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CAR PARKING NEEDS ANALYSIS AT CAMPUS A JAKARTA STATE UNIVERSITY IN THE CONSTRUCTION PERIOD

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ABSTRACT

The increase in the number of UNJ students every year certainly causes an increase in the need for parking, especially on Campus A UNJ as the main campus. Coupled with a construction project in Campus A UNJ, the car parking area is getting narrower. Based on these problems, it is necessary to research parking arrangements at Campus A UNJ. This study aims to determine the need for parking and arrange the car parking area for Campus A UNJ according to the demand for car parking space that existed during the construction period. Primary data was obtained by conducting a field survey using the number plate survey method and PSU calculation survey while secondary data was obtained from UNJ parking inventory data. The results showed that the value of the need for car parking in 2023 was 367 PSU cars, while the number of parking lots available at Campus A UNJ was 389 PSU. The peak day occurs on Tuesday and the peak hour for parking accumulation occurs at 13.00-14.00 WIB. With a parking index close to 100%, this can make it difficult for drivers to find an empty parking space, especially considering the pattern of car parking in the UNJ campus A parking area rotates in one direction so that the opportunity to find an empty parking space during peak parking hours only has a one-time or one-time chance. The arrangement of car parking modeling will also be presented in this article.

Keywords: *Car Parking, Parking Needs, Parking Characteristics, Parking Arrangement.*

1. INTRODUCTION

The area of parking on campus has been challenged in recent days. One reason for this challenge is the increase in the number of traffic activity on the campus[1], both motorcycles and car passengers. Another reason is the behavior and activities of parking users on campus increasing rapidly[2]. Several articles have been published to review, evaluate, and analyze the parking area on the global campus: MIT College[3], SSCET Campus [1], The University of Mosul[4], University of Wisconsin Milwaukee (UWM)[5], and Eastern Mediterranean University[6]. This article will analyze the characteristics of car parking in Jakarta State University (UNJ) which is located in the center of Indonesia's capital city, Jakarta.

Jakarta State University (UNJ) is one of the public universities located in East Province of Jakarta. The campus consists of four locations including Campus A Rawamangun, Campus B Pemuda, Campus D Halimun, and Campus E Setiabudi. UNJ Campus A is the main campus of the State University of Jakarta located on Jalan Rawamangun Muka, Rawamangun Village, Pulogadung District, East Jakarta Province where the majority of lecture activities take place[7].

UNJ Campus A is the main destination for students and staff traveling within the campus, the majority of whom are private vehicle users. To park these private vehicles, sufficient parking space would be required[8] [8]. But in fact, the parking demand that arises exceeds the available parking capacity so the parking pattern becomes irregular and disrupts the smooth flow of surrounding traffic, and pedestrian rights are obstructed, especially on peak days and hours of the lecture period. The current condition of

parking management in UNJ is still manually managed by security despite several parking areas in Jakarta already utilizing e-parking for managing the parking area[9][10][11][12] .

This is exacerbated by The Development and Upgrading of The State University of Jakarta (Phase-2) program that is being carried out by UNJ, especially in Campus A. Until 2024, this second phase of development will at least build 4 buildings consisting of 10 floors which will be used for learning classrooms, laboratories, studios, workshops, management rooms, meeting rooms, performance rooms, and supporting facilities[13]. To support this development, several existing parking lots, especially for four-wheeled vehicles, were displaced. The area of car parking lots, which was already small, is getting smaller, causing inconvenience to private vehicle users who have difficulty parking their vehicles. This study aims to determine the amount of demand for four-wheeled vehicle parking needs that arise on Campus A UNJ and model parking spaces on Campus A State University of Jakarta (UNJ) to meet the demand for parking needs that exist in the construction period. The reason for choosing four-wheeled vehicles is because, during the construction period, four-wheeled vehicle parking has the greatest negative impact in the form of reduced parking space compared to two-wheeled vehicles. Two-wheeled vehicles, both before construction and during the construction period were not significantly affected because the parking lot was still available in the parking lot behind the Faculty of Engineering UNJ and the UNJ Spiral Parking Building. Meanwhile, the parking lot for four-wheeled vehicles is affected by the construction at UNJ Campus A.



Figure 1. Construction Site of Tower A, B, C, D and Character Building at UNJ Campus A

2. LITERATURE REVIEW

a. Parking definition

According to the Indonesian dictionary, parking is defined as a place to store. According to the Decision of The Director General Of Land Transportation Indonesia Number: 272/HK.105/DRJD/96[14] concerning Technical Guidelines For Organizing Parking Facilities parking is a temporary state of inactivity of a vehicle.

