Analysis of Parking Space Requirements at Pedurungan Market, Semarang City

Elrisa Cika Setyoningrum[1*], Ikhwanudin[2], Agung Kristiawan[3].

Faculty of Engineering and Informatics, Universitas PGRI Semarang, Jl. Sidodadi-Timur No.24 Semarang, Central Java 50232, Indonesia

elrisa.cikas@gmail.com

Abstract. Pedurungan Market is a traditional market in Semarang City that attracts a large number of visitors daily. The high volume of visitors results in an imbalance between available parking spaces and the number of vehicles. This study aims to analyze parking space requirements and propose an optimal parking layout. A quantitative approach was used, with direct surveys conducted over three weeks, specifically on Fridays, Saturdays, and Sundays from 07:00 to 15:00. The analysis includes parking volume, accumulation, parking duration, turnover, parking index, and space requirements, referring to the standards of the Directorate General of Land Transportation. The results showed a shortage of 65 motorcycle SRPs, 9 car SRPs, and 4 truck SRPs during peak hours. The proposed parking layout includes an island pattern with 90° angle parking for motorcycles and 90° angle parking for cars and trucks to optimize space utilization.

Keywords: Parking pattern, parking demand, traditional market, Semarang, parking management.

1. INTRODUCTION

One of the main transportation issues in traditional market areas is the inefficient management of parking spaces. Many vehicles park haphazardly due to the absence of a clear and efficient parking pattern. At Pedurungan Market, vehicles often park in a disorganized manner without regard for direction or parking boundaries, making it difficult for other vehicles to enter or exit. Therefore, planning an efficient and standardized parking layout is an urgent need to support smooth trading activities.

2. RESEARCH METHOD

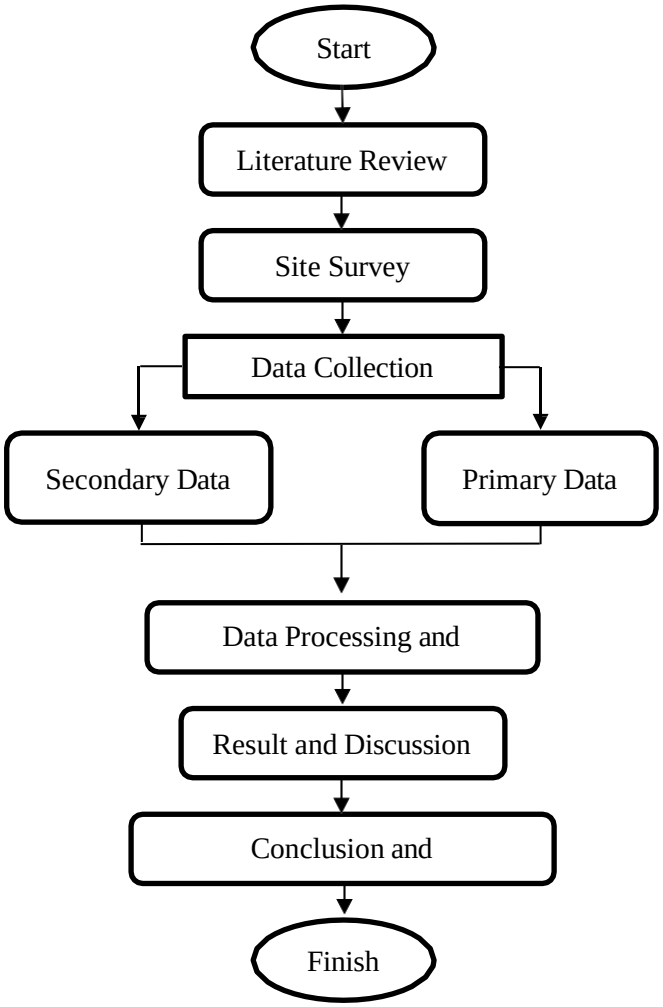
2.1 Reaseacrh Approach

This study employs a quantitative research approach. Data were collected through direct field observations using parking survey techniques, such as recording the number of incoming and outgoing vehicles, types of vehicles, and parking duration. Through this approach, the research results are expected to provide a clear picture of the parking demand level in the study area and offer recommendations for more effective and efficient parking planning.

