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Characteristics and Parking Needs of the Informatics and Environmental Engineering Building, State Polytechnic of Cilacap

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ABSTRACT

The rapid growth in student enrollment at Indonesian vocational higher education institutions has created substantial challenges for campus infrastructure, particularly parking facilities. The Informatics and Environmental Engineering Building (GTIL) at the State Polytechnic of Cilacap, which accommodates seven academic programs, experienced a 154% increase in student enrollment, from 678 students in 2022 to 1,723 in 2025, while its designated parking capacity remained unchanged at 407 motorcycle spaces and 12 automobile spaces. This study aimed to analyze parking characteristics and determine parking space requirements at GTIL following the expansion of its student population. A quantitative descriptive research approach was employed, with data collected through field observations conducted on Mondays and Fridays between 7:00 a.m. and 5:00 p.m. Western Indonesian Time (WIB). The analysis included parking volume, parking accumulation, parking turnover, parking index, vehicle headway, and parking space requirements. The findings indicated that motorcycle parking demand exceeded the designated capacity during peak periods, with the highest parking index reaching 3.01 on December 12, 2025, and peak parking accumulation reaching 491 motorcycles on December 15, 2025. The latter corresponded to an estimated parking space requirement of 736.5 m², exceeding the available motorcycle parking area of 610.5 m². In contrast, automobile parking demand was comparatively lower, although the maximum reported parking index of 1.43 indicated that demand exceeded the designated automobile parking capacity during certain periods. Nevertheless, the estimated automobile parking area requirement remained within the available 138 m². The study concluded that GTIL experienced an imbalance between motorcycle and automobile parking demand, with motorcycle parking presenting the more substantial capacity challenge. These findings highlighted the need for targeted parking management interventions, including optimizing parking layouts, improving space allocation, and expanding motorcycle parking capacity where necessary, rather than implementing uniform parking facility expansion.

INTRODUCTION

The Informatics and Environmental Engineering Building (GTIL) at the State Polytechnic of Cilacap accommodates academic activities for seven study programs: the Diploma III Program in Informatics Engineering; the Applied Bachelor's Programs in Software Engineering Technology, Multimedia Engineering Technology, Cybersecurity Engineering, Agroindustrial Product Development, Environmental Pollution Control Engineering, and Industrial Chemical Engineering Technology. As the building accommodates the largest number of study programs within the institution, it serves as a major center of academic activities and generates substantial demand for supporting facilities, particularly parking infrastructure (Andayani, 2023; Andry & Zulkifli, 2023; Hani, 2015; Housing, 2018; Krisdiyanto, 2021).

Student enrollment in the study programs housed at GTIL increased from 678 students in 2022 to 1,723 in 2025 (PDDikti, 2025), representing an increase of approximately 154% over three years. However, the designated parking capacity remained unchanged at 407 motorcycle parking spaces and 12 automobile parking spaces, measured in parking space units (satuan ruang parkir, SRP). The increase in student enrollment during the 2025–2026 academic year was expected to intensify parking demand and potentially alter parking characteristics, particularly following the beginning of the academic year in August 2025. These conditions highlighted the need for a systematic assessment of parking characteristics, capacity adequacy, and space requirements at GTIL (Government Regulation of the Republic of Indonesia No. 43 of 1993 Concerning Road Infrastructure and Traffic, 1993; Kurniawan & Sriharyani, 2018; Muharani, 2018; PDDikti, 2025; Rizki, 2025).

Previous studies on parking characteristics have established methodological approaches using indicators such as parking accumulation, turnover, parking index, and vehicle headway to evaluate parking demand and capacity adequacy in various Indonesian settings (Gumilang et al., 2024; Indrashwara et al., 2025; Irjayanti & Wibisono, 2024; Mawardin et al., 2022). Research conducted at Rejowinangun Market in Magelang reported an automobile parking index of 115%, indicating that observed demand exceeded the available capacity. Similarly, a study at the Vocational Faculty of Universitas Negeri Surabaya reported that 62.7% of respondents considered the available parking capacity inadequate, while 85.3% expressed concerns regarding parking security facilities. International research has also investigated parking demand and supply at university campuses, parking optimization, travel behavior, and transportation mode choice among academic populations. However, differences in transportation characteristics and vehicle ownership patterns across institutional and geographical contexts highlight the importance of examining parking conditions in environments where motorcycles constitute a substantial proportion of campus transportation (Alansyah & Susanti, 2025; Rusdianingrum et al., 2026; Sholikhin & Mudjanarko, 2017; Suarmawati, 2021; Suzanti, 2024; Yusuf & Hardjati, 2023).