Things that must be considered in determining the placement of a parking location, including[15] :

1. The parking location should not be too far from the destination because it will provide a sense of insecurity or other circumstances that make them feel unsafe.
2. The distance from the parking lot to the destination is generally closely related to the purpose of the trip and the length of parking time.
3. The location and size of parking lots should always be related to the ability of the surrounding road system to provide safe and efficient ingress and egress.

b. Parking type

Below are some of the types of parking that exist:

1. Parking by placement: on-street parking and off-street parking.
2. Parking by status: public parking, reserved parking, emergency parking, parking lots, and parking structures.
3. Parking by purpose: passenger parking and goods parking
4. Parking by type of ownership and operation: local government-owned parking, private-public parking, and public-private parking collaboration

c. Parking space unit

A Parking Space Unit (PSU) is a measure of the effective area for placing a vehicle (passenger car, bus/truck, or motorcycle), including free space and door opening width [14]. To measure parking demand, PSU is used, which consists of three types of vehicles, including passenger cars, buses/trucks, and motorcycles.

3. RESEARCH METHODOLOGY

This research uses descriptive quantitative methods and is conducted based on a direct survey system at the location using the license plate survey method, spot checker survey, and parking space unit (PSU) calculation survey. In this method, researchers can find out the number of vehicles entering and leaving the parking area in the Campus A area of the State University of Jakarta (UNJ) through several surveyors who will count the number of vehicles at the three gates of Campus A UNJ, namely the Pustikom Gate, the Open Theater Gate (Terbuk) and the Postgraduate Gate. Figure 3 is a flow chart of this research.

a. Place and Time of Research

This research was conducted at Campus A of the State University of Jakarta, Jalan Rawamangun Muka, East Jakarta. The license plate survey and spot checker survey were conducted on active lecture days for 5 days, namely on May 29-31, 2023, and June 8-9, 2023. While the PSU calculation survey was conducted on August 16, 2023. After obtaining the data, data analysis, and discussion were carried out.

b. Population and Sampling

The population in this study is four-wheeled motorized vehicles owned by students, staff/faculty, and visitors at Campus A, State University of Jakarta. However, this study does not take into account online taxi cars, bajajs (a three-wheeled motor vehicle), and other cars that enter and exit the parking lot in less than 15 minutes because it is considered that the car is not parked.



Figure 2. UNJ Campus A on-street parking condition

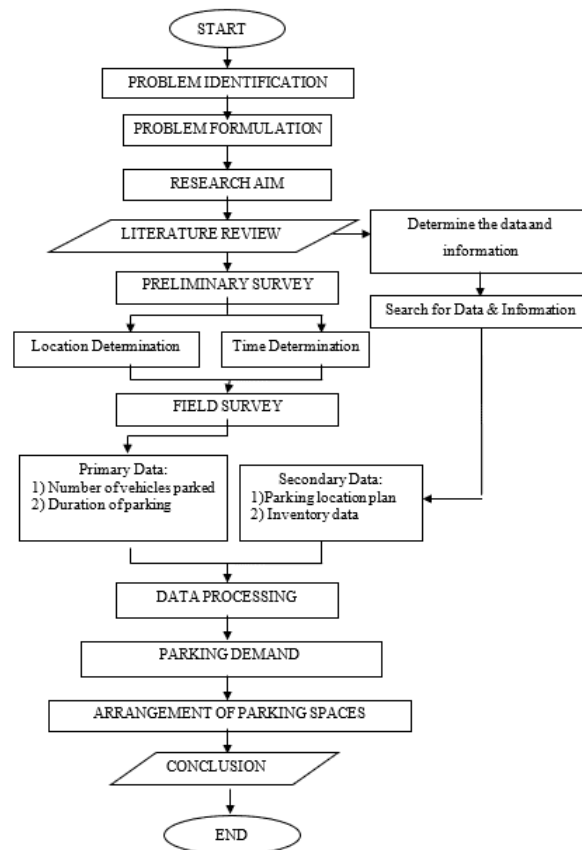


Figure 3. Research Methodology

c. Research Data

This research requires primary data and secondary data. Primary data is obtained from the results of the four-wheeled vehicle license plate survey, spot checker survey, and PSU (parking space unit) calculation survey conducted directly in the UNJ campus A parking area. While secondary data collection is looking for supporting data including:

