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Fixed-Time Signal Coordination on Arterial Streets in Sulaimani City

***Hirsh Muhammad Majid**
Department of Building and Construction Engineering – College of Engineering – University of Sulaimani
Iraqi Kurdistan Region
e-mail: herishmm2003@yahoo.com

Aso Faiz Saeed Talabany
Department of civil Engineering
College of Engineering
University of Salahaddin – Hawler
Iraqi Kurdistan Region
e-mail: aso_f@yahoo.com

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Abstract

In this study, five adjacent intersections on three links in Sulaimani city were selected to study the attainability of coordinating them by calculating the coupling index as an attempt to find a solution for some traffic problems which exist in these intersections. Based on the coupling index limited or simple progressive system was used in this study. The coordination between Mamostayan and Yakgirten intersections on Mamostayan1 link and between Palace, Aqaree and Engineering intersections on Salim1 and Salim2 links respectively had been studied. For each intersection in this study, traffic and geometric data were collected by various methods to find the elements which are necessary to obtain the coordination goal. These elements are peak hour volume, passenger car equivalent, saturation flow, link speed, approach speed, intersection stopped delay, and approach and intersection control delay, before and after coordination. In addition, the evaluation was made whether the two direction coordination is available for application or not by calculating the attainability factor and identifying its efficiency. The study demonstrates that the coordination between these intersections gives good results for one direction. But the coordination between Palace and Aqaree intersection (Salim1 link) in one direction or two direction progression gives best results.

Keywords: Traffic Signal, Signalized intersection, Signal Coordination, Signal Progression.

Introduction

As population and car ownership continues to grow, the demand on our existing transportation system will become increasingly hard to meet.

Sulaimani city is one of Iraqi Kurdistan cities, which is located in a mountainous terrain and due to its narrow streets and relatively large traffic volumes, it has many traffic problems, which cause discomfort to thousands of motorists, loss of time, and affect the economy of Kurdistan region.

The streets of the city are unlikely to expand much due to cost and dwindling land supply especially in central area, so intelligent systems such as advanced traffic signal control will be adequate for operating the current roadway systems at maximum capacity.

Significant improvements in traffic flow and reductions in vehicular delay may be realized by interconnecting individual, isolated intersections into a coordinated signal system, or by adding an adjacent signal to an existing progression system.

"Traffic signal coordination is when two or more traffic signals are working together so that cars moving through a group of traffic signals will make the least number of stops possible " [(1)].

In order for this to happen, each traffic signal in the group of signals must allow for a green light for all

* Cited from M.S.c. thesis.

directions of travel during the correct fixed time period. However, traffic signal coordination does not mean that drivers will never have to stop for red light because of some reasons which affect on the amount of time available for green light in that direction, those reasons are pedestrian crossings, cross traffic, left turn signals, two-way traffic flow and off-peak traffic periods [1].

Objective

The main objective of this research is to provide the foundation for the coordination of fixed time signals of some successive intersections on the selected arterials of the city (which their signal timing are not designed adequately nor coordinated); hence, minimizing the number of stops, delays and traffic jam, and optimizing the capacity of these intersections.

Methodology

This section explains the elements, which are necessary for the data collection and analysis and the equations used:

1- Passenger car equivalent (PCE)

Headway method, suggested by Gwyn, Reilly and Seifert [2] used to determine the PCEs.

This method is based on headways, and its basic equation is given as:

$$E_T = \left[\frac{\frac{h_1}{h_2} - b_1}{b_2} \right] \quad \ldots\ldots\ldots \quad \ldots\ldots\ldots \quad \ldots\ldots \quad (1)$$

Where:

E_T = Passenger car equivalent

h_1= Average headway for a sample of cars and truck

h_2= Average headway for passenger cars only

b_1= Proportion of cars

b_2= Proportion of trucks

2- Saturation flow rate

HCM2000[3] method was used for determining saturation flow.

3- Link speeds

i- Link speed

The speed data for the links between the surveyed intersections were measured by observations made by a moving vehicle (test car) method during the peak hour.

The observers in the test car made a number of test runs (at least 6) for each link and they recorded the required observations. From these observations, the mean speed and numbers of vehicles passing along a street could be obtained for all classes of selected vehicles.

ii- Mid-link spot speed

A spot speed study is carried out by recording the speeds of a statistically sufficient sample of vehicles at mid-link locations.

4- Traffic volume

i- Link volume

The link volume data is obtained from the observations made by the moving vehicle method.

ii- Intersection volumes

Video recording technique was used for the determination of intersection volumes.

5- Optimum cycle time

In this study Webster [4] method for fixed-time signal control was selected.

