

## Alternatives Scenarios for Transportation During The Morning and Evening Peaks (The Entrances of The Jadiriya Complex Study Case)

### "A Planning Vision"

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DOI: <https://doi.org/10.36231/coedw/vol30no4.13>

Received 1/9/2019

Accepted 3/12/2019

### Abstract

The research aims to develop alternatives to transportation at the entrance to the Educational City (University of Baghdad) during the morning and evening peaks, which result from of the traffic congestion at the entrances to the educational city (the University of Baghdad), and affects the emotional, functional, and social performance of the whole city, and leads to hotbeds of confluence and congestion at the entrances in the morning and evening peaks. This movement was measured on the ground for pedestrians and vehicles. Some criteria were adopted to determine the density of road length to the area and density of roads for the number of users and the rate of the area served by roads. The research reviews the experiences of some countries to solve the problem of overcrowding and the application of their standards and its applications to the problem of research to determine the correctness with the study case. The use of spatial data and the construction of a database through geographic information systems (GIS) software enables a spatial analysis to select temporary functional alternatives for these entrances to ensure easier and smoother traffic in the study area, as well as proposals for some theoretical alternatives. One of the most important findings of the research that the Education City needs additional double functional entrances and exits.

**Keywords** Alternatives, peaks, transportation

سيناريوهات البدائل لحركة النقل خلال الذروة الصباحية والمسائية

(مداخل مجمع الجادرية حالة دراسية)

"رؤية تخطيطية"

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### المخلص

يهدف البحث الى وضع بدائل لحركة النقل عند مداخل المدينة التعليمية (جامعة بغداد) خلال الذروتين الصباحية والمسائية نتيجة للاكتضاض المروري عند مداخلها الذي يؤثر على الاداء الوظيفي والنفسي والاجتماعي لمجتمع المدينة بأكمله، انه يؤدي الى بؤر من الاحتشاد والتزاحم المروري عند تلك المداخل في الذروتين الصباحية والمسائية. قيست هذه الحركة ميدانياً بالنسبة للمشاة والمركبات. واعتمدت بعض المعايير لمعرفة كثافة اطوال الطرق الى المساحة وكثافة الطرق لأعداد المستفيدين منها ومعدل المساحة المخدومة بالطرق، وعرضت خلال البحث تجارب بعض الدول لحل مشكلة الازدحام المروري وطبقت معاييرها وتطبيقاتها على مشكلة البحث لمعرفة مدى ملائمتها مع حالة الدراسة. يتيح استخدام البيانات الفضائية وبناء قاعدة بيانات من خلال برمجيات نظم المعلومات الجغرافية التحليل المكاني لأختيار بدائل وظيفية مؤقتة لتلك المداخل لضمان حركة مرورية اكثر انسيابية وسلاسة في منطقة الدراسة، فضلاً عن تقديم مقترحات لبعض البدائل النظرية ومن اهم النتائج التي توصل اليها البحث هي حاجة المدينة التعليمية الى مداخل ومخارج اضافية فضلاً عن ازدواجية عملها في الدخول والخروج من المدينة.

**الكلمات المفتاحية:** البدائل ، الذروات ، النقل

## Introduction

One of the main reasons that affect the productivity and job performance of individuals and their job performance is traffic congestion because it leads to the loss of time and daily exposure to physical and emotional exhaustion and delay on their schedules and submitting work in the time, which always make them feel emotional pressure and inability to do business actively, which result in low performance of individuals and poor productivity of organisations in general. The problem of traffic congestion in the study area is at the entrances and exits of the limited-numbered Educational City, especially at morning and evening rush hour, hence the need to find and provide solutions and alternatives that will ensure the movement of entry and exit for users of the Educational City easily and smoothly, some alternatives that are selected by researcher are presented based on field study.

### 1-Research problem

The entrances and exits of the movement of the educational city were limited to two entrances and exits, which was reflected in an inefficient system in regulating the movement of transport, leading to the crowd and traffic congestion during the morning and evening rush hours.

### 2- Hypothesis

The educational city (University of Baghdad) with its current staff, directors, and operating system is not efficient in providing transportation during the morning and evening peaks.

### 3- Objective

Finding alternatives to transportation during the morning and evening peaks at the entrances and exits of the educational city which contribute to reducing traffic congestion, save time, and organize work processes for customers and workers of the Educational City.

### 4- Significance:

Introducing some applied research to serve the community based on the spatial data and modern support provided by the GIS software and the construction of a spatial database to study the dimensions of this problem.

### 5- Method:

A descriptive and objective approach is implemented using quantitative analysis and analysis of the status of the entrances of the educational city during the two peaks to know the difference between the real and ideal time between the educational city's two entrants and exits and stations for the distribution of Users and what is reflected on the organization of the movement and the productivity of users by knowing the numbers and monitoring their daily movement rates during morning and evening rush hours, and processing it, as well as constructing a database of land use within the educational city and extracting its percentages of the total area of the study area.

