

## Parking Study in Al- Mustansiriya University Main Campus

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### Abstract

*Parking at universities campus has its environment and character and, it is not accurate to formalize generalized planning factors for this traffic and parking generators without some detailed study. The main purpose of this study is to evaluate and analyze the current parking supply and demand for Al-Mustansiriya campus for the target year 2015. The study consists of parking supply inventory, license plate survey and parkers questionnaire survey,. Data collected related to campus population and car ownership. The data were analyzed to determine major parking characteristics in the study area and identify the current parking inadequacies and the anticipated future parking situation in the study area. Based on the analysis of future parking demand, the growth and development within the university campus, the future parking demand is expected to exceed the current parking supply. According to the developed projection formulas the additional parking supply needed by the target year 2015 are 644 spaces to accommodate the future parking demand in university campus area.*

**Keyword:** Parking Supply, Parking Demand and Parking Studies.

### الخلاصة :

ان الوقوف للمركبات في حرم الجامعات لها ظروفها وخصائصها وليس من الدقة الاعتماد على اساسيات تكوين عوامل تخطيط عامة لهذه الاماكن التي تولد رحلات الوقوف دون اجراء دراسة تفصيلية.  
ان الغرض الرئيسي من هذه الدراسة هو لتقييم وتحليل الوضع الحالي لفضاءات المواقف و حجم الطلب وكذلك اعداد توصيات لعدد الفضاءات التي يجب توفيرها لخدمة المستخدمين بانواعهم في الحرم الجامعي لسنة الهدف 2015.  
الدراسة شملت مسح الجرد لمواقف المركبات , مسح لوحات التسجيل وكذلك مسح استمارة الاستبيان لمستخدمي المواقف. جمعت البيانات المتعلقة حول عدد السكان في الحرم الجامعي وملكية المركبات. جميع المعلومات التي جمعت تم تحليلها لتحديد الخصائص الرئيسية لمواقف المركبات في منطقة الدراسة ومن خلال معرفة هذه الخصائص؛ حددت الدراسة مقدار النقص في مواقف المركبات ومعرفة الوضع المستقبلي لمواقف المركبات في منطقة الدراسة. اعتمادا على تحليل الطلب على مواقف المركبات المستقبلي, النمو والتطور في حرم الجامعة, الطلب المستقبلي المتولد من الحرم

الجامعي من المتوقع ان يتجاوز مواقف المركبات المتوفرة في الوقت الحالي. حسب الصيغة المعدة فان الحاجة الاضافية لتوفير مواقف المركبات خلال سنة الهدف 2015 تكون بمقدار 644 فضاء وقوف لاستيعاب الطلب المستقبلي على مواقف المركبات.

## 1. Introduction

The central issue that transportation addresses is access from an origin to a destination. In many places, the automobile is the dominant means of transportation. In order to provide access for automobiles to a destination, these destinations require parking (1).

Parking is an integral component of any automobile-oriented transportation system. Every vehicle trip requires some form of parking at its destination, and parking that is difficult to find, inadequate, inconvenient, or expensive will not only lead to frustration but can also discourage travel to those locations (4).

As enrollment in colleges and universities increases, campuses are adding institutional space, often in settings where land is a significant constraint. Moreover, employees at universities are a significant source of transportation demand for the campus. The result is that students, faculty, and staff compete more acutely for fewer available parking spaces (6).

Finding a parking space at all is a perennial source of frustration on college campuses, and tough competition for the limited number of parking spaces compels drivers to arrive well in advance of their preferred time (7).

There are a number of characteristics of parkers and parking that have a significant influence on planning. Critical to parking supply needs are duration, accumulation, and proximity requirements of parkers. Duration and accumulation are related characteristics. In any area, or at any specific facility, the goal is to provide enough parking spaces to accommodate the maximum accumulation on a typical day (8).

In determining parking space requirements for universities, the specific characteristics and needs must be understood. In addition to being a major gathering place for students and visitors, the campus also serves as a place of employment; and it is a place of residence-for both students and staff (2).

The University of Al Mustansiriya main campus is a good example of a major trip attractor located at Baghdad city center adjacent to Palestine Street and Safi Al Din Al Hilli Street as shown in **Figure (1)**.

Also, enrollment at the University of Al Mustansiriya main campus continues to increase reaching about 9,800 undergraduate and graduate students and 2,350 faculty and staff members in the 2010-2011 school year (9).