2.2 Research Location and Time

This research was conducted at Pedurungan Market, located on Fatmawati Street, Pedurungan Kidul, Pedurungan District, Semarang City, Central Java. The research was carried out over a period of three weeks on Fridays, Saturdays, and Sundays from 07:00 AM to 03:00 PM, in order to obtain an overview of parking demand on both regular weekdays and weekends.

2.3 Research Flow



3. RESULT AND DISCUSSION

3.1 General Overview

Market in Semarang City is one of the busiest traditional markets in the eastern part of Semarang. This market serves as a center of daily trading activities involving small vendors, buyers, and informal workers. Therefore, the management of market facilities, including parking spaces, must be optimized to support the convenience and smoothness of community activities. The research was conducted in the designated parking areas at Pedurungan Market, Semarang City, with a motorcycle parking area of 520 m², a car parking area of 37.5 m², and a truck parking area of 126 m².

3.2 Survey Data Collection

a. Primary Data

Primary data refers to data collected directly by the researcher from the original source through various methods such as interviews and observations. This data is gathered firsthand in the field for specific research purposes and has not been previously published or used by other parties

Table 3.1 Parking Vehicle Count Data

No	Day	Motorcycle		Car		Truck	
1	07.00-08.00	385	307	42	23	15	7
2	08.00-09.00	393	351	35	31	20	13
3	09.00-10.00	368	322	35	29	13	15
4	10.00-11.00	334	291	27	30	9	5
5	11.00-12.00	291	258	20	23	8	7
6	12.00-13.00	242	208	12	18	9	7
7	13.00-14.00	166	154	7	10	0	6
8	14.00-15.00	123	130	7	9	0	8
Total		**2302**	**2021**	**185**	**173**	**74**	**68**

Source : Analysis Results, 2025

b. Secondary Data

Secondary data refers to information that has been previously collected and already exists. This data is obtained from sources or other parties and is not the result of direct collection by the researcher. It includes maps and site plans, the number of vendors, and visitors.

Table 3.2 Secondary Data

No	Data	Quantity
1	Vendors	582
2	Kiosks	108
3	Stalls	496
4	Motorcycle Parking Space	± 350 SRP
5	Car Parking Space	± 3 SRP
6	Truck Parking Space	± 4 SRP

Source : Analysis Results, 2025

3.3 Analysis of Parking Characteristics

a. Parking Volume

Parking volume analysis is used to determine the number of vehicles that arrive and utilize the parking facilities during the observation period, which can be used to calculate parking space requirements. Parking volume data is obtained by recording the number of vehicles entering the parking area during the 8-hour observation period, from 07:00 AM to 03:00 PM, and is analyzed by grouping the data into 1-hour time intervals.

Parking Volume Formula :

1) Motorcycle Volume $= Ei + X$
$= 283 + 2.302$

= 2.585

2) Car Volume = *Ei + X*
= 26 + 185
= 211

3) Truck Volume = *Ei + X*
=10 + 84
= 94

Table 3.3 Motorcycle Parking Volume

No	Day		Number of Vehicles	Volume
1	Week 1	Friday	237	265
		Saturday	249	281
		Sunday	272	308
2	Week 2	Friday	291	328
		Saturday	266	295
		Sunday	296	330
3	Week 3	Friday	210	235
		Saturday	221	250
		Sunday	260	293

Source : Analysis Results, 2025

Based on the survey results, the total parking volume during the observation period was 2,585 motorcycles. The highest number of motorcycles was recorded on Sunday, June 1, 2025, with 296 motorcycles, and the highest parking volume reached 330 motorcycles. Meanwhile, the lowest number was recorded on Friday, June 13, 2025, with 210 motorcycles, and the lowest parking volume was 235 motorcycles.