- a. Landscape plan of campus A of Jakarta State University (UNJ).
- b. Number of students, lecturers, and employees of UNJ
- c. Parking inventory data was obtained from the Inventory survey in the parking area of campus A UNJ.
- d. Data on construction works related to the reduction of UNJ parking area

d. Data Processing Stage

The existing data was analyzed in the following stages:

1. Parking accumulation is calculated based on a 60-minute time interval that counts the number of incoming vehicles and outgoing vehicles.
2. The result of the parking duration of each vehicle is obtained by reducing the vehicle exit time with the vehicle entry time.
3. The daily parking volume is obtained by summing the incoming vehicles for one day.
4. From the results of the above analysis, parking characteristics (accumulation, volume, turnover, parking index, parking duration), and parking space capacity in the UNJ Campus A parking area can be determined.

4. ANALYSIS AND RESULT

a. Character Analysis of Car Parking Campus A UNJ

Based on the results of the license plate survey that was conducted on Monday - Friday (May 29 - June 9, 2023) on parking at campus A of the Jakarta State University (UNJ), the results obtained in the form of the number of car vehicles as follows:

Table 1. Recapitulation of the number of parking vehicles on campus A UNJ during the survey

| Day | Number of Cars | | | |
|-----------|----------------|--------|-------------------------|------------------------|
| | Pustikom Gate | Terbuk | Pascasarjana Entry Gate | Pascasarjana Exit Gate |
| Monday | 476 | 420 | 134 | 190 |
| Tuesday | 445 | 369 | 196 | 264 |
| Wednesday | 487 | 436 | 172 | 214 |
| Thursday | 644 | 600 | 146 | 187 |
| Friday | 619 | 542 | 187 | 98 |

The data is then summed per hour of entry and per hour of parking exit. As a result of the number of vehicles, the accumulation value and parking volume of vehicles at UNJ campus A will be calculated during the survey time. The following is the accumulation value and parking volume of UNJ campus A for the 2023/2024 academic year based on the types of vehicles entering and exiting the UNJ parking area.

Table 2. Accumulation of car parking at UNJ campus A

| Time | Day | | | | |
|---------------|--------|---------|-----------|----------|--------|
| | Monday | Tuesday | Wednesday | Thursday | Friday |
| <7:00 | 40 | 125 | 86 | 48 | 50 |
| 07:00 - 08:00 | 97 | 168 | 134 | 131 | 109 |
| 08:00 - 09:00 | 161 | 231 | 199 | 214 | 186 |
| 09:00 - 10:00 | 214 | 288 | 251 | 278 | 236 |
| 10:00 - 11:00 | 276 | 322 | 313 | 274 | 259 |
| 11:00 - 12:00 | 287 | 357 | 340 | 244 | 289 |
| 12:00 - 13:00 | 262 | 360 | 325 | 261 | 272 |
| 13:00 - 14:00 | 258 | 367 | 308 | 246 | 282 |
| 14:00 - 15:00 | 238 | 310 | 273 | 220 | 259 |
| 15:00 - 16:00 | 197 | 236 | 231 | 163 | 226 |
| 16:00 - 17:00 | 79 | 139 | 126 | 80 | 163 |
| >17:00 | | | | | |

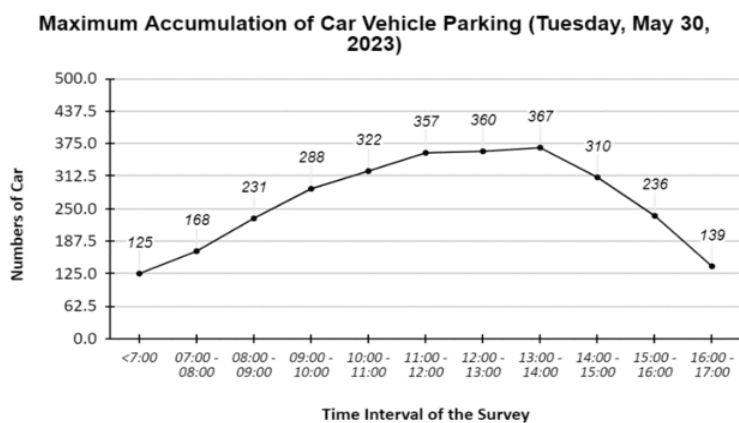


Figure 4. Parking accumulation chart of car vehicles at UNJ campus A

Based on the parking accumulation data of car vehicles above, the maximum parking accumulation occurs at 9-15 WIB, with peak parking hours at 13-14 WIB. The total demand for parking needs is 367 PSU cars. Therefore, the value of parking demand for car vehicles at UNJ campus A is 367 PSU in the 2023/2024 academic year.