### 6-Research area:

Education City is located within the boundaries of Baghdad province of Rusafa district and the city (Al-Jadriya complex) one of the educational complexes in Baghdad was built in the fifties of the twentieth century and was designed by architect Walter Kruppis with a capacity of 6800 students. It was expanded in 1982 with a capacity of almost 20,000<sup>(1)</sup> students in an area estimated at (2.26) Km<sup>2</sup>. Education City is located near and surrounded by the Tigris River is located at longitude (N 33 17 0\_33 16 1) and latitude ( E 44 33 3\_ 44 14 56 ).map(1)

### Material and Methods:

1. Arc GIS 10.4 software, including Arc Map 10.4, was used to view data, build layers and map.
2. Arc Catalog to build a geographic information base.
3. Arc Toolbox to perform workflow and analysis.

**Practical side: First:** Quantitative data collection and processing from the planning departments at the University of Baghdad and Al- Nahrin University

**Second:** the preparation of spatial data by relying on the visual space and building a database for the study area As illustrates in chart 1.

Chart (1) Practical side	
<b>Space data</b>	<b>Quantitative data</b>
<ol style="list-style-type: none"> <li>1. Access to satellite imagery from the Poconos satellite (at a distance of 60m in 2013) people going into and deduction of the study area.</li> <li>2. Building a database for land usages in the educational city</li> <li>3. Extracting study area space</li> <li>4. Extracting the ratio of the used space to the total space.</li> </ol>	<ol style="list-style-type: none"> <li>1. Prepare the users of the Educational city.</li> <li>2. Field scan rates for the number of people going into and out of the educational city entrances and exits during the morning and evening rush hours.</li> </ol>

**Reference: From the work of the researcher**

### Discussion: Analysis of transportation within the educational city

Humans usually move on a daily basis through trips performed according to their activities and their economic, cultural and social level. The most important motives for daily trips are the work and education trips, and the two factors of time and distance are two of the factors that affect those trips significantly as they affect the performance and productivity of individuals, and the time spent on the trip during peak periods is often increased as the traffic intensity increases, whether morning or evening. Since the educational city has only two entrances and directors, so the process of entry and exit of the users to their work destinations forced them to stop and wait in long lines, which adds extra time to their arrival and thus will increase the time of the daily journey to them. This will affect their performance, as in Table 1 and figure 1.

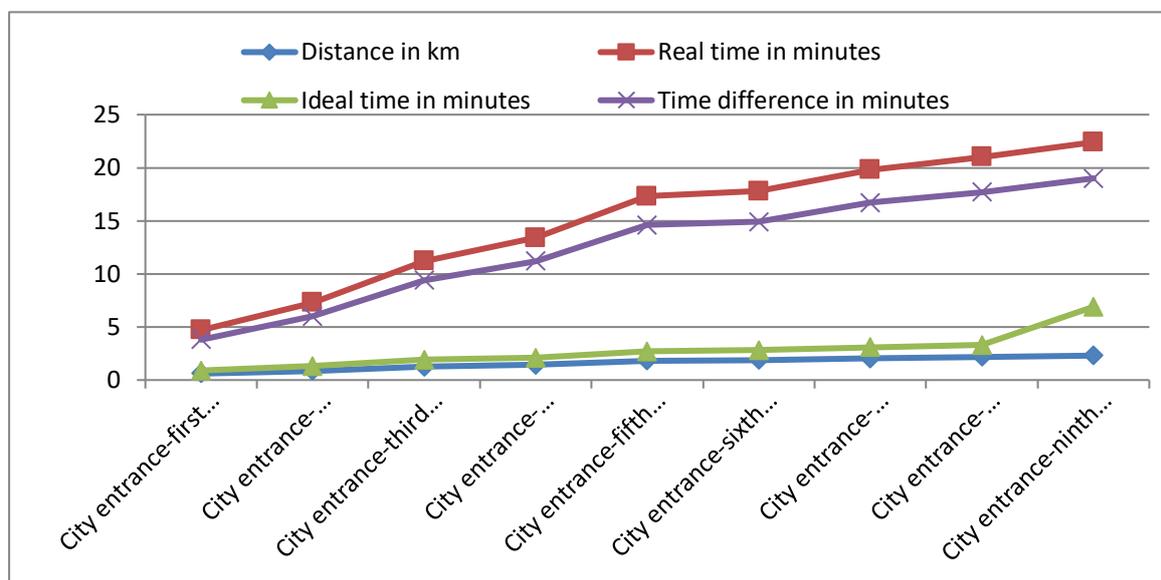
**Table (1)**

**The daily average distance traveled and the real and ideal time during the morning rush hour for the educational city's portal**

The route	Distance in km	Real time in minutes	Ideal time in minutes	Time difference in minutes
City entrance-first station	0.606	4.7	0.9	3.8
City entrance-second station	0.870	7.3	1.3	6.0
City entrance-third station	1.239	11.2	1.9	9.4
City entrance-fourth station	1.436	13.4	2.1	11.2
City entrance-fifth station	1.830	17.3	2.7	14.6
City entrance-sixth station	1.872	17.8	2.8	14.9
City entrance-seventh station	2.046	19.8	3.1	16.7
City entrance-eighth station	2.176	21	3.3	17.7
City entrance-ninth station	2.301	22.4	6.9	19.0
Total	14.378	135	21.6	113.7