Tabel 3.4 Car Parking Volume

No	Day		Number of Vehicles	Volume
1	Week 1	Friday	16	19
		Saturday	18	21
		Sunday	25	29
2	Week 2	Friday	26	30
		Saturday	24	27
		Sunday	28	32
3	Week 3	Friday	11	12
		Saturday	15	17
		Sunday	22	24

Source : Analysis Results, 2025

Based on the survey results, the total parking volume during the observation period was 211 cars. The highest number of cars was recorded on Sunday, June 1, 2025, with 28 cars, and the highest parking volume reached 32 cars. Meanwhile, the lowest number was recorded on Friday, June 13, 2025, with 11 cars, and the lowest parking volume was 12 cars.

Tabel 3.5 Truck Parking Volume

No	Day		Number of Vehicles	Volume
1		Friday	9	10

	Week 1	Saturday	9	11
		Sunday	7	9
2	Week 2	Friday	9	10
		Saturday	9	10
		Sunday	8	9
3	Week 3	Friday	8	8
		Saturday	8	8
		Sunday	7	9

Source : Analysis Results, 2025

Based on the survey results, the total parking volume during the observation period was 84 trucks. The highest number of trucks was recorded on Saturday, May 24, 2025, with 9 trucks, and the highest parking volume reached 11 trucks. Meanwhile, the lowest number of trucks was recorded on Sunday, June 15, 2025, with 7 trucks, and the lowest parking volume was 9 trucks.

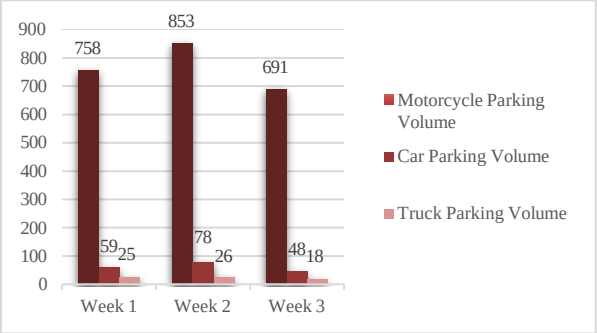


Figure 3.1 Parking Volume Graph

Based on the graph above, it can be seen that the highest motorcycle parking volume was recorded in Week 2 with 853 motorcycles, followed by Week 1 with 758 motorcycles, and the lowest in Week 3 with 691 motorcycles. The highest car parking volume occurred in Week 2 with 78 cars, and the lowest in Week 3 with 48 cars. Meanwhile, truck parking volume remained low and relatively stable each week, with a slight increase in Week 2 reaching 26 trucks.

b. Parking Accumulation

Parking accumulation analysis is conducted by recording the number of vehicles parked at each 1-hour time interval. This analysis aims to determine the peak parking occupancy time and the extent to which parking capacity is utilized.