After obtaining parking accumulation data, parking volume analysis was conducted to determine the maximum parking volume during the survey period. The results of the analysis are in Table 3. Based on the table, the maximum car parking volume occurred on Tuesday as many as 2903 car vehicles or equal to 290.3 vehicles per hour.

Table 3. Cumulative parking volume of car vehicles in dictionary A UNJ

| Time | Day | | | | |
|---------------|--------|---------|-----------|----------|--------|
| | Monday | Tuesday | Wednesday | Thursday | Friday |
| <7:00 | 40 | 125 | 86 | 48 | 50 |
| 07:00 - 08:00 | 137 | 293 | 220 | 179 | 159 |
| 08:00 - 09:00 | 298 | 524 | 419 | 393 | 345 |
| 09:00 - 10:00 | 512 | 812 | 670 | 671 | 581 |
| 10:00 - 11:00 | 788 | 1134 | 983 | 945 | 840 |
| 11:00 - 12:00 | 1075 | 1491 | 1323 | 1189 | 1129 |
| 12:00 - 13:00 | 1337 | 1851 | 1648 | 1450 | 1401 |
| 03:00 - 14:00 | 1595 | 2218 | 1956 | 1696 | 1683 |
| 14:00 - 15:00 | 1833 | 2528 | 2229 | 1916 | 1942 |
| 15:00 - 16:00 | 2030 | 2764 | 2460 | 2079 | 2168 |
| 16:00 - 17:00 | 2109 | 2903 | 2586 | 2159 | 2331 |
| >17:00 | | | | | |

b. Parking Duration Calculation

Based on the results of the survey of vehicle license plates that have been carried out on parking at campus A of the State University of Jakarta (UNJ), the results were obtained in the form of the duration of parking for car vehicles in the parking area of campus A UNJ. The parking duration value is obtained from the vehicle exit time minus the vehicle entry time in the UNJ campus A parking area, then the average is taken. The result of the calculation of the average duration of parking vehicles is 4 hours 0 minutes.

c. Calculation of PSU Campus A UNJ

The PSU (parking space unit) calculation is intended to determine the available parking capacity at UNJ Campus A during the construction period. These results will later be compared with secondary data on the amount of PSU available at UNJ Campus A before the construction period to find out how much PSU decreased in the UNJ Campus A parking area. The following is the PSU calculation data obtained from secondary data.

Table 4. Existing Capacity of UNJ Campus A Parking Lot (Before Construction)

| Location | Capacity | |
|--|----------------|-----------------|
| | Car | Motorcycle |
| Parking Lot Building UNJ (GPU) 1 st floor | 12 | - |
| Daksinapati | 53 | - |
| Hasyim Asy'ari | 19 | - |
| KH Dewantara | 6 | - |
| Walkabout | 317 | - |
| Faculty of Social Science | 15 | |
| UTC | 23 | |
| Total | 445 PSU | 2800 PSU |

The following are the results of the primary survey of PSU calculation. The data taken is the entire parking area at UNJ Campus A, both on-street and off-street parking.

Table 5. PSU Survey Calculation Results

| No | Location | PSU | |
|--------------|------------------------------------|------------|-----------|
| | | Off-street | On-street |
| 1 | Postgraduate parking lot | 26 | |
| 2 | Mechanical Laboratory | 9 | 6 |
| 3 | Faculty of Economy | 4 | |
| 4 | Faculty of Social Science | 13 | |
| 5 | Ki Hajar Dewantara | 6 | |
| 6 | Rectorate Building | 24 | |
| 7 | Parking Lot Building | 27 | |
| 8 | Klinik Pratama | 29 | |
| 9 | Walkabout | | 210 |
| 10 | Faculty of Education Science | | 13 |
| 11 | Faculty of mathematics and science | | 22 |
| Total | | 138 PSU | 251 PSU |
| | | 389 PSU | |