6- Coordination of traffic signals

i- Control strategy

For determining intersection control strategy the coupling index, I_c, is calculated for each link from two way peak hour volumes and link lengths:

$$I_c = V / d_L \quad \text{.....................} \quad (2)$$

Where:

d_L Link length (m)

V Two direction peak hour link volume (vph)

I_c Coupling index

When I_c is greater than 0.5, signal progression is recommended. As the link volume increases, so does the need to provide signal progression. Based on the coupling index, the signal is classified as an isolated, arterial, crossing arterial, or dense network intersection: [5]

1. Isolated $I_c \leq 0.5$ for all directions.
2. Arterial $I_c > 0.5$ for major street only.
3. Crossing arterial $I_c > 0.5$ for major street, and at least one side street link.
4. Dense network $I_c > 0.5$ for both the major street and minor street links.

Based on the coupling index the best control strategy was used in this study.

ii- Signal operational strategy

The critical volume ratio, (v/c) ratio, and turning movement percentages are determined from peak hour volumes for each approach. The capacity (c) was determined following the HCM 2000[3] method. Then v/c ratio was calculated in order to determine how likely the approach is to function as pretimed.

Then best signal operational strategy is selected from the most appropriate of the two signal control shown in Table (1). Depending on the variability of traffic patterns during the day, multiple worksheets can be prepared to justify a combination of signal operation modes used at different times of the day.

iii- Time-space diagram

To design a coordinated system, (to identify the green bandwidth at the target intersection and its effect on the overall progression of the arterial), and to determine the quality of signal progression, time-space diagrams were constructed.

iv- Bandwidth efficiency

This is simply the proportion of the cycle that is included in through green bands, extending the entire length of the system. A simple Time Space Diagram TSD showing perfect time-space progression illustrates the concept. Mathematically, efficiency is calculated as [6]:

$$E = \frac{B_f + B_r}{2C} \quad \text{.........................} (3)$$

Where:

B_f, B_r = Bandwidths in the forward (f) and reverse (r) directions with respect to the arterial orientation respectively, (sec).

E= Bandwidth efficiency

C= Cycle length (sec).

v- Bandwidth attainability

The attainability is the ratio of the total bandwidths to critical phase lengths for each of the directions on the arterial. Attainability is a measure of how much of the maximum available green is used for through progression.

This Measure Of Effectiveness (MOE) is a quantitative parameter indicating the performance of a transportation facility or service is only reported by PASSAR-II[7]. We can easily see that if attainability on a two-way street is less than 0.5, we can almost certainly improve the overall progression, including efficiency, by providing "perfect" one-way progression in the peak direction. Attainability is computed as follows [6]:

$$A = \frac{B_f + B_r}{G_f + G_r} \quad \text{.........................} (4)$$

Where:

A	Bandwidth attainability
G_f, G_r	The critical (or minimum) green periods (including change periods) in the forward (f) and reverse (r) directions with respect to the arterial orientation respectively, (sec).

7- Traffic delay

i- Approach delay

Approach stopped time delay was computed as follow [(6)]:-

Total delay = total number of vehicles observed x observation interval .... (5)

Average delay per stopped vehicle = total delay / number of stopping vehicles .... (6)

Average Delay per approach vehicle = total delay / approach volume .... (7)

percentage of vehicles stopped = number of stopping vehicles/ approach volume .... (8)

The method suggested by HCM 2000[(3)] was followed to determine the approach control delay.

ii-Intersection delay

The procedure for delay estimation yields the control delay per vehicle for each lane group. It is often desirable to aggregate these values to provide delay for an intersection approach and for the intersection as a whole [(3)].

$$d_A = \frac{\sum d_i V_i}{\sum V_i} \quad \text{.........................} (9)$$

Where:

d_A = Delay per vehicle for intersection A (sec/veh)

d_i = Delay for approach i (sec/veh)

V_i = Two direction peak hour volume (vph) for approach i

Data collection

1- Selection and description of study area

In order to fulfill the objectives of this study three 6-lane divided urban arterial roads were selected including five intersections. The selected links are Mamostayan1, Salim1 and Salim2. The studied intersections were Mamostayan (M), Yakgirten (Y), Palace (P),Aqaree, and Engineering (E). See Tables (2) and (3) and Figure (1) for details.

2- Collection of the required data

i- Period of data collection

The data of peak hours between 7:30 AM and 9:00 PM was selected.

ii- Methods of data collection

Manual method, moving vehicle method, and video recording technique was used in this study.

The following data were collected manually :

1. Saturation flow
2. Intersection delay
3. Mid-link spot speed

The link speed and volume data were observed using moving vehicle technique at peak hours.

The remainder of the data were collected by video-based technique, which overcomes many of the difficulties in collecting traffic data.

iii- Data abstraction

The data abstraction process was mainly achieved by replaying the video film and with the aid of a computer program named EVENT [(9)]. The abstracted data was then processed, using Microsoft Excel program and output data files from EVENT program.

