Characteristics of Selected Off-Street Parking in AL-Mansour Neighborhood / Baghdad

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Abstract. Car Parking is an important problem occurs in attracted zones in Baghdad city. AL-Mansour neighborhood is a commercial center in Baghdad city, which highly attract people from various zones. Limited parking spaces are provided in this area leads to appearance of traffic problems. Al-Mansour neighborhood is the study area that was chosen for surveying its parking (off-street parking). The purpose of the study is evaluating of characteristics of off street parking in AL-Mansour city. Four parking was selected, three located nearby AL-Mansour Mall and the others nearby Babylon Mall. From the results showed that PI of P4 is 103.33%, that mean demand is more than supply. The license plate method is used for collected data that used in assessing characteristics of parking in area such as parking duration, peak hours and parking turnover. Two kinds of data are collected, first about site characteristics, and the second is about parking vehicles accumulation sketch. Collected data in this study is from surveying each park for two days at PM period, all the data collected manually.

1. Introduction
Parking facilities are an important issue in urban transportation planning, it exists for serving office building, shopping center, bank, universitie, airfields, the stations of train, the stations of bus, and hospital, in suburban and urban area [1]. Great importance must given in consideration of parking planning in order for regulating traffic flow in main streets especially in CBD areas. There are direct relationship exists between land use and growth of population, where an increase in population leads to increase the number of private cars that coincides with ongoing development in land use, these increases without any expectations or studying will create problems pertaining congestion, level of service, increase on-street parking and pollution. Table (1) shows, parking requirement based on population in American in several cities, where an increase in demand for parking spaces is proportional to increase in population. Parking plays an significant role for providing services to customers by allowance them for stopping and storing their vehicles before sharing in activities. Parking areas take a serious part of the urban land use. The driver seeks parking stall, especially in the attractive areas such as commercial, shopping and residential areas. most of cities in the world use suitable parking management and full parking facilities for development and providing full efficiency [2] the types of parking system are, off-street and on-street parking. Consider on-street parking in most parking system is causing problems relating to stopping
nearby street. Decreasing in off-street spaces in the CBD were produced from absence of planning when owners or anybody builds any development such as shopping center or restaurants in the area, then it is important to consider laws oblige them to construct a suitable parking for occupation visitors. Management solutions are a primary step for control or treatment many of the main issues related to achieving balance between supply and demand, where management is a better solution than an extension or increasing spaces. Parking policy is a tool that links transport system and land-use in the area, in terms for better performance of parking [3]. The traditional parking policy has been focusing on increasing supply compared to excess of demand, enhancing use car while weakening public transit, walking and bicycling. While subsequent parking policy primarily focused on management of existing parking supply which leads to be a major obstruction for development or establishing a balanced urban transportation system [4]. The current study will deal with parking problems occurred in major attraction area in Baghdad city, parking characteristics should be identified in order to view all factors that effect on parking facilities. The Al Mansour area was selected to conduct the required surveys, and the analysis is represented and discussed.

| Number of population in urban area | Total number of spaces | Types of parking | Spaces for 1000 population |
|-----------------------------------|-----------------------|-----------------|---------------------------|
|                                   |                       | Off-street      | On-street                 |
|                                   |                       | Multistory     | Lot                       |
| 10000-25000                       | 2630                  | 10 (0)          | 1530(57%)                 | 1090(43%) | 150    |
| 25000-50000                       | 3990                  | 140(3%)         | 2420(59%)                 | 1430(38%) | 120    |
| 50000-100000                      | 4660                  | 260(5%)         | 2790(60%)                 | 1610(38%) | 70     |
| 100000-250000                     | 7710                  | 820(11%)        | 4760(62%)                 | 2130(27%) | 50     |
| 250000-500000                     | 12300                 | 1940(16%)       | 7910(64%)                 | 2450(20%) | 30     |
| 500000-1000000                    | 22600                 | 6900(30%)       | 12500(56%)                | 3200(14%) | 30     |
| _1000000                          | 58800                 | 18600(31%)      | 32200(55%)                | 8000(14%) | 20     |