1) *AP* Motorcycle $= X + Ei - Ex$
$= 283 + 2.302 - 2.021$
$= 564$

2) *AP* Car $= X + Ei - Ex$
$= 26 + 185 - 173$
$= 38$

3) *AP* Truck $= X + Ei - Ex$
$= 10 + 84 - 68$
$= 26$

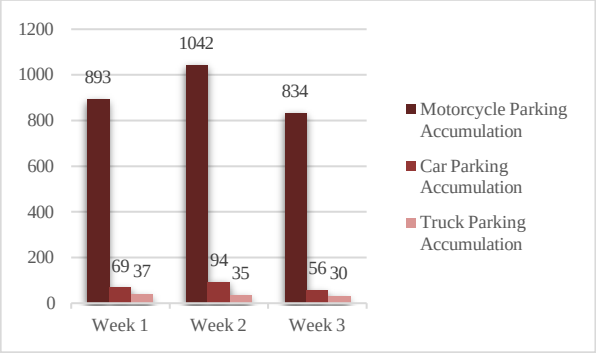


Figure 3.2 Parking Accumulation Graph

Based on the graph above, it shows that motorcycles have the highest parking accumulation each week, with the highest number recorded in Week 2 at 1,042 motorcycles and the lowest in Week 3 at 834 motorcycles. The highest car parking accumulation occurred in Week 2 with 94 cars, while the lowest was in Week 3 with 56 cars. Trucks showed the lowest and most stable accumulation, with the highest number in Week 1 at 37 trucks and the lowest in Week 3 at 30 trucks.

c. Parking Index

In parking space demand analysis, the parking index is used to assess whether the parking capacity is sufficient, and serves as a basis for formulating more effective parking management policies. The parking index value is expressed as a percentage (%) and is calculated by comparing the number of vehicles and parking capacity to the available parking space. According to secondary data, the SRP (Standard Parking Space) value is approximately ± 350 for motorcycles, ± 3 for cars, and ± 4 for trucks.

1) IP Motorcycle $= \frac{JKP}{JPP} \times 100\%$
$= \frac{369}{350} \times 100\%$
$= 1{,}05\ \%$

2) IP Car $= \frac{JKP}{JPP} \times 100\%$
$= \frac{32}{3} \times 100\%$
$= 10{,}67\ \%$

3) IP Truck $= \frac{JKP}{JPP} \times 100\%$
$= \frac{14}{4} \times 100\%$
$= 3{,}50\%$

Table 3.6 Motorcycle Parking Index

No	Day		Motorcycle		
			AP	JPP	IP (%)
1	Week 1	Friday	278	350	0,79
		Saturday	299		0,85
		Sunday	316		0,90
2	Week 2	Friday	369	350	1,05
		Saturday	308		0,88
		Sunday	365		1,04
3	Week 3	Friday	240	350	0,69
		Saturday	279		0,80
		Sunday	315		0,90

Source : Analysis Results, 2025

Based on the calculation above, the highest motorcycle parking index at Pedurungan Market, Semarang City, occurred on Friday, May 30, 2025, with a value of 1.05%. The lowest motorcycle parking index was recorded on Friday, June 13, 2025, with a value of 0.69%.

Table 3.7 Car Parking Index

No	Day		Car		
			AP	JPP	IP (%)
1	Week 1	Friday	19	3	6,33
		Saturday	21		7,00
		Sunday	29		9,67
2	Week 2	Friday	31	3	10,33
		Saturday	31		10,33
		Sunday	32		10,67
3	Week 3	Friday	15	3	5,00
		Saturday	17		5,67
		Sunday	24		8,00

Source : Analysis Results, 2025

Based on the calculation above, the highest car parking index at Pedurungan Market, Semarang City, occurred on Sunday, June 1, 2025, with a value of 10.67%. The lowest car parking index was recorded on Friday, June 13, 2025, with a value of 5.00%.

Table 3.8 Truck Parking Index

No	Day		Truck		
			AP	JPP	IP (%)
1	Week 1	Friday	11	4	2,75
		Saturday	14		3,50
		Sunday	12		3,00
2	Week 2	Friday	12	4	3,00
		Saturday	11		2,75
		Sunday	12		3,00
3	Week 3	Friday	9	4	2,25
		Saturday	9		2,25
		Sunday	12		3,00

Source : Analysis Results, 2025

Based on the calculation above, the highest truck parking index at Pedurungan Market, Semarang City, occurred on Saturday, May 24, 2025, with a value of 3.50%. The lowest truck parking index was recorded on Friday, June 13, 2025, with a value of 2.25%.