**Reference: From the work of the researcher depending on the GIS program.**

**Figure (1)**  
**The daily average distance traveled and the real and ideal time during the morning rush hour for the educational city's portal**



**Source: From the work of the researcher depending on the table (1)**

Note that there is a clear difference in time between the real-time rate of the average vehicle speed (40 km / h) inside the educational city and the ideal time in the morning and evening peak times, As the rate of difference increase between the entrances or exits and parking stations and access to the colleges or departments of the educational city, The total average of this difference was about (113.7) minutes during the morning peak, when the Work starts, which negatively affects the productivity of users of Education City, As in Table 2 and Figure 2, which shows the time difference during the evening peak at (05.3) minutes, ie, at the end of the working day and the start of the journey home. This will increase the time of the return journey due to crowding at the exits, from a number of colleges and institutes of the University of Baghdad and another to the University of Nahrain is noticed at table (3)

**Table (2)**  
**The daily average distance traveled and real and ideal time during the evening peak time for the exits of Education City**

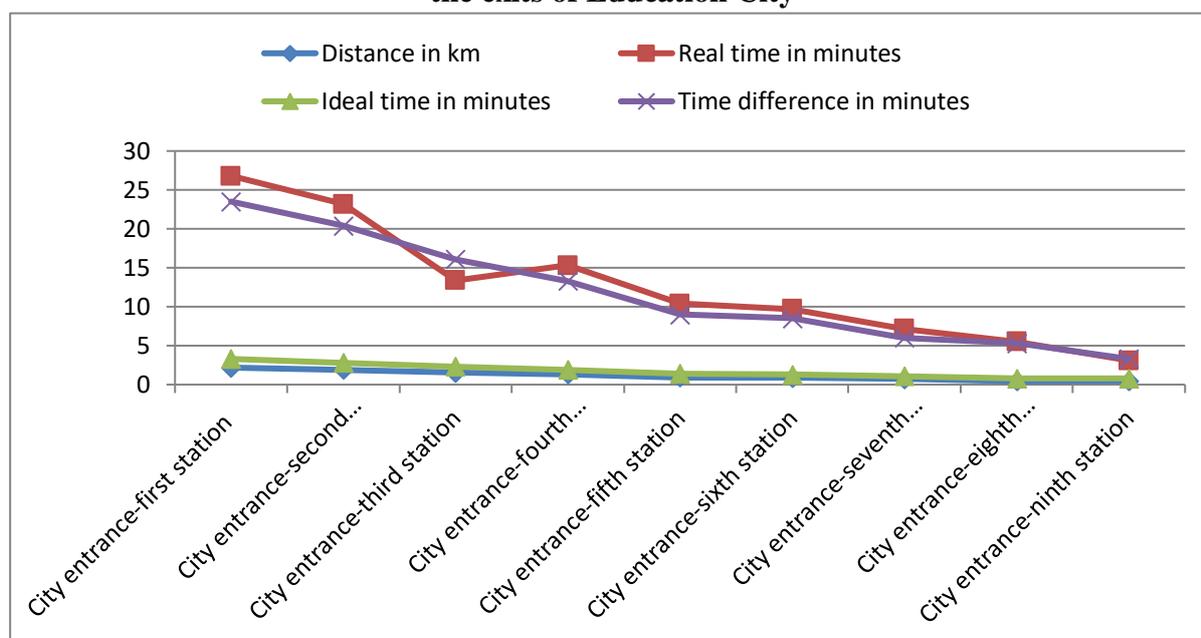
The rout	Distance in km	Real time in minutes	Ideal time in minutes	Time difference in minutes
City entrance-first station	2.185	26.8	3.3	23.5
City entrance-second station	1.921	23.2	2.8	20.4
City entrance-third station	1.551	13.4	2.3	16.1
City entrance-fourth station	1.330	15.3	1.9	13.3
City entrance-fifth station	0.935	10.4	1.4	9.0
City entrance-sixth station	0.893	9.7	1.3	8.5
City entrance-seventh station	0.719	7.15	1.1	6.0

City entrance-eighth station	0.341	5.5	0.8	5.3
City entrance-ninth station	0.466	3.1	0.8	3.3
Total	10.430	120	14.7	105.3

Reference: From the work of the researcher depending on the GIS program

Figure (2)

The daily average distance traveled and real and ideal time during the evening peak time for the exits of Education City



Source: From the work of the researcher depending on the table (2)

Table (3)

Preparing colleges, institutes and research and service centers in Education City

University	Number of colleges	Number of institutes	Research Centers	Service Centers
Baghdad	8	4	6	4
Nahrain	6	2	2	2
Total	14	6	8	6

Source: Department of Planning and Studies at the Universities of Baghdad and Nahrin, unpublished data 2017.