Therefore, the university can be seen as a work and school trip attractor for more than 12,150 persons on a regular basis excluding the university visitors. Although the university may attract 12,150 person trips during any given day, there only about 391 total parking spaces. These 391 parking spaces are further restricted by permits provided for faculty and employees only.

## 2. Problem Definition

With the rapid development of economy and significant changes, dramatic increase in motor vehicle ownership which has been experienced in Baghdad city, the number of vehicle increases more than two folds after 2003 (3). Due to the car ownership increase, the reliance on vehicles as a primary mode of transportation will increase causing pressure on the available parking supply. The main campus of Al Mustansiriya University in Baghdad city has a current parking supply of approximately 391 parking spaces in 2 surface lots and one adjacent street. While the permit badges issued were more than 800 including faculty and employee. Obviously, the current parking supply is less than 50 % of issued parking permit badges.

## 3. Study Objective

The main objective of this study is to evaluate current and future campus parking supply and demand for parking spaces as well as provide a recommendation for the number of parking spaces needed to serve the various Campus users at the target year 2015.

The target year 2015 has been selected because the car ownership depend on the roles of exporting and taxes which is still not stable and might be changed in long term period.

## 4. Study Methodology

The methodology of this study can be divided into three stages. These are:

1. Definition of study area
2. Data collection
3. Analysis of data

The first stage consist of, identifying the study area, location, adjacent streets, parking inventory for identifying the parking lots serving the university campus including the type of facilities and user groups and define the dominant land uses surrounding the campus.

The second stage includes designing and conducting of parking field surveys and parking questionnaire survey for parking lots serving the main campus of Al- Mustansiriya University. A typical weekday chosen for conducting license plate number and questionnaire survey on Tuesday 14-Dec.-2010 from 7:00 A.M. to 5:00 P.M coincidentally with other parking surveys, covering parking facilities serving the university campus.

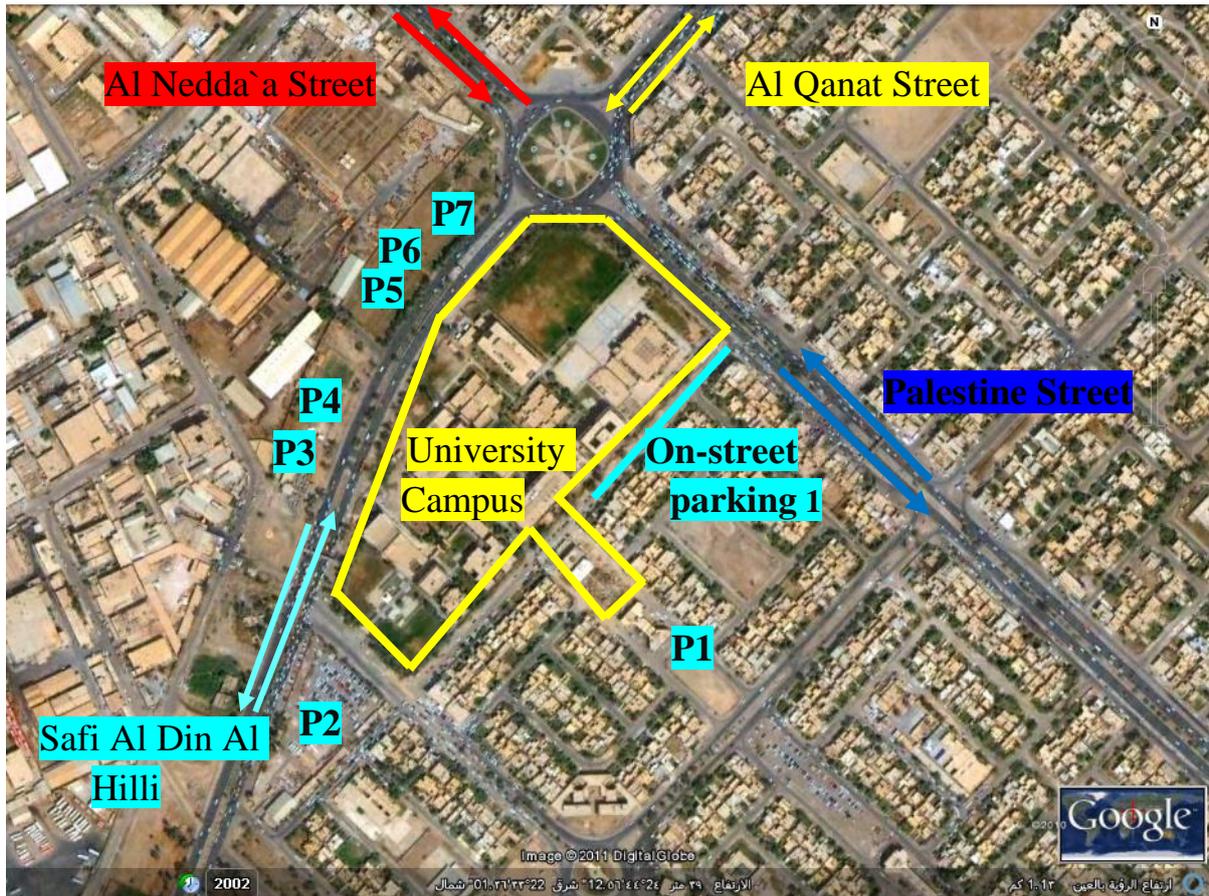
The third stage is the data analysis to determine major parking characteristics in the study area and through these parking characteristics the study can identify the current parking inadequacies and the anticipated target year 2015 parking situation to develop proposals to improve parking supply.