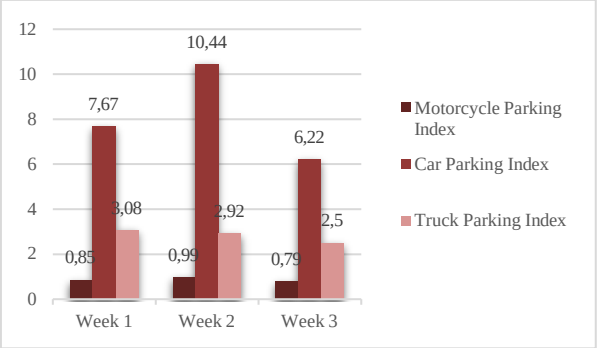


Figure3.3 Parking Index Graph

Based on the graph above, the motorcycle parking index is the highest, with the highest average value recorded in Week 2 at 0.99%, indicating a relatively high utilization of motorcycle parking spaces. The highest car parking index was also recorded in Week 2 with an average value of 10.44%, which then decreased in Week 3 to an average of 6.22%. Meanwhile, the truck parking index remained relatively stable, with an average value of 3.08% in Week 1 and a slight decrease to 2.5% in Week 3.

3.4 Analysis of Parking Space and Pattern

a. Parking Space Requirement Analysis

Parking space requirement analysis is a process of identifying, measuring, and providing the number of parking spaces needed at a location based on analytical data.

1) *FI* Motorcycle $= \frac{AP}{VPH}$ *x 100%*
$= \frac{59}{330}$ x 100%
= 17,88%

KRP = *F1 x F2 x VPH*
= 20,39% x 1,1 x 330
= 65 SRP

2) *FI* Car $= \frac{AP}{VPH}$ *x 100%*
$= \frac{8}{32}$ x 100%
= 25,00%

KRP = *F1 x F2 x VPH*
= 25,00% x 1,1 x 32
= 9 SRP

3) *FI* Truk $= \frac{AP}{VPH}$ *x 100%*
$= \frac{4}{10}$ x 100%
= 40,00%

KRP = *F1 x F2 x VPH*
= 40,00% x 1,1 x 10
= 4 SRP

Table 3.9 Motorcycle Parking Space Requirement

No	Day	Motorcycle				
		AP Max	VPH	F(2)	F(1)	KRP

1	Week 1					
	Friday	49	265	1,1	18,49%	54
	Saturday	50	281	1,1	17,79%	55
	Sunday	55	308	1,1	17,86%	61
2	Week 2					
	Friday	55	328	1,1	16,77%	61
	Saturday	51	295	1,1	17,29%	56
	Sunday	59	330	1,1	17,88%	65
3	Week 3					
	Friday	39	235	1,1	16,60%	43
	Saturday	45	250	1,1	18,00%	50
	Sunday	51	239	1,1	17,41%	56

Source : Analysis Results, 2025

Based on the calculation results in the table above, the highest motorcycle parking space requirement was on Week 2, Sunday, June 1, 2025, with a total of 65 SRP.

Table 3.10 Car Parking Space Requirement

No	Day	Car				
		AP Max	**VPH**	**F(2)**	**F(1)**	**KRP**
1	Week 1					
	Friday	4	19	1,1	21,05%	4
	Saturday	4	21	1,1	19,05%	4
	Sunday	6	29	1,1	20,69%	7
2	Week 2					
	Friday	8	30	1,1	26,67%	9
	Saturday	7	27	1,1	25,93%	8
	Sunday	8	32	1,1	25,00%	9
3	Week 3					
	Friday	4	12	1,1	33,33%	4
	Saturday	5	17	1,1	29,41%	6
	Sunday	5	24	1,1	20,83%	6

Source : Analysis Results, 2025

Based on the calculation results in the table above, the highest car parking space requirement was on Week 2, Friday, May 30, 2025, with a total of 9 SRP.