Data analysis and discussion

The collected data have been analyzed as follows:

1- PCE – values

Using equation (1), PCE- values were determined. Because of low percentages of heavy vehicles, PCEs are near to one (between 1.02 to 1.28).

2- Saturation flows

The results of saturation flows are shown in Table (4) below.

3- Link speeds

Table (5) shows the results of link average travel and running speeds

The mid-link spot speed data were statistically analyzed using SPSS version13 software[10]. Some statistical parameters were determined and presented in Table (6).

It can be realized that there is a big difference between link running and Mid-link mean speeds, see Table (7). This may be due to decelerations and accelerations near approaches to intersections, intermediate spacer, and uncontrolled crossing walk for pedestrian in the link.

4- Intersection traffic volume data

Figures (2) through (6) are showing results of peak hour volumes.

5- Signalization plans

Isolated signalization plan for the studied intersections was prepared. Cycle times for most of the intersections yield the maximum value; therefore, they were taken as 120 seconds. Then cycle times were split between phases with respect to their traffic volumes.

6- Coordinated signalization plan for the studied intersections

It should be noted that all signals within the same signal system must generally have the same cycle length, to make it possible for the pattern of timings to repeat every cycle. Special conditions, however, may make a limited number of multiple or submultiples cycle lengths desirable. This is the only reason, which makes signal time for "E" intersection to be changed.

The coordination application in the study area should be checked to know whether it is improved or not, and if the coordination application is fulfill, then the mode of coordination operation should be found out. To gain this check the coupling index was calculated using equation (2). See Table (8) for results.

From Table (8) it is obvious that coupling index is greater than 0.5; therefore, all intersections are appropriate for coordination.

All intersections have v/c value more than (0.8); therefore, according to Table (1) and taking the turning movements into consideration, pre-timed coordination is favorable mode of coordination.

i- Coordination of traffic signals under prevailing conditions

In this case, the prevailing traffic conditions used in the analysis and no improvements was recommended. The running speeds from the moving vehicle method were used in the analysis.

The coordination could be designed as one-direction, which achieves greater bandwidth, or two-direction coordination. See Table (9) for offsets and bandwidths.

For Mamostayan1 link the coordination was made in (M-Y) direction for (straight of North) and (left of East) of M intersection and in (Y-M) direction for the (straight of South) of Y intersection.

It can be seen that there is no difference in bandwidths, because coordination –through band– is

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For Mamostayan1 link the coordination was made in (M-Y) direction for (straight of North) and (left of East) of M intersection and in (Y-M) direction for the (straight of South) of Y intersection.

It can be seen that there is no difference in bandwidths, because coordination –through band– is restricted by the smaller green time which is in East of Y intersection.

For Salim1 link the coordination was made in (P-A) direction for (left of South) and (right of North) of P intersection and in (A-P) direction for (straight of West) and (left of North) of A intersection.

For Salim2 link the coordination was made in (A-E) direction for (straight of East) of A intersection and in (E-A) direction for (straight of West) and (left of North) of E intersection.

It can be seen that two direction coordination between M and Y intersections have too small bandwidth, so it is not preferable to be of two direction coordination.

ii- Coordination of traffic signals under controlled traffic conditions

To increase the efficiency and attainability, the use of traffic signs is recommended to prevent pedestrian crossing outside crossing areas. This prevention increases the running speed. The controlled running speed can be used to give more efficient coordination. The speeds were changed from the average running speed to mid-link mean spot speed to give greater bandwidths.

In the case of one direction coordination for both studied links, the offsets are changed, and there is no change in bandwidth and average control delay by increasing average running speed, because the bandwidth depends on the green split and then on running speed. Also, average control delay for intersections is affected by green split and volume of the intersections and not by the average running speed.

In the case of two direction coordination, both the offsets and the bandwidths are changed.

iii- Comparison between different coordination approaches

Comparisons between different coordination approaches are presented in Table 9.

iv- Bandwidth efficiency

Table (10) shows results of bandwidth efficiency which were obtained by equation (3).

These results show that the maximum efficiency for the coordination under prevailing conditions is equal to 23% for Salim1 link and maximum efficiency for coordination under controlled conditions, which is 25%, for the same link. Generally, the efficiency for controlled condition will be greater than prevailing conditions, because greater portion of green times for the phases are used in the coordination.

v- Bandwidth attainability

Table (10) also shows results of bandwidth attainability which were obtained by equation (4).

MnDOT [(6)] mentioned that, if attainability on a two-way street is less than 0.5, it can almost certainly improve the overall progression, including efficiency, by providing "perfect" one-way progression in the peak direction.

