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IMPROVEMENT OF TRAFFIC CAPACITY FOR AL-MUSTAINSIRIYAH INTERSECTION IN BAGHDAD CITY

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ABSTRACT

Capacity and level of service are the control points of the analysis of intersections and must be fully considered to evaluate the overall operator of the intersection.

The objectives of the present study include the analysis, evaluation and improvement of the operation for AL-Mustansiriyah Intersection in Baghdad city and to present the best proposal to enhance the performance from the capacity point of view.

To achieve these objectives, the estimated distribution of the traffic data in different directions that required for the traffic and geometrical analysis were gathered manually, while HCS traffic program is used for the requirements of traffic analysis process.

It has been concluded that the flyover between Al-Mustansiriyah University Street –Al-Talibia Street (Proposal No.2) is the best proposal to improve the operation ability of Al-Mustainsiriya roundabout Intersection.

تحسين السعة المرورية لتقاطع المستنصرية في مدينة بغداد

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الموجز

أن مفهوم الطاقة الاستيعابية ومستوى الخدمة هما نقاط السيطرة لعمليات تحليل التقاطعات ويجب أن تؤخذ بعين الاعتبار عند تقييم التشغيل للتقاطع. أن هذه الدراسة تشتمل على ؛ التحليل ، التقييم و تحسين القدرة التشغيلية لتقاطع المستنصرية في مدينة بغداد وعرض أفضل المقترحات لتحسين الأداء من حيث الطاقة الاستيعابية . ولتحقيق هذه الأهداف فقد تم جمع المعلومات المرورية يدويا لمختلف الاتجاهات لأغراض التحليل المروري والهندسي بينما تم استخدام برنامج HCS لأغراض عمليات التحليل المروري . لقد تم الاستنتاج بان اقتراح تنفيذ مجسر بمستوى واحد بين شارع المستنصرية وشارع الطالبية هو أفضل البدائل لتحسين القابلية التشغيلية لتقاطع المستنصرية .

KEY WORDS: Traffic Capacity, Level of Service (LOS), HCS Application, Peak Hour Factor (PHF), Saturation Flow.

NOMENELATURE

PHF = Peak-hour factor

V15 = Volume during the peak 15 min of the peak hour, on veh/15min

LOS = Level of Serves

PHV = Peak Hourly Volume

HCS = Highway Capacity Software

HCM = Highway Capacity Manual

HV =Heavy Vehicle

G =Green Time

Y =Yellow Time

L =Left Turn

TH = Through Turn

R = Right Turn

N = number of lanes in one direction

SF = service flow LOS under prevailing and traffic condition for N lanes in one direction (vph)

Cj = Capacity under ideal condition for freeway element of design speed.

fw = Factor to adjust for the effect of restricted lane widths (and lour) lateral clearance.

fHv = Factor to adjust for the effect of heavy vehicle.

fp = Factor to adjust for the effect of driven population

INTRODUCTION

The underlying objective of level of service analysis is to quantify a roadway's performance with regard to specified traffic volumes (i.e., its ability to efficiently handle a specified volume of traffic). This performance can be measured in terms of travel delay (as the roadway becomes increasingly congested) as well as other factors. The comparative performance of various roadway segments (which is determined from an analysis of traffic) is important because it can be used as a basis to allocate scarce roadway construction and improvement funds [4].

Capacity is simply defined as the highest traffic flow that a roadway is capable of supporting. For level of service analysis, a consistent and reasonably precise method of determining capacity must be developed within the definition. Because it can readily be shown that the capacity of a roadway section is a function of factors such as roadway type (e.g., freeway, multilane highway without full access control, or rural road), free-flow speed, number of lanes, and widths of lanes and shoulders [2].

This study will include traffic data collection, forecasting future traffic volumes, analysis of existing and projected traffic volumes, and suggestion of the possible geometric solutions to increase capacity and minimize the traffic delay.

DESCRIPTION OF SITE

Al-Mustansiriyah intersection is a signalized roundabout intersection located in educational zone in front of Al-Mustansiriyah university located in the North-East part of Baghdad city. **Figure 1** shows a satellite image for AL-Mustansiriyah Intersection and its approaches.

It is a four leg intersection type and represents the crossing node of two main arterials (Palestine Street and Safie Al-Deen Al-Hili Street), but they becomes freeways depending on pervious studies. The high traffic and pedestrian volume at this intersection affect highly the traffic flow especially through traffic along the above mentioned arterials.

SCOPE OF THE STUDY

1- Traffic data collection which include the counting of traffic volume for each traffic stream with classification of vehicle,

2- Traffic analysis using computer software for existing and future traffic conditions to get the level of service,

3- Suggest alternative geometric design proposals to improve the traffic performance across the intersection , and

4- Evaluation of the alternatives to choose the best one considering, the traffic performance parameters, safety to road users, and economic factors.

DATA COLLECTION

1-Traffic Volume

Counting of traffic volumes classified by movements and vehicle composition were conducted manually for the four approaches in an average four week days, good weather conditions in January, 2007.

The traffic volume for the counting period was recorded for each 15 minutes to calculate the peak hour factor at each approach, the peak hour and traffic volume variation

Peak Hour Volume

By considering the traffic volume account that previously presented in **Table 1**, an Excel program is used to specify the peak hour. The peak hour is found to be between 7:00 and 8:00 a.m. **Figure 2 (a) and (b)** shows the peak hour in addition to the variation of flow every 15 min during the time period of survey. From the traffic account, the following conclusions were observed:-

a. The total traffic volume during the peak hour for all approaches is (4501) pc/h. This peak hour is found to be between 7:00 and 8:00 a.m,

b. It was found that the approach from Palestine Street from Beirut intersection have the highest volume of traffic while the approach of Safie Al-Deen Al-Hili Street from Al-Qahera have the lowest volume during the hours of the account, and

c. For peak hour volume, the distribution of traffic volume in AL-Mustansiriyah Intersection is as shown in **Figure 3**. This Fig. shows the total volume during the peak hour for passenger

. **Peak Hour Factor (PHF)**

The peak hour factor is defined as the ratio of total hourly volume to the maximum 15- min rate of flow within the hour.

$$\mathbf{PHF} = \frac{Hourly\ \ volume}{peak\ \ rate\ of\ \ flow\ (within\ \ hour)} \quad (1)$$

$$\mathbf{PHF} = \frac{Hourly\ \ volume}{4 * V15\ \min} \quad (2)$$

Where:-

PHF= Peak-hour factor

$\mathbf{V_{15}}$= Volume during the peak 15 min of the peak hour, on veh/15min.

2-Saturation Flow Rate

Calculation of saturation flow rate depend on the headway data collected for queue vehicles at stop line for each approach at the time of departure on green time .

Saturation flow represents one of the main parameter in which has a major affect in the capacity of intersection [1 and 3]. The existing saturation flow is calculated by using HCS Software. **Table 1** shows the calculated saturation flow at the stop line for all approaches in Al-Mustansiriyah Intersection by using HCS Software.

