Analysis of parking needs for sustainable parking lots in commercial area of Pangkalpinang City

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Abstract. Pangkalpinang Plaza-Bangka Trade Center (BTC) Area is the largest commercial area in Pangkalpinang City. As the largest commercial area, this area causes a large pull of vehicle trips that needs a large number of parking spaces. Therefore, parking needs must be analyzed to provide sustainable parking lots in this area. This study aims to analyze parking needs for sustainable parking in Pangkalpinang Plaza-Bangka Trade Center (BTC) Area. In this research, the parking survey methods used are an inventory survey and a vehicle license plate survey. Parking needs analysis is reviewed based on parking volume and parking accumulation. Then, parking needs are determined based on the biggest interval between vehicle arrivals and departures from parking accumulation. The research finds that the amount of parking needs of on-street parking is 540 SRP for motorcycles and 120 SRP for passenger cars. Meanwhile, the amount of parking needs of off-street parking is 208 SRP for motorcycles in front of Ramayana and 238 SRP for motorcycles in basement Ramayana. Furthermore, these results will be useful for providing sustainable parking lots in Pangkalpinang Plaza – Bangka Trade Center (BTC) Area.

1. Introduction
Vehicles that make a move at some time will stop temporarily or stop long, which is called parking [1]. Parking is the state of the vehicle stopping or not moving for a few moments and left by driver [2]. Vehicles that move towards a place need space to park. The more vehicle trips that go to these places, the more need for parking spaces [3]. The commercial area is one of the places that has a large vehicle trip attraction. Pangkalpinang Plaza-Bangka Trade Center (BTC) Area is the largest commercial area in Pangkalpinang City. This area has two of the largest shopping centers in the City of Pangkalpinang. As the largest commercial area, this area causes a large pull of vehicle trips [4,5]. The amount of vehicle trips leading to this area raises the need for a large number of parking spaces [6].

Adequate and convenient parking ideally should be provided for the commercial area [7]. Provision of adequate and convenient means the parking space able to accommodate all parking vehicles. The inadequacy of parking spaces will lead to illegal parking, congestion, emissions, and traffic safety [8–10]. Besides the lack of parking lots, some vehicles park on the street because of easier access to destination [11]. These issues also happen in Pangkalpinang Plaza-Bangka Trade Center (BTC) Area. Due to lack of parking lots and easier access, vehicles park not only in off-street parking but also in on-street parking in this area. The provision of parking spaces is an essential component to accommodate
all parking vehicles [12]. Therefore, parking needs in Pangkalpinang Plaza-Bangka Trade Center (BTC) Area are required to be analyzed to manage the parking lots.

This study aims to analyze parking needs for sustainable parking in the commercial area of Pangkalpinang City, Pangkalpinang Plaza-Bangka Trade Center (BTC) Area. Parking characteristics must be known to analyze parking needs [13]. Parking characteristics that use for analysis of parking needs in this study are volume and accumulation. Furthermore, the results of this study can be useful for designing sustainable parking lots in Pangkalpinang Plaza – Bangka Trade Center (BTC) Area.

1.1. Types of Parking
In general parking divided into 2 types, consist of [7]:
1. Off-street parking, parking located on the land or the building.
2. On-street parking, parking located on the street or the road.

1.2. Parking Characteristics
There are some parameters of parking characteristics [14]. Parking characteristics that used in this study are as follows:
1. Parking accumulation, the number of vehicles that are in a parking lot at a particular interval time.
2. Parking volume, the number of vehicles that have used parking spaces in a parking lot at a given time.

1.3. Parking Space Unit
The Parking Space Unit (SRP) is an effective measure of the size of a vehicle (passenger car, bus/ truck or motorcycle), including the free space and width of the door opening. It can also be said that the SRP is a measure of space requirements for parking a vehicle comfortably and safely with the amount of space as efficient as possible [15].

| Number | Type of Vehicle | SRP (m²) |
|--------|----------------|----------|
| 1.     | a. Passenger car Type I | 2.30 x 5.00 |
|        | b. Passenger car Type II | 2.50 x 5.00 |
|        | c. Passenger car Type III | 3.00 x 5.00 |
| 2.     | Bus/ Truck | 3.40 x 12.50 |
| 3.     | Motorcycle | 0.75 x 2.00 |

2. Methodology
This study took place at the largest commercial area in Pangkalpinang City, Pangkalpinang Plaza-Bangka Trade Center (BTC) Area. Based on the decision of the mayor of Pangkalpinang City, this area is part of the Parking Zone B in Pangkalpinang City, 20 out of 33 Zone B parking lots are in the Pangkalpinang Plaza-Bangka Trade Center (BTC) Area shown in Table 1 and Figure 1 [16].

