Off-street parking characteristics in Al-Hilla City Center

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Abstract: Parking problems in an urban area are one of the serious problems everywhere, especially in Iraq. Therefore, this study has mainly focused on investigating parking characteristics in the city center of Al-Hilla. These parking characteristics include average turnover and efficiency for off-street parking. Sixteen off-street parking sites have been surveyed through this study. These facilities are within the CBD area in the city. The main results demonstrate a sharp lack of legal parking for off street and most of existing ones are illegal. The average turnover for off-street parking ranges from 1.9 to 2.6 which shows low utilization of each space with the city centre. The study has specific limitations to improve the parking activities with more sophisticated methods of managing off-street parking demand.

Keywords: Parking demand, on-street parking, average turnover.

1. Introduction

The Central Business District (CBD) in any city represents major activities creating high demands on parking spaces which are already limited in such areas. Understanding parking behavior is an effective way to analyze the effects of parking policy measures [1]. Parking facilities are mainly considered as an essential element of the highway mode of transportation. Any vehicle traveling on highways is usually parked at one time or another at some points for either a relatively short time or a much longer time, based on the reason for parking. In high density areas, especially in the city center; providing sufficient parking bays to meet the parking demand is very necessary to improve the capacity of the streets and absolutely affects the performance of traffic operation. Less space availability in urban areas results in increasing the parking space demand, especially in CBD affects the choice of mode and has a great economic impact [2].

In many urban centers, some areas are entirely assigned for parking which will be at some distance away from the mainstream of traffic. Such a parking is referred to as off-street parking. They may be run by either public agencies or private companies [3]. Other types of parking are called on-street parking or curb parking which could be parallel or angled parking at different angles. This study aims to evaluate the performance of parking facilities within the CBD area in Al-Hilla city.

2. Transport Demand Management

Transport Demand Management (TDM) tries to affect the individual behaviour of travel [4], as part of a package of factors which intended to encourage choosing the most sustainable travel means. Therefore, the aim of TDM measures is to change the selection made by individuals for the type of transport chosen to make a trip to a destination, i.e. a decision about which location wanted to travel to, or whether to own a vehicle at all [5]. Table 1 indicates the examples of TDM measures. This table indicates specifically that parking is the most important measures in the three types of measurements.

A parking aspect has a significant effect in TDM measures and has a central role in minimizing the negative influence of car use in urban areas. In Iraq, the parking system is so traditional and not as in
the developed countries such as in the UK. Different kinds of parking pay are in the UK and these parking either belong to the public sector (local government authorities) or private organizations; one of which is the commonly known private vehicle parking provider NCP (National Car Parks Ltd.). Parking can be classified into: publicly-owned on-street parking spaces; public off-street surface or multi-story car parks; privately-owned off-street parking is usually related to commercial uses; and private residential parking is provided only for the utilization by owners or tenants of the identified residences [6,7].

Table 1. TDM measures [adapted from 8]

| Type Measures            | Measures                                                      |
|--------------------------|---------------------------------------------------------------|
| Economic Measures        | Fuel tax                                                      |
|                         | Parking charges                                               |
|                         | Public transport subsidization                                 |
|                         | Road user charging                                            |
| Land Use                 | Land use and transportation strategy such as car-free developments and location of new developments |
|                         | Park and Ride facilities                                     |
| Information for Travellers| Travel information before a trip is undertaken                |
|                         | Car sharing                                                   |

As the level of car ownership increases in large cities, such as in Lithuania which is considered to be one of the Baltic states, it could cause a high lack of parking bays in multi-storey housing areas. Most of residential districts witness a problem of the high number of cars parking adjacent to residential houses [9]. According to the road safety point of view, this phenomenon is dangerous because these parked cars block the subways, sidewalks and green spaces, and considerably worsens the quality of life for local residents. One of the ways to minimize the demand for parking lots in urbanized areas is to utilize the parking lots of neighbouring shopping centres. The development of shopping centres in a periphery fulfils the needs of investors to acquire cheaper land, uncomplicated design and construction, and quick payback of investments [10].

Based on the Lithuanian Construction Technical Regulation (STR) the shopping centre shall ensure the minimum number of parking spaces, 20m² area of the shopping shall be accommodated with 1 parking space [11].

3. Parking in Al-Hilla city

Nowadays, a suitable vehicle parking space in big and median cities is one of the most common problems. Al-Hilla is considered as a medium city in Iraq. This city witnesses an obvious increase in population, and it extended broadly; however, the parking facilities are still limited and there is an absence of sophisticated method of parking management [12].

