Characteristics of on-street parking in Al-Diwaniyah urban street

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ABSTRACT

By creating enough parking places, cities may be able to lessen congestion and traffic disruption. Thus, the primary issue that frequently arises in urban areas is on-street parking. In Al-Diwaniyah city's urban streets, on-street parking is a common occurrence. In order to analyze on-street parking characteristics, this study has concentrated on three congested sites: Al-Orzady Street, Al Saray Street, and Almusawreen Street. Thus, field data were collected using in-out method. The characteristics and kind of parking were looked into. According to the activities at the three sites, it was mostly discovered that the peak time is in the afternoon between 3:10 PM and 4:40 PM. The results of the data analysis show that St3 has a high parking turnover of 1.348 and St1 has a low turnover of 0.67. It was also found through the questionnaire paper that the majority of the vehicles parked on the street are for the purpose of shopping. Finally, the results indicate that weekdays in the research area are a typical time for illegally parking.

1. Introduction

At the present time, there are many factors that encourage an increase in the demand for transportation, and consequently the number of vehicles increases, and with this increase, the demand for parking lots increases [1]. Increasing the number of cars that visit a particular location, it is required to provide parking for vehicles in that area [2]. Because of the rapid industrial development that the world is witnessing today, it has led to economic growth and a high level of income for the population. Therefore, we notice an increase in the number of privately owned vehicles [3]. The large number of vehicles in urban areas has increased the demand for parking spaces [4]. Most people prefer to do many activities at the same time and in one area, so the government and stakeholders must have the ability to provide various public utilities [5]. In the most city center, there is competition over the use of space between different urban activities. The authorities must consult and control for the purpose of giving the appropriate use of each place [6]. There have been many developments in the past decades in order to improve roads and meet parking requirements, the situation is constantly changing, which requires a new approach [7]. Most countries suffer from traffic problems at the present time due to the increase in vehicle ownership and the unattractiveness of public transportation, as well as limited parking spaces [8]. Public parking as an urban infrastructure is among the best parts of the urban transportation framework beyond reducing traffic on street corners [9]. City centers suffer from constant overcrowding due to their inability to provide sufficient parking spaces as a result of an increase in the number of cars heading to the city center, which represents the commercial and economic part of the city [10]. Since the number of vehicles has increased in cities, it has become more difficult to obtain parking for vehicles, and because of the slow driving of the driver while looking for a suitable place to park, it causes