In addition, each college contains at least 8 scientific sections, which means that the number of users on this city is high, as shown in the table (4):

Table (4) Number of Users of Educational City (Al Jadriya Complex)

Users	University of Baghdad	Al-Nahrain university	Total	percentage
Teachers	2308	773	3081	10
Primary and higher	19263	3015	22278	72.5

students				
Permanent staff	3665	1199	4864	15.8
Contracts employees	416	115	531	1.7
	25652	5102	30754	100%

**Source: Department of Planning and Studies at the Universities of Baghdad and Nahrin unpublished data.**

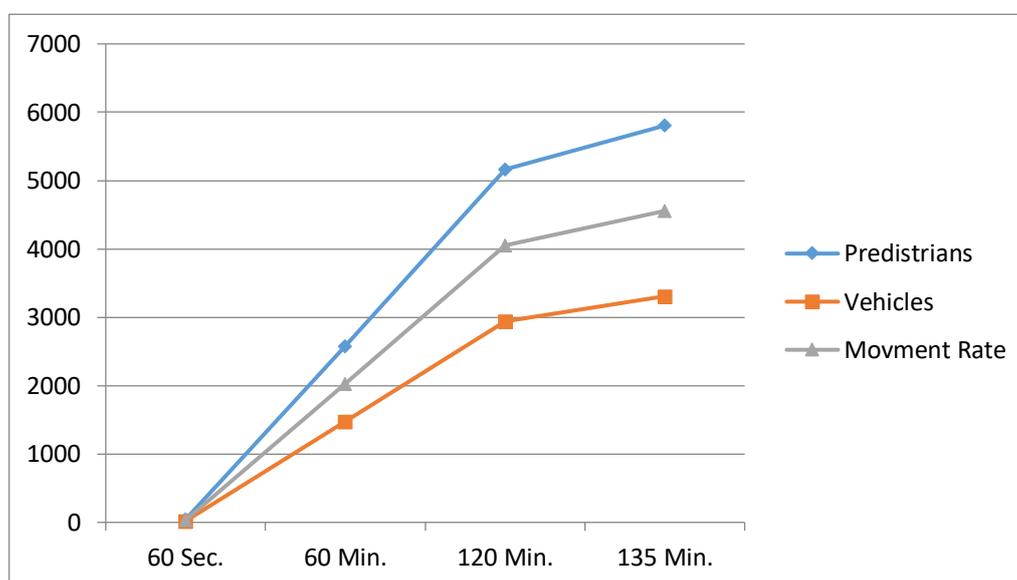
The number of visitors of the Educational City during different times of the academic year to complete their transactions puts additional pressure on the entrances and exits of the city. The movement of vehicles and pedestrians at the entrances and exits of the educational city was monitored during the morning and evening peaks as illustrated by tables (5,6).

**Table (5)**  
**Movement rate for morning peak (6:45-9:00) AM of educational city's entrance\***

Time	Pedestrians	Vehicles	The overall rate of movement
60 sec	43	20	31.5
60 min	2580	1470	2025
120 min	5160	2940	4050
135 min	5805	3308	4556.5

**Reference: From the work of the researcher depending on the field study.**

**Figure (3)**  
**Movement rate for morning peak (9-6.45) AM of educational city's entrance**



**Reference: From the work of the researcher based on the table (5).**

(\*)The field study was monitored for two different days, one on 19/9/2017, when the official working rate was approximately 40% and the second monitoring on 10/12/2017, when the official working rate was 100%.

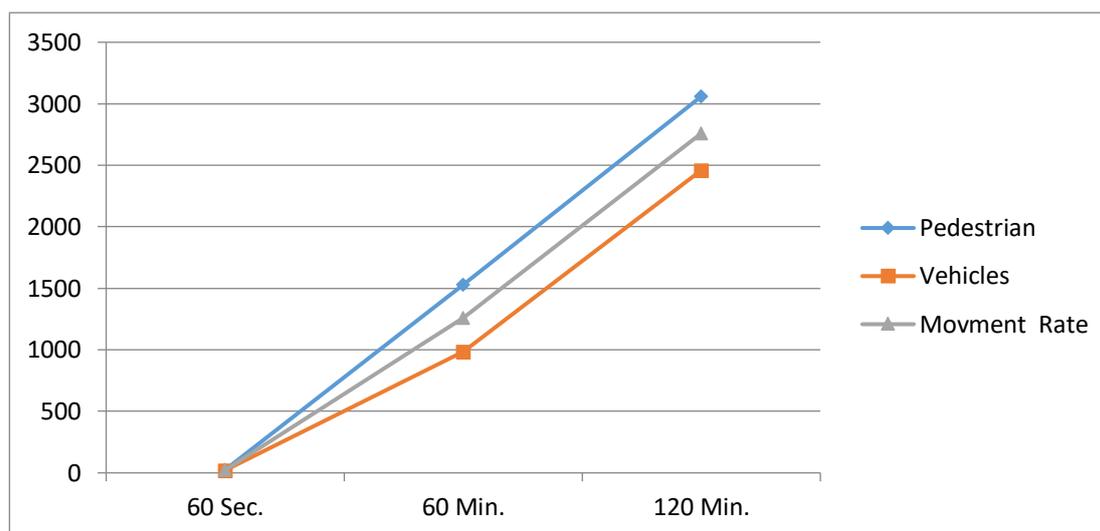
**Table (6)**  
**The movement rate for the evening peak (1:00-3:00) pm for the exits of the educational city**