Determination of current parking was based on parking inventory, parking field survey using License Plate Numbers Method and the parking questionnaire survey. This entire works had given the parking characteristic (existing condition) and the total load of the current parking. Thus, determination of future parking demand was based on current parking demand besides the additional demand due to increase in campus population, land use development and increase in usage of private car as mode of transport. In order to determine the future parking demand, university campus population data, land use development plan and information from questionnaire was needed for calculating the future parking demand.

## **5. Current Parking Supply**

The inventory of parking facilities in the study area revealed total available parking spaces of 709 including 60 on-street parking spaces distributed along two segments in the street adjacent to the university campus. There are 25 parallel on-Street parking spaces which represent (42%), the rest are angle parking spaces. It is obvious from the inventory results that the off-street parking is the dominant parking type and represents 92% of the available parking supply. The study area includes seven off-street parking facilities and one on-street parking. Only two parking lots (P1 and P2) are belong to the university campus which consisting of 331 spaces and allocated only for faculty and employees, while parking lots (P3, P4, P5, P6 and P7 ) are privately owned and used for all types of users. Figure (1) shows the labeled parking lots P1, P2, P3, P4, P5, P6, P7 and On-street parking 1.

The current ratio of available parking supply to the campus population is 5.8%, while the ratio of available parking supply for university faculty and employee population is 14 % taking into consideration only public facilities because it is owned for the university campus and allocated for university campus staff.



**Figure (1) Location of Al-Mustansiriya University Campus and Adjacent Parking Lots**

Table (1) shows the number of available parking spaces for each parking lot by parking type, parking class and type of users.

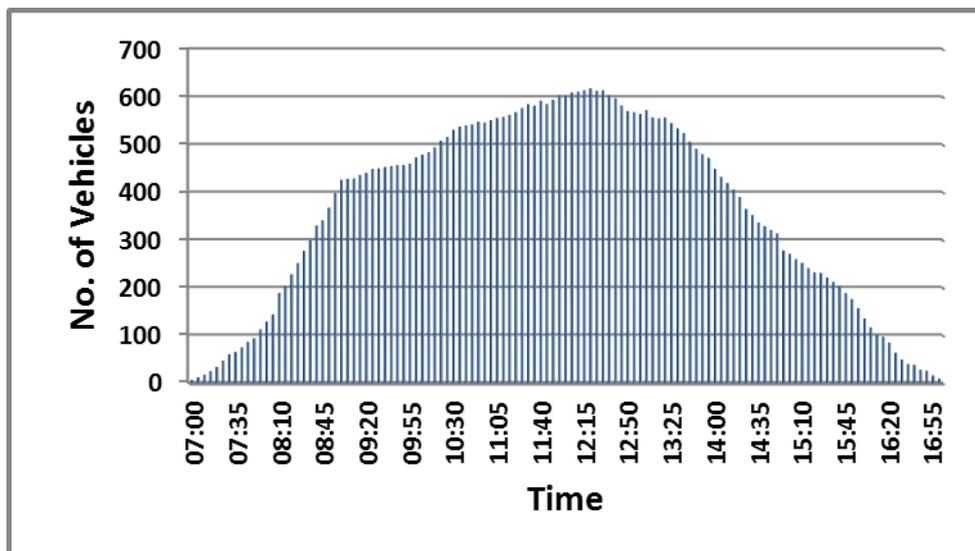
**Table (1) Parking Lots Characteristics in the Study Area**

