namely 5.46 vehicles/lot/hour, while the highest parking turnover rate for 4-wheeled vehicles occurs on Saturdays, namely 4.31 vehicles/lot/hour. The conclusion is that the turnover rate for 2-wheeled vehicle parking is higher when compared to 4-wheeled vehicles, this is because visitors at Sakura Mart Amurang prefer to use 2-wheeled vehicles rather than 4-wheeled vehicles.

### Analysis of Parking Space Needs

Based on previous data, we can analyze the need for parking space that will be provided so that it can accommodate vehicles that will later enter the parking area so that SRP needs can be met properly.

Table 17. 2-Wheeled Vehicle Parking Requirements at Sakura Mart Amurang

Parking Space Requirement Parameters	Amount
Highest number of vehicles in 1 hour (Y)	269
Length of Observation Time (T)	12
Average Duration (D)	5.53
Required SRP ( $Z = Y \times D : T$ )	124
Available RSP	32
<b>SRP Requirement ( Z -SRP )</b>	<b>92</b>

Table 18. 4-Wheeled Vehicle Parking Requirements at Sakura Mart Amurang

Parking Space Requirement Parameters	Amount
Jumlah Kendaraan tertinggi dalam 1 jam (Y)	74
Length of Observation Time (T)	12
Average Duration (D)	5.52
Required SRP ( $Z = Y \times D : T$ )	34
Available RSP	11
<b>SRP Requirement ( Z -SRP )</b>	<b>23</b>

The need for parking space units for 2-wheeled vehicles is 92 parking space units, while the available parking space units are 32 parking space units, so the shortage of parking space units based on the analysis of parking space requirements is 60 parking space units. The need for parking space units for 4-wheeled vehicles is 23 parking space units, the available parking space is 11 parking space units, so the shortage of parking space units based on the analysis is 12 parking space units, thus it turns out that the parking space unit is at Sakura Mart Amurang still lacking and unable to fulfill the Parking Space Units that should be prepared for visitors who will come to Sakura Mart Amurang. To minimize the accumulation of vehicles outside the parking area, the researchers redesigned the parking time and area by maximizing the available land area and the number of vehicles entering and leaving the parking area.

### 1. Vehicle Waiting Time

Vehicle waiting time aims to fill the Parking Space Unit with the number of vehicles in a certain period (research time), so that vehicle waiting time can be seen and used as a benchmark for the parking process at Sakura Mart Amurang so that there is no accumulation of vehicles outside the existing parking area.

$$\frac{T}{Y / (SRP \times H)}$$

- T = Time/Minute Division
- Y = Average total number of vehicles
- SRP = Available Parking Space Units
- H = Number of research days

- Waiting time for 2-wheeled vehicles

- T = 60 minute
- Y = 1167,7
- SRP = 32
- H = 7

$$\frac{60}{1167,7 / (32 \times 7)} = 11,51 \text{ minute}$$

converted to 11 minutes 30.6 seconds

- Waiting time for 4-wheeled vehicles

- T = 60 minute
- Y = 242
- SRP = 11
- H = 7

$$\frac{60}{242 / (11 \times 7)} = 19,09 \text{ minute}$$

converted to 19 Minutes 0.015 seconds

From the results above, it can be seen that the waiting time for vehicles so that there is no accumulation outside the provided parking area, each 2-wheeled vehicle must park its vehicle for 11 minutes 30.6 seconds and 4-wheeled vehicles for 19 minutes 0.015 seconds.

### 2. Land area for additional parking space at Sakura Mart Amurang

Based on the analysis of Sakura Mart Amurang's parking needs, it can be seen that the available parking space units are insufficient to accommodate vehicles, namely  $180 \text{ m}^2 \times 336 \text{ m}^2 = 516 \text{ m}^2$ .

### 3. Parking Design

This researcher will only carry out a design according to the currently available land area. Based on the results of the analysis of combining parameters, it can be seen that the parking space requirements at Sakura Mart Amurang currently do not meet the requirements for Parking Space Unit requirements, so a redesign needs to be carried out with the design limitation only maximizing parking space. which are available. To provide safe and comfortable parking space, it is necessary to pay attention to the size of the parking space for 2-wheeled vehicles, which is 75 cm x 200 cm, namely 75 cm wide and 200 cm long with a maneuvering lane of 400 cm. The parking pattern for 2-wheeled vehicles is a parking pattern at an angle of 90°, and the size of the parking space for 4-wheeled vehicles is 250 cm x 500 cm, namely 250 cm wide and 500 cm long. The parking pattern for 4-wheeled vehicles is a parking pattern at a 90° angle, (Kemenhub, 1996).