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traffic congestion on the street, and this is a serious problem [1]. One of
the negative effects on the flow of traffic is the parking of vehicles in the
road in order to obtain a place to stop [12]. At the beginning of the twentieth
century, a parking system was built in response to the use of storage areas
for automobiles [13]. As a result, much of the current research is directed
towards determining the role of the various factors that influence parking
policies. There is a previous study that worked in China to know the
characteristics of parking lots in the center of Shanghai, and the facilities
were analyzed based on parking indicators. It was found that market areas
and areas designated for food and drink show a high saturation of parking
spaces. Therefore, parking improvement policies have been proposed in
Shanghai city based on the current parking situation in the city (Chen et
al. 2016). A study was conducted in the city center of Najaf in both
locations (Al-Rawan, Al-Iskan) in order to verify the characteristics of
parking on the street. Data were collected by manual census, drones, and
video camera. The results indicated that the waiting time for most cars in
all the two locations (Al-Iskan, Al-Rawan) is more than 80% for a period
of 30 minutes (Al-Jameel and Muzhar, 2020). Study was conducted in the
city of Bat Yam to estimate parking patterns in the city, where it relied on
a spatially high-resolution display of heterogeneous demand and supply of
parking, as it was shown that the time approaches zero if the distance
between the place of parking the vehicle and the destination is less than 50
meters and the time reaches 4.5 minutes if the distance is 200 meters [14].
A study was conducted in the city center of Hilla, to address the problem of
high demand for on-street and off-street parking. Where he explained that
the vehicles parked on the street contribute to traffic accidents and affect
safety, so he suggested using some small spaces for the purpose of making
parking spaces for vehicles. [15]. Several studies of parking spaces were
made in nine sectors in Delhi, the business district where the peak for
parking was 3.25, as well as the peak for bicycles was 6.21, which indicates
a significant indirect condition (Mahmoud, 2011). There is a previous study
in Iran in the city of Sanandaj in which geographic information systems
were used to determine the parking spaces of vehicles, as it was shown that
234,887 m² or 14.16% of the study area would be suitable for constructing
parking spaces [9]. Among the factors that affect the choice of a place to
park vehicles (the distance that the driver walks from the parking place to
the exits of the car park, protecting the vehicle from sunlight, the safe place
to park the vehicle, the distance from the entrance to the parking lot to the
area where the car is parked) [16]. Urban planning often exceeds parking
problems and this is a reason for increasing traffic congestion in urban
areas, so solutions must be made during planning and design and improve
the level of management [17]. The urban planning of the city must take into
account the parking spaces [18]. Al-Diwaniyah city is one of the Iraqi cities
in which there are many daily commercial activities in general. The
majority of the activities in the city are concentrated in the central business
area (CBD), — in other words, the economic center of the city, where
people must be able to reach the places where we get activities easily.
Increasing demand for mobility the need to provide many parking spaces to
accommodate the number of parked cars increases [19]. Al-
Diwaniyah city suffers from scarcity of parking places in several regions such as Al-
Orzady Street, Al Saray Street and Almuswseen Street. [20] found that on-
street parking decreases roadway capacity in two ways. For begin, it
minimizes the width of the highways by limiting the traffic flow. Second,
overuse of parking of vehicles contributes to congestion in urban areas.
These two parking places on the street cause a reduction in road capacity
city streets.
This study’s aim is to evaluate on-street parking behavior in metropolitan
streets like, Al-Orzady Street, Al Saray Street, and Almusawinian Street in
Al-Diwaniyah city, because there are few or no studies that deal with on-
street parking in Al-Diwaniyah city or in Iraq in general. The aim of this
study may be achieved by gathering information and comprehending the
quantity of parked cars on both sides of the street as well as the properties
of street.

1.1 Parking characteristics
In the initial stage of the study, it is required to determine the number of
parking spots and to take sufficient and relevant information for the goal of
deriving different characteristics linked to on street parking, which are
called parking stats or characteristics. In generally, the following criteria
are utilized for car parks [21]:

1. Parking volume: The total number of cars parked at one time is
known as the parking volume. The recurrence of vehicles is not
taken into account. It is tracked how many vehicles actually enter
the region.

2. Parking accumulation: the quantity of parked cars in a studied
area at any specified instant. The fluctuation in parking
accumulation throughout the day can be shown by plotting this
data as a parking accumulation vs. time curve.

3. Parking load (space-hour): The area under the accumulation curve
is provided by the parking load. It can also be calculated by merely
multiplying the quantity of automobiles parked in the designated
location at each interval by the interval. It is described as (space-
hours).

\[ Parking\ load = \text{time interval (hr)} \times \sum \text{parked vehicles at each time interval} \]

4. Average parking duration is the amount of time a car is left parked
in a space. An indication of how frequently a parking place
becomes available is provided when the parking duration is
presented as an average. It represents the proportion of total
vehicle hours to the quantity of parked cars.

\[ Parking\ duration = \frac{Parking\ load}{Parking\ volume} \]

5. Parking turnover: is how frequently a parking place is used. It is
calculated by dividing the volume of parking for a given time
period by the quantity of parking spaces.

\[ Parking\ turnover = \frac{Parking\ volume}{\text{No. of bays available}} \]

6. Parking index: The term occupancy or efficiency also applies to
the parking index. It is described as the proportion of the total
space that is accessible to the number of bays that are occupied
throughout time. It provides a total assessment of how well the
parking space is used. Parking index can be found out as follows:

\[ f = \frac{Parking\ load}{Parking\ capacity} \times 100 \]

2. Methodology
The demand for parking lots varies by region. In this research, the city
center of Al-Diwaniyah (commercial center, government departments and
offices) was selected. Al-Diwaniyah City is the administrative, economic,
and political center of Al-Diwaniyah Governorate and one of the cities in...
Iraq in the middle Euphrates region. Fig 1 show the location of Al-Diwaniyah city.