In this research, data collection is carried out by a parking survey in Plaza Pangkalpinang - Bangka Trade Center Area. The parking survey methods used are an inventory survey and a vehicle license plate survey. The inventory survey carried out to know the existing condition of parking lots in Plaza Pangkalpinang - Bangka Trade Center Area, while a vehicle license plate survey to find out parking volume and parking accumulation through matching plates number [14,15]. The vehicle license plate survey was conducted on weekend for 15 hours survey from 07.00 until 22.00. The survey divided into on-street parking and off-street parking for motorcycles and passenger cars.

Parking needs analysis is reviewed based on parking volume and parking accumulation. Then, parking needs are determined based on the biggest interval between vehicle arrivals and departures from parking accumulation at a particular interval time [14].
Table 2. Information of parking lots

| Number | Location | Type of Parking | Number | Location | Type of Parking |
|--------|----------|-----------------|--------|----------|-----------------|
| 1      | Kopi O Cafe | On-street 2A, Off-street 2B-2C, On-street | 11     | Indo Fashion Store | On-street |
| 2A-2C  | In front of Ramayana | On-street 2A, Off-street 2B-2C, On-street | 12A-12B | Kelenteng | On-street |
| 3A     | Beside Ramayana | On-street | 13A-13E | In front of BTC | On-street |
| 4      | Basement Ramayana | Off-street | 14     | Cebotex Store | On-street |
| 5A-5D  | Behind Ramayana | On-street | 15     | Buku Pemuda Store | On-street |
| 6A-6F  | Beside BTC | On-street | 16     | Beside Buku Pemuda St | On-street |
| 7      | Obat Asli Store | On-street | 17     | In front of Anggrek Caffe | On-street |
| 8      | Masa Jaya Motor | On-street | 18     | Beside Anggrek Cafe | On-street |
| 9      | Mas Gunung Kawi St | On-street | 19     | Anugerah Motor | On-street |
| 10     | Jawa Timur Store | On-street | 20A-20I | Trem Street | On-street |

Figure 1. Location of parking lots
3. Result and Discussion
The result of parking needs analysis in Pangkalpinang Plaza Bangka Trade Center (BTC) Area divided into on-street parking and off-street parking for motorcycles and passenger cars. The result shows the amount of parking needs of on-street and off-street parking for providing sustainable parking lots in Pangkalpinang Plaza – Bangka Trade Center (BTC) Area.

3.1. On-street parking

Figure 2 and Figure 3 show the relationship between parking volume and parking accumulation on-street parking for motorcycles and passenger cars. Based on the graph, it knows that during the time interval from 07.00 - 22.00, there are 3842 motorcycles and 984 passenger cars parked on-street parking in Pangkalpinang Plaza Bangka Trade Center (BTC) Area. The maximum parking accumulation is 561 motorcycles at 11:45 - 12.00 and 130 passenger cars at 13.15 - 13.30.
Besides, it finds that from morning to afternoon, there is an increase in parking accumulation. Then, from day to night, there is a decrease in parking accumulation. By looking at the graph, it can also be determined the amount of parking needs is 540 SRP for motorcycles and 120 SRP for passenger cars.

3.2. Off-street parking

![Graph showing parking needs for motorcycles in front of Ramayana and basement Ramayana.]

**Figure 4.** Parking needs of off-street parking for motorcycles in front of Ramayana

![Graph showing parking needs for motorcycles in basement Ramayana.]

**Figure 5.** Parking needs of off-street parking for motorcycles in basement Ramayana

Figure 4 and Figure 5 show the relationship between parking volume and parking accumulation off-street parking for motorcycles in front of and basement Ramayana. Based on the graph, it knows that during the time interval from 07.00 - 22.00, there are 1332 motorcycles parked in front of Ramayana and 497 motorcycles parked in basement Ramayana. The maximum parking accumulation is 213 motorcycles in front of Ramayana at 11:45 - 12:00 and 254 motorcycles in basement Ramayana at 14.45 – 15.00.

The same has happened for off-street parking. It finds that from morning to afternoon, there is an increase in parking accumulation. Then, from day to night, there is a decrease in parking accumulation.
By looking at the graph, it can also be determined the amount of parking needs is 208 SRP for motorcycles in front of Ramayana and 238 SRP for motorcycles in basement Ramayana.

4. Conclusion
Based on the result of parking needs analysis in Pangkalpinang Plaza-Bangka Trade Center (BTC) Area, it finds that the amount of parking needs of on-street parking is 540 SRP for motorcycles and 120 SRP for passenger cars. Meanwhile, the amount of parking needs of off-street parking is 208 SRP for motorcycles in front of Ramayana and 238 SRP for motorcycles in basement Ramayana. Furthermore, these results will be useful for providing sustainable parking lots in Pangkalpinang Plaza – Bangka Trade Center (BTC) Area.

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