Time	Pedestrians	Vehicles	The overall rate of movement
60 sec	25	21	23
60 min	1530	987	1258

120 min	3060	2460	2760
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Reference: From the work of the researcher depending on the field study.

**Figure (4)**  
The movement rate for the evening peak (1 - 3) pm for the exits of the educational city



Reference: From the work of the researcher based on the table (6)

It is noticed from the tables and the previous forms that the overall rate of movement during the morning and evening peaks increases significantly when advancing in the minutes of the two peaks, increasing traffic congestion at the entrances and exits. And that the movement of pedestrians in the morning and evening peaks require a continuous movement of buses at a rate of two and a half minutes for one bus<sup>(2)</sup> to distribute the users, customers of the educational city, to their own destinations. Through the collection of quantitative data and making tables, GIS software has been used by deducting the study area from an Econos spacecraft of the satellite (Econos) with a survey accuracy of 60 cm and it was corrected and a database was built for the land use in the educational city And the porting of its entrances and exits map (1) illustrates these uses and it's ratio of the total area of the study area, Table (7) shows these squares and Ratios.

**Table (7) Area and ratios of land usage in Education City**

Land usage	Its space	Percentage
Buildings	277887.7	12.26
Parking	149624.18	6.6
Roads	17064.53	0.75

Source: From the work of the researcher depending on the GIS program

What takes attention in the previous table is that the percentage of roads in the Educational city from the college is very low, as it does not exceed (1%), while the percentage of land usage for roads is 33% in global cities, while in Baghdad it is (16%)<sup>(3)</sup>. This low rate and the number of limited entrances lead to the creation of hotbeds at the entrances and exits of Education City.

In order to analyze and evaluate the service performed by the road network in Education City, simple methods and mathematical statistics can be used, such as<sup>(4)</sup>:

1. Index of road density of the area: measured by the total lengths of roads on the site divided by the area, this ratio has reached 0.75%. Note Table (8) this means that the study area needs to increase the lines of the transport network to meet the needs of customers or users.

**Table (8)**  
**The density of lengths of roads to the area and users or customers and the ratio of area served**

<b>Roads to the area (100 km)</b>	<b>0.753</b>
<b>Roads to beneficiary numbers (km / 100 inhabitants)</b>	<b>554.87</b>
<b>Average area served by roads</b>	<b>132.73</b>

**Source: From the researcher's work based on the field study.**

2. Road density index for the population (users of the city): This indicator gives a more accurate picture of the previous indicator as the users customers of the roads are the users and they are the most affected by the density of roads, the ratio of this index (554.8 per 100 people), about 0.5 km per person which is a very high ratio but it changes many times in the morning and evening peaks.
3. The average area served by roads from the total area of Education City reached (123.5) which means that every 123.5 km<sup>2</sup> of the area is serviced by only one kilometer of roads. This ratio is very high, which means that the area of the educational city is large and requires an increase in the length of the road network.

To give a more accurate analysis, it is necessary to know the ratio of road density during the morning and evening peaks Table (8), during the peak hours, the intensity of the share of network users decreased from 97% to about 0.6%. The percentage of all those users by roads in Educational City decreases as we progress in the peak hours from 6:30 to 9:00, As well as the percentage of intensity during evening peak hours (Table 10), the percentage of the share of networked users decreased from 97% to 0.8% starting from 1 to 3 pm, so alternatives must be found to increase these percentages during the late hours of the two peaks.

**Table (9)**  
**Road density and percentage during peak hours**

<b>Time</b>	<b>Road density</b>	<b>Percentage</b>
60 sec	54173.1	97.06
60 min	842.69	1.50
120 min	421.34	0.75
135 min	374.5	0.67
Total	55811.63	100%