It is crucial to get parking information from urban streets in order to research the effects of on-street parking. Al-Orzady Street, Al Saray Street, and Almuswreen Street are the first three locations that have been chosen for this project to study its characteristics in the evening period. In Al-Diwaniyah city, these locations are among the busiest ones on-street parking. Fig 2 show the border of study area.

![Figure 1. A map of Iraq showing the location of the city of Diwaniyah](image)

![Figure 2. Screenshot for the study area](image)

The number of all vehicles parked on and off streets in the study area was calculated at the morning and evening at different days, and the parking sites on the street were chosen using the GIS application, which was also used to estimate the length of the street allowed for stopping. The attributes were ascertained using the in–out survey method. To find out why the car was parked on the street, a questionnaire was also created.

### 3. Data collection

The data of this study were collected for the purpose of finding the characteristics of parking in Al-Orzady Street, Al Saray Street, and Almuswreen Street at the evening period. The study does not include standing in the squares. The survey was conducted using the in–out method. Where three ways were chosen in which vehicles are allowed to stop, the survey that was conducted counted the number of vehicles parked on the street at the beginning of the survey, and counted the number of vehicles that parked or left the street at certain periods of time. The Fig 3 shows an aerial picture of the city center of Al-Diwaniyah, showing the roads for which, the survey was conducted. Streets for which properties were found ST1 Orzady Street, ST2 Saray Street and ST3 Street of Almuswreen. Table (1) show the information of on street parking in ST1, ST2, ST3.

![Figure 3. Location on-street parking in the study area](image)

| Street name | Width (m) | Length (m) | Number of lanes | Direction of flow | Number of spaces | Type of parking |
|-------------|-----------|------------|-----------------|------------------|-----------------|----------------|
| ST1         | 13        | 90         | 2               | One way          | 20              | One side (45 angle) |
| ST2         | 10        | 290        | 2               | Two way          | 50              | Both sides (parallel) |
| ST3         | 20        | 195        | 2               | Two way          | 43              | Both sides (parallel) |

Table 1. Existing on-street parking survey in Al-Orzady Street ST1, Al Saray Street ST2, and Almuswreen Street ST3.

Then a survey was conducted to determine the number of parked vehicles in all of the streets of Al-city Diwaniah's centre in the study area, as well as the number of parked vehicles in 22 parking spaces located in the city centre of Al-Diwaniyah. Fig 4 show the location of on street and off street parking lots in the study area.

![Figure 4. Screen shot for all roads and parks in the study area](image)
A questionnaire was undertaken in Al-Orzady Street, Al Saray Street, and Almuswreen Street. 60 vehicles were taken in the streets to determine the reason of parking a vehicle on the street, as well as the duration the vehicle was parked. According to the instructions on the questionnaire sheet. Shown in Table (2).