2. Background
Parking facilities divided into private or public use, where the parking that permits for customers to use it are called public use, other type is using from a specific people such as employees only using. [6]. Design of parking spaces is very important, if there will be reduced of parking spaces and facilities then lead to occurring a chaotic condition in the area especially in CBD. But planning for, designing any parking spaces are not easy where there are many of the parameters that it should take into account [7]. There are many off-street parking pattern:
1. Surface lots parking
2. Multistory parking
3. Roof parking
4. Mechanical parking
5. Underground parking

More parking problems happen in the Central Business District (CBD) area where there are not parking spaces for accommodating an increase in traffic as well as the problem that was pertained searching a parking space from drivers enter this area. As well as the distribution of parking places over
the region are close to each other, that causes increasingly concentrated near effective lands-use especially CBD and shopping center [8].

KRAIDI R. A. studied the off-street parking in Al Mustansiriyah university that owned by the campus, his goal is to evaluate current the demand and supply parking in AL-Mustansiriya campus as well as providing a recommendation for the number of parking spaces. The study reveals that there is a latent parking demand restrained mainly due to road congestion and shortage of parking facilities [9].

Islam K. and Chawdhury S. 2014, analyzed the demand and supply of on and off parking facilities in commercial area. The total capacity (supply) of the area is 280 cars per hour while demand in weekday is 488 cars per hour. Demand is much higher than the insufficient supply. For controlling problems that occurs, a management system must be applied [10].

Public off-street means any member can be use parking with subject to responding any regulations (e.g. maximum stay (in hour), fees). This type may be owned and operated by public or private sector. Private non-residential off-street pertains using from a particular building or land use, shopping center and an office building, only people who are coming to that building can use it. Private residential parking is off-street parking that only residents in these houses or apartment should use the parking [11]. An important idea in analysis of parking is the design parking depending on peak hour or day. It is not suitable to design the parking for the peak hour that might occur in one hour from the total hours in year 8760 hour, where it will cause in the remaining 8759 hour in vacant situation. Also, it is not feasible to design parking depending on the average condition, where this causes insufficient spaces in half of year [1].

Actually, when analyzing the parking market, it must take the supply and demand sides. Economics is one of important factors that must be studing, especially when deciding to create or study demand side by the customers (i.e. availability of suitable product, price, priority of customers for specific things, etc). In the same way, the analyzing of supply parking market is depended on the “creators” opinion (cost, revenue, profits, etc.) [12].

Conversely, in the city centre of most European cities, the number of stalls on-street parking is limited likes the number spaces off street parking. The price of the parking space is important. Low price is important for attractive, where customers in all condition must reach their destination by walk. Finally, the price of car parks that located away from the city centre usually is low, and they don’t have suitable quality, as car parking users prefer to decreasing in costs when the area located far away from city center. For example, the park & ride type of parking: when use it, it must be involving some benefits like the parking in city centre, such as a low prices, and providing bus services for connecting it to the city centre. Often, the parking that in away from city centres will be benefits for increasing attractive from customers depending on quality and availability. In contrast, many of the parking in city center has high cost and full service quality standards [13].

3. Study area:

The study area locates in the Baghdad in "Al-Karkh" side, where Al-Mansour city was chosen because it is an attractive area, all the selected parks are located particularly nearby shopping center "Al-Mansour Mall". In the study area, there are four parking facilities located nearby the mall; the selected parking are Al-Fanous Park (P1), Al Ruwwad Park (P2), Al-Amyrat Park (P3), Al-Mansour Mall Park (P4) which are shown in Image 1. The study area contains multi land uses such as restaurants, commercial, and business. Manual survey was done to collect the questionnaires and important data from the study area. A summarized description of each park is explicit in Table 2.
Table 2. Detail of Parking Facilities