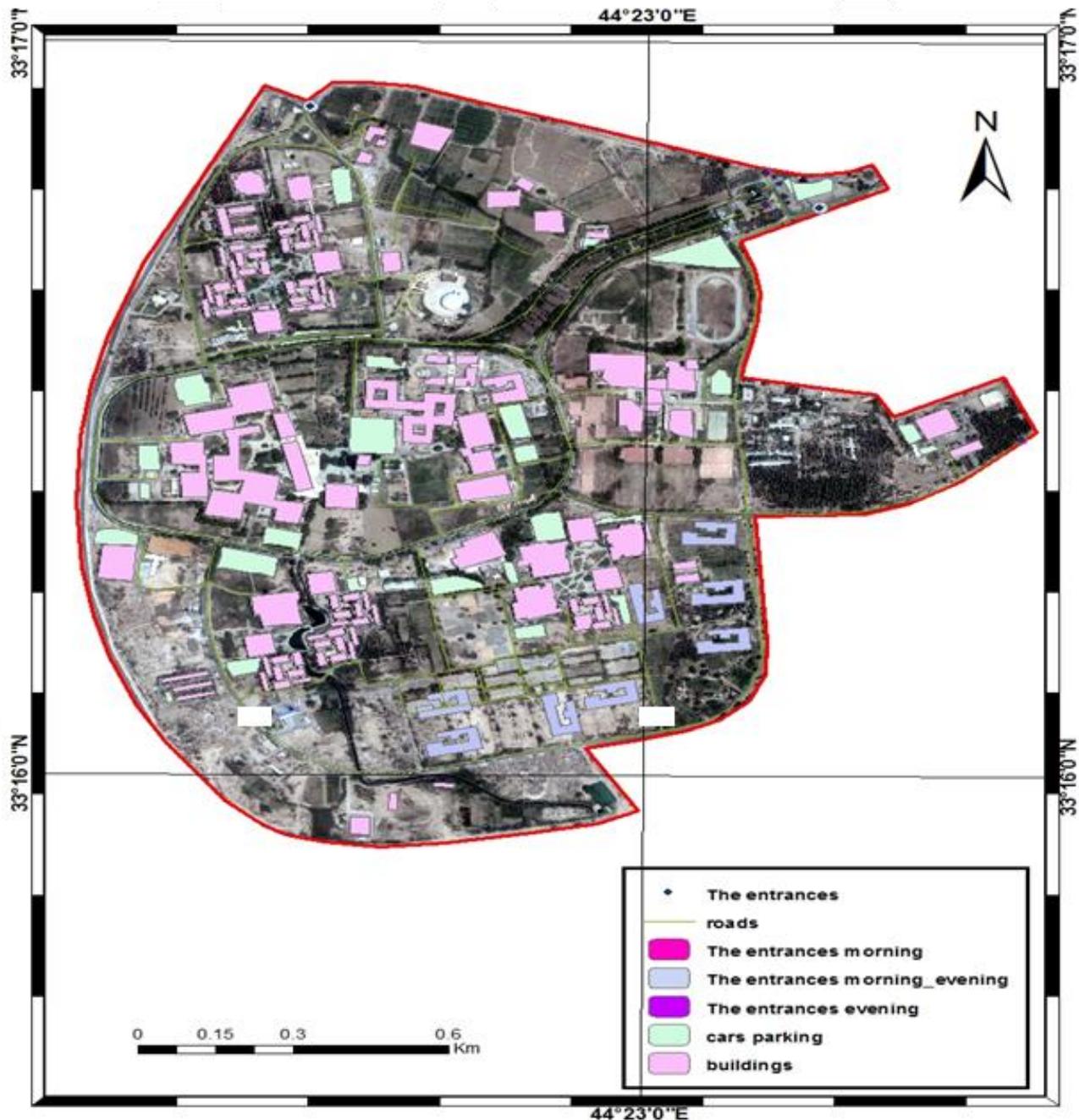
**Reference: From the researcher's work based on the field study.**

**Table (10)**  
**Road density and percentage during evening peak hours**

<b>Time</b>	<b>Road density</b>	<b>Percentage</b>
60 Sec	74193.6	97.4
60 min	1335.9	1.78
120 min	618.28	0.81
Total	76167.7	100%

**Reference: From the researcher's work based on the field study.**

**Map(1)**  
**Plan of Education City in Jadriya**



Source: From the work of the researcher based on the visual space for the year (2013)

### Experiences of some countries in solving the problem of traffic congestion:

Traffic congestion is one of the problems that hinder the movement of the daily journey of people from place to place going to work and cost a lot of time and money, hence it is necessary to refer to some international and Arab models to reduce this problem and to suggest some alternatives.

- 1) **West Midlands(USA):** Does not include its strategy to solve the problem of traffic congestion in terms of expanding the construction of roads, but worked on:
  1. Control the number of vehicles on the road through sustainable transport initiatives based on finding alternatives to mobility - other than vehicles - especially in short distances and encouraging it.
  2. Planning transportation related to education and work through the creation of collective means of mass transportation aimed at these trips. This planning achieved a decrease in the percentage

of students who use private vehicles to move to their schools and universities from 44% in 2003 to 28% in 2005.<sup>(5)</sup>

