Studying and evaluating the capacity of parking at commercial street in Amara city, Iraq

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Abstract. Studying and evaluating the parking is an important step in keeping up with the rapid development of parking. The present study aims to evaluate the parking capacity at one of the commercial streets in Amara city (Dijlah Street). The present study based on data that collected using special survey papers related to the parking. The collected data applied field work in order to observe and draw the actual layout for each park. Each park was planned to four cases of vehicle stall layout (90°, 60°, 45° and 30°) according to the global standards in order to obtain the designed capacity. The evaluation was implemented by comparing the actual parking situation and the new planning for each park. The current study indicates that all parking located at Dijlah Street (16 parks) are planned with a random approach for vehicles stalling. The general configuration of those parking is not plan with a constant system. From management point of view, the study presented the true guide line for parking planning, therefore; the competent authorities could be taken advantage of the study.

1. Introduction
Parking is one of the major problems that are generated by the increasing road traffic. The availability of less space in urban areas has increased the demand for parking space especially in areas like central business region [1]. Maysan governorate is from the southern governorates, which witnessed rapid and unprecedented development in all areas after 2003. The great development of the governorate in general and its center (Amara city) in particular has created several challenges in the field of social services. It is a governorate that has not prepared a realistic study in terms of population growth. This is reflected significantly on the transport network in general in terms of vehicles, type and the length of the network of main and subsidiary roads.

In Maysan, the number of private and public cars has increased from five to nine times over the past 14 years. Table 1 shows the increase in the number of vehicles from 9/4/2003 to 5/3/2017 [2]. This level of ownership of the car has led to increased levels of congestion and pollution, especially in densely populated areas. The results show an unprecedented increase in the number of vehicles, which is difficult to find any solutions. This is because the low level of annual household income before 2003, and the high rate of annual household income after 2003. In general, these large-scale vehicles need a transport network that is suitable for the size of a road network and parking lots for vehicles.

Several studies conducted in the field of parking. Some of those studies analysed the capacity of parking depending on the actual surveys through studding parking duration and time interval between vehicles arrival to a parking lot [3], [4].
Table 1. The increase in the number of vehicles during 14 year

| Type of vehicle    | Registered number in 2003 | Registered number until 2017 | The volume of increase over 14 years | Percentage of increase over 14 years |
|-------------------|---------------------------|------------------------------|-------------------------------------|-------------------------------------|
| Private vehicles  | 2200                      | 20177                        | 9.2                                 | 58.37%                              |
| Truck vehicles    | 3162                      | 16103                        | 5.1                                 | 29.23%                              |
| Taxi vehicles     | 3012                      | 20035                        | 6.7                                 | 40.37%                              |
| Construction vehicles | 200                  | 1804                         | 9.0                                 | 57.29%                              |
| Agriculture vehicles | 2800                   | 3488                         | 1.2                                 | 1.76%                               |
| Motors            | 1176                      | 3114                         | 2.6                                 | 11.77%                              |

Some of studies focused on how much curb-side to allocate to parking when the private sector provides garage parking [5]. Other researchers deliberated how to finding practical solutions to reduce the problems of parking lots and provide parking in the crowded areas [6], [12]. Several studies were conducted to lay the foundations of a methodology for parking analysis such as [7]. Also, a probabilistic approach based on the point estimate method may be useful [8]. Specific researchers develop a vision based smart parking framework to benefit the drivers in allocate and reserve an appropriate parking space [9].

The current study deal with studding and evaluating the capacity of parking at important location in the center of Amara city (Dijlah street). The evaluation process was done through the comparison between the actual and theoretical capacity.

2. Study Area
Dijlah Street locates at center of Amara city and lies from (703500 E, 3526021 N) to (703503 E, 3526032 N). It extends from Al-jumhuria Bridge to Al-saray Street with length of 1.345 km. Dijlah Street as shown in Figure 1 is considered one of the commercial and entertainment centers where the population is concentrated. The great development of this street led to create of several challenges in the field of social services. Dijlah Street is a vital center for Amara city due to the increase in the number of cars at recent times and traffic congestion and the limited space of parking available. 16 parks located at dijlah street where distributed as shown in Figure 1. Each park located a certain distance from the street, as presented in table 2 in below.