EXISTING GEOMETRIC DESIGN

To evaluate the level of service at AL-Mustansiriyah Intersection, it is very important to specify the number of lanes for each approach. The existing geometric layout for AL-Mustansiriyah Intersection and its approaches are shown in **Figure 4.**

DATA ANALYSIS

Analysis of Existing Conditions

The Highway Capacity Software (HCS-2000) is adopted to analyze traffic conditions and achieved the existing capacity, volume to capacity ratio and calculation of estimated delay for each traffic movement at each approach.

After specifying the peak hour which represent the design hour volume, it is very important to estimate the level of service (LOS) at AL-Mustansiriyah Intersection with existing geometric design and traffic flow.

To estimate the LOS For existing condition, the average delay at AL-Mustansiriyah Intersection must be calculated because the average delay represents the main parameter for LOS estimation.

According to Highway Capacity Manual the (LOS) classified into six types depending on the value of average delay as shown in **Table 2**.

By using HCS program, the average delay for existing geometric at AL-Mustansiriyah Intersection is (57.4) sec/veh and according to the U.S Highway Capacity Manual, AL-Mustansiriyah Intersection will operate in LOS (E). **Table 3** and **4** show the average delay, LOS's and some intersection properties for all approaches connected with AL-Mustansiriyah Intersection.

The delay values and LOS for most approaches is near the capacity, the result shown in **Table 3** is the unaccepted according to all international specification in traffic engineering.

Table 4 show that the LOS at Safie Al-Deen Al-Hili from Al-Talibia is exceeding the capacity (LOS E) and needed traffic or geometric improvement.

Analysis of Forecasted Traffic Data

HCS is used to analysis the forecasted data through calculation of capacity, delay and LOS for all approaches and the whole intersection.

For target year in 2025 (after 20 years with 3% annual increasing rate), the expected traffic volume will be as shown in **Table 5** and **Figure 5.**

The average delay will be (275.4) sec/veh and the Intersection will operate at LOS (F). **Table 6** and **7** show the LOS's level of service and some of intersection properties at target year. The results for target year are unaccepted according to the international traffic specification.

Table 6 Shows that all the approaches will have very high delay values which will lead to blockage of intersection area during peak hours.

From site observation and traffic accounts, it was found that the capacity of this Intersection is less than the traffic volume at peak hour. This means that the construction of a Flyover is very important at this site so it is very important to carry out a traffic study to perform the required improvement to solve the congested traffic problem at AL-Mustansiriyah Intersection.

PROPOSED DESIGN ALTERNATIVES

Three geometric design proposals were suggested, and analysis of expected traffic volumes is conducted for evaluation of these proposals as follows:

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Proposal NO.1:

This proposal includes the execution of flyover along Safie Al-Deen Al-Hili Street using the same roundabout in the ground level, the expected number of vehicles which will use the proposed flyover will be as follow:-

About 600 pc/h from Expressway towards Al-Talibia in peak hour.

About 600 pc/h from Al-Talibia towards Expressway in peak hour.

The expected traffic volume for peak hour at ground level will be as shown in **Figure 6** With the execution of the proposed flyover along Safie Al-Deen Al-Hili Street ,the same geometric for AL-Mustansiriyah Intersection was used with addition of flyover along Safie Al-Deen Al-Hili Street to increase the capacity of the intersection in addition to use traffic signals.

The expected average delay at the at-grade level will be (55.4) sec/veh, which means the intersection, will be in LOS (E). **Table 8** and **9** show the results of analysis and some of Al-Mustansiriyah intersection properties.

Proposal NO.2:

This proposal includes removing the Roundabout and use crossing intersection with signalization as shown in **Figure 7**. By using this proposal, the results show unaccepted level of service LOS (E) because the average delay will be (64.3) sec/veh. **Table 10** and **11** show the level of service and some intersection Properties at AL-Mustansiriyah Intersection.

Table 10 Shows that all the approaches will have very high delay values which will lead to blockage of intersection area during peak hours.

Proposal NO.3:

This proposal includes the execution of flyover along Safie Al-Deen Al-Hili Street with signalized intersection in the ground level ,the expected number of vehicles which will use the proposed flyover will be as follow:-

About 500 pc/h from Expressway towards Al-Talibia in peak hour.

About 600 pc/h from Al-Talibia towards Expressway in peak hour.

The expected traffic volume for peak hour at ground level will be as shown in **Figure 8** With the execution of the proposed flyover along Safie Al-Deen Al-Hili Street ,the new geometric for AL-Mustansiriyah Intersection need to enhance the number of lanes to increase the capacity of the intersection in addition to use traffic lights.

The expected average delay at the at-grade level will be (28.3) sec/veh, which means the intersection, will be in LOS (C). **Table 12** and **13** show the results of analysis and some of Al-Mustansiriyah intersection properties.

Table 12 Shows that all the approaches will have suitable delay values at base year, which will lead to work the intersection in good conditions.

For target year (after 20 years with 3% annual increasing rate), the expected traffic volume will be as shown in **Figure 9**. The average delay will be (35.2) sec/veh and the Intersection will operate at LOS (D). **Table 14** and **15** show the LOS's level of service and some intersection properties at target year. The results for target year are accepted according to the international traffic specification.

Table 14 Shows that all the approaches will have suitable delay values at target year, which will lead to work the intersection in good conditions.

Proposal No.4:

This proposal includes the execution of flyover along Palestine Street from with signalized intersection in the ground level .For this proposal the expected traffic volume at ground level in AL-Mustansiriyah Intersection will be as shown in **Figure 10**. The expected traffic volume, which will be use the proposed flyover, will be as follow:

About 400 pc/h from Beirut intersection towards Al-Qahera in peak hour.

About 400 pc/h from Al-Qahera towards Beirut intersection in peak hour.

For this proposal, the same number of lanes must be adopted as shown in **Figure 10**. This proposal includes traffic light at ground level.
For the base year, the results of analysis show that the average delay is (62.1) sec/veh and the Intersection will operate at LOS (E). **Table 16** and **17** show the level of service of AL-Mustansiriyah Intersection.
Table 16 Shows that all the approaches will have suitable delay values at Base year, which will lead to work the intersection in good conditions.
For target Year the expected traffic volume at the at-grade level will be as shown in **Figure 11**. On the target year, the average delay is (291.2) sec/veh and the level of service will be (F) this delay and LOS are unaccepted according to the international specification. **Table 18** and **19** presents the above-mentioned results and some of intersection properties.
Table 18 Shows that all the approaches will have very high delay values at the Target year, which will lead to blockage of intersection area during peak hours.

DESIGN OF FLYOVER (NUMBER OF LANE)

HCM specification is used to calculate the number of lanes for the proposed flyover:

For Proposal No. 3 on the Target Year

Flyover along Safie Al-Deen Al-Hili Street (from Al-Talibia towards Expressway)

$$N= [SF / (C_j \times \frac{v}{c} \times f_w \times f_{Hv} \times f_{p})] \quad (3)$$

Where
N = number of lanes in one direction
SF = service flow LOS under prevailing and traffic condition for N lanes in one direction (vph)
C_j = Capacity under ideal condition for freeway element of design speed.
f_w = Factor to adjust for the effect of restricted lane widths (and lour) lateral clearance.
f_{Hv} = Factor to adjust for the effect of heavy vehicle.
f_p = Factor to adjust for the effect of driven population.
SF = 1080 pc/h (HCS software)
Assume LOS (D)

$$\frac{v}{c} = 0.80,\ f_{Hv} = 1.0,\ f_p = 1.0,\ f_{w=}\ 0.93$$

Where
f_w = 0.93 (use standard lane with 1 ft obstruction on both sides)
$\approx N = [1080 / (1900 \times 0.80 \times 0.93 \times 1.0 \times 1.0)] = 0.76$ Lanes
$\approx$ Use two lanes for each direction is too enough.