The values of attainability more than 0.5 can provide two way progression and those which are less than 0.5 can be improved by providing one way progression. The type of progression that can be provided is shown in Table (11)

8- Traffic delay

The results are shown in Figures (7) and (8) and Tables (12) and (13).

These results show that coordination has good effect on reducing the traffic delay for all approaches and, therefore, for all studied intersections. This reduction in the traffic delay results in higher levels of service (LOS) for most of the approaches.

A comparison between control delay before & after coordination for the approaches and intersections may be remarked in same Figures.

Conclusions and recommendations

1- Conclusions

The following conclusions drawn from the analysis of the data:-

1. The coordination without controlling the traffic is as follows:
   - i. Coordination between M and Y intersection is possible in one way and two way progression with efficiency =11%.
   - ii. Coordination between P and A intersection is possible in one way or two way progression with efficiency =23%.
   - iii. Coordination between A and E intersection is possible in one way progression only from A to E intersection.
   - iv. It can be seen that coordination in Salim1 street is best suited than the other links coordination, because the efficiency of the coordination is greater than the efficiency of other links coordinated.
2. The coordination with controlling links speed are as follows
   - i. Coordination between M and Y intersection is possible in one way and two way progression with efficiency =16%.
   - ii. Coordination between P and A intersection is possible in one way or two way progression with efficiency =25%.
   - iii. It can be seen that coordination in Salim1 street is best suited than the other links coordination, because the efficiency of the coordination is greater than the efficiency of other links coordinated.
3. The range of intersection control delay before coordination is between 52.9 s/veh in Engineering intersection and 104.3 s/veh in Mamostayan intersection. While after coordination it will be between 35.24 s/veh in Engineering intersection and 90.60 s/veh in Mamostayan intersection resulting in a reduction in the value of intersection control delay between 13.4% in Engineering intersection and 33.38% in Mamostayan intersection.

2- Recommendations

1. Offering a proposal for executing the coordination on Salim1 link because it gives the best result in this study.
2. To control the traffic in the study area, traffic control devices and illumination on all streets and intersections should be provided.
3. It is extremely important to remember that the timing of two way signal system is considerably simplified when the block lengths are essentially equal. Therefore, consideration should be given regarding this factor in developing any new city plans.
4. Length of links, as much as possible, should not be more than ½ mile (800m), because links which have length more than ½ mile (800m) do not give good result for the coordination.
5. Studying the coordination for other modes like actuated, adaptive progression ….. etc.
6. Studying vehicle tail pipe emission for the coordinated intersections.

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Table (1) proposed signal control at specific intersections along arterials (5)

Cross street traffic v/c	Turning movem-ents	Arterial volume/cross street volume	
		≤1.3	>1.3
Low-moderate v/c≤0.8	≤20 %	Actuated 1	Actuated2
	>20 %	Actuated 2	Actuated
High v/c > 0.8	< 20 %	Pretimed	Pretimed
	> 20 %	Pretimed	Pretimed

Table (2) Geometric data for studied links

Link	No. of lanes/ direction	Length c-c (m)
Mamostayan1	3	830
Salim1	3	780
Salim2	3	1100

Table (3) Geometric data for studied intersections

Inter.	approach	Lane	Direction of flow	Width (m)	Width of approach (m)	Slope (%)
Mamostayan (M)	E	1	R	3.06	9.71	-0.8
		2	L+T	3.325		
		3	L+T	3.325		
	S	4	R	3.57	10.57	-2.9
		5	L+T	3.50		
		6	L+T	3.50		
	W	7	R	4.3	14.41	-3.5
		8	T	3.37		
		9	L+T	3.37		
		10	L+T	3.37		
	N	11	R	4.00	10.65	+2.78
		12	L+T	3.325		
		13	L+T	3.325		
Yakgirten (Y)	E	1	R	5.4	5.4	
	S	2	R	4.40	10.4	-1.55
		3	L+T	3		
		4	L+T	3		
	W	5	R	2.87	8.61	-2.1
		6	L+T	2.87		
		7	L+T	2.87		
	N	8	R	4.70	15.71	+2.1
		9	T	3.67		
		10	L+T	3.67		
		11	L+T	3.67		
Palace (P)	E	1	R	4.40	12.3	-3.7
		2	L+T	3.95		
		3	L+T	3.95		
	S	4	R	4.0	10.34	-0.95
		5	L+T	3.17		
		6	L+T	3.17		
	W	7	R	3.8	8.29	+2.6 %
		8	L+T	4.49		
Aqaree (A)	N	1	R	4.30	14.6	+0.6
		2	T	3.5		
		3	T	3.5		
		4	L	3.3		
	S	5	R	3.65	13.75	-1.35
		6	T	3.4		
		7	T	3.4		
		8	L	3.3		
	W	9	L+T+R	2.9	5.8	+0.35
		10	L+T	2.9		

Engineering (E)	N	1	R	4.7	12.1	+3.45
		2	T	3.7		
		3	T	3.7		
	S	4	T	3.25	6.5	-3.65
		5	T	3.25		
		6	L	5.90		
	W	7	R	3.5	6.7	-0.25
		8	L	3.2		

Table (4) Saturation flow (pcphpl)for all studied intersections.