A research gap was identified in the limited examination of parking demand associated with rapid enrollment growth at vocational higher education institutions, particularly polytechnics in secondary Indonesian cities. Existing studies have investigated parking characteristics at markets, transportation facilities, and university campuses, but the relationship between enrollment expansion and parking demand in polytechnic environments requires further investigation. Academic schedules involving laboratory sessions, practical activities, and multiple study programs may influence vehicle arrival patterns, parking duration, and peak accumulation. Furthermore, the substantial difference between motorcycle and automobile parking capacities at GTIL, comprising 407 motorcycle spaces and 12 automobile spaces, highlighted the need for vehicle-specific assessments of parking adequacy and circulation requirements.

The urgency of this study was reflected in the parking conditions observed at GTIL following the increase in student enrollment. Preliminary observations indicated that motorcycle parking accumulation reached 491 vehicles on December 15, 2025, corresponding to an estimated parking space requirement of 736.5 m², compared with an available area of 610.5 m². Meanwhile, the maximum automobile parking index reached 1.43, indicating that automobile parking demand exceeded its designated capacity during at least one observation period, although the spatial requirements and utilization patterns differed from those of motorcycles. Reported parking turnover values ranged from 0.004 to 0.383 for motorcycles and from 0.025 to 0.175 for automobiles. These findings highlighted the importance of evaluating parking demand, accumulation patterns, parking duration, and available space before determining appropriate infrastructure improvements. A comprehensive assessment was therefore necessary to distinguish between capacity limitations and potential inefficiencies in parking space allocation and management.

The novelty of this study lay in its integrated assessment of parking volume, accumulation, turnover, parking index, vehicle headway, and spatial requirements within a polytechnic building experiencing substantial student enrollment growth. The analysis focused on parking conditions following the expansion of the student population, providing an institutional context for interpreting observed parking demand. Unlike studies examining parking characteristics without explicitly considering changes in institutional enrollment, this research incorporated enrollment growth as contextual information in evaluating parking capacity and utilization. Furthermore, the inclusion of seven study programs within a single building provided an opportunity to assess aggregated parking demand in a multidisciplinary vocational education environment, where variations in academic schedules could influence vehicle arrival and departure patterns.

This study aimed to analyze parking characteristics and determine parking space requirements at the Informatics and Environmental Engineering Building of the State Polytechnic of Cilacap following the increase in student enrollment. A quantitative descriptive approach was employed, incorporating problem identification, literature review, field observations, and systematic analysis of parking data. The assessment included vehicle arrival and departure patterns, parking accumulation, parking turnover, parking indices, and space requirements for motorcycles and automobiles. The resulting analysis was intended to provide an empirical basis for evaluating existing parking conditions and identifying appropriate parking management strategies.

The study was expected to contribute to both transportation planning research and institutional infrastructure management. Academically, it provided a contextual application of established parking performance indicators in a vocational higher education environment characterized by substantial motorcycle use and rapid enrollment growth. Practically, the findings could support institutional decisions concerning parking layout optimization, improved allocation of existing spaces, parking access management, and potential capacity expansion. The analysis also offered insights relevant to other educational institutions experiencing similar pressures on parking infrastructure.

The primary objective of this study was to evaluate the adequacy of existing parking facilities by comparing observed parking demand with available capacity and calculating parking accumulation, turnover, parking indices, and spatial requirements for motorcycles and automobiles at GTIL. Through these measurements, the study sought to identify parking capacity constraints and provide evidence-based recommendations for facility management and infrastructure planning. The findings were intended to assist the State Polytechnic of Cilacap in prioritizing parking improvements, allocating infrastructure resources efficiently, and supporting the mobility needs of its growing academic community.

METHOD

Data Collection

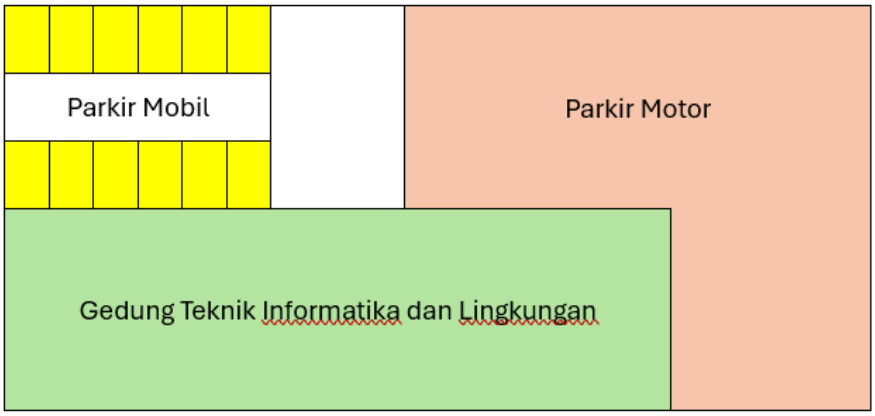
This study employed a quantitative descriptive approach to analyze parking characteristics and determine parking space requirements. Data were collected through direct field observations, including an inventory of available motorcycle and automobile parking spaces, vehicle arrival and departure times, parking duration, and vehicle accumulation during peak periods. Observations were conducted on Mondays and Fridays from 7:00 a.m. to 5:00 p.m. Western Indonesian Time (WIB) to capture variations in parking patterns across weekdays. The collected data were subsequently processed and analyzed to evaluate parking characteristics, capacity adequacy, and parking space requirements.

