The layout improvements of motorcycle parking facilities in hospital

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Abstract. Parking space is one of the facilities that must be considered in all types of public facilities buildings, one of which is a hospital. But unfortunately many hospitals make parking facilities tend to be careless and cause the parking space to become narrow, causing congestion in the entry and exit lanes, so that it can damage vehicle property. This research focuses on parking facilities for 2-wheeled vehicles in one of the largest hospitals in the Medan city area. The facilities of this hospital are classified as very severe. As for some of the problems contained in the parking lot are parking conditions that are always over (too full), very narrow parking lanes, and irregular parking conditions (causing severe congestion at certain hours). The final result of this study is to get the number of parking slots that must be provided and make a layout parking improvements.

1. Introduction
Parked one of the facilities provided by a place/factory/company to accommodate vehicles carried by visitors and employees. According to Hobbs (1995), parking is defined as an activity to place or save a certain vehicle whose duration depends on the completion of the driver's needs [1]. Parking is also a facility in the form of services that can provide comfort for vehicle owners to entrust their vehicles with a safe and comfortable guarantee. However, sometimes this is not considered by the company/place/factory, so vehicle owners sometimes feel very uncomfortable leaving their vehicle.

This hospital is one of the largest and most comprehensive hospitals in Medan. This hospital is still classified as very low in terms of managing their parking space. The parking space owned by this hospital is relatively small, especially for the motorcycle parking area. The motorcycle parking area for the hospital is used for employee parking and visitor parking. The arrangement of parking lots in the motorcycle area is also quite messy. This can be proven by finding the distance between motorbikes that are very close at the time of parking (for example 2 parking slots are forced to accommodate 3 vehicles), the width of the alley is very narrow, there are vehicles parked in the alley so there are many complaints from visitors about problems that occur with their vehicles such as scuffs, broken hoods, etc. The manager also did not determine the maximum number of motorized vehicles that could be accommodated so that parking capacity was booming.

Based on the existing problems, we will conduct research on the parking characteristics of the parking lot [2, 3] in order to determine the parking capacity that should be provided and redesign the ideal parking slot layout / arrangement to provide convenience for users of parking facilities [4, 5] by implementing the rules of the decision of the directorate general of land transportation number: 272/HK.105/DRJD/96 [6, 7].

2. Methodology
This study applies the SRP (Parking Space Unit) standard of the land transportation department [8, 9] and is based on the decision of the director general of land transportation number: 272/HK.105/DRJD/96.
The initial stage of the research was carried out by collecting primary data (such as data on incoming and outgoing vehicles and available parking slot data) and secondary data (such as current parking layout data) as needed. Then the data is processed to produce parking characteristics data such as parking accumulation, parking volume, parking duration, parking index [10 - 14] and the number of parking slots that must be provided. After that, the improvement of parking space will be adjusted to the number of parking slots obtained by applying the rules from the decision of the director general of land transportation. The stages of this research can be seen in Figure 1.

![Flow chart research](image)

**Figure 1.** Flow chart research

### 3. Results

3.1. Parking slots existing:
Existing parking slot data is 430 SRP / parking lot. The number of rows contained in the parking lot is 30 lines (5 slots = 1 row; 7 slots = 1 line; 13 slots = 8 rows; 14 slots = 5 rows; 15 slots = 15 rows; 19 slots = 1 line). This parking lot only has one access entry and one exit access. The road to the parking slot also only uses 1 lane for vehicles to leave and enter, so that traffic jams often occur at certain hours. The current parking layout can be seen in Figure 2.
3.2. Analyze parking characteristics data

Parking characteristics data consist of parking accumulation, parking volume, parking duration, and parking index. The maximum accumulated parking is on Tuesday, 24 September 2019 with 574 vehicles. The daily average parking volume is 729.5 vehicles / hour. The average daily parking duration is 7:23:16 or 7.38 hours / day. The highest 3-day parking index can be seen in Table 1.

![Image of parking lot layout](image1)

Figure 2. The current parking layout (a) Image details (b)

| No. | Icons | Meanings |
|-----|-------|----------|
| 01. |       | Parking Slot |
| 02. |       | Parking Entry Portal |
| 03. |       | Parking Administration Desk |
| 04. |       | Copied for Feedback Storage |
| 05. |       | Fences |

Table 1. The Highest 3-day parking index.