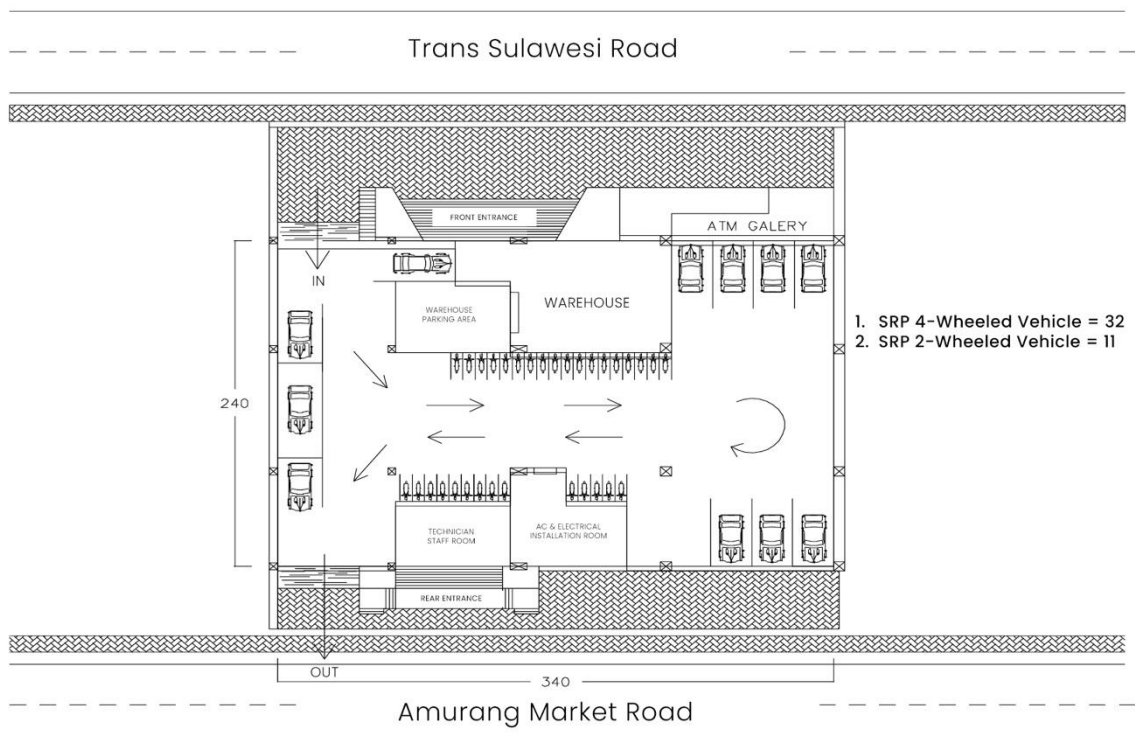


Figure 4. Existing Sakura Mart Parking

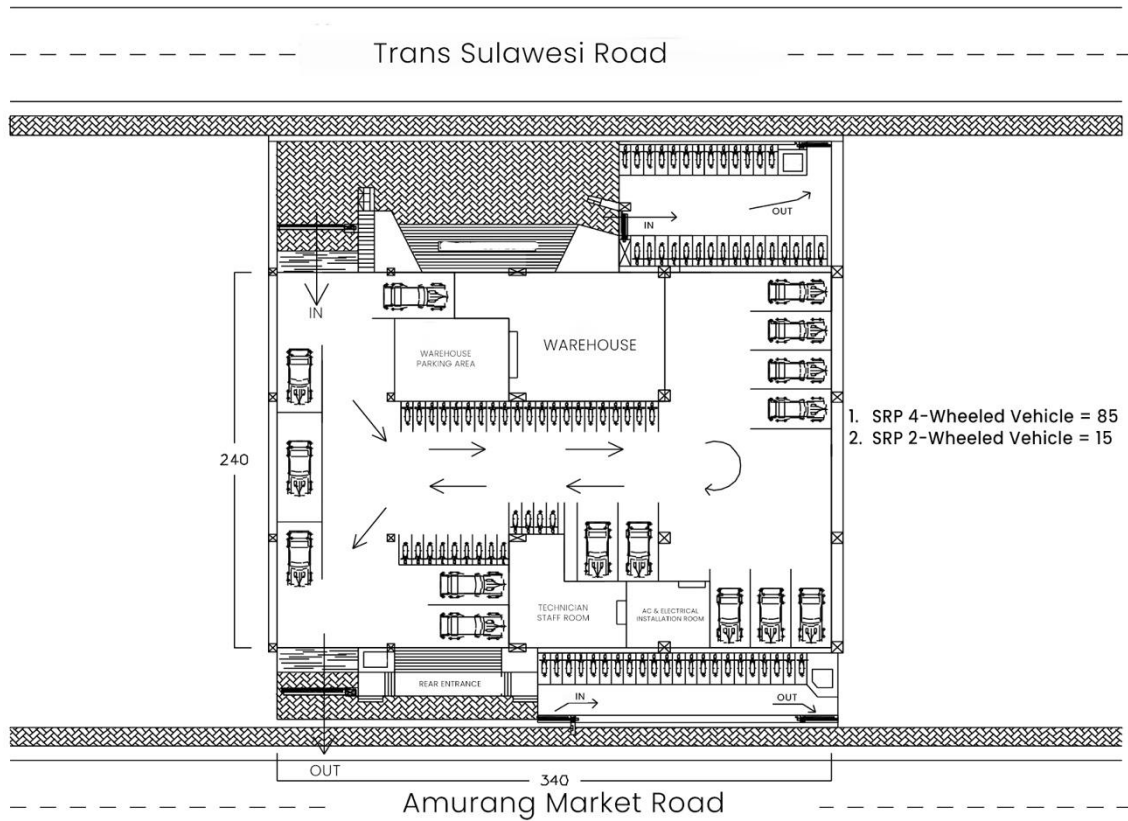


Figure 5. Redesign Sakura Mart Parking

After being redesigned by maximizing the available land area, it can be seen that the motorbike parking space units, which were previously only 32 parking space units, have now become 85 parking space units, while the car parking space units, which were previously 11, are now 15 parking space units. With Thus the remaining Parking Space Units for motorbikes that must be provided are  $92 - 85 = 7$  Parking Space Units and the remaining Parking Space Units for cars that must be provided are  $23 - 15 = 8$  Parking Space Units. For the remaining Parking Space Units, seeing that the design results maximize the existing land area, it turns out that it still cannot meet the needs of the Parking Space Units, so it will be continued for further research considering the limitations of the problems in the writing. Judging from the results of the redesign for the Parking Space Unit, it turns out that it does not meet existing needs, namely 92 Motorcycle Parking Space Units and 23 Car Parking Space Units, so it is possible to reduce the number of parked vehicles by limiting parking time using parking distribution costs so that each multiple is 0.9 hours or 45 minutes, the parking fee increases, in this way visitors will no longer park their vehicles for too long in the existing parking area so that the turnover of vehicles entering and leaving will be sufficient.