Data Analysis

Data analysis was carried out to obtain the parking index according to the type of vehicle, followed by SRP analysis to determine the need for parking spaces according to the type of vehicle

RESULTS AND DISCUSSION

Vehicle parking in the Informatics and Environmental Engineering Building can be categorized as off street parking or parking outside the road body which is on the front side of the building with separate car and motorcycle parking locations. Car parking in the Informatics and Environmental Engineering Building uses a two-sided parking pattern with a parking position of 900 while for motorcycles. Using an island parking pattern with a parking position of 900.



Parking Volume

The parking volume is obtained from the observation results during the observation period shown in table 2 below.

Table 2. Motorcycle and Car Parking Volume

Day	Vehicle Type	
	Engine	Cars
Monday, December 1, 2025	1311	9
Friday, December 5, 2025	774	13
Monday, December 8, 2025	1258	17
Friday, December 12, 2025	913	21

Monday, December 15, 2025	1557	17
Friday, 19 December 2025	1034	19
Monday, December 22, 2025	782	15
Friday, December 26, 2025	17	3
Monday, December 29, 2025	121	10

Parking Accumulation

GTIL parking accumulation shows the number of parked vehicles in a certain period of time obtained, adding up parked vehicles minus outgoing vehicles and plus inbound vehicles to be able to obtain the maximum number of parking vehicles in a certain period. Based on data obtained during the observation period in table 3, it shows that the highest car parking accumulation occurred on December 12 with a total of 10 vehicles, while the highest motorcycle parking accumulation occurred on December 15, 2025 with a total of 491 vehicles.

Table 3. Parking Accumulation

Day	Engine		Mobile	
	Peak Time	Vehicle Accumulation	Peak Time	Vehicle Accumulation
Monday, December 1, 2025	10.00-11.00	289	09.00-10.00	5
Friday, December 5, 2025	09.00-10.00	196	08.00-09.00	7
Monday, December 8, 2025	10.00 - 11.00	276	09.00-10.00	7
Friday, December 12, 2025	09.00-10.00	173	15.00-16.00	10
Monday, December 15, 2025	09.00-10.00	491	10.00-11.00	6
Friday, 19 December 2025	08.00-09.00	259	08.00-09.00	8
Monday, December 22, 2025	10.00-11.00	184	08.00-09.00	7
Friday, December 26, 2025	08.00-09.00	5	08.00-09.00	1
Monday, December 29, 2025	09.00-10.00	67	15.00-16.00	4

Parking Changes

The parking turnover rate reflects the use of parking space obtained based on the parking volume with the number of parking spaces during a given period of time expressed in vehicle units/SRP/Hours. The parking turnover rate in the Informatics and Environmental Engineering Building is shown in the following table 4.

Table 4. Turnover Rate

No	Date	Car Volume	Volume Motor	Car Change Rate	Motor Turnover Rate
1.	Monday, December 1, 2025	9	1311	0,075	0,322
2.	Friday, December 5, 2025	13	774	0,108	0,190
3.	Monday, December 8, 2025	17	1258	0,142	0,309
4.	Friday, December 12, 2025	21	913	0,175	0,224
5.	Monday, December 15, 2025	17	1557	0,142	0,383
6.	Friday, 19 December 2025	19	1034	0,158	0,254
7.	Monday, December 22, 2025	15	782	0,125	0,192
8.	Friday, December 26, 2025	3	17	0,025	0,004
9.	Monday, December 29, 2025	10	121	0,083	0,030

Parking Index

The parking index shows the ratio between the accumulation of parked vehicles and the available parking capacity. If the IP>1 value is obtained, it shows that the capacity/number of parking spaces is less than the parking needs, if the IP<1 value indicates the need for parking is below the capacity/number of parking spaces, while the value of IP=1 indicates the balance between needs and capacity. Based on the calculation of the parking index obtained in table 5, it shows that the value of the car parking index is highest at 1.43 while the value of the motorcycle parking index is at 3.01 so that it can be interpreted that the parking needs and cars in the Informatics and Environmental Engineering Building have exceeded the capacity.