4. Transportation infrastructure expansion index

Elnaggar [13] conducted an analysis of the expansion in transportation infrastructure depending on the three categories of roads in Al-Hilla city: highways, main roads and secondary roads. The road length increased rapidly from 202 km in 1999 to 425 km in 2007 (about 52.5% increase in road infrastructure with an annual rate of 6.56%). The road length also increased from 425 km in 2007 to 585 km in 2015 (about 27.3% increase in road infrastructure with an annual rate of 3.40%). Secondary roads were rapidly increasing during the studied period. Most of these secondary roads serve as main access
points for residential development especially when they have good connectivity with the main roads [13]. This also leads to increase in the demand for both off and on-street parking.

5. **How to encourage using public transportation at Al-Hilla city**

The suggestion of using public transportation facilities is to encourage employers to use these facilities to decrease the use of private transportation [14]. The study conducted by Dawood comprises a survey conducted on employers during the three months (March–May) (2017–2018) [14]. A total of 300 questionnaires were personally distributed inside the center of Al Hilla city and interviews were conducted with the employers. The survey results obtained the following statistics: 58% (the majority) of the people use cars inside the city, 31.4% take the bus, 7.6% use motorcycles, and 3% (the least percentage) use bicycles and walking. There are some strategies to improve usage of buses such as: increasing parking fees inside the city, increasing the number of buses inside the city and making them free. These strategies are effective in making use of bus transportation popular and the time between facilities should be made reasonable. Limiting the parking space can also be helpful to shift employers to use public mode [14].

6. **Parking surveys**

In this survey, the occupancy count in the selected parking lots is determined at the start of this task. Then the number of cars that enter the parking lot for a specific time interval is taken. The number of cars that leave the parking lot is also counted.

The license plate method was conducted in this study. It is thought to be more accurate and realistic data. Every parking space is monitored at a continuous interval of 30 minutes and the license plate number is written down. This provided the data regarding the duration for which a particular car was utilizing the parking space. This study has only focused on off-street parking.

7. **Study Area**

Al-Hilla city is the center of Babylon governorate in Iraq. It is located between these coordinates 44° 22’ 12.426” – 44° 22’ 12.554” E and 32° 24’ 23.54” – 32° 31’ 57.4767” N. It covers an area of about 161 km² as illustrated in Figure 1.

It has a population of about 465524 in 2015, according to the Iraqi Ministry of planning statistics. The area of study represents the central part of Al-Hilla city. This area compasses about 5.0 square kilometers surrounded by the following cities: Ha Babel from the north, Al Nezeza from the west, Al Shawe from the south and 60 streets from the east.
Figure 1. The map of Al-Hilla City and its road network in 2015 [13].

8. Data collection
The survey was conducted during January and February 2019. Each survey lasted for three hours and each off-street parking within the study area has been covered completely by using an inventory form. The survey has been implemented manually.

Sixteen parks have been chosen in the study area because they represent all off-street parking in this area. These parks are shown in Table 2. This table indicates the time of survey, the duration, the number of spaces depending on the occupied area assigned for each vehicle, and the peak value of accumulated parking vehicles for each park.

These parking facilities are: Al-Nessaa Park1 (P1), Park 2 (P2), Park 3 (P3), Park 4 (P4), Park5 (P5), Saad Park (P6), Alrahmaa Park (P7), Al tegara room Park (P8), Al akhwaan Park (P9), Park 10 (P10), Park 11 (P11), Park 12 (P12), Park13 (P13), Park14 (P14), Park15 (P15) and Park16 (P16) as indicated in Figure 2.