CONCLUSIONS

By considering the previous mentioned results, and throughout the presented four proposals, it is concluded that proposal No**. (**3**)** Reflects the best solution on the target year from the capacity and the performance operation point of view at AL-Mustansiriyah Intersection in Baghdad city. This proposal include construct flyover along Safie Al-Deen Al-Hili Street using four leg signalized intersection in the ground level with (28.3) and (35.2) sec/veh average delay in base and target year respectively, this is mean that the intersection work in LOS(C) and (D) for base and target year respectively.

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Table 1 Saturation Flow at -Mustansiriyah Intersection

approach	Movement	Saturation flow vphg
Palestine Street from Beirut intersection	TH	3149
	R	1409
Safie Al-Deen Al-Hili from Expressway	TH	3149
	R	1409
Safie Al-Deen Al-Hili Street from Al-Talibia	TH	3149
	R	1409
Palestine Street from Al-Qahera	TH	3149
	R	1409

Table 2 Level of Service Definitions Based on Delay (HCM method)

Level of service (LOS)	Control delay per vehicle in sec.
A	$d \leq 10$
B	$10 < d \leq 20$
C	$20 < d \leq 35$
D	$35 < d \leq 55$
E	$55 < d \leq 80$
F	$80 < d$

Table 3 Existing LOS at AL-Mustansiriyah Intersection

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	45.9	D
Safie Al-Deen Al-Hili from Expressway	32.6	C
Safie Al-Deen Al-Hili Street from Al-Talibia	75.9	E
Palestine Street from Al-Qahera	53.2	D
Average Intersection Delay	57.4	E

Table 4 Properties of Existing Geometry for Al-Mustansiriyah Intersection

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	TH	929	7	0.90	2	30	4
	R	535	7	0.90	1		
Safie Al-Deen Al-Hili from Expressway	TH	821	7	0.90	2	23	4
	R	480	7	0.90	1		
Safie Al-Deen Al-Hili Street from Al-Talibia	TH	847	7	0.90	2	26	4
	R	550	7	0.90	1		
Palestine Street from Al-Qahera	TH	814	7	0.90	2	25	4
	R	407	7	0.90	1		
Total						120	

Table 5 Traffic volume for current and expected volume for Al-Mustansiriyah Intersection

Approach	Movement	Current Volume	Expected Volume with 3 % Growth Factor,20 years
Palestine Street from Beirut intersection	L	376	680
	TH	553	998
	R	535	966
Safie Al-Deen Al-Hili from Expressway	L	199	360
	TH	622	1123
	R	480	867
Safie Al-Deen Al-Hili Street from Al- Talibia	L	177	320
	TH	670	1210
	R	550	993
Palestine from Al-Qahera	L	128	230
	TH	686	1234
	R	407	735

Table 6 Level of Service at AL-Mustansiriyah Intersection for the Target Year

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	328.0	F
Safie Al-Deen Al-Hili from Expressway	205.6	F
Safie Al-Deen Al-Hili Street from Al-Talibia	334.8	F
Palestine Street from Al-Qahera	285.8	F
Average Intersection Delay	275.4	F

Table 7 Al-Mustansiriyah Intersection Properties at Target Year.

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	TH	1678	7	0.90	2	30	4
	R	966	7	0.90	1		
Safie Al-Deen Al-Hili from Expressway	TH	1483	7	0.90	2	23	4
	R	867	7	0.90	1		
Safie Al-Deen Al-Hili Street from Al-Talibia	TH	1530	7	0.90	2	26	4
	R	993	7	0.90	1		
Palestine Street from Al-Qahera	TH	1470	7	0.90	2	25	4
	R	735	7	0.90	1		
Total						120	

Table 8 Level of Service at AL-Mustansiriyah Intersection at Target Year (proposal No.1).

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	25.1	C
Safie Al-Deen Al-Hili from Expressway	30.3	C
Safie Al-Deen Al-Hili Street from Al-Talibia	95.2	F
Palestine Street from Al-Qahera	43.3	D
Average Intersection Delay	55.4	E

Table 9 Properties of Al-Mustansiriyah Intersection after Proposal No. 1 at Target Year.

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	TH	929	7	0.90	2	30	4
	R	535	7	0.90	1		
Safie Al-Deen Al-Hili from Expressway	TH	221	7	0.90	2	23	4
	R	480	7	0.90	1		
Safie Al-Deen Al-Hili Street from Al-Talibia	TH	247	7	0.90	2	26	4
	R	550	7	0.90	1		
Palestine Street from Al-Qahera	TH	814	7	0.90	2	25	4
	R	407	7	0.90	1		
Total						120	

Table 10 Level of Service at AL-Mustansiriyah Intersection by Adopting Proposal (2) at Base Year

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	69.0	E
Safie Al-Deen Al-Hili from Expressway	53.0	D
Safie Al-Deen Al-Hili Street from Al-Talibia	59.8	E
Palestine Street from Al-Qahera	72.6	E
Average Intersection Delay	64.3	E

Table 11 Al-Mustansiriyah Intersection Properties after Proposal No.2 at Base Year

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	L	376	7	0.90	1	34	4
	TH	553	7	0.90	3		
Safie Al-Deen Al-Hili from Expressway	L	199	7	0.90	1	28	4
	TH	622	7	0.90	3		
Safie Al-Deen Al-Hili Street from Al-Talibia	L	177	7	0.90	1	20	4
	TH	670	7	0.90	3		
Palestine Street from Al-Qahera	L	475	7	0.90	1	22	4
	TH	570	7	0.90	3		
Total						120	

Table 12 Level of Service at AL-Mustansiriyah Intersection by adopting proposal NO. (3) on the base year.