Table 3.11 Truck Parking Space Requirement

No	Day	Truk				
		AP Max	**VPH**	**F(2)**	**F(1)**	**KRP**
1	Week 1					
	Friday	3	10	1,1	30,00%	3
	Saturday	3	11	1,1	27,27%	3
	Sunday	3	9	1,1	33,33%	3
2	Week 2					
	Friday	4	10	1,1	40,00%	4
	Saturday	3	10	1,1	30,00%	3
	Sunday	3	9	1,1	33,33%	3
3	Week 3					
	Friday	4	8	1,1	50,00%	4
	Saturday	4	8	1,1	50,00%	4

	Sunday	2	9	1,1	22,22%	2

Source : Analysis Results, 2025

Based on the calculation results in the table above, the highest truck parking space requirement was on Week 3, Friday, with a total of 4 SRP.

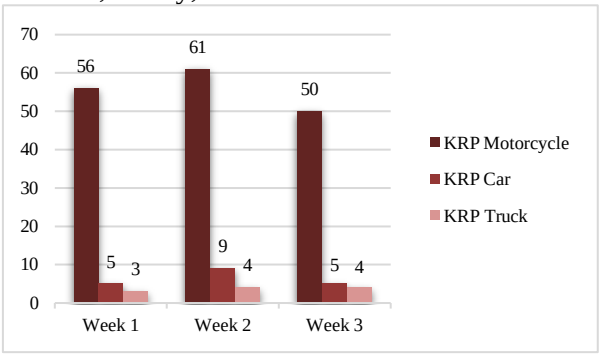


Figure 3.4 Parking Space Requirement Graph

The summary of the analysis results shows that motorcycles had the highest parking space requirement in Week 2 with 65 SRP, and the lowest in Week 3 with 43 SRP. Cars had the highest parking space requirement in Week 2 with 9 SRP, and the lowest with 4 SRP. Meanwhile, trucks had the highest average parking space requirement in Week 2 with 4 SRP, and the lowest with 2 SRP. Compared to the available capacity at Pedurungan Market, Semarang City — approximately 350 SRP for motorcycles, 3 SRP for cars, and 4 SRP for trucks — the number of parked vehicles exceeds the available capacity. Therefore, it can be concluded that the existing parking capacity is insufficient.

b. Eksisting Layout

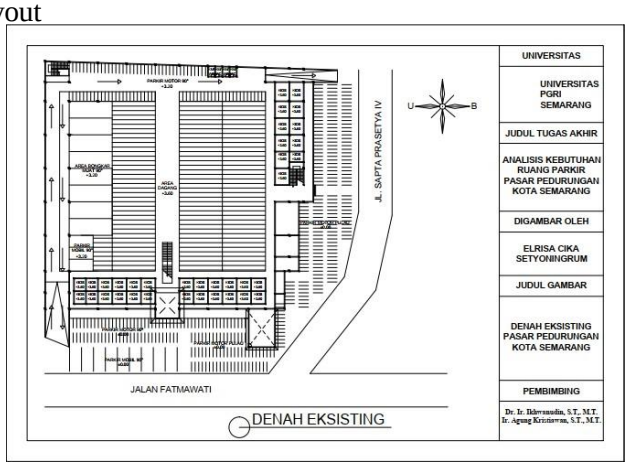


Figure 3.5 Eksisting Site Plan of the Parking Area at Pedurungan Market

Based on the survey results, it was observed that parking management and supervision have not been carried out professionally, resulting in vehicle congestion, especially between 08:00 AM and 11:00 AM. Given this existing condition, it can be concluded that although the parking area is still sufficient in terms of size, the parking pattern and management system are not optimal, making it unable to accommodate vehicle volume efficiently.

c. Parking Pattern Analysis

A parking pattern refers to the arrangement of vehicles within a parking area, aiming to optimize space usage, facilitate vehicle maneuvering, and maintain smooth traffic flow in and out of the area. Based on the analysis, the required parking capacity is approximately 415 SRP for motorcycles, 12 SRP for cars, and 8 SRP for trucks. In this study, a parking pattern analysis was conducted for the Pedurungan Market parking area based on vehicle type.