Table 2. The questionnaire sheet

| The name of on street vehicles which are allowed to park | St1 | St2 | St3 |
|--------------------------------------------------------|-----|-----|-----|
| Car no.                                                |     |     |     |
| The reason for stopping the vehicle                    |     |     |     |
| Shopping                                              | X   |     |     |
| Shop owner                                             |     | X   |     |
| Doctor review                                          |     |     | X   |
| Min hr.                                                |     |     |     |

Table 3. The demand for on-street and off-street parking for all of the local parked vehicles (22 park).

| Parking type     | Thursday (10:00Am. 2/12/2021) | Friday (4:30 P.m. 3/12/2021) | Wednesday (10:00Am. 8/12/2021) | Wednesday (4:30 P.m. 8/12/2021) |
|------------------|--------------------------------|-----------------------------|--------------------------------|----------------------------------|
| Off-street       | 749                            | 805                         | 586                            | 546                              |
| On-street        | 1626                           | 1501                        | 1539                           | 1250                             |
| Total            | 2375                           | 2306                        | 2125                           | 1796                             |

Table 4. The parking characteristics for the selected on-street parks at the evening

| Street name | Peak time | Peak parking accumulation | Parking load | Parking volume | Parking index | parking duration | Parking turnover |
|-------------|-----------|---------------------------|--------------|---------------|--------------|------------------|------------------|
| ST1         | 4:10PM    | 00:20                     | 2030         | 0030          | 37.59%       | 67.670           | 0.670            |
| ST2         | 3:10PM    | 00:45                     | 4860         | 0059          | 69.8%        | 82.37           | 1.017            |
| ST3         | 3:10PM    | 00:44                     | 4810         | 0058          | 93.22%       | 82.93           | 1.348            |

4. Results and discussion

In this research, what was inferred from the data collected in Al-Diwaniyah city center, where it was found that the total number of vehicles that parked on the street and the total number of vehicles parked in the parking. It was found that the number of vehicles parked in the street is twice the number of vehicles in the parking as shown in the Table (3) and Table (4) show the characteristics of on street parking at the evening in Al-Orzady Street, Al Saray Street and Almuswreen Street.

From Fig 5 found that the peak times for Al-Orzady Street ST1 are at (4:10 and 4:40 pm), Al Saray Street ST2 (3:10 and 3:20) while the peak times for Almuswreen Street ST3 are at (3:10, and 3:40 pm), because it is located in the center of Al-Diwaniyah, which is the commercial and administrative center of the city. Where these time periods are considered the time when most people perform their work in commercial areas and areas that contain medical centers, and after this time we notice a decrease in the number of vehicles parked on the street.

What was discovered from the questionnaire survey that took place in ST1, ST2, and ST3 to determine the reason for parking the vehicle on the street, as shown in the Fig 6.

The majority of parked vehicles are for the purpose of shopping, at a rate of 55%, 38 percent are for shop owners, and 7% are for the purpose of visiting medical facilities, as seen in the Fig 6.

What has been observed in the roads that have been studied is that the process of parking vehicles on the street occurs on a daily basis and can have a number of negative consequences, including a negative impact on traffic flow and a reduction in vehicle speed as a result of obstructing traffic, as well as a negative effect on road capacity and congestion.
5. Conclusions

The following conclusions are based on this study:

1- The peak time for ST1 (4:10 and 4:40 pm), ST2 (3:10 and 3:20) and ST3 are at (3:10 and 3:40 pm).

2- The average turnover for ST1, ST2, ST3 are (0.67, 1.017, 1.348). This suggests that the efficiency of existing parking spaces with low average turnover is less performance.

3- The high value of parking index in ST3 93.22% while the low value in ST1 37.59%.

4- Some people prefer to park the car on the street, because free parking.

5- Most of the vehicles parked on the street are for the visiting shopping center, because commercial area is the main area in the city, which attracts large numbers of people for shopping, in addition to government departments, offices and nearby banks, so this area needs to provide parking for vehicles with a high capacity and provide protection for the vehicle.

6- The paper indicates promoting advanced mobility technologies, such as smart parking.

REFERENCES

[1] Murad, A.A., Creating a GIS application for retail centers in Jeddah city. International Journal of Applied Earth Observation and Geoinformation, 2003. 4(4): p. 329-338.

[2] Surono, M. and S.B. Wasono, Evaluation of Parking Performance in the Maulana Malik Ibrahim Gresik. The Spirit Of Society Journal, 2019. 3(1): p. 11-20.