Table 2. Parking names at Dijlah Street

| NO. | Park Name       | Distance to Dijlah Street |
|-----|-----------------|---------------------------|
| 1   | AL- Iraq park   | 39.21m                    |
| 2   | AL-Jawadain     | 1 m                       |
| 3   | AL-Mustafa (1)  | 5.4m                      |
| 4   | Barber          | 75.91m                    |
| 5   | Al- Noor        | 27.29m                    |
| 6   | AL-Zahraa       | 98.4m                     |
| 7   | Dijlah Alkhayr  | 18.33                     |
| 8   | Reda-Alsudani   | 5.4 m                     |
| 9   | Sug-AL-dhab park| 60 m                     |
| 10  | Bghdad Street   | 17 m                      |
| 11  | Multi-Stories   | 80 m                      |
| 12  | AL-khiam        | 112.5 m                   |
| 13  | AL-Terbia       | 112.5 m                   |
| 14  | Misasn Park     | 63 m                      |
| 15  | AL-Mustafa (2)  | 2 m                       |
| 16  | Nioqbit Al-mulimin | 40.45m                   |
3. Methodology overview
The general methodology contains the following: first axis is the selection of study area, collect the data, and prepare the required surveys. In addition, the nature of the equipment used to study the reality of the transport network, the surrounding facilities and the nature of the prevailing movement in any direction. The second axis includes an extensive study of the designs at parking of different layout according to the nature of vehicles. The general methodology used in this study is shown in Figure 2.

Figure 1. The Study area
3.1. Data collection
This step contains field work survey using total station instrument and hand-held GPS to observe the locations of all parking in order to create the actual layout for each park. In addition, special survey paper [10] was used to collect different data and information (for example: as shown in Figure 3). These data will help us to study the capacity in each park located at the study area.

3.2. Capacity estimation
The parking capacity is estimated by two ways using two different data sources for the same park. Data collection using filed survey and survey paper will help to determine the raw and actual capacity; the design process with different cases will help to determine the theoretical parking capacity. Theoretical capacity can be divided by the area required for a vehicle parking and parking manoeuvres using the following formula [7]

\[ N_{spaces} = \frac{S - \left( \sum_{i=1}^{n} (L_i \times l_i) \right)}{a + \lambda} \]  

(1)

Where:
S: is the area of the parking area (m²).
Li: is the length of aisle i (m).
n: is the number of aisles.
l_i: is the width of aisle i (m).
\( \lambda \): is the necessary space around the vehicle for parking manoeuvres.
a: is the average area occupied by a parked car (m²).
### Off Street Parking Survey Field Sheet

| City          | district | parking name |
|---------------|----------|--------------|
| Misan         | Dijla Street | AL-Iraq     |

Recorder: Mohanad ali  
Date: 22/2/2019  
Weather condition: Sunny

Distance to main street: 39.21 m  
Parking is near to: Gala's restaurant

#### Parking specification:
- Ground area covered: 629.4225 $m^2$  
- Total parking area: 743.5350 $m^2$
- No. of vehicle stalls: 40 vehicles
- Parking surface type: Surface concrete
- Peak period: (3:00-7:00) pm, Friday (8:00 - 12:00) morning
- Work period and No. of working hours: (7:00 morning – 8:00 At night)
- Working days and rest days: Non
- Mean parking duration: Range (30-minute, 2-hour, 3 hour), vary
- entrances and exits (No. and width): 1, 4m
- aisle width: 3 m

#### Stall specification:
- Stall length: 5.5
- Stall width: 2.6
- Stall marking details: 90, 60, 45, 30, other

People with special needs parking: Non

#### Safety specification:
- 1. Security camera as
- 2. Fire Extinguisher

#### Weather protection: Non

#### Notes:

Sketches: (shows the details of)  
Outside dimensions of parking area.  
Location and width of entrances and exits.

Recorder: Mohanad ali

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*Figure 3.* A sample of survey paper used in this research [10]
3.3. Design of Off-Street Parking Facilities- Surface Car Parks

The primary aim in designing off-street parking facilities is to obtain as many spaces as possible within the area provided. Figure 4 shows different layouts that can be used to design a surface parking lot. The most important consideration is the layout should be such that parking a vehicle involves only one distinct maneuver, without the necessity to reverse. The layouts shown indicate that parking spaces are efficiently used when the parking bays are inclined at 90 degrees to the direction of traffic flow [10].