Intersection	North	East	South	West
Mamostayan	1639	1652	1597	1449
Yakgirten	1340	----	1235	1437
Palace	-----	1587	1459	1984
Aqaree (ST)	1379	-----	1367	-----
Aqaree (L)	1634	-----	1637	-----
Aqaree	-----	-----	-----	1486
Engineering	1646	-----	1615	1586

Table (5) Link average travel & running speeds

Link	Link	Stopped time (sec)	Travel speed (km/h)	Running speed (km/h)	Link length (m)
Mamos-tayan1	M-Y	50	21.8	34.4	830
	Y-M	87	16.9	33.2	830
Salim1	P-A	21	27.4	34.3	781
	A-P	23	25.2	32.1	781
Salim2	A-E	1	39.2	39.8	1103
	E-A	38	26.5	35.3	1103

Table (6) Results of statistical analysis of mid-links spot speed data

Link	Sample size (N)	Mean (kph)	P_{85} (kph)	Standard Deviation (kph)
M-Y	101	54.3	66.10	9.5
Y-M	103	59.7	69.50	10.8
P-A	108	45.6	54.80	7.5
A-P	103	51.0	61.90	9.9
A-E	108	54.3	66.40	10.5
E-A	100	52.1	61.10	8.5

Table (7) Mid-link mean speed and link average running speed

Link	Mid-link Mean speed(kph)	Running speed (kph)
M-Y	54.3	34.4
Y-M	59.7	33.2
P-A	45.6	34.3
A-P	51.0	32.1
A-E	54.3	39.8
E-A	52.1	35.3

Table (8) Coupling Index for all links

Link	Volume (2 way)vph	Length (m)	Coupling Index
Mamos-tayan1	863	830	1.04
Salim1	1803	781	2.3
Salim2	2161	1103	1.96

Table (9) Offsets & bandwidths of all intersections for different methods

Link	Direction	Prevailing (p) or (C) controlled	Progression (1or 2 way)	Offset (sec)	Band-width (sec)
Mamostayan1	M - Y	P	1	90	17.3
	M - Y	P	1	87	17.3
	Y - M	P	1	90	17.6
	Y - M	P	1	78	9.5
	Y - M	C	2	78	19
	Y - M	C	2	53	22
Salim1	P-A	P	1	101.5	14.7
	P-A	P	1	81.9	23.5
	P-A	P	1	81.9	24.5
	A-P	P	1	87.5	30
	A-P	P	2	81.5	30
	A-P	P	2	51.0	11
	A-P	P	2	81.5	30
	A-P	P	2	51.0	11
	A-P	C	2	51.0	36
Salim2	A-E	P	1	88	14.7
	A-E	P	1	61.7	25
	A-E	P	1	61.7	24.5

Table (10) Bandwidth Efficiency and attainability for all intersections

Link	Coordination	Progression	Efficiency, E	Attainability, A
Mamost -ayan1	P	2	0.11	0.53
	C	2	0.15	0.71
	C	2	0.16	0.77
Salim1	P	2	0.19	0.57
	P	2	0.14	0.44
	P	2	0.23	0.69
	P	2	0.11	0.33
	C	2	0.25	0.75

Table (11) Types of progression that can be provided

Link	Type of progression
Mamostayan1	One direction
	Two direction with low efficiency
Salim1	One direction
	Two direction
Salim2	One direction

Table (12) Approach control delay before and after coordination

Inter.	Ap p.	Approach control delay sec/veh		Reduction in approach delay (%)
		Before	After	
M	N	**106.95**	**98.85**	7.57
	E	**94.41**	**76.11**	19.38
	S	**101.24**	**88.89**	12.20
	W	**154.4**	**144.88**	6.17
Y	S	**95.87**	**71.98**	24.92
	W	**107.76**	**99.73**	7.45
	N	**106.45**	**98.43**	7.53
P	S	**60.04**	**37.26**	37.94
	E	**60.78**	**41.84**	31.16
	W	**141.96**	**132.36**	6.76
A	S	**72.64**	**54.38**	25.14
	W	**84.7**	**76.76**	9.37
	N	**75.14**	**63.4**	15.62
E	N	**44.87**	**22.77**	49.25
	SL	**71.39**	**62.96**	11.81
	WL	**67.29**	**58.5**	13.06