Parking lot	Capacity	Parking Type	Parking Class	Type of Users
P1	117	Off-Street	Public	Staff &Faculty
P2	214	Off-Street	Public	Staff &Faculty
On-street 1	60	On-Street	Public	Staff &Faculty
P3	63	Off-Street	Private	All
P4	130	Off-Street	Private	All
P5	33	Off-Street	Private	All
P6	42	Off-Street	Private	All
P7	50	Off-Street	Private	All

## 6. Parking Characteristics

There are a number of parking characteristics of parkers and parking lots that have a significant influence on planning of parking needs. Information on accumulation, walking distance, duration and turnover is needed for estimating the required parking supply, estimating access requirements and applying parking management practices and policies.

The parking accumulation data was obtained using the data of entering and exiting vehicles to parking lots, then taking the time of entering and exiting vehicles to derive parking accumulation by 5-minute period. **Figure (2)** illustrates the total parking accumulation data for all parking facilities adjacent to university campus included in the study. This is obtained by gathering the differences between entering and exiting vehicles to all parking facilities serving the university campus in 5-minute basis.



*Figure (2) Total Parking Accumulation Data for All Parking Facilities Adjacent to University Campus*

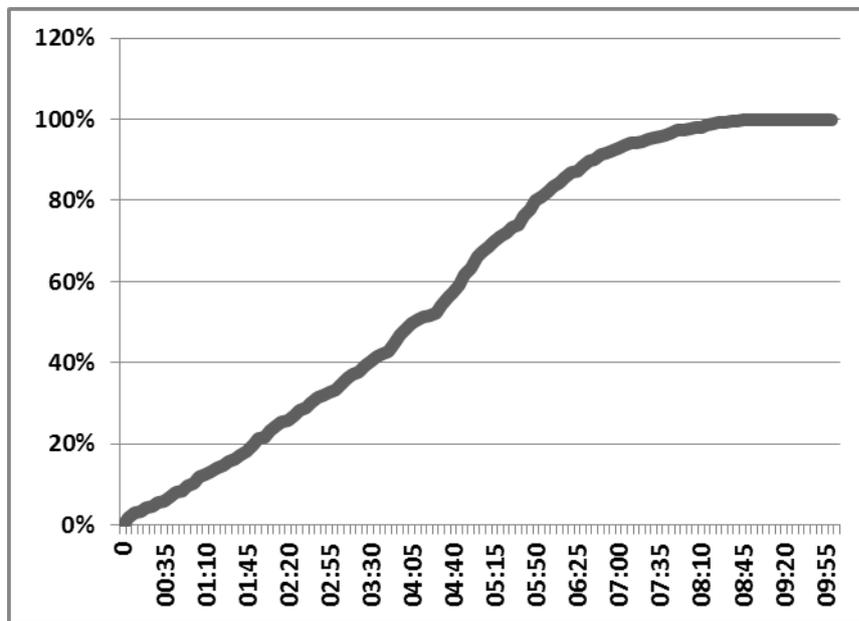
The maximum parking accumulation in study area occurred at 12:20 P.M. when a total of 618 vehicles were parked.

The parking accumulation at 7:00 A.M. (start of data collection), were 7 vehicles, then it increases gradually until reaching the peak hour in the period 11:45 A.M. to 12:40 P.M. when the parking accumulation averaged at 606 vehicles parked in the study area. After the peak hour, the parking accumulation starts to decrease gradually until reaching 9 vehicles at 5:00 P.M. which the end of data collection period.

Walking distance had been estimated by measuring the shortest normal walking path between pedestrian exit in parking facility and nearest pedestrian entrance at university campus. Two

entrances were considered in the study, the main entrance to university campus and the second entrance serve the new building of residency office. The average walking distance for university campus parkers was 271 meters.