| Site No | Date     | Spaces | The Peak value | Peak hour    |
|---------|----------|--------|----------------|--------------|
| P1      | 11/1/2019| 80     | 80             | (3:00 -- 4:00)PM |
| P2      | 13/1/2019| 50     | 30             | (4:00 -- 5:00)PM |
| P3      | 15/1/2019| 120    | 70             | (4:00 -- 5:00)PM |
| P4      | 18/1/2019| 60     | 40             | (11:00 -- 12:00)AM |
| P5      | 20/1/2019| 82     | 68             | (3:00 -- 4:00)PM |
| P6      | 23/1/2019| 170    | 150            | (3:00 -- 4:00)PM |
| P7      | 25/1/2019| 192    | 68             | (11:00 -- 12:00)AM |
| P8      | 31/1/2019| 70     | 30             | (4:00 -- 5:00)PM |
| P9      | 7/2/2019 | 45     | 15             | (4:00 -- 5:00)PM |
| P10     | 9/2/2019 | 125    | 120            | (3:00 -- 4:00)PM |
| P11     | 15/2/2019| 50     | 30             | (10:00 -- 11:00)AM |
| P12     | 22/2/2019| 50     | 30             | (9:00 -- 10:00)AM |
| P13     | 23/2/2019| 60     | 30             | (4:00 -- 5:00)PM |
| P14     | 25/2/2019| 50     | 30             | (4:00 -- 5:00)PM |
| P15     | 27/2/2019| 60     | 30             | (4:00 -- 5:00)PM |
| P16     | 26/2/2019| 50     | 20             | (4:00 -- 5:00)PM |
9. Data Analysis and discussion

Before starting the analysis of field data, the explanations of some of the terms used are as follows: firstly; the accumulated vehicles could be determined by checking the occupancy of each space every 30 minutes during the time of survey. Secondly; the average turnover represents the number of vehicles occupying specific space during the specific time. Finally, the capacity here represents that the number of parking vehicles equal to the number of spaces in specified park.

The percent of accumulated curves or the percentage of occupancy for these sixteen parking facilities have been indicated in figures 3 to 6. For example, both P1 and P3 are approximately within the capacity during the survey period. Similarly, P5, P7 and P16 are as indicated through these figures. Figure 3 demonstrates the percentage of occupancy (the accumulated curves) for P1 to P4. This figure indicates how these parking facilities reach their capacities at different times. For Figure 4, however, two of these parking facilities, P8 and P6, are less than their capacities during the time of survey. The same indication has been observed through figures 5 and 6. The survey has been implemented through different periods of time as indicated in table 2 concentrating on the peak period for each park. However, some of these parks did not reach their capacities. This could be mainly attributed because of lack of information by drivers about available spaces in these parks. This could be clearly seen through wide-spreading of illegally parked vehicles according to drivers' opinions investigated in the study area.

Figure 2. Location of parking lots in study area
Other important characteristics have been clearly indicated in Table 3 such as, parking volume, average turnover, occupancy, parking load and efficiency. The average turnover is mainly from the obvious indication about the number of times at which each space has been utilized. Therefore, P5 and P12 have the highest indices of utilization than other parks whereas P10 has the minimum usage than other parks.
Figure 5. The occupancy% for P9, P10, P11 and P12.

Figure 6. The occupancy% for P13, P14, P15 and P16.
On the other hand, the average efficiency is approximately the same for the most of these parks which is about 80%. However, even the parking demand is as high as observed in the field but some of the parks are still under capacity. This may be due to the lack of information about the availability of spaces by drivers in this area.

For more clarification, some results have been indicated in different figures. Figures 7, 8, 9 and 10 represent the average turnover, occupancy, parking load and efficiency, respectively.

### Table 3. Parking characteristics for surface parking in study area

| Parking number | Parking volume | Average Turnover | Average Occupancy | Parking Duration | Parking Load | Efficiency |
|----------------|---------------|------------------|-------------------|-----------------|-------------|------------|
| P1             | 143           | 1.98             | 84.9              | 76.78           | 61          | 84.7       |
| P2             | 115           | 2.34             | 95.5              | 68.86           | 44          | 89.7       |
| P3             | 199           | 2.21             | 87.6              | 71.3            | 18.83       | 87.59      |
| P4             | 149           | 2.29             | 84.3              | 66.2            | 54.8        | 84.3       |
| P5             | 214           | 2.6              | 83.1              | 57.4            | 68.3        | 83.3       |
| P6             | 335           | 2.39             | 88.5              | 66.6            | 124         | 88.5       |
| P7             | 380           | 2.42             | 84.8              | 63              | 133.16      | 84.8       |
| P8             | 133           | 2.18             | 71.8              | 59.3            | 43.8        | 71.8       |
| P9             | 98            | 2.33             | 82                | 63.3            | 34.5        | 82.1       |
| P10            | 241           | 1.92             | 90.8              | 56.51           | 113.5       | 90.8       |
| P11            | 107           | 2.37             | 80.6              | 61.1            | 63.3        | 80.7       |
| P12            | 78            | 2.6              | 66.65             | 42.3            | 18.3        | 61.1       |
| P13            | 79            | 2.15             | 77.8              | 64.9            | 35          | 77.7       |
| P14            | 89            | 2.1              | 89.25             | 75.84           | 37.5        | 89.2       |
| P15            | 118           | 2.2              | 84.8              | 68.6            | 45          | 84.9       |
| P16            | 104           | 2.31             | 73.9              | 57.6            | 33.3        | 74         |

![Figure 7. Average turnover for all surveyed parks.](image_url)
Figure 8. Average occupancy for all surveyed parks.