Table (13) Intersection control delay before and after coordination

Intersection	Intersection control delay (s/veh)		Reduction in approach delay (%)
	Before	After	
M	104.3	90.6	13.14
Y	102.2	87.26	14.62
P	63.6	43.11	32.22
A	75.7	61.64	18.57
E	52.9	35.24	33.38

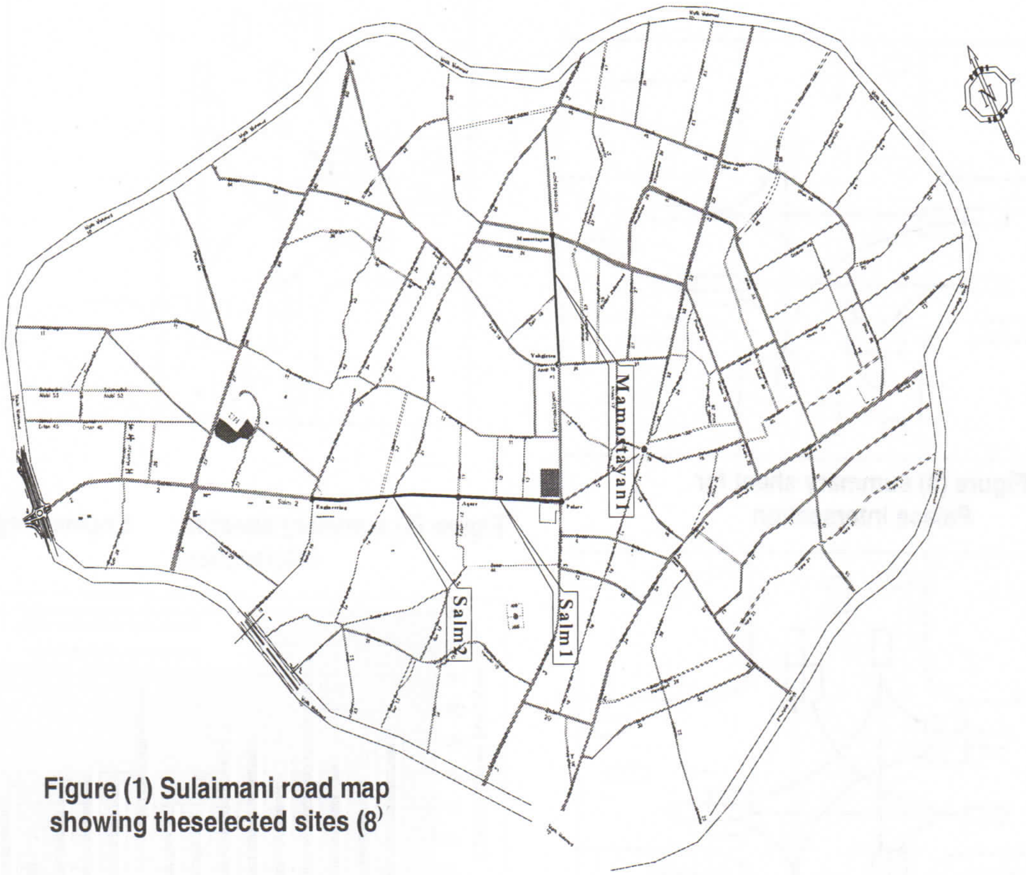

Figure (1) Sulaimani road map showing theselected sites (8)