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	27.0	C
Safie Al-Deen Al-Hili from Expressway	35.6	D
Safie Al-Deen Al-Hili Street from Al-Talibia	36.8	D
Palestine Street from Al-Qahera	24.3	C
Average Intersection Delay	28.3	C

Table 13 Al-Mustansiriyah Intersection Properties after Proposal No. 3 at Base Year

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	L	376	7	0.90	2	30	4
	TH	553	7	0.90	3		
Palestine Street from Al-Qahera	L	475	7	0.90	2	34	4
	TH	570	7	0.90	3		
Safie Al-Deen Al-Hili from Expressway	L	199	7	0.90	3	20	4
	TH	122	7	0.90	1		
Safie Al-Deen Al-Hili Street from Al-Talibia	L	177	7	0.90	3		
	TH	170	7	0.90	1		
Total						96	

Table 14 Level of Service at AL-Mustansiriyah Intersection for the Target Year (proposal NO.3)

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	33.3	C
Safie Al-Deen Al-Hili from Expressway	38.7	D
Safie Al-Deen Al-Hili Street from Al-Talibia	48.8	D
Palestine Street from Al-Qahera	31.3	C
Average Intersection Delay	35.2	D

Table 15 Al-Mustansiriyah Intersection Properties after Proposal No. 3 at Target Year

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	L	680	7	0.90	2	30	4
	TH	998	7	0.90	3		
Palestine Street from Al-Qahera	L	858	7	0.90	2	34	4
	TH	1029	7	0.90	3		
Safie Al-Deen Al-Hili from Expressway	L	360	7	0.90	3	20	4
	TH	219	7	0.90	1		
Safie Al-Deen Al-Hili Street from Al-Talibia	L	320	7	0.90	3		
	TH	306	7	0.90	1		
						96	

Table 16 Level of Service at AL-Mustansiriyah Intersection on Base Year (proposal No.4)

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	101.2	F
Safie Al-Deen Al-Hili from Expressway	25.2	C
Safie Al-Deen Al-Hili Street from Al-Talibia	28.5	C
Palestine Street from Al-Qahera	122.4	F
Average Intersection Delay	62.1	E

Table 17 Properties of Al-Mustansiriyah Intersection after Proposal No. 4 at Base Year.

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	L	376	7	0.90	2	24	4
	TH	133	7	0.90	1		
Palestine Street from Al-Qahera	L	475	7	0.90	2		
	TH	170	7	0.90	1		
Safie Al-Deen Al-Hili from Expressway	L	199	7	0.90	1	26	4
	TH	622	7	0.90	3		
Safie Al-Deen Al-Hili Street from Al-Talibia	L	177	7	0.90	1	23	4
	TH	670	7	0.90	3		
Total						85	

Table 18 Level of Service at AL-Mustansiriyah Intersection at Target Year (proposal No.4)

Approach	Average delay sec/veh	Level of service(LOS)
Palestine Street from Beirut intersection	478.6	F
Safie Al-Deen Al-Hili from Expressway	34.5	C
Safie Al-Deen Al-Hili Street from Al-Talibia	57.8	E
Palestine Street from Al-Qahera	777.2	F
Average Intersection Delay	291.2	F

Table 19 Properties of Al-Mustansiriyah Intersection after Proposal No. 4 at Target Year.

Approach	Movement	Vol.	% Hv	PHF	No. of Lane	Cycle length (sec.)	
						G	Y
Palestine Street from Beirut intersection	L	680	7	0.90	2	24	4
	TH	239	7	0.90	1		
Palestine Street from Al-Qahera	L	858	7	0.90	2		
	TH	306	7	0.90	1		
Safie Al-Deen Al-Hili from Expressway	L	360	7	0.90	1	20	4
	TH	1123	7	0.90	3		
Safie Al-Deen Al-Hili Street from Al-Talibia	L	320	7	0.90	1	23	4
	TH	1210	7	0.90	3		
Total						85	

Figure 1 Satellite Image for AL-Mustansiriyah Intersection in Baghdad City

a. car.

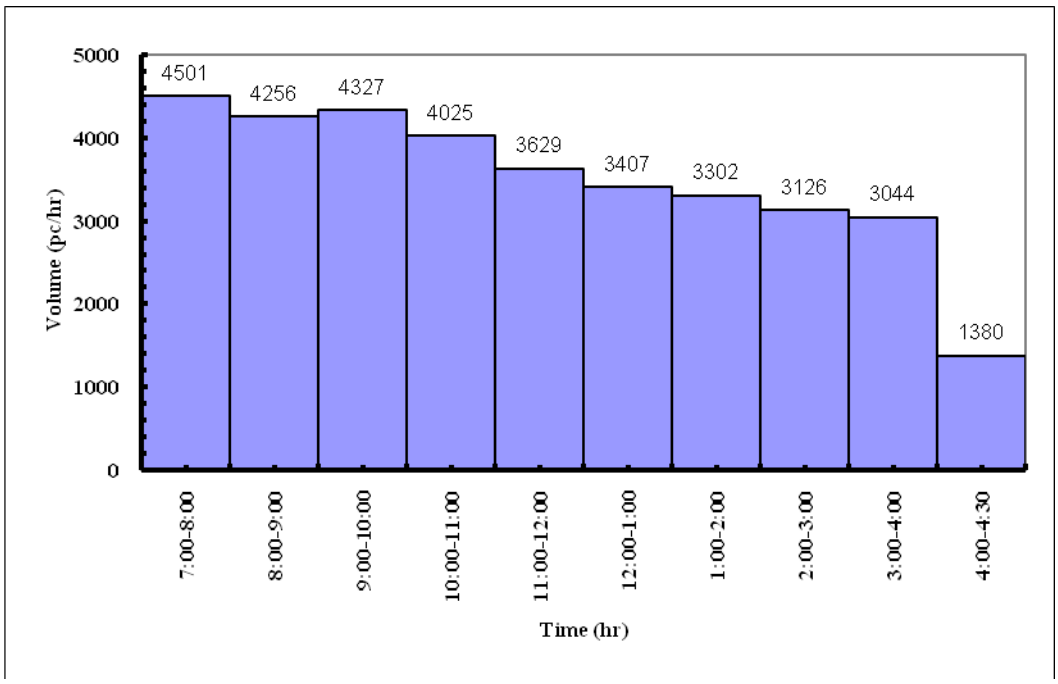

Figure 2 (a) Distribution of Traffic Volume from 7:00 a.m to 4:30 p.m at AL-Mustansiriyah Intersection.