3. Control the road network and traffic management by using advanced traffic control techniques and providing information on mobile networks to road users to choose the best route.
- 2) **The United States of America:** Some policies have been identified in reducing traffic congestion and the (FHWA) has committed a long-term and comprehensive approach to:
  1. Increasing the capacity of the roads and encouraging the optimal use of the movement and the better use of the land so that the collection of vehicles is less.
  2. Reliance on intelligent transportation systems by monitoring any road emergencies and providing the information that travelers need permanently to enable them to choose the less busy roads.
  3. Making special roads called the red roads, which prevents stopping on it.
  4. Providing parking for vehicles that do not obstruct public traffic, in addition to multiple means of transport inside and outside cities.
  5. Taxing vehicle owners and imposing fees on road users.<sup>(6)</sup>
  6. Providing common and fast means of transportation such as the metro.
- 3) **Vancouver:** The city of Vancouver adopted a comprehensive plan for the city's traffic congestion since 1995 to reduce it through a gradual plan to reach the increase in passenger rates in public transport. The regional survey of trips indicated that the increase rate was 16% between 2004-2008 accompanied by a clear decrease in the use of private vehicles from 60% - 55% during the same period of time, as well as increasing the percentage of sharing vehicle from 5.16% to 18%<sup>(7)</sup>
- 4) **Singapore:** The electronic pricing system for the road has been implemented which was applied in 1975, reducing road traffic by 45%<sup>(8)</sup>.

The experiences of the Arab countries are only attempts to reduce the congestion:

- 1) **Bahrain:**
  - 1- Adopting a traffic control program by collecting data from more than 100 stations distributed on Bahrain roads and implementing road more efficient and commensurate plans for the traffic situation.
  - 2- Seeks to implement the policy of changing the official working hours of government and civil services and schools to varying hours, which will contribute to reducing the traffic congestion to 50%<sup>(9)</sup>.
  - 3- Adoption of intelligent transport projects and replacement of intersections with bridges and tunnels to ensure the smooth flow of traffic.
- 2) **In the capital Amman:** A plan has been developed to establish a broad transport network that will enable it to cope with the rapid increase in population and vehicles, the maintenance of roads and bridges, the provision of common, cheap, environmentally friendly public transportation and the establishment of a light and fast urban rail network<sup>(10)</sup>.
- 3) **Kingdom of Saudi Arabia:** Most of the cities in the Kingdom suffer from the problem of traffic jams. All the solutions to investigate this problem have been focused on the establishment of a varying and circular road networks (Especially for high-speed buses), round roads and other secondary and local and provide a system of wide networks of buses covering areas not served by the fast train network as well as the activation of daily school transport and encourage the walking and use of bicycles.<sup>(11)</sup>
- 4) **Egypt:** Egypt's policy is based on two strategies: the creation of new axes consisting of a series of double-decker bridges (such as the October 6 bridge in Cairo) and the establishment of circular regional roads as well as the expansion of public transport, whether by metro or public transport buses. The municipalities of cities should also take some action to reduce the problem By not giving permits to build in cities unless there is ground parking of vehicles and the construction of multi-story or under-street parquet blocks, and preventing the high-load

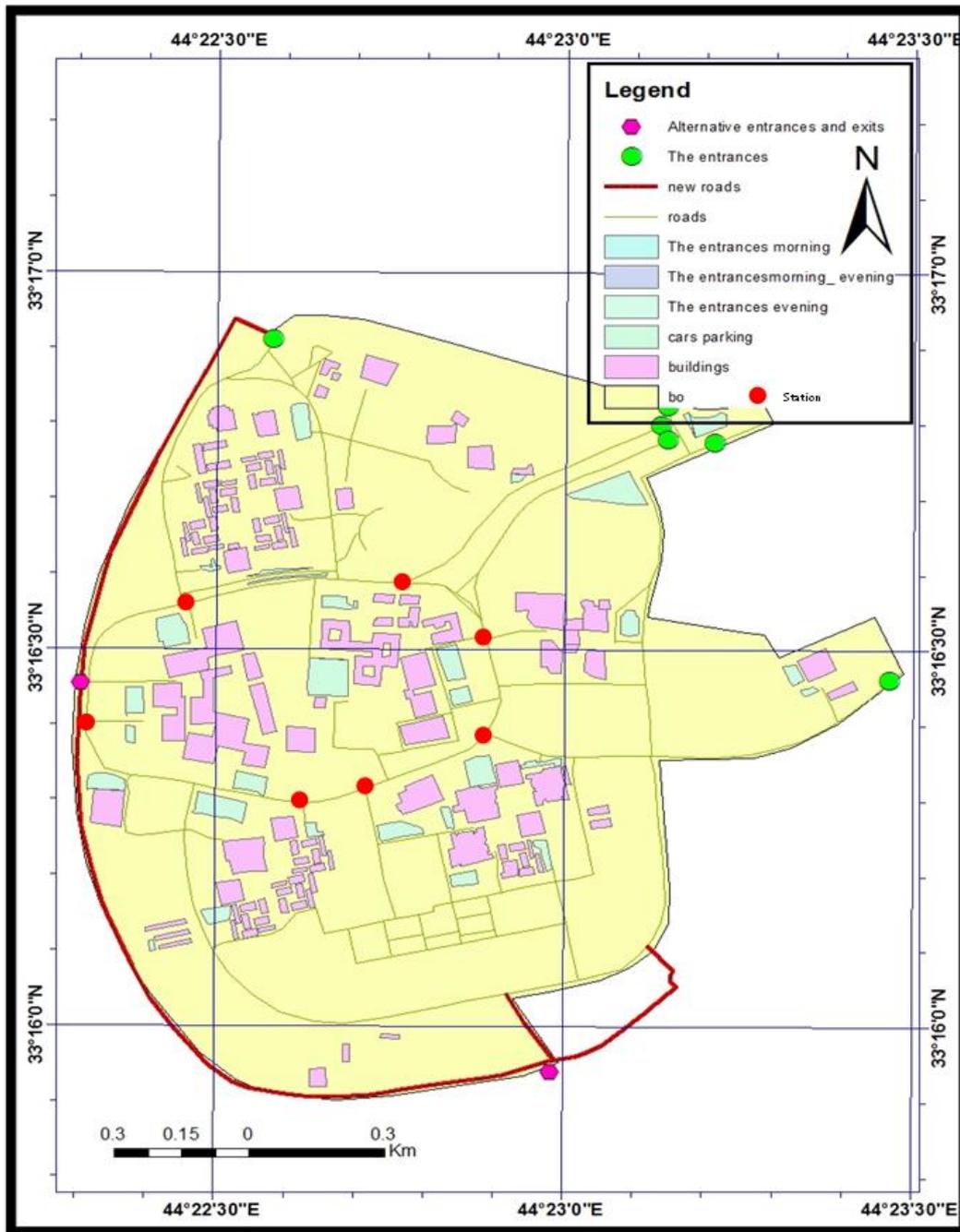
vehicles from entering into central places at peak times, setting special laws for motorcyclists, the limited use of tuk-tuk vehicles within cities and the limited operation of suburbs.<sup>(12)</sup>