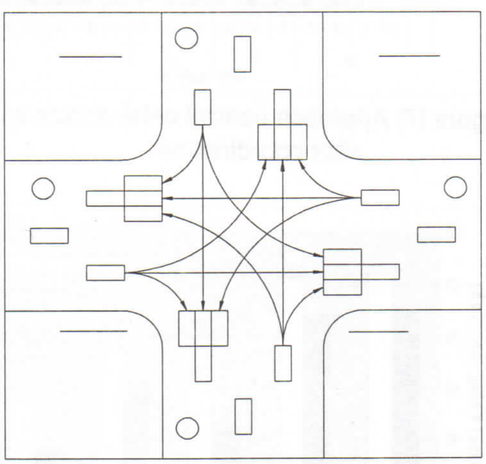

Figure (2) summary sheet for Mamostayan intersection

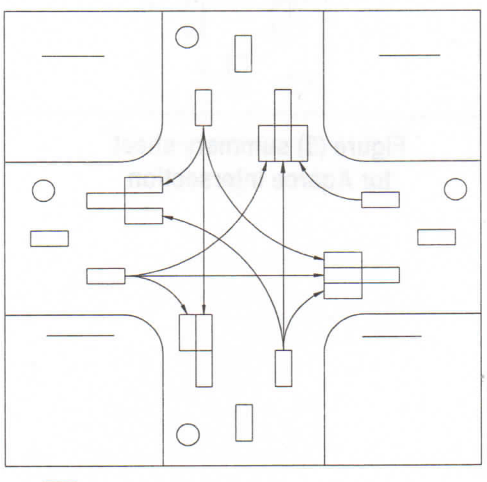

Figure (3) summary sheet for Yakgirten intersection

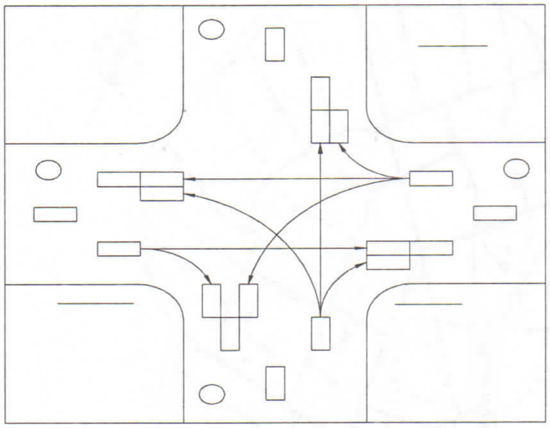

Figure (4) summary sheet for Palace intersection

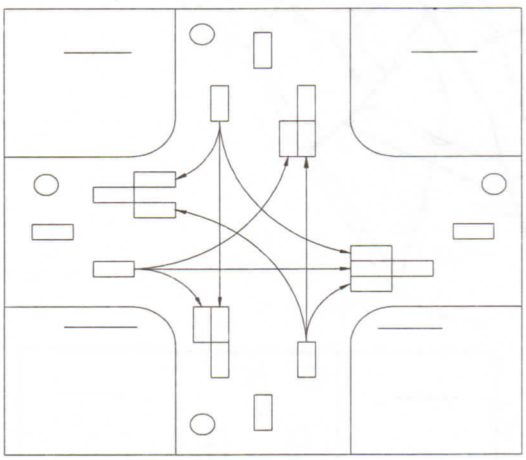

Figure (5) summary sheet for Aqaree intersection

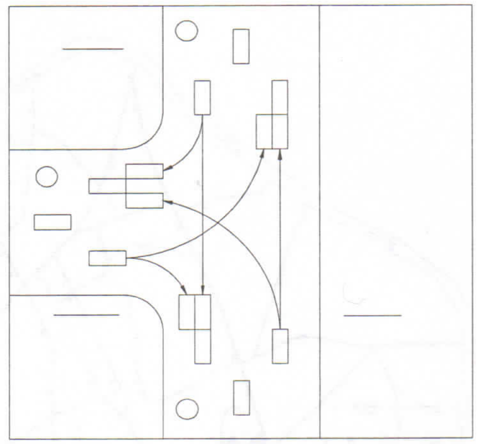

Figure (6) summary sheet for Engineering intersection

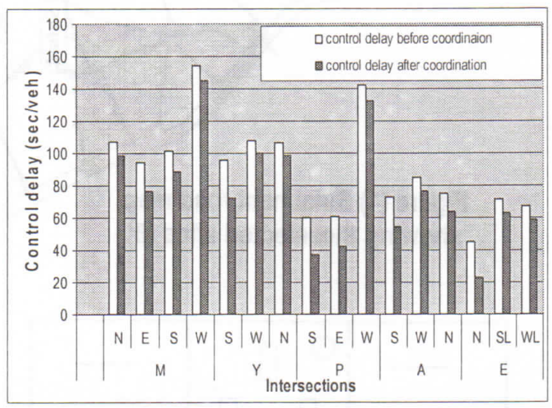

Figure (7) Approach control delay before and after coordination

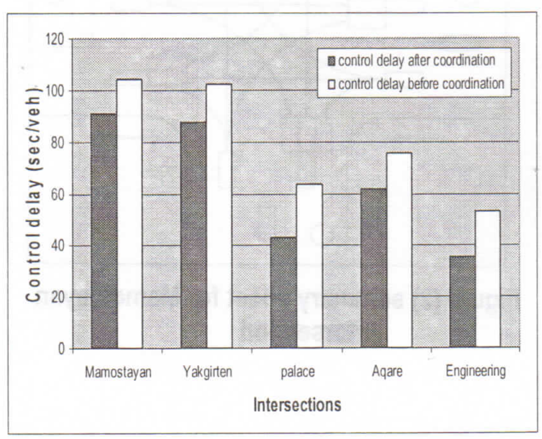

Figure (8) Intersection control delay before and after coordination

پوختە

لەم لێکۆڵینەوەیەدا پێنج یەکتربڕ لە لەسەر سێ شەقامی سەرەکی لەناو شاری سلێمانی هەڵبژێردراون بۆ لێکۆڵینەوە لە توانای ڕێکخستنیان لەگەڵ یەکتریدا (Coordination) لەڕێگەی دۆزینەوەی(Coupling Index) وەکو هەوڵێك بۆ دۆزینەوەی چارەسەری بۆ هەندێك لە گرفتەکانی هاتووچۆ کە هەن لەو یەکتربڕانە. هەر بەپشتبەستن بەو(Coupling Index)انەوە جۆری ڕێکخستنەکەیش دیاری کراوە (Simple) یان (Limited) بێت. بۆ ئەم مەبەستە توانای ڕێکخستن لەنێوان یەکتربڕانی مامۆستایان و یەکگرتن لەسەر شەقامی مامۆستایان۱ و یەکتربڕانی پالاس. عەقاری و ئەندازیاران لەسەر شەقامی سالم۱ و سالم ۲ ئەنجامدراوە. بۆ هەر یەکتربڕێك کەدەستنیشانکراوە لەم لێکۆڵینەوەیەدا داتای پێویست لەسەر هاتووچۆ و ئەندازە کۆکراوەتەوە بە هەندێك ڕێگای جیاواز بۆدۆزینەوەی هەندێك پارامیتەری پێویست بۆ ئەنجامدانی مەبەستی توێژینەوەکە. لەو پاراميتەرانە. قەبارەی هاتووچۆ(peak hour volume). بەرامبەرکردن بە ئۆتۆمبێلی بچوك(passenger car equivalent). (saturation flow). خێرایی لەسەر شەقام(link speed). خێرایی نزیك یەکتربڕ(approach speed). دواکەوتنی وەستان لە یەکتربڕ(intersection stopped delay). و دواکەوتنی (control delay) بۆ هەر لایەکی یەکتربڕەکە و بۆ یەکتربڕەکە بەگشتی پێش ڕێکخستن و دوای ڕێکخستنی یەکتربڕەکان. بێجگە