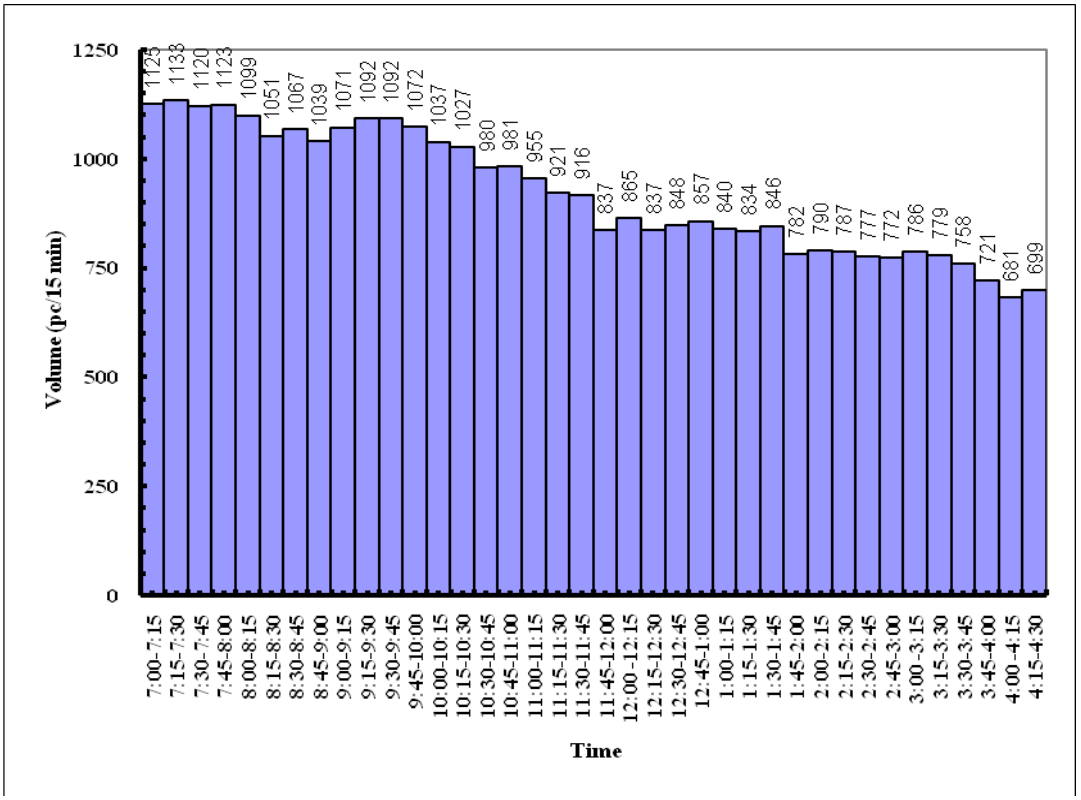

Figure 2 (b) Total of Traffic Volume every 15 min for all Approaches at AL-Mustansiriyah Intersection.

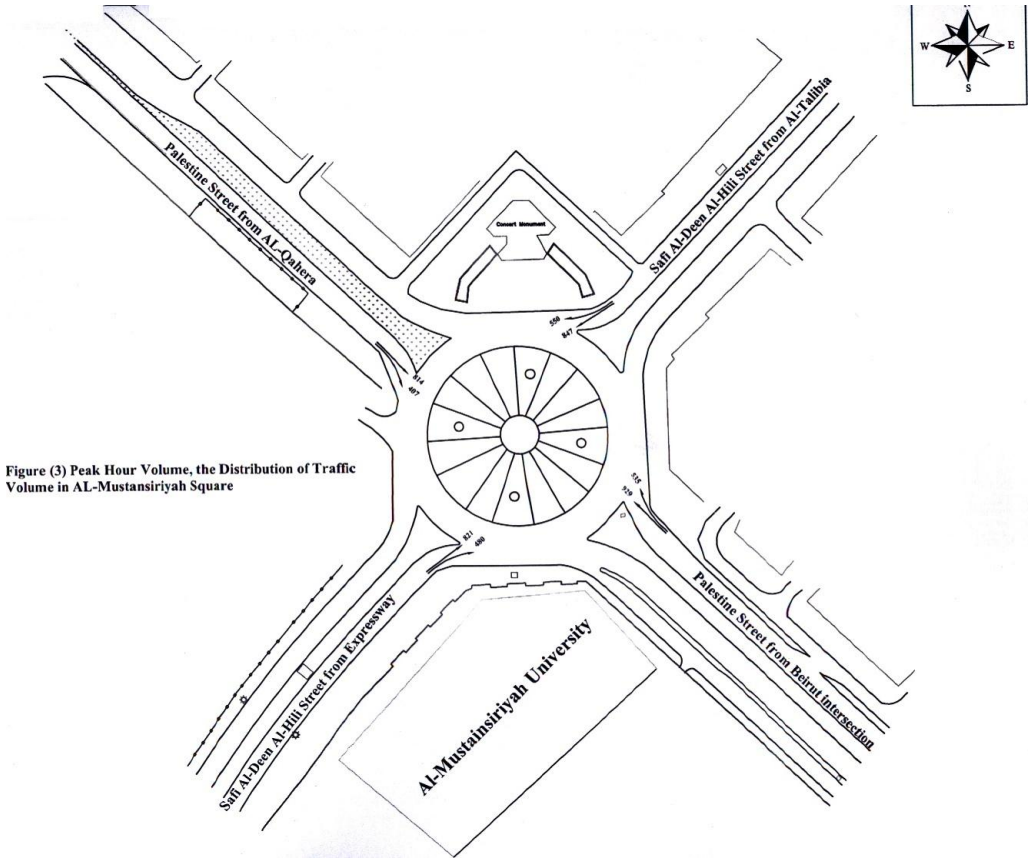

Figure (3) Peak Hour Volume, the Distribution of Traffic Volume in AL-Mustansiriyah Square

Figure 3 Peak Hour Volume, the Distribution of Traffic Volume in AL-Mustansiriyah Intersection.

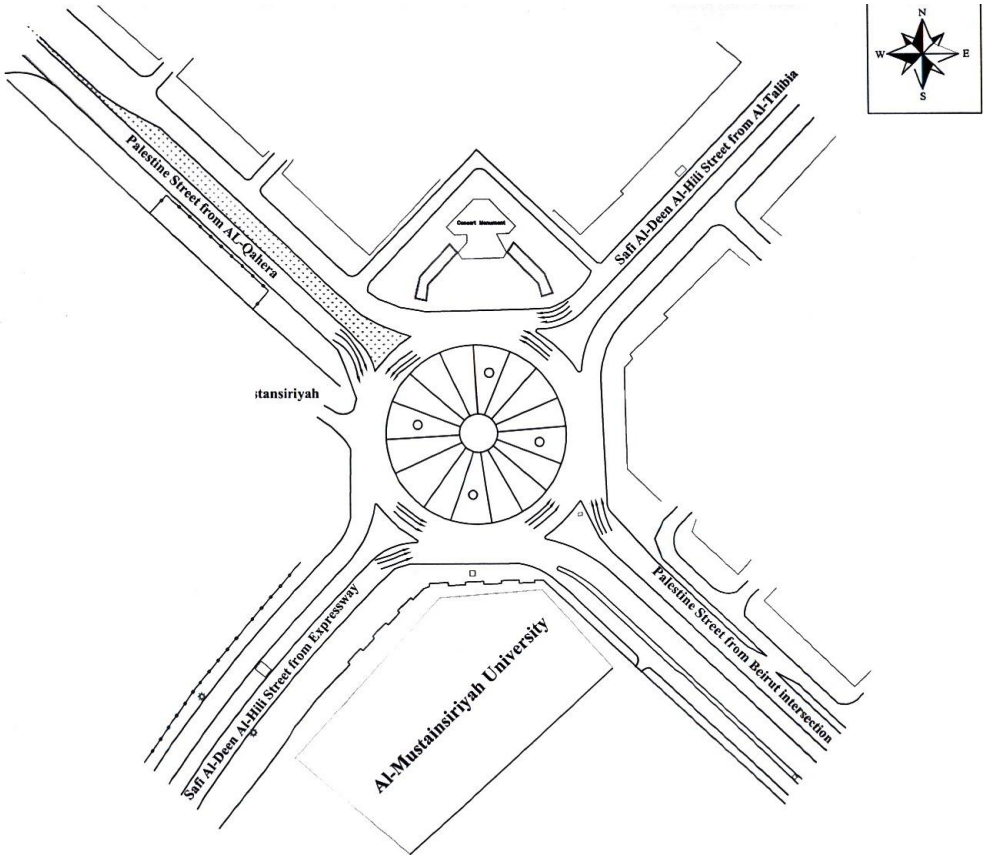

Figure 4 Existing Geometrical Design of AL-Mustainsiriya Intersection.