The duration of the parking associated with the trip is related to its purpose. The average parking duration for all study area was 4:00 hours, while the average parking duration for each population group were 4:21 hrs, 4:30hrs, 3:49 hrs and 2:50 hrs for faculty, students, employees and others respectively. The cumulative frequency curve for parking duration in the study area is shown in **Figure (3)** for an interval class of 5 minutes. The eighty fifth percentile (85.0 % of Parkers Park less than duration stated) is equal to 6:15 hrs and the median (50<sup>th</sup> percentile) is equal to 4:10, while 15<sup>th</sup> percentile is equal to 1:30 hr.



**Figure (3) Cumulative Frequency Curve of Parking Duration in Study Area**

Turnover obviously is a function of trip purpose. Turnover is the number of cars actually accommodated per parking space during the time span of the survey used to obtain the data. The time period in this study was 10 hours and the total parked vehicles during study period were 896 vehicles.

$$\text{Turnover} = \frac{\text{Total number of parked vehicles}}{\text{Total parking spaces}} \dots\dots\dots (1)$$

$$= 896/709 = 1.26 \text{ Vehicles/Space}$$

## 7. Current Parking Demand

The parking demand generated by university campus had been estimated by the total number of parkers destined to each parking facility. **Table (2)** provides a summary of parking demand and utilization each 30 minutes for available parking supply. It is also shows that parking demand exceeds 85% of available parking supply in the period 12:30 P.M. to 12:30 P.M. Also it is obvious that the peak parking demand occurs at 12:30 P.M. when the parking demand reach 86.6% of the available parking supply. During peak parking demand period, questionnaire survey forms show that 350 parkers were faculty and employee representing 57 % of all parkers, while 264 parkers were students and others representing 43% of all parkers. Thus, a supply of parking operates at peak efficiency when occupancy is 85% to 90%. When occupancy exceeds this level, there are delays and frustration in finding a space. The parking supply may be perceived as inadequate even though there are spaces available in the system (7).

In this study, the efficiency factor has been assumed 90 % as long as the parkers are regular users and familiar with parking facilities Therefore, parking demand derived by dividing the calculated demand over efficiency factor of 0.9. Then surplus or deficiency within parking facilities determined by the differences between demand and supply.

*Table (2) Summary of Hourly Parking Demand and Utilization.*

Time	Parking demand	Demand/Supply (Utilization %)	Time	Parking demand	Demand/Supply (Utilization %)
7:00 A.M.	7	0.99%	12:30P.M.	614	86.60%
7:30 A.M.	60	8.46%	1:00 P.M.	564	79.55%
8:00 A.M.	129	18.19%	1:30 P.M.	534	75.32%
8:30 A.M.	277	39.07%	2:00 P.M.	449	63.33%
9:00 A.M.	426	60.08%	2:30 P.M.	352	49.65%
9:30 A.M.	450	63.47%	3:00 P.M.	271	38.22%
10:00 A.M.	473	66.71%	3:30 P.M.	221	31.17%
10:30 A.M.	531	74.89%	4:00 P.M.	135	19.04%
11:00 A.M.	551	77.72%	4:30 P.M.	49	6.91%
11:30 A.M.	585	82.51%	5:00 P.M.	9	1.27%
12:00 P.M.	604	85.19%			

The parking demand generated by university campus population including faculty, employees, students and the visitors during peak time (12:30 P.M.) is 614 vehicles. The comparison between the parking supply provided by university campus and peak parking

demand of faculty, employees, students and visitors indicates that there is a deficient of 283 spaces needs to be provided by university campus to accommodate the parking demand which is currently accommodated by private parking lots and on-street parking.

## 8. Future Parking Demand

Additional future parking demand will be generated as a result of the anticipated campus population growth, land use development and increase in usage of private car as mode of transport.

The future parking demand will be developed by:

- Growth of the parking demand for the university campus by applying a growth factor of population increase for the target year 2015.
- Increase in parking demand due to the university campus redevelopment plan according to land use development plan.
- Adding the future parking demand due to increase in car ownership and usage.

The campus plan for the students enrollment and other plans considering faculty and staff employment and retirement are prepared annually and discussed with ministry of higher education and scientific research, so it is not possible to find out the predicted number of population groups for the target year 2015 for that reason, other methods is used based on analyzing the historical data of campus population during last 10 years to find the growth rate.