لەوانەی پێشوو. توانای ڕێکخستنی دوو لاییش هەڵسەنگێندرا ئەویش بەدۆزینەوەی (coefficient of attainability) و دیاری کردنی باشترینیان بە دۆزینەوەی (coefficient of efficiency). لەکۆتاییدا توێژینەوەکە سەلماندی کە ڕێکخستنی یەك لایی لەنێوان ئەو یەکتربڕانە ئەنجامی باشی هەیە. هەروەها ڕێکخستنی یەکتربڕەکانی پالاس و عەقاری لەسەر شەقامی سالم۱ بەڕێکخستنی یەك لایی و دوو لایی باشترین ئەنجامی دەبێت.

الخلاصة

تمت في هذه الدراسة تحديد خمسة تقاطعات على ثلاث شوارع رئيسة في مدينة السليمانية لدراسة إمكانية التنسيق فيما بينها بايجاد معاير الأزدواجية (Coupling Index) لحل عدد من المشاكل المرورية فيها. و بالاعتماد على معاير الأزدواجية (Coupling Index) تم تحديد نوع التنسيق من المحدد (Limited) او البسيط (Simple). لتحقيق أهداف هذه الدراسة جمعت البيانات المرورية اللازمة لتقاطعات ماموستايان و يەكگرتن الواقعة على شارع ماموستايان ١ و پالاس، عقارى و ئەندازياران الواقعة على شوارع سالم ١ و سالم ٢ بالترتيب. لكل تقاطع جمعت البيانات المرورية والبيانات الخاصة بالتصميم الهندسي بطرق مختلفة لايجاد المعايير الضرورية لتحقيق اهداف البحث. من هذه المعايير الحجم المروري في ساعة الذروة (peak hour volume), سيارات الركاب المعادلة (passenger car equivalent), السريان المشبع (saturation flow), السرعة على الشارع (link speed), السرعة عند مقترب التقاطع(approach speed), تاخيرات التوقف للتقاطع (intersection stopped delay), و تاخيرات (control delay) للمقترب و للتقاطع ككل قبل و بعد التنسيق. إضافة الى ذلک فقد تم دراسة إمكانية تنسيق هذه التقاطعات باتجاه واحد أو باتجاهين بايجاد معاير الامكانية (Coefficient of Attainability) و معرفة الاكفاء منها بايجاد معامل الكفاءة (Coefficient of Efficiency) وقد توصلت الدراسة الى أن تنسيق التقاطعات باتجاه واحد تعطي نتائج جيدة و أن تنسيق تقاطعي پالاس و عقارى تعطي أفضل النتائج باتجاه واحد و باتجاهين.

زانكۆ

گۆڤاری زانستە پەتی و پراكتیكیێ كان
زانكۆی سەلاحەددین ـ هەولێر

بەرگی (٢٠)، ژمارە (٤)، ساڵی ٢٠٠٨ز - ٢٧٠٨ك