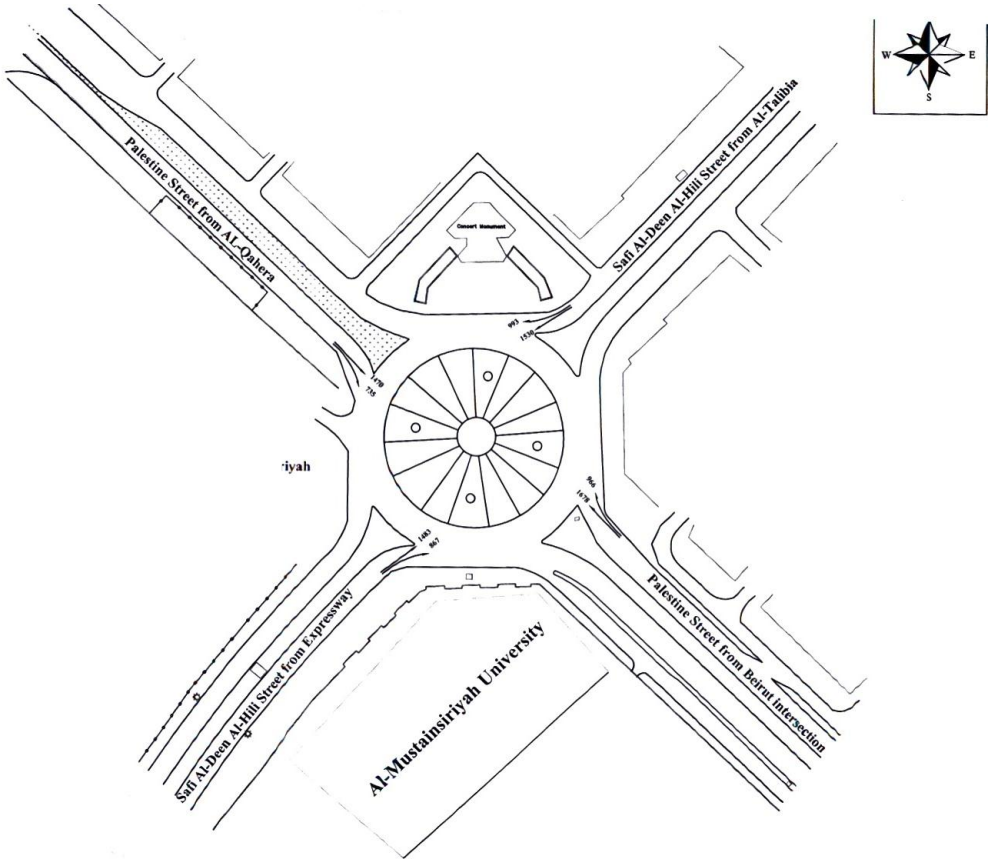

Figure 5 Expected Traffic Volume for AL-Mustainsiriya Intersection at Target Year.

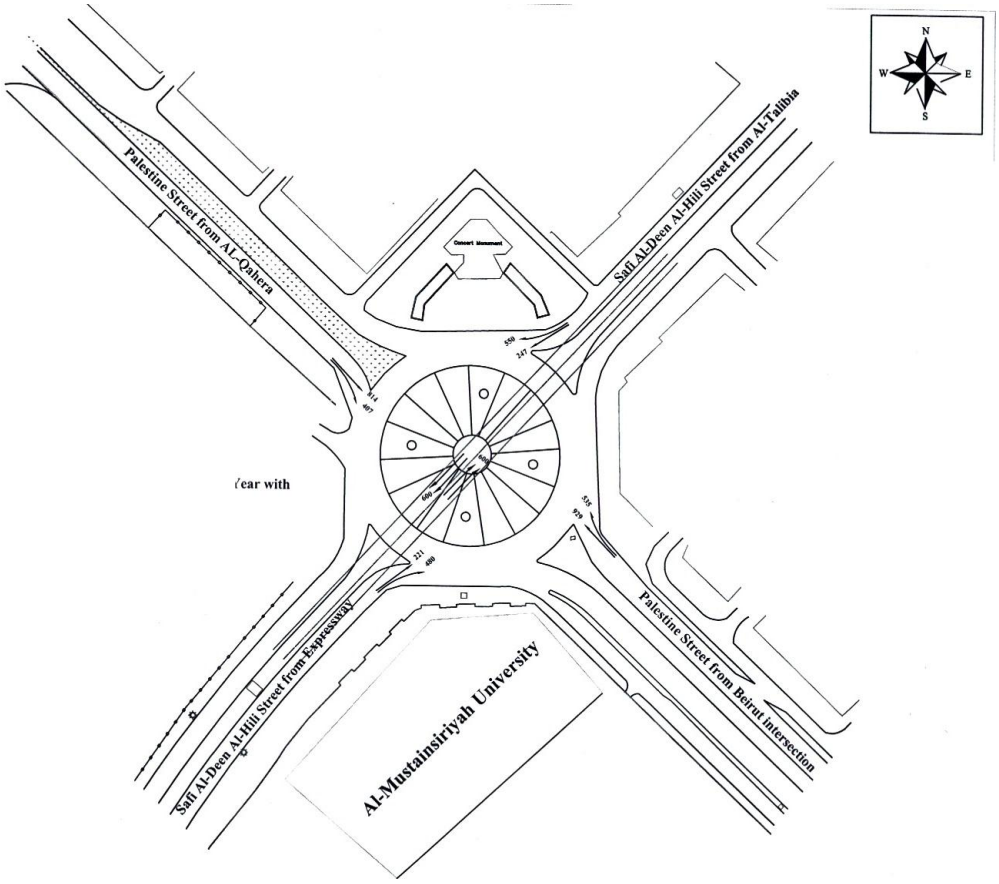

Figure 6 Expected Traffic Volume at Base Year with Adopting Proposal No. (1).