## CONCLUSION

Based on the results of the analysis and discussion, conclusions can be drawn:

1. On Saturday, in the parking area of Sakura Mart Amurang, there was a noteworthy maximum parking accumulation. For 2-wheeled vehicles, a total of 269 vehicles occupied the parking space between 12:00 - 13:00 WITA and 13:00 - 14:00 WITA. Meanwhile, for 4-wheeled vehicles, there were 74 vehicles utilizing the parking area during the 10:00 - 11:00 WITA time slot.
2. The average parking duration for visitors to Sakura Mart Amurang for 2-wheeled vehicles take more than 5 hours and the same goes for vehicles 4 wheels which is more than 5 hours. The Sakura Mart Amurang parking space cannot accommodate vehicles with a parking capacity for 2-wheeled vehicles of 269 vehicles/hour and 4-wheeled vehicles of 74 vehicles/hour and efficient waiting times along with good parking patterns to maximize the available parking space considering the conditions in the field in a matter of time wait that's there then It's best to avoid accumulation in the area outside the parking lot every 2-wheeled vehicle only parks its vehicle for a while 11 minutes 30.6 seconds and 4-wheeled vehicles for 19 minutes 0.015 second.
3. By referring to usage standards and needs, as well as the conditions of the Sakura Mart Amurang parking space, the suitable parking design is to park at a 90° angle and the required parking space for 2 wheels is 39 and 19 for 4 wheels.

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