1) Motorcycle Parking Pattern – First Floor

The motorcycle parking area on the first floor uses an island pattern and a 90˚ double-sided angle pattern with a central circulation aisle.

2) Motorcycle Parking Pattern – Second Floor
   For the second-floor motorcycle parking area, a 90˚ single-sided angle pattern is applied.
3) Car and Truck Parking Pattern
   For car and truck parking, a 90˚ single-sided angle pattern is used.

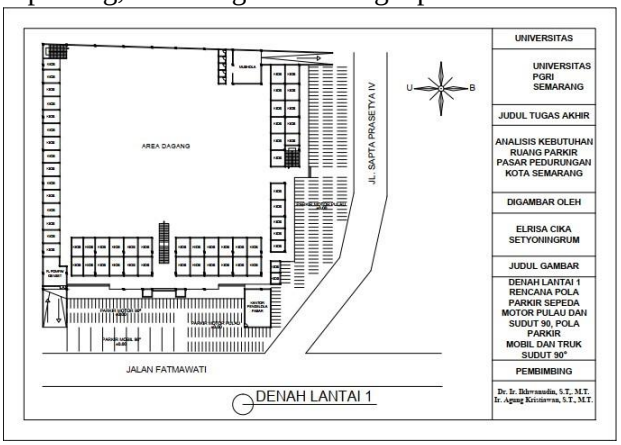


Figure 3.6 Proposed Parking Pattern Layout of the First Floor

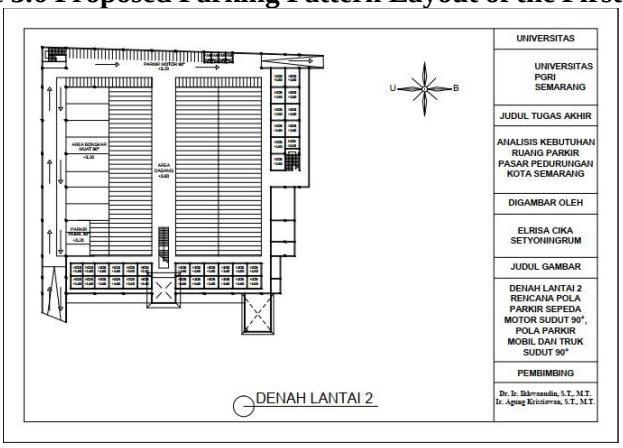


Figure 3.7 Proposed Parking Pattern Layout of the Second Floor

3.5 Discussion

The results of the study show that the parking space demand at Pedurungan Market in Semarang City is influenced by the high volume of vehicles, especially during peak hours and holidays. Based on the surveys conducted over three weeks (every Friday to Sunday from 07:00 AM to 03:00 PM), the total parking volume was recorded at 2,585 motorcycles, 211 cars, and 94 trucks. These figures indicate a high level of vehicle mobility accessing the market, including visitors, vendors, and goods distribution vehicles.

It is known that the motorcycle parking area covers 520 m², the car parking area covers 37.5 m², and the truck parking area covers 126 m². Based on calculations of parking space requirements considering accumulation, fluctuation, and daily parking volume factors, it is evident that the available space is not optimally sufficient. The high parking index during peak hours indicates that the existing capacity is often exceeded, resulting in many vehicles being forced to park outside the designated area, including on the roadside.

4. CONCLUSION/SUMMARY

Optimal parking facility planning requires a reorganization of the parking pattern by maximizing the use of available land. The recommended parking patterns are:

a. **Motorcycles on the first floor** should use an island pattern and a 90˚ double-sided angle pattern to increase capacity.
b. **Motorcycles on the second floor** should use a 90˚ single-sided angle pattern to facilitate easier maneuvering and maintain smooth circulation.
c. **Cars and trucks** should use a 90˚ single-sided angle pattern to ensure more efficient use of space.

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