Figure 4. Parking Stall Layout [10]

4. Results and discussion

4.1. Planning of Parking

After the final layout of each park was gotten using surveying work, all parking was planned and designed with four different layouts (90, 60, 45, and 30 degrees) according to AASHTO [11]. This is will help us to choose the suitable theoretical (designed) capacity for each park. All parks (16 parks) were planned with the same approach. The next section shows the followed method for planning the Multi-Stories Park as example for design process which applied for all parks. Multi-Stories Park contains five stories and each one was planned as individually. The third and fourth stories are with the same design because they have the same layout. In the planning of this park with the required layout, the suitable design is shown in case of the planning with 90°. The theoretical capacity is as follow: in case of 90 degree, the capacity was 325, and in case of 45 degree, the capacity was 263, while in case of 30 degree, the capacity was 263 cars, and 273 cars in case of 60 degree. As a result, the best design for this park was the planning with (90) degree. Figure 5, 6, 7 and 8 show all cases of planning.

The design standards are applied for 16 parks depending on AASHTO [11], where the required dimensions for cars stall and the distance between one stall and another are drawn. In addition, the blue badge parking design is applied. The blue badge spaces used for people with disabilities which must be located adjacent to entrances [10].
Figure 5. Different layout for Multi-stories Park, first floor

Figure 6. Different layout for Multi-stories Park, second floor
Figure 7. Different layout for Multi-stories Park, third, fourth floor

Figure 8. Different layout for Multi-stories Park, fifth floor
4.2. Evaluating of parking situation

After the design capacity was obtained, the actual parking situation must be evaluated. The evaluation is implemented by comparing the actual parking capacity with the new planning for each park. Depending on the final result, there is a noted difference between the actual number of vehicles and the designed capacity in all parking. This is because the random arrangements for vehicle in all parking situated at the study area, where these parking are not following to the global standards in design process. There is a constant standard for planning the parking, but the parking located at study area used a random approach in parking stall except the multi-stories park, in this park, the planning is executed but with specific dimensions not equivalent to the required dimensions. Table 3, Figure 9 show the comparison between the actual and theoretical capacity which obtained through the planning with four cases (90°, 45°, 60° and 30°). The final results show the best planning for parking. The planning with the angle (90°) indicates to the optimal design for all parking, consequently, the result need be depended.

| Parking Name          | Actual Capacity | Theoretical Capacity |
|-----------------------|-----------------|----------------------|
|                       |                 | 90 Degree | 45 Degree | 60 Degree | 30 Degree |
| AL-Iraq               | 40              | 20        | 13        | 16        | 11        |
| Missan                | 60              | 21        | 15        | 11        | 15        |
| Barbar                | 25              | 9         | 6         | 8         | 7         |
| Reda Al-sudani        | 55              | 34        | 28        | 28        | 25        |
| Al-Noor               | 75              | 29        | 26        | 9         | 13        |
| AL-Mustafa (1)        | 250             | 28        | 18        | 12        | 16        |
| AL-Mustafa (2)        | 33              | 52        | 47        | 45        | 35        |
| Nioqbit Al-mulimin    | 50              | 31        | 20        | 17        | 15        |
| AL-Zahra              | 40              | 16        | 16        | 14        | 13        |
| Sug-AL-dhab           | 40              | 15        | 11        | 12        | 10        |
| AL-Terbia             | 35              | 17        | 18        | 14        | 19        |
| Multi-Story           | 390             | 325       | 285       | 273       | 263       |
| AL-Jawadain           | 45              | 57        | 39        | 49        | 28        |
| AL-Khiam              | 46              | 29        | 17        | 15        | 20        |
| Dijlah Alkhayr        | 120             | 75        | 55        | 62        | 56        |
| Baghdad Street        | 50              | 25        | 17        | 14        | 16        |

Figure 9. Chart shows the actual and theoretical capacity at cases (90°, 45°, 60° and 30°)
5. Conclusions
In order to evaluate the parking at study area, several methods for analyzing data must be applied. The result of the study indicated that all parking is not using the modern designs for parking where the traditional approaches are useful. All parks are depending a random approach for vehicles stall except the multi-stories park, where there is a specific planning for vehicles arrangement but not conform to the global standards. Through the process of collecting information and interviews with parks owners can be concluded that their main goal was economically regardless of building appropriate design layout of the stalls for the parking. The study indicated that all parks are planned with the angle 90° although there are different cases for vehicle stopped. The study showed that the suitable theoretical capacity (designed capacity) when the parking is planned with the angle 90°.

6. References

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