Table 5. Parking index

No	Date	Car Volume	Volume Motor	Motorcycle Parking Index	Car Parking Index
1.	Monday, December 1, 2025	289	5	1,48	1,37
2.	Friday, December 5, 2025	196	7	2,21	0,97
3.	Monday, December 8, 2025	276	7	2,39	1,32
4.	Friday, December 12, 2025	173	10	3,01	0,73
5.	Monday, December 15, 2025	491	6	1,32	1,43
6.	Friday, 19 December 2025	259	8	0,89	0,58
7.	Monday, December 22, 2025	184	7	0,39	0,23
8.	Friday, December 26, 2025	5	1	0,03	0,00
9.	Monday, December 29, 2025	67	4	0,18	0,07

Headway Parkir

Headway refers to the distance of arrival time between vehicles. The calculation of the parking headway of the Informatics and Environmental Engineering Building is based on data obtained during observation with a time interval of every 60 minutes as shown in table 6 for the parking headway of motor vehicles with the calculation results showing that the parking headway of motor vehicles is a minimum of 0.05 minutes/vehicle while the headway of parking of a motor vehicle is a minimum of 0.02 minutes/vehicle as shown in table 7 below.

Table 6. Motor Vehicle Parking Headway

No	Date	Time	Incoming Vehicle	Vehicle headway (Minutes/Vehicle)
1.	Monday, December 1, 2025	10.00-11.00	59	0,98
2.	Friday, December 5, 2025	08.00-09.00	46	0,77
3.	Monday, December 8, 2025	09.00 -10.00	61	1,02
4.	Friday, December 12, 2025	08.00-09.00	43	0,72
5.	Monday, December 15, 2025	09.00-10.00	95	1,58
6.	Friday, 19 December 2025	08.00-09.00	57	0,95
7.	Monday, December 22, 2025	08.00-09.00	44	0,73
8.	Friday, December 26, 2025	08.00-09.00	3	0,05
9.	Monday, December 29, 2025	09.00-10.00	17	0,28

Table 7. Car Parking Headway

No	Date	Time	Incoming Vehicle	Vehicle headway (Minutes/Vehicle)
1.	Monday, December 1, 2025	08.00-09.00	2	0,03
2.	Friday, December 5, 2025	08.00-09.00	3	0,05
3.	Monday, December 8, 2025	08.00-09.00	4	0,07
4.	Friday, December 12, 2025	15.00-16.00	7	0,12
5.	Monday, December 15, 2025	09.00-10.00	3	0,05
6.	Friday, 19 December 2025	08.00-09.00	5	0,08
7.	Monday, December 22, 2025	08.00-09.00	3	0,05
8.	Friday, December 26, 2025	08.00-09.00	1	0,02
9.	Monday, December 29, 2025	15.00-16.00	3	0,05

Parking Space Requirements

The need for parking space is obtained from the result of multiplying the accumulation of vehicles multiplied by the SRP obtained based on the type of vehicle for the next time compared to the Availability of Parking Space. The availability of motorcycle parking space for the Informatics and Environmental Engineering Building is 610.5 m2 or equivalent to 407 SRP so that the parking needs on Monday, December 15, 2025 of 736.5 m2 or equivalent to 491 SRP are not met, even though the need for motorcycle parking on other days can still be met with the existing availability as shown in table 8. The availability of car parking space for the Informatics and Environmental Engineering Building of 138 m2 or equivalent to 12 SRPs is able to meet the needs of parking space during the observation period with the highest parking space requirement occurring on Friday, December 12, 2025 in the amount of 115 m2 as shown in table 9 below.

Table 8. Motorcycle Parking Space Requirements

No	Date	Motor Vehicle Accumulation	SRP	Availability of Parking Space (m2)	Parking Space Requirements (m2)	Remarks
1.	Monday, December 1, 2025	289	0,75 x 2,00	610,5	433,5	Enough
2.	Friday, December 5, 2025	196	0,75 x 2,00	610,5	294	Enough
3.	Monday, December 8, 2025	276	0,75 x 2,00	610,5	414	Enough
4.	Friday, December 12, 2025	173	0,75 x 2,00	610,5	259,5	Enough
5.	Monday, December 15, 2025	491	0,75 x 2,00	610,5	736,5	Less
6.	Friday, 19 December 2025	259	0,75 x 2,00	610,5	388,5	Enough
7.	Monday, December 22, 2025	184	0,75 x 2,00	610,5	276	Enough
8.	Friday, December 26, 2025	5	0,75 x 2,00	610,5	7,5	Enough
9.	Monday, December 29, 2025	67	0,75 x 2,00	610,5	100,5	Enough