From both primary and secondary survey data, it can be seen that there is a reduction in the number of PSUs. Before the construction period, UNJ Campus A had 445 car PSU. However, during the construction period, there was a reduction in the number of car plots so the number of available parking plots is now 408 PSU, a reduction of 37 PSU. For the analysis process, the number of parking spaces used is 408 PSU.

d. Parking Turnover Rate

The maximum value of car vehicle parking volume occurs on Tuesday, May 30, 2023, with a total volume of 2903 cars and the number of available car parking plots is 408 PSU. Therefore, the parking turnover rate $TR(\text{Total Parking Volume})=2908/408=7.11$ vehicles/parking plot. This shows that the parking turnover rate for car vehicles can be said to be quite high, where in one car parking plot available in the UNJ campus A parking area must serve 7 to 8 vehicles.

e. Parking Index

The peak parking hour occurs at 13.00-14.00 WIB. With the maximum number of parking accumulations is 367 cars and the total available parking capacity is 408 PSU. So the parking index value for car vehicles $IP=\text{Max parking accumulation}/\text{parking capacity} \times 100\% = 367/389 \times 100\% = 94.3\%$. With a parking index value that is almost close to 100%. This shows that the condition of car parking density in the UNJ campus A parking area almost exceeds the available parking capacity.

f. Car Parking Arrangement in Campus A UNJ

Thousands of vehicles entering the UNJ Campus A area will certainly cause problems if not handled and regulated properly. These problems include comfort factors, safety factors, security factors, and environmental factors. With the full parking area, building users will feel uncomfortable because it is difficult to find empty areas to park their vehicles. finding an empty area to park the vehicle. In addition, vehicles are also prone to damage because vehicles look for parking spaces in such a way that they are crammed together in the parking lot. Vehicle damage such as broken mirrors, damaged helmets, vehicles experiencing scratches due to rubbing against other vehicles, and other problems often occur.

In this research observation, which focuses on car parking at UNJ Campus A, it is known that off-street parking is 138 PSU and on-street parking is 251 PSU. From this data, it can be seen that the majority of building users use on-street parking facilities, which means that the car is not parked in the official plot on the road. This condition, if left unchecked, will result in an increasingly narrow space for pedestrians whose pedestrian area is blocked by hundreds of parked cars. In addition, on-street parking also creates

inconvenience for vehicle users who are worried that their cars will be scratched by the parking lot. who are worried that their cars will be scratched because they are not parked in the official parking area.

In the license plate survey, it was also found that the number of vehicles parked in the peak hour (Tuesday 13.00-14.00) was 367 vehicles while the available parking plots both off-street and on-street amounted to 389 PSU. The parking index calculation reached 94.3%. With a parking index value that is almost close to 100%. This shows that the condition of car parking density in the UNJ campus A parking area almost exceeds the available parking capacity.

This can make it difficult for drivers to find an empty parking space, especially considering the pattern of car parking on the UNJ campus A parking area rotates in one direction so that the opportunity to find an empty parking space during peak parking hours only has a chance to find an empty parking space.



Figure 5. Modelling of Car Parking Arrangement in Campus A UNJ During Construction

5. CONCLUSION

Based on the results of the analysis that has been carried out, the following suggestions can be made:

1. In the calculation obtained parking space capacity can not meet the needs of parking space capacity. Considering that the parking area cannot be added because there is no more vacant land, the author's suggestion is to build a special car parking building. The creation of a vertical parking system at the Jakarta State University (UNJ), especially campus A, is intended to overcome the excess demand for existing car parking with limited land.
2. Implement a maintenance program for existing parking facilities to keep them as useful as they should be.
3. Implement a computerized parking system in the UNJ parking area so that the parking operation process can be more optimal.

4. To reduce the demand for parking spaces that arise, UNJ should impose several other policies on parking regulations on the UNJ campus, including:
 - a. Increasing the basic parking tariff in the UNJ parking area.
 - b. Restrictions for new students, so that they are not allowed to bring private vehicles into the UNJ parking area during their first academic year.
 - c. The implementation of a subscription card that can only be owned by second year students and so on as well as lecturers and employees who are still active as UNJ community.
5. It is necessary to conduct further research into the parking study at UNJ campus A, in order to obtain the following results:
 - a. Evaluation of the application of the existing parking space arrangement after construction
 - b. Cost Benefit Analysis of the existing parking space arrangement at campus A of the State University of Jakarta.
 - c. UNJ's readiness to develop sustainable parking management that takes into account environmental and social aspects.

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