[3] Parmar, J., P. Das, and S.M. Dave, Study on demand and characteristics of parking system in urban areas: A review. Journal of Traffic and Transportation Engineering (English Edition), 2020. 7(1): p. 111-124.

[4] Cherian, J., et al. Parkgauge: Gauging the occupancy of parking garages with crowdsensed parking characteristics. in 2016 17th IEEE International Conference on Mobile Data Management (MDM). 2016. IEEE.

[5] Kain, A.I., Evaluation of Parking characteristic on International Ferry Port. International Journal of Engineering Inventions, 2021. 10(7).

[6] Golas, J., G. Yannis, and M. Harvatis, Off-street parking choice sensitivity. Transportation Planning and Technology, 2002. 25(4): p. 333-348.

[7] Tiwari, N., Simulation Based Evaluation of Parking Facilities 2006.

[8] Margreiter, M., F. Orfanou, and P. Mayer, Determination of the parking place availability using manual data collection enriched by crowdsourced in-vehicle data: Transportation research procedia, 2017. 25: p. 497-510.

[9] Karmi, H., et al., Identifying public parking sites using integrating GIS and ordered weighted averaging approach in Sanandaj city, Iran. J Crit Rev, 2020. 7(4): p. 506-513.

[10] Han, Y., et al., Optimization design and evaluation of parking route based on automatic assignment mechanism of parking lot. Advances in Mechanical Engineering, 2017. 9(7): p. 1687814017712416.

[11] Miura, S., Y. Zhan, and T. Kuroda. Evaluation of parking search using sensor network in 2006 1st International Symposium on Wireless Pervasive Computing. 2006. IEEE.

[12] Karasuci, F. and Y. Iida. Simulation Analysis on the Evaluation of Parking Reservation System. in Eastern Asia Society for Transportation Studies. 2008. Citeseer.

[13] Neamah, Z.K., S. Al-Busaltan, and Z. Al-jwahery, Developing a Relationship Between Land Use and Parking Demand for The Center of The Holy City of Karbala Health, 2017. 2059: p. 0.15.

[14] Levy, N. and I. Benenson, GIS-based method for assessing city parking patterns. Journal of Transport Geography, 2015. 46: p. 220-231.

[15] Al-Jameel, H.A.E. and R.R. Muzhar. Characteristics of On-street Parking On-street Parking in Al-Najaf City Urban Streets. Transportation Research Procedia, 2020. 45: p. 612-620.

[16] JI, Y., W. WANG, and W. Deng. Micro-level parking behaviors within parking facilities and optimal parking space choice model. Journal of Southeast University (Natural Science Edition), 2009. 39(2): p. 399-403.

[17] Ibrahim, H. Car parking problem in urban areas, causes and solutions in 1st International Conference on Towards a Better Quality of Life. 2017.

[18] Yaliniz, P., et al., Evaluation of Park & Ride Application with AHP and ANP Methods for the City of Eskisehir, Turkey. Journal of Urban Planning and Development, 2022. 148(1): p. 04021066.

[19] Farhan, S.L., I.A. Jasim, and S.K. Al-Mamoori, The transformation of the city of Najaf, Iraq: Analysis, reality and future prospects. Journal of Urban Regeneration & Renewal, 2019. 13(2): p. 160-171.

[20] Charlton, S.G. and P.H. Baas, Speed change management for New Zealand roads. 2006: Land Transport New Zealand Wellington, New Zealand.

[21] Noyce, D.A., Review of Traffic and Highway Engineering, by Nicholas J. Garber and Lester A. Hoel: CENGAGE Learning, Toronto ON, Canada, 2009. 1.230 pp. Price: $160. 2009; American Society of Civil Engineers.

[22] MAHMOUD, T. S. 2011. تقييم تكلفة موقف السيارات في مركز مدينة الرمادي Journal for Engineering Sciences