Table 9. Car Parking Space Requirements

No	Date	Car Vehicle Accumulation	SRP	Availability of Parking Space (m2)	Parking Space Requirements (m2)	Remarks
1.	Monday, December 1, 2025	5	2,30 x 5,00	138	57,5	Enough
2.	Friday, December 5, 2025	7	2,30 x 5,00	138	80,5	Enough
3.	Monday, December 8, 2025	7	2,30 x 5,00	138	80,5	Enough
4.	Friday, December 12, 2025	10	2,30 x 5,00	138	115	Enough
5.	Monday, December 15, 2025	6	2,30 x 5,00	138	69	Enough
6.	Friday, 19 December 2025	8	2,30 x 5,00	138	92	Enough
7.	Monday, December 22, 2025	7	2,30 x 5,00	138	80,5	Enough
8.	Friday, December 26, 2025	1	2.30 x 5.00	138	11,5	Enough
9.	Monday, December 29, 2025	4	2.30 x 5.00	138	46	Enough

CONCLUSION

Based on the analysis of parking characteristics at the Informatics and Environmental Engineering Building (GTIL) of the State Polytechnic of Cilacap, the findings indicated that existing motorcycle parking facilities were insufficient to accommodate peak demand following a 154% increase in student enrollment between 2022 and 2025, without a corresponding expansion of parking infrastructure. The maximum reported motorcycle parking index reached 3.01 on December 12, 2025, although this value requires verification against the reported accumulation of 173 motorcycles and the designated capacity of 407 spaces. Peak motorcycle parking accumulation reached 491 vehicles on December 15, 2025, corresponding to an estimated parking space requirement of 736.5 m², exceeding the available area of 610.5 m². In contrast, automobile parking exhibited different utilization characteristics, with a maximum parking index of 1.43 and an estimated maximum spatial requirement of 115 m², compared with an available area of 138 m². Although the reported automobile parking area was sufficient to accommodate the estimated spatial requirement, the maximum parking index indicated that demand exceeded the designated number of automobile parking spaces during at least one observation period. Parking turnover values ranged from 0.004 to 0.383 for motorcycles and from 0.025 to 0.175 for automobiles, while minimum recorded vehicle headways were 0.05 minutes for motorcycles and 0.02 minutes for automobiles. These findings highlighted differences in parking demand and utilization between vehicle types, although additional analysis of parking duration and arrival patterns would be necessary to determine the underlying causes of congestion and capacity constraints. Overall, the study demonstrated the need for targeted parking management strategies, particularly the optimization of motorcycle parking layouts, improved space allocation, and capacity expansion where necessary, rather than uniform expansion of all parking facilities.

Future research should extend the observation period to cover an entire academic semester, including midterm and final examination periods, to capture temporal variations in parking demand that may not have been fully represented during the nine-day observation period. Subsequent studies should also incorporate parking user surveys and transportation

mode-choice analyses to investigate factors influencing motorcycle use and assess potential demand management strategies, including staggered class schedules, campus shuttle services, and incentives for alternative transportation modes. Comparative investigations involving other buildings at the State Polytechnic of Cilacap and similar polytechnic institutions in Central Java would provide additional evidence regarding the generalizability of the observed parking characteristics. Furthermore, future research could employ traffic and parking simulation models to evaluate proposed interventions, including optimized motorcycle parking layouts, designated parking zones, multilevel parking facilities, and real-time parking availability systems. Such analyses would support evidence-based infrastructure planning and help determine the operational feasibility and cost-effectiveness of alternative parking management strategies before substantial investments were undertaken.

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CONFLICT OF INTEREST

The author states that there are no conflicts of interest, whether personal, commercial, or financial, that can affect the implementation and results of this study.

AUTHOR CONTRIBUTIONS

Muhamad Sofi Ardani contributes to research design, data collection and processing, system development, result analysis, and article manuscript preparation.

GENERATIVE AI STATEMENT

In the process of compiling this article, the author uses generative artificial intelligence (AI) as a tool in language refinement, writing structure, and grammar improvement. The use of AI is carried out on a limited basis and remains under the supervision of the author. All data, analysis, interpretation, and scientific substance in this article have been checked and verified by the author. The author is solely responsible for the accuracy, authenticity, and final content of the manuscript.

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