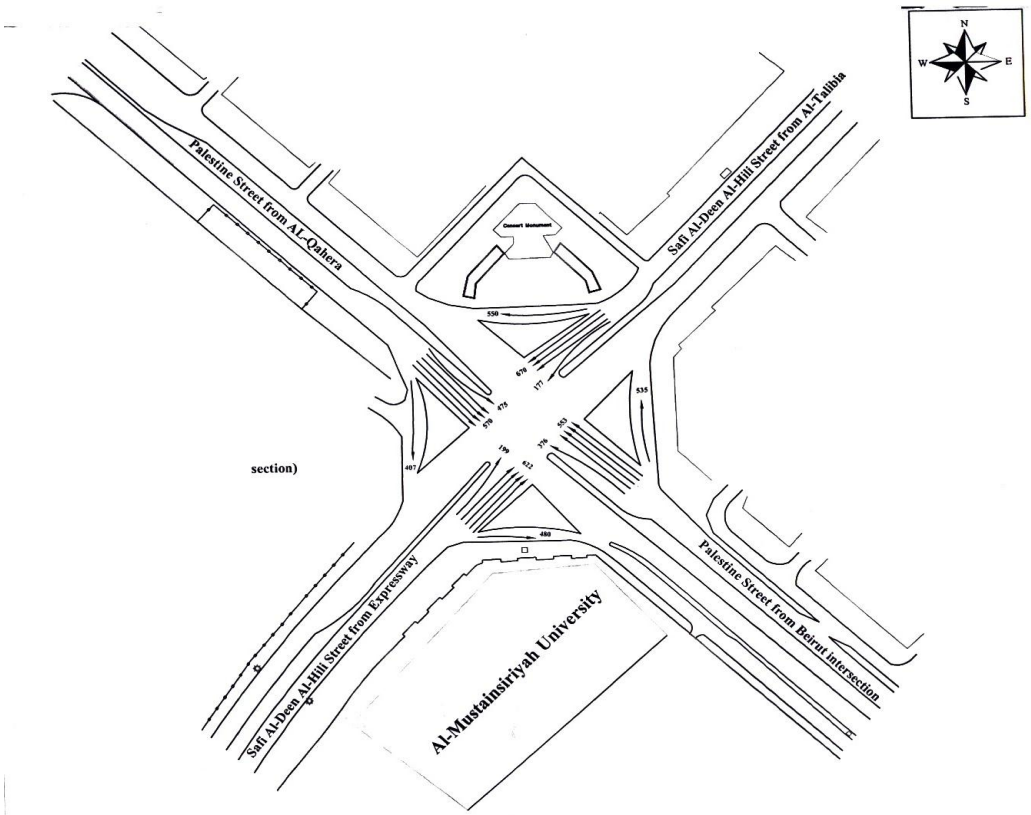

Figure 7 Proposal NO.2 (crossing intersection).

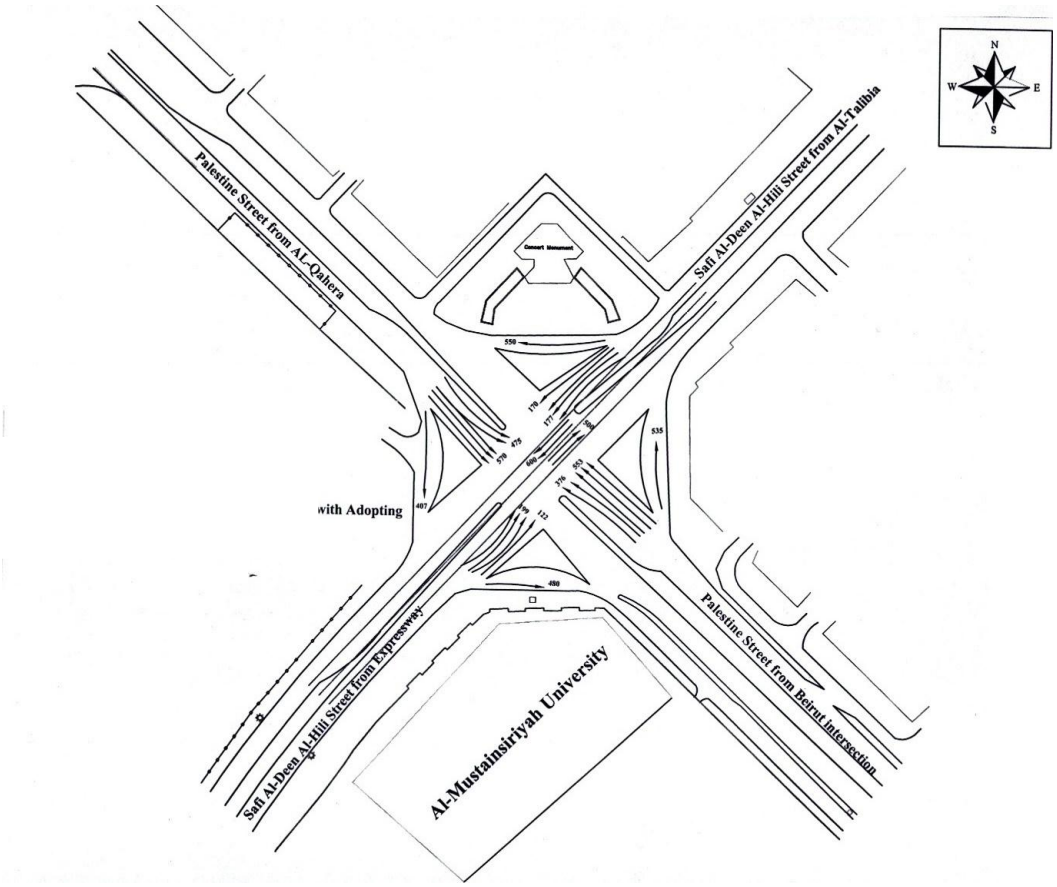

Figure 8 Expected Traffic Volume at Base Year with Adopting Proposal No. (3)

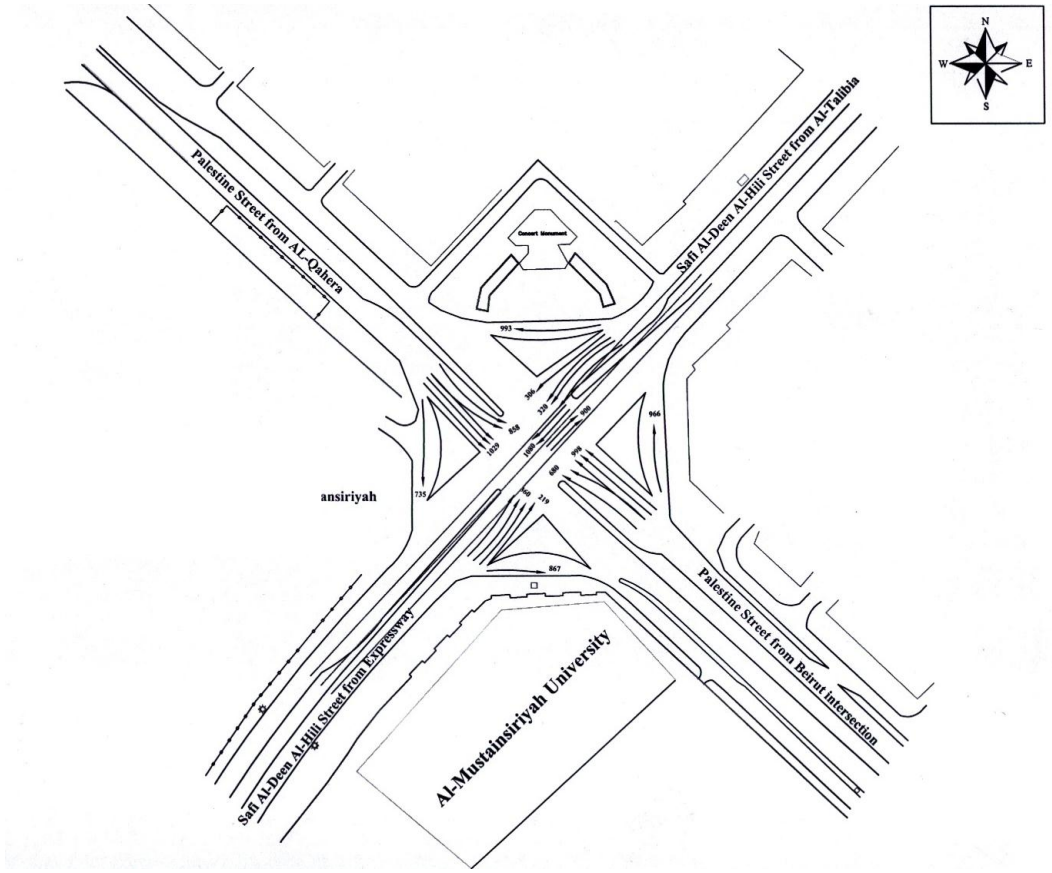

Figure 9 Expected Traffic Volume for AL-Mustansiriyah Intersection at Target Year