The campus land use redevelopment plan has been discussed with the authorized department in the university campus

The car ownership for the campus and each population group in this study can be calculated depending on the parking questionnaire survey using the parker answers to plot a graph of car ownership against the time in years for each population group. This will show the increase car ownership over last years and can be used to estimate the future car ownership.

As mentioned previously, the campus population growth factor calculations based on the population growth history is 1.15 for the year 2015. There will be no increase in parking demand due to campus land use development as there is no available plan for land use development at university campus for the next 5 years (2015) (10), while the increase in parking demand due to increase in car ownership by the campus population has been calculated depending on the results of questionnaire survey for the years 2011, 2012, 2013, 2014 and 2015 (i.e.251 vehicle will be added to parking demand by 2015).

After applying the current parking demand by the population growth factor and adding the increase due to car ownership, the future parking demand will be 1281 vehicle expected to arrive to university campus by the year 2015. The future peak parking demand can be estimated as follow:

Future peak parking demand=1281 \* 614/896=878 vehicles

The future parking supply = 878/0.9=975 parking spaces

Where:

614 vehicles: the current peak parking demand

896 vehicles: the current total parking demand during study period

0.9: the efficiency factor

The future parking supply distribution should be 57% allocated for faculty and employees, while 43% allocated for students and others (i.e. 556 spaces for employees and faculty, and 419 for students and visitors).

The provided parking spaces by university campus are 331 allocated for faculty and employee only, so the additional parking supply needs to be added by year 2015 are 225 spaces for faculty and employees and 419 spaces for students and visitors.

If the university campus adopted a parking policy allowing students to use the public parking lots, the future parking demand will be 975 spaces. In this case, additional 644 parking spaces should be provided to accommodate the future parking demand generated by university campus faculty, employees and students at public lots.

## 9. Comparison with ITE Parking Generation

The current parking demand for Al-Mustansiriya university campus has been calculated using the parking generation suggested formula for universities located in urban areas which is (5):

$$P = 0.17X + 327 \dots\dots\dots (2)$$

Where

P: Peak period parking demand

X: University population

According to this formula, parking demand during peak period is 2394 vehicles, while the field calculations found that the parking demand during peak period is 614 vehicles.

The comparison revealed that the current parking demand in Al Mustansiriya campus is much lower than the parking demands calculated by ITE formula. This may attributed to the differences in car ownership, socioeconomic characteristics, and lack of available parking supply, traffic congestions which forcing many users to switch the mode of transportation and avoiding private car usage.

## 10. Conclusions

Within the limitations of study, the key findings are summarized as follows:

1. The total parking supply of 709 Spaces were found in the study area during the inventory time.

2. The car ownership of campus population was 17.8% distributed as: 31% faculty members, 24% of employee members, and 15% students while approximately half of car owners only use their cars as a mode of transport.
3. The maximum parking accumulation in the study area occurred at 12:30 P.M when a total of 614 vehicles were parked utilizing 86.6% of available 709 spaces.
4. Average walking distance for university campus parkers was 271 meters.
5. The average parking duration for all parkers in the study area was 4:00 hours.
6. Average turnover rate for parking facilities at study area were 1.26 Vehicles/Space.
7. Parking demand exceeds 85 % of available parking supply between 12:00 P.M and 12:30 P.M.
8. Based on anticipated campus population growth, increase in usage of private car as mode of transport and land use development, additional spaces required for the year 2015 to accommodate the future parking demand are 225 spaces for faculty and employees and 419 spaces for students and others.

## **11. Recommendations**

Based on the analysis of future parking demand and the assumed growth and development within the study area, the future parking demand generated by university campus is expected to exceed the current parking supply. The university should consider the following recommendations and strategies:

1. Increase the campus parking supply by constructing a new multistory garage in the main campus surface parking lot, with approximately 650 spaces added to the current parking supply.
2. Establishing parking pricing mechanisms in conjunction with subsidizing campus transit service to reduce parking demand within the study area by encouraging those provided parking by the campus to utilize transit services for their regular commute.
3. Establish clear policies and strictly enforced regarding parking permit badges in accordance with the available parking spaces.
4. Improve the available surface lots by paving and space marking, providing security systems and cameras and using modern technologies of magnetic badges and gates systems.

## **Acknowledgments**

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