| Parking name           | Parking code | Capacity (No. of spaces) | Area (m²) | District/Area                      | Parking use Characteristics                     |
|-----------------------|--------------|--------------------------|-----------|-----------------------------------|-------------------------------------------------|
| Al-Fanous Park        | P1           | 60                       | 1200      | Nearby Town Center Mall           | Commercial and Shopping                           |
| Al-Ruwad Park         | P2           | 135                      | 2800      | Nearby Al-Mansour Mall            | Commercial and Shopping                           |
| Al-Amyrat Park        | P3           | 65                       | 1300      | Nearby Town Center Mall           | Commercial and Shopping                           |
| Al-Mansour Mall Park  | P4           | 120                      | 2500      | Nearby Al-Mansour Mall            | Commercial and Shopping                           |

Image 1. Location of Parking Facilities

4. Methodology:
Parking studies are carried out to collect information that is required for the demand for parking and as well as the supply and use facilities of existing parking. License plate method of survey was selected to collect information, the survey was done at a continuous interval of 15 minutes, the number of cars enter or exit the parking was recorded. This gives data about the duration of vehicles that use the parking space. After conducting a survey and aggregation data from parking, these data were analyzed and computed. Important parameters, which give outcomes about parking supply, were defined and calculated as follows: The duration of parking: it represents the average duration of a parked vehicle; it changes with different vehicles and purpose. The Duration time that vehicles using parking have calculated from average times, which vehicles use parking (stopping time).
Parking accumulation (PA): The most important index is the calculation number of Parking vehicles stopping in a park at an period of time. It can be showing as a curve of parking accumulation with time.
Parking Volume (PV): is the total number of vehicles that use a park at a given time or it is the sum of initial of existing vehicles in the park (I) before starting the survey and the number of arrival (A) that is the number of vehicle arrives to the park during survey interval, without repetition of vehicles.

Parking Load (PL): is area under curve of accumulation. It compute by simply multiplying the number of vehicles in the parking area at each time interval with time interval. It equals the capacity of parking at peak hour.

Parking Index (PI): is the number of spaces available (N) and average parking duration (PD).

Parking Turnover (PT) is the ratio between parking volume and spaces available in park. Below some equations which describe characteristics of parking supply:

I + A = PV (1)
PL / N = PI (2)
PL / PV = PD (3)
PV / N = PT (4)

5. Data Collection:
Data was collected on December 2019. The collection of data was aggregated manually based on initial questionnaires and the surveying was done in weekday during peak hour. The work hours in Al-Mansour area ranges from 5 p.m to 10 p.m where most of the people prefer night time for shopping or buying. This survey was done during a good weather. All vehicles parked in the study area were counted during each 15 minutes of an average week day. Two types of data were collected, first the parking site characteristics was defining then questionnaire and survey of number of vehicles using the parking was done.

6. Parking Data Analysis
The following are analysis of data collected:

6.1. Parking Accumulation:
Parking accumulation means the total vehicles that use parking at a given time from 5:00 p.m. to 10:00 p.m. The accumulation data for surface parking was illustrated in Figure (1) to (2). The peak hour in the study area is located between 8 p.m. to 9 p.m. as represented in Figure (5) where the total vehicles that existed in the parking was 311 vehicles at time 8:30 p.m. From these Figure, it shows the differences between peak hour of parking facilities located near from the Al-Mansour Mall, where it observed that P4 located nearby the Mall, therefore starting peak hour in this parks between 5:30 p.m. to 6:30 p.m. because most of people who come to the mall mainly use this park (p4), also more that 98% of users have gone to the Mall. In the park (p2) locates nearby (p4), where the peak hour was between 8:00 p.m. to 9:00 p.m., parking (p1 and p3) consider a minor parking uses from people, because they locate far from Al-Mansour Mall, however the large users who use it are from these people who go to the Mall more than 95% from all respondents.
Figure 1. Off street parking accumulation for Al-Fanous Park (P1)

Figure 2. Off street parking accumulation for Al-Ruwwad Park (P2)
Figure 3. Off street parking accumulation for Al-Amyrat Park (P3)

Figure 4. Off street parking accumulation for Al-Mansour park (p4)
Figure 5. Off street parking accumulation for (P1,P2,P3,P4)

In a general situation in Al-Mansour city, especially near the Mall, most of consumers suffer from unavailability spaces especially at weekday and days of celebrations. Also on-street parking is full in the street, where this parking causes a traffic jam in the peak hours in the study area.