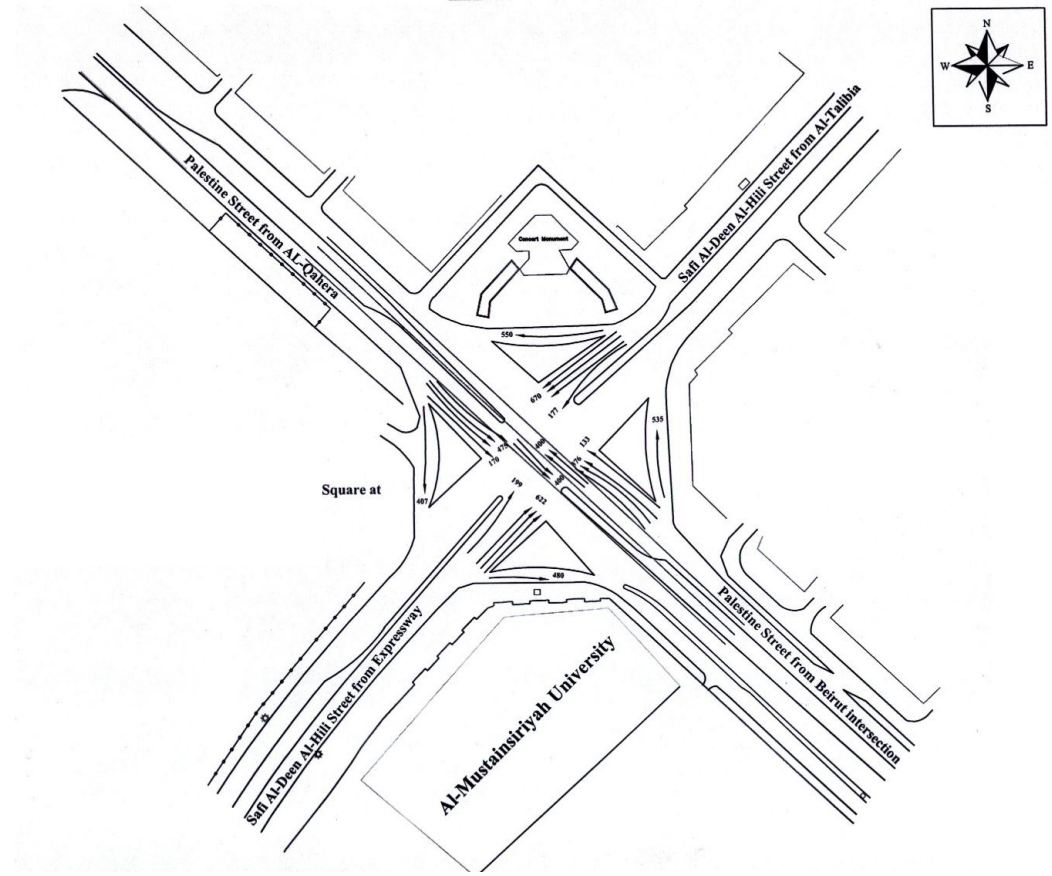

Figure 10 Traffic Volume at AL-Mustansiriyah Intersection at Peak hour with Proposal 4 at Base Year.

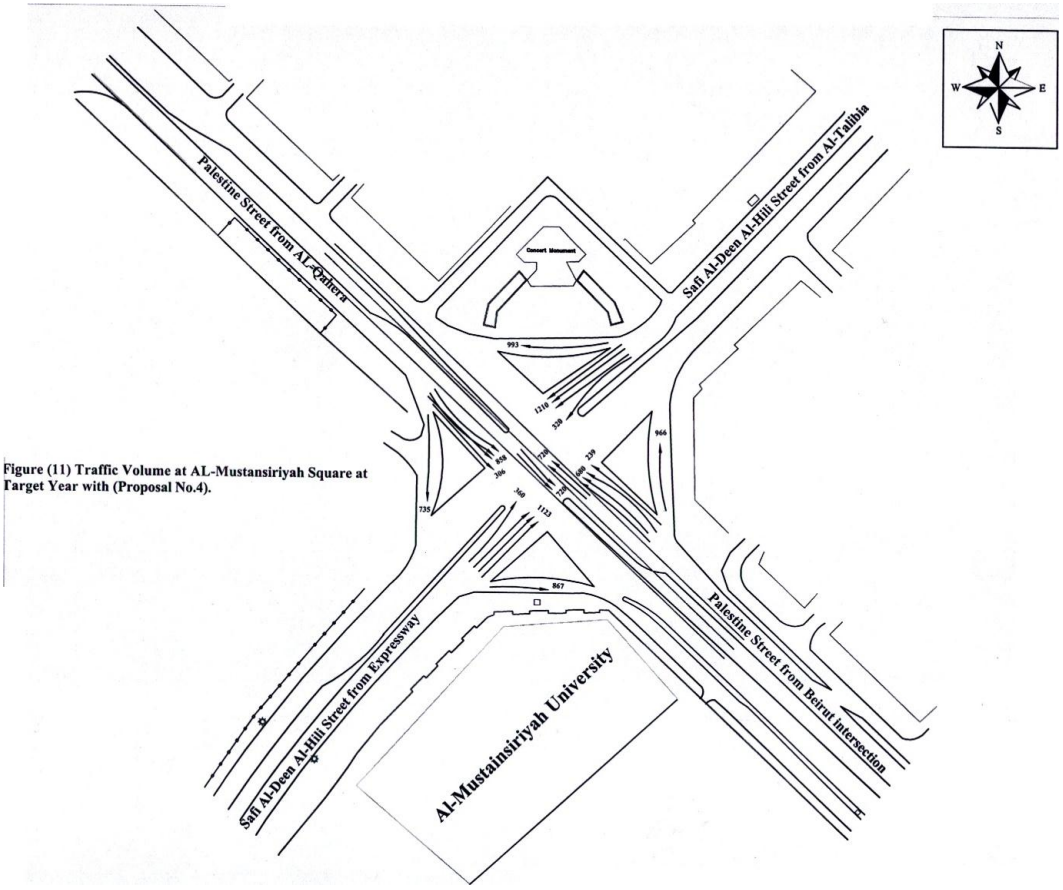

Figure (11) Traffic Volume at AL-Mustansiriyah Square at Target Year with (Proposal No.4).

Figure 11 Traffic Volume at AL-Mustansiriyah Intersection at Target Year with (Proposal No.4).