Figure 9. Average parking load for all surveyed parks.

Figure 10. Average efficiency for all surveyed parks.
10. Suggested improvements

Referring to Sections 2, 3 and 4, in addition to the above discussion, there is a real need to provide the suitable information of the availability of gap in each park. Because it was noticed during the survey there is no information about the off-street parking either by signs or internet messages. This makes the drivers take a long time to search for parking or park illegally resulting in congestion and blocking other movements. So, the main solution is to adopt intelligent transportation system or applying the smart parking system such as using sensors and variable message signs as mentioned by Alabassi and Al-Jameel [15].

11. Conclusions and recommendations

1. Al-Hilla CBD area suffers from a parking problem as noticed by field survey and there is an obvious lack of off-street parking.
2. The number of off-street parking in the study area is limited. However, two parks are under 80% of occupancy (P8 and P12) which could be due to lack of guiding information for these off-street parking facilities.
3. The highest value for average turnover is 2.6 for just two parks whereas the average turnover for the rest is approximately 2. The average turnover is considered moderate which could be improved by putting parking fee per hour.
4. The average occupancy and efficiency indicate that there is a need for providing more information about the availability of spaces within each park using modern means.

References

[1] Teknomo K and Kazunori H 1997 Parking behavior in Central Business District-A case study of Surabaya, Indonesia, EASTS Journal, Vol.2 (2), pp 551-570
[2] Al-Obaidi M. Ahmed A, Aboud S, Khalaf A, Ibrahim I and Abdullah B 2018 Analysis of parking performance of public off-street parks in Baghdad City. International Journal of Advances in Scientific Research and Engineering (IJASRE). Vol.4 (7), pp111-125
[3] Kadiyali L 1987 Traffic Engineering and Transportation Planning Khanna Publishers, New Delhi, 1987
[4] Ison S and Rye T Eds 2008 The Implementation and effectiveness of transport demand management measures: An international perspective Ashgate Publishing Ltd., Aldershot, UK.
[5] Ison S and Mulley C 2014 Introduction in Parking: Issues and Policies. Transport and Sustainability, Emerald Group Publishing Ltd., Bingley, UK.
[6] Ison S 2014 Parking Management Policy: Its Potential in Improving Urban Traffic Flows. European Automobile Manufacturers Association (ACEA), Brussels, Belgium.
[7] Rye T and Koglín T 2014 Parking: Issues and Policies. Transport and Sustainability, Emerald Group Publishing Ltd., Bingley, UK.
[8] Brooke S 2015 Factors Influencing urban On-street Parking Search Time using a Multilevel Modelling Approach. PhD Thesis, Loughborough University
[9] Palevičius V, Burinskienė M, Podvezko V, Paliusis G, Šarkienė E and Šaparauskas J 2014 Research on the Demand for Parking Lots of Shopping Centres (https://www.researchgate.net/publication/308662049)
[10] Burinskiene M and Munch H 2003 Traffic development in Lithuania and East Germany (The Former GDR) in the past twenty years. Urbanistica Architektura Vol.17, pp 3-10
[11] Zagorskas J and Palevičius V 2011 Estimation of efficiency of retail centers car parking-lots. The 8th International Conference “Environmental Engineering”: Selected papers, pp 1014-17
[12] Yassin 2015 Reality study about vehicles positions in Al Hilla City, Iraq. Babylon University Journal of Scientific & Engineering Research Vol. 23(1)
[13] ElNaggar A, Elmwafi M and Ismael M 2016 Road network and its evaluation for sustainable development in Al-Hilla City, Iraq. *International Journal of Scientific & Engineering Research, Vol 7*(10), pp 2229-5518

[14] Dawood S 2018 Factors that effect on shifting employers to use public transportation at Al-Hilla City by Logit Method. *International Journal of Scientific & Technology Research Vol 7* (8)

[15] Alabassi S and Al-Jameel H 2018 Design and Study of a Smart Park System: University of Kufa as a Case Study. *Engineering Journal of Kufa, Vol 9* (4)