6.2. Parking Duration:
Parking duration is the spending time of vehicle in park (stopping time inside park). Parking duration depends on trip purpose, city size and type of parking. The average parking duration period ranges between (1.97 to 2.59) hour for the average parking duration in four parking because most of users destination to Al-Mansour Mall. Also from questionnaire results stated many respondents use parking in duration range from (2-3) hours. Where P2 and P4 use from people destination to the Mall for shopping or entertainment.

6.3. Parking turnover:
The parking turnover is defined as the number of vehicles that uses park per spaces of parking (veh/stall/hr). Turnover rate is calculated for one day or part of the day, for instance, the period 8:00 am to 9.00 p.m., and it is measured in (vehicle/space/day). In this study, the parameter was calculated by using the following equation:

\[
\text{Parking turnover} = \frac{\text{parking volume (number of vehicles using a park at period study)}}{\text{capacity of parking}}.
\]

Table (3) shows turnover rate of parking for our study area.

6.4. Parking occupancy (Parking Index)
Defined as the percentage of parking stalls used by vehicles at a period of time, which calculated from parking load(demand of parking in peak hour) divided by capacity of parking. Table (3) shows Parking Index. Where it noticed that P4 was greater than other park, which means capacity at peak hour is more that capacity of other parking, or means demand more than supply.
Table 3. Parking Characteristics in the study area.

| Parking Code | Parking index % | Turnover rate (vehicle/space/period) | Average parking duration(hour) | Parking volume vehicle |
|--------------|-----------------|-------------------------------------|-------------------------------|-----------------------|
| P1           | 93.33%          | 1.12                                | 1.97                          | 67                    |
| P2           | 91.11%          | 0.7                                 | 2.59                          | 94                    |
| P3           | 98.23%          | 1.6                                 | 2.54                          | 105                   |
| P4           | 103.33%         | 0.8                                 | 2.42                          | 99                    |

6.5. Required Parking Spaces:
The area of Al-Mansour Mall is 32,000 m² and has four floors. Using Parking Generation rate of ITE manual for estimating the number of spaces that will serve the demand occurring in area, that should provide for customers, where parking generation is the number of parked vehicles created by land use such as building, shopping center, hospital, hotel room, etc. In our study, the generation rate is 2.55 for each 93 m² for area of the Al-Mansour Mall according to ITE manual.

Required spaces = \( \frac{32,000}{93} = 344.086 \)  
= 344.086 * 2.55 = 877 spaces

The total number of spaces that exist nearby Al-Mansour Mall is 380 spaces (supply). That means the number of spaces in the area is not enough for accommodating for the demand.

7. Conclusions
The study area is located in major attraction area with multi land-use, Al-Mansour Mall is one of the important place for many people from other sites in Baghdad. There are four parking located nearby Al-Mansour Mall. The purpose of this surveying is determining parking characteristics. The survey started from 5:00 p.m. to 10:00 p.m. in surveying for accommodating vehicles. In P1 and P2, the peak hour was ranged (8:00 – 9:00) p.m., in P3 and P4 are (6:00-7:00) p.m. the peak hour in all parks are located (6:00-8:30) p.m. On the other hand, License plate method was taken for calculating PI, PD and PT, which express the efficiency of parking. From the results showed that PI of P4 is 103.33%, that mean demand is more than supply because the parking don’t use an electronic system for control entrance of vehicles and bad management for accommodation most of vehicles especially problems that occurs in entrance and in the street nearby entrance of park. Also, PI for other is below the capacity of the parking. Also, parking duration is between 2-3 hr., in addition, PT is 1.12, 0.7, 1.6 and 0.8 veh/space for P1, P2, P3 and P4 respectively.

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