| NO | PERIOD     | Monday, 23 September 2019 | Tuesday, 24 September 2019 | Wednesday, 25 September 2019 |
|----|------------|---------------------------|-----------------------------|-------------------------------|
|    |            | Number of Parking Vehicles | Parking Index (%) | Number of Parking Vehicles | Parking Index (%) | Number of Parking Vehicles | Parking Index (%) |
| 1  | 06.00 - 06.59 | 197                        | 45.81                      | 208                          | 48.37                      | 137                          | 31.86                      |
| 2  | 07.00 - 07.59 | 337                        | 78.37                      | 327                          | 76.05                      | 300                          | 69.77                      |
| 3  | 08.00 - 08.59 | 482                        | 112.09                     | 483                          | 112.33                     | 407                          | 94.65                      |
| 4  | 09.00 - 09.59 | 498                        | 115.81                     | 501                          | 116.51                     | 418                          | 97.21                      |
| 5  | 10.00 - 10.59 | 498                        | 115.81                     | 508                          | 118.14                     | 425                          | 98.84                      |
| 6  | 11.00 - 11.59 | 506                        | 117.67                     | 521                          | 121.16                     | 439                          | 102.09                     |
| 7  | 12.00 - 12.59 | 527                        | 122.56                     | 539                          | 125.35                     | 452                          | 105.12                     |
| 8  | 13.00 - 13.59 | 570                        | 132.56                     | 581                          | 135.12                     | 502                          | 116.74                     |
| 9  | 14.00 - 14.59 | 574                        | 133.49                     | 572                          | 133.02                     | 512                          | 119.07                     |
| 10 | 15.00 - 15.59 | 548                        | 127.44                     | 558                          | 129.77                     | 486                          | 113.02                     |
| 11 | 16.00 - 16.59 | 496                        | 115.35                     | 518                          | 120.47                     | 428                          | 99.53                      |
| 12 | 17.00 - 17.59 | 371                        | 86.28                      | 354                          | 82.33                      | 298                          | 69.30                      |
| 13 | 18.00 - 18.59 | 328                        | 76.28                      | 322                          | 74.88                      | 266                          | 61.86                      |

Max Parking Index | 133.49 | 135.12 | 119.07

Based on the parking characteristics from the data above, we can analyze and conclude that the parking situation cannot accommodate the demand for the number of vehicles available. This can be proven by the maximum motorcycle parking index found on Tuesday, 24 September 2019 at 13.00 - 13.59 at 135.12%, which is greater than 100%, so additional parking slots should be added to the parking lot.
3.3. Calculate the capacity of parking spaces;
The parking index obtained states that the state of the currently available parking slots is no longer able to accommodate parking requests. Next is doing calculations to determine the optimal capacity that must be provided by the hospital in order to meet the existing parking needs. The results of the calculation of parking space capacity can be seen in table 2.

| Date and Time            | Survey Time (hr.) | Volume (Vehicle) | Average Parking Duration (hr.) | Parking Space Capacity (SRP) |
|---------------------------|-------------------|------------------|-------------------------------|-----------------------------|
| Monday, 23 September 2019 | 13                | 853              | 7.38                          | 484                         |
| Tuesday, 24 September 2019| 13                | 836              | 7.38                          | 475                         |
| Wednesday, 25 September 2019 | 13            | 812              | 7.38                          | 461                         |

Table 2. The results of the calculation of parking space capacity.

3.4. Proposed layout improvement design
Based on the results obtained from the calculation of the optimal parking capacity, the layout will be redesigned by implementing regulations from the Director General of Land Transportation. The proposed layout improvement design can be seen in Figure 3.

Figure 3. Proposed layout improvement design 1.

Based on the layout design adapted to the implementation of the rules of the directorate general of land transportation, parking spaces that can be provided with the current state of the parking area are 263 SRP / slots / parking spaces. In order to fulfill the parking capacity that should be provided, an additional parking area must be made to accommodate the required SRP by utilizing other areas with a lower frequency of use. For a layout design that utilizes an area with a lower frequency of use, it can be seen in Figure 4.
In Figure 4, it can be seen that there is an addition of parking slots in areas with low frequency of use, such as: In area A, an additional parking area of 396 m² should be added which can accommodate an additional 223 SRP and in area B an additional parking area of 28 m² should be added which can accommodate an additional 16 SRP. With the addition of the parking area above, the number of parking slots that can be provided has increased to 486 SRP.

The comparison between the existing layout vs. the improvement design layout can be seen in the following table.

**Table 3.** Table Comparison between existing layout vs. improvement design layout.

| Information                  | Existing          | Improvement Design |
|------------------------------|-------------------|--------------------|
| The number of slots that can be provided | 430 SRP          | 486 SRP           |
| SRP size                     | 0.5 x 1.8 m²      | 0.7 x 2.0 m²      |
| Hallway Width                | 1 meter for 2-way line | 0.8 meter for 1-way lines |
| Parking Circulation          | The circulation between incoming and outgoing vehicles collides with each other | The circulation between incoming and outgoing vehicles is no longer colliding |

**4. Conclusions**

Based on the results of the research above, from the parking characteristics data, it can be concluded that the parking situation can no longer accommodate the number of parking requests at XYZ Hospital because the maximum parking index obtained is 135.12% (> 100%) so repairs or additional parking slots must be made. The optimal parking space capacity required after calculation is 484 SRP / slot / parking space. Based on the implementation of the Director General of Land Transportation, with the
current condition of the area, the parking slot that can be accommodated after being relayed is 263 SRP. In order to meet optimal needs, it is advisable to increase the parking area of 396 $m^2$ as many as 223 slots (area A) and 28 $m^2$ 16slot (area B) by taking advantage of another area that is rarely used so that the problems described can be resolved.

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