### **Result: Scenarios that can be applied with the study case**

After reviewing some of the experiences of Arab and foreign countries, some alternative scenarios can be developed to solve the problem of traffic congestion in the study area:

1. Transport planning related to education. This kind of transport serves educational trips through the allocation of mass transport buses to transport all users of the Educational City.
2. The entrance of private vehicles to the campus of the Educational City shall be limited to the vehicles of the teachers and staff and the use of the outdoor parking lot for the vehicles of visitors and students.
3. Changing the working hours of students and staff, and that this disparity in the times of entry to the educational city will allow continuity of entry smoothly without the accumulation of vehicles at the entrances.
4. Encourage the idea of walking in and out of the city through attractive banners that encourage it to be a useful and entertaining sport especially in the peak hours of morning.
5. The double-function of the entrances and exits of the educational city in the peak hours of morning and evening, meaning that all the ports can be in the morning to enter and all evening to exit.
6. Benefiting from the financial return of the monthly subscriptions to the parks within the educational city, as well as the return of the issuance of the badges and the amount of bus fare on the campus by increasing the efficiency of the transport network within the educational city. This aspect includes several scenarios, the most important of which are:
  - Increase the width of the road routes within the Education City and make it two corridors to go and return
  - Re-working (or repairing; restoring) of the outer road that surrounds the educational city and complete its extension with the University's main roads to serve all faculties located back from the university center, such as the Faculty of Agriculture, Veterinary Medicine, Girls' Science and Political Science, and Market Research Center, Psychological and Educational Research Center and Urban and Regional Planning Center.
  - Opening alternative entrances and exits through the construction of walkways for walkers or vehicles on the Tigris River map(2).
  - Establishing a direct transfer from the bridge of Jadiriya to the entrance to the city of education at the University of Nahrain.

Map (2)  
Plan of Alternatives



Source: From the work of the researcher based on the visual space for the year (2013)

### Conclusions

1. The educational city (Al-Jadriya complex) needs several entrances and exits to avoid the problem of overcrowding, which has a great impact on the users.
2. GIS software provides the possibility of building an integrated geographic database that enables researchers to find appropriate solutions to the problems that impede the progress of development and society.
3. Scenarios of alternatives proposed by the research the first two types can be applied, one outside the educational city, which reduces traffic congestion in general, and the second within the

educational city, which can provide the entry and exit of their users more smoothly and quickly.

### الاستنتاجات و التوصيات:

1. تحتاج المدينة التعليمية (مجمع الجادرية) الى عدة مداخل ومخارج لتلافي مشكلة التزاحم المروري عندها والذي له انعكاسات كبيرة على المستخدمين منها .
2. توفر برمجيات نظم المعلومات الجغرافية امكانية بناء قاعدة بيانات جغرافية متكاملة تمكن الباحثين من ايجاد حلول مناسبة للمشاكل التي تعيق تقدم التنمية والمجتمع .
3. سيناريوهات البدائل التي اقترحها البحث نوعان الاول يمكن تطبيقه خارج المدينة التعليمية مما يخفف من الازدحامات المرورية بشكل عام والثاني داخل المدينة التعليمية يمكنه من توفير دخول وخروج للمستخدمين منها بصورة اكثر سلاسة وسرعة .

### الهوامش:

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